Immigration and the US Wage Distribution: A Literature Review*

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Immigration certainly is not a 20th century phenomenon. Since ancient times, groups of people have migrated in search of food and shelter, or in general better subsistence conditions. In modern times, migrants are often attracted to better wages or working conditions. The scale of migrant flows across countries is not trivial. At the end of the 20th century, approximately 2 percent of the world's population resided in a country in which they were not born[1].

Particularly, immigration to the United States is quite large. In the last decade, approximately 1.25 million people have immigrated to the US yearly with increasing intensity each year[2]. In fact, the percent of the total labor force that is foreign born has gone from 12.9% in 2000 to 15.6% in 2006, an

*Completed as a final project in Econ 250A labor economics field course.

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[1] Borjas (1999)

[2] Card (2009)

increase of approximately 5.3 million people[3].

Not only is the flow of immigrants into the US large, but outflows of US workers are relatively low. Between 1990 and 2006 net migration[4] has been about 4.2 people per 1000, ranking fourth among OECD countries behind Luxembourg, Spain, and Australia[5]. These statistics lead to the conclusion that the United States has experienced a relatively rapid growth in the labor force. A question concerning economists and policy-makers is to what extent this rapid growth has affected the wage distribution of natives.

The effects and causes of immigration are applicable to many fields in economics: labor, international trade, development. This review will focus, however, on a specific question: How does immigration affect the U.S. wage distribution for natives? Labor demand theory has some simple predictions about the effects, however, the empirical evidence concludes with somewhat contradictory results which lead to avenues in need of further exploration.

1 Theory

The literature has dominantly taken a demand side approach in modeling the effects of immigration on the labor market, largely borrowing from the factor

[3]Census: Table 1297

[4]Net migration is defined to be the difference in the number of people entering and leaving a country per 1000 persons.

[5]Census: Table 1297

demand theory dating back to the findings of Marshall[6]. The supply side is typically assumed to be perfectly inelastic and competitive in the sense that firms are price takers.[7].

In the context of native wages, the effects of immigration are theoretically the response of factor payments to an increase in the supply of factor inputs. Classic factor demand theory provides predictions on the size and scale of these responses. First let us consider the the simplest version of factor demand, a model with homogeneous inelastic labor and inelastic capital[8]. Let the production function take a general form

$$Q = f(K, L)$$

where L is a labor aggregate of the form $L = M + N$. M represents the number of *immigrant* workers in labor while N represents the number of *native* workers. Since labor is homogeneous, immigrant and native workers are perfect substitutes in the production function. Production markets are perfectly competitive, so factors get paid their marginal products in equilibrium. Borjas (1999) shows that in this simple model, an increase in the number of immigrant workers, M, affects factor payments to labor and capital according

[6]See P.R.G Layard (1978): Chapter 9
[7]See Section 3 for more thoughts on this approach.
[8]Notation here follows Borjas (1999)

to:

$$\frac{\Delta w_N N}{Q}\Big| = \quad \alpha_L \epsilon_{LL} m(1-m) \tag{1}$$

$$\tag{2}$$

$$\frac{\Delta r K}{Q}\Big| = \; -\alpha_L \epsilon_{LL} m(1-\frac{m}{2}) \tag{3}$$

where α_L is the labor share of national income, ϵ_{LL} is the elasticity of wage, and $m = \frac{M}{L}$ represents the fraction of the workforce that are foreign born. From equation (1), we see that an increase in the amount of foreign workers decreases the labor earnings of natives while increasing the earnings of capitalists. If we assume that natives own capital (and since capital is perfectly inelastic), capitalists win while native workers loose. This result isn't surprising. It is a direct consequence of the perfect substitutability of native and immigrant labor in the production function. In fact, the theory tells us in perfect competition, an increase in the supply of a certain factor should decrease the payment to all substitutable factors, ceteris paribus.

It could be reasonable to believe that native labor and immigrant labor aren't perfectly substitutable. We know both kinds of labor are distributed over different types of skills. Therefore, the next reasonable question is: How do factor payments respond to increased immigration with a relaxed assumption about relative skill distributions? Again following Borjas (1999), let us consider a model of heterogeneous workers, inelastic labor and capital supply,

and perfectly competitive product markets. Production technology is now given by

$$Q = f(K, L_s, L_u) \tag{4}$$

where $L_s = bN + \beta M$ and $L_u = (1-b)N + (1-\beta)M$ represent skilled and unskilled workers respectively. b and β represent the fraction of skilled workers among natives and immigrants. Borjas (1999) shows that the effects of an increase in immigrant labor M on the interest rate and both the wage of skilled and unskilled workers, r, w_s, and w_u respectively, can be written as

