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ABSTRACT

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This paper develops a descriptive methodology for the analysis of wage growth of immigrants, based on human capital theory. The sources of the wage growth are: (i) the rise of the return to imported human capital; (ii) the impact of accumulated experience in the host country; and, (iii) the mobility up the occupational ladder in the host country. Using human capital theory, we derive a non-linear model that imposes restrictions across the earning equations of natives and immigrants. The two earning functions are estimated jointly, using repeated cross section data. Using data on immigrants from the former Soviet Union to Israel, we find: Upon arrival, immigrants receive no return for imported skills. In the ten years following arrival, wages of highly skilled immigrants grow at 8% a year. Rising prices of skills, occupational transitions, accumulated experience in Israel and economy-wide rise in wages account for 3.4, 1.1, 1.5 and 1.4 percent each. In the long run, the return for schooling converges to .028, substantially below the .069 for natives. We do not reject the hypothesis that the return for experience converges to that of natives, and immigrants receive higher return for their unmeasured skills. We find that there is some downgrading in occupational distribution of immigrants relative to that of natives. Moreover, the average wages of immigrants approach but do not converge to the wages of comparable natives. The main reason for that is the low return to their imported skills.

JEL Classification: J24, J31, J6

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1. Introduction

Immigration is an important part of the adjustment of labor markets to varying economic circumstances, as individuals try to move to where they can get the highest rewards for their skills. Typically, immigrants start at a low wage and then experience a relatively fast earning growth (see the surveys by Borjas, 1994, 2000 and LaLonde and Topel, 1997). As they arrive, immigrants learn the local language, the local institutions, the local market conditions, adjust their skills in training programs, accumulate local experience and find a better matches with local employers (see Weiss, Sauer and Gotlibovski, 2003 and Cohen and Eckstein, 2002). At the same time, employers become less uncertain of the immigrant's potential and realized quality (see Chiswick, 1978). These processes combine to provide immigrants with earnings that are relatively low and equal at arrival to the new country. However, overtime wages become higher and less equal as the rewards for their imported skills rise and immigrants choices affect their wage. In particular, expecting wages to grow, immigrants have special incentive to invest in human capital and to "try harder".

Several decades after the initial estimates of the returns to schooling (Becker, 1975, Mincer, 1974, and Griliches, 1977), the volume of research on the estimation methods and interpretations of the schooling coefficient in the wage equation continues to grow. This paper contributes to this literature, by analyzing wages of immigrants, claiming that the market returns to their imported schooling and experience *rise* with time in the host country. We derive the implications of such a trend for the investment behavior of immigrants in the host country and for the specification and estimation of earning equations of immigrants and natives.

We present a simple human capital model that explains the connections between rising prices of skills and investment in human capital and describes the dynamics of the earnings of immigrants vis-a-vis the earnings of comparable natives. In the model, the rising prices of skills and occupational transitions are given exogenously, but the investment in local skills is endogenous. We use the theoretical model to specify the wage equations for natives and immigrants. The wage equations for natives and immigrants are jointly estimated, using the restrictions implied by the theoretical analysis. Combining the estimated wage functions with estimates of occupational transitions, we provide a quantitative model that allows us to

identify the sources of wage growth of immigrants and natives and to analyze the assimilation of immigrants from the former USSR in Israel. In particular, we distinguish three sources of wage growth for immigrants: (i) the rise of the return to imported human capital; (ii) the impact of accumulated experience in the host country; and, (iii) the mobility up the occupational ladder in the host country, and estimate their relative importance.

The mass immigration of Jews from the former Soviet Union to Israel, which started towards the end of 1989, is characterized by an exceptionally high level of education and prior experience in academic jobs (see Table 1).[1] The unexpected change in the emigration policy of the former USSR and the policy of Israel to accept all Jews combined to create a large wave which is almost free of selection. Despite its large size and high level of skills, this wave had almost no impact on the wages or employment of native Israelis.[2] The focus of this paper, however, is on the dynamics of the wages of immigrants in the first ten years following entry. The annual income surveys from 1991 to 2000 and the 1995 census, that are used by us in this study, show that, on arrival, immigrants start at low skill occupation receiving low wages (about 70 percent of an average native), which are, on the average, the *same,* independently of their level of schooling (see Tables $1-3$). After ten years, the wage for immigrants with at least 16 years of schooling increases by 81% and for immigrants with at most 12 years of schooling the wage increases only by 27%, thereby creating inequality among immigrants based on their imported skills. The figures in Table 3 show that recent immigrants, with experience in Israel of 5 years or less, earn less than native workers with the same experience in Israel (who are, on the average, 14 years younger), suggesting that experience acquired abroad is of little value. In contrast, immigrants who have spent in Israel more than 5 years earn, on average, about the same wage as natives with the same experience in Israel (who are, on the average, 8 years younger). This raw data show that on arrival the

[1] The Israeli population at the end of 1989 was 4.56 million and the pre-migration population growth rate during the 1980's was between 1.4% and 1.8% per annum. The 1990-91 wave of immigration increased the population by 7.6%, in two years, which is more than twice the normal population growth. Since 1995 until 2000 the flow of immigrants is about 55 to 65 thousands a year. Compared with the immigration into the US and other receiving countries, this wave stands out in its magnitude.

