UC DAVIS DEPARTMENT OF ECONOMICS

Working Paper Series

Rethinking the Area Approach: Immigrants and the Labor Market in California, 1960-2005.

Giovanni Peri
UC Davis

May 21, 2010

Paper # 10-10

I show that a CES production-function-based approach with skill differentiation and integrated national labor markets has predictions for the employment effect of immigrants at the local level. The model predicts that if I look at the employment (rather than wage) response by skill to immigration in a state, I can estimate the substitutability-complementarity between natives and immigrants. This allows me to infer, other things constant, how immigrants stimulate or depress the demand for native labor. I also use a novel instrument based on demographic characteristics of total Central American migrants or of the Mexican Population to predict immigration by skill level within California. Looking at immigration to California between 1960 and 2005 my estimates support the assumption of a nationally integrated labor market by skill and they support the hypothesis that natives and immigrants in the same education-experience group are not perfectly substitutable. This, in turn, explains the counter-intuitive fact that there is a zero correlation between immigration and wage and employment outcomes of natives.

Department of Economics
One Shields Avenue
Davis, CA 95616
(530)752-0741

http://www.econ.ucdavis.edu/working_search.cfm

Rethinking the Area Approach:

Immigrants and the Labor Market in California, 1960-2005.

Giovanni Peri, (University of California Davis and NBER)*

This Draft: May, 2010

Abstract

I show that a CES production-function-based approach with skill differentiation and integrated national labor markets has predictions for the *employment effect* of immigrants at the local level. The model predicts that if I look at the employment (rather than wage) response by skill to immigration in a state, I can estimate the substitutability-complementarity between natives and immigrants. This allows me to infer, other things constant, how immigrants stimulate or depress the demand for native labor. I also use a novel instrument based on demographic characteristics of total Central American migrants or of the Mexican Population to predict immigration by skill level within California. Looking at immigration to California between 1960 and 2005 my estimates support the assumption of a nationally integrated labor market by skill and they support the hypothesis that natives and immigrants in the same education-experience group are not perfectly substitutable. This, in turn, explains the counter-intuitive fact that there is a zero correlation between immigration and wage and employment outcomes of natives.

Key Words: Immigration, Native Employment, Inter-state migration, Complementarity.

JEL Codes: F22, J61, J31, R13.

*Giovanni Peri, Department of Economics, UC Davis, One Shields Avenue, Davis, CA 95616. Email: gperi@ucdavis.edu. I am grateful to Will Ambrosini, David Card, Gordon Dahl, Christian Dustmann, Ethan Lewis, Leah Platt-Bustan, Steve Raphael and participants to several seminars for suggestions. I am grateful for the "Population Study Grant" awarded to me by the UC Davis Gifford Center and used in part to fund the present research.

1 Introduction

The recent literature on the effect of immigration on US labor markets has made important progress from the simple area-based approach of the early studies[1]. Following the lead of Borjas, Freeman and Katz (1997), Borjas (2003) and Borjas and Katz (2007) economists have recognized that there can be small (or null) wage effects of differential immigration flows at the local level if natives respond by moving out. As a result, the search for the wage effects of immigration has been in part relocated to the national level. The recent literature has also carefully separated workers into a finer classification of observable skills (experience and education) and has examined the impact of national immigration on the wage of natives by skill group. The estimates of wage effects have been usually based on a nested constant elasticity of substitution (CES) production function. This approach allows economists to estimate elasticity of substitutions and to analyze the substitutability and complementarity of workers across skills enabling them, in turn, to calculate the effects of immigrants on the wages of natives, accounting for own- and cross-skill effects (Borjas 2003, Borjas and Katz, 2007, Ottaviano and Peri, 2008).

There is still some disagreement on the extent to which the supply of immigrant workers depresses (or stimulates) the demand for native workers overall and within each skill group. This depends, crucially, on the estimates of some elasticities of substitution. An important one is the substitutability between immigrant and native workers of similar observable characteristics (see Ottaviano and Peri 2008 and Borjas, Grogger and Hanson 2008) as that would determine to what extent immigrants compete with or are complements of native workers of the same observable characteristics.

The national approach, however, has two weaknesses relative to the area approach and has failed, so far, to explain one puzzle at the local level. The first weakness of the national approach is that in estimating the wage response to immigration it makes no use of instrumental variables to proxy for supply-driven immigrant shocks. The area approach, to the contrary, has been eminently concerned with the issue of endogeneity of immigrants flows to wage and it has used for a long time (at least since Card 2001) the historical location of immigrants across states by national group and the aggregate flow by nationality to impute supply-driven immigrant changes. While the national approach includes several sets of fixed effects to absorb demand shocks, if immigrants to the US in a skill group are attracted by lingering skill-specific productivity shocks the OLS estimates of the fundamental elasticities may still be biased. The second issue is that, by aggregating at the national level, the variation of immigrant workers across skill groups is much reduced. By using state data one would exploit much larger identifying variation. Finally, an unsolved issue of the national approach, as already emphasized by Card and DiNardo (2000) and several studies after them, is that it rests on the assumption of integrated national markets. Under such assumption, at least in the long run, native workers of a certain skill

[1] E,g, Altonji and Card (1989) or Grossman (1982).

(education-experience group) should move out of the area that receives a disproportionate inflow of immigrants re-balancing the relative supply in that skill group. The failure to identify such outflow of natives by skill group in response to immigration, combined with the very small effects of immigrants on native wages by skill (found by Card 2001, Card and DiNardo 2000 and confirmed in Card 2009) cannot be explained by a national model in the way of Borjas (2003) or Borjas and Katz (2007). This has convinced some authors to keep considering local labor markets (cities, states) as somewhat segmented so that local evidence on wage effects is still informative (Card 2009). The problem of explaining the lack of native employment effects with imperfect labor mobility in the long run is that the evidence relative to responses to other types of demand shocks (e.g. Blanchard and Katz 1992) suggests a high degree of labor mobility of workers across US states in the long run.

This paper's main contribution is to adapt the structure of the national approach to the local area analysis, maintaining the nested CES production structure and the assumption of nationally integrated skill-specific labor markets. I use local (California) data to estimate substitutability between native and immigrants of identical observable characteristics. The basic estimated specification, regresses inter-census changes in native labor inputs in California relative to the rest of the US on changes in immigrant labor inputs (also for California relative to the rest of the US) by education-experience cells controlling for education-experience and education year effects. Several empirical papers using data from US states or cities, such as Card and DiNardo (2002), Card (2001), Card (2007) and Card and Lewis (2007) use a similar empirical specification. A novel implication of this framework, however, is that using this specification I can test whether the degree of complementarity between natives and immigrant workers is different from the degree of complementarity between workers of different experience groups. The principal finding of the paper is that when I perform this test, I cannot reject that these levels of complementarity are the same. The model predicts, furthermore, that if this is true than there should be zero correlation between immigration and native employment outcomes. This is precisely the zero correlation observed in the data. These IV estimates are compared with the direct national estimates from Ottaviano and Peri (2008) and Borjas, Grogger and Hanson (2008). The result is an estimate of the complementarity between natives and immigrants somewhat larger than those found by those approaches.

The two results of integrated national markets for native workers and imperfect substitution with immigrants, together, explain the puzzle of insignificant wage and employment effects at the local level in response to immigration. Intuitively this is what happens: US-born workers are perfectly mobile and would respond to wage differentials by moving across states. The inflow of immigrants in the state, however, has two effects on native of similar education and age. On the one hand, it provides some competition that would depress their wage, as the observable skills are similar. On the other hand, it stimulates their demand through complementarity as their actual skills are not identical. The size of these two opposite effects depend on the substitutability between workers of different age groups (within an education group) and on the substitutability between native and immigrants within an age group. The two effects are equal and off-set each other when those elasticity of substitution are equal. Hence even with perfect mobility the inflow of migrants does not change real wages of natives and does not trigger their cross-state migration.

Such explanation uses a framework that is perfectly compatible with the national approach using the variation proposed by Ottaviano and Peri (2008). This paper, therefore, represents a resolution of the disparities between the area and national approaches. The only other paper that proposes a reconciliation of the estimates of the effects of immigrants on wage and employment at the area and at the national level is Borjas (2006). In that paper the author argues that using local markets (cities-states) as units of analysis one does not find a wage effect but only a negative employment effect of immigration. To the contrary at the Census region level most of the effects of immigration are on wages. The author argues that this is due to the compensating effect of native migration, that is strongest between cities and states. My results, consistently with those of Borjas (2006) do not identify any wage effect of immigrants at the state level. However, contrary to that paper, I do not identify any employment effect at the local level either[2].

I apply my analysis to California whose recent experience with immigration makes it one of the best laboratories for testing the consequences of immigration on native wages and employment. California, in *every* decade since 1960, has had immigrant inflows into its workforce of the same magnitude as those from the famous Mariel boatlift to Miami or from the post-Communist migrations to Israel or those experienced recently by Spain[3]. As with all these cases, California poses a dramatic test of the popular notion that immigration harms natives' employment opportunities in those labor markets where immigrants settle. And that dramatic test has an equally dramatic resolution: there has been no systematic association between immigration and employment outcomes of natives. By focusing on California I can also address the two limitations of the national approach.

First, the large initial share of Mexicans and Central Americans in California (relative to other states) combined with the large total migration rates of these groups in the 1960-2005 period allows me to use an instrument in the spirit of the enclave one proposed by Card (2001). The change in demographic structure of all Mexican migrants (and more in general of the Mexican population) is a supply driven change in the number of foreign-born by cell that affected California more then the rest of the US. Hence I use the changes in distribution of all Mexican and central American migrants and, even more conservatively, the change in population of

[2] Most of the other empirical studies at the state and city level (Card 2001, Card 2005, Card and Lewis 2007) fail to find negative employment effects of immigrants on natives. The specification used in the employment analysis of Borjas (2006) is unusual in this literature. It regresses native employment in an education-experience-state group on the share of immigrants in the same group. As argued in Peri and Sparber (2008) the presence of native employment at the denominator of the explanatory variable (which equals foreign-born employment divided by native plus foreign born employment) induces mechanically a negative correlation which is larger the larger is the variance of native employment. This may explain the unusual negative and significant effect of immigrants on employment found by Borjas (2006).

[3] California, the largest immigrant recipient over 45 years among US states, received in each decade between 1970 and 2000 an inflow of immigrants equal to 8% of its population. Miami's working population increased by 7% in 1980 due to the Mariel boatlift. Israel received an inflow of immigrant between 1989 and 1994 equal to 10% of its population, but much less in any other period outside it. And Spain, the European country with largest recent immigration surge, experienced an inflow equal to 9% of its population between 1998 and 2007, but none before and has had negative immigration since then.

Mexican origin across education-experience groups, obtained from the Mexican Censuses, as instruments. I also add several different sets of dummies to account for unobservable demand shocks. Additionally, I perform several model and measurement related robustness checks. I use different measures of employment and hours worked; I group workers by skills in different ways; I select only some decades or some skill groups; and finally, I control for initial conditions and for lagged employment growth. While each of these specifications may be criticized on its own, the stability of the estimated coefficient of the domestic labor response to immigrants gives me some confidence in my results.

Second, as California is the state with largest inflow of immigrants, by using its differences with the rest of the US, I am exploiting the largest variation in the labor supplied by immigrants among the US states. Finally, focusing on California also allows me to address another issue raised by the critics of the area approach (e.g. Aydemir and Borjas 2007). Local area estimates, they argue, are based on less precise measures of immigrant shares, as they include states or cities for which there are small samples. This measurement error can induce attenuation bias in the estimated coefficient of the wage regression. By limiting my analysis to California and using IPUMS Census (and American Community Survey) data I rely on several thousands of individual observations in each skill cell. Hence such error in measuring immigrant as share of employment (or population) is likely to be negligible.

In the last section of the paper I compare the employment based estimate of native-immigrant substitutability from this paper with previous estimates that are mainly based on national wage regressions. I provide some explanation to reconcile the differences and I review some reasons proposed by the literature for the imperfect substitution between natives and immigrants. I also consider alternative explanations for the small wage and employment effect of immigrants. Namely, immigrants may improve efficiency of production by improving skill to task matches or by encouraging the adoption of technologies appropriate to the skill group. Lewis (2005) and Peri (2009) pursue these alternative productivity channels to explain the lack of negative labor market effects of immigrants. I also show, for completeness, what is the implication of the estimated immigrant-native substitutability on simulated national effect of immigrants on wages over the period 1990-2005.

The remainder of the paper is organized as follows. Section 2 presents the theoretical model and the derived empirical framework used to analyze the effect of immigration on the labor demand for natives. Section 3 describes the data on immigration, employment and wages in California, relative to the rest of the US, and presents some tendencies and facts. Section 4 tests the hypothesis of integrated national markets by skill. Section 5 presents the estimates of the main parameter of interest–the effect of immigration on employment of US-born workers in California– and derives the implications for the substitutability between natives and immigrants. Section 6 reconciles this estimates with those obtained using the direct method at the national level and other empirical evidence. I also present some alternative explanations proposed in the literature for the null effect of immigration on local employment and wages. Section 7 derives the implications of my estimates for the national effects of immigration on wages. Section 8 provides some concluding remarks.

2 The Framework: National Labor Markets and Local Employment Response

Let me consider a smaller economy California (Cal) and a larger economy, the rest of the US (US), whose labor markets are integrated in the sense that workers can move between them. The subscript s will indicate one of this two economies. Total output in California (or the rest US), Y_{st}, is tradable, it is the numeraire good and it is produced by combining Labor, N_{st}, Physical Capital, K_{st} and Productivity A_{st}. The function used is the popular Cobb-Douglas production function, with elasticity of output to capital equal to α:

$$Y_{st} = A_t N_{st}^{\alpha} K_{st}^{1-\alpha} \tag{1}$$

The recent literature using the national approach considers the aggregate labor input N_{st} as a nested CES combination of labor inputs by workers with differentiated skills. The relevant skills are education, and potential experience, (or age) plus the attribute of being foreign-born or US-born. Consistently with Ottaviano and Peri (2008) I assume that cells differing by each category of skill are separate and nested into a cell in the upper category. The type of nest used is illustrated in Figure 1, and generalizes the model in Borjas (2003) following the specification preferred in Ottaviano and Peri (2008). The partitions into groups, from the more general to the more specific category are as follow. There are two broad education groups (H, L for High and Low); within each of them I allow for two education (Edu) sub-groups (No degree and High School Graduates within L and Some College and College Graduates within H). Then within each education sub-group I nest 8 potential experience groups (Exp) dividing into 5-year-intervals the range from 0 to 40 years of experience. Finally within each education-experience group I separate immigrants and natives[4]. At each level of the nest I allow for constant elasticity of substitution across groups in the category, the notation for these elasticities is shown on the right part of Figure 1. I also allow for differences in the relative productivity of each group at each level of the nest. From such production function I derive the marginal productivity of native and immigrant workers in each cell[5].

