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Does Immigration Raise Natives' Income? National and Regional Evidence from Spain

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ABSTRACT

Does Immigration Raise Natives' Income? National and Regional Evidence from Spain*

How immigration affects the labor market of the host country is a topic of major concern for many immigrant-receiving nations. Spain is no exception following the rapid increase in immigrant flows experienced over the past decade. We assess the impact of immigration on Spanish natives' income by estimating the net immigration surplus accruing at the national level and at high immigrant-receiving regions while taking into account the imperfect substitutability of immigrant and native labor. Specifically, using information on the occupational densities of immigrants and natives of different skill levels, we develop a mapping of immigrant-to-native self-reported skills that reveals the combination of natives across skills that would be equivalent to an immigrant of a given self-reported skill level, which we use to account for any differences between immigrant self-reported skill levels and their effective skills according to the Spanish labor market. We find that the immigrant surplus amounts to 0.04 percent of GDP at the national level and it is even higher for some of the main immigrant-receiving regions, such as Cataluña, Valencia, Madrid, and Murcia.

JEL Classification: J61, F22

Keywords: international migration, regional, national, immigration surplus, Spain

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I. Introduction

How immigration affects the labor market of the host country is a topic of major concern for many immigrant-receiving nations. Spain is no exception following the rapid increase in immigrant flows experienced over the past decade. In 1991, only 1.2 percent of the Spanish adult population (about 300,000 individuals) was foreign-born. Within a decade, this percentage quadrupled to 4.0 percent (1,370,000 individuals) and, by 2007, it reached 10 percent (4,500,000 individuals). Not surprisingly, the majority of Spanish citizens usually declare immigration as one of their main social concerns together with unemployment, housing and terrorism according to the Spanish Sociological Research Centre (CIS). Yet, immigration concerns vary by region along with the geographic distribution and impact of immigrants. Indeed, most immigrants are concentrated in a few Spanish regions that absorb about 83.5 percent of the immigrant population, i.e. Andalucía, Balearic Islands, Canary Islands, Cataluña, Valencia, Madrid and Murcia (see Tables 1 and 2).

Does immigration benefit Spanish natives income-wise? And, if it does, does the increase in income substantially differ by region? In this paper, we address these two questions. As in the Hecksher-Olin Model, where trade raises national income if the factor shares of the trading partner differ from those of the home country, immigration raises income inasmuch the skill shares of the inflow of immigrants differ from those of natives. The greater the difference between the skill shares of natives and immigrants, the greater the increase in income will be. This implies that the increase in income depends on the degree of substitutability between natives and immigrants, with an underlying redistribution of income from groups of natives to those of incoming immigrants with similar skills as well as to groups of immigrants and natives with complementary skills. It is this income redistribution that often lies behind antiimmigration sentiments and substantiates the need to gain a better understanding of the consequences that the geographic distribution of immigrants may have on the well-being of natives at the regional and national levels.

To date, most studies concerning the effects of immigration on natives on account of the differential skill share of immigrant and native groups have focused on the impact of immigration on the national economy (e.g. Altonji and Card 2001; Card 2001; Borjas 1995, 2003; Ottaviano and Peri 2005, 2006). Peri (2006), with its focus on the effect of immigration on natives' wages in California, is an exception. Furthermore, with the exclusion of a few recent studies, such as Ottaviano and Peri (2006), Peri (2006) and Manacorda et al (2006), most analyses assume perfect substitutability between immigrants and natives within the same self-reported skill level, where skill is defined in terms of educational attainment and age –a proxy for labor market experience. However, it is by no means clear that immigrants and natives within the same self-reported skill group are perfect substitutes. Instead, immigrants may face language and other barriers that prevent their human capital to be perfectly transferable to a host country. As a result, immigrants' educational attainment and experience are likely to be valued differently from those of natives. Under such circumstances, immigrants are likely to hold different occupations and earn different wages than natives with similar education and work experience.

In this paper, we assess the impact of immigration on Spanish natives' income by estimating the net immigration surplus accruing at the national level and at high immigrant-receiving regions while taking into account the imperfect substitutability of immigrant and native labor. Specifically, using information on the occupational densities of immigrants and natives of different skill levels, we develop a mapping of immigrant-to-native self-reported skills that reveals the combination of natives across skills that would be equivalent to an immigrant of a given self-reported skill level. In this manner, we account for any differences between immigrant self-reported skill levels and their effective skills according to the Spanish labor market.

The rest of the paper is organized as follows. Section II provides a description of the data we will be using in our analysis and Section III discusses some descriptive evidence on the regional distribution by skill level of the foreign-born relative to natives. Section IV explains how the analysis accounts for the imperfect substitutability of immigrant and native labor and Section V presents the production function we use in our structural approach to estimate the immigration surplus at the national and regional levels. Results and shortcomings of the analysis are discussed in Section VI and Section VII concludes the study.

II. Data

The main database for our analysis is the 2001 Census. The Census has the advantage of surveying immigrants regardless of their legal status. Nonetheless, we are aware that an important fraction of unauthorized immigrants may not fill in the questionnaire and, as such, this group is likely to be under-represented in the Census. The Census gathers information on personal and demographic characteristics (such as age, education and province of residence). This information is used to group individuals into education and experience (proxied by age) cells.

However, the Census is limited with respect to the list of variables for which data are compiled. For instance, it lacks information on where respondents completed their schooling. As such, we are left to assume that, for our group of recent migrants, this is likely to have taken place in their countries of origin.[1] Additionally, the Census does not contain any data on language skills or on the nationality of respondents'

[1] The Census question regarding the educational attainment of individuals 10 years of age and older is phrased as follows: "What is the highest grade you have completed?"

parents and grandparents. Therefore, we define immigrants as individuals reporting a foreign nationality. More important to the study at hand is the lack of information on labor earnings. To supplement this shortcoming, we rely on data from the 1995 and 2002 *Earnings Structure Surveys* (ESS) –known by their acronyms of EES-95 and EES-02. These surveys include wage data for workers employed in random samples of establishments in the manufacturing, construction and service industries. The wage data are then complemented with employment data for those two years from the 1995 and 2002 *Encuesta de Población Activa* (EPA) –a current population survey containing detailed employment information on a representative sample of individuals for the two time periods under consideration. We rely on the data from the ESS and the EPA surveys to, later on, derive labor and income shares for natives and immigrants in the various skill groups. Finally, for the computation of the elasticities of substitution across education groups, as well as between workers with different experience levels but within the same education group, we need information on employment and wages for several time periods. Therefore, we make use of Spanish data from the *European Community Household Panel* (ECHP) for the 1994 through 2001 time period.

III. Some Descriptive Evidence

A) Differences in the Regional Distribution of Immigrants and Natives

The figures in Table 1 and Table 2 provide testimony of the fast growing presence of immigrants in the various Spanish regions. Specifically, the first three columns of Table 1 display the increasing fraction of the overall adult population –defined as individuals 16 years of age and older– with a foreign nationality. In certain immigrant-receiving regions, such as Cataluña or Madrid, the percentage of immigrants has grown from 2 percent to around 12 percent in approximately 14 years. As a fraction of the adult working population, the increase is even more pronounced, rising from 2 percent to as much as 17 percent in Madrid or 19 percent in Balearic Islands.

Furthermore, as noted in the Introduction, immigrants are unevenly distributed throughout the Spanish territory. The figures in Table 2 show that a few regions, such as Andalucía, Balearic Islands, Canary Islands, Cataluña, Valencia, Madrid and Murcia, concentrate most immigrants. In 1991, these Spanish regions accounted for 78 percent of all immigrants –a percentage that grew to 83 percent by 2001. In contrast, only 65 percent of natives lived in those regions during that period of time.