[2] The average real wage stayed almost constant, and the wage of natives with more than 16 years of schooling have risen during the period 1991-1995. See Eckstein and Weiss (2002) and Cohen and Hsieh (2000) for the possible explanations for this, somewhat surprising, outcome.

earning distribution is relatively equal and independent of imported skills. Overtime, the earning distribution become unequal and the rewards for imported and accumulated skills increases.

The estimated earning function confirm that upon arrival immigrants receive no return for imported human capital in terms of schooling and experience. The prices of these skills rise with time spent in Israel, but a large gap remains between the prices that immigrants and natives obtain in the Israeli labor market. This is mainly reflected in a low return for schooling acquired abroad, which we estimate to be, in the long run, .028 for immigrants, substantially below the .069 for natives (Freidberg, 1999, reports a similar finding). We cannot reject the hypothesis that immigrants eventually obtain the same return on experience as natives, and the importance of unobserved skills declines sharply with time spent in Israel. We find that the growth of wages is non-linear in the time since migration and most of the growth occur at the first few years.

Wage growth is closely linked to changes in occupation and improved job matching. Immigrants from the former USSR entered the Israeli labor force quickly, willing to accept any available job. The occupational distribution of first jobs among immigrants is similar to the distribution of jobs in the Israeli economy, implying a substantial occupational downgrading. In the second phase, the highly educated immigrants climb up the occupational scale, obtaining better jobs and higher wages in each job. We find that, in the initial ten years following arrival, wages of immigrants grow at a fast rate of 6.6 percent a year (8.03 percent for immigrants with more than 16 years of schooling). Using the estimated wage equations, we find that half of this growth can be ascribed to rising return to imported skills. Occupational transitions account for a growth of 1.1 percent per year among immigrants with 16+ years of schooling, and accumulated experience in Israel and the economy wide rise in wages account for about 1.5 percent, each, per year. During that same period, the proportion of skilled immigrants (with 16 years of schooling or more) who work in high skill occupations in Israel rose from 20 percent to 35 percent.

We find evidence for reduced quality for more recent cohorts of immigrants from the former USSR. This trend holds for both observable skills, such as schooling and occupation and for unobservable skills. Accounting for this effect, we find that conditional on occupation, there is no long run convergence of wages of immigrants to natives. In high skill occupations,

the final gap is small, but immigrants who remain in unskilled jobs receive lower wages than comparable Israelis even after a long stay in Israel.

Most existing studies on wages of immigrants in the US focused on the rather speedy assimilation rate to the wage of comparable natives of the same ethnicity. For instance, LaLonde and Topel (1997) reported rates of assimilation, that is, changes in the wage differences rate between comparable workers, that range from 8% among Europeans to 24% among Asians (Brojas (1985) reports similar results). We find that immigrants from the USSR to Israel assimilate at a rate of about 20 percent during the first ten years that is similar to the rate of assimilation of Asian immigrants in the US during the 1970's who also had a high level of schooling.

The rest of the paper is organized as follows. In the next section, we analyze a human capital model that justifies the wage equations that we estimate for natives and immigrants. In section 3, we describe the data and in section 4 we present the estimation results. Section 5 describes the occupational dynamics of immigrants and natives and sections 6 and 7 discuss the implications for wage growth and wage convergence, respectively.

2. A Model for Earning Equations of Immigrants

We now present a simple human capital model that allows us to compare the patterns of earnings functions for immigrants and natives. The model describes the investment decisions of immigrants and natives and derive the implications for wage growth. The new feature in this analysis is the explicit introduction of time since arrival effects on prices of skills that influence the immigrants investment decisions. An immigrant brings with him a fixed set of marketable skills such as schooling, occupation and work experience acquired abroad. As time passes, these skills are gradually adapted to the new labor market, and their quality and market value rises. The immigrant may also augment his skills or acquire new skills in new labor market. The acquisition of new skills requires some sacrifice of current earning. The investment decisions interact with the changes in the market value of the immigrant's skills and together determine his earning growth. In particular, rising prices for imported skills provides an added incentive for investment because the sacrifice of current earnings is low relative to the growth in future earning capacity. A native faces a similar investment

problem, except that he does not have skills that were acquired abroad and are being adapted to the host country's labor market.