The marginal productivity (MP) of each worker depends on the productivity parameters and on the supply of labor in each other skill group. When the supply of workers in California or the rest of the US changes for

[4] I also maintain the possibility of a segmentation by gender by considering males and females in separate and then combined estimations.

[5] Appendix A shows the exact expressions for the production function and the formulas (and simplifications) needed to obtain the marginal productivity of labor of skill j.

any reason (say a symmetric immigration from the rest of the world) the marginal productivity of each worker changes as well. The total differential of the logarithmic MP of a native worker of skill $j = (Edu_j, Exp_j)$ in location s in response to a variation of labor supply *in all other skill groups* in location s can be simplified (thanks to the nested CES structure) into the following expression:

$$\frac{\Delta MP_{jt}^s}{MP_{jt}^s} = \phi_{s,t} + \phi_{s,Edu,t} - \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\left(\frac{\Delta F_{jt}^s}{F_{jt}^s + D_{jt}^s}\right) - \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}} + \frac{1}{\overline{\varkappa}\sigma_{IMMI}}\right)\left(\frac{\Delta D_{jt}^s}{F_{jt}^s + D_{jt}^s}\right) - \Delta \ln \theta_{jt}^s \tag{2}$$

where ϕ_{st} and $\phi_{s,Edu,t}$ are complicated function of all labor input changes but they only vary, for each economy s, over time and over education by time, respectively. The parameters σ_{EXP} and σ_{IMMI} are, respectively, the constant elasticity of substitution between workers of different experience levels and between workers of different native status (i.e. foreign-born and US-born). The terms $\frac{\Delta F_{jt}^s}{F_{jt}^s+D_{jt}^s}$ and $\frac{\Delta D_{jt}^s}{F_{jt}^s+D_{jt}^s}$capture respectively the change in labor inputs by immigrants (F as in foreign) and natives (D as in domestic) as a percentage of the initial employment of skill group j in location s. $\overline{\varkappa}$ is the average share of wage bill to natives and $\Delta \ln \theta_{jt}^s$ is the change in productivity specific to group j in location s.

I now assume that the wage of each group in each location w_j^s equals its marginal productivity MP_j^s. Moreover, in the long run, workers of each skill group j move between locations in order to eliminate differences in wages[6] so that $\ln w_j^{Cal} = \ln w_j^{US}$ which also implies, taking the differentials in the long-run, the following equality $\frac{\Delta w_{jt}^{Cal}}{w_{jt}^{Cal}} = \frac{\Delta w_{jt}^{US}}{w_{jt}^{US}}$. Using the equality between wages and marginal products and expression 2 for each location the wage equalization condition gives the following simple expression:

$$0 = \widetilde{\phi}_t + \widetilde{\phi}_{Edu,t} - \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\left(\frac{\widetilde{\Delta F_{jt}}}{F_{jt} + D_{jt}}\right) - \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}} + \frac{1}{\overline{\varkappa}\sigma_{IMMI}}\right)\left(\frac{\widetilde{\Delta D_{jt}}}{F_{jt} + D_{jt}}\right) - \Delta \ln \widetilde{\theta}_{jt} \tag{3}$$

In expression 3 the tilde$^{\sim}$ above a variable means that it is taken in difference between the Cal and the US values. Hence, for instance, $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}} = \frac{\Delta F_{jt}^{Cal}}{F_{jt}^{Cal}+D_{jt}^{Cal}} - \frac{\Delta F_{jt}^{US}}{F_{jt}^{US}+D_{jt}^{US}}$. It expresses the percentage change in labor inputs (employment or hours worked) of type j due to the inflow of immigrants in California vis-a-vis the rest of the US. Similarly, $\frac{\widetilde{\Delta D_{jt}}}{F_{jt}+D_{jt}}$ represents the change in labor inputs in skill group j due to changes in natives relative to the initial inputs in the group for California vis-a-vis the rest of the US. From (3) I can solve for $\frac{\widetilde{\Delta D_{jt}}}{F_{jt}+D_{jt}}$:

[6] In Appendix B I show how the model would change if one assumes movement of workers in response to wage differentials but not perfect movement (i.e. not to fully equalize wages). This would correspond to a case with upward sloping (not horizontal) labor supply. I will show how expression 3 is modified to include the elasticity of supply and how the interpretation of the estimated parameters is only slightly changed.

assuming that the term $\Delta \ln \widetilde{\theta}_{jt}$ is a relative skill-specific random technology shock uncorrelated with the inflow of immigrants (ν_{jt}) and I can re-write equation (3) in the following form:

$$\frac{\widetilde{\Delta D_{jt}}}{F_{jt}+D_{jt}} = \Phi_t + \Phi_{Edu,t} + \beta \frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}} + \nu_{jt} \qquad \text{where } \beta = -\frac{\sigma_{IMMI} - \sigma_{EXP}}{\sigma_{IMMI} + \left(\frac{1-\overline{\varkappa}}{\overline{\varkappa}}\right)\sigma_{EXP}} \tag{4}$$

Equation (4) is the basis of my empirical analysis. It provides an interpretation in terms of the elasticity parameters for a simple "employment" regression that, in similar form, has been estimated in other studies (e.g. Card 2001, Card and DiNardo, 2000, Card and Lewis 2007). The terms Φ_t and $\Phi_{Edu,t}$ [7] capture the effects on the overall aggregate labor input and on the education-specific labor input. Thanks to the nested CES form the term $\Phi_{Edu,t}$ absorbs all the marginal productivity effects due to labor input changes in the same education group and the term Φ_t absorbs all the productivity effects from changes in inputs in other education groups as well as the effects of capital mobility to equate the rate of returns of capital between California and the rest of the US. The random disturbance ν_{jt} as noted above is a California-specific, skill-specific productivity shock. I allow this shock to have a systematic time component and an education-time-specific component[8]. In order to estimate β consistently the remaining variation of ν_{jt} needs to be uncorrelated with $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ or, in the instrumental variable approach, one needs to use as an instrument a portion of the variation of $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ that is uncorrelated with the relative productivity-demand shock of a skill group in California relative to the rest of the US.

The coefficient of interest, β, can therefore be estimated in a regression of the change in the labor supply of natives (relative to the initial total supply in the skill group) on the change in supply due to immigrants (also relative to the initial supply) instrumented with a purely supply-driven change in immigrants. Both variables are expressed for California relative to the rest of the US level; the unit of observations are the changes for 32 skill (education by experience) groups over the periods 1960-70, 1970-80, 1980-90, 1990-2000 and 2000-2005.

The important feature of equation 4 is that the parameter β has an interpretation in terms of σ_{IMMI} relative to σ_{EXP}[9]. First, if natives and immigrants are perfectly substitutable within the group ($\sigma_{IMMI} = \infty$) then I would observe $\beta = -1$ independently of the value of σ_{EXP} (as long as it is finite). The traditional literature has called this case the "full crowding-out" case, in which one immigrant displaces exactly one native. Second, since the denominator of β is always positive the sign of the effect is determined by whether immigrants and natives are more or less substitutable than workers with different experience levels. If $\sigma_{IMMI} = \sigma_{EXP}$ then one would estimate that $\beta = 0$. This case has been called in the empirical literature the "no crowding out" situation

[7] These terms are equal to $\widetilde{\phi}_t$ and $\widetilde{\phi}_{Edu,t}$ divided by $\left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}} + \frac{1}{\overline{\varkappa}\sigma_{IMMI}}\right)$.

[8] As the exact expression of the terms Φ_t and $\Phi_{Edu,t}$ is complicated I will absorb them into a set of time effects and of education by time effects. Those fixed effects will also absorb the variation of the systematic components of technological shocks.

[9] Remember that I absorb any systematic variation by education group over time ($\Phi_{Edu,t}$) by using the set of fixed effects. This implies that neither the elasticity of substitution between education groups nor any other "higher level elasticity" (such as that one between capital and labor) affect the estimate of the coefficient β.

and occurs in my framework when immigrants and natives in a group substitute for each other to the same extent as workers of different experience levels. Alternatively, if immigrants and natives are closer substitutes than workers with different experience levels ($\sigma_{IMMI} > \sigma_{EXP}$), but not perfect substitutes, one would obtain a negative value of β, but smaller than one in absolute value. This is usually referred to as "partial crowding out". Finally, if natives and immigrants are less substitutable than workers of different experience levels then one would obtain a positive estimate of β. This would be called "crowding in". As there are several estimates of σ_{EXP} for the US available from the literature (Welch 1979, Card and Lemieux 2001, Borjas 2003, Ottaviano and Peri 2008), and since the average $\overline{\varkappa}$ is measurable one can identify the values of σ_{IMMI} implied by the estimates of β from equation 4.

3 Immigration to California: Data

The inflow of the foreign-born into California over the period 1960-2005 has been remarkable. Using data from the IPUMS for Censuses 1960 (1% sample), 1970 (1% sample), 1980 (5% sample), 1990 (5% sample), 2000 (5% sample) and 2005 (ACS, 1% sample), I measure that the California population between 18 and 65 years of age grew during those 45 years by 12.3 million people. Of these, natives had a net increase of 5.8 million while foreign-born grew by 6.5 million. Among the foreign-born (identified as individuals born abroad without US citizenship at birth) a net increase of 4 million was due to immigrants from Mexico and Central America. Hence more than half of the net adult population growth in California over the period 1960-2005 was due to immigrants and a 30% of it was due to Mexican and Central American immigrants. The evolution of immigrants as a share of total employment in California vis-a-vis the entire US[10] is shown in Figure 2, and the actual percentage values, together with their breakdown by education group, are shown in Table A1[11]. Immigrants went from 9% (in 1960) to 36% (in 2005) of total employment in California while the corresponding percentages in the US were 5% (in 1960) and 16% (in 2005)[12]. Even more remarkably, Table A1 shows that the percentage of immigrants in the group of workers with no high school diploma went from 12% to 78% in California (versus an increase from 6% to 42% for the US as a whole). More than four fifth of this remarkable 66% increase was due to the inflow of Mexican and Central American workers. By all accounts California experienced the extent and type of immigration that many portray as disruptive to the job opportunities of natives, especially for native workers with low levels of education. By way of comparison, the industrialized countries that experienced the largest concentrated increase in employment due to immigrants in recent times where Israel that experienced an

[10] The absolute number of immigrant and total employment in US and California is shown in Figures A1 and A2 in the Tables and Figures Appendix.

[11] I consider as "employed" those individuals between 18 and 65 year of age who worked at least one week in the reference year. Moreover, I restrict the sample to those individuals with not more than 40 years of potential experience.

[12] If compared to any OECD country in 2005, California had the largest share of foreign -born population (33%) relative to any of them except Luxembourg (34%).

increase of population by 10% between 1989 and 1994 and Spain that experienced an increase of population of 8% due to immigrants between 1998 and 2008. California received an inflow comparable to those (as percentage of population) in each of the decades between 1970 and 2000. Hence, if there is a US state, or an economy in the world, where the labor market consequences of immigration should have been dramatic, California clearly qualifies. California, however, is also an open labor market vis-a-vis the rest of the United States. Every decade gross flows equal to more than 20 percent of its population move across its border to and from other states. Hence, it would be very reasonable to expect that, in spite of these massive inflows of immigrant workers, unevenly distributed across skill groups, the wages of natives in each skill group are not very different in California than in the rest of the country. This does not mean that there are no effects of immigrants on the labor demand for natives. Native workers may move in response to immigrant inflows and thereby equate wages across the national market. As I have shown in section 2 the labor demand consequences of immigration on native workers in an open labor market are captured through employment, rather than wage, effects. I now check that the data on wages by skill group are consistent with this "national labor market" assumption.

4 Testing the National Market Hypothesis

I begin with some simple evidence on correlations. I measure the percentage change in native wages for the education-experience groups defined in section 2 over each inter-census period (1960-2000) plus 2000-2005, for California relative to the rest of the US. This variable is $\Delta\widetilde{w}_{Djt}/\widetilde{w}_{Djt}$[13]. I plot this against $\widetilde{\Delta F}_{jt}/(F_{jt}+D_{jt})$, the increase in immigrant labor supply in the same skill group (j) over the same inter-census plus 2000-2005 periods, divided by initial labor supply in the group (also relative to the US aggregate). The scatter-plot produced is reported in Figure 3. It suggests no correlation at all (the point estimate is slightly positive and not significant) between native wage changes and immigration rates by cell-decade.

Table 1 explores more systematically the proposition that there is no correlation between native wage changes and inflows of immigrants at the skill-group level which is at the heart of the national integrated market assumption. I run the following weighted least squares regression, using as weights the employment size of each cell:

$$\frac{\Delta\widetilde{w}_{Djt}}{\widetilde{w}_{Djt}} = \phi_j + \phi_{Edu,t} + \gamma\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}} + \varepsilon_{jt} \tag{5}$$

In specification (5) I control for education-experience effects ϕ_j as well as education-time effects $\phi_{edu,t}$ in

[13] The average wage by education-experience group in each year is calculated by averaging the weekly wage of all working individuals that are not self-employed, each one weighted by the number of hours worked times his sample weight (PERWT). The definition of the four education groups, eight experience groups and the selection of working individuals along with the exact procedure adopted to calculate the wages is identical to Ottaviano and Peri (2008). The Appendix to that paper describing the details of data selection and econometric implementation.

order to allow for wage trends depending on skill type and common decade effects by education group. ε_{jt} is a zero-mean, random error uncorrelated with the explanatory variable. In the simplest specification (Column 1 of Table 1) I omit the fixed effects, in column (2) I include them, in column (3) I limit the regressions to cells containing workers with a high school degree or less, and in the last column, (4), I do not weight by cell size. Each entry in Table 1 reports the estimates of the coefficient γ from regression 5 and the rows differ by the measure used for labor supply changes ($\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$) which is based, alternatively, on hours worked, employment or population. Moreover, the top part of the table only includes male workers while the bottom part includes males and females. The results could not be clearer. The estimated coefficient is always very small, precisely estimated and not different from zero. The estimated correlations are consistent with the idea that even extremely large inflows of immigrants into a skill cell (for California relative to the US average) have not been associated with any significant wage change for native California workers relative to native workers across the rest of the US. For instance, taking the estimates of Column 2 (γ =0.02), which use hours worked to measure supply, I find that an inflow of immigrants into a skill group equal to 60% of the group's initial employment, which is the largest observed data point for the whole period across cells, would be associated with a deviation in the wages of California native workers (relative to US workers) of about 1% (and positive!). More ordinary inflows would be associated with essentially no wage deviations. This is consistent with national labor markets, by skill, that are perfectly integrated at least in the long run (over decades).