B) Accounting for Differences in the Skill Distribution of Immigrants and Natives

In order to compute the net immigration surplus, we focus on working individuals. Additionally, given the young age at which most individuals migrate and the fact that most natives do not enter the job market until age 20, we center our attention on working individuals between 20 and 50 years of age.

Before proceeding any further, we first look at the skill distribution of immigrants and natives across Spanish regions. We consider 16 skill levels resulting from 4 educational categories (i.e. less than primary, primary, secondary and university) and 4 age intervals (i.e. 20-30 years, 31-35, 36-40 and 41-50 years). One of the interesting features that emerge from Figures 1 through 6 is the concentration of most immigrants and natives within skill groups 9 through 12 (secondary education at each age interval) across regions. Despite some differences between immigrants and natives –such as the greater relative concentration of immigrants in skill groups 1 through 7 and of natives in higher ranked skill groups, the fact that most immigrants and natives are found within a limited number of skill cells suggests that both groups display similar self-reported skill levels.

However, are these apparently similar self-reported skill levels similarly valued in the labor market? Or, does the market under-reward immigrants' skills resulting in an occupational distribution that significantly differs from that of similarly skilled natives? As noted earlier, if immigrants and natives were perfect substitutes within skill levels, the occupational distributions of both groups within skill should look alike. Figures 7 through 12 display the occupational distribution (at the two-digit ISCO level) of immigrants and natives in skill level 9 (secondary education, less than 30 years) – where the density of natives and immigrants is the highest for the overall country, as well as for each of the five highest receiving regions.[2] For conciseness, we show those occupations where the density of either natives or immigrants is at least 1 percent. One of the key findings from those figures is the unequal occupational distribution of immigrants and natives within that skill. In particular, immigrants display a significantly greater concentration in occupation no. 50 (i.e. restaurants and food services), occupation no. 91 (i.e. domestic service), occupation no. 94 (i.e. agriculture workers), and occupation no. 96 (i.e. non-qualified construction workers) than similarly skilled natives. Overall, relative to immigrants, natives appear to display a greater concentration in occupations placed to the left of the graphs (i.e. more qualified non-manual jobs), whereas the opposite is true for immigrants. In sum, the figures suggest that the market does not value similarly skilled immigrant and native labor equally. If immigrant skills are valued differently than those of their native counterparts in the job market, immigrant and native labor within a skill group can no longer be considered perfect substitutes as it has been traditionally done by the literature. Instead, we need to account for any differences between immigrant self-reported and effective skills according to the Spanish labor market.

[2] A very similar picture emerges for the other skill levels. Figures are available from authors upon request.

IV. Addressing the Imperfect Substitutability of Immigrant and Native Labor within self-reported skill groups – Self-reported versus Effective Immigrant Skills.

One way to address the imperfect substitutability of immigrant and native labor is to develop a mapping of immigrant-to-native skills that reveals the "equivalence" between immigrants and similarly skilled natives in various occupations.[3] We proceed to do so in two steps:

First, for each skill group *i*, we look for a set of weights, i.e. w_1, …, w_{16}, where sixteen is the number of skill levels, such that an immigrant in a given skill cell *i* is equivalent to: w_1 natives in skill level 1 plus w_2 natives in skill level 2, …, plus w_{16} natives in skill level 16. This equivalence is done according to the occupational distribution of immigrants and natives in each skill group *i* across occupations 1, …, *j*. Denote by $p_{1i},...,p_{ji}$ the occupational distribution of natives with skill *i* across occupations 1,…*j* –where: $p_{1i}+...+p_{ji}=1$ for all *i*, and $q_{1i},...,q_{ji}$ the occupational distribution of immigrants with skill *i* –where: $q_{1i}+...+q_{ji}=1$ for each skill level *i*. We can then run the following regression across occupations:

$$q_{ij} = w_{1i}\, p_{1j} + \ldots + w_{16i} p_{16j} + \varepsilon_{ij}, \text{ where: } w_{1i} + \ldots + w_{16i} = 1$$

and derive the set of weights that give a combination of natives of each skill level that is closest to one immigrant with skill *i*.

Once we have estimated the set of weights for each skill group *i*, we use the estimated weights to construct what we refer to as the effective immigrant skill share, which is the linear combination of native skill shares: $\beta_i^{'} = w_{1i}b_1 + ... + w_{16i}b_{16}$ (where b_i denotes the share of natives in skill cell *i*) that is equivalent to one immigrant with skill *i*. Figures 13 through 18 display the differences between immigrants' and natives' skill

[3] We are very grateful to David Card for suggesting using this approach to compute the effective immigrants' skill shares according to how their self-reported skills are valued in the Spanish labor market.

shares using the immigrant skill shares that result from immigrants' self-reported skills (β), as well as the effective immigrant skill shares computed above (β'). There are significant differences between the effective and the self-reported skills in the case of older workers with primary education (i.e. skill group 8) and younger workers with secondary education (i.e. skill groups 9 and 10) –precisely the skill levels where most of the immigrant and native populations are concentrated. Such differences are suggestive of the importance of using the computed effective immigrant skill shares relative to the immigrant skill shares resulting from immigrants' self-reported skills in the computation of the immigration surplus.

V. The Immigration Surplus

To compute the immigration surplus, we extend the framework used in Borjas (1995) to compute the immigrant surplus under the assumption of homogeneous labor to a case of heterogeneous labor where workers can present up to *n* different skills. We assume a production technology that can be described by the following concave and linear homogeneous production function:

$$Q = f\left(K, L_1, \dots, L_n\right) \quad (1)$$

Each skill level *i* is defined in terms of educational attainment $\left(k\right)$ and experience$\left(j\right)$. Educational attainment is measured in four categories: less than primary, primary, secondary and university, while experience is proxied with the following four age categories: 20-30, 31-35, 36-40 and 41-50.

We make several assumptions about the production function. First, we assume that all capital is owned by natives. Immigrants do not contribute any capital. If they did, the immigration surplus accruing to natives would only be smaller as we shall discuss later on. Second, the supply of labor is perfectly inelastic. As noted by Borjas

(1995), this assumption only makes the calculation of the immigration surplus simpler. Third, we assume that capital is infinitely elastically supplied at a constant rate *r*. This assumption is more realistic than assuming a fixed-capital stock. Capital owners do not obtain any gain as there is no change in the interest rate, *r*. Fourth, we assume that the production function exhibits constant returns to scale; therefore, the entire output is distributed among workers. Under these conditions, the immigration surplus is positive as long as the skill composition of immigrants differs from that of native workers, i.e., inasmuch as the immigrants' effective skill shares (β'_i) differs from the natives' skill share (b_i). Otherwise, wages would be unaffected by immigration and the immigration surplus would equal zero. Finally, it is worth noting that, although the production function assumes that immigrants and natives are perfect substitutes within skill cells, we address their imperfect substitutability by using the computed effective immigrant skill shares.[4]

At equilibrium, the price of each of the factors of production has to equal the value of its marginal product and, consequently, the increase in income accruing to natives following the entry of *M* immigrants (i.e. the increase in national income per unit of output accruing to natives) is given by:

$$IS = \frac{\Delta Q_N}{Q} = (K\frac{\partial r}{\partial M} + b_1 N\frac{\partial w_1}{\partial M} + b_2 N\frac{\partial w_2}{\partial M} + ... + b_n N\frac{\partial w_n}{\partial M})\frac{M}{Q} \qquad (2)$$

where b_i denotes the share of natives with a particular skill level with $i = 1...n$. Under the assumption that capital is infinitely elastically supplied at a constant rate *r*, that only immigrants whose effective skills differ from natives create a positive surplus, and