To formalize this process, let x_s be quantity of skill s, $s = 1, 2...S$, that an individual possesses. Human capital, K, is an aggregate which summarizes individual skills in terms of productive capacity. Different skills are rewarded differentially at different occupations and we assume that this aggregate may be represented as

$$K_j = \exp(\sum \theta_{sj} x_s), \tag{1}$$

where θ_{sj} are non negative parameters that represent the contribution of skill s in occupation j (see Welch, 1969). Firms reward individual skills indirectly by renting human capital at the market determined rental rate, R. Thus, the parameter θ_{sj} is the proportional increase in earning capacity associated with a unit increase in skill x_s if the individual works in occupation j. Because θ_{sj} is independent of skill acquisition, each individual may view it as the implicit "price" (or "rate of return") of skill s.[3] In a frictionless economy, each worker will apply his human capital to the occupation in which his bundle of skills yields the highest reward. However, we allow here for the possibility that occupational assignments are an outcome of a two sided search process, whereby individuals may not end up in their most preferred occupation. Earning capacity is then

$$Y = RK, \tag{2}$$

where K is the worker's human capital in the chosen or assigned occupation. To simplify our analysis, we assume here that the transitions up the occupational scale occur exogenously

[3]Since the relative prices of skills are determined by the technology of production, i.e., the demand side, the coefficients θ_s may also be interpreted as quality parameters, objective or perceived, which change as the immigrant's imported skills become more applicable to local market conditions. For the analysis of individual investment decisions, the distinction between price and quality makes no difference. Following recent literature (e.g., Juhn et al., 1993) we shall use the term price. At the aggregate, the different θ_s together with the available number of people with each skill, determine the supply of K and the rental rate R. Given the equilibrium value of R and the vector of θ_s, the bundle of skills that each person possesses can be evaluated in terms of the consumption good. In a more general specification skills need not be perfect substitutes and their respective prices will depend on the aggregate stocks of the different skills (see Heckman et al., 1997).

and are fully anticipated. [4]

For the analysis of immigrants' earnings, it is important to partition skills into two groups: locally acquired skills and imported skills. The imported skills are fixed in quantity, but an immigrant may acquire local skills. A basic feature that we wish to introduce is that the prices of imported skills rise with time spent in the host country, relative to the prices of locally acquired skills. This rise in prices, which reflects gradual adoption of imported skills to local market conditions through improved job matching, may influence local investment decisions.

We denote the subsets of skills acquired abroad and in Israel by S_0 and S_1, respectively, and assume that for all $s \in S_0$, the quantities x_s are fixed at $x_s(0)$, but prices are allowed to vary with time in Israel, while for all $s \in S_1$, prices are fixed but quantities can vary. Correspondingly, we define $K_{0j}(t) = \exp(\sum_{s \in S_0} \theta_{sj}(t) x_s)$, $K_{1j}(t) = \exp(\sum_{s \in S_1} \theta_{sj} x_s(t))$. An immigrant can augment his local skills by training in school or on the job or in the job in the new country. We shall focus here on investments on the job. Assuming that investment in any skill requires the same sacrifice of earnings, and because prices of local skill are fixed, each immigrant will choose to invest only in the skill that maximizes his life time earnings. We denote the resulting value of local human capital by $K_1(t)$. In short, the immigrant's earning capacity is given by

$$Y = RK_1(t)K_0(t), \tag{3}$$

where $K_0(t)$ reflects the process of the adoption of the worker's imported skills through changing prices and occupational transitions and $K_1(t)$ reflects the process of investment in local skills. Note that the the two types of human capital are *complements* in their influence on the immigrants earning capacity in the host country.

