The Effect of Learning English on the Earnings of Hispanic Men

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ABSTRACT

Discrimination explains a large part of the difference in earnings between Hispanics and non-Hispanics according to the standard view. Using Survey of Income and Education data, we distinguish between different Hispanic subgroups, we use a replicable and reasonably scaled measure of language proficiency, and (most notably) we take account of the possibility that language proficiency may be endogenous. We find that most of the difference in earnings between Hispanics and non-Hispanics is due to differences in characteristics (such as education level and English proficiency) rather than to labor market discrimination.

INTRODUCTION

The labor market differences between Hispanics and non-Hispanics could be examined along several dimensions, including frequency and duration of unemployment, the distribution of occupations and the level of earnings. In this paper we focus on the last dimension. We restrict the comparison to Hispanic men and native, white, non-Hispanic men. The two groups will be referred to simply as Hispanics and non-Hispanics.

Differences in earnings between Hispanics and non-Hispanics have been noticed for some time, but it was not until fairly recently that researchers began to look at lack of English proficiency as a potential explanation of such differences. The earlier inattention to English proficiency was probably due to the lack of data sets with good language information. The 1976 Survey of Income and Education (SIE) and the 1980 Census have remedied that situation and they have been widely applied to the analysis of English proficiency as a determinant of the earnings of Hispanics.

The state of the literature on wage differences, as of 1994, has been summarized by Borjas (1680-1685) as part of his broader survey of the economics of immingration. We summarize some of the important literature here.

Using SIE data, Reimers (1983) finds that, depending upon which subgroup is considered, language proficiency and other personal characteristics account for from 3-20% of the earnings differences between Hispanics and non-Hispanics. She concludes that a substantial part of earnings differences are due to discrimination. Several other studies (Veltman 1983; McManus, Gould and Welch 1983; McManus 1984; McManus 1985; and Stolzenberg 1982), however, conclude that Hispanics are not discriminated against in earnings, though there is a positive return to knowing English. Non-English speaking Hispanics will earn less than non-Hispanics not because they are Hispanic, but because they lack English skills or have lower levels of education, experience or some other kind of human capital.

The general approach in the literature has been to estimate earnings functions for Hispanics which include a measure of English proficiency as one of the explanatory variables. Veltman, for example, uses a set of dummy variables for the reported level of English proficiency. He estimates a joint earnings function for Hispanics and non-Hispanics, restricting all parameters to be the same across the two groups. The significance or non-significance of the Hispanic dummy is the test of whether or not Hispanics are discriminated against in earnings. The McManus et al paper estimates separate earnings functions for Hispanics and non-Hispanics. The authors use a complicated measure of English proficiency which appears by itself and interacted with education, experience, and an urban-rural dummy (all interactions turn out to be significant). When the earnings functions are evaluated at the means of the characteristics of Hispanics, there is no significant difference between Hispanics and non-Hispanics (Hispanics are slightly higher).

Chiswick (1991) estimates a regression explaining the level of English proficiency, in his study of the wages of Hispanics. But he does not incorporate his language estimation in the earnings regression to make language endogenous.

Although previous authors have treated English proficiency as exogenous, we believe, to the contrary, that treating English proficiency as endogenous may prove fruitful. One reason is that doing so will allow us to address the issue of self-selection that is raised when we consider whether Hispanics who are proficient in English earn more because of such proficiency, or because such proficiency is associated with unmeasured productivity. Another advantage of treating English proficiency as endogenous is that it permits us to avoid the assumption of previous authors that the path of English acquisition is independent of the path of acquisition of other human capital. To see why this may be an unrealistic assumption, consider, for example, two individuals who currently have the same level of English proficiency and all other characteristics, but who differ in the age at which they achieved their proficiency. One individual acquired his English proficiency prior to his work experience while the other acquired it at the same time as his work experience. We expect that during his working life the first individual will have acquired more human capital than the second and consequently have higher current earnings.

Ignoring the possibility of self-selection may result in overestimating the return from learning English, and thereby underestimating the earnings differential between Hispanics and non-Hispanics. Assuming that the timing of the acquisition of English proficiency does not affect the acquisition of other forms of human capital will tend to underestimate the return to learning English, and consequently overestimate Hispanic/non-Hispanic earnings differences. Our main objective here is to implement an estimation procedure that takes into account these two indirect effects on earnings from the direct effect of learning English, thereby providing a more accurate estimate of the return to learning English and of the unexplained earnings differential, if any, between Hispanics and non-Hispanics.

DESCRIPTION OF THE DATA

The most widely used data set to study the role of language in the earnings of Hispanics is the 1976 Survey of Income and Education (SIE). The Survey's large sample size and its rich language questions make it an attractive data set for this study.[i] A competitor that is now available is the 1980 Census, which was the first Census to ask Hispanics a question on English proficiency. Some authors have in fact made use of the Census data (Borjas 1984; and McManus 1986). The main advantage of the Census data is the enormous sample size (1% and 5% samples are available).

The SIE includes information on respondent's characteristics prior to immigration to the U.S. We judge that this advantage outweighs the greater number of observations in the Census data set, so in what follows we make use of the SIE data. Particularly valuable, for our objective of treating English proficiency as endogenous, are variables that are plausible exogenous determinants of the respondent's initial level of English proficiency, e.g., the variables on years of education abroad, whether such education took place in English, and whether Spanish was spoken in the respondent's home when he was a child.

Hispanics in the SIE can be classified as falling into one of five ethnic subgroups: Cubans, Mexicans, Puerto Ricans, Central and South Americans, and "Other Spanish." We classify together as Mexicans four separate ethnic categories reported in the SIE, viz., "Mexican American," "Chicano," "Mexican," and "Mexicano." We exclude the "Central and South American" category since this category may contain some serious coding errors.[ii] This leaves only the category entitled "Other Spanish." In addition to Hispanics native to Spain this group might also include Hispanics whose ancestors were colonists in Spanish North America before the area was ceded by Spain and Mexico.