4.1 Instruments and 2SLS estimation

The OLS estimates of γ produced above show no correlation between the change in immigrant labor input and native wage changes across skill groups in California relative to the rest of the US. One concern is that, in spite of the fixed effects accounting for systematic education-by-year and skill-group specific effects there might still be some lingering changes in the productivity of specific age-education groups in California that are correlated with inflow of immigrants. To reduce these concerns I use an instrumental variable strategy in this and in the next section. California had a sizable community of Mexicans and Central Americans as of 1960 because of its proximity to that region and due to the Bracero program (1942-1964) that attracted agricultural workers. The inflow of those groups of immigrants increased greatly over the considered period, especially during the 1980's and 1990's. Those migrants, from Mexico and Central America had a particular age and education distribution. For instance a "baby boom" generation was hitting the labor market in Mexico in the 1980's and 1990's and less educated workers did not have good job opportunities in Mexico (see Hanson and McIntosh, 2009). As a result, total emigration of Mexican and Central American workers was characterized by a specific age-education distribution: many young, poorly-educated workers emigrated while few middle-aged, better-educated individuals did. This wave of emigrants from Mexico and Central America affected California disproportionately relative to the rest of the US because of the preferences of incoming immigrants to join already existing communities of Latin Americans. In the spirit of the “enclave" instrument used in Card (2001), Card (2009), and several other papers, I instrument the immigrant inflow to California (relative to the rest of the US) by skill-cell in each decade with the distribution by skill-cell of Mexican-Central American migrants to the US as a whole. In particular I construct the following variable $\frac{\Delta CenAm_{jt}^{(US+Cal)}}{F_{jt}^{(US+Cal)}+D_{jt}^{(US+Cal)}}$.The numerator measures the net inflow of Mexican and Central American migrants in the whole US for a certain education-experience j in decade t. This inflow is standardized by the total initial population for the whole US in that group.

To the extent that the skill-distribution of all migrants from Mexico and Central America to the US was not affected by the skill-specific labor demand of California *relative to the US*, the instrument would capture a pure supply shock as it will be correlated with the inflow of immigrants to California only through the demographics of Mexican and Central American emigrants.

Table 2 reports the estimates of γ using 2SLS methods with different measures of labor supply (population, employment and hours worked) considering alternatively all workers or males only for exactly the same specifications as the last three columns of Table 1. The lower part of the table shows the first stage coefficient and F-test of the instrument, and confirms that the instrument (Inflow of Mexican and Central American immigrants in the US as share of the population in the cell) is working in the correct direction and is relatively strong (F-stats above 14). The scatter-plot in Figure A3 of the "Tables and Figures Appendix" shows that there is a clear positive correlation between the instrument and the dependent variable by cell and decade. The following scatter-plot in the figure appendix (Figure A4) is meant to confirm that the above correlation is not driven by skill-specific demand pull factors shared by California and the US. In fact when I consider European immigrants to the US (that likely shared the same US-wide pull factors but did not have specific age-education push factors of the Mexican-Central American immigrants) I observe no correlation between their inflow and the relative immigration to California by skill. Table 2 shows that, using 2SLS, the point estimates of the parameter γ are still always very small (ranging between -0.02 and 0.10) and insignificantly different from 0. The standard errors are larger than in Table 1 but still rather small on average (around 0.10). Even in this case I can never reject the assumption of 0 wage effect of immigrants which is consistent with nationally integrated labor markets. Hence, the assumption incorporated in equation 3 stands and will be maintained throughout the rest of the analysis.

5 The Response of Native Employment to Immigrants

5.1 Basic Specification

The main goal of this empirical section is to estimate the coefficient β in equation 4. As discussed above, this coefficient can be smaller than, equal to, or larger than zero depending on the size of the elasticity of substitution between natives and immigrants (of similar skills) relative to the elasticity between workers in different experience groups. Before navigating the details of the empirical estimation, let me provide a simple figure that conveys the basic result, which will be confirmed time and again by more demanding specifications and 2SLS estimation techniques. Figure 4 presents a scatter-plot of the changes of immigrant employment as percentage of the skill group (horizontal axis) and the change in native employment (vertical axis) also as a percentage of the group, by cell and decade for California relative to the rest of the US. The figure demonstrates that there is essentially no correlation whatsoever between the native and immigrant employment change. This is, ultimately, what accounts for the zero coefficient that will be estimated below. Moreover, the variation in native employment growth (ranging between -50% and +50% of group employment) is larger than the variation in immigrant employment (ranging between -20% and +40%). This, mechanically, implies that the standard errors of the estimates will be relatively large.

The possibility of estimating β consistently rests on my ability to control for all the factors that may induce a systematic correlation between the inflow of immigrants $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ and the productivity shock $\Delta \ln \widetilde{\theta}_{skjt}$ in equation (3). Only if the error is uncorrelated with the explanatory variable are the OLS estimates of β consistent. In Table 3 I first present the estimates of β resulting from a simple OLS regression of $\frac{\widetilde{\Delta D_{jt}}}{F_{jt}+D_{jt}}$ on $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ in Column 1. Then in column 2 I add the education by year effects which absorb the terms Φ_t and $\Phi_{Edu,t}$ of equation 4 and the education by experience effect that capture any skill-specific employment trend. I run these regressions using hours worked, employment or population as measures of labor supply and also, alternatively, on male workers only (in the top panel) or on male and female together (in the bottom panel). All specifications, except for one, produce an estimate of β not significantly different from zero. Nine out of twelve point estimates are positive. The estimates that include fixed effects (column 2) are systematically smaller than the "simple" estimates in column 1. This may indicate that without controlling for systematic California-specific, skill-specific demand shocks one may obtain, spuriously, a slightly positive employment effect. If there is some persistence in demand shocks, captured by the lagged native-employment growth, one should also include that lagged dependent variable in the regression. This is what I do in specification (3) and I still obtain estimates of β insignificantly different from zero[14]. In order to inquire whether more recent immigration had a different effect, I estimated specification (5) restricted to post-1980 years. Finally in (6) I did not weight cells for their employment size. Both specifications still produce very small estimates of β in absolute value, never statistically different from zero. It is worth mentioning that specification (4), where the sample is restricted to include only cells of less educated workers (defined as those with an high school degree or less) generates positive estimates that are mostly significant at the 5% level. This implies (if the coefficient estimate can be confirmed in other specifications) that for cells with less educated workers, immigrants are even less substitutable with natives than

[14] And I do not find any significant correlation of change in immigrant employment by skill between decades.

in cells with high education levels. A value of $\beta = 0$ can be taken to be the "focal point" for my parameter estimates as it is almost never rejected by a formal t-test. I remind the reader that most existing estimates of the elasticity of substitution σ_{EXP} across age groups (experience groups) for the US national market range between 4 and 14. More precisely, Welch (1979) (Table 9 page 90) estimates the elasticity of substitution between US white male workers of different experience groups and finds it to be between 4 and 12 (using one-year cells). Card and Lemieux (2001) estimate an elasticity ranging from 4 to 10 (Table V of Card and Lemieux, 2001) between US workers of different experience groups (five-year cells). Borjas (2003) estimates an elasticity of 3.5 between US workers of different experience groups (five-year cells). Ottaviano and Peri (2008) estimate an elasticity ranging from 6.25 to 14 (Ottaviano and Peri 2008, Table 6) between US workers of different experience groups (five-year cells). The formula of equation 4 and my estimates therefore imply a similar range for σ_{IMMI}, the elasticity between natives and immigrants. In particular, I can always rule out perfect substitutability across age groups ($\sigma_{IMMI} = \infty$ which would imply $\beta = -1$) while I never rule out $\sigma_{IMMI} = \sigma_{EXP}$. I will discuss and compare this range with the direct measures of σ_{IMMI} in section 6.

5.2 2SLS Estimation and Mexican Demographics

The magnitude and pattern of the 2SLS point-estimates reported in Table 4 is very similar to the OLS ones. In Table 4 I use the inflow of Mexican and Central American migrants to the whole US by cell, described in section 4.1, as instrument. The preferred specification with all fixed effects (column 2) shows for any measure and any sample an insignificant (usually positive) estimate of β. Including lagged native employment changes (column 3) or excluding the older period (column 5) or dropping the regression weights does not change the estimates much. The estimates with no fixed effects tend to be positive and often significant, indicating the potential presence of decade-specific, education-specific demand shocks in California correlated with the inflow of foreigners. However, once fixed effects are introduced the point estimates are very close to zero. The estimates including only less educated workers tend to be positive indicating, possibly, a larger complementarity of immigrants to natives in these groups. The 2SLS results thus uphold the findings of Table 3, confirming that an estimate of $\beta = 0$ cannot be rejected in most cases (and when it can be rejected, the preferred alternative is $\beta > 0$). In Table 5 I push the instrument a step further. I introduce estimates that use an instrument that is purely driven by the relative size of age-education groups born in Mexico relative to the corresponding group in the US. In particular, to avoid any lingering pull-effect of the Californian economy on immigrants of different skills I construct the following variable as instrument: $\frac{\Delta Mexican_{jt}}{F_{jt}+D_{jt}}$. The variable $\Delta Mexican_{jt}$ is the decade-change in population in skill group j of Mexican-born currently residing in Mexico or the US. This variable is obtained adding up residents of Mexico (constructed from the Mexican Census micro data available at the international IPUMS, Ruggles et al 2006) and Mexicans in the US and captures changes in the potential pool of migrants in the group, purely driven by Mexican demographics. This cell-composition of Mexican-born population only affects immigration to California if the variation in size of the potential pool of Mexicans in each cell is correlated with actual size of actual migrants to California by cell. As long as demographics in Mexico did not depend on California skill-specific productivity shocks at the time a group is in the labor market, the instrument variation should be completely exogenous and demography-driven[15]. Table 5 show the estimates of β when using this instrument. First, let me notice that the instrument is correlated with the endogenous variable but the correlation is not too strong (the F-stats in the last row range from 2.31 to 11.4), especially when used with the fixed effects[16]. Hence the standard errors of the estimates tend to be large and weak instrument bias may also be present[17]. However, neither when excluding fixed effects (Column 1) nor when including them (Column 2) nor when I consider only less educated workers (Column 3) can I find any negative and significant estimate of β. In general the estimate is positive and not significant. While the standard errors are sometimes as large as 1.1 I can never reject a value of $\beta = 0$ in the estimates with fixed effects. This implies again that the elasticity of substitution between natives and immigrants is equal to the estimated elasticity of substitution between workers of different experience groups.

5.3 Effect on Black Native Workers

It is interesting to analyze specifically the employment effects of immigrants on African American workers. African Americans are more concentrated in the skill-groups (young and less educated) most affected by the inflow of immigrants. Furthermore, their occupations and jobs are intensive in manual and physical tasks (as pointed out in Peri and Sparber 2009) and this group may be in more direct competition with immigrants. Hence I estimate the same regression 4 using the same specifications and variable definitions as in Table 4, but restricting the measure of native employment change to African-American employment. Figure A6, in the Tables and Figures Appendix, shows the scatter-plot of changes in African American employment by decade (as a percentage of initial cell employment) versus the change in immigrant employment as a percentage of initial cell-employment. In every cell and decade the changes in employment of African Americans in California are much smaller than changes in immigrant employment and also there is no apparent correlation (possibly a small positive one) between the two variables. Table 6 shows the estimates of β using the same specifications and methods as in Table 4, but using the employment change of African Americans relative to the total initial employment as the dependent variable. In particular, all estimates use the 2SLS method with the age-education

[15] By including education by period effect I effectively identify the coefficients on variations across age groups within an education cell.

[16] Figure A5 in the Tables and Figure Appendix shows the scatter-plot of the instrument based on Mexican-Born population and the explanatory variable based on total inflow of immigrants in California (relative to rest of the US). The correlation is clearly positive but not too strong.

[17] I also performed a LIML estimation, more robust to the issue of weak instruments, obtaining very similar point estimates and only marginally larger standard errors.

composition of Mexican-Central American immigration to the US as an instrument for the immigrant inflow by cell into California relative to the US. Consistent with the previous results, in the specifications including fixed effects and all skill groups the estimates of β are insignificantly different from zero. In the case with no fixed effects (Column 1) or in the specification including less educated workers only (Column 4), the parameter β is actually estimated to be positive and significant, between 0.10 and 0.20. The estimated effects on African Americans are even more convincing in ruling out a crowding-out of native employment by immigrants. In fact, the point estimates are never smaller than -0.002 and the standard errors are between 0.03 and 0.09, which implies that in most cases I can reject at the 5% level any negative effect of immigrants on native employment larger (in absolute value) than -0.1. In contrast, in several instances I cannot rule out positive effects on the order of 0.2-0.3. The response of African American employment to immigrants with similar age and education, much like the response of all natives, does not exhibit any evidence of even mild crowding out. Applying the interpretation from my model, based on the existence of a national labor market and mobility of natives in the long-run[18], this implies that immigrants and natives are not perfect substitutes within a skill group but their degree of substitution is similar to that of natives with different experience levels. By choosing a conservatively high value of the elasticity of substitution across age group, such as 10, and the 0 estimate of β prevailing in this section, I will therefore consider an estimate of $\sigma_{IMMI} = 10$ as reasonable and supported by my empirical evidence.

6 Explanations and Comparison with National Estimates

Summarizing the results of section 5, I can say that the inflow of immigrants to California within a certain education-age cell stimulated the demand for native labor of that type enough that the jobs taken by immigrants did not crowd out any jobs for natives. In fact, it is possible that the net effect was a small amount of net job creation for natives (especially in cells with low education) while I never found a net job-destruction effect for natives. Interpreting the results in light of the model in section 2 and summarized in equation 4, there are, in fact, two possible explanations for this phenomenon. The first, which I have privileged so far, is that immigrants and natives are not perfect substitutes in production, so that other things equal the inflow of immigrants not only affects the supply of that type of worker, but also positively affects the marginal productivity (and demand) for the native workers within that skill group. Given my controls for education-year effects, if the degree of substitutability between immigrants and natives is equal to that between natives of different age groups, the implied push in demand for natives exactly compensates the increased competition from immigrants in the same age-education cell implying no employment effect.

[18] I also tested and never rejected the assumption that the wage changes of black native workers (in California relative to the rest of the nation) are uncorrelated with immigration shocks. I used the same regressions, with wages of black workers as dependent variable, as those of section 4 for all US-born workers.