Using a specification suggested by Ben Porath (1967), we can characterize the investment

[4] This assumption effectively ignores the selection issues that result from endogenous occupational switches. It is substantially more difficult to analyze and estimate models in which occupational switches and investment are jointly determined. Although, Weiss et al (2003) and Cohen and Eckstein (2002) estimate such structural models, we adopt here a less structural and more descriptive approach that allows us to cover a broader set of issues.

policy in the following manner. The local current earnings of the immigrant is

$$y(t) = Y(t)(1 - x(t)), \tag{4}$$

where $x(t)$ is the proportion of earnings that is forgone as a result of investment on the job. The accumulation of local human capital is given by

$$\dot{K_1}(t) = f(x(t)Y(t)) - \delta K_1(t). \tag{5}$$

The function $f(I_t)$ is assumed to increase in I_t and strictly concave, with $f(0) = 0$, and δ is the depreciation rate of local human capital. The immigrant maximizes his life time earning and the optimal investment policy is characterized by

$$\frac{RK_0(t)}{f'(x(t)Y(t))} = R\int_0^{T-t} e^{-(r+\delta)\tau} K_0(t+\tau)d\tau, \tag{6}$$

where T is the end of the work period, assuming an interior solution for the rate of investment. Condition (6) equates the marginal cost for an additional unit of K_1 in time t to the expected additional earnings that this unit will provide throughout the remaining work period. The current value of the imported human capital $K_0(t)$ influences the marginal cost of investment, while the future value of imported capital $K_0(t+\tau)$ influences the future benefits. Assuming that the local value of the imported skills is rising, $K_0(t+\tau) > K_0(t)$, which provides an additional incentive for investment to immigrants. To ensure that investment declines with experience, we shall assume that the growth rate in imported human capital $\frac{\dot{K_0}}{K_0}$ declines with time spent in the new country.

Although the implications of changing prices for the unobserved investment are quite clear, it is less obvious what are the implications for observed earnings. For the purpose of our empirical work, we shall use, therefore, a different specification for the production function, suggested by Blinder and Weiss (1976),

$$\frac{\dot{K_1}(t)}{K_1(t)} = g(x(t)) - \delta, \tag{5'}$$

where $g(x(t))$ is increasing and concave, with $g(0) = 0$.[5] If we parametrize this function as

$$g(x(t)) = \gamma - \gamma(1-x)^{\frac{1}{\alpha}}, \tag{7}$$

[5]The two "production functions" (5) and (5') share the crucial simplification that the value of human

with $0 < \alpha < 1$ and $\gamma > r + \delta$, then the optimal earning path satisfies

$$\frac{\dot{y}}{y} = \begin{cases} \frac{\frac{\dot{K}_0}{K_0} + \gamma - r\alpha - \delta}{1-\alpha} & if \quad t \leq t_1 \\ \frac{\dot{K}_0}{K_0} - \delta & if \quad t > t_1 \end{cases} . \tag{8}$$

Thus, the growth rate of earning is a simple piece-wise *linear* function of the growth rate in the value of imported skills. When the worker does not invest in local skills the change in prices translates into a change in earning on one to one basis. However, when the worker also acquires local skills, there is a "multiplier effect", given by $\frac{1}{1-\alpha}$, reflecting the impact of increasing prices of imported skills on the investment in local skills.[6]

We can now compare the earning paths of immigrants and natives. The basic difference between natives and immigrants is that immigrants bring with them skills which are not immediately applicable to the local market conditions. Consider a native and an immigrant with the same skills then, assuming no occupational switches, their earnings during the investment period are given by

$$\begin{aligned} \ln y_m(t) &= \ln K_0(0) + \ln(1 - x_m(0)) + \frac{1}{1-\alpha}(\ln K_0(t) - \ln K_0(0)) + \frac{\gamma - r\alpha - \delta}{1-\alpha}t, \\ \ln y_n(t) &= \ln K_1(0) + \ln(1 - x_n(0)) + \frac{\gamma - r\alpha - \delta}{1-\alpha}t, \end{aligned} \tag{9}$$

where m indicates an immigrant, n indicates a native, $K_0(0)$ is the initial local value of the immigrant's imported skills and $K_1(0)$ is the initial human capital of the native. At the early stage of stay in Israel, immigrants are paid lower prices for their skills. Hence, $K_0(0) < K_1(0)$. In addition, because the immigrant expects a rise in these prices, he invests more in local human capital and, therefore, $x_m(0) > x_n(0)$. Together, these facts imply that

depends only on the remaining work horizon and is thus independent of the current stock (see Weiss 1986). The difference between the two specification is that in (5), " time", local and imported capital enter symmetrically into the production of local human, while in (5') local human capital is produced by local capital and local time. Thus, imported skills enter only through their effect on local earnings.