In previous work, the measures of English proficiency are either too complex and irreproducible, (as in McManus et al), or are scaled in an arbitrary fashion (as in Stolzenberg), or enter in an unrealistic fashion (as in Veltman).[iii] We use the simplest and most direct measure of English proficiency in the SIE. Two questions from the SIE were the main source of our coding of English proficiency. In the first, the respondent was asked by a bilingual interviewer[iv] whether he understood English "not at all," "not well--just a few words," "not well--more than a few words," "well," or "very well." In the second question, the respondent was asked to classify into the same categories his ability to speak English. In most cases the respondent placed himself in the same category both for understanding and for speaking English. If the categories differed, then we coded English proficiency as the lower of the two. Thus, if the respondent reported that he spoke English "well," but understood it "not well--more than a few words," we would assign an English proficiency of "not well--more than a few words" to the respondent.

The questions on English were not asked of those who, because of responses to previous questions were assumed to speak English "very well." Thus, those who spoke English at home at the time of the survey, had spoken English as a child and were born in the U.S. were not asked about their ability to speak and understand English. We assigned a "very well" to those not asked their English skills because of the plausible assumption that they were proficient. Because so few observations fell under the lowest English proficiency category, we combined it with the next higher category for the analysis.

As in much previous work, we estimate Hispanic earnings regressions on a sample that includes all Hispanic males residing in any SMSA in the U.S., with regional differences in earnings captured by a set of broadly defined regional dummy variables. One way in which regions may differ is in the return to learning English. There may be enclaves of Hispanics (McManus 1990), where not knowing English is less severe a handicap than it is outside those enclaves.

In constructing our samples we imposed basically the same restrictions as McManus, Gould and Welch (1983, p. 106) and McManus (1985, pp. 820-821) since their samples seem to be the most carefully constructed, and since using the same inclusion criteria facilitates the comparison of our results with the main body of existing work in this area. Specifically McManus et al described their samples as follows:

> The data in our study refer to Anglo and Hispanic males described in the 1976 SIE. Both groups are civilian, age 16-64, not now in school (as the major activity of the last week before questioning), who either worked 50-52 weeks in 1975 or report the reason for working fewer weeks as something other than being in school or retired. Those self-employed or working without pay are excluded. In addition, those with missing information either for weeks worked or for wage and salary in 1975 and those whose weekly wage (computed as the ratio of wage and salary earnings to weeks worked) is less than $10 are also excluded. White non-Hispanics, referred to as Anglos in this paper, were also excluded if they were not born in the United States or if they did not report English as their only language. (p. 106)

The only restriction we did not impose was the exclusion of Hispanics who ". . . reported pathological language information." In the McManus et al paper the authors elaborate slightly by adding in a footnote that "for example, Hispanics who reported English as their first language but who spoke only a few words of English were excluded." (p. 106) We chose not to exclude such responses mainly because the small number of such cases did not justify the time required to distinguish genuine "pathologies" from unusual, but accurate responses.

The definitions of the variables used in the study are reported in Table 1 and sample means for the key variables are reported in Table 2.

MODELLING ENGLISH PROFICIENCY AND EARNINGS

The model is a simple version of Ben-Porath's model of human capital. Let us begin with an individual at time τ who is *proficient* in English. Proficiency is defined as $E(t) \geq 0$. His objective is to find the path of investment in human capital, $I(t)$, that maximizes the present value of income, $Y(t)$, given by

$$\int_{\tau}^{T} e^{-rt}\, Y(t)dt$$

The objective is maximized subject to the following constraints:

$$ah = Y + I$$
$$\dot{h} = g(I)$$
$$h(\tau) = h_{\tau}$$

where "r" is the discount rate, "a" is a parameter measuring ability in the labor market, γ is a parameter measuring ability in learning English, T is the working life span; and at time t: $Y(t)$ is income, $h(t)$ is human capital, $I(t)$ is investment in human capital, $E(t)$ is level of English, and $Q(t)$ is investment in English. The function $g(I)$ has the properties that $g'(I)>0$, $g''(I)<0$, and $g'(I) \to \infty$ as $I \to 0$. We have omitted the time argument when possible to keep the notation simpler. We have also assumed no depreciation, as it is not needed for our purposes.

The Hamiltonian of the problem is

$$H(h(t), Y(t), t) = e^{-rt}\, Y(t) + \pi(t) g(ah(t) - Y(t))$$

Here $\pi(t)$ is the costate variable. The first order conditions are

$$\frac{\partial H}{\partial Y(t)} = e^{-rt} - \pi(t) g'(I(t)) = 0$$

$$\dot{\pi} = -\frac{\partial H}{\partial h(t)} = -a\pi(t) g'(I(t))$$

$$\dot{h}(t) = \frac{\partial H}{\partial \pi(t)} = g(I(t))$$

The transversality condition is $\pi(T) = 0$. The solution to the above problem can be characterized as follows:

$$\pi_P(t) = \frac{a(e^{-rt} - e^{-rT})}{r}$$

$$g'(I_P(t)) = \frac{e^{-rt}}{\pi_P(t)}$$

The subscript *P* denotes optimal values given that the individual is proficient in English. The optimal level of human capital, $h_P(t)$, is therefore given by

$$h_P(t) = \int_{\tau}^{t} g(I_P(s))ds \quad + \quad h(\tau)$$

The solution for income, $Y_P(t)$, is

$$Y_P(t) = ah_P(t) - I_P(t)$$

and the maximum present value of income is

$$V(\tau, h_\tau) = \int_{\tau}^{T} e^{-rt} Y_P(t)dt$$

Let us suppose that the individual became proficient in English precisely at time τ, i.e. $E(\tau) = 0$. Over the time interval $[0, \tau)$ he was not proficient. ***Taking τ as given***, his objective is to maximize:

$$\int_{0}^{\tau} e^{-rt} Y(t)dt \quad + \quad V(\tau, h(\tau))$$

subject to:

$$\alpha\, ah = Y + I + Q$$
$$\dot{h} = g(I)$$
$$\dot{E} = \gamma\, w(Q)$$
$$h(0) = h_0$$
$$E(\tau) = 0$$