An alternative possibility, however, is that the skill-specific productivity shock $\Delta \ln \widetilde{\theta}_{jt}$, captured in equation 4 by the random error ν_{jt} is, in actuality, systematically positively correlated with the inflow of immigrants for some structural reason, even after I control for the education by time and education-experience effects. Following the insight of Lewis (2005) it may be the case that by receiving large inflow of immigrants in some skill cells (say among young and low educated) local economies such as California adopt technologies more efficient in the use of those skills benefiting productivity of all workers in that skill group, through an increase in $\ln \widetilde{\theta}_{skjt}$. Alternatively, following the idea proposed in Peri and Sparber (2009), it may be the case that in education-age cells with many immigrants the manual-physical skills are particularly abundant relative to communication-interactive skills because immigrants have a comparative advantage in them. Hence in those cells, natives specialize in communication tasks (hence the imperfect substitution) also improving skill-specific productivity, $\ln \widetilde{\theta}_{skjt}$. In such cases, the estimated coefficient in the regression of $\frac{\widetilde{\Delta D_{jt}}}{F_{jt}+D_{jt}}$ on the variable $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ would actually capture $\beta + \frac{1}{1-\overline{x}}\left(\frac{\Delta \ln \widetilde{\theta}_{jt}}{\Delta \ln \widetilde{F}_{jt}}\right)$. This includes the term reflecting the native-immigrant elasticity of substitution β, as well as the productivity effect of the inflow of immigrants$\frac{\Delta \ln \widetilde{\theta}_{jt}}{\Delta \ln \widetilde{F}_{jt}}$. In this section I review the estimates of σ_{IMMI} from California employment and compare them with the *direct* evidence, from wage data. The indirect evidence presented so far (based on employment changes) suggests that $\sigma_{IMMI} \approx \sigma_{EXP} \approx 10$ (possibly as low as 4 or as large as 14). I also present some stylized statistics that may indicate, following the specialization-productivity theory, that immigrants into California also stimulated specialization and productivity. This may represent part of the explanation for the absence of crowding-out, i.e., a positive contribution from the $\frac{\Delta \ln \widetilde{\theta}_{skjt}}{\Delta \ln \widetilde{F}_{skjt}}$ effect.

6.1 Previous Estimates

There are three sets of recent estimates of the parameter σ_{IMMI} from the existing literature for the US. One is from Ottaviano and Peri (2008) who use a national panel of 32 education-experience groups and Census years between 1960 and 2000 plus 2006 and obtain values that cluster around $\sigma_{IMMI} = 20$ (from their Table 2, Basic Specification). The second set is from Borjas, Grogger and Hanson (2008) who use a similar methodology and the national approach, but control for a larger set of fixed effects and obtain, in general, $\sigma_{IMMI} > 30$ often not significantly different from infinity. The third is from Card (2009) who uses cross-sectional city data in year 2000 and finds values ranging from 16 to 50, with most estimates around 25 and significantly different from infinity. In each of these estimates native and immigrants of identical education and experience groups are found to be closer substitutes than what implied by the estimates of section 5 which, as I said above, are consistent with a value of $\sigma_{IMMI} = 10$.

All previous estimates are based on regressions of the following type:

$$\ln(w_{Fjt}/w_{Djt}) = Fixed\ Effects + \delta \ln(F_{jt}/D_{jt}) + u_{jt} \tag{6}$$

where w_{Fjt} and w_{Djt} are, respectively, the wages of immigrants and natives in education-experience group j and F_{jt} and D_{jt} are their respective employment. Expression 6 is consistent with a production function (labor demand side) as in section 2, and if the variation of $\ln(F_{jt}/D_{jt})$ is purely driven by exogenous supply shifts (and uncorrelated with relative productivity shocks) then the estimates of δ would be equal to $-\frac{1}{\sigma_{IMMI}}$. However, as I showed in that same section 2 above, if the supply of native workers responds as they move across states to equate wage differentials, even if one identifies exogenous changes of F_{jt}, the responses of D_{jt} and w_{Djt} would systematically contribute to biasing towards zero the correlation between $\ln(w_{Fjt}/w_{Djt})$ and $\ln(F_{jt}/D_{jt})$. Hence direct estimates of δ based on local data (as Card 2009) will be systematically biased towards a zero coefficient and not consistently identifying $-\frac{1}{\sigma_{IMMI}}$. On the other hand, national estimates of an equation like (6) may suffer from another problem. In this case national employment by skill is not likely to change in response to immigrants. However foreign workers in the US as a whole may be systematically attracted by unobserved pull factors that increase their wages relative to that of similar natives. This would tend to generate a systematic positive correlation between $\ln(F_{jt}/D_{jt})$ and the residual relative productivity term u_{jt} in equation (6). This introduces a positive bias in the estimate of δ. As that coefficient is smaller than 0 the positive bias will reduce the absolute value of the estimate, giving the impression of a smaller value of $\frac{1}{\sigma_{IMMI}}$ and hence larger substitutability than there really is between native and immigrants. Hence my renewed "area" approach, accounting for the labor supply response of natives in a nationally integrated labor market and amenable to the use of instruments, orthogonal to area-specific productivity shocks, addresses the problems whose solution has eluded previous approaches and produces an interesting alternative estimate of the important parameter σ_{IMMI}.

6.2 Specialization in tasks and productivity effects

There are potential mechanisms that may create a correlation between the inflow of immigrants in a state, $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ and the productivity change of the skill group $\Delta \ln \widetilde{\theta}_{jt}$. I illustrate a mechanism and some stylized evidence that supports the idea that production in California responded to immigration with efficient specialization of natives in production tasks, thereby enhancing the productivity of those skill cells with larger inflows of immigrants. In this case the lack of negative employment effects would be in part due to improvement of productivity for the whole skill group and not only to imperfect substitution between immigrants and natives. Peri and Sparber (2009) show that among less educated workers immigrants in the last forty years have increasingly specialized in manual-intensive occupations, pushing natives to take communication-intensive jobs. Such a reallocation mechanism, based on the productive comparative advantages of each group of workers, has been efficient. They show that the complementarity between the two types of tasks and the efficiency gains from the reallocation enhanced the productivity and wages of natives. California is shown to have experienced immigration inflows and reallocation of natives into communication tasks to the largest extent. Figure 5, based on the data from Peri and Sparber (2009) updated to 2005, shows the strong and positive correlation between the share of immigrants among less educated workers and the degree of specialization of native workers in occupations with high Communication relative to Manual skills across 50 US states. The vertical axis of the graph reports the average use of Communication relative to Manual skills for native workers in a state, imputed by aggregating individual occupation data weighted by the intensity of Manual and Communication content of the occupations (as measured by the O*NET variables). The horizontal axis reports the share of immigrants among workers with a high school degree or less. The observation for California shows the highest concentration of immigrants and the second highest specialization of natives in communication tasks, emphasizing that the specialization mechanism was at its strongest in California. Moreover Peri (2009) shows that, across US states, large immigration is associated (possibly causally) with higher total factor productivity growth, and particularly high growth in the productivity (efficiency) of workers with low education levels. Figure 6, based on data from Peri (2009) shows in fact that the total factor productivity in California has been larger and has grown faster relative to the national average, especially in the decades of highest immigration (1980's and 1990's). While these are only aggregate correlations they are compatible with the idea that the large immigration flows produced a particularly large task specialization in California and this was associated with more efficient organization of production and consequently higher productivity. These mechanisms suggest that when $\frac{\widetilde{\Delta F_{jt}}}{F_{jt}+D_{jt}}$ was large for a skill group and/or a period, $\Delta \ln \widetilde{\theta}_{skjt}$ was also large for that group and/or period. Hence, the expected negative impact of immigration on the employment of natives of similar skills, which would occur in an open economy where native and immigrants are perfect substitutes, does not occur in part due to imperfect substitutability between the two groups and in part because of positive productivity effects of immigration on the skill group.

7 Implication of the Estimates on National Wages

The identification of the substitutability between native and immigrant workers of similar education and age using California data allows me to calculate the wage effects of immigrants nationally. As illustrated previously in Borjas (2003), Borjas and Katz (2007) and Ottaviano and Peri (2008), the knowledge of the elasticity of substitutions between groups in a nested CES model and the knowledge of inflow of immigrants over a certain period allow for the calculation of the effects on marginal products (wages) of native workers in each education and experience group. So using the CES nested model described in section 2, the elasticity estimates for education and experience groups consistent with the existing literature[19] and the inflow of immigrants to the

[19] In particular I choose the elasticity of substitution between more educated (H) and less educated (L) equal to 1.5. This is close to the value in Katz and Murphy (1992). I choose the elasticity of substitution between education sub-group within H and L to be equal equal to 10, which is compatible with Ottaviano and Peri (2008) and Goldin and Katz (2008). Finally I choose the elasticity of substitution between experience groups to be equal to 10, which is in the high estimated range of Card and Lemieux (2001) and Ottaviano and Peri (2008). These values are reported in Table 7.

US as observed in the 1990-2005 period I calculate the percentage effects on native wages (by education group) and wages of immigrants (also by group). Tables 7 shows these calculated long-run effects[20]. In particular the goal of the exercise is to show the difference in wage effects between the case of perfect native-immigrants substitutability (Column 1) and the case supported by the evidence of section 5 where $\sigma_{IMMI} = 10$ (column 3) and two cases situated at the extremes of the plausible range compatible with section 5 estimates, namely $\sigma_{IMMI} = 20$ and $\sigma_{IMMI} = 6$ (Columns 2 and 4).

The main two differences in the calculated effects between column 1 and 3 are easily described. First with imperfect substitution the effect on wages of all native workers are small and actually positive. In particular the least educated native workers who would suffer a wage loss of 1.4 points with perfect native-immigrant substitutability experience a small wage gain of 0.9. Second, all immigrants workers (new and long-time immigrants) receive a significant wage loss in the case of imperfect substitutability (on average -12.7%), while they did not have such losses under perfect substitutability. In summary, the imperfect substitution implies that new immigrants compete more with other immigrants than with natives, hence concentrating wage-competition effects on their more similar coworkers and projecting complementarity effects on the less similar ones.

8 Conclusions

This paper has revisited the area approach by analyzing the effects of immigrants on the labor demand for natives in the US. First, I have obtained an estimating equation relating native employment to immigrant employment in a skill group using assumptions about the production-function and the long-run mobility of workers between California and the rest of the US. Second, I have focused on California, the largest US state economy, and the largest immigrant destination. This ensures very small errors in the measures of immigrant employment by skill group and very large variation in the explanatory variable. Third, I have proposed a new instrument based on the age and education composition of migrants from Mexico and Central America and one based on education and age composition of Mexican-born individuals.

Two separate results should be emphasized. First, the estimates of the wage and employment effect of immigrants on natives in an education-experience group are never negative and significant. These results, while not new in the literature, are consistent with a specific interpretation of nationally integrated labor markets, by skill, and imply no negative effects of immigrants on the labor demand for natives. Second, adopting my model and assumptions, this zero estimate implies an elasticity between natives and immigrants of similar skills of around 10; equal, that is, to the elasticity of substitution between workers with similar education across age cohorts. Such estimates are somewhat smaller than the direct estimates of substitutability between natives

[20] In the calculations the physical capital is allowed to adjust to keep its return constant. This implies that the average overall wage of the economy, that depends on capital-labor ratio only is unchanged by immigration.

and immigrants. I first emphasize that the previous area and national estimates could suffer from biases that would produce smaller estimates, and such biases are likely reduced or eliminated by my approach. However I also raise the possibility that, on top of imperfect substitution, part of the native labor demand stimulated by immigrants, which offsets the competition effect and leads to no negative employment effects on natives, may be due to efficient specialization and a positive productivity effect within the skill group of the kind found suggested by Lewis (2005) and Peri (2009).

References

Altonji, Joseph G. and David Card, (1989). "The Effects of Immigration on the Labor Market Outcomes of Natives," NBER Working Papers 3123, National Bureau of Economic Research, Cambridge, Ma.

Aydemir, Abdurrahman and George J. Borjas (2007) "A Comparative Analysis of the Labor Market Impact of International Migration: Canada, Mexico, and the United States" (2007). *Journal of the European Economic Association* . Vol. 5, issue 4, p. 663-708.

Borjas, George J. (2003) "The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market" *Quarterly Journal of Economics*, CXVIII (4), 1335-1374.

Borjas, George J. (2006) "Native internal migration and the Labor Market Impact of Immigration" *Journal of Human Resources*, XLI (2), pp. 222-258.

Borjas, George J. and Lawrence F. Katz (2007) "The Evolution of the Mexican-Born Workforce in the United States" in *Mexican Immigration to the United States*, edited by George J. Borjas, University of Chicago Press, 2007, pp. 13-55.

Blanchard, Olivier Jean and Lawrence F. Katz (1992). "Regional Evolutions," *Brookings Papers on Economic Activity*, Economic Studies Program, The Brookings Institution, vol. 23(1992-1), pages 1-76.

Card, David (2001) "Immigrant Inflows, Native Outflows, and the Local labor Market Impacts of Higher Immigration"

Borjas, George J, Richard Freeman, and Larry Katz (1997) "How Much Do Immigration and Trade Affect Labor Market Outcomes?" *Brookings Papers on Economic Activity 1997, no1: 1-90ournal of Labor Economics*, XIX (2001), 22-64.

Card, David. (1990). The Impact of the Mariel Boatlift on the Miami Labor Market. *Industrial and Labor Relation Review* 43, no 2: 245-257.

Card, David. (2001). Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration. *Journal of Labor Economics* 19, no 1: 22-64.

Card, David. (2007). How Immigration Affects U.S. Cities. CReAM Discussion Paper, no. 11/07.

Card, David (2009) "Immigration and Inequality" *American Economic Review, Papers and Proceedings,* 99:2, 1-21.

Card, David & John DiNardo, (2000). "Do Immigrant Inflows Lead to Native Outflows?," *American Economic Review*, American Economic Association, vol. 90(2), pages 360-367.

Card, David and Lemieux, Thomas (2001) "Can Falling Supply Explain the Rising Returns to College for Younger Men? A Cohort Based Analysis" *Quarterly Journal of Economics*, Vol. CXVI, pg. 705-746.

Card, David and Ethan Lewis (2007) "The Diffusion of Mexican Immigrants During the 1990s: Explanations and Impacts" in *Mexican Immigration to the United States*, George J. Borjas editor, The University of Chicago Press, Chicago, London, 2007.

Goldin, Claudia and Larry Katz. 2008. The Race Between Education and Technology. , Harvard University Press, Cambridge Mass, 2008.

Grossman, Jean B. (1982) "The Substitutability of Natives and Immigrants in Production," *Review of Economics and Statistics* 64, no.4: 596-603.

Hanson G. and C. McIntosh (2009) "The Demography of Mexican Migration to the United States," *American Economic Review: Papers and Proceedings* 2009, 99:2, 22-27.

Katz, Larry, and K. Murphy (1992) "Changes in Relative Wages 1963-1987: Supply and Demand Factors," *Quarterly Journal of Economics* 107, no.1: 35-78.