[6]The time in which investment stops, t_1 is determined endogenously by the condition

$$\frac{\alpha}{\gamma}K_0(t_1) = \int_0^{T-t_1} e^{-(r+\delta)\tau} K_0(t_1 + \tau)d\tau.$$

the initial observed earnings, $y(0) = K(0)(1 - x(0))$ are lower for the immigrant. However, because of the rise in the prices of imported skills and the higher investment, the immigrant's earnings grow faster. After sufficient time in the host country, the prices of imported skill may converge to the prices that the native obtains so that $K_0(t)$ converges to $K_1(0)$. If this happens, $y_m(t)$ can exceed $y_n(t)$, because

$$\ln K_0(0) + \frac{1}{1-\alpha}(\ln K_1(0) - \ln K_0(0)) > \ln K_1(0).$$

Thus, earnings of immigrants can *overtake* the earnings of natives if the prices of imported skills converge to the *same* price as obtained by natives for locally produced skills, because increasing prices on imported human capital imply higher investments by immigrants. However, if imported skills are of lower quality, and their long run price falls short of the value of locally acquired skills, then earnings of immigrants may never catch up with those of natives. The later case is likely when immigrants arrive from less advanced country to a much more advanced market as is the case of immigrants from the former Soviet Union to Israel. However, this is an empirical issue that this study investigates.

The positive interaction between rising prices for imported skills and the incentive to invest in local human capital provides a simple answer to a query raised by Borjas (1994, p. 1672) "why would immigrants accumulate more human capital than natives?" within the context of standard human capital theory. There is no need to rely on heterogeneity or self selection to explain overtaking. Immigrants may "try harder", simply because they have stronger market incentives to invest in human capital. The same principle applies to any group that has a lower rental rate for human capital and expects it to rise with time. Racial discrimination is a possible example. Formally, our model of increasing prices of skills due to adaptation is indistinguishable from an increase in rental rates due to a gradually reduced discrimination by employers.

3. The Empirical Earning Function

The empirical earning function suggested by Mincer assumes static conditions and that investment declines linearly with the remaining working time. The model in this paper implies that investment is done under time varying conditions, and the investment rule is

influenced not only by the remaining work time but also by the behavior of the local value of imported skills.

We make the following functional form assumptions. Let $t - t_0$ be the time since arrival of the immigrant, then

$$\theta_{sj}(t - t_0) = e^{-\lambda((t-t_0)}\theta_{sj}(t_0) + (1 - e^{-\lambda((t-t_0)})\overline{\theta}_s \tag{10}$$

Thus, the current price $\theta_{sj}(t - t_0)$ is a weighted average of the initial price $\theta_{sj}(t_0)$ and the long run value $\overline{\theta}_s$. As the immigrant spends more time in the host country, the price of each imported skill approaches $\overline{\theta}_s$. The specification imposed in (10) has the convenient property that the price of skill s in occupation j can be written as

$$\theta_{sj}(t - t_0) = d_{sj}e^{-\lambda((t-t_0)} + e^{-\lambda((t-t_0)}\theta_s(t_0) + (1 - e^{-\lambda((t-t_0)})\overline{\theta}_s, \tag{10'}$$

where θ_s and $\overline{\theta}_s$ can be interpreted as the prices that the immigrant receives when he reaches his "final" occupation, where his skills match well with that occupation skill requirement, and d_{sj} is a constant that represents the initial difference between the prices of skill s in the first and final occupation. The parameter $\lambda > 0$ controls the speed of adjustment, given by

$$\dot{\theta}_{sj} = \lambda(\overline{\theta}_s - \theta_{sj}(t - t_0)). \tag{11}$$

An important feature that is captured by these assumptions is that the value of imported capital $K_0(t - t_0)$ of an immigrant may follow a different time path in the new country, depending on the *composition* of skills that he brings and on his success in climbing up the occupational scale in the host country. Although we assume a common rate of adjustment, the change in the price of each skill may differ, depending upon the distance between the current price from the long term price. The value of the immigrants's imported skills rises, continuously within each occupation and may jump up when he switches occupations. By construction, the rate of increase in the price of each skill declines with its current level, implying that $\frac{\dot{K_0}}{K_0}$ declines with the time spent in the new country.

It remains to specify the impact of age, or the remaining work horizon of the immigrant on his earnings. Equation (8) implies that if prices are fixed, log earning rise at a fixed rate until they reach a peak, and then decline at a fixed rate, when investment stops. Because workers

switch jobs and reach the peak at different ages, we shall assume, as an . approximation, that earnings grow according to

$$\frac{\dot{y}}{y} = a\frac{\dot{K_0}}{K_0} + b - ct, \tag{8'}$$

where the price and age effects are additive, and the age effect declines linearly. We can now pool the two equations for immigrants and natives and jointly estimate following earning function