where $\alpha < 1$. This is the "penalty" the individual pays for not being proficient in English. Notice that not being proficient is like reducing human capital available for earning income or for investing in more human capital. Assume that the function $w(Q)$ has the same properties as $g(I)$, namely that $w'(Q) > 0$, $w''(Q) < 0$, and that $w'(Q) \to \infty$ *as* $Q \to 0$. The transversality condition for this problem is:

$$\pi(\tau) = \frac{\partial V(\tau, h_\tau)}{\partial h_\tau}$$

This simply states that the marginal value of human capital at the end of the period of no proficiency, τ, is equal to the marginal contribution to the present value of earnings from τ to T. The Hamiltonian of the problem now is

$$H(h(t), Y(t), t) = e^{-rt}Y(t) + \pi(t)g(\alpha\, ah(t) - Y(t) - Q(t)) + \lambda(t)\gamma\, w(Q)$$

where $\lambda(t)$ is the costate variable for English. The solution, denoted by the subscript N, can be characterized as:

$$\pi_N(t) = \frac{a(\alpha e^{-rt} + (1-\alpha)e^{-r\tau} - e^{-rT})}{r}$$
$$\lambda_N(t) = \lambda_N$$
$$g'(I_N(t)) = \frac{e^{-rt}}{\pi_N(t)}$$
$$w'(Q_N(t)) = \frac{e^{-rt}}{\gamma\lambda_N}$$

Notice that $\pi_P(t) > \pi_N(t)$ (the marginal value of human capital is greater if you are proficient), implying by the concavity of $g(I)$ that $I_N(t) < I_P(t)$ (the individual invests more in human capital if proficient). Human capital at time t is now given by:

$$h_N(t) = \int_0^t g(I_N(s))ds$$

which is lower than the level of human capital the individual would have had, had he been proficient in English from the start. The solution for income, $Y_N(t)$, is

$$Y_N(t) = \alpha a h_N(t) - I_N(t) - Q_N(t)$$

Income tends to be lower if the person is not proficient because $\alpha < 1$, human capital is lower, and some human capital may be devoted to improving English. On the other hand, investment in human capital is lower. Of course, the present value of income is higher for someone who is proficient from the start than for one who is not. It is possible, therefore, that for low levels of work experience (when I is highest) a person who is not proficient may have higher income than one who is, especially if he is not investing in improving English skills.

The level of English skills for $t < \tau$ is given by:

$$E(t) = \gamma \int_0^t w(Q_N(s))ds + E_0$$

This equation, along with the first order conditions and the definition of τ, determines the costate variable for English, λ_N, as a function of τ, γ and E_0.

Once an individual becomes proficient in English, his income is given by:

$$Y_P(t) = a\int_\tau^t g(I_P(s))ds + ah_\tau - I_P(t)$$

Which can be re-written as:

$$Y_P(t) = a\int_0^t g(I_P(s))ds + a\int_0^\tau (I_N(s) - I_P(s))ds - I_P(t)$$

Since $I_N(s) < I_P(s)$ for all s in the interval $[0, \tau)$, income after becoming proficient is lower than it would have been if the person was proficient when he entered the U.S. labor market at time $t = 0$. This result is important and is used below.

Define $Y_0(t)$ as the income of a non-proficient person if he is constrained to making no investment in English ($Q(t)=0$). It is given by:

$$Y_0(t) = \alpha a\int_0^t g(I_N(s))ds + \alpha a h_0 - I_N(t)$$

The income of a non-proficient person is then given by:

$$Y_N(t) = Y_0(t) - Q_N(t)$$

Notice that for given ability *a*, the income of a non-proficient person is lower if he invests in acquiring English skills during the period of non-proficiency. This result is also used below.

The present value of income is

$$\int_0^{\tau} e^{-rt} Y_N(t)dt \quad + \quad V(\tau, h(\tau))$$

and the individual will choose τ so as to maximize it. The first order condition, assuming an interior solution is

$$\text{(1)} \qquad \int_o^{\tau} e^{-rt} \frac{\partial Y_N(t)}{\partial \tau} dt \quad = \quad e^{-r\tau}(Y_P(\tau) - Y_N(\tau)) + \pi_P(\tau)(g(I_P(\tau) - g(I_N(\tau))$$

It can be shown that $\partial Y_N(t)/\partial \tau > 0$. That is, postponing becoming proficient raises income in the non-proficient state. This is because if one learns English at a slower pace there will be more human capital for earnings and *I(t)* is lower. The LHS of the above equation is the marginal gain in present value of postponing achieving the proficient state. The RHS has two expressions. The first is the income gain, in present value terms, experienced on becoming proficient in English at time τ. Becoming proficient not only raises income, however, it also raises investment in human capital at time τ. The present value of the returns from the additional human capital created by the increase in investment at time τ is the second expression on the RHS. Of course, an interior solution may not exist, and the person can choose not to invest in becoming proficient, even if he is not proficient from the start.

At this point it is useful to introduce the latent variable τ^*, which can be viewed as the desired time until one becomes proficient. It is the solution to (1) above. If $\tau^* < 0$, the individual is proficient when he enters the U.S. labor market, so that $\tau = 0$ in the maximization problem above, and $Y_P(t)$ is his income path throughout his working life. If $\tau^* > T$, the person never learns English, makes no investment in learning, and therefore has income path $Y_0(t)$. If $0 \geq \tau^* \geq T$, then $\tau = \tau^*$. A person at time *t* will be proficient if $t \geq \tau^*$, and not proficient otherwise.

Earnings if proficient, $Y_P(t)$, is a function not only of *t*, but also of *a*, of h_0, and of τ. Let *t* and the observable characteristics on which *a* and h_0 depend, be represented by vector *X*, and the unobservables by ε_p. Following the standard expectation that the natural log of earnings is linear in *X* and ε_p, and that $\varepsilon_p \sim N(0, \sigma_p)$, we write that:

$$\ln(Y_P(t)) = y_P(X,\tau,\varepsilon_P) = \begin{cases} X'\beta_p + \varepsilon_p,\ m(\tau^*) \le 0 \\ X'\beta_p - r_p m(\tau^*) + \varepsilon_p,\ 0 < m(\tau^*) \le m(t) \end{cases}$$

where $r_p > 0$. τ^* is a function of the exogenous variables a, γ, h_0, and E_0, but not of t.[v] The variables a, γ, h_0, and E_0 depend on observable and unobservable characteristics. Let the observable characteristics be represented by vector Z, and the unobservables by u. Define $m(\tau^*)$ as a monotonic function of τ^*, with $m'(\tau^*)>0$ and $m(0)= 0$. We assume that:

$$m(\tau^*) = Z'\theta + u$$

where $u \sim N(0,\sigma_u)$. A person at time t is observed to be proficient if $m(t) \ge m(\tau^*)$, and not proficient otherwise.