Lewis, Ethan (2005) "Immigration, Skill Mix, and the Choice of Technique," Federal Reserve Bank of Philadelphia Working Paper #05-08, May 2005

Manacorda, Marco, Alan Manning and Jonathan Wadsworth (2006) "The Impact of Immigration on the Structure of Male Wages: Theory and Evidence from Britain" manuscript, London School of Economics, June 2006.

Ottaviano, Gianmarco I.P. and Peri Giovanni (2008) "Immigration and National Wages: Clarifying the Theory and the Empirics" NBER Working Paper 14188, July 2008.

Peri Giovanni (2009) "The Effect of Immigration on Productivity: Evidence from U.S. States" NBER working paper # 15507. November 2009.

Peri, Giovanni and Chad Sparber (2008) "The Fallacy of Crowding-Out: A Note on "Native Internal Migration and the Labor Market Impact of Immigration"," Working Papers 2008-01, Department of Economics, Colgate University.

Peri, Giovanni and Chad Sparber (2009) "Task Specialization, Immigration and Wages", *American Economic Journal*: *Applied Economics,* Vol 1:3.

Ruggles, Steven , Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander (2006). *Integrated Public Use Microdata Series*: Version 3.0

[Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor], 2004. http://www.ipums.org.

Welch, Finis (1979) "Effects of Cohort Size on Earnings: the Baby Boom babies' financial Bust" *Journal of Political Economy*, 87:5, pp.65-97

A Details of the model

A.1 Nested CES specification

I assume that the composite labor input in location s, N_{st} is obtained by the following nested combination of workers of different characteristics.

$$N_{st} = \left[\theta_{H,s,t} N_{H,s,t}^{\frac{\sigma_{HL}-1}{\sigma_{HL}}} + (1-\theta_{H,s,t}) N_{L,s,t}^{\frac{\sigma_{HL}-1}{\sigma_{HL}}}\right]^{\frac{\sigma_{HL}}{\sigma_{HL}-1}} \tag{7}$$

$$N_{HL_i s,t} = \left[\theta_{Edu_j,s,t} N_{Edu_{i1},s,t}^{\frac{\sigma_{EDU}-1}{\sigma_{EDU}}} + (1-\theta_{Edu_j,i,t}) N_{Edu_{i2},s,t}^{\frac{\sigma_{EDU}-1}{\sigma_{EDU}}}\right]^{\frac{\sigma_{EDU}}{\sigma_{EDU}-1}} \quad i = H, L \tag{8}$$

$$N_{Edu_{ik},s,t} = \left[\sum_{Exp_j=1}^{8} \theta_{Exp_j,s,t} N_{j,s,t}^{\frac{\sigma_{EXP}-1}{\sigma_{EXP}}}\right]^{\frac{\sigma_{EXP}}{\sigma_{EXP}-1}} \quad ik = \{\text{Some HS, HS, Some Co, Co graduates}\} \tag{9}$$

$$N_{j,s,t} = \left[\theta_{D,s,j,t} D_{j,s,t}^{\frac{\sigma_{IMMI}-1}{\sigma_{IMMI}}} + (1-\theta_{D,s,j,t}) F_{j,s,t}^{\frac{\sigma_{IMMI}-1}{\sigma_{IMMI}}}\right]^{\frac{\sigma_{IMMI}}{\sigma_{IMMI}-1}} \quad j = 1, ...8 \tag{10}$$

As can be seen in equations 7 and 8, two imperfectly substitutable education groups (H and L) that enter production in a symmetric way and within each of them I include two more education subgroups. In practice the groups of workers with no degree and high school degree are combined into L and those with some college education and college graduates are combined into H. Equation 9 suggests that workers of similar education can be divided into eight imperfectly substitutable skill groups according to their potential experience (eight five-year intervals between 0 and 40). Equation 10 suggests that domestic (native) workers D and foreign-born workers F are also potentially imperfectly substitutable. The terms denoted with θ capture the efficiency/productivity of each group in production they are skill and location specific. The elasticity of substitution across education groups, experience groups and natives-immigrants ($\sigma_{HL}, \sigma_{EDU}, \sigma_{EXP}$ and σ_{IMMI}) are structural parameters and are assumed to be equivalent across locations. I also impose standardizations at each level of aggregation as well as the following one: $\sum_{Exp_j=1}^{8} \theta_{Exp_j,s,t} = 1$, Together, they imply that all the productivity parameters in each labor aggregate add up to one.

A.2 Wages and National Labor Markets by skill

Given this productive structure the logarithmic wage of domestic workers in skill group j in location s and year t, calculated as the (logarithm of the) marginal productivity of a domestic worker, is:

$$\begin{aligned}\ln(MP)_{sjt} \quad = \quad & \ln w_{sjt} = \ln\left(\alpha A_t \kappa_{st}^{1-\alpha}\right) + \frac{1}{\sigma_{HL}}\ln(N_{st}) + \ln\theta_{HL_j t} - \\ & \left(\frac{1}{\sigma_{HL}} - \frac{1}{\sigma_{EDU}}\right)\ln(N_{HL_j,s,t}) + \ln\theta_{Edu_j,s,t} + \\ & \left(\frac{1}{\sigma_{EDU}} - \frac{1}{\sigma_{EXP}}\right)\ln(N_{Edu_j,s,t}) + \ln\theta_{Exp_j s} - \\ & \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\ln(N_{sjt}) + \ln\theta_{Dj} - \frac{1}{\sigma_{IMMI}}\ln(D_{sjt})\end{aligned} \tag{11}$$

At this point I use the assumption of integrated national labor markets for each skill-type (j) for native workers which implies that in the long-run the wages, $\ln w_{sjt}$, are equated between California and the rest of the US. Taking the total differential of equation (11) over time with respect to the logarithmic change in immigrant and native labor inputs in each skill group j for California and for the US average, and subtracting one from the other ($d\ln w_{CALDkjt} - d\ln w_{USADkjt}$), should equal zero if the wage equalization condition across states holds for each skill in the long-run. I impose such a condition and I use the fact that the total differential of the term $\ln\left(\alpha A_t \kappa_{st}^{1-\alpha}\right) + \frac{1}{\sigma_{HL}}\ln(N_{st})$, which varies only over time, is common to all skill groups and hence can be captured by a pure location-time-effect, ϕ_t. I then use the fact that the total differential of the term $-\left(\frac{1}{\sigma_{HL}} - \frac{1}{\sigma_{EDU}}\right)\ln(N_{HL_j,s,t}) + \left(\frac{1}{\sigma_{EDU}} - \frac{1}{\sigma_{EXP}}\right)\ln(N_{Edu_j,s,t})$ varies only across education groups and years and hence can be captured by an education-by-year effect, ϕ_{kt}. Assuming that the productivity parameters θ are independent of the supply of each skill I can re-write the total differentials in a more compact form. Imposing the condition that the labor markets are nationally integrated and therefore, the total (log) differential of (11) for California has to be equal to the total (log) differential for the rest of the US I obtain:

$$\begin{aligned}&\phi_{CAL,t} + \phi_{CAL,edu,t} - \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\frac{\partial\ln(N_{CAL,jt})}{\partial\ln(F_{CAL,jt})}\frac{\Delta F_{CAL,jt}}{F_{CAL,jt}} - \\ &\left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\frac{\partial\ln(N_{CAL,jt})}{\partial\ln(D_{CAL,jt})}\frac{\Delta D_{CAL,jt}}{D_{CAL,jt}} - \\ &\frac{1}{\sigma_{IMMI}}\frac{\Delta D_{CAL,jt}}{D_{CAL,jt}} - \Delta\ln\theta_{CAL,jt} = \\ &= \phi_{US,t} + \phi_{US,edu,t} - \left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\frac{\partial\ln(N_{US,jt})}{\partial\ln(F_{US,jt})}\frac{\Delta F_{US,jt}}{F_{US,jt}} - \\ &\left(\frac{1}{\sigma_{EXP}} - \frac{1}{\sigma_{IMMI}}\right)\frac{\partial\ln(N_{USjt})}{\partial\ln(D_{USjt})}\frac{\Delta D_{USjt}}{D_{USjt}} - \\ &\frac{1}{\sigma_{IMMI}}\frac{\Delta D_{US,jt}}{D_{US,jt}} - \Delta\ln\theta_{USjt}\end{aligned} \tag{12}$$

The term $\frac{\Delta F_{sjt}}{F_{kjt}}$, $\frac{\Delta D_{kjt}}{D_{kjt}}$ represents the discrete logarithmic change in foreign-born and native-born (respectively) of group j (for California when carrying the subscript Cal and for the rest of the United States when carrying the subscript US) over the inter-census period. It is easy to show that the partial derivative $\frac{\partial \ln(N_{jt})}{\partial \ln(D_{jt})}$ is equal to the share of wages going to native workers in the skill group j, which I can call $\varkappa_j$, and if natives and immigrants in the same skill groups are paid roughly the same wage this is approximately equal to their share in employment: $D_{jt}/(F_{jt}+D_{jt})$. Similarly, $\frac{\partial \ln(N_{jt})}{\partial \ln(F_{jt})}$ is the share of wages going to immigrants in skill group j and is equal to $F_{jt}/(F_{jt}+D_{jt})$. Hence $\frac{\partial \ln(N_{jt})}{\partial \ln(F_{jt})}\frac{\Delta F_{jt}}{F_{jt}}$ can be written as $\frac{\Delta F_{jt}}{F_{jt}+D_{jt}}$ and $\frac{\partial \ln(N_{jt})}{\partial \ln(D_{jt})}\frac{\Delta D_{jt}}{D_{jt}}$ can be written as $\frac{\Delta D_{jt}}{F_{jt}+D_{jt}}$ using the appropriate subscripts for California and the US. This substitutions and the (first order) approximation of $\varkappa_j$ with its average across cells $\overline{x}$ allows me to simplify 12 into 3.

B Extension: Upward Sloping Labor Supply

There is an easy way to relax the assumption of perfect labor mobility between states. Rather than assuming that workers move between California and the rest of the US to eliminate completely their wage differentials, namely imposing $\widetilde{\frac{\Delta w_{jt}}{w_{jt}}} = 0$, one can assume that their net flows is a log-linear increasing function of the wage differentials so that $\widetilde{\frac{\Delta D_{jt}}{F_{jt}+D_{jt}}} = \eta \widetilde{\frac{\Delta w_{jt}}{w_{jt}}}$ where $\eta > 0$ would be the supply elasticity of labor. $\eta = 0$ would imply no mobility at all of labor between California and the rest of the US, while $\eta = \infty$ would correspond to the assumption of perfect mobility. Under this specification of supply one can substitute the condition of change in demand equal to change in supply (California relative to the US). This would imply that the left hand side of equation 3 would be $(1/\eta)\widetilde{\frac{\Delta D_{jt}}{F_{jt}+D_{jt}}}$ rather than 0 and solving for $\widetilde{\frac{\Delta D_{jt}}{F_{jt}+D_{jt}}}$ would still produce an equation like 4 but now the expression of β would be: $\beta = -\frac{\sigma_{IMMI}-\sigma_{EXP}}{\sigma_{IMMI}+\left(\frac{1-\overline{x}}{\overline{x}}\right)\sigma_{EXP}+\frac{1}{\eta}}$.

It is immediate to verify that even in this case, unless $\eta = 0$ which would imply no mobility at all, the only case that would generate $\beta = 0$, is $\sigma_{IMMI} = \sigma_{EXP}$. Hence my main result, that $\sigma_{IMMI} = \sigma_{EXP}$, supported by the estimated value of $\beta = 0$, holds even when there is imperfect mobility of native workers, as long as their mobility responds positively to wage differentials between areas, for a given skill.

Figures and Tables

Table 1,
Native wage changes and inflows of immigrants, OLS estimates
Units of observation: Decennial changes, 1960-2000 and 2000-2005 for 32 education-experience cells.

Measures of Immigrants' Labor Supply:	(1) Simple	(2) With Fixed Effects (FE)	(3) Low education groups only, with FE	(4) Non weighted with FE
Males Only				
Hours Worked	0.003	0.02	0.02	-0.004
	(0.02)	(0.03)	(0.025)	(0.25)
Employment	0.006	0.058	0.01	-0.01
	(0.037)	(0.037)	(0.04)	(0.04)
Population	0.007	0.06	0.02	-0.006
	(0.03)	(0.05)	(0.05)	(0.04)
Males and Females				
Hours Worked	-0.005	0.028	0.03	0.007
	(0.02)	(0.024)	(0.02)	(0.025)
Employment	0.001	0.04	0.05	0.01
	(0.04)	(0.04)	(0.04)	(0.04)
Population	-0.006	0.04	0.05	0.01
	(0.04)	(0.04)	(0.04)	(0.04)
Education-by-Experience Effects	No	Yes	Yes	Yes
Education-by-year effects	No	Yes	Yes	Yes
Observations	160	160	80	160

Note: Dependent variable: percentage change (inter-census 1960-2000 plus 2000-2005) in weekly wage of US-native California workers relative to native workers in the rest of the US. The method of estimation is weighted least squares with analytical weights equal to the employment (number of observations) in each cell. The standard errors reported in parentheses are heteroskedasticity-robust and clustered by education-experience group. Specification (1) does not include any fixed effects, specification (2) includes education-by-experience and education-by-year effects, specification (3) includes only cells of workers with high school degree or less, specification (4) does not weight cells in the least square estimates.

Table 2

Native wage changes and inflows of immigrants, 2SLS with Central American immigrant to US as IV

Units of observation: Decennial changes, 1960-2000 and 2000-2005 for 32 education-experience cells.

Measures of Immigrants' Labor Supply:	(1) With Fixed Effects (FE)	(2) Non weighted with FE	(3) Low education groups only, with FE
Males			
Hours Worked	0.02	-0.01	0.01
	(0.07)	(0.06)	(0.07)
Employment	0.03	-0.01	0.02
	(0.09)	(0.08)	(0.09)
Population	0.02	-0.02	0.02
	(0.09)	(0.08)	(0.09)
Males and Females			
Hours Worked	0.07	0.05	0.06
	(0.09)	(0.10)	(0.10)
Employment	0.10	0.08	0.09
	(0.13)	(0.14)	(0.14)
Population	0.10	0.08	0.09
	(0.13)	(0.14)	(0.14)
Education-by-Experience Effects	Yes	Yes	Yes
Education-by-year effects	Yes	Yes	Yes
First Stage Statistics, Endogenous variable is Population, Male and Female,			
Change population by Cell of Mexican-Central American in the whole USA	2.21**	2.02**	2.13**
	(0.47)	(0.53)	(0.51)
F-stat	22.91	14.52	17.36
(p-value)	(0.00)	(0.00)	(0.00)
Observations	160	160	80

Note: Dependent variable: percentage change (inter-census 1960-2000 plus 2000-2005) in weekly wage of Native California workers relative to native workers in the rest of the US, measured across 32 skill cells. The method of estimation is 2SLS using the changes in total Mexican and Central American migrants in each cell as an instrument for the increase of immigrants of California, relative to the whole US. The standard errors reported in parentheses are heteroskedasticity-robust and clustered by education-experience group. Specification (1) includes education-by-experience and education-by-year effects, specification (2) does not weight cells in the least square estimates, specification (3) includes only workers with education equal or below high school diploma.

