How Low-skilled Immigration Is Changing US Prices and Labor Markets: Three Essays

by

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Abstract

This dissertation consists of three essays on the effects of low-skilled immigration on US prices and labor markets.

The first essay uses confidential data from the Consumer Price Index to estimate the causal effect of low-skilled immigration on the prices of non-traded goods. Then, it combines wage and price effects with consumption patterns of native skill groups to determine the net benefits and distributional impacts of immigration on the native economy. The results suggest that a 10 percent increase in the share of low-skilled immigrants in the labor force decreases the price of immigrant-intensive services by 1.3 percent. I also find that wage effects are significantly larger for low-skilled immigrants than for low-skilled natives because the two are imperfect substitutes. Overall, the results imply that the low-skilled immigration wave of the 1990s increased the purchasing power of high-skilled natives by 0.65 percent but decreased the purchasing power of low-skilled natives by 2.66 percent.

The second essay, coauthored with Jose Tessada, is motivated by the first essay's finding that low-skilled immigration reduces the prices of services such as housekeeping and babysitting. Because these services are close substitutes for home production, a decrease in their price should affect natives' time use. Using time-use surveys, we find that low-skilled immigration has increased the consumption of market-provided household services and has decreased the time women spend on household chores. As a result, women have significantly increased their supply of market work, both at the intensive and extensive margin. We estimate that the immigration flow of the 1990s decreased by 20 minutes the time women spend daily on household chores and increased by 5 percentage points the likelihood that a woman reports working in the market.

The third essay formalizes and empirically explores how immigrants' lack of English skills determines immigration's impact on the US labor market. I present a theoretical model in which low-skilled native workers can perform both "manual" and "language" tasks, immigrants perform manual tasks only, and the two tasks are q-complements. The model predicts that an immigration flow reduces the relative returns to manual skills and makes some natives shift from manual to language occupations. Using data from the Occupation Information Network and the Census, I find that: (1) within a city, occupations that require fewer language skills have a higher ratio of low-skilled immigrants to natives, and (2) after an immigration shock, there is a disproportional reduction in the wages of natives that work in manual occupations.

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Contents

[1] **This paper is joint work with Jose Tessada.**

Chapter 1

The Effect of Low-skilled Immigration on US Prices: Evidence from CPI Data

1.1 Introduction

Most research to date on the impact of low-skilled immigration on the US economy has focused on native wage levels. The net effect of immigration on natives' purchasing power, however, depends not only on wage but also on price effects. If immigration bids down the price of low-skilled labor, this will reduce the price of unskilled-intensive goods and services, thereby raising the welfare of consumers of these goods. This paper uses confidential microdata from the Consumer Price Index to estimate the causal effect of low-skilled immigration on prices. Then, using a unified conceptual framework, combines wage and price effects with consumption patterns of native skill groups to determine the net benefits and distributional impacts that low-skilled immigration has had on the native economy. [1]

The paper exploits the large variation across cities and through time in the relative size of

[1] I am very grateful to Joshua Angrist, David Autor, and Esther Duflo for their support and valuable comments. I thank Daron Acemoglu, Abhijit Banerjee, Jose Tessada, and participants in seminars at MIT, IADB, UCSD, UC Irvine, Northwestern University, and GSB Chicago for useful comments. I also thank the CPI unit of the BLS, in particular William Cook, for generous assistance with the data.

the low-skilled immigrant population to identify the impact of immigration on prices. The use of cross-city variation allows for the identification of the full price effects of immigration as long as natives do not respond to the impact of immigration on a local market by moving their labor or capital to other cities. Most studies that have looked at this issue find no displacement effects due to immigration[2], and the results of this paper also support this finding.[3] To ameliorate the bias that arises from endogenous location choices of immigrants, I use as instrument for the recent distribution of the immigrant population, the historical distribution of Mexicans, Cubans, and Italians, major sources of low-skilled immigrants to the US.

As initial evidence of the impact of low-skilled immigration on prices, I present reduced-form price equations for non-traded services in which the regressor of interest is the share of immigrant high school dropouts in the labor force. The price data, obtained through a confidentiality agreement with the Bureau of Labor Statistics (BLS), is made of price indexes at the city level for all components of the Consumer Price Index (CPI). The instrumental variable estimates suggest that low-skilled immigration lowers the prices of immigrant-intensive services such as gardening, housekeeping, babysitting, and dry cleaning. At current immigration levels, a 10 percent increase in the proportion of low-skilled immigrants in the labor force reduces prices of immigrant-intensive services by 1.3 percent.

The reduced-form estimates show that there is a causal effect of low-skilled immigration on the prices of low-skilled-intensive services, but do not illuminate how that effect occurs. In the second part of the paper, I construct a simple, small-open-economy model with a non-traded sector where low-skilled immigration lowers the relative price of non-traded goods and services by decreasing the wages of low-skilled immigrants and low-skilled natives. I use the model's implications to empirically estimate the magnitude of the effect of a low-skilled immigration shock on wages and prices. I find that, at current US immigration levels, a 10 percent increase in the share of low-skilled immigrants in the labor force reduces the wages of other low-skilled immigrants by 8.0 percent and of low-skilled natives by 0.6 percent, and that these decreases in wages account for 50-80 percent of the decrease in prices of non-traded goods.

The focus on local conditions limits the set of goods and services whose prices can be

[2] See Card (2001), Card and DiNardo (2000), Federman *et al.* (2005), Card and Lewis (2005) and Saiz (2006).

[3] The exception is Borjas, Freeman, and Katz (1997) who find a correlation of negative 1 between native net migration and immigration by state.

analyzed to those considered non-tradeable at the city level. Consistent with the theoretical framework, in which US cities are considered small open economies, I find that the local concentration of low-skilled immigrants has little impact on the prices of traded goods.

The final section of the paper combines data on consumption patterns from the Consu' mer Expenditure Survey (CEX) with the price-and-wage effects obtained from the structural model to estimate how natives' purchasing power was changed by the immigration wave of the 1990s. I find that price effects were larger for high-skilled natives, rather than for low-skilled natives, because they devoted a larger share of their budget to non-traded goods, and within non-traded goods they consumed relatively more immigrant-intensive services. Overall, I find that the low-skilled immigration of the 1990s increased the purchasing power of high-skilled workers living in the 25 largest cities by an average of 0.65 percent and decreased the purchasing power of native high school dropouts by an average of 2.66 percent. I conclude that, through lower prices, low-skilled immigration brings positive net benefits to the US economy as a whole, but generates a redistribution of wealth.

Very few papers have looked at the immigration's impact on prices of goods and services. To my knowledge, only one other study, Khananusapkul (2004), has empirically explored the effect of low-skilled immigration on the prices of immigrant-intensive services. Using a comparable empirical methodology, the author finds that a single percentage point increase in the proportion of low-skilled female immigrants in a metropolitan area raises the proportion of private household workers by 6 percentage points and lowers their wages by 3 percent. Back-of-the-envelope calculations suggest that her results are not very different from mine.[4] However, my paper is significantly more comprehensive because it estimates price effects for many non-traded goods (rather than for a single service), estimates wage effects, and calculates changes in the purchasing power of natives.

Saiz (2003) and Saiz (2006) provide a nice complement for the present paper by studying immigration's effects on rental prices. The author finds that an immigration inflow equal to 1

[4] A single percentage point increase in the proportion of low-skilled female immigrants in the population of a city corresponds to a roughly 40 percent increase in their number. If 40 percent of total low-skilled immigrants are women, then the 40 percent increase in the number of low-skilled female immigrants raises the number of low-skilled immigrants by 16 percent. Assuming that wages of household workers account for 70 percent of the price of housekeeping services, then Khananusapkul's results imply that a 10 percent increase in the number of low-skilled immigrants decreases the prices of this service by close to 1.4 percent.

percent of a city's population is associated with increases in average rents of about 1 percent.

On the other hand, a vast literature has looked at the wage effects of immigration. My estimates of the impact of low-skilled immigration on natives' wages are in line with what most other cross-city studies have found:[5] the effect of immigration on the labor market outcomes of natives is small. A few hypotheses have been proposed to explain this finding. Borjas (2003) argues that if labor and capital adjust to immigration by moving across cities, then the relevant unit of analysis is the entire country, and cross-city comparisons will fail to find significant effects. However, as mentioned above, most of the available evidence suggests that there are no displacement effects of immigration on native labor, and no study yet has focused on capital adjustments to immigration. Lewis (2005), on the other hand, claims that local economies are the relevant unit of observation, but that the technologies of local firms – rather than the wages that they offer – respond to changes in local skill mix associated with immigration. The hypothesis that cities adapt to immigration by shifting industry composition is rejected by Card and Lewis (2005).

My structural estimates suggest an alternative explanation: low-skilled natives and low-skilled immigrants are far from being perfect substitutes (I estimate an elasticity of substitution of 1.32); therefore, a low-skilled immigration shock should affect mostly the wages of other low-skilled immigrants and have little effect on the wages of low-skilled natives. Because the literature on the own-wage effects of low-skilled immigrants is scant[6], I provide several consistency checks on my estimates. In particular, I show that low-skilled immigration has a much larger negative effect on the wages of native Hispanics with low English proficiency than on the wages of other low-skilled native groups.

The rest of the paper is organized as follows. In the following section, I describe the data and the descriptive statistics, and discuss industry variation in the use of low-skilled immigrant labor. The reduced-form estimates are reported and discussed in Section 1.3. A simple theoretical framework to interpret the results from Section 1.3 is presented in Section 1.4. In Section 1.5 I describe the structural approach and discuss the main results of the paper. Purchasing

[5] See Altonji and Card (1991),Card (1990), Card (2005), and Card and Lewis (2005).

[6] Card (1990) and Borjas (2003) are the only two studies that estimate the effect of low-skilled immigration on the wages of other immigrants; the former finds no significant negative effect of an immigration shock on the labor outcomes of earlier immigrants, and the latter a sizeable, but not statistically significant, negative effect.

power calculations are reported in Section 1.6, and Section 1.7 concludes.

1.2 Data

Immigration Data

This paper uses the 1980, 1990, and 2000 Public Use Microdata Samples (PUMS) of the Decennial Census to measure the concentration of low-skilled immigrants among cities. Low-skilled workers are defined as those who have not completed high school. An immigrant is defined as someone who reports being a naturalized citizen or not being a citizen. This analysis is restricted to people age 16-64 who report being in the labor force.

Table 1.1 shows the evolution of the share of low-skilled immigrants in the labor force for the 25 largest cities in the US. Two facts should be emphasized. First, there is substantial variation across cities in the concentration of low-skilled immigrants. Immigrants are heavily concentrated in large cities, such as Los Angeles, New York, and Miami. In Los Angeles, for example, one out of six workers is a high school dropout immigrant. In other smaller cities, low-skilled immigrants are a negligible share of the labor force. In Cincinnati, for example, in 2000 there were fewer than 5 low-skilled immigrant workers per 1000 participants in the labor force. Second, during the 1990s, new waves of low-skilled immigrants chose to locate in new cities. So despite the large flows of new immigrants to the country, Los Angeles, New York, and Miami didn't see an increase in the share of high school dropout immigrants in their labor forces. Cities like Denver, Dallas, Washington DC, and especially Atlanta, experienced a significant increase in the concentration of low-skilled immigrants, though.

Price Data

Under a confidentiality agreement with the Bureau of Labor Statistics (BLS), I was granted access to the CPI research dataset (RDB). This dataset is comprised of the store-level data used to construct the CPI. It also includes estimates of price indexes at lower levels of geography and product classification that are not available to the public. The RDB covers only the years 1986-2002, which restricts most of my empirical analysis to price changes between 1990 and 2000.

The paper uses price indexes at the city-industry level. The analysis is restricted to A-

sized cities as defined by the BLS (Metropolitan Areas with 1980 populations greater than 1.2 million), where sufficient quotes are collected to produce reliable indexes. The number of goods and services included in the CPI that can be used in the present analysis is restricted by the ability to match them to the industry classification of the 1980 Census. The paper uses the Census data to construct a measure of the industry's low-skilled labor factor share.[7] The matching process results in a sample of 70 goods and services, 33 of them non-tradeable (See Appendix A for a list of goods and services).[8]

Industries Intensive in Low-skilled Immigrant Labor

There is much between-industry variation in the use of low-skilled immigrant labor. Agriculture is the prime example of a low-skilled-immigrant-intensive industry: 25 percent of all workers in the industry are low-skilled immigrants, 8 times the percentage in the overall labor force. On the other hand, there are industries with virtually no low-skilled immigrants: in the accounting services industry, for example, less than one out of every 1000 employees is a foreign-born high school dropout.

Table 1.2 shows the 15 industries with the highest share of low-skilled immigrants, low-skilled female immigrants, and low-skilled male immigrants in the year 2000. With the exception of agriculture and textiles, almost all other industries fall into the category of non-traded services: landscaping, housekeeping, laundry and dry cleaning, car wash, shoe repair, and services for buildings and dwellings. The low-skilled immigrant concentration in these services is very large. For example, whereas low-skilled immigrant women represented 1.9 percent of the total labor force in the year 2000, they represented more than 25 percent of the workers in private household occupations and 12 percent of the workers in laundry and dry cleaning services. Similarly, the immigrant men's share in gardening was 9 times larger, and their share in shoe repair 6 times larger, than their share in the total labor force.

The concentration of low-skilled immigrants in these industries is not solely an outcome of their low education level; indeed, native high school dropouts are much less likely to work

[7] A Revision to the CPI in 1998 changed some of the geographic area samples and incorporated a new item structure. Buffalo and New Orleans, A-sized units before the revision, were excluded from this group after the revision, and Washington DC and Baltimore were merged into a single unit. For these cities, in an effort to maximize the number of observations, the present analysis assigns the index value of December 1997 to January 2000. A similar strategy was followed for items that did not have a perfect match in the new structure.

[8] Because of confidentiality restrictions, I cannot present detailed statistics of the price data used in this paper.

in these industries. Gardening and housekeeping are one good example; whereas 60 percent of high school dropouts in the labor force in 2000 were natives, less than one third of the dropouts working in one of these two services were. The correlation between the share of high school dropouts in the total employment in an industry and the percentage of those high school dropouts that are immigrants is 0.44 and is statistically significant. This correlation suggests that low-skilled immigrants and natives are not perfect substitutes; if they were, the correlation would be close to zero. Immigrants' low proficiency in English, and for some their legal status, limit their job opportunities compared to low-skilled natives. Because of this observation, I do not assume but rather empirically test for the degree of substitutability of low-skilled immigrants and natives.

1.3 Initial Evidence on the Effect of Low-skilled Immigration on Prices

1.3.1 OLS Estimates

A first approach to the study of the effect of low-skilled immigrants on prices is to look only at the prices of services that use their labor intensively. The services included in the empirical analysis of this section are those for which I have data both on prices and on the composition of employment, and whose intensity in the use of low-skilled immigrant labor was at least 10 percent in 1980.[9] These are: laundry and dry cleaning, shoe repair, babysitting, housekeeping, and other household services (includes gardening).[10] Ideally, I would have liked to have run a separate regression for each service, and to have estimated a separate effect of the immigration shock and separate city fixed effects. Because I have so few observations (25 cities and two decades), I pool all indexes in the same regression and restrict the city fixed effects and the effect of immigration to be equal across all services. I then control for industry fixed effects. The general estimating equation is:

[9] I use the 1980 data to avoid endogeneity of technology choices. I chose 10 percent as the threshold because it is approximately double the share of low-skilled immigrants in the labor force.

[10] The 1987 CPI product classification does not have a separate item strata category for gardening services. Gardening and lawncare services are included in the item strata "Other Household Services", which also includes water softening services, moving and storage services, and coin-operated laundry.

$$LnP_{ijt} = \delta Ln(\frac{LS\ Immigrants}{Labor\ Force}_{it}) + \phi_i + \zeta_j + \psi_t + \varepsilon_{ijt}, \quad (1.1)$$

where i is city, j industry, and t decade. The parameter δ represents the average treatment effect of an immigration shock on the US largest cities.[11]

Table 1.3, Column 1 reports the OLS estimation of equation (1.1). The coefficient for the immigration variable is positive, very close to zero, and not statistically significant. However, as has been emphasized in the immigration literature[12], the cross-sectional correlation between immigrant inflows and economic outcomes is likely to be biased upwards; immigrants choose their location based, at least in part, on the economic opportunities that cities offer. Given that the economic growth of cities usually is accompanied by higher prices and inflation, a positive correlation between immigration concentration and prices may be observed in the data, even if there is no causal relation between the two.

The results are generally invariant to the inclusion of controls for economic trends that potentially attract immigrant flows. For example, the coefficients of Columns 2 and 3 of Table 1.3, which include region-specific time trends and the log of population although smaller are still positive. However, the inclusion of the log of the level of employment[13] (Column 4) changes the sign of the immigration concentration coefficient, supporting the hypothesis that OLS coefficients are biased upward because immigrant flows are correlated with unobserved economic conditions. The coefficient is close to being significant at 10 percent, and its magnitude could imply that an increase of 10 percent in the share of low-skilled immigrants in the labor force the prices of low-skilled immigrant intensive services by 0.4 percent.

This regression is, however, potentially flawed since employment is likely to be endogenous. To address the problem of omitted variables, as well as the possibility of feedback between employment growth and immigration, I use the IV strategy described below.

[11] As Section 1.4 shows, the elasticity of prices to an immigration shock is increasing in the initial share of immigrants in the low-skilled labor force.

[12] See Altonji and Card (1991) and Borjas (2001).

[13] I thank David Card and Ethan Lewis for sharing their data on city-employment.

1.3.2 Instrumental Variables Estimates

The instrument used in the present paper exploits the tendency of immigrants to settle in a city with a large enclave of immigrants from the same country. Immigrant networks are an important consideration in the location choices of prospective immigrants because these networks facilitate the job search process and the assimilation to the new culture (Munshi, 2003). The instrument uses the 1970 distribution of immigrants from a given country across US cities to allocate the new waves of immigrants from that country.

The instrument is likely to predict new arrivals if: (1) there is a large enough number of immigrants from a country in 1970 to influence the location choices of future immigrants, and (2) there is a steady and homogeneous wave of immigrants after 1970. Therefore, I include in the instrument the countries that were in the top 5 sending countries in 1970, and which continued to be important senders of immigrants in the decades that followed. As can be seen in Table 1.4, only Mexico, Cuba, and Italy satisfy these conditions.[14] Many European countries and Canada, important contributors to the low-skilled immigrant population in 1970, were replaced by Latin American and Asian countries starting in 1980.

Formally, the instrument for the log of the number of low-skilled immigrants in city i and decade t can be written as,[15]

$$Ln\left(\frac{Mexicans_{i,1970}}{Mexicans_{1970}} * LSMexicans_t + \frac{Cubans_{i,1970}}{Cubans_{1970}} * LSCubans_t + \frac{Italians_{i,1970}}{Italians_{1970}} * LSItalians_t\right),$$

where $\frac{Mexicans_{i,1970}}{Mexicans_{1970}}$ represents the percentage of all Mexicans included in the 1970 Census who were living in city i, and $LSMexicans_t$ stands for the *total* flow of low-skilled Mexican immigrants to the US between 1971 and decade t. Similar notation is used for Cubans and Italians. I use all Mexicans, Cubans, and Italians in the US –and not only low-skilled workers– to construct the initial distributions. This maximizes the number of cities included in the analysis.

[14] Appendix C, Table C1 reports the first stage for instruments that include alternative sets of countries.

[15] I use a logarithmic functional form because the price equation derived from the theoretical model (Section 1.4.3) is expressed in logs. Appendix C, Table C2 presents alternative specifications for the first stage as a check on the robustness of the instrument.

As can seen in Table 1.5, the instrument is a good predictor of low-skilled immigrant shares.[16] The magnitudes of the coefficients suggest that, at current US immigration levels, an increase of 10 percent in the predicted number of low-skilled Mexicans, Cubans, and Italians increases the share of low-skilled immigrants in the labor force by between 4 and 7 percent.[17]

Most of the econometric specifications in the paper include city and region*decade fixed effects. Therefore, the instrument will help in identifying the causal effect of immigration concentration on prices as long as the unobserved factors that determined that more immigrants decided to locate in city i vs. city $i\prime$ (both cities in the same region) in 1970, are not correlated with changes in the relative economic opportunities offered by the two cities during the 1990s. Given that cities i and $i\prime$ should be in the same region, the identification assumption is not violated, for example, by sunbelt cities growing faster than cities in other regions (for several decades) and at the same time being important immigrant cities. The identification assumption will be violated, however, if, for example, what determined that more immigrants settled in city i vs. city $i\prime$ was a shock to the demand for immigrant-intensive services in city i (or any other type of shock) that although temporary, took a very long time (20 years) to vanish.[18]

Some specifications in Section 1.5 include city*decade fixed effect (they exploit inter-industry variation in the use of immigrant labor). The identification assumption in these cases would be violated only if the unobserved factors that determined that more immigrants decided to locate in city i vs. in city $i\prime$, also influenced the changes in relative prices of two industries within city i in the 1990s.