The earnings of a person who is proficient upon entering the U.S. labor market, $m(\tau^*) \le 0$, are given by $X'\beta_p + \varepsilon_p$. A person who became proficient after entering the U.S. labor market, $0<m(\tau^*)\le 0$, has earnings that are lower than if he had been proficient from the start by an amount equal to $r_p m(\tau^*)$.

The structure for those who are not proficient is similar. If a person never becomes proficient, $m(\tau^*)>m(T)$, his earnings are simply $X'\beta_N + \varepsilon_N$, where once again $\varepsilon_N \sim N(0,\sigma_N)$. If he learns English before retiring, the investment will have a cost in terms of lower earnings, with the cost being greater the faster English proficiency is acquired. We have chosen to model this as follows:

$$y_N = \begin{cases} X'\beta_N + \varepsilon_N,\ m(\tau^*) > m(T) \\ X'\beta_N - k + r_N m(\tau^*) + \varepsilon_N,\ m(t) < m(\tau^*) \le m(T) \end{cases}$$

where k, $r_N > 0$. Notice that we use the time until proficiency is achieved as an inverse measure of the speed of learning English, and therefore of the intensity of investment. This is not exactly correct. While it is true that the more intense one's investment in English and the higher one's ability, the faster one will learn, a person may also achieve proficiency quickly simply because he starts off being close to proficient.

From the above we can compute expected log earnings. First define the following quantities:

$$\Omega_1 = \frac{-Z'\theta}{\sigma_u}, \qquad \Omega_2 = \frac{m(t) - Z'\theta}{\sigma_u}, \quad \Omega_2 = \frac{m(T) - Z'\theta}{\sigma_u}$$

Expected log earnings conditional on being proficient is given by:

(2) $$E(y_P|m(\tau^*) \leq m(t)) = X'\beta_p - r_p\Delta_p - \frac{\sigma_{pu}}{\sigma_u}\frac{\phi(\Omega_2)}{\Phi(\Omega_2)}$$

where ϕ and Φ are the unit normal density and distribution, σ_{pu} is the covariance of ε_p and u, and

$$\Delta_p = \frac{Z'\theta(\Phi(\Omega_2) - \Phi(\Omega_1)) + \sigma_u(\phi(\Omega_1) - \phi(\Omega_2))}{\Phi(\Omega_2)}$$
$$= E(Z'\theta + u\,|\,0 < Z'\theta + u \leq m(t))\;P(0 < Z'\theta + u \leq m(t)\,|\,Z'\theta + u \leq m(t)) > 0$$

The RHS of equation (2) above has three terms. The first term is the expected log of earnings of someone who was proficient in English when he entered the U.S. labor market, $X'\beta_p$. The second term, $r_p\Delta_\beta$, is the expected earnings penalty of not having been proficient upon entering the U.S. labor market. The last term is the self-selection bias. If we assume that unobserved ability in learning English is positively correlated to unobserved labor market ability, then $\sigma_{pu} < 0$ (the more able learn English faster).

The expected log earnings conditional on not being proficient is given by the following:

(3) $$E(y_N|m(\tau^*) > m(t)) = X'\beta_N + r_N\Delta_N - k\left(\frac{\Phi(\Omega_3) - \Phi(\Omega_2)}{1 - \Phi(\Omega_2)}\right) + \frac{\sigma_{Nu}}{\sigma_u}\frac{\phi(\Omega_2)}{(1 - \Phi(\Omega_2))}$$

where σ_{Nu} is the covariance of ε_N and u, and

$$\Delta_N = \frac{Z'\Theta(\Phi(\Omega_3) - \Phi(\Omega_2)) - \sigma_u(\phi(\Omega_2) - \phi(\Omega_3))}{(1 - \Phi(\Omega_2))}$$
$$= E(Z'\theta + u\,|\,m(t) < Z'\theta + u \leq m(T))\,P(m(t) < Z'\theta + u \leq m(T)\,|\,Z'\theta + u > m(t)) > 0$$

The first term on the RHS of (3), $X'\beta_N$, is the expected log of earnings of someone who will never become proficient in English, and consequently makes no investment in learning the language. The next two terms are the expected earnings penalty from investing in English skills. The last term is the selectivity bias. The sign of this last term depends on the sign of σ_{Nu}. The same argument given above for the proficient would seem to apply here, implying that $\sigma_{Nu} < 0$. We believe, however, that this case is more complicated. The most able of the non-proficient persons are more likely to benefit from learning English. While they are learning, however, many may not be able to practice their professions. They will likely have to work in jobs which are not among the higher paying ones among those that do not require English proficiency. A lawyer, therefore, works as a janitor while he is learning English, rather than as a carpenter, which would pay more but for which he does not have the training. The sign of σ_{Nu} is thus in doubt.

ECONOMETRIC ESTIMATION

The most basic approach is to ignore English completely, estimate earnings functions for Hispanics and Non-Hispanics, and compare the parameter differences. This amounts to assuming that (i) rp=rN=k=0, or that no one becomes proficient after entering the U.S. labor market, (ii) σpu=σNu=0, and (iii) βp=βN=β in the above conditional expectations. The results from such regressions are reported in columns three and four of Table 3. Column four differs from column three and from most previous work in that we have included the variable HISPS - the fraction of an SMSA's population that was Hispanic in the 1980 Census. McManus (1991) included such a variable in his study of ethnic enclaves, finding some evidence that the larger HISPS is, the lower Hispanic wages.