$$\begin{aligned} \ln y \;=\; & b + \sum b_t year_t \\ & + b_{occ1} occ1 + b_{occ2} occ2 + (b - \frac{c}{2} exp_1) exp_1 + b_s(s_1 + s_0) \\ & + D(IM)\{[b' + de^{-\lambda exp_1}] + [b_{<90} c_{<90} + b_{92-2000} c_{92-2000}] \\ & + [(b'_{occ1} + d_{occ1} e^{-\lambda exp_1}] occ1 + [b'_{occ2} + d_{occ2} e^{-\lambda(t-t_0)}] occ2 \\ & + [b'_{exp} + d_{exp} e^{-\lambda exp_1)}][(b - \frac{c}{2} exp_0) exp_0] \\ & + [(b'_s + d_s e^{-\lambda exp_1}] s_0\} + \varepsilon, \end{aligned} \tag{12}$$

where $D(IM) = 1$ is equal to one if the observation is of an immigrant and to zero otherwise. Potential experience in Israel is denoted by exp_1 and exp_0 is potential experience in former USSR. The number of years of schooling in the USSR are denoted by s_0 is and s_1 is the number of years of schooling acquired in Israel. The occupational dummies $occ1$, and $occ2$ indicate if the individual works in occupations 1 or 2 in Israel, respectively, (occupation 3 is the reference group).[7] The year dummies indicate the year of observation that ranges from 1991 to 2000, the cohort dummies $c_{<90}$ and $c_{92-2000}$ indicate if the immigrant entered Israel, before 1990 or between 1992 and 2000, respectively.[8]

The observed imported skills in equation (12) are schooling and experience acquired abroad. Schooling is measured simply by years spent in school. However, experience is

[7] The occupational transitions are assumed to occour exognously. Later in the paper we estimate the occupational allocation probability using a multinomial logit model. The occupational dummies are consistent with our assumption that the value of K_0 (or R) may be different for each occupation.

[8] The year effects allow for changes in the rental rate due to common aggregate shocks during the period of mass immigration and the cohort effects represent changes in the unobserved quality of different cohorts as well as congestion effects.

not simply potential or actual work experience, instead, it is the amount of human capital or skills accumulated in work. We measure this quantity by the expression $[b\,\mathsf{exp} - \frac{c\,\mathsf{exp}^2}{2}]$, where *exp* denotes experience, defined in the usual way (age-schooling -6-military service). We normalize by setting the price (in terms of log earnings) which is paid to Israelis for their "true" experience to unity. We shall *define* the "true" work experience that immigrants import as $[b\,\mathsf{exp}_0 - \frac{c\,\mathsf{exp}_0{}^2}{2}]$, using the *same* values for b and c as for Israelis.[9] We then estimate the time pattern of the price that immigrants receive for this quantity.

The sum of the coefficients $b'_s + d_s$ measures the difference between the rate of return (price) that immigrants get for their imported schooling at the first year of their arrival and the rate of return that Israelis (and immigrants) receive for locally acquired schooling, and b'_s is the long run difference in the rate of return for schooling between immigrants and Israelis. Similarly, The sum of the coefficients $b'_{\mathsf{exp}} + d_{\mathsf{exp}}$ measures the initial difference between the rate of return (price) that immigrants get for their imported experience and the rate of return that Israelis (and immigrants) receive for locally acquired experience, while b'_{exp} is the long run difference in this price. The parameter λ describes the speed of adjustment between these short term and long term effects. The coefficients $b\prime$ and d associated with the immigrant's occupation in Israel capture the different evaluation of the immigrant skills in different occupations, which may also vary with time. Finally, The coefficients $b\prime$ and d associated with immigrant dummy itself captures the effect of unmeasured skills of the immigrants on the adjustment process.

Equation (12) allows us to describe and compare the parameters governing the dynamics and convergence of the difference between the earnings of immigrants and natives. Thus, if the parameter b'_k corresponding to skill k is not significantly different from zero then the price of this skills converges to that of locally acquired skills. However, if this coefficient is negative, there is no convergence. In addition, if the speed of adjustment, represented by λ, is slow then immigrants who entered at an old age will never catch up with similar Israeli within their working lifetime. We thus obtain a flexible specification which *allows* for

[9] If both the parameters b and c differ between Israelis and immigrants, one cannot separate "quantity" from "price". It is possible, however, for one parameter, to differ across these groups. We have estimated the model, allowing the coefficient c to differ. We found that this coefficient was $-.00061$ for immigrants and $-.00066$ for Israelis. The difference between the two estimates is statistically insignificant.

convergence but does not impose it.

Equation (12) is nonlinear in the parameters and we estimate it by nonlinear least squares.[10] The joint estimation is due to the cross-equations restrictions implied by the human capital model of section 2. In a previous draft we imposed the restrictions by using a two-step procedure, yielding very similar results.[11]

4. Data

The main source of data for this paper are the Central Bureau of Statistics (CBS) income and labor force surveys for the years 1991-2000. The descriptive statistics for these data are displayed in Appendix Table A1.