[4] Alternatively, other authors like Ottaviano and Peri (2005, 2006) and Manacorda et al (2006) assume a production function where immigrants and natives within self-reported skill groups are imperfect substitutes and estimate the elasticity of substitution between immigrants and natives. Unfortunately, there are no representative Spanish data on wages according to nationality for the time periods under consideration. As such, our approach must be seen as an alternative way to address the imperfect substitutability between immigrants and natives within self-reported skill groups in the absence of wage data.

evaluating the derivatives of wages at the average rate (i.e., at: (1/2)*M*), which implies obtaining half the gain obtained when the derivatives are evaluated at *L=N+M*, we can rewrite equation (2) as :

$$IS = \frac{\Delta Q_N}{Q} = \frac{1}{2}\left[b_1 N\left(\beta'_1 - b_1\right) M \frac{\partial w_1}{\partial M} + b_2 N\left(\beta'_2 - b_2\right) M \frac{\partial w_2}{\partial M} + ... + b_n N\left(\beta'_N - b_N\right) M \frac{\partial w_n}{\partial M} \right] \quad (3)$$

where β_i' denotes the effective share of immigrants within skill cell *i*. As in free trade, immigrants create a surplus as long as their skills differ from those of natives, i.e. the immigration surplus is positive only when $\left(\beta'_i - b_i\right) \neq 0$. Otherwise, owing to the CES assumption, the prices of the various factors of production would remain unchanged (as their relative supplies would remain unaltered) and natives would not gain anything from immigration.

Given that: $\frac{\partial w_i}{\partial M} = \sum_{j=1}^{n} \frac{\partial w_i}{\partial L_j} \frac{\partial L_j}{\partial M}$, we can convert equation (3) into elasticity terms which yields the following expression for the immigration surplus at the national level[5]:

$$IS = \frac{1}{2}(1-m)m\left[\left\{\sum\nolimits_{i=1}^{n}\left[(\beta'_i - b_i)^2 \frac{s_i}{p_i}\left[\sum\nolimits_{j=1}^{n} e_{ji}\right]\right]\right\}\right] \quad (4)$$

where $m = \frac{M}{L}, s_i = \frac{w_i L_i}{Q}, p_i = \frac{L_i}{L}$, and e_{ij} stands for the (absolute value of the) inverse of factor price elasticity within and across skills. According to equation (4), the immigration surplus increases with: (i) the difference in the actual skill composition of the native and immigrant workforce, (ii) the shares of national income accruing to each skill level, and (iii) the total factor price elasticity (in absolute value), which will be larger when labor demand is inelastic.

What would be the immigration surplus accruing to natives in a particular region *c*? In order to answer this question with a similar formula to the one in equation (4), we

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[5] A detailed description of all steps involved in deriving equation (4) can be found in Appendix #1.

make some assumptions. First, we assume that the production function is the same across regions, i.e. e_{ij} is the same across regions. Second, we assume that natives do not move across regions in response to immigrant inflows. This assumption, if incorrect, could lead us to overestimate the labour supply shock caused by the incoming flow of immigrants. Peri (2006) looks at whether this assumption holds in California and does not find evidence of much native mobility. Likewise, we find no empirical evidence on the inter-regional mobility of natives in Spain. This is a well-known fact in the Spanish case, where native inter-regional mobility has been found to be negligible. Instead, most native mobility takes place within regions (Bentolila 2001). Under these assumptions, the immigration surplus in region *c* could be written as:

$$IS(c) = \frac{1}{2}\left(1-m(c)\right)m(c)\left[\left\{\sum_{i=1}^{n}\left[(\beta'_i(c)-b_i(c))^2\frac{s_i(c)}{p_i(c)}\left[\sum_{j=1}^{n}e_{ji}\right]\right]\right\}\right] \qquad (5)$$

- <u>Computing Factor Price Elasticities:</u>

In order to compute the immigration surplus accruing to the main immigrant-receiving regions and to the nation as a whole, we need information on $b_i, \beta'_i, m, p_i, s_i$ and e_{ij}. The first four parameters can be easily computed using information from the 2001 Census. However, in order to compute the factor price elasticities $\left(e_{ij}\right)$, we need to make some specific assumptions regarding the technology at hand. Following Borjas (2003), we assume a three-level CES technology. Under the three-level CES production function, we assume that workers with similar educational attainment are aggregated to form the labor supply of a particular education group. Workers of different educational levels but with the same work experience, as captured by age, are, in turn, aggregated to form the national labor supply. As such, the aggregate production function for the whole economy at time *t* is given by:

$$Q_t = \left[\lambda_{K_t} K_t^{v} + \lambda_{L_t} L_t^{v}\right]^{\frac{1}{v}} \tag{6}$$

where $v = 1 - 1/\sigma_{KL}$, with σ_{KL} being the elasticity of substitution between capital and labor. As suggested by Hamermesh (1993, p.92) and assumed in Borjas (2003), we allow for σ_{KL} to take the value of 1. The lambdas represent time-variant technology shifters, which satisfy that: $\left(\lambda_{K_t} + \lambda_{Lt}\right) = 1$. The labor aggregate L_t includes workers that differ in their educational attainment and experience and is defined as:

$$L_t = \left[\sum_{k=1}^{4} \theta_{kt} L_{kt}^{\rho}\right]^{\frac{1}{\rho}} \tag{7}$$

where *k* stands each of the educational categories. The parameter ρ is given by: $\rho = 1 - 1/\sigma_E$, where σ_E is the elasticity of substitution across education groups. Within each educational group *k*, we allow for workers with different experience levels to be imperfect substitutes. As such, the labor supply of workers within a particular educational group at a point in time is given by:

$$L_{kt} = \left[\sum_{j=1}^{4} \alpha_{kj} L_{kjt}^{\eta}\right]^{\frac{1}{\eta}} \tag{8}$$

where *j* are age intervals. The parameter η is given by: $\eta = 1 - 1/\sigma_j$, where σ_j measures the elasticity of substitution between workers with different experience levels but within the same educational group.

One advantage of the three-level CES production function is that the technology can be summarized in terms of three elasticities of substitution: $\sigma_{KL}, \sigma_E, \sigma_j$. As noted by Card and Lemieux (2001), the marginal productivity condition describing the wage for workers in skill group (k, j, t) for this type of production function allows us to get an estimate of σ_j as follows:

$$\log\left(w_{kjt}\right) = \delta_t + \delta_{kt} + \delta_{kj} - \left(1/\sigma_j \right) \log L_{kjt} \quad (9)$$

whereas the marginal condition determining the wage of workers in a particular educational group *k* allows us to derive an estimate of σ_E from:

$$\log\left(w_{kt}\right) = \delta_t + \delta_{kt} - \left(1/\sigma_E \right) \log L_{kt} \quad (10)$$

In order to estimate equations (9) and (10), we need aggregate data on wages and total employment for each skill category in different time periods. As noted in the Data section, one important drawback of the Census and the *Encuestas de Población Activa* is that they lack information on wages. While the *Earnings Structure Surveys* have wage data for a large sample of individuals, the ESS surveys are only available for 1995 and 2002. In order to estimate equation (9) and equation (10), we need wage and employment data for each skill category for more than two time periods. Therefore, we get wage and employment data from the *European Community Household Panel* (ECHP) –a longitudinal survey that collects demographic and employment information on a random sample of Spanish individuals for up to eight waves (i.e. from 1994 through 2001). One drawback of the ECHP, however, is that there are only three possible educational categories: primary or less, secondary and university. Therefore, we estimate σ_j and σ_E using three educational categories instead of four. Overall, we have twelve skill cells resulting from three educational categories, four age groups and eight time periods, which yields 96 observations for the estimation of equation (9) and 24 observations (i.e. three educational categories and eight time periods) for the estimation of equation (10). In the estimation of equation (9), we include time, education and age fixed-effects, as well as interactions between education and age,[6]

[6] We do not include interactions between education and time fixed-effects because, when we do so, the regressors become highly collinear.

whereas equation (10) is estimated with time and education fixed-effects. All estimations are weighted using the cell size.