Columns 1 and 2 of Table 1.6 present the IV estimates of equation (1.1). The results suggest that an increase of 10 percent in the share of low-skilled immigrants in the labor force of a city reduces the prices of services that intensively use immigrant labor by 1.3 percent. For example, the low-skilled immigration shock experienced by the average city during the 1990s should have reduced the prices of these services by 2.4 percent. Notice that the IV estimates confirm that

[16] In Table 1.6, I include estimations with and without data for 1980 because some of the empirical exercises in the paper are restricted to the period 1990-2000 and others to the period 1980-2000.

[17] In estimations not shown here, I find that a 10 percent increase in the predicted number of Mexicans, Cubans, and Italians increases between 5.5 percent and 9.4 percent the actual share of low-skilled immigrants from Mexico, Cuba, and Italy in the labor force.

[18] If the demand shock was permanent, such that it changed the preferences of city i forever, the identification assumption will not be violated, but the coefficient of the second stage should be interpreted as a city-average treatment effect (average in terms of tastes).

the OLS estimates are upward biased; even after controlling for the log of employment, the OLS estimate is half as large as the IV estimate.

I also estimate equation (1.1) for two other groups of goods and services: non-traded goods with higher than average intensity in the use of low-skilled immigrants; and all non-traded goods. Columns 3 to 6 of Table 1.6 present the results. As expected, the less intensive in low-skilled immigrants the industries included in the sample are, the smaller is the effect.

1.4 Theoretical Framework

Up to this point, I have not imposed any economic structure on the estimation of the price effects of low-skilled immigration. The estimated coefficients from the previous section demonstrate that low-skilled immigration has an effect on the prices of low-skilled immigrant intensive services, but these same coefficients are mute about the channels through which the effect takes place. In other words, they do not represent any structural parameter. The second part of the paper adopts a semi-structural approach. In this section I develop a simple model in which wages are the main mechanism through which the impact on prices occurs; the next section empirically implements the predictions of the model.

I use a simple Heckscher-Ohlin framework in which the presence of a non-traded sector in the model breaks the "factor price insensitivity" result of a two-traded-sectors model (Leamer (1995)). I consider US cities to be small open economies.

1.4.1 Setup

Consider a small open economy that produces two goods, one traded (T) and one non-traded (NT). There are three factors of production: high-skilled native labor (H), low-skilled native labor (L), and low-skilled immigrant labor (I). The total supply of factors is represented by $\overline{H}, \overline{L}$, and $\overline{I}$ respectively. For simplicity, I assume that only high-skilled native labor participates in the production of the traded good:[19]

$$T = H_T. \tag{1.2}$$

[19] The results hold under a more general specification as long as the traded good is relatively less intensive in low-skilled labor.

The non-traded good production function is a nested CES:

$$NT = H_{NT}^{\alpha}\left[(\beta L_{NT}^{\rho} + (1-\beta)I_{NT}^{\rho})^{\frac{1}{\rho}}\right]^{1-\alpha}, \tag{1.3}$$

where $0 < \rho \leqslant 1$ and $0 < \alpha < 1$. This specification implies that the elasticity of substitution between the low-skilled labor aggregate and high-skilled labor is equal to 1, and that the elasticity of substitution between L and I is $\sigma = \frac{1}{1-\rho}$. This specification allows for perfect substitution between immigrant and native low-skilled labor ($\sigma = \infty$), for a Cobb-Douglas specification between the two factors ($\sigma = 1$), and for perfect complementarity between them ($\sigma = 0$).

To keep the analysis simple, I have excluded capital from the production functions. Doing so is equivalent to keeping the supply of capital perfectly elastic, a reasonable assumption for local markets.

The economy admits a representative consumer with a Cobb-Douglas type utility:

$$U = T^{\gamma}\left(NT\right)^{1-\gamma} \tag{1.4}$$

Note that the assumption of homotheticity of the utility function implies no income effects and no role for differences in preferences between natives and immigrants.

I assume that all markets are competitive. The economy takes the price of the tradeable good P_T which is normalized to one, as given.

1.4.2 Equilibrium

The maximization of utility leads consumers to spend a fraction γ of their income in the consumption of the traded good and $(1-\gamma)$ in the consumption of the non-traded good. This condition plus market-clearing in the non-traded market imply that the following equation holds:

$$H_{NT}^{\alpha}\left[(\beta\overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}\right]^{1-\alpha} = \frac{(1-\gamma)(w_H\overline{H} + w_L\overline{L} + w_I\overline{I})}{P_{NT}}, \tag{1.5}$$

where the left side of equation (1.5) represents the total supply of the non-traded good and the right side the total demand. Note that I have already incorporated the conditions $L_{NT} = \overline{L}$

and $I_{NT} = \overline{I}$.

Because all factors will be paid the value of their marginal product in competitive markets, and because the marginal product of high-skilled workers should be equal in both sectors, the following equilibrium equations result:

$$w_L = (1-\alpha)\beta P_{NT} H_{NT}^{\alpha} \overline{L}^{\rho-1} (\beta \overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho})^{\frac{1-\alpha}{\rho}-1}, \tag{1.6}$$

$$w_I = (1-\alpha)(1-\beta) P_{NT} H_{NT}^{\alpha} \overline{I}^{\rho-1} (\beta \overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho})^{\frac{1-\alpha}{\rho}-1}, \tag{1.7}$$

$$1 = \alpha P_{NT} H_{NT}^{\alpha-1} \left[(\beta \overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}} \right]^{1-\alpha}, \tag{1.8}$$

where the right sides of equations (1.6), (1.7), and (1.8) represent the value of the marginal product of low-skilled natives, low-skilled immigrants, and high-skilled workers respectively.

Equations (1.5) to (1.8) provide a system of four equations and four unknowns (P_{NT}, H_{NT}, w_L, w_I). Solving the system, I obtain that the equilibrium relative price of non-traded goods is given by

$$P_{NT} = \frac{(1-\gamma)^{1-\alpha}}{\alpha^{\alpha}(\alpha+\gamma(1-\alpha))^{1-\alpha}} * \left(\frac{(\beta \overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}} \right)^{-(1-\alpha)}. \tag{1.9}$$

Equation (1.9) shows that the relative price of the non-traded good depends positively on the consumer's preference for it, $(1-\gamma)$, and on the total supply of high-skilled labor. An increase in $\overline{H}$ will raise the relative production of the traded good (and therefore, reduce its relative price), the more so the higher is $1-\alpha$, that is, the less intensive is the non-traded good in high-skilled labor. The same logic explains why the relative price will decrease as low-skilled labor becomes more abundant.

1.4.3 The Effect of an Immigration Shock

To determine the effect of an immigration shock on prices, I begin by taking logs of equation (1.9) :

$$Ln(P_{NT}) = \vartheta - (1-\alpha)Ln\left(\frac{(\beta\overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}}\right), \tag{1.10}$$

where $\vartheta = Ln(\frac{(1-\gamma)^{1-\alpha}}{\alpha^{\alpha}(\alpha+\gamma(1-\alpha))^{1-\alpha}})$.

Differencing (1.10) with respect to low-skilled immigration, I obtain the elasticity of the relative price of the non-traded good to low-skilled immigration:

$$\frac{\partial LnP_{NT}}{\partial Ln\overline{I}} = -(1-\alpha)\frac{\partial Ln\left(\frac{(\beta\overline{L}^{\rho}+(1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}}\right)}{\partial Ln\overline{I}} < 0. \tag{1.11}$$

Equation (1.11) shows that the impact of a shock to low-skilled immigration on the relative price of the non-traded good depends on two factors: the low-skilled-labor intensity of the non-traded good (1-α) and immigration's effect on the relative amount of aggregate low-skilled labor to high-skilled labor. If displacement effects are negligible, it can be shown that:

$$\frac{\partial LnP_{NT}}{\partial Ln\overline{I}} = -(1-\alpha)\left(\frac{(1-\beta)\overline{I}^{\rho}}{\beta\overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho}}\right) < 0. \tag{1.12}$$

Equation (1.12) suggests that a higher relative productivity of low-skilled immigrants with respect to natives, ($\downarrow \beta$), also increases the magnitude of the effect of the shock. Intuitively, prices can be reduced further if the factor whose price is going down the most is also the most productive. Finally, note that the elasticity of prices with respect to a low-skilled immigration shock is increasing in the initial share of immigrants in the low-skilled labor aggregate.[20]

The negative effect of an immigration shock on the relative price of the non-traded good will hold under more general constant-returns-to-scale technologies if two conditions are satisfied: there are more factors than traded goods and the non-traded sector is more intensive in low-skilled immigrant labor than the traded sector. The magnitude of this effect will depend on the difference in skill-intensities between the two sectors.

[20] Equation (1.12) makes clear why δ in equation (1.1) represents the average treatment effect.

1.5 Empirical Implementation

This section estimates the parameters of the model that determine the price effects of low-skilled immigration and discusses the implied wage effects. The results are compared to estimates in the literature.and several consistency checks are performed.

1.5.1 Price Effects of Low-skilled Immigration

To obtain estimates of the parameters of equation (1.11), I follow several steps. First, I show that the displacement effects of low-skilled immigrants on low-skilled natives are negligible. Based on this result, I estimate the elasticity of substitution between immigrants and natives, $(\frac{1}{1-\rho})$, and their relative efficiency (β). With the estimated ρ and β, I construct the low-skilled labor aggregate. Finally, I estimate the low-skilled labor factor share $(1-\alpha)$. Each step is discussed in detail in the following sections.

Displacement Effects

To test for the displacement effects of low-skilled immigration I use the following econometric specification:

$$Ln\overline{L}_{it} = \kappa Ln\overline{I}_{it} + \phi_i + \psi_t + \varepsilon_{ijt}. \tag{1.13}$$

The coefficient κ represents the average treatment effect. If there are displacement effects, κ should be negative; if displacement effects are such that for every low-skilled immigrant that moves to a city, one native moves away, $\kappa \approx -\frac{2}{3}$.[21]

My estimates, presented in Table 1.7, confirm what other studies have found: low-skilled immigrants do not displace low-skilled natives from the labor force. As observed in the table, $\widehat{\kappa}$ is small, positive, and statistically indistinguishable from zero.

[21] This number comes from the fact that for the average US city there were aproximately 1.5 low-skilled natives per low-skilled immigrant in 2000.

Elasticity of Substitution between Low-skilled Natives and Immigrants

To arrive at an expression that can be used to estimate ρ, I start by inserting equation (1.9) into equation (1.6):

$$Lnw_L = -(1-\rho)Ln\overline{L} - Ln(\beta\overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho}) + Constant. \tag{1.14}$$

Differencing equation (1.14) with respect to $\overline{I}$, assuming $\overline{L}$ and $\overline{H}$ to be fixed, and multiplying both sides of the equation by $\overline{I}$, shows that the elasticity of the wages of low-skilled natives to low-skilled immigration is

$$\frac{\partial Lnw_L}{\partial Ln\overline{I}} = -\rho\left(\frac{(1-\beta)\overline{I}^{\rho}}{\beta\overline{L}^{\rho} + (1-\beta)\overline{I}^{\rho}}\right) = -\rho\left(\frac{w_I\overline{I}}{w_L\overline{L} + w_I\overline{I}}\right). \tag{1.15}$$

Hence, if there exists an estimate of the share of immigrant labor in total low-skilled labor costs, then the coefficient from a regression of the log of the wages of natives on the log of the supply of low-skilled immigrants should provide an estimate of ρ.

To implement equation (1.15) empirically, I use the following econometric specification:

$$Lnw_{nit} = \theta Ln(\overline{I}_{it}) + X_n'\Lambda + W_{it}'\Sigma + \phi_i + \psi_t + \varepsilon_{ijt} \tag{1.16}$$

where n is a native low-skilled worker, i a city, and t a decade. X_n are individual level characteristics, namely age, age squared, and sex. W_{it} represents city time-varying variables, such as the percentage of males in the low-skilled labor force and the log of the city's population. Wage data for the estimation of equation (1.16) comes from the 1980, 1990, and 2000 Census. The sample is restricted to non-agricultural workers who reported a positive annual labor income, a positive number of total weeks worked last year, and a positive number of "usual hours worked per week". Top-coded incomes were multiplied by 1.5, and wages were adjusted for inflation. The dependent variable uses hourly wages, and the aggregate supply of low-skilled immigrants is expressed in the number of hours per year.[22]

Note that the total supply of low-skilled natives in the city is not included in this estimation. Given that the low-skilled native labor supply measure is orthogonal to the instrument (as shown

[22] Workers with a wage per hour of less than two dollars were excluded from the sample.

in Table 1.7), excluding it from the regression should not affect the validity of the estimation.[23]

The estimated θ, reported in Table 1.8, is negative and statistically significant at 10 percent under all specifications. Its magnitude suggests that a 10 percent increase in the number of low-skilled immigrants in a city reduces the wages of low-skilled natives by approximately 0.6 percent. Adding $Ln\overline{L}_{it}$ does not change the magnitude or the significance of the coefficient. The effect of an immigration shock is of similar magnitude for male and female natives.

As indicated in equation (1.15), to recover an estimate for the elasticity of substitution I need the city-average share of immigrant labor in the low-skilled labor wage bill. Using the 1990 Census and restricting the sample to the 25 cities included in the analysis, I find that immigrants' wages account for approximately 24 percent of all low-skilled labor costs. Therefore, the implied elasticity of substitution is 1.32 ($\widehat{\rho} = 0.24$): low-skilled natives and immigrants are imperfect substitutes in production.[24]

Using the estimated ρ and the identity $\left(\frac{(1-\beta)\overline{I}^{\rho}}{\beta\overline{L}^{\rho}+(1-\beta)\overline{I}^{\rho}}\right) = \left(\frac{w_I\overline{I}}{w_L\overline{L}+w_I\overline{I}}\right)$, I estimate the relative efficiency $\widehat{\beta}$ using Non-linear Least Squares and cross-sectional data. I obtain a relative efficiency of 0.590 (std. deviation of 0.036). That is, natives are more efficient than immigrants.

Price Equation

With $\widehat{\rho}$ and $\widehat{\beta}$, I construct an estimate of $\frac{(\beta\overline{L}^{\rho}+(1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}}$, which the model suggests is the relevant factor ratio for the study of price effects. To calculate the price effects of a change in this ratio, I use the following econometric specification, based on equation (1.10):

$$Ln\left(P_{NT}\right)_{ijt} = -(1-\alpha) * Ln\left(\frac{(\widehat{\beta}\overline{L}^{\widehat{\rho}} + (1-\widehat{\beta})\overline{I}^{\widehat{\rho}})^{\frac{1}{\widehat{\rho}}}}{\overline{H}}_{it}\right) + \phi_i + \psi_t + \zeta_j + \varepsilon_{ijt}, \qquad (1.17)$$

where $(1-\alpha)$ is the low-skilled labor share in the production of the non-traded good. I use the number of high school equivalents as a measure of the supply of high-skilled workers. This skill margin – those with a very low education level relative to those with high school and vocational

[23] In one specification, I include $Ln\overline{L}$ as a component of W_{it} to explore how sensitive the estimated coefficients are to the introduction of this variable and treat it as exogenous.

[24] Note that this value for the elasticity of substitution is obtained under the assumption of a perfectly elastic capital supply. If this assumption does not hold, however, part of the negative effect on natives' wages should come from a dilution of the capital-labor ratio, and the implied elasticity of substitution should be smaller.

training – is the one most influenced by immigration (Lewis (2005)).[25]

I begin by estimating (1.17) using only immigrant-intensive industries. The results suggest that the technology used to produce these immigrant-intensive goods is characterized by a factor share of low-skilled labor of 0.27 (See Table 1.9, Columns 2).[26] This estimate is quite comparable to 0.29, the average observed low-skilled-labor wage bill share for these industries, which I calculate using Census data.[27]

I perform the same analysis for broader groups of non-traded goods, and expect $\widehat{(1-\alpha)}$ to decrease as I introduce goods that are less immigrant-intensive (Columns 3-6, Table 1.9). The estimates of $(1-\alpha)$ present a clear declining pattern; $\widehat{(1-\alpha)}$ =0.184 when the sample is restricted to non-traded goods with higher than average concentration of low-skilled immigrants and $\widehat{(1-\alpha)}$=0.031, when the sample includes all non-traded goods. When compared to the observed low-skilled-labor wage bill share (0.24 for the first sample and 0.12 for the second), the estimated $(1-\alpha)$s appear to be a little low (especially 0.031). However, because these are imprecise estimates, I cannot reject the hypothesis that the observed and estimated $(1-\alpha)$s are the same.

To obtain *industry-level* price effects, I slightly modify equation (1.10) to exploit variation in low-skilled labor intensity across non-traded sectors: .

$$Ln(P_{NTj}) = \vartheta_j - (1-\alpha_j)Ln\left(\frac{(\beta\overline{L}^{\rho}+(1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}}\right),$$

where j represents a non-traded sector. Then, I use the constructed low-skilled-labor wage bill shares as proxies for $(1-\alpha_j)$, to estimate the following econometric specification:

$$Ln\left(P_{NT}\right)_{ijt} = \theta LS\dot{W}ageBillshare_j * Ln\left(\frac{(\widehat{\beta\overline{L}^{\rho}}+(1-\widehat{\beta})\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}}_{it}\right)+(\phi_i\times\psi_t)+\zeta_j+\varepsilon_{ijt}, \quad (1.18)$$

[25] Results are very similar when other definitions of high-skilled labor are used. See Table 1.12.

[26] The IV methodology not only solves the endogeneity problem, but produces correct standard errors in the presence of generated regressors.

[27] I construct the low-skilled labor wage bill share using data from the 1980 Census and assuming a capital share of 30 percent for all industries. The formula I use is:

$LSWageBillshare_j$=$0.7*\frac{\sum_{k\in LS} wageincome_{kj}}{\sum_k wageincome_{kj}}$ where j is industry and k is worker. Note that I am allowing wages to vary across industries (the model assumes they are fixed across industries).

where j represents a non-traded sector, and $LSWageBillshare_j$ the low-skilled-labor wage bill share of sector j.

My instrument is the predicted number of low-skilled Mexicans, Italians, and Cubans multiplied by the wage-bill share of low-skilled workers in industry j. If my constructed low-skilled-labor wage bill share was a perfect measure of $(1-\alpha)$, and the assumptions of the model represented reality perfectly[28], θ=1. However, because neither of these conditions is likely to hold, I do not restrict $\widehat{\theta}$=1.

Table 1.10 presents estimates of θ under different specifications. My preferred estimate is in Column 4, where I allow for city fixed-effects to differ by group[29] and for region-decade shocks to differ by industry. Because the goods and services included in the sample are very diverse, there is no obvious reason why the effect of city characteristics should be equal across all types of goods; for example, the city's weather might be an important determinant in the market for gardening services, but not necessarily in the market for dental services. Assuming that groups of goods whose use of low-skilled immigrant labor is similarly intensive will also experience similar effects of city characteristics on their prices, it seems that allowing for different city fixed effects provides for a more accurate model. The preferred estimate, -0.483, suggests, for example, that an increase of 10 percent in the relative endowment of low-skilled labor in a city, decreases the price for housekeeping services ($LSWageBillshare = 0.4$) by 1.93 percent and the price of the average non-traded good ($LSWageBillshare = 0.12$) by 0.58 percent. When I restrict city fixed effects to be equal across all groups of non-traded sectors (Column 1), the coefficient is statistically significant and has the expected sign, but its magnitude appears to be too small. To see this, consider low-skilled-immigrant-intensive goods: their average low-skilled wage bill share is 0.29. When multiplied by the estimated coefficient (-0.22) this suggests an elasticity of prices of -0.07, much smaller than the -0.27 shown in Table 1.9.

By multiplying the price effects from Tables 1.9 and 1.10 by $\left(\frac{w_I\bar{I}}{w_L\bar{L}+w_I\bar{I}}\right)_i$, one obtains the effect of low-skilled immigration on the prices of nontradeable goods at the current immigration level of city i.

[28] For example, if the elasticity of demand for immigrant-intensive services is not unitary, but (in absolute value) greater than one, then one expects $\widehat{\theta} < 1$.

[29] The groups correspond to the three samples presented in Tables 1.6 and 1.9.

Traded Goods

If US cities behave as small open economies, then the model states that low-skilled-immigrant concentration should have no effect on the prices of traded goods. In reality, most goods, especially when considered from the point of view of the consumer, are not purely tradeable; there is always a part of the price that reflects the retailer's handling costs, and these costs are likely to be affected by local relative endowments. However, for most goods, these handling costs represent only a small share of the final price. For example, Barsky et al. (2001) estimate an upper bound for the retailing costs of grocery goods, such as cookies and soft drinks, of approximately 15 percent. Also, assuming that the effect of retailing costs on prices of goods is not systematically related to the percentage of low-skilled employees producing the good, it appears that even if the traded goods are affected by local endowments, that effect should not follow the declining pattern observed for the non-traded-goods groups in Table 1.9. Nor should it be captured by the interaction of the low-skilled-labor wage share bill with local relative endowements.