Table 3

Change in native labor in response to changes in immigrant labor, OLS estimates

Units of observation: Decennial changes 1960-2000 and 2000-2005 for 32 education-experience cells.

Measures of Labor Supply:	**(1) Simple**	**(2) With Fixed Effects (FE)**	**(3) FE plus lagged dependent variable**	**(4) Low education groups only, with FE**	**(5) 1980-2005 period only With FE**	**(6) Non weighted with FE**
			Male Only			
Hours Worked	0.28**	0.17	0.15	0.29*	0.09	0.21*
	(0.08)	(0.12)	(0.15)	(0.10)	(0.12)	(0.10)
Employment	0.13	0.04	-0.04	0.19*	0.07	0.13
	(0.07)	(0.10)	(0.14)	(0.08)	(0.12)	(0.08)
Population	0.11	-0.02	-0.06	0.17*	0.04	0.10
	(0.07)	(0.10)	(0.12)	(0.07)	(0.11)	(0.08)
			Male and Female			
Hours Worked	0.23	0.13	0.12	0.34*	-0.07	0.20
	(0.14)	(0.20)	(0.22)	(0.15)	(0.19)	(0.16)
Employment	0.05	-0.06	-0.13	0.20*	-0.08	0.06
	(0.12)	(0.17)	(0.19)	(0.11)	(0.17)	(0.12)
Population	0.01	-0.08	-0.15	0.19*	-0.06	0.05
	(0.12)	(0.15)	(0.18)	(0.08)	(0.17)	(0.10)
Education-by-Experience Effects	No	Yes	Yes	Yes	Yes	Yes
Education-by-year effects	No	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	80	96	160

Note: Dependent variable is the change (inter-census 1960-2000 plus 2000-2005) in native employment relative to total initial employment in the skill group for California relative to the rest of the US. Explanatory variable is the change in immigrant employment relative to total initial employment in the skill group for California relative to the average US. Each cell in the table shows the estimate of coefficient β from equation (4) in the main text. The method of estimation is weighted least squares with analytical weights equal to the employment (number of observations) in each cell.

The standard errors reported in parentheses are heteroskedasticity-robust and clustered by education-experience group. ** significant at 1%, * significant at 5%.

Table 4
Change in native labor in response to changes in immigrant labor, 2SLS estimates
Units of observation: Decennial changes 1960-2000 and 2000-2005 for 32 education-experience cells.

	(1) Simple	(2) With Fixed Effects (FE)	(3) FE plus lagged dependent variable	(4) Low education groups only, with FE	(5) 1980-2005 period only With FE	(6) Non weighted with FE
Male						
Hours Worked	0.81**	0.24	0.21	0.52**	0.15	0.35*
	(0.27)	(0.20)	(0.25)	(0.14)	(0.38)	(0.16)
Employment	0.85**	0.16	0.10	0.36**	0.13	0.24
	(0.28)	(0.25)	(0.29)	(0.13)	(0.39)	(0.15)
Population	0.67**	0.15	0.07	0.47*	0.13	0.33
	(0.21)	(0.24)	(0.29)	(0.18)	(0.42)	(0.20)
Male and Female						
Hours Worked	0.77*	0.14	0.16	0.60**	-0.13	0.26
	(0.35)	(0.35)	(0.42)	(0.18)	(0.54)	(0.27)
Employment	0.84*	-0.01	-0.04	0.59*	-0.18	0.20
	(0.39)	(0.49)	(0.42)	(0.29)	(0.64)	(0.33)
Population	0.84*	0.01	-0.09	0.52**	-0.02	0.23
	(0.34)	(0.33)	(0.39)	(0.21)	(0.54)	(0.26)
Education-by-Experience Effects	No	Yes	Yes	Yes	Yes	Yes
Education-by-year effects	No	Yes	Yes	Yes	Yes	Yes
First Stage Statistics, Endogenous variable is Population, Male and Female,						
Change population by Cell of Mexican-Central American in the whole USA	1.01**	2.21**	2.34**	2.13**	1.33*	2.02**
	(0.19)	(0.47)	(0.47)	(0.51)	(0.60)	(0.53)
F-stat of the instrument	26.17	22.91	24.12	17.36	5.01	14.52
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.00)
Observations	160	160	128	80	96	160

Note: Dependent variable is the change in native employment relative to total initial employment in the skill group for California relative to the rest of the US. Explanatory variable is the change in immigrant employment relative to total initial employment in the skill group for California relative to the rest of the US. Each cell in the table shows the estimate of coefficient β from equation (4) in the main text. The method of estimation is two stage least squares. The instrument used is the Mexican-Central American population by cell in the US. The standard errors reported in parentheses are heteroskedasticity-robust and clustered by education-experience group. ** significant at 1%, * significant at 5%.

Table 5
2SLS using change in population of all individuals born in Mexico, by cell
Units of observation: Decennial changes 1960-2000 and 2000-2005 for 32 education-experience cells.

Measures of Immigrants' Labor Supply:	**(1) Simple**	**(2) With Education by experience Fixed Effects (FE)**	**(3) Low education groups only, with FE**
	Males		
Hours Worked	0.90*	0.03	0.49
	(0.47)	(0.50)	(0.70)
Employment	1.01*	0.16	0.86
	(0.54)	(0.51)	(1.14)
Population	0.87*	0.13	1.01
	(0.43)	(0.51)	(1.14)
	Males and Females		
Hours Worked	0.87*	-0.16	0.53
	(0.41)	(0.52)	(0.64)
Employment	1.01**	0.05	1.01
	(0.46)	(0.51)	(1.16)
Population	0.93**	0.01	0.77
	(0.36)	(0.44)	(0.70)
Education-by-Experience Effects	No	Yes	Yes
Education-by-year effects	No	No	Yes
Observations	160	160	80
	First stage		
Coefficient in the first stage	0.30**	0.35**	0.21
	(0.09)	(0.16)	(0.15)
F-stat of the instrument	11.4	4.66	2.31

Note: Dependent variable is the change in native employment relative to total initial employment in the skill group for California relative to the average US. Explanatory variable is the change in immigrant employment relative to total initial employment in the skill group for California relative to the average US. Each cell in the table shows the estimate of coefficient β from equation (4) in the main text. The method of estimation is two stage least squares. The instrument used is the population born in Mexico by cell from the Mexican Census. The standard errors reported in parentheses are heteroskedasticity-robust and clustered by education-experience group. ** significant at 1%, * significant at 5%.

Table 6
Change in native African-American labor in response to changes in immigrant labor
Units of observation: Decennial changes 1960-2000 and 2000-2005 for 32 education-experience cells.

	(1) Simple	**(2) Basic With Fixed Effects (FE)**	**(3) FE plus lagged dependent variable**	**(4) Low education groups only, with FE**	**(5) 1980-2005 period only With FE**	**(6) Non weighted with FE**
Male						
Hours Worked	0.15**	0.05	0.05	0.10**	0.10	0.06*
	(0.05)	(0.026)	(0.028)	(0.02)	(0.07)	(0.02)
Employment	0.18*	0.044	0.042	0.08**	0.08	0.043
	(0.06)	(0.042)	(0.05)	(0.03)	(0.08)	(0.027)
Male and female						
Hours Worked	0.17**	0.028	0.028	0.11**	0.06	0.043
	(0.07)	(0.058)	(0.053)	(0.02)	(0.12)	(0.039)
Employment	0.20**	0.005	-0.003	0.09*	0.02	0.02
	(0.08)	(0.07)	(0.09)	(0.03)	(0.011)	(0.04)
Education-by-Experience Effects	No	Yes	Yes	Yes	Yes	Yes
Education-by-year effects	No	Yes	Yes	Yes	Yes	Yes
First Stage Statistics, Population Male and Female as endogenous variable						
Change population by Cell of Mexican-Central American in the whole USA	1.01**	2.21**	2.34**	2.13**	1.33*	2.02**
	(0.19)	(0.47)	(0.47)	(0.51)	(0.60)	(0.53)
F-stat of the instrument	26.17	22.91	24.12	17.36	5.01	14.52
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.00)
Observations	160	160	128	80	96	160

Note: Dependent variable is the change in employment of US-born African American relative to total initial employment in the skill group for California relative to the rest of the US. Explanatory variable is the change in immigrant employment relative to total initial employment in the skill group for California relative to the rest of the US. Each cell in the table shows the estimate of coefficient β from equation (8) in the main text. The method of estimation is two stage least squares. The Instrument used is the Mexican-Central American migrant population by cell in the US. The standard errors reported in parentheses are heteroskedasticity-robust and clustered by education-experience group. ** significant at 1%, * significant at 5%.

Table 7:
Implications of σ_{IMMI} for National wages

Simulated Wage Effects of Immigrants, 1990-2005, using a Nested CES production function (for US output): Long Run Effects, i.e. with capital adjustment to keep return to capital constant

Parameters:	(1) Perfect substitutability **σ_{IMMI}=infinity**	(2) **σ_{IMMI}=20**	**(3) Preferred estimated σ_{IMMI}=10**	**(4) σ_{IMMI}=6**
σ_{H-L}	1.5	1.5	1.5	1.5
σ_{EDU}	10	10	10	10
σ_{EXP}	10	10	10	10
σ_{IMMI}	infinity	20	10	6
% Real Wage Change of US-Born Workers Due to Immigration, 1990-2006				
Less than High School	-1.4%	-0.2%	0.9%	2.4%
High School graduates	0.0%	0.4%	0.9%	1.6%
Some College	0.7%	1.0%	1.3%	1.7%
College graduates	-0.2%	0.5%	1.3%	2.3%
Average US-born	**0.0%**	**0.6%**	**1.2%**	**2.0%**
% Real Wage Change of Foreign-Born Workers Due to Immigration, 1990-2006				
Less than High School	-1.4%	-5.5%	-9.6%	-15.0%
High School graduates	0.0%	-7.0%	-13.9%	-23.1%
Some College	0.7%	-3.9%	-8.5%	-14.6%
College graduates	-0.2%	-8.0%	-15.7%	-26.0%
Average Foreign-born	**0.0%**	**-6.5%**	**-12.7%**	**-21.1%**
Overall average	0.0%	0.0%	0.0%	0.0%

Note: The percentage wage changes for each education group are obtained averaging the wage change of each education-experience group (calculated using the CES nesting structure described in Figure 1 and the coefficient listed in the first 4 rows). Those percentage changes are weighted by the wage share in the education group. The US-born and Foreign-born average changes are obtained weighting changes of each education group by its share in the 1990 wage bill of the group. The overall average wage change adds the change of US- and foreign-born weighted for the relative wage shares in 1990 and it is always equal to 0 due to the long-run assumption that the capital-labor ratio adjusts to maintain constant returns to capital.