$$\frac{dlog(r)}{dlog(M)}\Big|_{dK=0} = \epsilon_{Ks}\frac{(\beta - b)}{p_s p_u}(1-m)m - \epsilon_{KK}\frac{1-\beta}{p_u}m \tag{5}$$

$$\tag{6}$$

$$\frac{dlog(w_s)}{dlog(M)}\Big|_{dK=0} = \epsilon_{ss}\frac{(\beta - b)}{p_S p_U}(1-m)m - \epsilon_{SK}\frac{1-\beta}{p_U}m \tag{7}$$

$$\tag{8}$$

$$\frac{dlog(w_u)}{dlog(M)}\Big|_{dK=0} = -\epsilon_{uu}\frac{(\beta - b)}{p_s p_u}(1-m)m - \epsilon_{uK}\frac{1-\beta}{p_u}m \tag{9}$$

where p_i is the share of total labor in skill group i. First, suppose that immigrants and natives have the same skill distribution so that $\beta = b$. Under perfectly inelastic capital, an increase in the supply of immigrant labor will increase the rental rate, r, and reduce both the wage of skilled and unskilled workers (since ϵ_{sK} and ϵ_{uK} are both positive). Therefore, in the short run,

we should expect both high and low skilled wages to fall if immigrants have the same skill distribution. This is in essence, the same effects derived in the previous model.

Next, suppose immigrant labor is relatively more skilled than native labor ($\beta > b$). Then the wage effect for skilled labor would be unambiguously *negative* while the effect for unskilled labor could be either positive or negative. The reverse is true if native labor is relatively more skilled than immigrant labor ($\beta < b$). In other words, the influx of immigrant labor will hurt the skill group that is more represented in the immigrant inflow.

The inelasticity of capital is typically considered a short run assumption. To analyze the long-run effects of immigrant inflows on wages, capital is assumed to be perfectly elastic. Again, Borjas (1999) shows that the wage responses can be written as

$$\frac{dlog(w_s)}{dlog(M)}\Big|_{dr=0} = \frac{\alpha_s}{c_{KK}}(c_{ss}c_{KK} - c_{sK}^2)\frac{(\beta - b)}{p_s p_u}(1-m)m \tag{10}$$

$$\tag{11}$$

$$\frac{dlog(w_u)}{dlog(M)}\Big|_{dr=0} = \frac{-\alpha_u}{c_{KK}}(c_{uu}c_{KK} - c_{uK}^2)\frac{(\beta - b)}{p_s p_u}(1-m)m \tag{12}$$

where c_{ij} refers to the elasticity of complementarity between factor i and j. Following the same exercise as above, first assume that the skill distributions are identical. When capital is freely able to respond to factor changes, the wage effects for both skill inputs are zero. Since immigration enters both skill

groups evenly, there is no substitution effect between high and low skill wages. Additionally, since capital is perfectly elastic, the interest rate cannot adjust to the increased labor supply, and hence the wage effects are zero. Now assume that immigrants are relatively more skilled, then we get the same (*negative*) effect on wages of skilled workers, but now there is an unambiguous *positive* effect on the wages of unskilled workers. The opposite is true when $\beta < b$. Therefore, not only do wages of substitutable workers decrease, but wages of complementary workers increase.

There are three important conclusions the above theory provides: (i) capital mobility plays an important role in the wage effects of complementary workers, (ii) the relative skill distribution of both native and immigrant workers can lead to largely different theoretical outcomes, and (iii) the degree of substitution between skill groups is important.

2 Empirical Evidence

The theory of labor demand provides clear predictions on the effect of immigrant labor on the wage distribution. If immigrant labor is similar to native labor in the sense that there is a degree of substitutability between the two, then increased immigration should have a negative effect on native wages. Empirically, the literature has provided contradictory conclusions about the magnitude, and to some extent, the direction of the effect.

The empirical side of the literature has taken essentially two approaches in estimating the effect of immigration on native wages: i) the "spatial correlations" approach as termed in Borjas (2003) and ii) and the factor proportions approach. This section will outline both approaches and their results.

It is a well known fact that immigrants tend to cluster in country specific groups in a relatively small number of geographic regions. Borjas notes that in 1990, "32.5 percent of the immigrant population lived in only three metropolitan areas (Los Angeles, New York, and Miami)"(Borjas (2003) pg. 1337). This geographical variation is used to identify the effect of immigration on wages.