Table 1.11 shows that the data support these predictions. Panel A presents the same estimations as Table 1.9 for traded goods; as observed, the coefficients are all close to zero and do not show a declining pattern as the samples become broader.

Panel B reports the estimation of the following equation, which includes both traded and non-traded goods:

$$Ln\left(P_{NT_{ijt}}\right) = \lambda * LSWBS_j * Ln\left(\frac{\widehat{AggL}}{\overline{H}}_{it}\right) + \tau * LSWBS_j * Ln\left(\frac{\widehat{AggL}}{\overline{H}}_{it}\right) * t_j + (\phi_i \times \psi_t) + (\zeta_j \times \psi_t) + \varepsilon_{ijt} \tag{1.19}$$

where $\widehat{AggL} = (\widehat{\beta L^{\rho}} + (1-\widehat{\beta})\overline{I}^{\rho})^{\frac{1}{\rho}}$, $LSWBS_j$=the low-skilled-labor wage bill share in industry j, and t_j is a dummy variable for traded goods.[30]

My hypothesis implies that $\tau \simeq -\lambda$: the effect of low-skilled immigration (interacted with the low-skilled intensity of the sector) on the prices of traded goods should be close to zero. As seen in Table 1.11, I cannot reject this hypothesis.

[30] See Appendix A for the classification of goods and services into traded and non-traded categories.

I interpret these findings as evidence that treating US cities as small open economies is a reasonable assumption.

Robustness Checks

Table 1.12 presents several checks on the robustness of the price effects presented in Table 1.10. The second and third rows use different values for the elasticity of substitution and the relative efficiency.[31] As expected, the magnitude of the effect increases with the elasticity of substitution, but the numbers are not statistically different from the baseline estimate. The fourth row uses an alternative definition for high-skilled labor (all workers with a high school degree or higher) and the fifth excludes Los Angeles from the analysis. The magnitude and significance of the coefficient changes little under both specifications.

Given that the set of goods and services included in the analysis is determined somewhat arbitrarily (by the ability to be matched to the Census classification) and that the classification of goods into the non-traded category is open to debate, Table 1.12 also presents estimations where groups of goods and services are excluded. The estimated coefficient is somewhat larger in absolute value when medical services are excluded. Most coefficients are significant at the 10 percent level or better.

1.5.2 Implied Wage Effects for Low-skilled Natives and Immigrants

A discussion about the magnitude of the wage effects implied by the empirical analysis is key to the credibility of the structural estimates, because the model posits wages as the main mechanism through which immigrants change prices, and because the wage effects can be compared to previous estimates in the literature.

The estimation of equation (1.16) presented in Table 1.8 suggests that an increase of 10 percent in the number of low-skilled immigrants in a city reduces the wages of low-skilled natives by approximately 0.6 percent. This estimate is in line with the small effect of immigration on the labor market outcomes of natives found in most other cross-city studies.[32] My results are

[31] The values for ρ are chosen to suggest a plausible range and the correspondent β are estimated using the same methodology described in section 1.5.1.

[32] See Altonji and Card (1991),Card (1990), Card (2005), and Card and Lewis (2005).

at variance with Borjas (2003), who finds a large and significant negative effect of immigration on natives' wages. His empirical approach is different from the one presented here, though; he uses the national level as the unit of analysis and exploits variation in immigrant shocks across education-experience groups.

I also can calculate the effect of a low-skilled immigration shock on the wages of other low-skilled immigrants using my estimate for the elasticity of substitution. Following steps similar to those in Section 1.5.2, I show that

$$\frac{\partial Lnw_I}{\partial Ln\overline{I}} = -(1-\rho) - \rho\left(\frac{w_I\overline{I}}{w_L\overline{L} + w_I\overline{I}}\right) \tag{1.20}$$

Using my estimate of ρ, I calculate that a 10 percent increase in the supply of low-skilled immigrants reduces the wages of other low-skilled immigrants by 8 percent. The evidence in the literature on the wage effects on other immigrants is scarce and inconclusive. The only two papers that study the impact of immigration on earlier immigrants are Card (1990) and Borjas (2003); the former finds no significant negative effect of an immigration shock on the labor outcomes of earlier immigrants, and the latter a sizeable, but not statistically significant, negative effect.

Given the lack of evidence in the literature about the magnitude of the own-wage effects for low-skilled immigrants, I provide several consistency checks for my estimate. First, I note that my estimate corresponds to an own-labor demand elasticity of -1.21 –a number slightly higher than the range of the consensus estimates of the elasticity of native male labor demand[33], and in the range for the elasticity of female labor demand estimated by Acemoglu *et.al* (2004).

Second, if the calculation based on equation (1.20) is accurate, then I should find a similar own-labor demand elasticity by estimating a wage equation like (1.16) for low-skilled immigrant workers. Because wage data for low-skilled immigrants (most of whom are undocumented) is very noisy, I do not find any significant effects of an increase in the number of immigrants on their own wage (See Rows 1-3 Table 1.13), but I am able to provide indirect evidence on the plausibility of the calculated effect by estimating equation (1.16) for the native groups who are similar to low-skilled immigrants in terms of race, English proficiency, and disadvantaged

[33] See Hammermesh (1993).

minority status. My argument is that the effect of low-skilled immigration on the wages of these groups should provide a lower bound for the wage effects on other low-skilled immigrants. As observed in Table 1.13, the wage effects are more than four times larger for native Hispanics than for all low-skilled natives. The fact that for blacks, a similarly underprivileged minority, the wage effects are comparable to the ones for all low-skilled natives suggests that language is an important factor in the degree of substitutability between groups of low-skilled workers. To check for this hypothesis, I restrict the sample to native Hispanics who reported that they "speak English, but not well". As Table 1.13 shows, the wage effects of low-skilled immigration on this native group are very large: a 10 percent increase in low-skilled immigration reduces the wages of native Hispanics with low English proficiency by about 3.5 percent (4.5 percent for females). The wage effects of low-skilled immigrants on other low-skilled immigrants are expected to be even higher; the legal status of many low-skilled immigrants prevent them from competing with native Hispanics for certain jobs, even conditional on their English proficiency.[34] I conclude, therefore, that the estimated own-labor elasticity for low-skilled immigrants calculated from (1.20) is reasonably supported by the wage data.

As a final check I compare the wage effect derived from equation (1.20) with that implied by my price estimates. The estimates from Table 1.10 suggest that a 10 percent increase in the share of low-skilled immigrants in the labor force decreases prices for the average non-traded good by 0.20 percent. For this number to be consistent with a 10 percent increase in the share of low-skilled immigrants reducing low-skilled native wages by 0.6 percent, and with a cost share of high school dropouts wages of 4.5 percent[35], wages for low-skilled immigrants should decrease by 8.3 percent.[36]

[34] Kossoudji et al (2002) estimate that the wage penalty for being unauthorized is between 14 percent and 24 percent, and that the wage benefit of legalization under IRCA (Immigration Reform and Control Act) was approximately 6 percent.

[35] See Autor, Katz and Krueger (1998)

[36] An effect of 8.3 percent is calculated using the following formula, $0.045 * (0.5 * (0.006) + 0.5 * x) = 0.0020$ (recall that about half of all LS workers in the US largest cities are immigrants).

1.6 Purchasing Power Calculations

The previous sections demostrate how low-skilled immigration affects the native economy. This evidence alone is not sufficient to calculate purchasing power effects, though; data on native preferences is needed. This section combines data on consumption patterns from the Consumer Expenditure Survey (CEX) with the price and wage effects obtained in Section 5 to estimate how natives' welfare was changed by the immigration wave of the 1990s.

Natives of all skill levels benefit from low-skilled immigration through the reduction in the non-traded-goods component of the cost of living. I use the expenditure shares from the 1990 CEX to calculate changes in Laspayres index caused by the 1990s immigration shocks, and interpret these changes as the price benefits from immigration.[37] The first row of Table 1.14 presents the 25-city average of the estimated change in the price index of non-traded goods by skill level.[38] Notice that to obtain more realistic estimates, I allow for variation in consumption patterns across skill groups, even though my theoretical model assumes there is none. As the table shows, college graduates experienced a larger reduction in their non-traded component of the cost of living because they tended to consume relatively more immigrant-intensive non-traded goods, whereas high school dropouts benefited slightly less. The average decrease for the 25 cities is 0.65 percent for high school dropouts, 0.68 percent for high school graduates and workers with some college, and 0.73 percent for college graduates. College graduates also benefited more from low-skilled immigration because they devoted a higher share of their total expenditures to the purchase of non-traded goods (Second row, Table 1.14).

Lower prices come at a cost. As discussed in the previous section, the wages of low-skilled natives are reduced by the inflows of foreign-born high school dropouts. The trade model presented in Section 5 predicts no impact of low-skilled immigrants on the wages of high-skilled workers; the wage is always equal to one because of the constant marginal productivity of high-skilled labor in the production of the traded good, and the assumption that cities take the price

[37] Because Laspayres indexes do not take into account substitution effects, the estimates provide a lower bound for the reduction in non-traded component of the cost of living. I calculate the price effects using my estimate from Table 1.10 Column 4 and $\left(\frac{w_I \overline{I}}{w_L \overline{L} + w_I \overline{I}}\right)_i$ for 2000. Note that I am subestimating the reduction in prices because my structural estimates explain only 55-80 percent of the total price effects.

[38] Table 1.14 also shows population-weighted city-averages. The results are very similar.

of the traded good as given. In reality, though, low-skilled workers participate in the production of traded goods and, therefore, the wages of high-skilled workers are likely to be affected by shocks to the supply of low-skilled immigrants. The direction of the effect depends on whether low-skilled and high-skilled labor are q-complements or q-substitutes. Borjas (2003) finds q-complementarity between workers of different education groups; his results suggest, therefore, that an increase in immigration raises the wages of high-skilled workers. I use Borjas's estimates of factor-price elasticities across education groups and my own estimate of the impact of low-skilled immigration on the wages of low-skilled natives to calculate the wage effects (by skill level and by city) caused by the 1990s immigration flows.[39] The third row of Table 1.14 report these calculations. As observed, although the cross-education wage effects are positive, they are small compared to the negative effects on high school dropouts' wages. The average decrease in the wages of low-skilled natives for the 25 cities is 2.9 percent, the average increase for high school graduates and workers with some college education is 0.29 percent, and the average increase for college graduates is 0.37 percent.

I combine the cost of living effects[40] and the wage effects to calculate the net impact of low-skilled immigration on natives' purchasing power by skill group. As observed in the third column of Table 1.14, low-skilled natives' purchasing power was reduced by the low-skilled immigration wave of the 1990s; their real wage decreased by an average of 2.66 percent. On the other hand, high school graduates and workers with some college, and college graduates, benefited: their purchasing power increased by 0.59 and 0.71 percent respectively. Given that low-skilled natives represent a small fraction of all native workers, the average net benefit for the native population was positive.[41]

[39] Borjas's estimates of cross-education groups elasticities are 0.02 for high school graduates, 0.02 for workers with some college, and 0.025 for college graduates. Borjas presents estimates for several experienced groups. I use his numbers for workers with 21-25 years of experience.

[40] I multiply the changes in the price indexes for non-traded goods by the share of non-traded goods in total expenditures.

[41] These numbers are likely to underestimate the benefits from low-skilled immigration because they don't take into account the complementarities between low-skilled labor and capital, and thus, they exclude from the calculations the gains to the owners of capital.

1.7 Conclusion

A large body of literature analyzes the impact of immigration on the employment opportunities of native workers and the costs it imposes on taxpayers. With the exception of Borjas (1994), this literature has not addressed the gains that immigration brings to the native population. The study of the benefits from immigration is important, because the contrast between benefits and costs (not only economic, of course) inform decisions about immigration policy. This paper contributes to the immigration literature by estimating, using a unified framework, the impact of low-skilled immigration on prices, wages, and the purchasing power of natives.

I find that low-skilled immigration benefits the native population by decreasing the non-traded-goods component of the cost of living. At current US immigration levels, a 10 percent increase in the average city's share of low-skilled immigrants in the labor force decreases the price of immigrant-intensive services such as housekeeping and gardening by 1.3 percent, and price of the average non-traded good (in terms of intensity in the use of low-skilled immigrants) by 0.2 percent. My structural estimates suggest that wages are a likely channel through which these effects take place. The wage effects are sizeable but plausible: a 10 percent increase in the number of low-skilled immigrants in a city reduces the wages of low-skilled natives by 0.6 percent and of low-skilled immigrants by 8 percent (an own-labor demand elasticity of -1.2). My results imply that the low-skilled immigration wave of the 1990s increased the purchasing power of high-skilled workers living in the 25 largest cities by an average of 0.65 percent and decreased the purchasing power of native high school dropouts by an average of 2.66 percent. I conclude that, through lower prices, low-skilled immigration brings positive net benefits to the US economy as a whole, but generates a redistribution of wealth: it reduces the real income of low-skilled natives and increases the real income of high-skilled natives.

This paper also provides an alternative explanation as to why the literature has repeatedly found that immigration has little impact on the wages of low-skilled natives: low-skilled immigrants and low-skilled natives are far from being perfect substitutes in production. Therefore, a low-skilled immigration shock should affect the wages of other low-skilled immigrants mostly and the wages of low-skilled natives least. Although I have no direct evidence of the wage effects of immigration on other immigrants, I find that low-skilled immigration has a much larger negative effect on the wages of native Hispanics with low English proficiency than on the wages

of other low-skilled native groups.

Due to the focus on city level outcomes, this paper has looked only at prices of non-traded goods and services. Low-skilled immigration is also likely to have effects on the prices of traded goods, but these will occur at an aggregate, national level. A theoretical and empirical exploration of this issue is needed in order to have a complete assessment of the effects of low-skilled immigration.

Table 1.1 Share of Low-skilled Immigrants in the Labor Force (%)

City	1980	1990	2000
Atlanta	0.38	0.84	3.23
Baltimore	0.76	0.44	0.67
Boston	3.53	2.71	2.62
Chicago	4.99	5.09	5.86
Cincinnati	0.44	0.23	0.34
Cleveland	1.82	0.89	0.65
Dallas	2.13	5.17	8.63
Denver	1.18	1.42	4.13
Detroit	1.76	0.93	1.35
Houston	3.96	7.03	9.21
Kansas City	0.58	0.47	1.44
Los Angeles	11.64	15.90	15.09
Miami	15.13	14.44	11.36
Milwaukee	1.07	0.84	1.54
Minneapolis	0.49	0.37	1.43
New Orleans	1.20	1.13	1.08
New York City	8.91	7.82	8.15
Philadelphia	1.39	0.91	1.06
Portland	1.03	1.53	3.27
St. Louis	0.49	0.24	0.53
San Diego	4.59	5.92	6.34
San Francisco	4.40	6.73	6.19
Seattle	1.22	1.00	1.94
Tampa	1.50	1.69	2.15
Washington, DC	1.61	2.52	3.76

Source: US Census

Table 1.2 Top Industries Intensive in Low-skilled Immigrant Labor (2000)

All Low-skilled Immigrants		Male LS Immigrants		Female LS Immigrants	
	%*		%		%
Labor Force	5.3	Labor Force	3.3	Labor Force	1.9
Textiles	44.8	Gardening	28.5	Textiles	27.9
Gardening	29.2	Shoe repair	19.2	Private households	25.8
Leather Products	28.4	Crop production	19.0	Leather products	16.1
Private households	27.4	Car washes	17.5	Fruit and veg. preserv.	13.1
Animal slaughtering	25.3	Textiles	16.9	Dry cleaning and laundry SS	12.0
Crop production	24.0	Animal slaughtering	16.5	Services to buildings	11.6
Fruit and veg. preserv.	21.9	Furniture manuf.	15.9	Sugar products	11.2
Car washes	20.2	Carpets manuf.	15.2	Animal slaughtering	8.8
Services to buildings	20.0	Recyclable material	12.7	Hotels	8.0
Carpets manuf.	19.8	Wood preservation	12.4	Pottery, ceramics	7.6
Furniture manuf.	19.8	Leather products	12.3	Nail salons	7.5
Sugar products	19.3	Construction	12.3	Home health care SS	6.7
Dry cleaning and laundry SS	19.3	Fishing, hunting	12.0	Plastics products manuf.	6.5
Shoe repair	19.2	Bakeries	11.9	Seafood	6.3
Bakeries	17.9	Aluminum prod.	11.8	Toys manufacturing	6.1

*% of LS Immigrants in Tot. Employment of Industry. Includes only the 25 largest cities.

Source: Census (2000)

Table 1.3. The Effects of LS Immigration on Prices of Immigrant-intensive Industries
OLS Estimates

	(1)	(2)	(3)	(4)
	Dependent Variable : Log(Price Index)			
Ln(LS Immigrants/LF)	0.014	0.010	0.005	-0.043
	(0.025)	(0.023)	(0.023)	(0.028)
Region*Decade FE	No	Yes	Yes	Yes
Log(Population)	No	No	Yes	Yes
Log(Employment)	No	No	No	Yes
Industry*Decade FE	Yes	Yes	Yes	Yes

Note: Services included in the reg. are: Baby-sitting, housekeeping, gardening, dry cleaning, shoe repair and barber shops. All regressions include city, industry, and decade fixed effects. Std. Errors clustered at the city*decade level are reported in parenthesis. The number of observations if 300 (25 cities and 6 industries).

Table 1.4 Origin of Low-skilled US Immigrants

	Top Sending Countries	%. Tot LS Immigrants	Top Sending Countries	%. Tot LS Immigrants
Rank	1970*		1980	
1	Mexico	15.19	Mexico	46.14
2	Italy	13.40	Cuba	3.69
3	Canada	9.61	Portugal	3.51
4	Germany	6.53	Italy	3.01
5	Cuba	6.43	Philippines	2.77
Rank	1990		2000	
1	Mexico	53.54	Mexico	64.01
2	El Salvador	5.22	El Salvador	4.93
3	Cuba	3.63	Guatemala	3.90
4	Italy	2.78	Vietnam	2.89
5	China	2.33	Honduras	2.45

* The numbers for 1970 represent the composition of the stock of LS immigrants, and the numbers for 1980-2000 represent the composition of the decade flows.

Source: US Census

Table 1.5 First Stage

Dependent Variable : Log (LS Immigrants/Labor Force)				
	(1)	(2)	(3)	(4)
Instrument*	0.565	0.675	0.384	0.443
	(0.130)	(0.183)	(0.128)	(0.197)
Region*Decade FE	No	Yes	No	Yes
Includes 1980	Yes	Yes	No	No
No. Obs.	75	75	50	50

* Instrument $=\text{Ln}\ [\ (Mex_{i,1970}/Mex_{1970})*LSMex_t+(Cub_{i,1970}/Cub_{1970})*LSCub_t+(Ital_{i,1970}/Ital_{1970})*LSItal_t]$

Note: OLS estimates. City and decade fixed effects are included in all the regressions.

Robust Std. Errors are reported in parenthesis.

Table 1.6 The Effects of Low-skilled Immigration on Prices of Non-traded Goods and Services
IV Estimates

	Dependent Variable : Log(Price Index):					
	Ind. highly intensive in the use of LS Immigrants		Ind. with higher than average concentration of LS Immigrants		All Non-Traded Goods and Services	
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(LS Immigrants/LF)	-0.097	-0.126	-0.039	-0.096	0.029	-0.017
	(0.053)	(0.063)	(0.049)	(0.059)	(0.026)	(0.032)
Region*Decade FE	No	Yes	No	Yes	No	Yes
No. of Observations	300	300	500	500	1750	1750
No. of Cities	25	25	25	25	25	25
No. of Industries	6	6	10	10	35	35

Note: All regressions include city, industry, and decade fixed effects. Std. Errors clustered a the city*decade level are reported in parenthesis.

Table 1.7 The Displacement Effects of Low-skilled Immigration

	(1)	(2)
	OLS - Dep. Variable : Ln (Low-skilled Natives)	
Ln(LS Immigrants)	0.198	0.217
	(0.064)	(0.078)
	RF - Dep. Variable : Ln (Low-skilled Natives)	
Instrument*	0.041	0.034
	(0.079)	(0.091)
	IV - Dep. Variable : Ln (Low-skilled Natives)	
Ln(LS Immigrants)	0.071	0.048
	(0.131)	(0.124)
Region*Decade FE	No	Yes
No. Observations	75	75

Source: 1980, 1990, and 2000 Census. City and decade fixed effects are included in all specifications. Robust Std. Errors are reported in parenthesis.