Figure 1: CES nesting structure

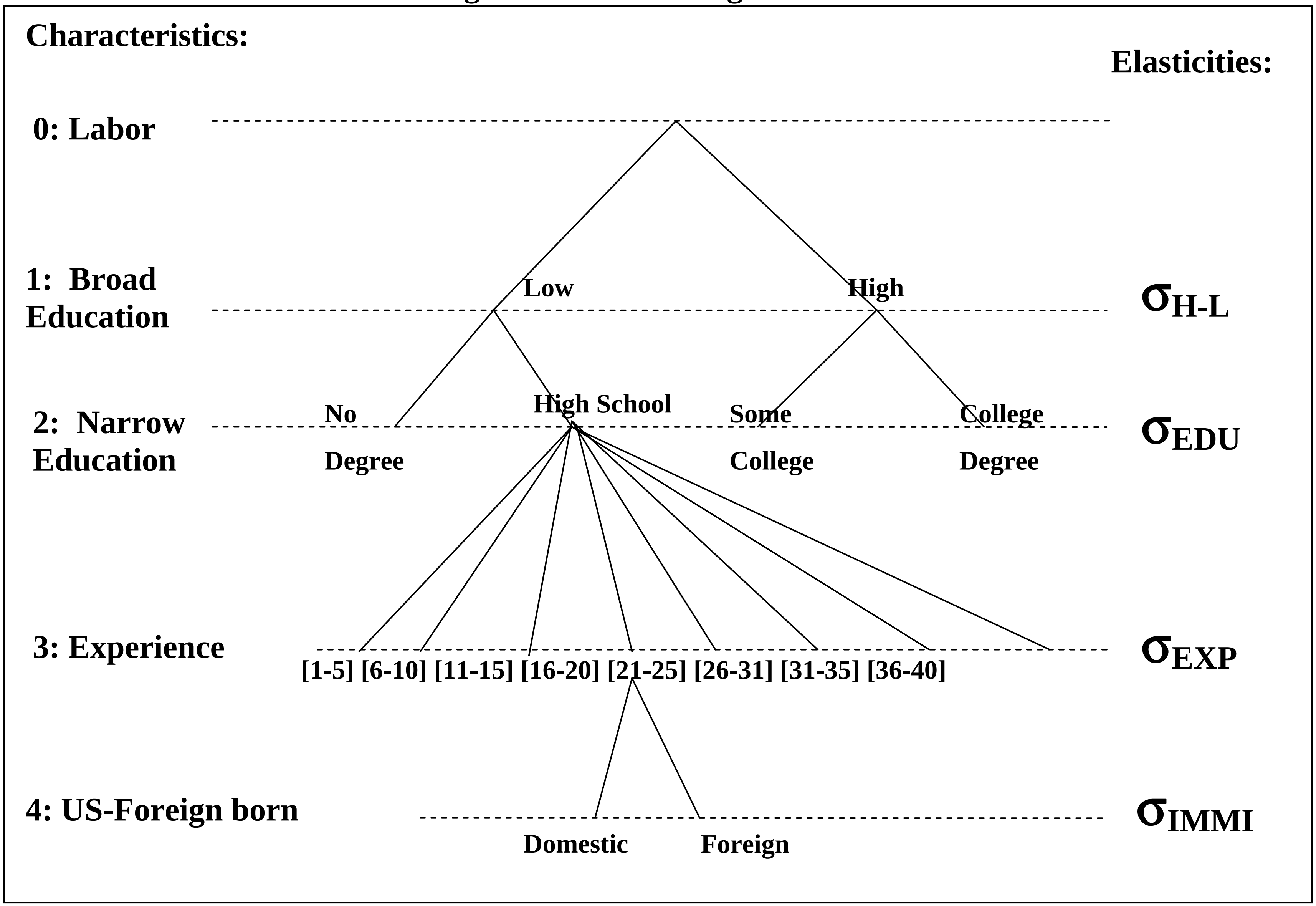
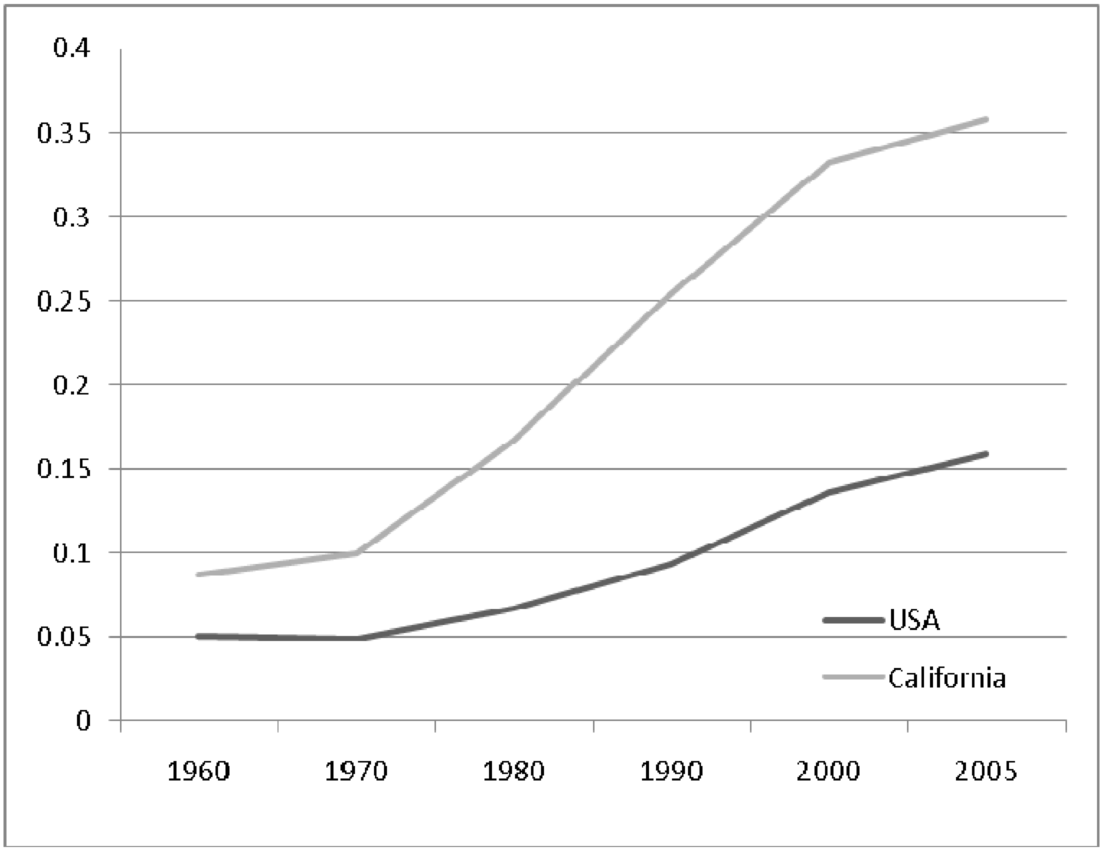
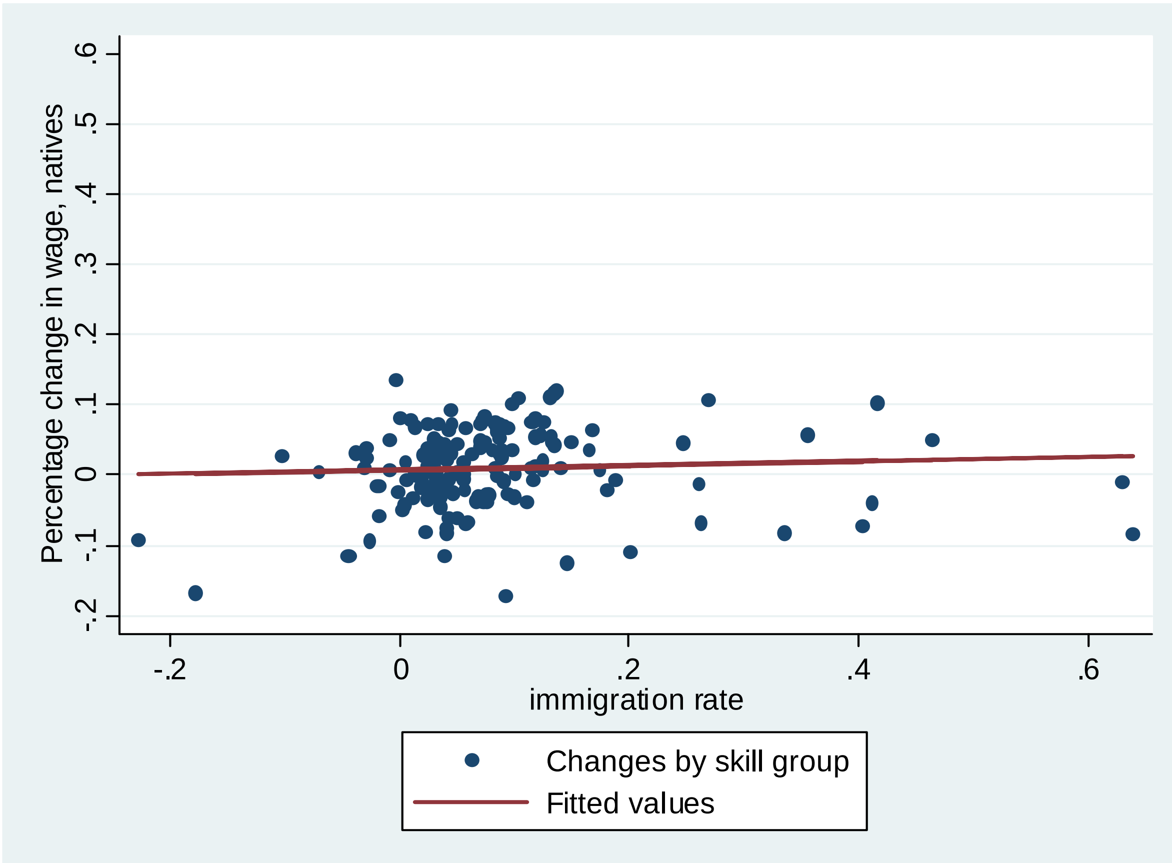


Figure 2
Share of immigrants in employment 1960-2005



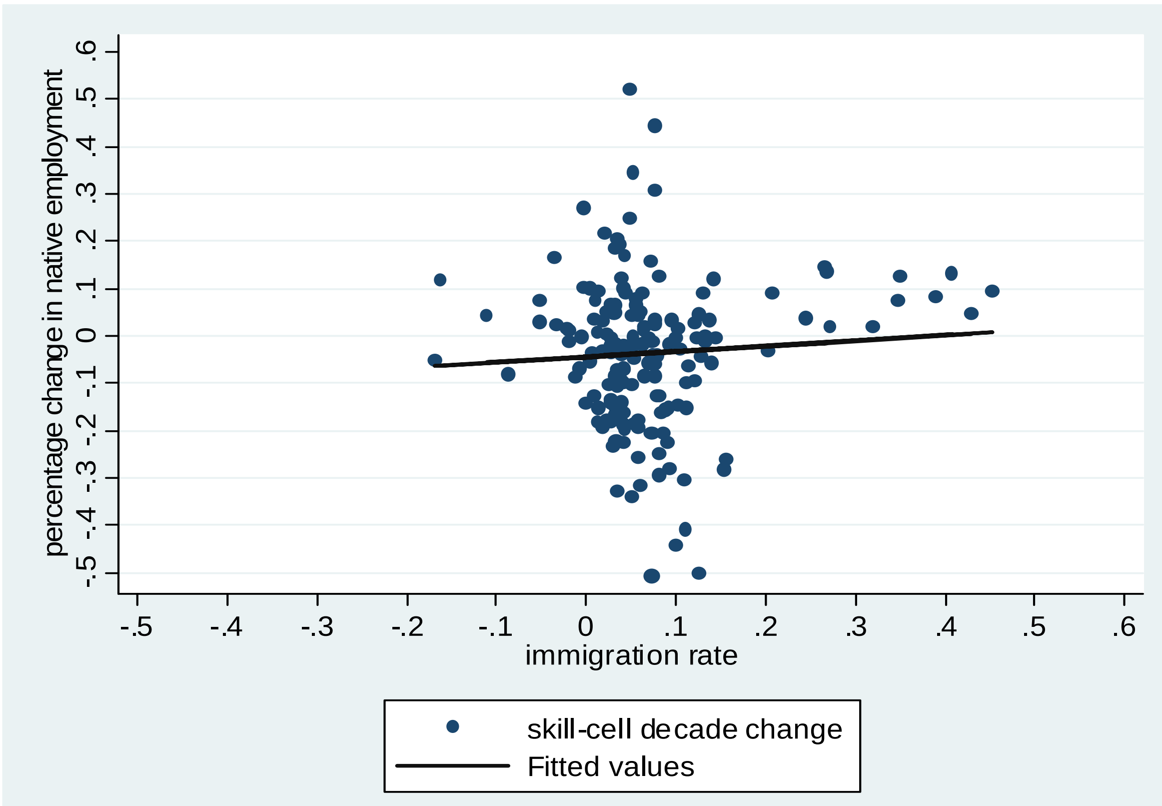
Note: The data are from Census 1960-2000 and ACS 2005. Employed workers are defined as the sum of individuals of ages between 18 and 65, not residing in group quarters, and who worked at least one week during the preceding year with potential experience between 1 and 40 years.

Figure 3
Native wage changes and immigrant inflow
California, relative to rest of US, 32 skill groups,
decade changes 1960-2000 plus 2000-2005 change



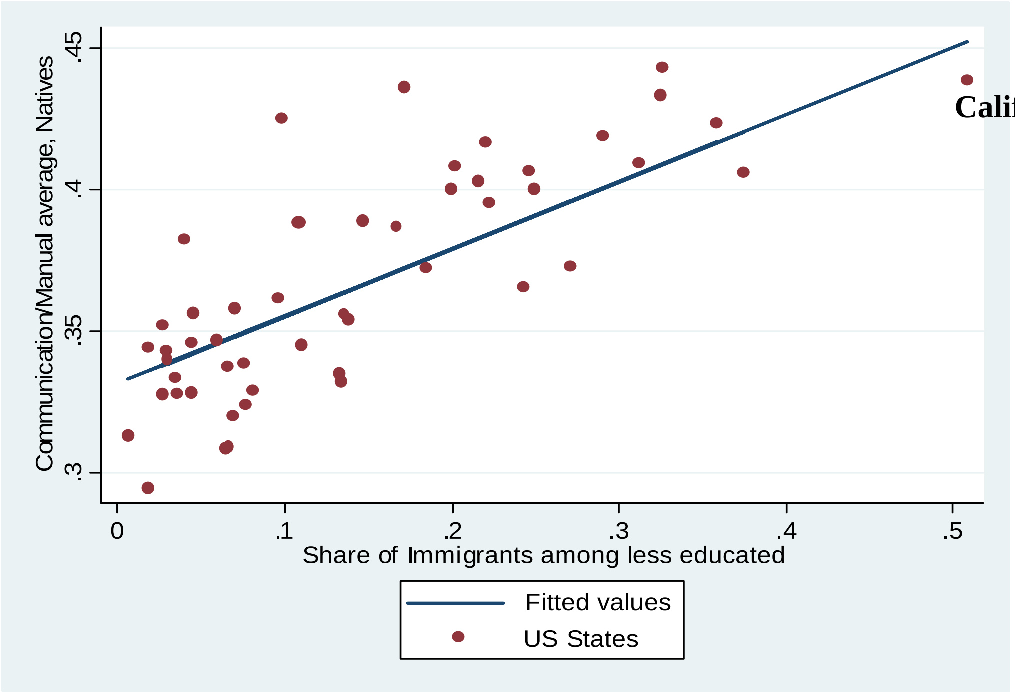
Note: The vertical axis measures the percentage change in weekly wages of native workers in the cell for each inter-census period (1960-2005) plus 2000-2005. The horizontal axis measures the inflow of immigrants as percentage of initial employment in the cell for each inter-census period (1960-2005) plus 2000-2005.

Figure 4
Native employment change and immigrant inflow
California, relative to rest of US, 32 skill groups,
decade changes 1960-2000 plus 2000-2005 change



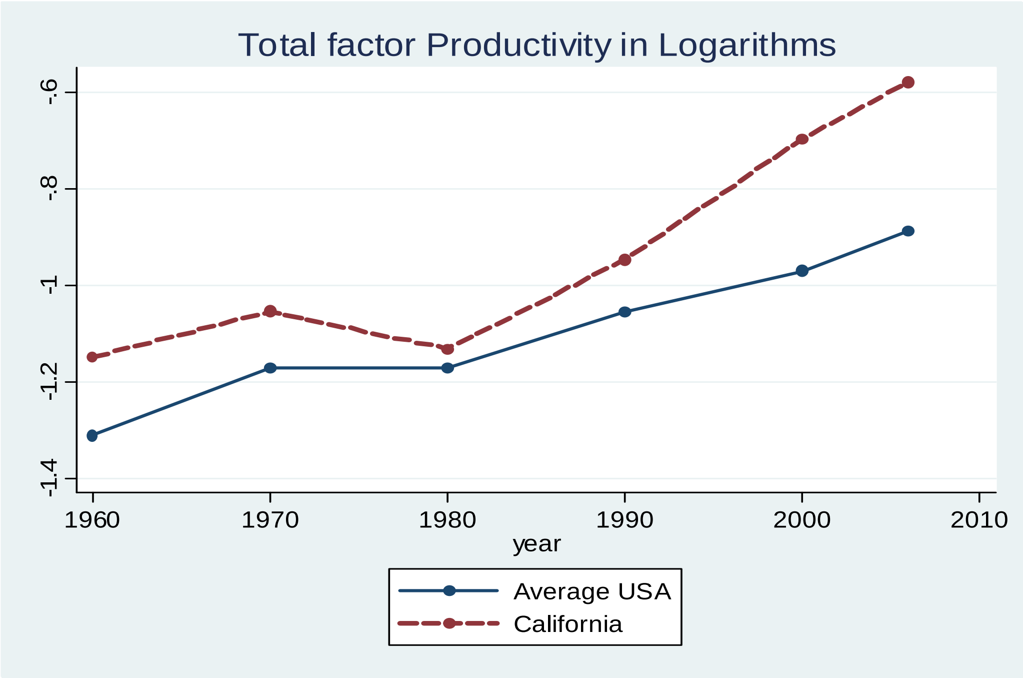
Note: The vertical axis measures the change in employment of native workers as percentage of initial employment in the cell for each inter-census period (1960-2005) plus 2000-2005. The horizontal axis measures the inflow of immigrants as percentage of initial employment in the cell for each inter-census period (1960-2005) plus 2000-2005.