We first estimate equations (9) and (10) using OLS.[7] Subsequently, we account for the endogeneity of the workforce size with respect to the average wage in a particular cell using the number of immigrants in that cell at the national level as an instrument for the cell's workforce size.[8] Table 3 displays the results from the estimation of equations (9) and (10) at the national and regional levels using OLS and instrumental techniques. The implied elasticity of substitution across experience (age) groups is approximately 4.5 —a figure very close to Card-Lemieux (2001) estimates, which range between 3.8 to 4.9 using U.S. data. Likewise, the point estimate of the elasticity of substitution across education groups is 1.44 –very similar to the one found by Borjas (2003) and Katz-Murphy (1992) for the U.S. (between 1.1 and 3.1).

With estimates for the three elasticities summarizing our production function, we can proceed to compute the factor price elasticities describing the wage impacts of immigration on natives in the same education-experience group, as well as in other education and experience categories. Following Hamermesh (1993), the three-level CES technology leads to an equation of the wage effect of an increase in the supply of workers with education k and experience j as follows:

$$e_{kj,kj} = -\frac{1}{\sigma_j} + \left(\frac{1}{\sigma_j} - \frac{1}{\sigma_E}\right)\frac{s_{kj}}{s_k} + \left(\frac{1}{\sigma_E} - \frac{1}{\sigma_{KL}}\right)\frac{s_{kj}}{s_L} + \frac{1}{\sigma_{KL}} s_{kj} \tag{11}$$

where $e_{kj,kj}$ are the own factor price elasticities, and s stands for the share of income accruing to each input. Likewise, the cross-factor price elasticities are given by:

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[7] We use the logarithm of gross hourly wages as the dependent variable and weight the regressions by the cell size. Standard-errors are corrected for clustering at the cell level.

[8] This instrument is valid insofar the number of immigrants in a particular cell is independent of the relative wages of the various cell categories. Even if this unlikely, cells with higher relative wages should have a larger number of workers in them and, therefore, we would still have underestimates of the negative impact of a labor supply increase on the average cell wage.

$$e_{kj,kj'} = \left(\frac{1}{\sigma_j} - \frac{1}{\sigma_E}\right)\frac{s_{kj'}}{s_k} + \left(\frac{1}{\sigma_E} - \frac{1}{\sigma_{KL}}\right)\frac{s_{kj'}}{s_L} + \frac{1}{\sigma_{KL}} s_{kj'} \tag{12}$$

and:

$$e_{kj,k'j'} = \left(\frac{1}{\sigma_E} - \frac{1}{\sigma_{KL}}\right)\frac{s_{k'j'}}{s_L} + \frac{1}{\sigma_{KL}} s_{k'j'} \tag{13}$$

To compute the factor price elasticities summarized in equations (11) through (13), we use a value of 0.7 for the labor share of income.[9]

Regarding the income shares for each education-age group, and given that we want to compute the immigration surplus for 2001, we make use of the most representative data sample of the Spanish workforce, the *Encuesta de Población Activa* (second term 2002), together with wage information coming from the biggest micro-data that contains information on wages, i.e. the *Earnings Structure Survey* (EES), 2002.[10] Table A in Appendix #2 displays the income shares of each of the 16 skill cells, whereas Table B (also in Appendix #2) displays the estimated own elasticitiy, the elasticity across age groups within educational categories and the elasticity across educational categories. The own elasticities range between -0.1 and -0.3, cross elasticities within an education branch fluctuate between -0.01 and -0.1, and cross elasticities between workers with different educational attainments are close to zero. These factor price elasticities are, overall, of similar magnitude to the ones reported by Borjas (2003) for the U.S.

[9] See Conesa (2004) for the calibration of the labor share of income in Spain.
[10] We do use the ECHP dataset to derive information on wages for various reasons. First, the sample size is significantly smaller than the one of the ESS. Second, we do not have the four education categories used in the analysis impeding us to compute the income share of the 16 skill levels. Third, the ECHP does not contain information on the autonomous communities where individuals reside, making it impossible to compute the immigration surplus in each of the main immigrant-receiving regions. We use 2002 instead of 2001 to compute the labor share of income because the EES, which contains wage information, is only carried out in 1995 and in 2002. We expect labor income shares not to change significantly between 2001 and 2002.

VI. Results

To finally estimate the immigration surplus at the national and regional levels, we combine the estimated factor price elasticities and labor income shares with information on the parameters $b, \beta', p,$ and m using equations (4) and (5). Table 4 shows the estimated immigration surplus at the national and regional levels in column (1). At the national level, the immigration surplus amounts to approximately 0.02 percent of GDP, that is, roughly 12 million euros per year using 2001 GDP figures. While this figure is smaller than previous U.S. estimates (about 0.1 percent of GDP, see Borjas (1995)), it is still quite significant in magnitude considering the recent character of Spanish immigration.[11] Furthermore, in most of the main immigrant-receiving regions, i.e. Cataluña, Valencia, Madrid and Murcia, the immigration surplus is greater than the national average, accounting for anywhere between 0.03 to 0.09 percent of their GDP. Only in the case of Andalucía do we see a similar contribution of immigration to its regional GDP than the national average. On the contrary, Murcia –perhaps owing to its high immigrant share in 2001 (i.e. *m* was the largest for Murcia at 0.1, see Table C in Appendix #2) and the large differences between immigrants' and natives' skills (i.e. β'_i-b_i) depicted in Figure 18[12]– displays the largest immigration surplus.

To assess the robustness of our estimates, we re-compute the immigration surplus at the national and regional levels while taking into account the potential endogeneity of the skill share of immigrants at the regional level. As previously mentioned in the text, this parameter is unlikely to be exogenous as immigrants may locate themselves in regions where their skills are most valued. We thus instrument the skill share of immigrants in each region with the share of immigrants in a particular

[11] Here, it is worth noting that, while immigrants account for as much as 40 percent of the workforce in some U.S. regions, in Spain this figure never exceeds 15 percent.
[12] Note the drastic difference between immigrants' and natives' skills depicted in Figure 18, which already uses a larger scale than Figures 13 through 17.

education-experience category at the national level. For the most part, the immigration surplus figures displayed in column (2) of Table 4 are similar to those in column (1), thus suggesting that the possible endogeneity of β'_i is not driving our estimates.