* Instrument $=\text{Ln}\left[(Mex_{i,1970}/Mex_{1970})*LSMex_t+(Cub_{i,1970}/Cub_{1970})*LSCub_t+(Ital_{i,1970}/Ital_{1970})*LSItal_t\right]$

Table 1.8 Estimation of the Elasticity of Substitution between LS Natives and Immigrants

	(1)	(2)	(3)	(4)
	OLS - Dep. Variable : Ln (Hourly Wage) - Only Natives			
	All LS Natives		Male LS Natives	Female LS Natives
Ln(LS Immigrants)	-0.008	-0.008	-0.020	0.006
	(0.015)	(0.015)	(0.018)	(0.012)
Ln(LS Natives)	-	-0.019	-	
		(0.023)		
	IV - Dep. Variable : Ln (Hourly Wage) - Only Natives			
	All LS Natives		Male LS Natives	Female LS Natives
Ln(LS Immigrants)	-0.058	-0.058	-0.059	-0.060
	(0.034)	(0.033)	(0.035)	(0.034)
Ln(LS Natives)	-	-0.020	-	
		(0.024)		
Number of Observations	355730	355730	220555	135175
Estimated rho	0.243	0.242	0.246	0.252
Implied Elasticity of Substitution	1.32	1.32	1.33	1.34

Source: 1980, 1990, and 2000 Census. City and decade fixed effects are included in all specifications. Controls at the individual level include age, age squared, and gender. Other included controls are % males in the low-skilled native population of the city and log of the city's population. Standard Errors clustered at the city*decade level are reported in parenthesis.

Table 1.9 IV Estimation of the Price Effects of Changes in the LS Labor Aggregate Non-Traded Goods by Groups

	Dependent Variable : Log(Price Index):					
	Ind. highly intensive in the use of LS Immigrants		Ind. with higher than average concentration of LS Immigrants		All Non-Traded Goods and Services	
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Agg LS/HS)	-0.189	-0.274	-0.076	-0.208	0.056	-0.032
	(0.101)	(0.136)	(0.097)	(0.133)	(0.047)	(0.069)
Implied (1-α)	0.189	0.274	0.076	0.208	-0.056	0.032
Region*Decade FE	No	Yes	No	Yes	No	Yes
No. of Observations	300	300	500	500	1650	1650
No. of Industries	6	6	10	10	33	33

Notes: All regressions include city, decade, and industry*decade fixed effects. Standard Errors clustered at the city*decade level are reported in parenthesis.

Table 1.10 IV Estimation of the Price Effects of Changes in the LS Labor Aggregate Non-Traded Goods - Pooled Estimation

	Dependent Variable : Log(Price Index):			
	(1)	(2)	(3)	(4)
Ln(Agg LS/HS)	0.084	0.021	0.024	-
	(0.050)	(0.078)	(0.082)	
LSWageBillShare*Ln(Agg LS/HS)	-0.226	-0.461	-0.483	-0.483
	(0.103)	(0.201)	(0.226)	(0.227)
City*Group FE	No	Yes	Yes	Yes
Industry*Decade FE	Yes	Yes	Yes	Yes
Industry*Region*Decade FE	No	No	Yes	Yes
Region*Decade FE	Yes	Yes	-	-
City*Decade FE	No	No	No	Yes

Notes: All regressions include city and decade fixed effects. 25 cities and 33 goods or services are included. Standard Errors clustered at the city*decade level reported in parenthesis.

Table 1.11 IV Estimation of the Price Effects of a Change in the LS Labor Aggregate Traded Goods

Dep. Variable: Log(Price Index)			
	Panel A. By Group - Only Traded Goods		
	Highly Intensive In LS Immigrants	Higher than avg. concent. of LS Imm.	All Traded Goods and SS
	(1)	(2)	(3)
Ln(Agg LS/HS)	0.037	-0.012	-0.004
	(0.113)	(0.079)	(0.039)
Industry*Decade FE	Yes	Yes	Yes
Region*Decade FE	Yes	Yes	Yes
No. of Observations	750	1100	1850
No. of Industries	15	22	37
	Panel B. Pooled Estimation- Traded vs. Non-Traded		
	(1)	(2)	(3)
LSWageBillShare*Ln(Agg LS/HS)	-0.244	-0.370	-0.395
	(0.140)	(0.166)	(0.179)
LSWageBillShare*Ln(Agg LS/HS)*Traded	0.213	0.411	0.497
	(0.121)	(0.354)	(0.463)
Ho: $\tau=-\lambda$ (p-value)	0.872	0.898	0.796
City*Group FE	Yes	Yes	Yes
Traded*City*Group FE	No	Yes	Yes
Industry*Decade FE	Yes	Yes	Yes
City*Decade FE	Yes	Yes	Yes
Traded*City*Decade FE	No	No	Yes
Number of Observations	3500	3500	3500

Notes: All regressions include city and decade fixed effects. Std. errors clustered at the city*decade level reported in parenthesis.

Table 1.12 Robustness Checks

Dep. Variable: Ln(Price Index)		
	IV	
Specification	LSWageBillShare*Ln(Agg LS/HS)	N. Obs.
Baseline - Column (4) Table 10	-0.483	1650
	(0.225)	
Rho=0.5, Beta=0.56	-0.524	1650
	(0.242)	
Rho=1, Beta=0.53	-0.633	1650
	(0.285)	
Alternative Definition of	-0.472	1650
High-skilled Labor*	(0.225)	
Los Angeles excluded	-0.527	1584
	(0.248)	
Utilities excluded	-0.459	1350
	(0.279)	
Medical SS excluded	-0.586	1400
	(0.213)	
Household SS excluded	-0.476	1250
	(0.234)	
Education excluded	-0.493	1450
	(0.248)	

Standard Errors clustered at the city*decade level are reported in parenthesis.

Table 1.13 Wage Effects of LS Immigration on Various Groups

	IV - Dep. Variable : Ln (Hourly Wage) - Micro Data		
	Low-skilled Group	Coeff. Ln(LS Immigrants)	N. Obs.
(1)	LS Immigrants	0.037	210219
		(0.034)	
(2)	LS Male Immigrants	0.052	133729
		(0.045)	
(3)	LS Female Immigrants	0.026	76490
		(0.020)	
	Native Groups		
(4)	Blacks	-0.055	82932
		(0.049)	
(5)	Male Blacks	-0.056	47626
		(0.057)	
(6)	Female Blacks	-0.049	35036
		(0.040)	
(7)	Hispanics	-0.254	53059
		(0.111)	
(8)	Male Hispanics	-0.220	32849
		(0.099)	
(9)	Female Hispanics	-0.313	20210
		(0.140)	
(10)	Hispanics with Low English Proficiency	-0.339	4742
		(0.155)	
(11)	Male Hispanics with Low English Proficiency	-0.269	3097
		(0.146)	
(12)	Female Hispanics with Low English Proficiency	-0.462	1645
		(0.206)	

Source: 1980, 1990, and 2000 Census. City and decade fixed effects are included in all specifications. Controls at the individual level are age, age squared, and gender. Other controls are % males in the native group studied and log of the city population. Regressions for Hispanics include dummies for hispanic group (mexican, cuban, etc) and the percentage of each hispanic group in the hispanic population of the city. Standard Errors clustered at the city*decade level are repoted in parenthesis.

Table 1.14 Purchasing-power Effects of the LS Immigration Wave of the 1990s Average for the 25 Largest Cities

	HS Dropouts	HS Grads & SC	College Grads
Simple City-Average			
% Change in Price Index of NT Goods	-0.65	-0.68	-0.73
Share of NT Goods in Tot. Exp. (%)	41.25	44.40	46.47
% Change in Wages	-2.93	0.29	0.37
% Change in Purchasing Power	-2.66	0.59	0.71
Population-Weighted City-Average			
% Change in Price Index of NT Goods	-0.60	-0.62	-0.67
Share of NT Goods in Tot. Exp. (%)	41.25	44.40	46.47
% Change in Wages	-2.70	0.27	0.34
% Change in Purchasing Power	-2.45	0.55	0.65

Note: Calculations use estimates from Table 1.10 and wage-bill shares from the 2000 Census.

Appendix A. Classification of Goods and Services

Non-Traded Goods and SS

Utilities
Electricity
Utility Natural Gas Services
Telephone SS, Local Charges
Water and Sewage Maintenance
Cable TV
Garbage and Trash Collection

Medical Servies
Hospital and other Medical Care SS
Physicians' Services
Dental Services
Eyeglasses and Eye Care
SS. By other Medical Prof.

Education
College Tuition and Fees
Elementary and High School Tuition
Child Daycare
Other Tuition and Fees

Household SS.
Food Away from Home
Baby-Sitting
Domestic Service
Other Household SS (Incl. gardening)
Appliance and Furniture Repair
Care of Invalids, Elderly at Home
Other Apparel SS (Incl. Shoe Repair)
Laundry and Dry-Cleaning

Other
Beauty Parlos
Barber Shops
Tenants' Insurance
Automobile Insurance
Automotive Repair
Automotive Maintenance and Servicing
Intracity Transportation
Admissions (Movies, etc)
Legal Fees
Cemetery Lots and Funeral Expenses

Traded Goods and SS.

Food
Cereals
Bakery Products
Beef and Veal
Pork
Other Meats
Fish and Seafood
Fresh Milk and Cream
Processed Dairy Products
Fresh Fruits
Fresh Vegetables
Processed Fruits
Processed Vegetables
Sugar and Sweets

Apparel and Textiles
Apparel
Footwear
Textile House Furnishing

Gadgets
Household Appliances
TV and Sound Equipment
Toys, Hobbies, etc.
Photographic Supplies and Eq.
Watches
Sporting Goods and Equipment

Supplies
Maintenance and Repair Commodities
Toilet Goods and Personal Care Appliances
Laundry and Cleaning Products
Household Paper Products

Other
Intrastate Telephone SS
Airline Fare
Fuel Oil
Furniture and Bedding
Tires
New Vehicles
Prescription Drugs and Medical Supplies
Nonprescription Drugs and Medical Supplies
Reading Materials
School Books and Supplies
Tobacco Products

Appendix B. Goods and Services included in Table 7

Ind. with higher than average use of LS Immigrants

Other Apparel SS (Incl. Shoe Repair)*
Baby-Sitting*
Domestic Service*
Other Household SS (Incl. gardening)*
Laundry and Dry-Cleaning*
Barber Shops*
Automotive Repair
Food Away from Home
Automotive Maintenance and Servicing
Beauty Parlors

* *Ind. highly intensive in the use of LS Immigrants*

Ind. with lower than average use of LS Immigrants

Appliance and Furniture Repair
Garbage and Trash Collection
Care of Invalids, Elderly at Home
Intracity Transportation
Hospital and other Medical Care SS
Admissions (Movies, etc)
Child Daycare
Cemetery Lots and Funeral Expenses
SS. By other Medical Prof.
Electricity
Physicians' Services
Utility Natural Gas Services
Water and Sewage Maintenance
Other Tuition and Fees
Elementary and High School Tuition
Tenants' Insurance
Automobile Insurance
College Tuition and Fees
Telephone SS, Local Charges
Cable TV
Dental Services
Eyeglasses and Eye Care
Legal Fees

Appendix C

Table C1. First Stage: Alternative Instruments

	Dependent Variable : Log(LS Immigrants/Labor Force)											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Inst. includes top 3 countries in 1970				Inst. includes top 5 countries in 1970				Inst. includes top 10 countries in 1970			
Log(Instrument*)	0.577	0.575	0.311	0.259	0.628	0.678	0.385	0.372	0.713	0.729	0.429	0.404
	(0.163)	(0.238)	(0.147)	(0.265)	(0.154)	(0.228)	(0.156)	(0.249)	(0.173)	(0.226)	(0.181)	(0.271)
Region*Decade FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Includes 1980	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
Number of Obs.	75	75	50	50	75	75	50	50	75	75	50	50

Note: OLS estimates. City and decade fixed effects are included in all the regressions. Robust Std. Errors in parenthesis. I exclude Germany and former Yugoslavia from the ranking of countries because numbers are not comparable between 1980 and 1990.

The top 3 countries are Canada, Mexico, Italy; the top 5 countries also include Cuba and Poland; the top 10 include in addition Ireland, China, Greece, Philippines and England.

* Instrument = $\Sigma_c(Imm_{c,i,1970}/Immi_{c,1970})$*$LSImmi_{c,t}$

Table C2. First Stage - Alternative Functional Forms

Dependent Variable : LS Immigrants/Labor Force						
	(1)	(2)	(3)	(4)	(5)	(6)
Instrument*	0.110	0.087	0.369	0.071	0.167	0.604
	(0.041)	(0.052)	(0.139)	(0.107)	(0.090)	(0.167)
Instrument Squared	-	-	-0.732	-	-	-1.131
			(0.309)			(0.346)
Region*Decade FE	No	Yes	Yes	No	No	Yes
Includes 1980	Yes	Yes	Yes	No	No	No
Excludes Los Angeles	No	No	No	No	Yes	No
No. Obs.	75	75	75	50	48	50

Note: OLS estimates. City and decade fixed effects, and the log of the city's population are included in all the regressions. Robust Std. Errors are reported in parenthesis.

* Instrument = $(Mex_{i,1970}/Mex_{1970})$*$LSMex_t$+$(Cub_{i,1970}/Cub_{1970})$*$LSCub_t$+$(Italians_{i,1970}/Italians_{1970})$*$LSItalians_t$

Chapter 2

Cheap Maids and Nannies: How Low-skilled Immigration is Changing the Time Use of American Women[1]

2.1 Introduction

The share of low-skilled immigrants in the labor force has more than doubled in the last three decades. Concerns about the effects on native welfare have spawned a large literature, that has focused almost exclusively on the impact on native wages (Altonji and Card (1991), Card (1990) , Card and Lewis (2005), Card (2005), Borjas et. al (1996), and Borjas (2003)).[2] Only recently, labor economists have explored other potentially important impacts of immigration (Lewis (2005), Cortes (2006)). The first essay of this dissertation studies the effects of low-skilled immigration on prices of non-traded goods. One of its main findings, that low-skilled immigration has significantly reduced the prices of immigrant-intensive services, such as housekeeping, babysitting and gardening, motivates the question of the present paper. The results suggest that low-skilled immigration might affect natives' time use by reducing the prices of

[1] **This paper is joint work with Jose Tessada.**

[2] We thank Marios Angeletos, Josh Angrist, David Autor, Olivier Blanchard, Esther Duflo, and Jeanne Lafortune and participants in the field lunches at MIT for helpful comments. Tessada thanks financial support from the Chilean Scholarship Program.

services that are close substitutes for home production. Natives will tend to substitute their own time invested in the production of household goods with the purchase of low-cost household services. The freed time constitute an important channel through which low-skilled immigrants unambiguously increase native welfare. Furthermore, low-skilled immigration might decrease inequality if as suggested by Kremer and Watts (2006), the freed time is used to increase market work and high-skilled women are the first to return to the job market. [3]

This paper uses time-use surveys and cross-city variation in low-skilled immigrant concentration to study how low-skilled immigration has changed the time use of American women. To identify a causal effect we instrument for low-skilled immigrant concentration using the historical distribution of immigrants of a country to project the location choices of recent immigrant flows.

As a first step in our empirical analysis, we use data from the Consumer Expenditure Survey (CEX) to test if natives have changed their consumption of market-provided household services as a consequence of low-skilled immigration. In order to study consumption of these services we use CEX data on expenditure to construct a dummy variable that takes a value of 1 if positive expenditures in housekeeping and gardening services are reported.[4] We find that the immigration flow of the 1990s increased by a city-average of 1.4 percentage points the probability that a household reported a purchase of housekeeping services.[5]

Having confirmed that natives are buying more household services as a result of immigration, we turn to test if this has translated into a decrease in the time used by natives in household production. Using data from the recently released 2003-04 American Time Use Survey conducted by the Bureau of Labor Statistics and from the 1993 National Human Activity Pattern Survey (NHAPS), we find that the immigration wave of the 1990s reduced by a city-average of 20 minutes the time American women spend daily on household chores (not including child-

[3] [28] construct a simple model that illustrates the economic impact of foreign private household workers on natives. Their calibration exercise suggests that the admission of 7% of the labor force as foreign private household workers could potentially increase welfare among natives by as much as a 2.0% increase in GDP. Moreover, this type of immigration could increase the ratio of low-skilled native wages to high-skilled native wages by around 3 - 9%.

[4] The main problem comes from the distinction between expenditure and consumption. This can be a serious problem in the case of durable goods or other storable goods; in this case where we focus on services, as long as they are not paid in advance for long periods (i.e. do not pay all the semester the first week), reported expenditure should be a very good proxy for effective consumption.

[5] We calculate the effect for each city in the sample and then take a population-weighted mean.

care). The result, combined with the first essay's estimate of the price effects of immigration, suggests a price elasticity of demand for household services of 3.

The effect on time spent in child care is also sizeable for women with children younger than five. Our result suggest that low-skilled immigration caused mothers to spent 42 minutes less a day providing childcare if a weekday, but (probably to compensate) 45 minutes more on weekend days. We didn't find a significant effect on childcare for any other group of women.

Finally, we study how American women are spending the extra time they have after reducing their household work. We find that women have significantly increased their supply of market work (measured as hours worked), both at the intensive and extensive margins. The larger magnitude of the change in market work hours vs. the magnitude in the change in household work suggests that the effect seems to be happening mostly at the extensive margin. We find that as a result of the low-skilled immigration wave of the 1990s, women are 5 percentage points more likely to report working in the market.

We also find that high-skilled women are the most sensitive to the prices of household services; women with college degree or higher are relatively more responsive to immigration flows, both in terms of reporting positive household services expenditures and in their labor supply. If low-skilled immigration is driving very high skilled women to the labor market, it might be contributing to a decrease in wage inequality though a general equilibrium effect on wages.[6]

Positive changes in leisure consumption are not observed in the data, and if anything, the change has been negative. Inflexibility in the hours worked might explain this somehow counter-intuitive result. A potentially large effect on the extensive margin may also contribute to this result.

Ours is not the first paper to study the employment effects of low-skilled immigration. Previous papers whose main focus is on wage levels also include regressions of employment levels. They explore a different channel than ours, however; their focus is on the effects that immigrants have on native workers that compete in the same labor market. There is a great deal of dispersion in the findings reported by the various studies. As expected, studies that

[6]Notice that this mechanism will also depend on whether low and high skill workers are substitutes or complements in production.

find no effect on wages, also find no effect on employment or labor force participation. In his Mariel Boatlift paper, Card concludes that the 1980 influx of Cubans to Miami had no effects on the employment and unemployment rates of unskilled workers, even for earlier cohorts of Cubans.[7] A similar result is obtained by Altonji and Card (1991), who find no significant effect of low-skilled immigrants on the labor force participation and hours worked of low-skilled native groups. On the other hand Card (2001) calculates that "the inflow of new immigrants in the 1985-90 period reduced the relative employment rates of natives and earlier immigrants in laborer and low-skilled service occupations by up to 1 percentage point, and by up to 3 percentage points in very high-immigrant cities like Los Angeles or Miami". It is unclear from his results, however, if the displaced workers in these occupations moved out of the labor force, or simply shifted to another occupation. Borjas (2003) estimates suggest that a 10 percent supply shock (i.e an immigrant flow that rises the number of workers in a education-experience skill group by 10 percent) reduces by approximately 3.5 percent the fraction of time worked by workers of that skill group (measured as weeks worked divided by 52 in the sample of all persons, including nonworkers). The effect is significantly smaller and not statistically significant when the sample is limited to high school dropouts.

Our paper is also related to the literature on female labor supply and child care provision and prices. Gelbach (2002) estimates the effect of public school enrollment for five-year-old children on measures of maternal labor supply using as instrument for enrollment the quarter of birth of the child. His main results suggest that public pre-school enrollment of a child has a strong effect on the labor supply of the mother, especially on single women whose youngest child is five years old, and on all married women with a 5-year-old child, implying elasticities between -0.13 and -0.35 depending on the specification. Strong effects of the availability/price of child care on labor supply are also found by Baker et. al (2005), who study the introduction of universal, highly subsidized childcare in Quebec in the late 1990s. The authors estimate difference-in-differences models comparing the outcomes in Quebec and the rest of Canada around the time of this reform. Using additional information on family and child outcomes they also find that the provision of this subsidy has been associated to worse outcomes for the children. Several other studies have looked at this question, and while many of them report

[7] See Card (1990).

significant effects of childcare costs on (female) labor supply[8], with estimated elasticities of labor supply with respect to childcare costs that fall in the range from 0 to –1.26.

The rest of the paper is organized as follows. The next section discusses the predictions of a simple time use model regarding the effect of a decrease in the prices of household related services on the time women spend working in the market, working in the household, and consuming leisure. Section 1.3 describes the data and the descriptive statistics. Section 1.4 presents the empirical strategic and discusses the main results, and Section 1.5 concludes.

2.2 Theoretical Framework

Consider a standard time allocation problem with household production. A household supplies labor and uses the income to buy goods in the market. Final consumption goods are a mixture of market goods and time (*household production*). The original work by Becker (1965) introduces a very flexible form with the idea that consumption requires time and market goods (commodities). Alternatively, subsequent work by Grounau (1977) proposes a formulation where goods can be either purchased in the market or produced at home. We follow Grounau (1977)'s assumption associating household production with activities that could be done by somebody else (eg. nannies, maids, etc.) if wanted.