Figure 5
Communication/Manual skill supply of natives and immigrants among less educated workers
US States, 2005



Note: The data on average Communication/Manual skills by state are from Peri and Sparber (2009), obtained from the manual and communication intensity of occupations, weighted according to the distributional occupation of natives.

Figure 6
TFP in California and the US 1960-2005



Note: TFP for the US and California is calculated in Peri (2009)

Tables and Figure Appendix

Figure A1
Total employment of natives and immigrants, California 1960-2005

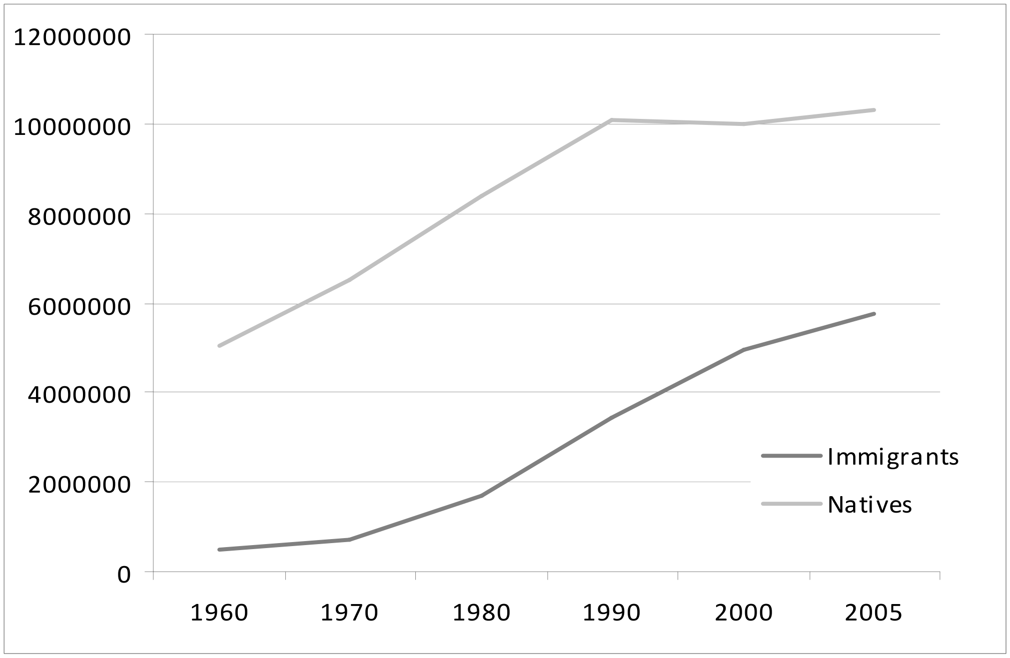


Figure A2
Total employment of natives and immigrants, USA 1960-2005

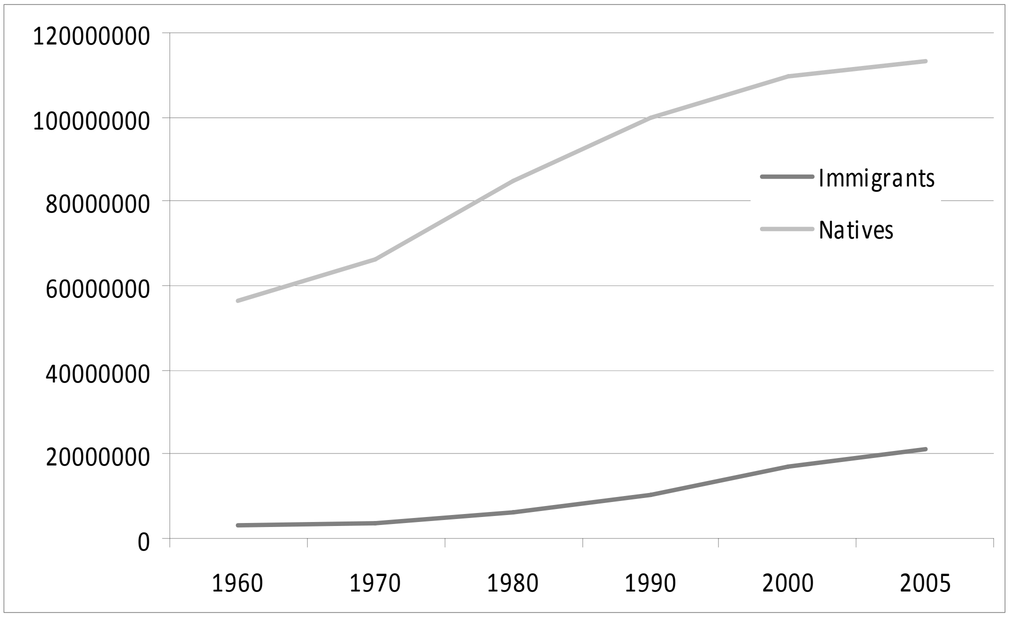


Figure A3

Mexican-Central American Immigration in the US and relative immigration to California

Immigrants as percentage of the Education-Experience cell, decade-change 1960-2005

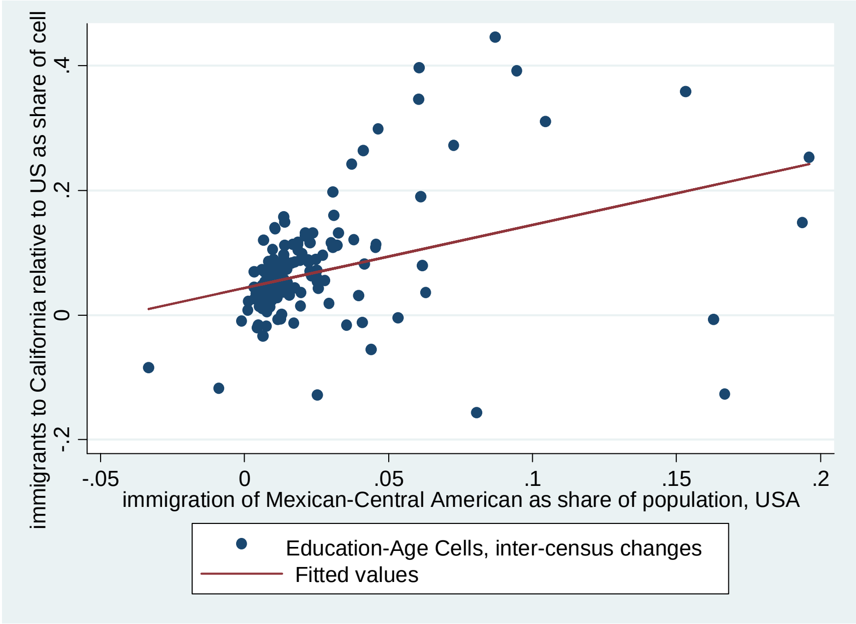


Figure A4

European Immigration in the US and relative immigration to California

Immigrants as percentage of the Education-Experience cell; decade-change 1960-2005

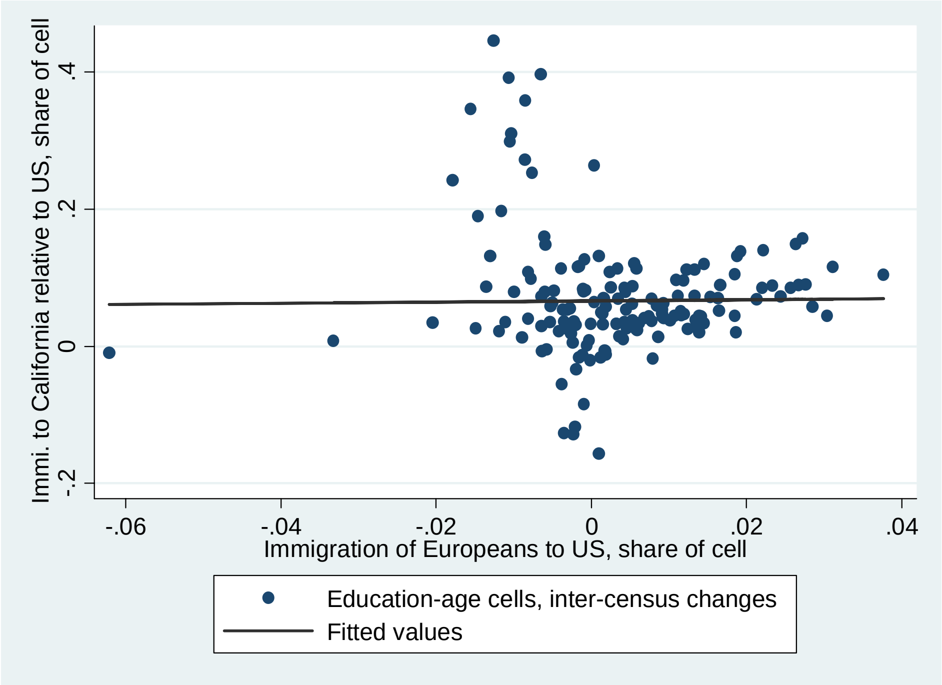


Figure A5
Mexican population change relative to the US and relative immigration to California
Education-Experience cell, decade-change 1960-2005

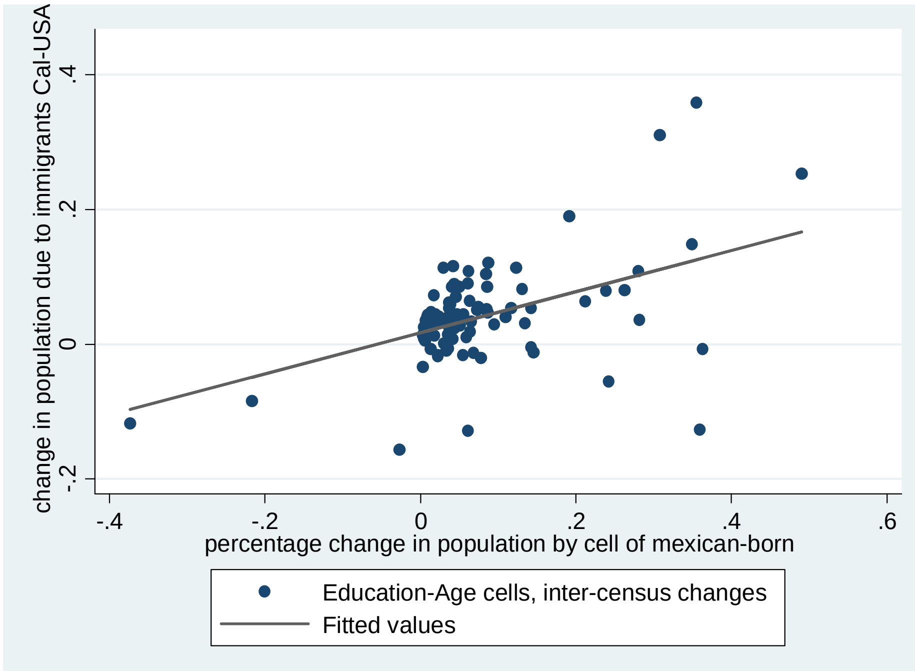


Figure A6
Relative employment change: Immigrants and Black US-born. California relative to average US, by skill and decade

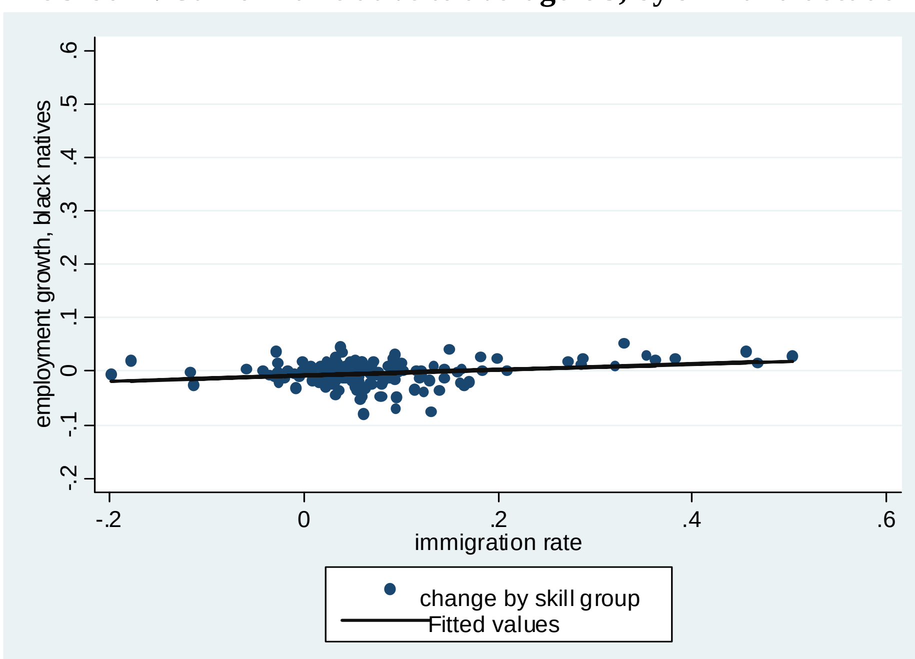


Table A1:
Share of foreign-born workers by schooling, USA and California 1960-2005

Schooling	**1960 Census**	**1970 Census**	**1980 Census**	**1990 Census**	**2000 Census**	**2005 ACS**
			California			
No Degree	0.12	0.16	0.37	0.65	0.75	0.78
High School Degree	0.06	0.07	0.11	0.22	0.33	0.36
Some College Education	0.07	0.08	0.11	0.16	0.21	0.23
College Degree	0.07	0.08	0.14	0.19	0.26	0.29
Average	*0.09*	*0.10*	*0.17*	*0.25*	*0.33*	*0.36*
			USA			
No Degree	0.06	0.06	0.11	0.22	0.36	0.42
High School Degree	0.04	0.03	0.05	0.07	0.11	0.14
Some College Education	0.05	0.05	0.06	0.07	0.09	0.10
College Degree	0.05	0.06	0.07	0.09	0.13	0.15
Average	*0.05*	*0.05*	*0.07*	*0.09*	*0.14*	*0.16*

Note: Author's calculation using Census 1960-2000 and American Community Survey 2005 IPUMS data. Employment is calculated as the sum of individuals of ages between 18 and 65, not residing in group quarters, and who worked at least one week during the preceding year with potential experience between 1 and 40 years. Population in working age is calculated as the sum of all individuals aged 17 to 66 not residing in group quarters with potential experience between 1 and 40 years.