Table 5 presents the differences between Hispanics and Non-Hispanic, native whites that are due to parameters. Ignoring HISPS, the difference due to parameters (DDP) is -0.106, which is significant since the s.e. is only 0.0113. The HISPS variable is quite important. At HISPS = 0.0755 (the average for SMSA's in 1980) the DDP drops to -0.0577, and is still significant. The returns to education and experience are shown in Table 6.

The simplest way to incorporate English proficiency is to treat it as completely exogenous, as the earliest works did. This means setting $r_p=r_N=k=0$ (or again that no one becomes proficient after entering the U.S. labor market) and $\sigma_{pu}=\sigma_{Nu}=0$. In this case we can estimate earnings functions by OLS for the proficient and non-proficient groups separately. The results are reported in Table 3 (columns five and six). In Table 5 are reported the DDP's between each language group and the Non-Hispanics. With HISPS=0.0755 the DDP for the proficient group is only -0.0255, and not significant (s.e.=0.0175). Recall that biases introduced by ignoring the endogeneity of English proficiency work in opposite directions. For the Non-proficient the DDP is large (-0.136) and significant (s.e.=0.0286).

The returns to education and experience are in Table 6 and the returns to learning English are in Table 7. Notice that the latter is very sensitive to the weights used. For the mean characteristics of the proficient group the return to learning English is very high at 0.184, but when evaluated at the mean characteristics of the non-proficient group it is only 0.022.

The next step would be to consider the possibility of selectivity bias. Essentially this means that we are still setting r_p=r_N=k=0, but are dropping the assumption of independence between u and ε_p and $\varepsilon_{N.}$

Here we estimate the full model. This was done by full information maximum likelihood, not a two step procedure. Before deriving the likelihood function, let us define some quantities and some joint probabilities.

Let

$$A = \frac{-Z'\theta - \sigma_u \rho_p \varepsilon_p / \sigma_p}{\sigma_u (1-\rho_p^2)^{1/2}}$$

$$B = \frac{m(t) - Z'\theta - \sigma_u \rho_v v / \sigma_v}{\sigma_u (1-\rho_v^2)^{1/2}}$$

$$C = \frac{-Z'\theta - \sigma_u \rho_v v / \sigma_v}{\sigma_u (1-\rho_v^2)^{1/2}}$$

$$D = \frac{m(T) - Z'\theta - \sigma_u \rho_N \varepsilon_N / \sigma_N}{\sigma_u (1-\rho_N^2)^{1/2}}$$

$$E = \frac{m(T) - Z'\theta - \sigma_u \rho_w w / \sigma_w}{\sigma_u (1-\rho_w^2)^{1/2}}$$

$$F = \frac{m(t) - Z'\theta - \sigma_u \rho_w w / \sigma_w}{\sigma_u (1-\rho_w^2)^{1/2}}$$

where v=ε_p - $r_p u$, w=ε_N + $r_N u$, σ_v is the standard deviation of v, σ_w is the standard deviation of w, ρ_p is the correlation of ε_p and u, and ρ_V is the correlation of ε_N and u.

We can now express the following joint probabilities:

$$P_1 = P(y_p = y, m(\tau^*) \le 0) = \frac{\phi(\varepsilon_p / \sigma_p)}{\sigma_p} \Phi(A)$$

$$P_2 = P(y_p = y, 0 < \tau^* \le m(t)) \quad = \frac{\phi(v / \sigma_v)}{\sigma_v} (\Phi(B) - \Phi(C))$$

$$P_3 = P(y_N = y, m(\tau^*) > m(T)) = \frac{\phi(\varepsilon_N / \sigma_N)}{\sigma_N} (1 - \Phi(D))$$

$$P_4 = P(y_N = y, m(t) < \tau^* \le m(T)) \quad = \frac{\phi(w / \sigma_w)}{\sigma_w} (\Phi(E) - \Phi(F))$$

The log of the likelihood function can now be expressed as follows:

(4) $$\ln L = \sum_i I_i \ln(P_{1i} + P_{2i}) + \sum_i (1 - I_i) \ln(P_{3i} + P_{4i})$$

where $I_i=1$ if person *i* is proficient and $I_i=0$, otherwise. The results of maximizing (4) are shown in Table 4. We used *ln(1+t/10)* for the function *m(t)*.[vi] Note that r_p, r_N, and *k* are all of the expected sign and significant. ρ_p is also of the expected sign and significant. ρ_N is positive, but insignificant. The corresponding parameter differences and returns to education, experience and English are reported in Tables 5, 6 and 7.

CONCLUSIONS AND FUTURE WORK

The most important conclusion of our paper is that very little of the difference in Hispanic and non-Hispanic earnings is due to differences in parameters in the earning function. This implies that those who are proficient in English enjoy very similar returns to investment in human capital (education and experience) as Non-Hispanics, if proficiency is achieved at the same age for both.. Although this result is robust, it can be illustrated with our most sophisticated estimation technique and most appropriate weights. For the estimation including the HISPS variable, treating language as endogenous, and using the proficient group's own weights, we find a return to education 0.0826 and a return to experience of 0.0283. The Non-Hispanics' returns using the same proficient group weights are a return to education of 0.0812 and a return to experience of 0.0309. These returns are very similar, with the Hispanic rate of return slightly higher for education and the Non-Hispanic rate of return slightly higher for experience. Thus, for those Hispanics proficient in English, we find no evidence of labor market discrimination against Hispanics.

Previous work, including our own early empirical analysis, suggested that almost all of the wage premium due to English proficiency, occurred by achieving the highest proficiency category ("very well"). It was a major puzzle why substantial wage gains were not also observed as the Hispanic moved from "none" to "some" and from "some" to "well." Our model makes a major contribution by suggesting an answer to the puzzle. Hispanics who are investing in English proficiency, have less time to invest in other forms of human capital. Hence during the period of learning English, those in the middle English categories may earn the same, or even less than those Hispanics who have decided to remain at the "none" level.

Looking at the differences due to the presence of other Hispanics (Table 5) we see that a robust conclusion under all cases is that Hispanics are paid less when the labor market has a significant number of Hispanics: in the table observe that the difference due to parameters is always greater when HISPS=0.0755 than when HISPS=0. The most straightforward explanation is a compensating differentials argument suggesting that Hispanics are willing to pay a premium for living and working in proximity to other Hispanics. Discrimination would potentially be an alternative explanation, in the case Becker discusses where a group is more discriminated against as the group becomes larger. But even in this case, Hispanics would have to have a preference for proximity to other Hispanics, or else they would be induced to move to less Hispanic areas, thereby decreasing the discrimination, and increasing wages.