2.2.1 Set-up

Consider an agent with preferences given by

$$u(x, l) \tag{2.1}$$

where x is the consumption of goods and services and l is leisure time. Assume $u(\cdot)$ is strictly concave, strictly increasing in both arguments, and satisfies Inada conditions at 0. We introduce household production as in Grounau (1977), i.e. assuming that x can be purchased in the market or produced at home using time, h, according to a *household production function* $f(h)$, and that the agent is indifferent between them.[9] Denoting by x_m market purchases, the following

[8] See Blau (2003) for a survey.

[9] Throughout the paper we assume $f(\cdot)$ is strictly increasing and concave, and $\lim_{h \downarrow 0} f'(h) = \infty$.

equation gives us total consumption of goods and services as the sum of market and home produced goods

$$x = x_m + f(h). \tag{2.2}$$

The (endogenous) budget constraint is

$$R + wj = px_m, \tag{2.3}$$

where R is non labor income (measured in "dollars"), j is hours of market work, and p is the price of market goods. The agent also faces the time constraint:

$$1 = j + l + h, \tag{2.4}$$

with total time normalized to be 1.[10]

The agent maximizes (2.1) subject to (2.2), (2.3) and (2.4), plus nonnegativity constraints on j, h, and l, and the restriction that $x_m \geq R/p$. We use (2.4) to eliminate leisure from the optimization problem. Note that the properties of $f(\cdot)$ guarantee that h cannot be 0, thus we write the lagrangean for this problem

$$\max_{x_m,h,j} \mathcal{L} = u[x_m + f(h), 1 - j - h] + \lambda[R + wj - px_m] + \eta j + \theta[-R/p + x_m] \tag{2.5}$$

with first order conditions

$$\begin{aligned} u_x - \lambda p + \theta &= 0 \\ u_x f'(h) - u_l &= 0 \\ -u_l + \lambda w + \eta &= 0 \\ R + wj - px_m &= 0, \end{aligned}$$

[10] Using (2.4) to eliminate j from (2.3) we obtain

$$\underbrace{R + w}_{\text{full income}} = px_m + w(h + l),$$

where the left hand side corresponds to *full income* in this set-up.

plus nonnegativity constraints and complementary slackness conditions.

The solution to the problem is easily characterized using the graphic tools Gronau introduced in his original paper. There will be two possible cases depending on the parameters; in one the agent will not supply labor in the market ($j = 0$).[11]

Lets first look at the case where both x_m and j are strictly positive. In this case the first order conditions collapse into

$$\begin{aligned} f'(h) &= \frac{w}{p} \\ \frac{u_l}{u_x} &= \frac{w}{p}. \end{aligned}$$

Point A in Figure 2-1 corresponds to this type of outcome. Point E is the point where the production function $f(\cdot)$ has a slope equal to w/p; the straight blue line is the corresponding budget constraint, and at point A the indifference curve (solid red line) is tangent to the budget constraint. Notice also that at the point where an indifference curve is tangent to the household production function the slope $f'(\cdot)$ is lower than w/p.

If we look at Figure 2-1, we see that for certain parameters and/or preferences the optimal consumption point might be to the right of point E, and optimality implies tangency between the indifference curve and the household production function and

$$f'(h) > \frac{w}{p},$$

i.e. the marginal productivity at home is higher than the market transformation rate between work and goods. The agent is thus better off by working at home and using non-labor income and household production to obtain the goods and services she wants. Point B in Figure 2-1 represents this solution, the agents supplies no labor to the market. Note that agents with low wages and/or high non-labor income are more likely to be in a situation like this.[12]

[11] A third case, with $x_m = 0$ and $j > 0$, is not possible under our assumptions about $u(\cdot)$. To see this, notice that in this case $\theta > 0$ and $\eta = 0$, hence the budget constraint does not bind in equilibrium ($\lambda = 0$). Furthermore, the first order with respect to l can be written as

$$u_l = 0,$$

violating our assumption about Inada conditions at 0 for marginal utilities.

[12] It is worth mentioning that if the non-negativity constraint on j binds, then the constraint on market

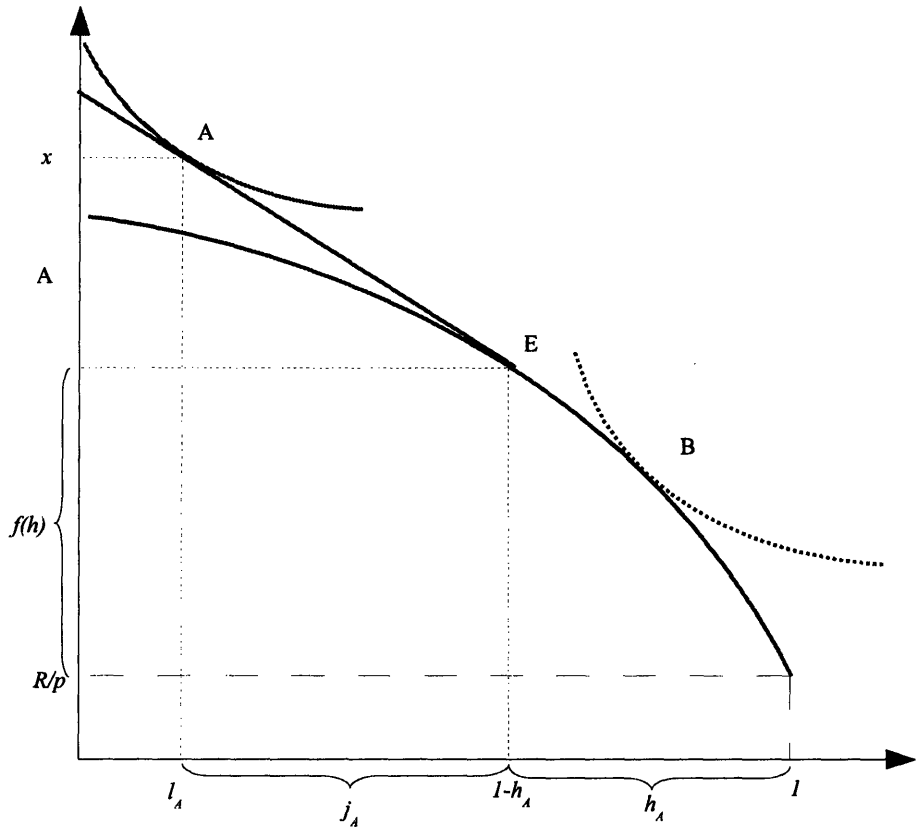


Figure 2-1: Household Production and Labor Supply in the Gronau Model

Equation (2.2) assumes that services purchased in the market and the services produced by the agent in the household are perfect substitutes. Notice, however, that the concavity of the household production function $f(\cdot)$ implies that substitution is less than perfect between *household time* and *market services.* Moreover, the assumption of Inada conditions for the production function $f(\cdot)$ is sufficient to guarantee that the agent will always spend a strictly positive amount of time in household work. In other words, the agent will never, at any price, buy all of her childcare or housekeeping on the market.

purchases of goods, $x_m \geq R/p$, cannot be slack at the same time. The reverse case is not possible either. This rules out the other two cases.

2.2.2 The Effect of a Fall in p

The effect of low-skilled immigration on time use corresponds in the model to a fall in p. In this section we discuss the predictions of the model regarding the effect of a reduction in the market price of services on labor supply and household work. According to our model, the agent will always work at home, and thus the effects of low-skilled immigration on this activity will only be at the intensive margin. On the other hand, labor supply effects can happen both at the intensive and extensive margin: agents who were already working will adjust their hours of work in response to the changes in p, and some agents may move in or out of the labor market.

Intensive Margin: Effect on Hours of Work at Home and in the Market

Let us consider first the case when $j > 0$, i.e. the agent is active in the labor market and the labor supply is positive. In this situation we have that the agent chooses h such that:

$$f'(h) = \frac{w}{p}. \tag{2.6}$$

Totally differentiating equation (2.6) we obtain

$$\frac{dh}{dp} = -\frac{w}{p^2}\frac{1}{f''(h)} > 0, \tag{2.7}$$

implying that a fall in p will lead to a reduction in hours of household work for people who are already working. Note also that the effect is increasing in the wage, for a given h.[13]

Using the budget constraint (equation 2.3) we find that

$$sign\left(\frac{dj}{dp}\right) = sign\left(\frac{d(px_m)}{dp}\right), \tag{2.8}$$

thus hours of market work increase with a lower p if the elasticity of demand for market services

[13] This derivation assumes that the wage does not move together with p, if this were the case we obtain

$$\frac{dh}{dp} = \frac{1}{pf''(h)}\left[\frac{dw}{dp} - \frac{w}{p}\right] > 0,$$

and thus our rationale is correct unless wages respond strongly to p. We know that this is true only for low-skilled workers, in particular previous immigrants. (See the series of papers by David Card and George Borjas, and the work of Cortes)

is larger than 1. In this adaptation of Grounau (1977) model, if leisure is an inferior good then $dj/dp < 0$.[14] Unless leisure increases sharply with income, a fall in p will never induce an agent to abandon the labor force.

Extensive Margin: The Decision to Work

As mentioned above, a decrease in p might change the labor force participation of the agent. Consider first the simplified scenario in which $R = 0$. In this case, an agent that was previously working cannot be made better off by stop working in the market, and therefore we should either see no change in the labor force participation status of the person or a transition from working only at home to working in the market. Hence, in this case we have a very clear prediction, for single agents (remember we are not modelling household decisions), labor force participation is non-decreasing, i.e., the price has a positive effect on the decision to work. We call this *opportunity/substitution* effect.

Consider now the case of an agent who is not initially working. Note that, ceteris paribus, the higher the market wage of the agent the lower the level of p that will make her join the market. We can see this in Figure 2-1, with $R = 0$ point B does not change when p falls, while a higher wage implies that for the same p the initial position of point E is further to the right, and thus the agent is more likely to supply labor in the market as p falls. If $R > 0$, it is possible that a very strong (positive) income effect might lead to an agent that was previously working in the market to stop.[15]

Summary of Predictions

We do not attempt to provide a very detailed set of predictions, but there is a set of clear results and we will use them later in our empirical analysis. Particularly, we use them to find support

[14] Leisure being an inferior good is a sufficient but not a necessary condition. Suppose that in fact leisure does not change as p falls (i.e. income effect perfectly offsets the substitution effect), then as long as $dh/dp > 0$, as is the case with a strictly concave household production function, we will have that $dj/dp < 0$.

[15] The distinction between the extensive and intensive margin responses of labor supply are of particular relevance in our exercise, but their importance goes beyond it. For example, Saez (2002) introduces both margins in a labor supply model to analyze the optimal income transfers for low income households. In his model, the intensive and extensive margin elasticities play a key role in determining the shape of the optimal transfer schemes.

for our idea that migration affects time use through reduction in the price of non-tradable services and not through a decrease in the market wages.

- A decrease in the market price of services should reduce the time spent in household production and this effect should be more pronounced for people with higher wages. In our empirical analysis we will use education level as a proxy for wages.
- Effects on labor supply take place both at the intensive and extensive margin. Assuming that the elasticity of demand for market services is greater than 1, a decrease in p should increase the number of hours worked in the market.
  - The effect on the extensive margin will depend on how strong the income effect of a reduction in p is. In the case of no non-labor income ($R = 0$), a decrease in p should either keep constant the labor force participation status of the person or generate the transition from working only at home to working in the market. This is a prediction we do take to the data and find support for a positive effect: The *opportunity/substitution* effect (from the increase in w/p) dominates the *income* effect (from the increase in R/p);
  - Women with higher market wages should be the first to change their labor force status from non-participant to participants.

2.2.3 The Case with Fixed Hours of Work

Consider the same model we present above but assume the agent cannot work less than J hours if she decides to participate in the market. In this case we can rewrite problem (2.5) as

$$\max_{x_m,h,j} \pounds = u\left[x_m + f\left(h\right), 1 - j - h\right] + \lambda\left[R + wj - px_m\right] + \widetilde{\eta}\left[J - j\right] + \theta\left[-R/p + x_m\right], \quad (2.9)$$

where all the variables are as defined before, but we now restrict $j \geq J$. Without digging deeper into the model we can use the same simple graphical tools to show that the intuition remains the same in this case.

Consider a case like the one depicted in figure 2-2 where for simplicity we assume $R = 0$. If w/p is such that at E_1 $f'\left(h\right) = w/p$, then the agent's decision to work is just a choice between

points A (which implies that E_1 determines the hours of household work) and C (where the agent does not participate in the market). In the case depicted in the figure, the agent chooses C, as the indifference curve U is above point A.

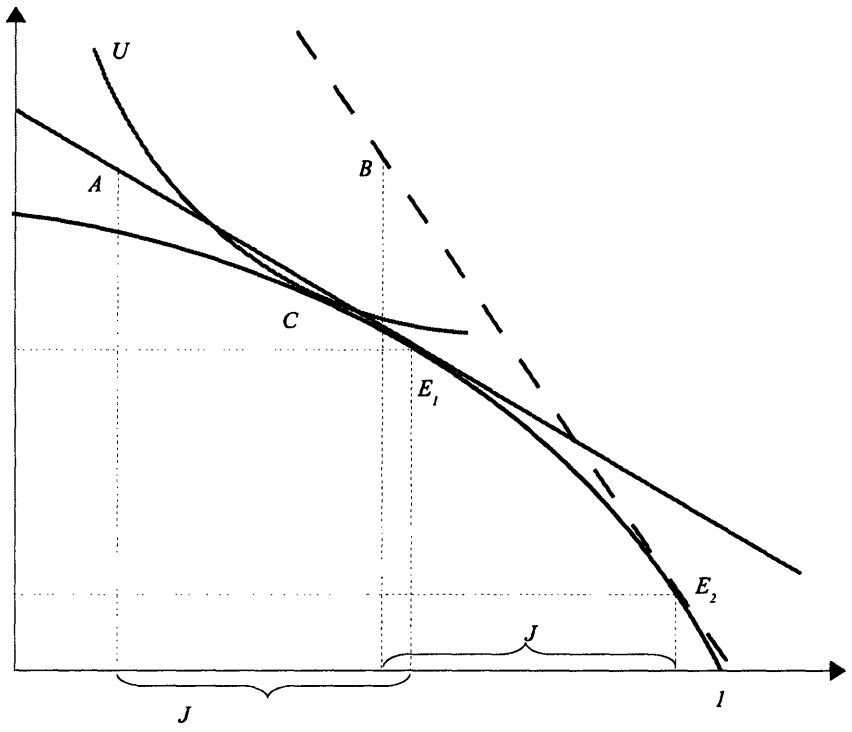


Figure 2-2: Labor Supply Decision with Fixed Hours of Work (J) and zero non-labor income ($R = 0$)

Assume now that w/p increases. Given our assumption that $R = 0$, there is no change in point C, i.e. the "outside" option remains the same. If the agent chooses to supply market work in this situation, her initial choice (just J hours of market work) is given by point B, with a higher utility than the consumption bundle in point C, thus the agent will work in the market. Under the assumption of no non-labor income, for a given $J, f(\cdot)$ and preferences, there is a value of (w/p) that makes the agent indifferent between working at least J hours or

not working at all; we can also show that option to work becomes more attractive as (w/p) increases, and thus decreases in p will make the agent switch from no market work to at least J hours. This adjustment likely comes with a (disproportionate) sudden reduction in leisure time that wouldn't be observed otherwise.[16] Like the previous case with no fixed hours, if $R = 0$, a fall in p will make some agents transition into the labor force, thus, our previous prediction remains valid (see section 2.2.2).

For the more general case when $R > 0$, point C will now move if p changes because of the effect on the real value of R. As before, this income/endowment effect will affect the allocation of leisure and household work in the "autarky" situation depending on the exact preferences. It is clear though that the main idea and intuition remain valid in the case when hours of work can only be chosen in discrete amounts.

2.3 Data and Descriptive Statistics

Immigration Data As the first essay of this dissertation, the present paper uses the 1980, 1990, and 2000 Public Use Microdata Samples (PUMS) of the Decennial Census to measure the concentration of low-skilled immigrants among cities and industries. Low-skilled workers are defined as those who have not completed high school. An immigrant is defined as someone who reports being a naturalized citizen or not being a citizen. We restrict the sample to people age 16-64 who report being in the labor force.

Time-use Data Two time-use surveys are used for the empirical analysis: the 2003 and 2004 ATUS (American Time Use Survey) and the Fall 92-Summer 94 National Human Activity Pattern Survey (NHAPS).

Until recently, only scattered time-use surveys were available for the US. Since 2003, the BLS has been running the ATUS, a monthly survey, whose sample is drawn from CPS – two months after households complete their eight CPS interview. An eligible person from each household is randomly selected to participate, and there are no substitutions. The week on the month and the day of the week in which the survey is conducted is randomly assigned;

[16] Introducing a fixed cost of work creates a relatively similar effect.

weekends are oversample, they represent 50 percent of the sample. The overall response rate is 58 percent and the aggregated sample for 2003 and 2004 consists of approximately 38 000 observations.

The NHAP was conducted by the Survey Research Center at UMD and sponsored by the US Environmental Protection Agency. The day of the week and person in the household are randomly chosen. The sample is limited to household with a telephone. Total sample size is 9400. Unfortunately, the NHAP has very little demographic information on the individuals, so we would not be able to control for marital status or size of the household.

For both surveys, our sample consists of women ages 21-64 that have completed the time-use survey. We exclude low-skilled women of Hispanic origin[17] and end up with 5850 observations, most of them (78 percent) from the ATUS.

The surveys have different activity classifications, which we match to the best of our ability. We divide activities in 6 main categories: market work (includes breaks and travel to/from work), household work (food preparation, food cleanup, cleaning house, clothes care, car repair, plant care, animal care, shopping for food, shopping for clothes/HH items), child care (baby/child care, helping/teaching, talking/reading, indoor/outdoor playing, medical care, travel childcare), personal care (sleeping, eating, washing, personal hygiene, dressing, etc.), leisure (social activities, sports/hobbies, TV, radio, reading, thinking/relaxing, conversations) and rest (all activities not included in the previous categories such as education, religion and volunteering). Given the difficulty in defining leisure, we also work with a second leisure variable defined as the residual after market work, household work, and child care.

Tables 2.1 and 2.2 present the descriptive statistics of our time use data. Despite the differences in the surveys, the time-use of the average women in both years looks remarkably similar (Table 2.1). The average women spends 40 percent of her weekday time in personal care (includes sleeping), 20 percent working in the market, 10 percent doing household chores, 5 percent taking care of the children and 16 percent consuming all types of leisure.[18] During the weekend, household work increases, market work decreases and, personal care and leisure

[17] We include native high school dropouts because Cortes (2006) suggests that low-skilled immigrants and natives are not close substitutes. Although our results change little if native drop-outs are excluded, they are less precise because of the fewer observations.

[18] The female labor force participation in our sample is very similar to the one reported by the BLS (60 vs. 57.5 in 1990 and 61 vs. 59.9 in 2000).

increase.

Time use presents important variations when we look at specific groups of the population. As shown in Table 2.2, women whose youngest child is below five spend significantly more time taking care of the children and doing more household chores, and less time working. Women without children below the age of 17, on the other hand, supply more market work and less household work than the average.

As expected, the time use of men is very different. Men spend a significantly larger share of their weekday's time working in the market, and less time doing household chores (See Table 2.2). They compensate, however, with relatively more household work and child care on weekends.

Consumption Data As mentioned in Section 2.1, we use the CEX to construct our measure of consumption of market supplied household services: a dummy variable for positive reported expenditures in household and gardening services.[19] As observed in Table 2.3, close to 8 percent in 1990 and 9 percent in 2000 of households in the urban US reported positive expenditures in housekeeping services and 16 percent in 1990 and 20 percent in 2000 consumed market supplied gardening services. The percentage of households consuming these services is increasing in the education level of the household head. Note however, that the consumption of high school dropouts is, though small, not negligible, and very similar to that of high school graduates.

2.4 Empirical Strategy and Estimations

2.4.1 Identification Strategy and Econometric Specification

Our empirical strategy is very similar to the one used in the first essay: we exploit the intercity variation in the (change of) concentration of low-skilled immigrants to identify their effect on the time use of American women. [20]

Ideally, and as suggested by our theoretical framework, we would have liked to use the first essay's price data (in particular, the price index of household services in a city) as the

[19] We only look at housekeeping and gardening services because the variable for child-care at home was redefined between 1990 and 2000.