On the average, immigrants are 4 years older than native workers[12], have one more year of schooling (13.7 for immigrants vs.12.8 years for natives) and earn about 65 percent of the monthly wage of native Israelis (and 66 percent of their hourly wage). Among male immigrants who arrived during 1989-1992, about 78% had more than 12 years of schooling (14.6 on average), compared with 34% (12.3 average years of schooling) among Israeli male workers in 1991. Only 29 percent of the immigrants worked in the former Soviet Union in blue-collar occupations, while 69 percent of native Israelis work in these occupations in 1990.[13] During the first ten years in Israel more than 68 percent of the male immigrants work in blue-collar occupations (see Table 4).

For the analysis of wage assimilation, we use the CBS income surveys for the years 1991 to 2000. These data are annual random samples of the whole Israeli population. We construct

[10] We implicitly assume that the variance of the errors is the same for immigrants and natives. We later empirically analyses this assumption. It should be noted that we have also estimated the model by a two stage method and the results turned out to be almost the same.

[11] The main restrictions are that the time effects are the same for natives an immigrants, as in Borjas (1985), and that immigrants obtain the same reward as natives, for locally acquired experience, implying common values for the parmaters b and c.

[12] This feature is in contrast to most immigrations, where immigrants tend to be relatively younger, and reflects the exogenous relaxation of emigration from the USSR and the free entry to Israel. Immigrants from the USSR.

[13] About 57,400 of those who arrived until the end of 1993 defined themselves as engineers and 12,200 as medical doctors, compared with 30,200 engineers and 15,600 physicians who were working in Israel in 1989.

two sub-samples of native born Israelis and immigrants from the former USSR who were older than 13 upon arrival.[14] Our data source for occupational transitions of immigrants is the CBS Labor Force Survey, from which the Income Survey is drawn (both surveys report occupation, but only the Income Survey has wage data). This is relatively large sample with almost 15.000 observations (see Table A1). We also use retrospective data contained in the Brookdale Survey of Engineers, which reports detailed work history for 714 male engineers from the former USSR who entered Israel in the recent wave, following 1989, and were surveyed in 1995.[15] To analyze occupational transitions in Israel, we define three broad occupational categories: occupation 1 ($occ1$) includes engineers, physicians, professors, other professionals with an academic degree and managers; occupation 2 ($occ2$) includes teachers, technicians, nurses, artists and other professionals; occupation 3 ($occ3$) includes blue collar and unskilled workers. The occupational distribution of working immigrants is quite similar to the occupational distribution of working Israelis.

The immigration flows from the former USSR were concentrated in two time periods; about 16 percent of the immigrants, observed in 1991-2000 arrived in the early wave of 1970-79, about 18 percent arrived in 1992-95 and 56 percent arrived in the recent wave of 1989-1992. Seventy nine percent the immigrants in the sample are newly arrived and have been in Israel for less than 10 years.

5. Estimation Results

In this section we report the results from estimating equation (12) using the data on natives and immigrants from 1991 to 2000.[16]

[14]The two subsamples include only Jewish men of ages 26 to 65 who worked more than two weeks during the month prior to the survey date more than 25 hours per week. We also exclude all individuals with no information on age, or on the number of years of schooling and with more than 31 years of schooling. The wage and hours of work are the average during the complete month before the survey.

[15]The average schooling of these engineers is 16.4 years, with 36 percent having 15 years of schooling, reflecting the fact that, in the former USSR, one could become an engineer by acquiring 10 years of elementary and high school education plus 5 years of university education.

[16]In a previous version of the paper we estimated this equation using data from 1991-1995 only. The results using the extended sample reported here are extremely close to the earlier version which can be found in Eckstein and Weiss (1998) where we used a two step method. The joint estimation with the shorter sample

5.1. Results for Natives

The estimates of the model for native Israelis (presented in Table 5) are similar to those obtained in other applications of Mincer's wage function. The only non standard feature is that we allow occupation to have separate effect on wages, beyond schooling. This is mainly done to allow comparability with immigrants, for whom occupational transitions play an important role. The introduction of occupational dummies has little impact on the estimated coefficients, except for the schooling coefficient that rises from .0694 to .0952 when occupation is omitted. The wages in occupation 1 and occupation 2 are, respectively, about 29 and 21percent higher than in occupation 3. There is a 4.2 percent increase of the hourly wage with the first year of experience and about 6.9 percent increase of the hourly wage with a year of education. The yearly dummies represent the difference from the wage in 1995. The estimated yearly dummies show that, despite the mass immigration, the wage per hour for Israelis is *increasing* during the period. Controlling for schooling, occupation and experience, the hourly wage in 1991 is about fourteen percent lower than in 1995 and all other years the real hourly wages of natives were lower than 1995. We interpret the reason for these observations for macroeconomic reasons that to some extend may be related to the aggregate number of immigrants.