Table 1: Definition of Variables

BORNUS	born in the U.S. (=1 if born in U.S.; = 0 otherwise)
NONE	the lowest two categories (these were combined into NONE because of the sparsity of observations)
SOME	middle English proficiency category
WELL	next to highest English proficiency category
VWELL	highest English proficiency category
PROFICIENT	Hispanics in the highest English proficiency category
NON-PROFICIENT	Hispanics in any English proficiency category except the highest
FOREXP	years of potential work experience abroad
EXPER	years of potential work experience
EXPSQ	years of potential work experience squared
EDUC	years of education
EDUCEXP	interaction between years of education and years of potential work experience
CUBAN	=1 if person was of Cuban heritage; = 0 otherwise
MEXICAN	=1 if Hispanic was of Mexican heritage; = 0 otherwise
PUERTO	=1 if person was of Puerto Rican heritage; = 0 otherwise
OTHER	=1 if person was Hispanic, but was neither Cuban, Mexican nor Puerto Rican; = 0 otherwise
LNWAGE	natural log of weekly earnings
HISPS	the fraction of an SMSA's population that was Hispanic in the 1980 Census
AGEIM	age of immigration to the U.S.; constructed on the basis of range of years in which immigration, years of schooling abroad and in the U.S., and other variables
TRANSITION TIME	number of years to change from non-proficient to proficient (starting at the time of entrance to the U.S. labor market (may be zero for someone entering proficient, but may not be negative)
K	the investment cost to achieve proficiency if English was learned instantaneously
SCHENG	years of schooling in English, regardless of where it took place (or just in America?)
T0	time in the U.S. before entering the U.S. labor market
CORRELATION	the correlation between unobserved ability in learning English with unobserved labor market ability
S.D.	standard deviation of error terms in earnings regressions (ε_p, ε_N , and u)

For the purpose of estimation convenience, all variables measured in years have been divided by 10.

Table 2: Sample Means

Variable	Hispanics	Non-Hispanics
LNWAGE	5.12	5.39
EDUC	10.07	12.63
EXPER	19.18	19.73
NEWENGL	0.02	0.12
NEAST	0.12	0.13
EASTMW	0.07	0.14
WESTMW	0.03	0.13
CENTATL	0.02	0.06
SOUTH	0.03	0.09
TEXREG	0.13	0.05
NORTHW	0.21	0.18
SOUTHW	0.21	0.02
PACIFIC	0.18	0.08
MEXICAN	0.61	NA
CUBAN	0.05	NA
PUERTO	0.10	NA
OTHER	0.24	NA
BORNUS	0.65	NA
FOREXP	3.18	NA
HISPS	0.18	NA
NONE	0.09	NA
SOME	0.07	NA
WELL	0.17	NA
VWELL	0.67	NA

Table 3: Standard Earnings Regressions Without English Proficiency

	Non-Hispanics	Hispanics			
		Entire Sample		Proficient	Non-Proficient
CONSTANT	3.325	3.564	3.633	3.285	4.377
	(151.83)	(39.17)	(39.55)	(26.68)	(28.80)
EDUC	0.109	0.0921	0.0926	0.118	0.0249
	(74.59)	(13.73)	(13.85)	(13.17)	(1.97)
EXPER	0.0943	0.0754	0.0755	0.929	0.0452
	(86.19)	(14.32)	(14.39)	(13.81)	(5.03)
EDUCEXP	-0.00165	-0.00142	-0.00144	-0.00229	-0.0000989
	(-28.24)	(-5.370)	(-5.440)	(-6.28)	(-0.218)
EXPERSQ	-0.00131	-0.00106	-0.00106	-0.00117	-0.000706
	(-96.01)	(-13.39)	(-13.37)	(-12.24)	(-4.96)
CUBAN		-0.0175	0.0131	0.143	0.142
		(-0.286)	(0.214)	(1.65)	(1.42)
OTHER		0.0250	0.0371	0.0543	0.0298
		(0.860)	(1.275)	(1.73)	(0.448)
PUERTO		-0.00656	-0.00596	0.0205	-0.0782
		(-0.140)	(-0.128)	(0.345)	(-0.982)
HISPS			-0.437	-0.384	-0.449
			(-4.611)	(-3.53)	(-2.45)
FOREXP				-0.0138	-0.0121
				(-3.25)	(-4.98)
NEWENGL	-0.113	-0.0816	-0.162	-0.0883	-0.143
	(-12.45)	(-0.9467)	(-1.846)	(-0.834)	(-0.931)
NEAST	0.0268	-0.0447	-0.0733	0.0146	0.0481
	(2.976)	(-0.892)	(-1.457)	(0.223)	(0.551)
EASTMW	0.0484	0.199	0.146	0.126	0.231
	(5.480)	(3.951)	(2.840)	(1.98)	(2.71)
WESTMW	-0.0659	0.0790	0.00905	-0.0587	0.104
	(-7.382)	(1.234)	(0.138)	(-0.811)	(0.755)
CENTATL	0.0412	0.0562	-0.0153	0.0700	0.0648
	(3.786)	(0.627)	(-0.169)	(0.668)	(0.373)
SOUTH	-0.104	-0.0951	-0.0966	-0.199	0.121
	(-10.60)	(-1.292)	(-1.318)	(-2.20)	(0.985)
TEXREG	-0.0675	-0.1170	-0.0690	-0.0830	-0.0583
	(-5.979)	(-2.938)	(-1.683)	(-1.70)	(-0.808)
NORTHW	-0.0641	0.0177	-0.0327	-0.0442	-0.0781
	(-7.558)	(0.499)	(-0.871)	(-1.05)	(-1.02)
SOUTHW	-0.0634	-0.0813	-0.00707	-0.0434	-0.00743
	(-4.291)	(-2.261)	(0.0177)	(-0.932)	(-0.0921)
R2	0.313	0.227	0.233	0.301	0.130
No. cases:	64998	2548	2548	1726	822

t-statistics are in parentheses below each coefficient.