[20] For the concerns with the validity of the strategy, we refer the reader to the first essay.

explanatory variable in our analysis of time use and consumption. Unfortunately however, the price data used in the first essay is available only for 25 cities in the US, and its variation is not large enough to identify the effect we are interested in. To address this problem, we make use of the first essay's price equations' main explanatory variable, which is available for many more cities and combine our estimates with the first essay's to calculate an implied demand elasticity for housekeeping services. The main explanatory variable is the log of the relative endowment of low-skilled vs. high-skilled labor in a city, or more specifically:[21]

$$Ln\left(\frac{(\beta\overline{L}^{\rho}+(1-\beta)\overline{I}^{\rho})^{\frac{1}{\rho}}}{\overline{H}}\right)$$

where $\overline{L}$ represents the supply of native low-skilled labor, $\overline{I}$ the supply of immigrant low-skilled labor, and $\overline{H}$ native high-skilled labor; ρ is a function of the elasticity of substitution between $\overline{L}$ and $\overline{I}$ ($\rho=\frac{\sigma-1}{\sigma}$), and β measures the relative efficiency of natives vs. immigrants. We use the first essay's estimates of ρ and β.

Our main econometric specifications are the following:

$$\text{Consumption:}\qquad Dummy(Exp>0)_{nit}=\delta*Ln\left(\frac{(\widehat{\beta}\widehat{\overline{L}^{\rho}}+(1-\widehat{\beta})\widehat{\overline{I}^{\rho}})^{\frac{1}{\widehat{\rho}}}}{\overline{H}}_{it}\right)+X_n'\Lambda+\phi_i+\psi_t+\varepsilon_{ijt} \tag{2.10}$$

where n represents a household, i city, and t year. $Dummy(Exp>0)$ is a dummy variable for positive reported expenditures in housekeeping or gardening, and X_n are household level characteristics, namely age, sex, and education of the head of the household, and household size and demographic composition. ϕ_i and ψ_t represent city and decade fixed effects, respectively.

We expect $\delta>0$: an immigrant induced increase in the relative endowment of low-skilled vs. high-skilled workers reduces the prices of housekeeping services and thus increases the likelihood that a household purchases them.

[21] See the first essay for a derivation of the variable from a model that aims at explaining how low-skilled immigration affects the prices of low-skilled intensive services.

$$\text{Time Use:} \qquad time\ spent\ act\ Y_{nit} = \theta * Ln\left(\frac{(\widehat{\beta}\overline{L^{\rho}} + (1-\widehat{\beta})\overline{I^{\rho}})^{\frac{1}{\rho}}}{\overline{H}}_{it}\right) + W_n'\Omega + \phi_i + \psi_t + \varepsilon_{ijt} \tag{2.11}$$

where *time spent act* Y_{nit} are daily minutes spent in activity Y by woman n in city i and year t. W_n are individual level characteristics: age group, education, race, demographic composition of her children, and the day of the week to which the time diary refers to. For some activities, we replace the time spent with a dummy variable for positive number of minutes.

The sign of θ depends on the activity analyzed, and because the number of minutes in a day is fixed at 1440, we should have that $\sum_Y \widehat{\theta} = 0$.

To test for the theoretical prediction that high-skilled women should have higher sensitivity (than low-skilled women) to prices of services that are close substitutes for household production, we allow for δ and θ to vary by the education level of the woman.[22] Because the time distribution of women depends heavily on the age of her children, we also allow for different effects of immigration on women whose youngest child is less than 5, more than 5 but less than 17, and on the rest.[23]

Given that what we are ultimately interested in is the magnitude of the effect of immigration flows on consumption and time use, we use the chain rule for its estimation:[24]

$$\frac{d\,(time\ spent\ act\ Y)}{d\,(\ln \overline{I})} = \frac{d\,(time\ spent\ act\ Y)}{d\left[\ln\left(\frac{(\widehat{\beta}\overline{L^{\rho}}+(1-\widehat{\beta})\overline{I^{\rho}})^{\frac{1}{\rho}}}{\overline{H}}\right)\right]} * \frac{d\left[\ln\left(\frac{(\widehat{\beta}\overline{L^{\rho}}+(1-\widehat{\beta})\overline{I^{\rho}})^{\frac{1}{\rho}}}{\overline{H}}\right)\right]}{d(\ln \overline{I})} = \theta * \left(\frac{(1-\beta)\overline{I^{\rho}}}{\beta\overline{L^{\rho}} + (1-\beta)\overline{I^{\rho}}}\right) \tag{2.12}$$

The last equality is based on the assumption that $\frac{d(Ln\overline{L})}{d(Ln\overline{I})} = 0$, i.e. there are no displacement effects. Note that $\left(\frac{(1-\beta)\overline{I^{\rho}}}{\beta\overline{L^{\rho}}+(1-\beta)\overline{I^{\rho}}}\right)$ varies significantly by city. We use the value of $\left(\frac{(1-\beta)\overline{I^{\rho}}}{\beta\overline{L^{\rho}}+(1-\beta)\overline{I^{\rho}}}\right)$

[22] Because of limitations of the data, for the consumption regressions we use the education level of the head of the household instead of the woman's. We interact our explanatory variable of interest with dummies for the different education levels. We restrict all other controls to have a common effect.

[23] We would have liked to have more detailed categories about the age distribution of the children, but the limited number demographic variables in 1993 survey prevents us to do so.

[24] A similar equation is used for the consumption variables.

for each city from the 1990 Census to calculate the city-specific immigration effect on consumption and time use of the low-skilled immigration flow of the 1990s. We usually report the average across cities of these effects.

We estimate equations 2.10 and 2.11 using 2SLS, instrumenting the relative endowment of low-skilled vs. high-skilled workers with the variable described below. We cluster all of the standard errors at the city level.

2.4.2 Instrumental Variables Estimates

We use the instrument introduced in the first essay:

$$Ln\left(\frac{Mexicans_{i,1970}}{Mexicans_{1970}} * LSMexicans_t + \frac{Cubans_{i,1970}}{Cubans_{1970}} * LSCubans_t + \frac{Italians_{i,1970}}{Italians_{1970}} * LSItalians_t\right),$$

where $\frac{Mexicans_{i,1970}}{Mexicans_{1970}}$ represents the percentage of all Mexicans included in the 1970 Census who were living in city i, and $LSMexicans_t$ stands for the *total* flow of low-skilled Mexican immigrants to the US between 1971 and decade t. For a discussion of the instrument, we refer the reader to the first essay.

As Table 2.4 shows, the instrument is a good predictor of the relative endowment of low-skilled vs. high-skilled workers in a city. The magnitudes of the coefficient suggest that, at current US immigration levels, an increase of 10 percent in the predicted number of low-skilled Mexicans, Cubans, and Italians increases the ratio of low-skilled workers to high-skilled workers by 3.2 percent.

Identification Assumption All of the econometric specifications in the paper include city and decade fixed effects; therefore, the instrument will help in identifying the causal effect of immigration concentration on time use as long as the unobserved factors that determined that more immigrants decided to locate in city i vs. city $i\prime$ in 1970, are not correlated with *changes* in the *relative* economic opportunities offered by the two cities (or other factors that might have had affected the time use of women) during the 1990s. The identification assumption will be violated, if, for example, what determined that more immigrants settled in city i vs. city $i\prime$ was a shock to the demand for immigrant-intensive services in city i (or any other type of shock)

that although temporary, took a very long time (20 years) to vanish.[25] An additional concern is the violation of the exclusion restriction, .i.e., that low-skilled immigrant concentration might affect the time use of American women through other channels besides changing the prices of household related services, in particular, through lowering the wages of competing natives. We use two arguments to make the case that the effects we find are mainly driven by changes in services' prices. First, the first essay and many previous studies have found no significant effect of immigrants on the wages of groups of natives with similar education level, including low-skilled native women. Second, we find that low-skilled immigration disproportionately affects the time use of highly educated women, a result consistent with our theoretical predictions and more difficult to justify if the effect comes mainly from wage effects.[26] Note, however, that even if the exclusion restriction is violated, our estimates still capture the causal effect of low-skilled immigration on the time use of American women.

Consumption

Table 2.5 presents the OLS and IV estimates of equation (2.10). As observed, the OLS coefficients are systematically smaller than their IV counterparts and negative in many cases. This fact is consistent with the OLS upward bias in the effect of low-skilled immigration on prices found in the first essay. If immigrants choose to locate in thriving cities where prices are higher and inflation is present, a positive spurious correlation between immigration concentration and prices may be observed in the data, and through this channel, a negative correlation between immigration concentration and market-supplied housekeeping and gardening consumption.

The IV coefficient of the first row ($\hat{\delta} = 0.09$) suggests that an increase of 10 percent in the relative supply of low-skilled vs. high skilled workers of a city rises by close to 1 percentage point the probability that a household reports positive expenditures in housekeeping services. The effect on gardening services, though positive, is far from statistically significant. The second

[25] If the demand shock was permanent, such that it changed the preferences of city i forever, the identification assumption will not be violated, but the coefficient of the second stage should be interpreted as a city-average treatment effect (average in terms of tastes).

[26] Note also that we find in Table 2.10 that even native high school dropouts *increase* their market labor as a result of higher low-skilled immigration. One can argue however, that the fact that the effect is smaller for the unskilled than for the skilled shows that there might be an offsetting negative effect through lower wages, but the income effect still dominates.

panel of the table shows the interactions of the explanatory variable with the education levels of the head of the household. The increasing pattern in the coefficients is very strong, both for housekeeping and gardening services. Note, however, that none of the coefficient for gardening services is statistically significant. The coefficient on housekeeping is statistically significant only for household heads with some college or more, and the magnitude for household heads that have a graduate degree ($\hat{\delta} = 0.19$) is almost double that for people with some college.

Using equation (2.12), we estimate that the immigration flow of the 1990s increased by a city-average of 1.8 percentage points the probability that an average household reported a purchase of housekeeping services, which corresponds to a 20 percent increase on the 1990's probability.

Time Use

We study the effect of immigration on the time distribution of American women on various dimensions. First, we use as dependent variable the number of minutes a day spent in each activity. Next, we concentrate on the extensive margin, in particular, in the immigration effect on the probability that a woman reports positive minutes of market work. A logarithm specification for household chores and child-care is used to recover demand elasticities. We allow these estimated effects to vary by the education level of the women and by the demographic composition of her children.

Table 2.6 presents the effects on the number of minutes spent in each of the 6 categories of activities. The estimates suggest that as a result of low-skilled immigrants reducing the prices of household services, American women are working more in the market, less at home, and because the reduction in household work does not compensate for the increase in market work, are having less leisure. The magnitudes suggest that an increase of 10 percent in the relative supply of low-skilled vs. high skilled labor in a city increases by approximately 30 minutes the average time a woman works in the market, of which, 17 minutes are taken away from household work, and 13 from leisure activities. The reduction in leisure, counterintuitive if framed in a standard model where leisure is a normal good, can be explained by rigidities in the number of hours a women can supply (for example if she only has the option of working either half or full time). As expected, most of these effects are observed during weekdays.

No significant impact is found for child-care. This is not surprising, because we are pooling together women with and without small children. However, if we restrict the sample to women with a child younger than 5 (see last row of Table 2.6), we find a significant negative effect on time spent in child care during weekdays. We also find positive (but not statistically significant) effect during weekends, as if parents want to compensate for less time spent with their children on weekdays.

Given that for some of our dependent variables there are many observations with zeros, in particular, for minutes spent working in the market, we estimate a linear probability model to test how low-skilled immigration affects the labor force participation of American women. Panel B of Table 2.6 presents the results of this exercise. We find that the effect of immigration on the extensive margin is very strong: a 10 percent in the relative supply of low-skilled vs. high-skilled labor in a city increases by 3.6 percentage points the probability that a woman reports working on a randomly selected day (this probability was 45 percent in 1990).

The second row of Panel B of Table 2.7 uses as dependent variable the logarithm of the minutes spent on household chores. This specifications allows us, when combined with the results from the first essay, to estimate the price elasticity of demand for household services. Note that we cannot use the logarithmic specification for labor supply and some other activities, because these variables take the value of zero for many observations.[27] Our estimate (0.9), when combined with Cortes's estimate of $\frac{\partial LnP_{hhldSS}}{\partial Ln\left(\frac{(\widehat{\beta}\overline{L^{\widehat{\rho}}}+(1-\widehat{\beta})\overline{T^{\widehat{\rho}}})^{\frac{1}{\widehat{\rho}}}}{\overline{H}}\right)} \approx -0.3$, suggests a price-elasticity of demand for household services of about -3.[28]

Allowing for the coefficient on the relative supply of low-skilled vs. high-skilled labor to vary with the education level of the woman produces very interesting results: educated women's time use is more sensitive to price changes than the time use of high school dropouts and high school graduates (See Table 2.7). For women with a graduate degree, for example, an increase of 10 percent in the relative supply of low-skilled vs. high-skilled labor increases by 35 minutes the time they spend working out of the household on weekdays and by approximately 10 the time

[27] The percentage of zeros for household work is lower than 15 percent. We drop these observations and hope that the bias introduced by selections is not significant enough to drive our results.

[28] Note that we are assuming that whatever time women have taken away from household chores is being replaced by a maid/babysitter/gardener, etc.

working on weekends. A similar increasing pattern is observed on the extensive margin (see Panel B, Table 2.7).

In Table 2.8, we calculate what our results imply for the effects of the low-skilled immigration wave of the 1990s on the time use of the different groups of American women. Women of all education levels reduced their time spent in household work (during weekdays) by an average of 25 minutes, with the most skilled women (those with a graduate degree) reducing it by half an hour. The average women increased her work in the market by 48 minutes, with women with a graduate degree increasing it by ten more minutes than high school graduates (during weekdays). Low-skilled immigrants increased the probability that a women reported positive minutes working in the market by 5 percentage points for the average women, with effects ranging from 3 percentage points for high school dropouts to 7 percentage points for women with a graduate degree.[29] Women with children younger than 5 decreased their childcare time during weekdays by approximately 40 minutes a day, but all (except for the high school dropouts) compensated the reduction by increasing childcare time during weekends, especially the most highly educated.

We also estimate the effects on the time use of men and present the main coefficients in Table 2.9. Although not a perfect falsification exercise, because a decrease in the price of household services should also affect the time use of men (besides other reasons, because decisions about time use are likely to be taken jointly and time use of both husband and wife should be interdependent) we do expect the effects to be much weaker. In fact, estimates go in the same direction as those for women, but are almost always smaller in magnitude and not statistically significant.

2.5 Conclusion

Our results contribute to the growing literature of the impact that low-skilled immigration have on native welfare, by providing evidence of an unexplored channel through which low-skilled immigrants improve the welfare of natives. We show that low-skilled immigration has changed the time use of American women by reducing the prices of market-provided household

[29] The estimated effect is very large. The actual change in labor force participation of women between 1990 and 2000 was 3.5 percent.

services. In particular, we find that low-skilled immigration has reduced the household work and increased the market work of women, especially of the most educated. Ours results suggest that the low-skilled immigration wave of the 1990s reduced the time American women work in the household by 17 minutes a day and increased the average time they work by half an hour. Most of the increase in the city-average market work takes place at the extensive margin.

Additionally, we find that women with a child younger than 5 have decreased their time providing childcare to their children during weekdays, and that they tend to compensate with more time in the weekends. The substitution between household and market provided services might come at a high cost however, if as found by Baker et al. (2005) it has negative effects on the welfare of the child.

A potential implication of our results suggested by Kremer and Watts (2006) is that low-skilled immigration might reduce wage inequality by giving incentives to the most educated women to work more in the market, therefore reducing their wages. Testing this hypothesis is an area of future research.

Table 2.1 Descriptive Statistics of the Time Use Surveys

	All Women		All Women		Women %>0		All Men	
Activity (Min. per day)	1990	2000	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Market Work	235.2	230.0	297.6	69.7	60	21	435.7	113.6
	(282.7)	(270.4)	(279.0)	(172.7)			(282.1)	(227.6)
Household Work	145.8	146.1	133.0	177.7	88	89	53.5	100.2
	(146.1)	(143.3)	(138.0)	(152.9)			(87.1)	(121.3)
Child Care	38.1	57.1	56.3	45.0	39	33	22.6	24.1
	(82.0)	(107.1)	(104.9)	(96.1)			(62.9)	(67.7)
Basic Care	617.0	621.2	598.1	674.2	100	100	574.7	646.6
	(133.1)	(134.1)	(125.4)	(139.5)			(138.8)	(147.8)
Leisure	280.5	248.7	231.4	314.3	94	96	243.2	399.7
	(197.5)	(179.2)	(175.5)	(190.1)			(195.9)	(226.6)
Other	123.5	137.0	123.7	159.1	83	88	110.3	155.8
	(152.4)	(156.5)	(153.6)	(158.0)			(164.9)	(176.7)
Number of Obs.	1264	4586	3084	2766	3084	2766	2543	2133

Source: ATUS and National Human Activity Pattern Survey

Table 2.2 Descriptive Statistics of the Time Use of American Women by Groups (Mean (Std Dev))

	Children Demographics			Education Level				
	Youngest<5	Youngest>5	No Child <18	HS Drop	HS grad	Some Col	College	Plus College
Market Work	156.7	231.1	255.2	134.1	210.9	223.3	254.9	293.2
	(243.9)	(261.2)	(281.9)	(230.8)	(266.5)	(265.9)	(281.5)	(288.3)
Household Work	167.5	172.3	129.3	172.6	161.0	142.1	140.4	117.2
	(138.8)	(159.1)	(137.1)	(156.4)	(153.9)	(144.1)	(135.1)	(120.8)
Child Care	152.4	60.8	17.8	50.5	52.2	50.4	54.8	58.7
	(131.8)	(84.7)	(71.2)	(98.7)	(101.0)	(96.7)	(104.1)	(118.0)
Basic Care	620.7	605.3	625.7	624.1	622.8	623.1	618.2	609.3
	(131.6)	(129.7)	(136.3)	(162.0)	(141.5)	(131.4)	(128.7)	(119.7)
Leisure	225.4	233.4	273.6	343.3	273.4	255.0	230.2	228.6
	(165.2)	(170.4)	(191.9)	(221.3)	(194.6)	(178.5)	(163.6)	(175.1)
Rest	117.3	137.1	138.3	115.4	119.8	146.1	141.3	133.0
	(131.1)	(159.9)	(161.0)	(151.3)	(146.4)	(162.5)	(160.1)	(151.2)
N. Observations	1183	1375	3292	251	1615	1423	1801	758

Notes: Means are calculated using survey weights,

Table 2.3 Descriptive Statistics Consumer Expenditure Survey (1990-2000)

Sample	% that reported positive expenditures in: Housekeeping		Gardening		No. Observations
	1990	2000	1990	2000	
All	0.080	0.087	0.162	0.200	11478
	(0.271)	(0.282)	(0.368)	(0.400)	
Hhld. Head:					
High School Drop	0.044	0.024	0.093	0.119	1657
	(0.205)	(0.153)	(0.290)	(0.324)	
High School Grad	0.029	0.038	0.113	0.141	3331
	(0.167)	(0.191)	(0.316)	(0.348)	
Some College	0.072	0.071	0.155	0.187	3128
	(0.258)	(0.258)	(0.362)	(0.390)	
College Grad	0.135	0.142	0.216	0.262	2076
	(0.342)	(0.350)	(0.412)	(0.440)	
More than College	0.203	0.216	0.326	0.352	1286
	(0.402)	(0.412)	(0.469)	(0.478)	

Notes: Means are calculated using survey weights.

Table 2.4 First Stage

	Dep.Variable
	Ln(AggLS/HS)
Instrument	0.326
	(0.06)
F-stat	29.5
N.cities	63

* Instrument =Ln [$(Mex_{i,1970}/Mex_{1970})$*$LSMex_t$+$(Cub_{i,1970}/Cub_{1970})$*$LSCub_t$+$(Ital_{i,1970}/Ital_{1970})$*$LSItal_t$]

Standard Errors are clustered at the city level

Ln(AggLS/HS)=Ln($(\beta*LS^{\rho}+(1-\beta)*I^{\rho})^{1/\rho}$/HS)

Table 2.5 The Effect of Low-skilled Immigration in the Consumption of Hhld. Services

Explanatory Variable:	Dep. Var: Dummy for positive expenditures in: Housekeeping		Gardening	
	OLS	IV	OLS	IV
Ln (Agg LS/ HS Labor)	-0.022	0.093	-0.094	0.062
	(0.027)	(0.057)	(0.058)	(0.105)
Ln (Agg LS/ HS Labor) interacted with a dummy for:				
High School Drop	-0.044	0.086	-0.127	0.048
	(0.032)	(0.062)	(0.065)	(0.103)
High School Grad	-0.046	0.053	-0.107	0.023
	(0.030)	(0.057)	(0.064)	(0.099)
Some College	-0.017	0.101	-0.104	0.054
	(0.026)	(0.060)	(0.060)	(0.112)
College	0.016	0.134	-0.047	0.127
	(0.034)	(0.061)	(0.062)	(0.108)
More than College	0.039	0.191	-0.029	0.152
	(0.030)	(0.060)	(0.069)	(0.126)

Note: Regressions include city and year fixed effects, and demographic controls (see text)
Standard Errors are clustered at the city level
$Ln(AggLS/HS)=Ln((\beta*LS^{\rho}+(1-\beta)*I^{\rho})^{1/\rho}/HS)$

Table 2.6 The Effect of Low-skilled Immigration on the Time Use of American Women (Coefficient on Ln(AggLS/HS))

Dependent Variable	All Days Together		Weekdays	Weekends
(in minutes per day)	OLS	IV	IV	IV
Panel A. Effect on Minutes Spent in Each Activity (Sum zero)				
Market Work	93.2	216.1	321.2	106.3
	(80.6)	(132.2)	(175.2)	(104.8)
Household Work	-69.8	-130.7	-167.2	-82.7
	(43.4)	(59.3)	(72.3)	(71.5)
Child Care	-16.5	-0.7	-22.5	53.7
	(15.6)	(40.8)	(44.2)	(79.5)
Leisure (Residual)	-6.9	-84.7	-131.6	-77.3
	(61.8)	(111.0)	(138.7)	(124.7)
Basic Care	-10.5	-25.5	-21.1	-82.4
	(32.3)	(59.5)	(61.8)	(102.3)
Leisure	3.6	-59.2	-110.5	5.1
(Social/Home/Sports)	(43.6)	(80.3)	(107.6)	(99.1)
Other	-21.9	-51.0	-22.8	-177.3
	(27.5)	(44.4)	(29.7)	(98.3)
Panel B. Alternative Specifications				
Dummy (Mkt Work>0)	0.18	0.36	0.41	0.29
	(0.13)	(0.19)	(0.26)	(0.21)
Log(HHld work)	-0.63	-0.91	-1.13	-0.98
	(0.33)	(0.45)	(0.58)	(0.61)
Child Care (Youngest<5)	-101.5	-126.7	-281.0	304.7
	(45.3)	(100.5)	(136.5)	(351.7)
N.obs.	5850	5850	3084	2766

Note: Each entry comes from a separate regression.