Beginning with Grossman (1982) and Borjas (1983), most empirical studies regress some measure of native wages on immigrant densities defined across metropolitan areas. The most cited example of this approach is in Card's exploration of the Mariel Boatlift's effects on the Miami labor market (Card (1990)). Card uses the 1980 Mariel Boatlift as a natural experiment and compares the labor market conditions of groups in Miami before and after the boatlift and in comparison cities. The boatlift created a permanent 7% increase in Miami's labor force (after controlling for immigrants that moved away from Miami). This increase was largely unexpected and therefore serves as a valid test of the reponse to wages from a sudden unexpected shock in immigrant labor.

Card's results can be primarily summarized by Figure 1. The table shows log

Table 3. Logarithms of Real Hourly Earnings of Workers Age 16–61 in Miami and Four Comparison Cities, 1979–85.

Group	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*
Miami:							
Whites	1.85	1.83	1.85	1.82	1.82	1.82	1.82
	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.05)
Blacks	1.59	1.55	1.61	1.48	1.48	1.57	1.60
	(.03)	(.02)	(.03)	(.03)	(.03)	(.03)	(.04)
Cubans	1.58	1.54	1.51	1.49	1.49	1.53	1.49
	(.02)	(.02)	(.02)	(.02)	(.02)	(.03)	(.04)
Hispanics	1.52	1.54	1.54	1.53	1.48	1.59	1.54
	(.04)	(.04)	(.05)	(.05)	(.04)	(.04)	(.06)
Comparison Cities:							
Whites	1.93	1.90	1.91	1.91	1.90	1.91	1.92
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Blacks	1.74	1.70	1.72	1.71	1.69	1.67	1.65
	(.01)	(.02)	(.02)	(.01)	(.02)	(.02)	(.03)
Hispanics	1.65	1.63	1.61	1.61	1.58	1.60	1.58
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.02)

Note: Entries represent means of log hourly earnings (deflated by the Consumer Price Index—1980 = 100) for workers age 16–61 in Miami and four comparison cities: Atlanta, Houston, Los Angeles, and Tampa–St. Petersburg. See note to Table 1 for definitions of groups.

Source: Based on samples of employed workers in the outgoing rotation groups of the Current Population Survey in 1979–85. Due to a change in SMSA coding procedures in 1985, the 1985 sample is based on individuals in outgoing rotation groups for January–June of 1985 only.

Figure 1: Card (1990)

real hourly wages for four ethnicity groups from 1979 to 1985. We see that for whites, wage levels were relatively unchanged during the entire period, and no significant difference is seen around the time of the boatlift. Card notes this is somewhat surprising since it "contrasts with the general decline in real wages in the U.S. economy over this period" (Card (1990) pg. 249). A possible explanation factor demand theory provides is that native white labor could be complementary to Marielito workers, and hence in the long-run (when captial is mobile) there should be upward pressure on native white wages.

Subsequently, theory tells us the movement in wages should be clearly negative for labor that is most substitutable to the Marielitos. In examining the wage paths among other ethnicities, however, there are no large drops in wages during the time of the boatlift. Hispanic wages increased from 1979 to 1980 and remained about constant for the remainder of the period considered. Black wages fell, but coincide with the wage path of blacks from comparison cities. Indeed the most dominant effect can be seen in the wage path of Cuban workers. From 1979 to 1981 Cuban wages declined by 6-7 percentage points. The paper goes on to investigate this effect more closely and concludes that the Cuban wage decline is consistent with an experiment that simply increases the proportion of Cuban workers in the Miami labor market, and no extra decline can be attributed to immigration.

These results lead to the conclusion that the overall effect of immigration is small, having its largest effects on groups with hypothetically the same skill set as immigrants. LaLonde and Topel (1989) investigate this effect in more detail, concentrating on the effect of immigration on immigrant wages. The paper estimates the effects using a within-area regression equation of native wages according to:

$$w_{cjlt} = \beta_{cj} + \beta_{0t} + \delta X_{cjlt} + \sum_{i=1}^{k} \gamma_{jls} ln(M_{cit}) + \nu_{cjlt} \tag{13}$$

where w_{cjt} is the difference in log wages of immigrant cohorts and M_{cit} are within-area changes in immigrant densities. t, c, j, and l index time, locale,

immigrant cohort, and individuals respectively. The coefficients γ_{jl} are the parameters of interest and are used to identify the effects of immigration on immigrant wages. First, using natives as a comparison group, they are not able to reject the hypothesis that $\gamma_{jl} = 0$ for wages of immigrants that have lived 30 or more years in the US, suggesting near full assimilation. Secondly, they run the regression using immigrants with 30 or more years in the US as the comparison group, and find that increased immigration has a negative effect, though relatively small across various cohorts considered. The largest effect is for immigrants with 0-6 years of time lived in the US, and the effect diminishes as time increases, suggesting again that immigrant groups are fully assimilating in the long run.