Table 4: Full Information Maximum Likelihood Estimation of

Earnings Functions and Transition Time [for *m(t)=ln(1+t/10)*]

	Earnings Functions					
Variable	Proficient		Non-Proficient		Transition Time	
CONSTANT	3.221	(27.56)	4.551	(32.70)	5.588	(1.06)
EDUC	0.120	(14.20)	0.0132	(1.02)	-1.892	(-4.34)
EXPER	0.0940	(14.56)	0.0334	(4.10)		
EDUCEXP	-0.00222	(-6.371)	0.000257	(0.622)		
EXPER2	-0.00119	(-13.27)	-0.000556	(-4.33)		
CUBAN	0.0934	(1.14)	0.0927	(1.022)	-0.106	(-0.051)
OTHER	0.0644	(2.25)	-0.0251	(-0.412)	0.184	(0.162)
PUERTO	-0.0055	(-0.10)	-0.153	(-2.125)	-0.585	(-0.381)
HISPS	-0.356	(-3.59)	-0.570	(-3.48)		
FOREXP	-0.0188	(-3.481)	-0.00762	(-2.843)	0.122	(0.288)
TRANSITION TIME	2.144	(9.094)	3.801	(5.56)		
K			4.01	(4.232)		
BORNUS					9.63	(2.88)
SPANCHI					11.056	(3.964)
AGEIM					0.377	(0.900)
SCHENG1					-0.595	(-1.67)
T0					-1.175	(-2.50)
CORRELATION	-0.254	(-1.786)	0.0958	(0.849)		
S.D.	0.454	(49.81)	0.473	(36.54)	13.26	(5.26)
NEWENGL	-0.0224	(-0.233)	-0.0857	(-0.570)		
NEAST	0.0335	(0.559)	0.0804	(1.02)		
EASTMW	0.124	(2.13)	0.176	(2.33)		
WESTMW	0.0071	(0.108)	0.0763	(0.625)		
CENTATL	0.0587	(0.605)	0.0651	(0.429)		
SOUTH	-0.186	(-2.22)	0.158	(1.415)		
TEXREG	-0.0929	(-2.08)	-0.0533	(-0.821)		
NORTHW	-0.0239	(-0.621)	-0.0389	(-0.557)		
SOUTHW	-0.0420	(-0.991)	0.0457	(0.622)		
Mean Log-Likelihood -1.057						
Number of Cases: 2548						

Assymptotic t-statistics are in parentheses beside each coefficient.

Table 5: Decomposition of Hispanic and Non-Hispanic

Earnings Differential (ln Y_H - ln Y_N)

Case	Entire Difference[*]	Difference due to Parameters $X_N(B_H-B_N)$	Standard Error of Difference
Entire Hispanic Sample			
Without HISPS, or Language Variables	-0.27	-0.106	0.0113
Without Language Variables			
HISPS = 0.00	-0.27	-0.0247	0.0210
HISPS = 0.0755	-0.27	-0.0577	0.0154
Proficient & Non-Proficient Groups			
Exogenous Language			
Proficient Group			
Own Weights	?		
HISPS = 0.00	?	0.00348	0.0239
HISPS = 0.0755	?	-0.0255	0.0175
Entire Hispanic Sample Weights			
HISPS = 0.00	?	-0.0275	0.0254
HISPS = 0.0755	?	-0.0565	0.0200
Non-Proficient Group			
Own Weights			
HISPS = 0.00	?	-0.103	0.0398
HISPS = 0.0755	?	-0.136	0.0286
Entire Hispanic Sample Weights			
HISPS = 0.00	?	-0.147	0.0462
HISPS = 0.0755	?	-0.181	0.0361
Endogenous Language			
Proficient Group			
Own Weights			
HISPS = 0.00	?	-0.00709	0.0283
HISPS = 0.0755	?	-0.0339	0.0245
Entire Hispanic Sample Weights			
HISPS = 0.00	?	-0.0555	0.0414
HISPS = 0.0755	?	-0.0824	0.0393
Non-Proficient Group			
Own Weights			
HISPS = 0.00	?	-0.105	0.0484
HISPS = 0.0755	?	-0.148	0.0419
Entire Hispanic Sample Weights			
HISPS = 0.00	?	-0.165	0.0687
HISPS = 0.0755	?	-0.208	0.0640

[*]The entire difference can be decomposed into the difference due to parameters and the difference due to characteristics.

Table 6: Returns to English, Education and English for

Non-Hispanics and Hispanics

Case	Return to Education	Return to Experience
NON-HISPANICS		
Non-Hispanic Group Weights	0.0767	0.0217
Entire Hispanic Sample Group Weights	0.0776	0.0273
Proficient Group Weights	0.0812	0.0309
Non-Proficient Group Weights	0.0700	0.0198
HISPANICS		
Entire Hispanic Sample		
Without HISPS or Language Variables	0.0648	0.0203
Without Language Variables	0.0651	0.0205
Proficient & Non-Proficient Groups		
With HISPS and Exogenous Language		
Proficient Group		
Own Weights	0.0790	0.0272
Entire Hispanic Sample Weights	0.0740	0.0251
Non-Proficient Group		
Own Weights	0.0225	0.0109
Entire Hispanic Sample Weights	0.0230	0.0171
With HISPS and Endogenous Language		
Proficient Group		
Own Weights	0.0826	0.0283
Entire Hispanic Sample Weights	0.0777	0.0260
Non-Proficient Group		
Own Weights	0.0193	0.00878
Entire Hispanic Sample Weights	0.0182	0.0146

Table 7: Returns to English for Hispanics

Case	Return to English
With HISPS and Exogenous Language	
Proficient Group Weights	0.184
Non-Proficient Group Weights	0.0223
Entire Hispanic Sample Weights	0.132
With HISPS and Endogenous Language	
Proficient Group Weights	0.161
Non-Proficient Group Weights	-0.0583
Entire Hispanic Sample Weights	0.0900