Standard Errors are clustered at the city level

$\text{Ln(AggLS/HS)}=\text{Ln}((\beta * LS^{\rho}+(1-\beta) * I^{\rho})^{1/\rho}/HS)$

Table 2.7 The Effect of Low-skilled Immigration on the Time Use of American Women by Education Level (IV Coefficient on Ln(AggLS/HS))

Dependent Variable	HS Drops		HS Grads		Some College		College Grad		Grad. Degree	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
	Panel A. Effect on Minutes Spent in Each Activity (Sum zero)									
Market Work	296.6	54.0	284.9	52.6	348.0	91.1	299.9	154.5	356.9	103.5
	(194.8)	(30.5)	(176.7)	(62.1)	(174.8)	(62.0)	(178.1)	(82.1)	(186.7)	(72.2)
Household Work	-173.0	35.4	-139.0	0.7	-155.0	-0.2	-168.2	-44.9	-202.6	19.3
	(103.7)	(32.02)	(89.2)	(43.2)	(74.3)	(49.2)	(72.9)	(63.3)	(72.5)	(53.8)
Child Care	-30.2	-16.2	-27.1	46.1	-22.3	30.0	-18.7	20.1	-20.4	31.4
	(56.5)	(20.3)	(47.3)	(48.3)	(51.4)	(49.2)	(44.0)	(48.3)	(43.0)	(56.9)
Leisure (Residual)	-93.3	-73.2	-118.8	-99.4	-170.7	-120.9	-113.0	-129.7	-133.9	-154.2
	(160.1)	(43.0)	(136.0)	(67.6)	(142.5)	(84.1)	(138.0)	(74.1)	(145.3)	(87.0)
	Panel B. Alternative Specifications									
D(Market Work >0)	0.27	0.19	0.28	0.22	0.46	0.33	0.43	0.37	0.51	0.27
	(0.31)	(0.06)	(0.26)	(0.12)	(0.26)	(0.13)	(0.26)	(0.16)	(0.27)	(0.13)
Child Care (Minutes)	-226.7	-49.3	-313.0	182.6	-308.2	186.2	-268.8	104.9	-225.5	319.5
(Restr. Sample child <=5)	(142.7)	(34.2)	(138.8)	(202.0)	(131.6)	(218.7)	(142.6)	(218.4)	(170.0)	(262.4)

Note: $Ln(AggLS/HS)=Ln((\beta*LS^{\rho}+(1-\beta)*I^{\rho})^{1/\rho}/HS)$

Table 2.8 Effects of the LS Immigration Wave of the 1990s on the Time Use of Women (In Minutes - City average)

	All	HS Drops	HS Grads	Some College	College Grad	Grad. Degree
Market Work						
Minutes - Weekday	48.2	44.5	42.7	52.2	45.0	53.5
Minutes - Weekends	16.0	8.1	7.9	13.7	23.2	15.5
Prob. Of Minutes>0	0.05	0.03	0.04	0.06	0.06	0.07
Household Work						
Minutes - Weekday	-25.1	-26.0	-20.8	-23.3	-25.2	-30.4
Minutes - Weekends	-12.4	5.3	0.10	-0.03	-6.7	2.9
Child Care (agekid=<5)						
Minutes - Weekday	-42.2	-34.0	-47.0	-46.2	-40.3	-33.8
Minutes - Weekends	45.6	-7.4	27.4	27.9	15.7	47.9

Note: Calculations use estimates from Tables 2.6 and 2.7 and data from the 1990 Census.

Table 2.9 The Effect of LS Immigration on the Time Use of Men (Coefficient on Ln(AggLS/HS))

Dependent Variable (in minutes per day)	All Days IV	Weekday IV	Weekend IV
Market Work	56.6	86.0	6.5
	(87.3)	(114.8)	(193.4)
Household Work	-48.1	-96.1	90.2
	(38.0)	(38.4)	(67.7)
Child Care	-1.0	-13.1	34.8
	(29.3)	(35.2)	(38.7)
Leisure (Residual)	-7.5	23.1	-131.5
	(77.0)	(102.5)	(218.3)
Dummy for Market >0	0.07	0.16	-0.19
	(0.12)	(0.19)	(0.36)
Child Care	7.9	-59.9	192.5
(Restr. Sample <=5)	(96.8)	(116.8)	(145.1)

Note: Each entry comes from a separate regression.
Standard Errors are clustered at the city level
$Ln(AggLS/HS)=Ln((\beta*LS^{\rho}+(1-\beta)*I^{\rho})^{1/\rho}/HS)$

Chapter 3

Language Skills and the Effect of Low-skilled Immigration on the US Labor Market

3.1 Introduction

Most of leading papers in the literature on the effects of low-skilled immigration on wages have assumed perfect substuitability between immigrants and natives of similar education and experience levels.[1] Recently, however, studies such as Ottaviano and Peri (2006) and the first essay of this dissertation, have suggested that low-skilled immigrants and natives are far from perfect substitutes. What explains the less than perfect substitution? The first essay's finding of a big and negative effect of low-skilled immigration only on the wages of natives of Hispanic origin and low English proficiency, and the large share of low-skilled immigrants that do not speak English [2], suggest that immigrants' lack of English skills might be one of the main causes behind the low substituitability between natives and immigrants of similar education levels. The degree of substituitability between immigrants and natives has direct implications for the

[1] I thank David Autor and Josh Angrist for helpful comments.

[2] Census data for 2000 shows that more than 80 percent of the low-skilled immigrants that arrive each year to the US speak very little English and that even after 10 years in the country, still 60 percent report not speaking English or speaking it not well (See Table 3.1)

magnitude and direction of the effects that immigrant shocks should have on average native wages. For example, under perfect substitution, the standard result in cross-city studies of no significant effect of immigration on natives' wages presents a puzzle. On the other hand, if the average low-skilled native and a low-skilled immigrant are far from perfect substitutes, a large and positive immigration shock should have, if any, only a small negative effect on the wage of the average native.

The present paper formalizes and empirically explores how immigrants' lack of English skills determines immigration's impact on the US labor market. I start by developing a very simple model based on Autor et al. (2003) in which low-skilled native workers can perform both "manual" and "language" tasks, immigrants perform manual tasks only, and the two tasks are q-complements. Manual tasks might include, for example, bricklaying, fruit picking, dish washing and operating textile machines. Language tasks, on the other hand, require people to communicate with others, for example, as in taking an order in a restaurant, answering phone calls, and selling merchandise. I show that an immigration inflow will reduce the relative returns to manual skills and will make some natives shift from manual to language occupations. Manual occupations will expand compared to language occupations.

I follow the empirical strategy of the first two essays to test the predictions of the model. Specifically, I exploit intercity variation in low-skilled immigrant concentration and variation in language skills required by occupation, and instrument for immigrant concentration using the historical distribution of immigrants. In line with the predictions of the model, I find that: (1) within a city, occupations that require fewer language skills have a higher ratio of low-skilled immigrants to low-skilled natives, and (2) after an immigration shock, there is a disproportional reduction in the wages of natives that work in manual occupations. I am not able, however, to distinguish between changes in the returns to skills and selection (the theory predicts that after an immigration shock, the most skilled natives are the ones that move from physical to language intensive occupations).

Unlike cross-city studies that find a very small wage effect of low-skilled immigrants on the average low-skilled native, my results suggest that there is a significant and large wage effect (even using cross-city variation), but only on some groups of low-skilled natives: those who work in physically intensive occupations and could be considered perfect substitutes for low-skilled

immigrants. Low-skilled natives who work in low-skilled language intensive occupations, on the other hand, see almost no decrease in their wages as a result of an immigration shock. The main results of the present paper imply that low-skilled immigrants increase wage inequality, not between average low-skilled natives and high-skilled natives, but within native high-school dropouts. Immigrants are having a pervasive effect on the wages of the least skilled people among the natives with low education.

How low-skilled immigrants impact the labor market has important consequences for native welfare beyond those experienced by competing low-skilled natives. Changes in the occupational distribution affect relative prices of goods and services, for example. As shown in the first two essays, the fact that immigrants work disproportionably in services such as housekeeping, gardening, and babysitting, that are close substitutes to household production, have reduced the prices of these services, and consequently, have also changed the time use of American women. Also, because high-skilled natives consume disproportionably the services provided by immigrants, they are benefiting the most from the price changes.

There is now a large literature on the wage effects of immigration to the US and I will refer the reader to the surveys by Borjas and Katz (2005) and Card (2005). There are two papers, however, that are particularly related to the present one and should be discussed here. Like the present paper, Card (2001) uses city-occupation-specific labor market outcomes to study the wage effects of immigration to the US.[3] Card (2001) does so in order to have an extra level of variation in the supply shocks of immigration and assumes that local labor markets are stratified along occupation lines. My focus, on the other hand, is in understanding how particular characteristics of the incoming low-skilled immigrants affect the US labor market, in particular, the role of language skills. Card finds that immigrant inflows over the late 1980's reduced the relative wages of laborers and less-skilled service workers in high immigrant cities by close to 3 percent[4]. Friedberg (2001), on the other hand, finds a positive effect of Russian immigrants on the wages of Israelis that work in the same occupation. Her empirical strategy solves for the endogeneity of occupational choice by instrumenting the Russians' occupational

[3] Card uses the six main occupational categories. I use a much more refined categorization to exploit the variance in language skills requirements within low-skilled service workers, for example.

[4] Another difference between the present paper and Card (2001) is that my empirical strategy requires of a weaker identification assumption, given that I use panel data and not just a cross-section.

distribution in Israel with the occupation they had back home. As an explanation for her counterintuitive result she mentions the possibility of complementarity between immigrant and natives within a given occupation. She cites Sussman and Zakai (1998), who found that Russian physicians—even those with considerable prior experience and expertise— were confined to positions as generalists at the lower end of the pay scale in Israeli hospitals, enabling native Israeli physicians to be promoted to fill the higher-paying ranks in an expanding health-care system. The idea of immigrant workers filling positions at the lower end of the job ladder and pushing natives up the ranks into more supervisory, high-paying roles is similar in spirit to the present paper. Within low-skilled workers, immigrants take the jobs that require less English skills (and that are usually perceived as the worst jobs), and natives move to jobs in which their ability to speak English is valued.

This paper is also related to the literature on the returns to language skills. A short review of the literature is presented in Bleakly and Chin (2004), arguably the paper with the best empirical strategy to date. To identify the causal effects of English skills on earnings, Bleakly and Chin (2004) exploit the phenomenon that younger children learn languages more easily than older children to construct an instrumental variable for language proficiency. In line with the results of the present paper, they find a significant positive effect of English proficiency on wages among adults who immigrated to the US as children.

The rest of the paper is organized as follows. Section 3.2 presents the theoretical framework. Section 3.3 describes the data and descriptive statistics. The empirical strategy and main results are discussed in Section 3.4, and Section 3.5 concludes.

3.2 Theoretical Framework

3.2.1 Setup

The native economy has two types of labor: high-skilled (H) and low-skilled (L) (both have measure 1). Low-skilled workers perform two different types of tasks: manual tasks (M) and language tasks (E). Each low-skilled native is endowed with 1 unit of labor time that produces either $\overline{p}$ efficiency units of the manual task ($0<\overline{p}<1$), or e_i efficient units of language task input, where e_i has continuous support on (0,1).

The aggregate production function of the economy is given by:

$$Y = H^{\alpha} E^{\beta} M^{1-\alpha-\beta} \tag{3.1}$$

A low-skilled native endowed with $(e_i, \overline{f})$ decides to perform tasks that require language skills $\longleftrightarrow e_i > \frac{w_M}{w_E}\overline{p}$. There exists a native endowed with e^*, who is indifferent between supplying manual or language labor. All low-skilled natives with $e_i > e^*$ will perform language tasks and all natives with $e_i < e^*$ will supply manual labor.

Total supply of language skills is described by the continuous downward sloping function $g(e)$, which sums the population endowment of efficient units of language skills. Hence $g(e) = \int_e^1 xf(x)dx$, where $f(x)$ is the density function of e. Similarly, the total supply of native manual labor is given by the continuous upward sloping function $h(e) = \overline{p}\int_0^e f(x)dx$.

Assume that immigrants are all low-skilled and are endowed with $\overline{p}$ only ($e_i = 0$, if i is an immigrant); there are I immigrants (assume $I < 1$).

Therefore, the aggregate Production Function can be written as:

$$Y = H^{\alpha}(g(e^*))^{\beta}(h(e^*) + \overline{p} * I)^{1-\alpha-\beta}$$

Assume all markets are perfectly competitive.

3.2.2 Equilibrium

In equilibrium, all workers receive the value of their marginal product:

$$w_H = \alpha H^{\alpha-1}(g(e^*))^{\beta}(h(e^*) + \overline{p} * I)^{1-\alpha-\beta} \tag{3.2}$$

$$w_E = \beta H^{\alpha}(g(e^*))^{\beta-1}(h(e^*) + \overline{p} * I)^{1-\alpha-\beta} \tag{3.3}$$

$$w_M = (1-\alpha-\beta)H^{\alpha}(g(e^*))^{\beta}(h(e^*) + \overline{p} * I)^{-\alpha-\beta} \tag{3.4}$$

$$e^* = \frac{w_M}{w_E}\overline{p} \tag{3.5}$$

These equations provide equilibrium conditions for the model's four endogenous variables (w_M, w_E, w_H and e^*). Dividing (3.4) by (3.3) results in the following condition for the equilibrium relative wage of manual vs. English skills:

$$\frac{w_M}{w_E} = \frac{(1-\alpha-\beta)}{\beta} * \frac{g(e^*)}{h(e^*) + \overline{p} * I}, \tag{3.6}$$

Equations (3.5) and (3.6) provide a simple system for the key variables of interest, e^* and $\frac{w_M}{w_E}$.

An increase in Immigration $\uparrow I$

Combining (3.5) and (3.6) and applying the Implicit Function Theorem, the following effect of a low-skilled immigrant shock on the distribution of natives between language and manual skills is derived:

$$\frac{\partial e^*}{\partial I} = \frac{\overline{p} * g(e^*)}{g`(e^*) * (h(e^*) + \overline{p} * I) - h'(e^*) * g(e^*) - \frac{\beta}{(1-\alpha-\beta)*\overline{p}}(h(e^*) + \overline{p} * I)^2} < 0 \tag{3.7}$$

Based on the equation above and equations (3.5) and (3.6), I obtain the following four propositions that support the empirical analysis of the paper:[5]

(i) An increase in immigration induces more low-skilled natives to concentrate in "language" tasks. (equation (3.7))

(ii) The more intensive the production function is in manual vs. language tasks, the larger the magnitude of the effect, i.e. $\frac{\partial\left|\frac{\partial e^*}{\partial I}\right|}{\partial\frac{(1-\alpha-\beta)}{\beta}} > 0$ (equation (3.7)) In other words, the larger the β, the larger the increase in the share of immigrants in manual occupations as a result of an immigration shock (as more natives move to language occupations).

[5] To apply the implications of the model to individual cities, I need to assume that cities are closed economies. I will need at least one non-traded good (as in Cortes (2006)) for free trade between cities not to pin down prices of goods and wages.

(iii) The effect of an immigration shock on the relative wage of manual vs. English skills is negative (equations (3.7) and (3.5)).

(iv) The relative supply of total manual vs. English skills increases with an immigration shock (equations (3.7), (3.5) and (3.6)).

3.3 Data and Descriptive Statistics

Immigration Data As the previous two essays, this paper uses the 1980, 1990, and 2000 Public Use Microdata Samples (PUMS) of the Decennial Census to measure the concentration of low-skilled immigrants among cities and occupations.

Table 3.2 presents the descriptive statistics of the variables at the city, occupation, and individual level that will be used in the empirical analysis. There is substantial variation across cities in the concentration of low-skilled immigrants. For example, in Los Angeles almost one out of 5 workers is a high school dropout immigrant, whereas in Cincinnati there are fewer than 5 low-skilled immigrant workers per 1000 participants in the labor force. The ratio of low-skilled immigrants to natives at the city-occupation-decade level also varies significantly, from 0.002 immigrants per native truck drivers in Baltimore in 1990, to 100 immigrants per native in textile sewing machine operators in San Francisco in 2000. The average is close to the national ratio of high-school dropouts immigrants to natives: one. Naturally, there is wide variation in the percentage of total-city low-skilled workers that work in a given occupation. For example, cashiers always represent a high share of total low-skilled workers (average of 8 percent), whereas gardeners' share varies from less than 0.5 percent in Detroit or Providence, to close to 7 percent in West Palm Beach, Florida.

The last panel of Table 3.2 presents the wage data.[6] Natives received about half a dollar more per hour than immigrants in 1980 and 1990. The gap was closed by 2000. A potential explanation for the reduction in the gap is that the quality of high school dropout natives relative to immigrants has declined over the last decade. As observed in the table, the absolute number of native dropouts has decreased significantly over time (and the number of immigrants

[6] I have restricted the sample to those workers with an hourly wage between 50 cents and 250 dollars. Note that the hourly wage is not reported; I construct it by dividing annual wage income by number of hours worked. To avoid significant division bias, I limit the sample to workers that reported working at least 10 hours a week. All wages are expressed in 1990 dollars.

has increased), suggesting that in recent years, only natives with the lowest abilities were the ones that did not finish high school.

Occupational Data The empirical analysis requires measures of the level (importance) of language skills needed for a given occupation. I use information from the Occupational Information Network (O*NET). O*NET has replaced the Dictionary of Occupational Titles (DOT) as the primary source of occupational information for the US. The network is administered and sponsored by the US Department of Labor and provides more than 275 standardized descriptors of skills, knowledges, tasks, occupation requirements, and worker abilities, interests, and values for 974 occupations.

As measures of required language skills, I use the indexes for the importance and level of oral comprehension and oral expression in a given occupation. The *importance* indexes take values between 1 and 5, with 5 representing very important. The *level* indexes range from 0 to 7, where a 2 in oral comprehension corresponds to being able to understand a T.V. commercial and a 2 in oral expression to being able to cancel a newspaper delivery by phone.

Table 3.3 presents the indexes for selected low-skilled occupations. Language skills are important, for example, for sales agents, hosts and hostesses, and waiters and waitresses, and much less so for construction workers, textile production workers, and agricultural workers. Given that a priori there is no reason to prefer one index to another, and that there is a high correlation between the different indexes, I concentrate on the results that use the first principal component of the 4 indexes as the measure of required language skills in an occupation.

I matched the O*NET occupational classification to the 2000 Census using the Standard Occupational Classification (SOC), included in both data sets. To match the 1980, 1990 and 2000 Census Occupational classifications I use the standardized list of Census occupations created by the Office of Productivity and Technology of the BLS.[7] After doing the match, I am left with 343 occupations.

A limitation of the O*NET variables is that they cannot be treated as cardinal. To partially overcome this limitation, I transform the individual indexes and the principal component of the O*NET measures into percentile values.[8]

[7] http://www.bls.gov/ore/pdf/ec050090.pdf

[8] More accurately, the variable I use for the regressions is 1 - percentile. I make this transformation to have

Figure 3.1 presents suggestive evidence that the lack of language skills affects how immigrants integrate into the US labor market. There is a strong negative correlation between the language skills intensity of a low-wage occupation and the ratio of immigrants to natives that work in that occupation. The next section tests this, and other relationships more formally.