To learn more about how the magnitude of the immigration surplus may change when we incorporate the more recent and higher immigration rates, column (3) of Table 4 uses immigrant penetration rates from 2007 (as opposed to 2001) in the computation of the immigration surplus. As documented in Table C in Appendix #2, this is an important exercise as immigrant penetration rates grew from 5 to 10 percent over the six year period at the national level. The increase was even more pronounced in some of the main immigrant receiving regions, like Madrid, Murcia, and Valencia, where immigrant penetration rates reached 15 percent. Given the large increase in the immigration population, it is not surprising to find that, in most instances,[13] the new immigration surpluses more than double the estimates reported in column (1). At the national level, immigration appears to raise GDP by 0.04 percent, in Cataluña and Valencia the increase is approximately 0.1 percent and, for Murcia, it reaches 0.25 percent.

To conclude, and for comparison purposes, columns (4) through (6) in Table 4 also report the immigration surplus resulting from using immigrants' self-reported skill shares β_i (versus the so-called effective or actual immigrant skill shares β'_i) in specifications (1) through (3). In all instances, the immigration surplus decreases significantly, thus emphasizing the role played by differences in skill between immigrants and natives –already underscored by the figures in column (4)— in raising the immigration surplus.

[13] Except for Madrid, where it rises from 0.03 to 0.04.

In sum, the figures in Table 4 indicate that immigration does benefit Spanish natives as a whole. The increase in GDP is particularly large for Murcia, where immigrant penetration is greater and immigrants' skill shares differ the most from those of natives. What are some of the policy implications stemming from these findings? To the extent that the magnitude of the immigration surplus depends on the degree of substitutability between natives and immigrants, if attempting to maximize the contribution of immigrants to national income, immigration policy should favour immigrant inflows with complementary skills to those of natives.

At this juncture, one might argue that one shortcoming stemming from our analysis is the assumption of identical factor price elasticities across the various Spanish regions. As noted by Ciccone and Peri (2006), immigration may create positive externalities affecting the local wage structure. In that event, we may underestimate factor price elasticities in those regions where the externalities are larger. However, the assumption of factor price equalization across regions in a smaller economy, like Spain, where wages are often negotiated at the sector or national level in collective bargaining agreements may not be farfetched. Yet, to further assess the extent to which this shortcoming may bias our estimates, we use data we have for one of the communities reported separately in the PHOGUE as a region, i.e. Madrid, to compute factor price elasticities for that region, which we subsequently use to re-calculate that region's immigration surplus.[14] The new value of the elasticity of substitution across experience groups in Madrid is: -0.50 (0.08) using OLS and -0.71 (0.57) using IV methods. Likewise, the elasticity of substitution across education groups for Madrid is: 0.73

[14] As noted earlier in the text, the ECHP database for Spain –the database we use to estimate the elasticities of substitution in Table 3– does not contain wage and employment data information for each autonomous community but, rather, at a more regional aggregated level. Only for the autonomous community of Madrid, which is reported as a separate region in the ECHP (i.e. ES=3), we have access to wage and employment data for the eight year period in the ECHP that we can rely upon to calculate the elasticities of substitution at the regional level.

(0.18) using OLS and -2.01 (1.70) using IV methods. These values are higher than those reported in Table 3 and, consequently, when used in the computation of the immigration surplus for Madrid with the value of *m* from 2001 (as in column (1)), the immigration surplus doubles from 0.03 percent (in column (1)) to 0.06 percent. The latter suggests that, in the case of Madrid, we are, in any case, obtaining an underestimate of the contribution of immigrants to GDP.

VII. Summary and Conclusions

Spain has experienced growing immigration inflows during the past decade. As such, it is only logical to question how these new immigrants are impacting the economic well-being of Spanish natives. Additionally, given the uneven distribution of immigrants throughout the Spanish territory and the important labor market disequilibria found across the various regions, it is also important to understand how these recent immigrant inflows may impact each of the main immigrant-receiving regions. In this paper, we address these questions using data from the 2001 Census, along with aggregate time series data from the 2002 *Encuestas de Población Activa* and the *Earnings Structure Survey*. With the aforementioned data and assuming a three-level CES production function, along with minimal interregional labor mobility and changes in the industries that intensively employ migrants (Lewis 2003), we compute the immigration surplus accruing to Spanish natives at the national and regional levels via changes in relative factor prices. In addition to examining the impact of recent immigration inflows on the Spanish economy, a major contribution of our analysis is the recognition of and allowance for the imperfect substitutability within cells between immigrants and natives in our calculations. After all, immigrants seem to be more concentrated in lower wage occupations than their similarly skilled native counterparts.

We find that the immigrant surplus amounts to approximately 0.04 percent of GDP at the national level when we use 2007 figures on immigrant penetration. The immigration surplus accruing to some of the main immigrant-receiving regions, such as Cataluña, Valencia, Madrid, and Murcia, is significantly higher, ranging between 0.04 and 0.25 percent of their GDP. Specifically, the increase in GDP is the largest for Murcia, where immigrant penetration is greater and immigrants' skill shares differ the most from those of natives. Consequently, our findings underscore the overall benefit to natives from immigration. In particular, to the extent that the immigration surplus increases inasmuch immigrants differ from natives, our study helps inform future immigration policy which, if attempting to maximize the contribution of immigrants to national income, should favour immigrant inflows with complementary skills to those of natives.

Finally, we note that the computed immigration surplus does not take into account the fact that immigrants create valuable consumption externalities, such as a growing demand for various goods and services. The latter shifts the labor demand curve to the right, creates employment, and can raise the immigration surplus beyond the figure computed herein. Likewise, the computed immigration surplus does not include other benefits stemming from the increased immigration. In particular, immigrants shape the population pyramid –a contribution that may be crucial in financing the retirement of a progressively older population owing to declining fertility rates and increasing longevity. Therefore, the computed immigration surplus may understate the significant bearing of immigration on the Spanish economy.

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Table 1: Percentage of Immigrants in Population and Employment (1991-2005)

Regions	Percent of Immigrants in the Adult Population			Percent of Immigrants in the Adult Employed Population		
	1991 Census	2001 Census	2005 Padrón	1991 Census	2001 Census	2005 Padrón
Average	1.2	4.0	8.5	1.1	4.6	10.9
Andalucía	1.0	2.5	5.6	0.8	2.9	7.2
Aragón	0.5	3.0	7.2	0.5	4.1	10.0
Asturias	0.8	1.3	2.7	0.7	1.6	3.1
Balearic Islands	2.9	8.4	16.3	2.3	8.4	18.9
Canary I.	2.6	6.1	11.5	0.3	6.2	14.0
Cantabria	0.7	1.3	3.8	0.4	1.5	4.9
C. León	0.5	1.5	3.5	0.5	1.9	5.0
C. La Mancha	0.2	2.9	6.1	0.2	3.4	8.6
Cataluña	1.6	4.6	11.3	1.4	5.2	12.9
C. Valenciana	1.6	5.6	12.6	0.8	5.3	15.4
Extremadura	0.3	1.2	1.9	0.3	1.5	2.4
Galicia	1.1	1.2	2.6	0.9	1.3	2.9
Madrid	1.9	6.6	13.2	1.7	8.4	17.0
Murcia	0.4	5.9	12.5	0.4	8.8	16.3
Navarra	0.6	4.1	7.8	0.6	5.1	10.0
P.Vasco	0.6	1.5	3.5	0.5	1.6	4.5
Rioja	0.6	4.5	10.4	0.7	5.5	13.1
C. y Melilla	0.3	7.8	-	2.7	5.4	-

Notes: The adult population is defined as individuals 16 years of age and older. Adult Population (1991 Census): 30,665,000. Adult Population (2001 Census): 34,223,000. Adult Population (2005 Padrón): 36,415,975.