In sum, the spatial correlations approach has found small negative or zero effects on native wages, and a relatively small effect even for the closest substitutes for immigrant labor, immigrants themselves.

Two problems with this approach are widely noted in the literature. First, immigrant inflows do not penetrate geographic locations exogenously. If immigrants respond to favorable labor market conditions, then there would be a spurious positive correlation between regions with high wages and high immigrant densities. Borjas (2001) shows that there is evidence indicating that certain groups of immigrants tend to settle in regions that offer higher wages.

Secondly, the spatial correlations approach assumes that native labor and

capital are inelastic and not able to respond to immigrant inflows. If labor and capital are mobile, then the true effects of immigration on native wages would be spread across regions. This could be a possible explanation of the low estimated effects derived using the spatial correlations approach.

To control for mobility between local labor markets, Borjas et al. (1997) suggest using data at the national level as opposed to the local level and introduce a method termed as the factor proportions approach. The methodology is as follows: If the aggregate production technology can be represented by a CES production function with skill groups as inputs, then the relative wage between any two skill groups can be written as a linear function of the relative supply of the inputs. More formally, if we assume aggregate labor can be broken up in to two skill groups (similar to the technology in equation 4) taking the CES form:

$$Q = A[\alpha_s L_s^{\rho} + \alpha_u L_s^{\rho}]^{\frac{1}{\rho}}$$

where the elasticity of substitution is given by $\sigma = \frac{1}{1-\rho}$. If labor supply is inelastic and the demand curve is downward sloping, then log relative wages of skilled to unskilled workers can be written as

$$ln(\frac{w_s}{w_u}) = D - \frac{1}{\sigma} ln(\frac{L_s}{L_u}) \tag{14}$$

where D is a relative demand shifter. In this framework the effect of increased

relative labor supply on relative wages is captured entirely by the elasticity of substitution[9]. The factor proportions approach first calculates the change in the relative supply of labor over some time period. It then uses estimates of σ, to calculate the predicted change in relative log wages. The method then compares the predicted change in log relative wages to the actual change observed in the data.

Borjas et al. (1997) run this same experiment considering two specifications of high and low skilled workers. Figure 2 shows their results. The first col-

Table 9
The impact of immigration on the United States using the factor proportions approach[a]

	Definition of skill groups	
	High school dropouts and high school graduates	High school equivalents and college equivalents
Relative number of post-1979 unskilled immigrants in 1995 ($m_{ut} = M_{ut}/N_{ut}$)	0.207	0.056
Relative number of post-1979 skilled immigrants in 1995 ($m_{St} = M_{St}/N_{St}$)	0.041	0.043
Log change in relative supplies $= \log(1 + m_{St}) - \log(1 + m_{ut})$	−0.149	−0.013
Estimate of relative wage elasticity	−0.322	−0.709
Change in log relative wage attributable to post-1979 immigration	0.048	0.009
Actual change in log relative wage between 1980 and 1995	0.109	0.191

[a] Source: Borjas et al. (1997, Tables 14 and 18).

Figure 2: Borjas (1999)

umn defines low skilled workers as those without a high school degree and high skilled workers as all others. The second column separates according

[9] An important underlying assumption is that *within* a particular skill group, native and immigrant labor are perfectly substitutable.

to high school equivalents and college equivalents for low and high skilled workers respectively. They use estimates of wage elasticities found in the literature, -.322 and -.709 for classification 1 and 2 respectively. They find that immigration's role in the relative labor supply change reduced the relative wage of high school dropouts by 4.8 percent which accounts for about 44% of the total wage decline between 1980 and 1995. However if skills are specified according to the second column, they only find a reduction of .9 percent attributable to immigration, which accounts for only 5% of the total wage decline.

The results point to a large negative effect of immigration on native high school dropouts, and a negative (and much smaller) effect on high school equivalent workers. They do not find that immigration plays a large role in the determination of high skilled wages. In fact, they state that "immigration is not a major determinant of the regional structure of labor market outcomes for natives [as a whole]" Borjas et al. (1997). These results are in some sense in support of basic factor demand theory. Over the time period from 1980 to 1995, the skill distribution of immigrants has been lower than for natives. The theory, then, predicts that if a low skilled immigrant worker is a perfect substitute for a low skilled native worker, then low skilled wages should decrease. However if high school dropouts and high school equivalents are perfectly substitutable, then the implied effect is drastically reduced.