3.4 Empirical Strategy and Estimations

The empirical strategy of the present paper is similar to the one used in the first two essays. Specifically, I exploit the intercity variation in the (change of) concentration of low-skilled immigrants and the variation across low-wage occupations in their intensity in language skills to identify the effect of immigration in the occupational distribution and wages of low-skilled natives. Concerns with the validity of the strategy are discussed in the first essay.

3.4.1 Econometric Specifications

To test for the effect of low-skilled immigration on the occupational distribution of cities, I use the following two specifications, one for the determinants of the ratio of immigrants to natives in an occupation, and the other, for the relative size of a given low-wage occupation:

$$\frac{LSImm_{ijt}}{LSNat_{ijt}} = \alpha_i + \gamma_j + \delta_t + \tau \frac{LSImm_{jt}}{LabForce_{jt}} * LanguageSkills_i + \varphi \frac{LSImm_{jt}}{LabForce_{jt}} + \varepsilon_{ijt} \quad (3.8)$$

$$\frac{LSWorkers_{ijt}}{LSWorkers}_{jt} = \alpha_i + \gamma_j + \delta_t + \eta \frac{LSImm_{jt}}{LabForce_{jt}} * LanguageSkills_i + \lambda \frac{LSImm_{jt}}{LabForce_{jt}} + \varepsilon_{ijt} \quad (3.9)$$

where i is occupation, j is city and t is year. α_i, γ_j, and δ_t represent occupation, city, and decade fixed effects, respectively. I expect $\tau > 0$: occupations that don't require language skills should have a higher ratio of immigrants to natives, and this ratio should be even higher in cities

higher values represent lower English requirements.

Most of the results in the paper are robust to using any individual index (either in percentile or raw score form) as the measure of language skills.

that have more immigrants (I have transformed the language skills variable such that higher values represent lower English abilities required for the occupation). I also expect physically intensive occupations to expand in cities with a higher concentration of low-skilled immigrants ($\eta > 0$).

For the wage regressions, I use individual level data from the Census. I use the following specification:

$$\ln w_{nijt} = \gamma_j + \delta_t + \rho \frac{LSImm_{jt}}{LabForce_{jt}} * LangSkills_i + \lambda \frac{LSImm_{jt}}{LabForce_{jt}} + \upsilon LangSkills_i + \Gamma X_{nijt} + \varepsilon_{ijt} \tag{3.10}$$

where n is a native worker, i is occupation, j is city and t is year. X_{nijt} represents a matrix of the standard individual characteristics used in wage regressions (gender, race, age, and age squared). I expect $\rho < 0$, immigration has a negative wage effect in occupations that require low language skills. However, as mentioned in the introduction, I cannot distinguish between lower wages being caused by changes in the returns to skills or by the most able natives switching occupations.

3.4.2 Instrumental Variables Estimates

I use as instrument for $\frac{LSImmigrants_{jt}}{LaborForce_{jt}}$ a function of the following expression:[9]

$$\frac{Mexicans_{i,1970}}{Mexicans_{1970}} * LSMexicans_t + \frac{Cubans_{i,1970}}{Cubans_{1970}} * LSCubans_t + \frac{Italians_{i,1970}}{Italians_{1970}} * LSItalians_t, \tag{3.11}$$

where $\frac{Mexicans_{i,1970}}{Mexicans_{1970}}$ represents the percentage of all Mexicans included in the 1970 Census who were living in city i, and $LSMexicans_t$ stands for the *total* flow of low-skilled Mexican immigrants to the US between 1971 and decade t. Table 3.4 presents various specifications for the first stage. A quadratic function of (3.11) fits the data very well (Column 1). Also does a log-linear function (Column 2). The explanation for the non-linear relationship between the

[9] See the first essay for a detailed discussion about the construction of the instrument.

instrument and the dependent variable is suggested by the Table 1.1 of the first essay.[10] During the 1980's most immigrants went where previous generations of immigrants had gone (LA, Miami and New York), but after immigration concentration in these cities reached a very high level, immigrants decided to go to new places. A plausible explanation for this phenomenon is that there is a trade-off in locating in cities where many immigrants from the worker's country of origin already live. On one hand, networks are larger and it is easier to find a job, a house, etc.; on the other hand, however, there might be a congestion effect (competition from fellow immigrants drives wages down, see the first essay). When the congestion effect dominates the network effect, arriving immigrants choose new locations.

I use a quadratic form of (3.11) to instrument for $\frac{LSImmigrants_{jt}}{LaborForce_{jt}}$, and a quadratic form interacted with a measure of language skills to instrument for $\frac{LSImmigrants_{jt}}{LaborForce_{jt}} * LanguageSkills_i$.

Table 3.5 presents the OLS and IV estimates of (3.8) and (3.9) using several measures of language skills requirements. The estimates from Panel A strongly support one of the main predictions of the model: the effect of an immigration shock on the immigrant to native ratio of an occupation is higher for occupations that require low language skills[11]. To have an idea of what the magnitude of the coefficients implies, consider an example. Suppose that the share of low-skilled immigrants in the labor force of a city increases by 1 percentage point. The coefficient 41.41 (fifth row, second column) suggests that the difference in the ratio of immigrant to natives between the least language-intensive and most language-intensive low-wage occupations increases by 0.41 immigrants per native.

Panel B of Table 3.5 tests the second prediction of the model: after an immigration shock, occupations that don't require language skills should expand relative to occupations intensive in language skills. Support for this hypothesis is ambiguous, the coefficients of the interaction changes its sign and significance when different measures of language skills are used. When the indexes related to the importance of language skills are used, the results coincide with the predictions of the model and the coefficients are statistically significant. However, the coefficient has the wrong sign (though it is not statistically significant) when the indexes representing the language level requirements and the first principal component of the four indexes are used.

[10] Note that a simple linear function does not work well (Column 3, Table 3.4); although the coefficient has the expected sign, it is not statistically significant.

[11] Note that the coefficient is robust to the choice of the language skills variable.

Table 3.6 shows the estimation of the wage equations for three samples of the low-skilled population: natives, immigrants, and both groups together. I present only the results using the first principal component of the four O*NET indexes as the language skills variable. However, the results are robust to using any of the indexes used in Table 3.5.

Several things should be pointed out. First, there is an upward bias of the OLS coefficients of the effect of low-skilled immigration on wages. The bias is likely to come from immigrants moving to thriving cities, where wages are growing. Second, after instrumenting, the direct effect of immigration on the wages of low-skilled natives, although negative, is not statistically significant. However, it is large and statistically significant for low-skilled immigrants. The result on natives is in line with other cross-city studies in the literature, and the significant coefficient on immigrants is consistent with the results found in the first essay. Third, there is, for immigrants only, a negative and significant correlation between working in occupations with low language requirements and the worker's wage. I say correlation, because working in a low English skill occupation is likely to be correlated with unobservables. The magnitude of the direct effect of language skills requirements suggests that in a city with very few immigrants, immigrants working at the very top percentile of language skills will earn about 12 percent more than those in the bottom.

The most interesting coefficient from the point of view of the question of the present paper, that of the interaction, is negative and statistically significant for natives, although not for immigrants. In other words, the effect of an immigration shock on a native that works in an occupation intensive in manual skills is much larger (at least twice as large) than the effect on a native that works in an occupation where language skills are important (the effect on the later is not statistically different from zero). On the other hand, immigrants are all affected similarly by an immigration shock, irrespective of their occupation.

The magnitude of the coefficients could be interpreted as follows: if a city goes from having 3 to having 4 percent of its labor force being low-skilled immigrants (roughly the change experienced by the US as a whole in the 1990s), the wages of natives that work in occupations where no language skills are required, or are not important, will decrease by around 1.5 percent, whereas the wages of natives that work in language intensive occupations will be reduced by at most 0.7 percent. The wages of all immigrants will decline by 1 percent. In a city where

many immigrants choose to locate, like Los Angeles during the 1980s, the effects are much more pronounced. For example, the wage of a native gardener in LA in 1990 was close to 7 percent lower to what otherwise would have been if not for the 1980's immigration of low-skilled foreigners to the city.[12]

The sample of the regressions shown in the third panel of Table 3.6 consists of *all* low-skilled workers. As observed, the coefficient of the interaction in similar to that for natives only, but the direct effect is surprisingly much larger than for each group separately. Given that it is expected that city and decade fixed effects, and demographic variables, have a different impact on the wages of immigrants vs. natives, my preferred estimates come from panels 1 and 2.

As the table shows, the coefficients on the direct effects and the interaction terms are robust to the introduction of occupation fixed effects. Although including them in the regressions allows controlling for occupation specific characteristics that affect wages, occupation might be an endogenous variable.

The average effect of immigration on the wages of low-skilled natives depends on their distribution across occupations of different language skills requirements; if most of low-skilled natives work in occupations with very low-English requirements, the average wage effect might be large. Using the occupation distribution of 1990 and the immigration shock to each city during the 1990s, I find that the average decrease in the wage of a low-skilled native as a result of the immigration wage of the 1990s was close to 0.71 percent[13] The maximum decrease in wages was 6.3 percent in Salinas, California, the maximum increase was 4.7 percent in Miami.

3.5 Conclusion

This paper shows that immigrants' lack of English skills has important consequences for the effects of low-skilled immigration on the US labor market. Understanding the role of language skills is important, especially from the point of view of public policy, because it is expected that most of future low-skilled immigrants will continue to come from non-English speaking

[12] Note that the native gardener in 1990 could have very different unobserved characteristics and abilities from the native gardener in 1980.

[13] This number is smaller than the close to 2 percent I estimated in Cortes (2006). The discrepancy is explained by the sample. In Cortes (2006), only the largest 25 cities (where most immigrants live) are included in the estimation, whereas the present paper estimations include data for 100 metropolitan areas.

countries.

This paper has found that low-skilled immigrants reduce the wages mostly of those low-skilled natives who work in occupations in which manual, rather than language skills, are important. The affected group of natives is probably at the very bottom of the skill distribution, and therefore, low-skilled immigrants increase inequality among high school dropouts.

This paper also helps resolve the puzzle presented by previous cross-city studies, that have failed to find a significant negative wage effects of low-skilled immigration on the wages of native high school dropouts. This paper suggests that one should not expect a big effect on all low-skilled natives, but should concentrate on those that resemble immigrants in a broader set of skills, not only on education attainment.

Table 3.1 English Skills of Low-Skilled Immigrants (2000 Census)

	Time of arrival to the US		
(%)	This year	5 years ago	10 years ago
Doesn't Speak English	62	30	21
Speaks English not well	22	38	38
Speaks English well	5	15	20
Speaks English very well	7	11	14
Speaks only English	4	6	7

Table 3.2 Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Nobs.
City Level					
LS Imm. / Labor Force - 1980	0.023	0.030	0.001	0.151	116
LS Imm. / Labor Force - 1990	0.026	0.034	0.001	0.160	118
LS Imm. / Labor Force - 2000	0.031	0.036	0.0003	0.181	115
Occupation-city Level					
LS Immigrants/LS Natives	0.796	1.744	0.002	100	25729
(weighted)	1.201	3.080	0.002	100	25729
Share of Tot. LS Workers	0.013	0.025	0.00004	1	25729
(weighted)	0.032	0.035	0.00004	1	25729
Individual Level - Average hourly wages					
1980					
Natives	6.02	6.10	0.5	250	468480
Immigrants	5.60	6.00	0.5	233	83998
1990					
Natives	8.74	9.37	0.5	250	245581
Immigrants	8.23	9.19	0.5	250	103901
2000					
Natives	10.84	12.80	0.5	250	204909
Immigrants	10.90	13.94	0.5	250	129218

Note: The city level statistics are unweighted. The individual level statistics use Census weights. Only workers that reported working at least 10 hours a week are included in the wage means. Data come from the Census.

Table 3.3 O*NET Indexes for Selected Unskilled Occupations

Occupation	Oral Comprehension		Oral Expression	
	Importance	Level	Importance	Level
Hosts and Hostesses, Restaurant and Coffee Shop	4.5	3.5	4.5	3.63
Advertising Sales Agents	4.38	4.25	4.5	4.38
Office Clerks General	4.13	3.5	3.88	4
Waiters and Waitresses	4.13	3.88	3	3.38
Taxi Drivers and Chauffeurs	4	3.38	3.75	3.63
Receptionists and Information Clerks	4	3.5	4	4
Telemarketers	4	3.5	4.13	4
File Clerks	3.88	3.88	3.5	3.38
Counter Attendants, Cafeteria, Food Concession	3.88	3.25	3.63	3
Retail Salesperson	3.75	3	3.75	3.63
Cashier	3.75	3.25	4.25	3.88
Head Cooks	3.6	3.4	4.4	4
Service Station Attendants	3.6	2.8	3.2	2.8
Ushers, Lobby Attendants, and Ticket Takers	3.38	3.13	3.5	3.25
Maids and Housekeeping Cleaners	2.83	2.66	3	2.66
Grounds Maintenance Workers	2.4	1.6	1.6	1.8
Construction Laborers	2.2	2	1.8	1.4
Agricultural Workers	2	1.6	1.8	1.6
Shoe and Leather Workers and Repairers	2	1.8	1.8	1.4
Textile Production Workers	1.6	1.4	1.2	0.8

Table 3.4 First Stage

Dependent Variable : LS Immigrants/Labor Force			
	(1)	(2)	(3)
Instrument*	0.049		0.011
	(0.010)		(0.009)
Instrument Squared	-0.006		
	(0.001)		
Log (Instrument)		0.362	
		(0.058)	
No. Obs.	349	349	349

* Instrument = $(Mex_{i,1970}/Mex_{1970})$*$LSMex_t$+$(Cub_{i,1970}/Cub_{1970})$*$LSCub_t$+$(Ital_{i,1970}/Ital_{1970})$*$LSItal_t$

Note: OLS estimates. City and decade fixed effects are included in all the regressions.

Robust Std. Errors are reported in parenthesis.

Table 3.5 Effects of Low-skilled Immigration on Occupational Distribution

A. Dependent Variable: LS Imm. $_{ijt}$/LS Nat. $_{ijt}$

Language Skills Variable	Coefficient of LS Imm./LF * Language skills	
	OLS	IV
(1- Percentile in Oral Comp. Importance)	50.93	68.79
	(9.64)	(10.90)
(1- Percentile in Oral Comp. Level)	39.77	49.56
	(8.91)	(11.39)
(1- Percentile in Oral Expr. Importance)	42.37	54.38
	(7.95)	(9.57)
(1- Percentile in Oral Expr. Level)	41.39	46.73
	(9.64)	(13.90)
(1-Percentile in First Principal Component)	32.59	41.41
	(7.25)	(9.78)

B. Dependent Variable: LS Workers $_{ijt}$/LS Workers $_{jt}$

Language Skills Variable	Coefficient of LS Imm./LF * Language skills	
	OLS	IV
(1- Percentile in Oral Comp. Importance)	0.109	0.155
	(0.020)	(0.030)
(1- Percentile in Oral Comp. Level)	-0.089	-0.108
	(0.047)	(0.067)
(1- Percentile in Oral Expr. Importance)	0.093	0.105
	(0.018)	(0.020)
(1- Percentile in Oral Expr. Level)	-0.063	-0.123
	(0.056)	(0.094)
(1-Percentile in First Principal Component)	-0.044	-0.062
	(0.037)	(0.050)

Notes: *i* represents occupation, *j* city, and *t* decade.

Each row corresponds to one IV regression and one OLS regression. City, decade and occupation fixed effects, and the direct effect of LS Imm/LF are included in all specifications.

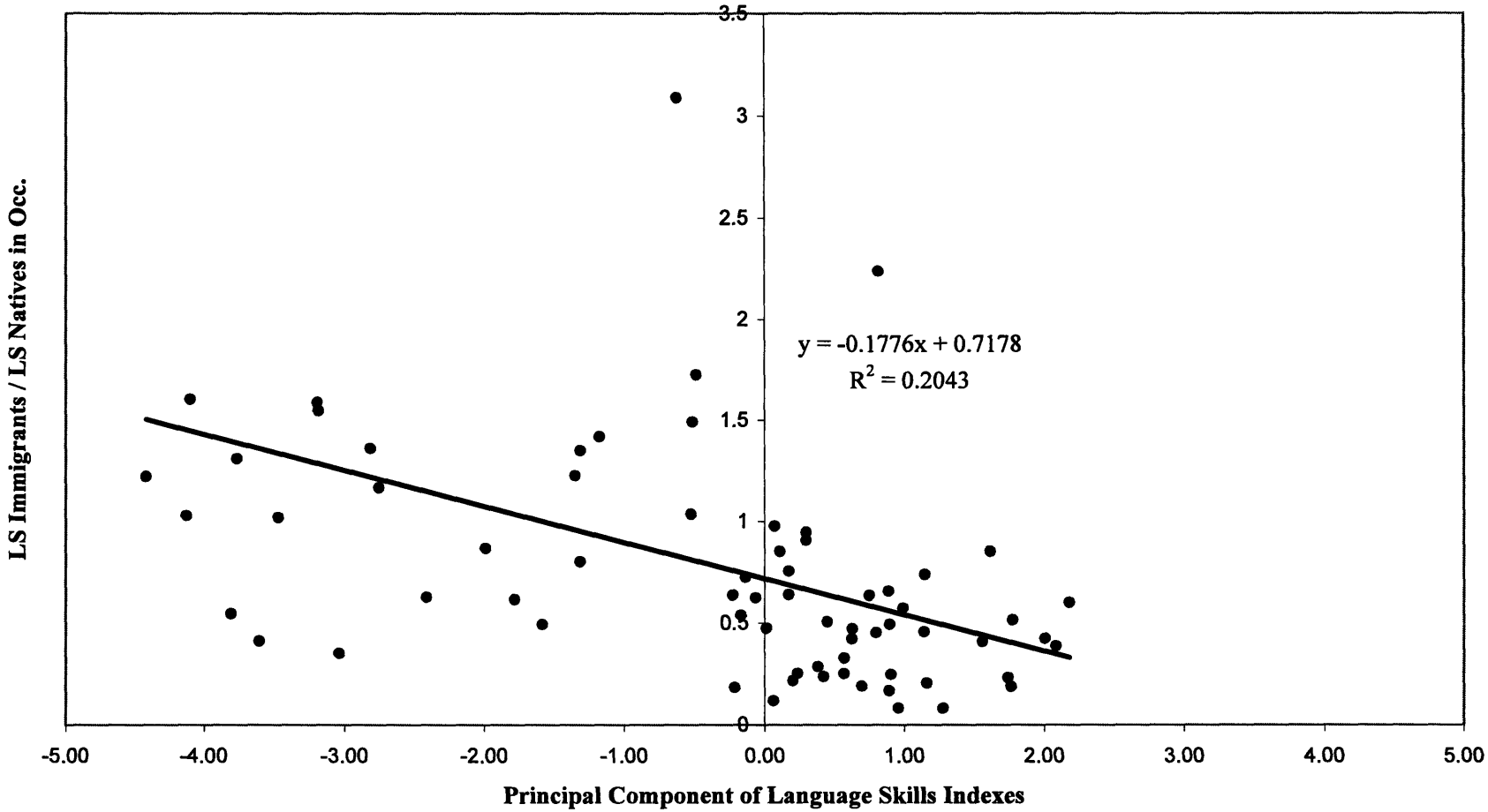
The total number of low-skilled workers used to construct the dependent variable are used as weights.

Table 3.6 Low-Skilled Immigration Effect on Wages

	Dependent Variable: Log(hourly wage)								
	Sample								
Explanatory Variable:	1. Natives			2. Immigrants			3. All		
	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
LS Imm / LF	0.605	-0.517	-0.708	-0.169	-0.998	-1.014	0.030	-1.799	-1.640
	(0.406)	(0.534)	(0.497)	(0.256)	(0.384)	(0.397)	(0.323)	(0.660)	(0.612)
Language Skills	-0.005	-0.006		-0.068	-0.128		-0.004	-0.017	
	(0.007)	(0.009)		(0.013)	(0.035)		(0.007)	(0.011)	
LS Imm./LF * Lang. skills	-0.822	-0.787	-0.805	-0.276	0.462	-0.093	-1.046	-0.745	-0.835
	(0.173)	(0.193)	(0.175)	(0.121)	(0.408)	(0.201)	(0.138)	(0.171)	(0.130)
Occupation Fixed Effects	No	No	Yes	No	No	Yes	No	No	Yes
Number of Observations	872132	872132	872132	306083	306083	306083	1178215	1178215	1178215

Each row corresponds to one IV regression and one OLS regression. City and decade fixed effects and individual controls are included in all specifications.
The measure of language skills corresponds to (1-percentile of first principal component of the four O*NET indexes mentioned in the text)
The sample is restricted to workers that reported working at least 10 hours a weeks.

Figure 3.1
Language Skills vs. Ratio of Immigrants to Natives in Occupation



Source: O*NET and Census

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