Table 2: Distribution of Immigrants and Natives across Regions (Adult Population)

Regions	Immigrants	Natives	Immigrants	Natives	Immigrants
	1991 Census		2001 Census		2005 Padrón
Andalucía	14.1	17.5	11.4	17.6	11.3
Aragón	1.2	3.0	2.4	3.0	2.6
Asturias	1.8	2.9	0.9	2.8	0.7
Balearic Islands	1.2	1.7	4.5	1.9	4.2
Canary Islands	8.3	3.9	6.4	3.9	6.0
Cantabria	0.7	1.4	0.5	1.4	0.6
C. León	2.8	6.5	2.4	6.3	2.4
C. La Mancha	0.9	4.1	2.6	4.3	3.1
Cataluña	21.1	16.0	19.0	15.6	21.4
C. Valenciana	12.4	9.7	14.6	10.0	15.6
Extremadura	0.7	2.6	0.8	2.6	0.7
Galicia	6.3	6.9	2.2	7.0	1.9
Madrid	19.7	12.9	23.1	12.9	20.9
Murcia	0.9	2.7	4.4	2.8	4.4
Navarra	0.7	1.4	1.5	1.3	1.3
P.Vasco	2.9	5.9	2.0	5.4	2.0
Rioja	0.4	0.7	0.8	0.7	0.8
C. y Melilla	0.9	0.3	0.6	0.3	-

Table 3: Elasticities of Substitution at the National Level
(Dependent Variable: Log Gross Hourly Wages)

	Elasticity of Substitution across Experience Groups ($1/\sigma_j$)		**Elasticity of Substitution across Educational Groups ($1/\sigma_E$)**	
	OLS	**IV**	**OLS**	**IV**
	-0.34	-0.22	-0.65	-0.69
	(0.04)	(0.15)	(0.16)	(0.25)

Notes: Standard errors in brackets**.** The regressions estimating ($1/\sigma_j$) include 3 education fixed-effects, 3 fixed-age effects and 7 year fixed-effect. We do not include interaction terms between education and experience (age) groups because it results in a very high multicollinearity. We instrument the log of the number employed in each cell with the number of working immigrants in that cell. The regressions estimating ($1/\sigma_E$) include 7 year fixed-effect and 3 education fixed-effects.

Table 4: Estimates of the 2001 Immigration Surpluses at the National and Regional Levels

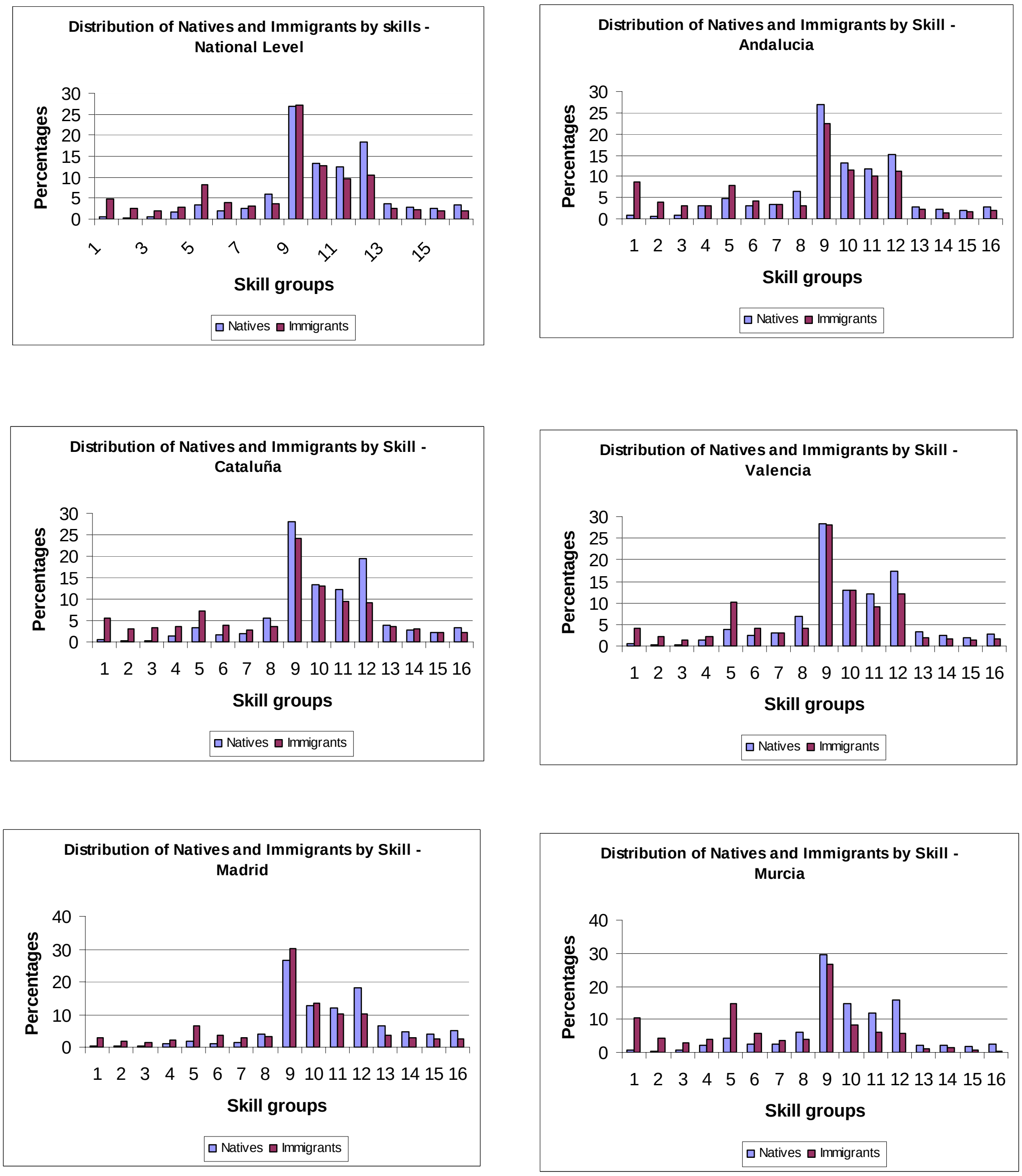
	Using the Estimated or Actual *β*'s (%)			Using the Self-reported *β*'s (%)		
National and Regional Level	**IS (1)**	**IS (2)**	**IS (3)**	**IS (4)**	**IS (5)**	**IS (6)**
National	0.02	-	0.04	0.017	-	0.002
Andalucía	0.02	0.015	0.04	0.006	0.005	0.01
Cataluña	0.05	0.046	0.1	0.013	0.013	0.028
Valencia	0.04	0.033	0.09	0.005	0.004	0.011
Madrid	0.03	0.034	0.04	0.019	0.019	0.027
Murcia	0.09	0.056	0.25	0.033	0.033	0.044

Notes: Columns 1 and 4: indicate the value of the immigration surplus at the national and regional levels that results from estimating equation (4) at the national level and equation (5) at the regional level.

Columns 2 and 5: indicate the value of the immigration surplus when the regional *β*'s are instrumented with *β*'s computed at the national level.