It is important to note the shortfalls that are implicit in the previous frame-

work. The procedure relies heavily on model assumptions. First, if the production function or wage elasticities are misspecified or miscalculated, the simulation would provide incorrect results. Secondly, the framework assumes that within a skill class, immigrant and native labor are perfectly substitutable. The evidence supporting this assumption largely depends on the scope of skill groups used.

While the two approaches differ in some aspects, they are quite similar and produce similar results along several other dimensions. Most importantly they both conclude that relative wage changes across across an array of geographical specifications are largely uncorrelated with immigrant flows through time. The spatial correlations approach yields low and precise estimates of the effect while the factor proportions approach presents slightly higher but more variable estimates.[10] Card (2009), shows using city-level data that model parameter estimates are indeed consistent with those estimated from aggregate data. He verifies three hypotheses that sum up the empirical evidence nicely: (i) High school dropouts and those with a high school education are perfectly substitutable in the production function, (ii) High school equivalent and college equivalent workers are imperfectly substitutable, and (iii) within skill groups, immigrants and natives are imperfectly substitutable. These hypotheses imply that immigration indeed has only had minor effects on the the wage distribution for natives.

[10]The higher standard errors are a direct result of the low number of observations common in using aggregate data

3 Extensions

The two separate approaches and wide array of results still lead to uncertainty about whether either procedure is correctly identifying the wage effects of immigration. The main driver of the ambiguity seems to be from a lack of understanding about how natives and immigrants move between localities in response to wage changes or other economic conditions. To advance the understanding of immigration's effect on local labor markets, this avenue needs further exploration. Currently there is no model that explains the internal movement of labor or capital that also includes immigration.[11] A model incorporating mobility decisions and immigration would be helpful in three dimensions.

First, the model should endogenize location choices of immigrants and natives. These choices should reflect economic conditions, location preferences, and immigrant density preferences. If preferences include inputs for location and preferences, then we could better examine how shocks to immigrant densities affect mobility decisions.

Secondly, it should explicitly model locations and movements between locations. This could be accomplished with discrete or a continuum of locations, either of which receive exogenous shocks to wages or wage volatility. Ex post, wages would be a sum of two components, exogenous shocks and endogenous

[11] Card (2001) does estimate the response of intercity mobility rates of natives to immigrant inflows, but his methodology differs from the type I propose here.

supply shifters. These two effects are difficult to separate from the data, so to be able to model them explicitly is advantageous.

Finally, the model should incorporate capital mobility. Capital mobility strongly sways the theoretical predictions of increased immigration. From equations (10) and (12), we saw that if capital is perfectly mobile, the wage effects of immigration are somewhat mitigated (and fully mitigated if the skill distribution is the same between immigrants and natives. Instead of separating cases along the short and long-run, a model incorporating capital mobility would be able to control for these conditions explicitly by using data on inter-city flows of capital through time.

The demand side of the labor market could easily be modeled with CES production. There is somewhat of a consensus about the estimated elasticity of substitution between skill groups. The model could incorporate these estimates from the data into the CES production function to fairly accurately account for the labor demand side of the economy. A model of this sort would hopefully provide a useful lab to test reactions to immigration shocks (those coming from outside the model) or other transitory phenomena seen in the data.

4 Conclusion

Factor demand theory provides some simple predictions about the direction and scale of wage effects in response to labor inflows. The empirical findings however largely tell a different story. Whether the metric is on a local level or national level, the results show that immigration on the whole has had small effects on the native wage distribution. For those workers who are largely complementary to immigrant labor, namely higher skill and more educated, the effects are practically zero. The wages most affected are for those who most closely resemble immigrant workers. For less educated natives and immigrants themselves, increased immigration lowers the relative wages of these groups. The literature differs on the scale of this last effect, but the sign is no doubt negative.

The disconnect between what the theory predicts and what the empirical evidence shows is largely due to the essence of the problem considered. Wages are a result of numerous observable and unobservable effects; the movement of wages even more so. To show a direct causality between immigrant inflows and lower native wages requires a better framework to build empirical tests. Unfortunately, the process is not a static one. People move in response to wages, and wages move in response to labor flows. In the end, the question could be greatly advanced by explicitly modeling the mobility decisions of natives and immigrants.

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