FOOTNOTES

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i. Stolzenberg gives a set of criteria for the choice of an appropriate data set and concludes that the SIE meets such criteria. His criteria are:

a. Data must be relatively recent, so they will be relevant to current policy concerns.

b. Data must include variables which are known or thought to be important to understanding occupational achievement in general, and the labor market experiences of Hispanics in particular--for example, English language ability.

c. Data must identify specific geographic areas in which respondents reside or work, and specific ethnic groups of which they are members, to allow investigation of the geographic and ethnic differences in occupational achievement which are the subject of this research.

d. Data must include sufficient numbers of respondents, and Hispanic respondents in particular, to estimate models which are appropriate for testing hypotheses about subgroup and geographic differences in occupational achievement of Hispanics and non-Hispanics. In particular, sample size must be sufficient to address the current great policy interest in State or SMSA differences in Hispanic/non-Hispanic occupational inequality.

ii. Barry Chiswick pointed out to us that this category seems to contain non-Hispanics who are from central and southern United States.

iii. See McManus (1985, p. 821) for a convincing critique of the complexity and irreproducibility of the measure in McManus et al. McManus also notes that by incorporating a variable on household language that McManus et al measure may be picking up the effects of cultural assimilation as well as the conceptually distinct affects of language proficiency. Stolzenberg arbitrarily gives a value of one to five to each of five levels of English proficiency. In Veltman English proficiency affects only the level of the earnings function.

iv. On 10/26/87 we spoke with Arthur Cresce one of the Spanish population experts at the Bureau of the Census who told us that it was routine procedure for interviewers for the Current Population Survey (CPS), of which the SIE was a one-time adjunct, to be bilingual in areas with heavy concentrations of persons who do not speak English. Furthermore, he said that it is routine procedure for an interviewer to call in help from a translator for languages in which the interviewer is not fluent. On the issue of inclusion of non-documented aliens ('illegals') he said that although no effort was made to exclude them, and it is not possible to distinguish them in the data set, no effort was made to reassure them of the confidentiality of their responses. He went on to say that when an effort was made to reassure them in the 1980 Census, approximately five million more Hispanics responded than had been estimated. The bottom line for the SIE is that it probably includes few undocumented aliens. (The available documentation on the SIE is surprisingly silent on these issues.)

v. In the empirical work we also assume that τ^* does not depend on region or the concentration of Hispanics, for reasons that we state later.

vi. In the future, we will try other forms for the function m(t). The following forms will work, i.e. they have the properties that $m(0)=0$, $m'(t)>0$, and if $t<0$ then $m(t)<0$: $m(t) = \ln(1+\delta t)$, $\delta>0$; $m(t)=t$; $m(t)=t^{\delta}$, δ odd.

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APPENDIX

Table A-8: Full Information Maximum Likelihood Estimation

of Earnings Functions and Transition Time [for *m(t)=???ln(1+t/10)*]

Variables	Coefficient	t-statistic
SIGP	-0.7755	(-40.336)
SIGN	-0.7486	(-27.171)
SIGU	3.5963	(19.099)
RHOP	-0.38	(-1.675)
RHON	0.1472	(0.813)
RP	30.547	(0.703)
RN	54.645	(0.51)
AP	3.22	(27.529)
EDUCP	1.2027	(14.208)
EXPERP	0.9333	(14.447)
EDEXPP	-0.2211	(-6.323)
EXPER2P	-0.1172	(-13.021)
FOREXP	-0.1888	(-3.687)
CUBANP	0.0999	(1.222)
OTHERP	0.0618	(2.132)
PUERTOP	0.0027	(0.05)
HISPP	-0.36	(-3.599)
NEWENGLP	-0.0195	(-0.201)
NEASTP	0.0298	(0.492)
EASTMWP	0.1204	(2.052)
WESTMWP	0.0123	(0.183)
CENTATLP	0.0594	(0.613)
SOUTHP	-0.191	(-2.281)
TEXREGP	-0.0877	(-1.95)
NORTHWP	-0.0242	(-0.623)
SOUTHWP	-0.0372	(-0.871)
AN	4.5341	(32.426)
EDUCN	0.1469	(1.12)
EXPERN	0.3408	(4.156)
EDEXPN	0.0211	(0.504)
EXPER2N	-0.0564	(-4.363)
FOREXN	-0.0768	(-2.853)
CUBANN	0.104	(1.15)
OTHERN	-0.0226	(-0.368)
PUERTON	-0.1522	(-2.105)
HISPN	-0.557	(-3.393)
NEWENGLN	-0.0693	(-0.468)
NEASTN	0.0824	(1.038)
EASTMWN	0.1836	(2.418)
WESTMWN	0.0756	(0.612)
CENTATLN	0.0667	(0.434)
SOUTHN	0.1486	(1.336)
TEXREGN	-0.0555	(-0.851)
NORTHWN	-0.0438	(-0.626)
SOUTHWN	0.0346	(0.471)
A0	18.1431	(1.231)
BORNUS	26.5004	(2.869)
SPANCHI	30.8643	(4.014)
AGEIM	7.2617	(0.636)
SCHENG1	-15.777	(-1.62)
T0	-35.334	(-2.637)
CUBAN	0.3127	(0.054)
OTHER	0.2443	(0.078)
PUERTO	-1.7644	(-0.416)
EDUC0	-50.7855	(-4.395)
FOREXP0	6.2588	(0.532)
K	2.4461	(11.313)

Mean Log-Likelihood: -1.0618
Number of Cases: 2548

Borjas, George J. "Immigrant and Emigrant Earnings: A Longitudinal Study" Economic Inquiry 27, no. 1 (Jan. 1989): 21-37.

You may want to reference this in your Hispanics paper with Locay.

McManus, Walter S. "Labor Market Effects of Language Enclaves: Hispanic Men in the United States." Journal of Human Resources 25, no. 2 (Spring 1990): 228-252.

from abstract:

"Empirical results are consistent with theoretical predictions: enclaves do reduce the earnings losses associated with limited English skills for Hispanic men, . . . " (p. 228)

Chiswick, Barry R. "Hispanic Men: Divergent Paths in the U.S. Labor Market." Monthly Labor Review 111, no. 11 (Nov. 1988): 239-253.