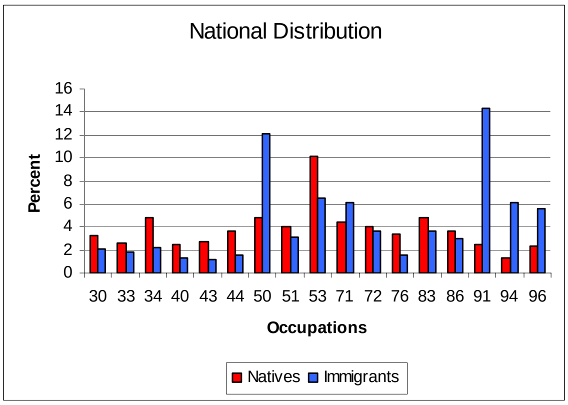
Columns 3 and 6: indicate the value of the immigration surplus when using the immigration figures (parameter *m*) for 2007 instead of those of 2001.

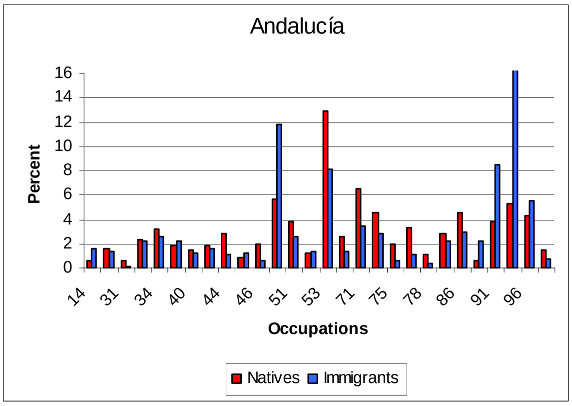
Figures 1-6:
Distribution of Immigrants and Natives across Skill Groups

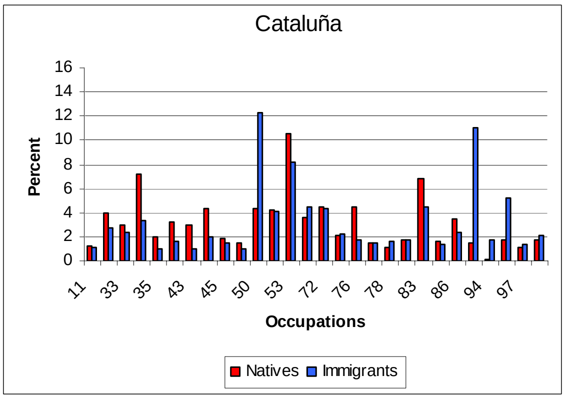


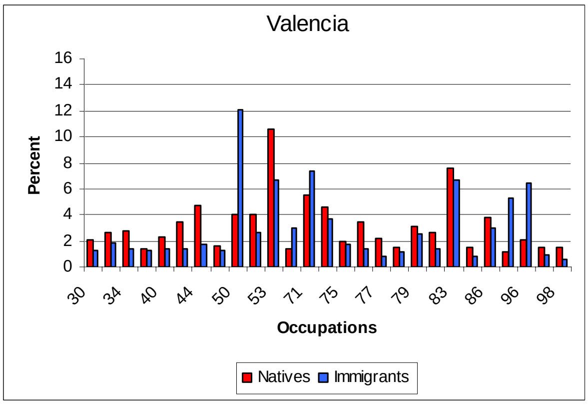
Notes: Skills are defined as follows: 1=Less than primary and less than 30 years; 2= less than primary and 31-35 years; 3= less primary and 36-40 years; 4=less than primary and 41-50 years; 5=Primary and less than 30 years; 6=Primary and 31-35 years; 7= Primary and 36-40 years; 8=Primary and 41-50 years; 9=Secondary and less than 30 years; 10=Secondary and 31-35 years; 11=secondary and 36_40 years: 12=secondary and 41-50 years; 13=University and less than 30 years; 14=university and 31-35 years; 15=university and 36-40 years; 16=university and 41-50 years.

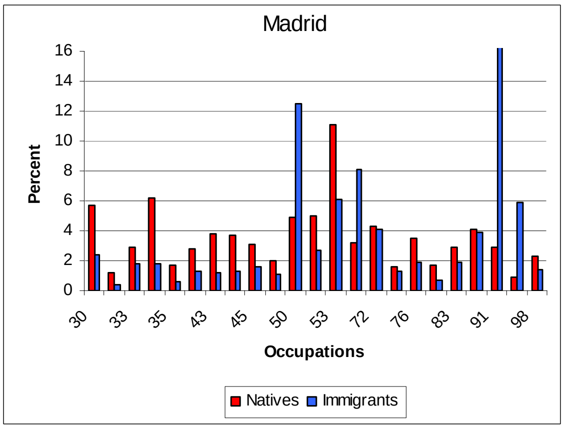
Figures 7-12:
National and Regional Occupational Distributions of Immigrants and Natives in Skill Cell No. 9
(Secondary education, less than 30 years)

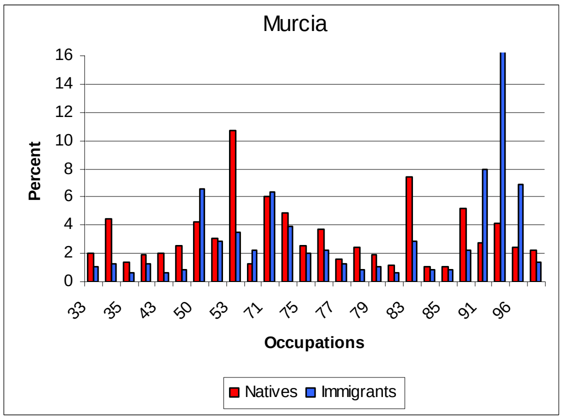




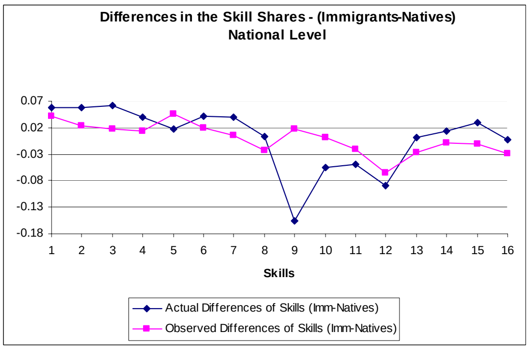


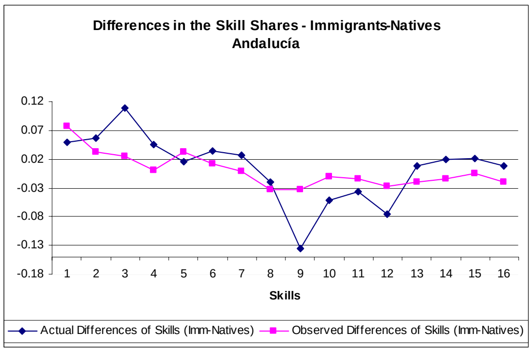


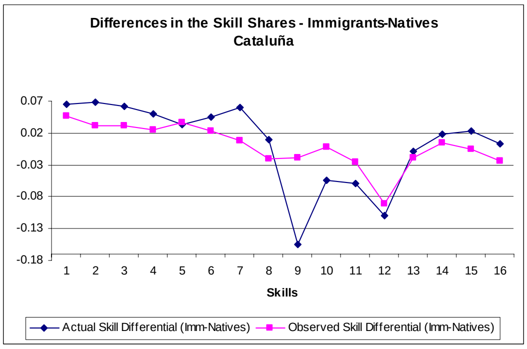


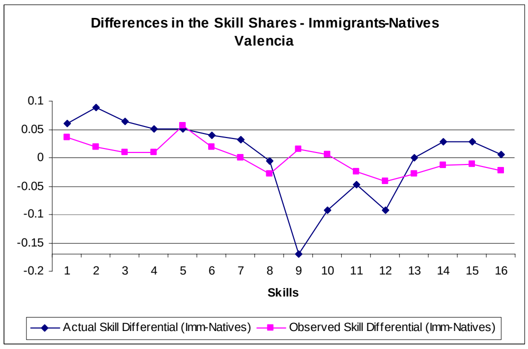


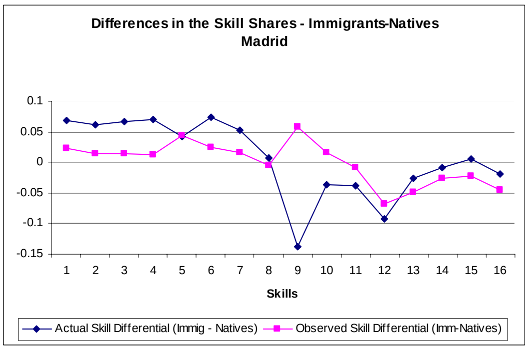
Figures 13-18:
Differences in Self-reported versus Effective or Actual Immigrant vs. Native Skill Shares

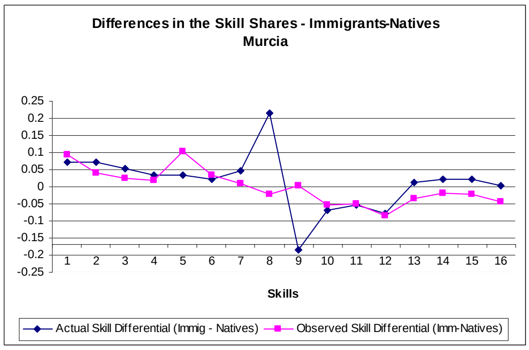












Notes: Skills are defined as follows: 1=Less than primary and less than 30 years; 2= less than primary and 31-35 years; 3= less primary and 36-40 years; 4=less than primary and 41-50 years; 5=Primary and less than 30 years; 6=Primary and 31-35 years; 7= Primary and 36-40 years; 8=Primary and 41-50 years; 9=Secondary and less than 30 years; 10=Secondary and 31-35 years; 11=secondary and 36_40 years: 12=secondary and 41-50 years; 13=University and less than 30 years; 14=university and 31-35 years; 15=university and 36-40 years; 16=university and 41-50 years.

APPENDIX #1: Derivation of the Immigration Surplus in Equation (4)

The increase in income accruing to natives following the entry of *M* immigrants (i.e. the increase in national income per unit of output accruing to natives) is given by:

$$IS = \frac{\Delta Q_N}{Q} = (K\frac{\partial r}{\partial M} + b_1 N\frac{\partial w_1}{\partial M} + b_2 N\frac{\partial w_2}{\partial M} + ... + b_n N\frac{\partial w_n}{\partial M})\frac{M}{Q} \qquad (2)$$

where b_i denotes the share of natives with a particular skill level with $i = 1...n$. Under the assumptions that: (a) capital is infinitely elastically supplied at a constant rate *r*, and that (b) immigrants create a surplus as long as their skills differ from those of natives and, therefore, the immigration surplus is positive only when: $(\beta'_i - b_i) \neq 0$,[15] we can evaluate the derivatives of wages at the average rate (i.e., at: (1/2)*M*, which implies obtaining half the gain obtained when the derivatives are evaluated at *L*=*N*+*M*) and rewrite equation (2) as :

$$IS = \frac{\Delta Q_N}{Q} = \frac{1}{2}\left[b_1 N(\beta'_1 - b_1)M\frac{\partial w_1}{\partial M} + b_2 N(\beta'_2 - b_2)M\frac{\partial w_2}{\partial M} + ... + b_n N(\beta'_N - b_N)M\frac{\partial w_n}{\partial M}\right] \qquad (3)$$

where β_i' denotes the effective share of immigrants within skill cell *i*.

Given that: $\frac{\partial w_i}{\partial M} = \sum_{j=1}^{n}\frac{\partial w_i}{\partial L_j}\frac{\partial L_j}{\partial M}$ and $\frac{\partial L_j}{\partial M} = (\beta_j' - b_j)$, after some manipulation to get the elasticities and income shares for each skill level *i*, we can rewrite equation (3) as:

$$IS = \frac{\Delta Qn}{Q} = -\frac{1}{2}\frac{N}{L}\frac{M}{L}\left\{\sum_{i=1}^{n}\left[(\beta'_i - b_i)^2\frac{s_i}{p_i}\left[\sum_{j=1}^{n} e_{ji}\right]\right]\right\}$$

where $s_i = \frac{w_i * L_i}{Q}$, $p_i = L_i/L$, and e_{ji} stands for the (absolute value of the) inverse of factor price elasticity within and across skills. Substituting those terms in the equation above, we obtain the final expression for the immigration surplus at a national level:

$$IS = \frac{\Delta Q_N}{Q} = -\frac{1}{2}(1-m)m\sum_{i=1}^{n}\left(\frac{(\beta'_i - b_i)^2 s_i}{p_i}\left(\sum_{j=1}^{n} e_{ij}\right)\right) \qquad (4)$$

where $m = M/L$ and $(1-m) = N/L$.

[15] The supply shock then is not *M*, but: $\sum_{i=1}^{n}(\beta'_i - b_i)M$.

APPENDIX #2: Tables A through C

Table A: Income Shares by Skill Group

Education	Age	Cell Income Shares	Income Shares (within education branch)
Less than Primary	20-30	0.001	0.008
Less than Primary	31-35	0.001	0.008
Less than Primary	36-40	0.001	0.008
Less than primary	41-50	0.005	0.008
Primary	20-30	0.010	0.084
Primary	31-35	0.008	0.084
Primary	36-40	0.012	0.084
Primary	41-50	0.060	0.084
Secondary	20-30	0.118	0.365
Secondary	31-35	0.064	0.365
Secondary	36-40	0.070	0.365
Secondary	41-50	0.111	0.365
University	20-30	0.074	0.243
University	31-35	0.043	0.243
University	36-40	0.045	0.243
University	41-50	0.071	0.243

Table B: Estimated Factor Price Elasticities, by Skill Group

Education	Age	Own Elasticity	Cross Elasticity (within education branch)	Cross Elasticity (across education branches)
Less than Primary	20-30	-0,280	-0,060	0,00059
Less than Primary	31-35	-0,280	-0,060	0,00059
Less than Primary	36-39	-0,295	-0,074	0,00073
Less than Primary	41-50	-0,523	-0,303	0,00299
Primary	20-30	-0,273	-0,053	0,00580
Primary	31-35	-0,261	-0,041	0,00452
Primary	36-39	-0,283	-0,063	0,00697
Primary	41-50	-0,528	-0,308	0,03400
Secondary	20-30	-0,307	-0,087	0,06662
Secondary	31-35	-0,267	-0,047	0,03610
Secondary	36-39	-0,273	-0,053	0,04061
Secondary	41-50	-0,273	-0,053	0,04061
University	20-30	-0,323	-0,103	0,04186
University	31-35	-0,281	-0,060	0,02456
University	36-39	-0,283	-0,063	0,02560
University	41-50	-0,319	-0,099	0,04027

Table C: Immigrants' Penetration (*m*) Values at the National and Regional Levels

National and Regional Level	2001	2007
National	0.05	0.10
Andalucía	0.03	0.06
Cataluña	0.06	0.13
Valencia	0.06	0.15
Madrid	0.09	0.14
Murcia	0.10	0.14

Source: Padrón Municipal - INE