5.2. Results for Immigrants

As explained above, the wage equation for immigrants is estimated jointly with that of Israelis and the results are shown in Table 6. In this case, the addition of occupational dummies influences all the coefficients and we shall discuss here the specification in which these effects are included.

The estimated speed of adjustment, λ, is .0995 per year, implying that within a period of ten years each skill price is adjusted by 63 percent of the initial distance from it's long run value. However, convergence in prices also depends on the initial and the long term differences between the prices that Israelis and immigrants obtain for their skills. We discuss each of the prices, for schooling, experience and unobserved skills, separately.

The initial difference, upon arrival, in the price (rate of return) of schooling between

was also very close to the results reported here.

immigrants and Israelis is $b_s + d_s = -.0429 - .0288 = -.0717$. Given the estimated rate of return of 0.0694 for native Israelis, the initial reward for schooling is slightly negative (but not significantly different from zero) for an average immigrant. The long run difference in the rate of return for schooling $b_s = -.0429$, and the rate of return that immigrants can expect in the long run is only $.0694 - .0429 = .0265$. This substantial gap between natives and immigrants suggests that schooling acquired in the former USSR is not fully transferable to Israel, either because differences in quality or informational frictions which cause immigrants to "give up" in their search for better jobs (see Weiss et al., 2003) The rate of increase in the return that immigrants obtain for their schooling is such that, after ten years, the rate of return reaches 0.0158 which is about 60 percent of its long run value.[17]

The initial difference, upon arrival, in the value of experience acquired abroad is $b_{exp} + d_{exp} = -.363 - 1.01 = -1.373$. Since the price of accumulated experience that Israelis obtain is normalized to one, this means that the initial return for accumulated experience is $1 - 1.373 = -.373$. This means that, initially, experience accumulated in the former USSR has negative value in the Israeli labor market. With time, however, the price rises to $1 - b_{exp} = 1 - .363 = .637$, which, given the high standard error on b_{exp}, is not significantly different from 1. Thus, we cannot reject the hypothesis that, in the long run, immigrants obtain the same rate of return for experience as native Israelis.

The occupational dummies show that immigrants who work in the high skill occupations 1, and in occupation 2, obtain higher premia (relative to occupation 3) than comparable Israeli workers. In the short run, the premia for occupations 1 is: $(.292 + (.346 - .253)) = .385$, and for occupation 2 it is: $(.206 + (.168 - .142)) = .232$. In the long run, these premia are even higher: $.292 + .346 = .638$ and $.206 + .168 = .374$, respectively. However, a large part of these occupational effects is a consequence of the lower rate of return for schooling in occupation 3.

We now turn to the discussion of the constant terms which summarize the *average* im-

[17] In estimating the wage equation for immigrants, we also allowed for an interaction between schooling and occupation. We find a lower rate of return for schooling in $occ3$ than $occ1$ and $occ2$. We present the results without the schooling-occupation interaction in order to keep the specification closer to the standard specifications. The rate of return reported here is similar for that of occupation 3 in the modified equation, because the data is dominated by immigrants who work in this occupation during the sample period.

pact of unmeasured characteristics (and their prices) of immigrants. As seen in Table 6, for both specifications, the coefficients b and d are positive and large, indicating that, in the short run, there is not much to distinguish between immigrants with different human capital indicators. However, with time, the constant term declines and more weight is shifted to observable characteristics, since their prices rise. Note that the cohort dummies indicate a reduction in the unmeasured quality of immigrants. Holding measured characteristics constant, immigrants who came before 1990 earn 4.99 percent more than immigrants who came in 1990-1991 (the omitted group), who earn 4.70 percent more than immigrants who came after 1992. This pattern is consistent with the observed deterioration, in terms of schooling, reported in Appendix Table A2. As noted by Borjas (1985), under the circumstances of declining cohort quality, control for cohort effects reduces the estimated effect of time spent in Israel.

6. Occupational Distribution and Transitions

In interpreting the data, we shall assume that market conditions, such as the demand for particular occupations and market evaluation of imported skills, largely determine the occupational transitions, and take occupational transitions to be exogenous.[18] The results, so far, show that the occupation in which an immigrant is employed has a strong impact on his wages. Therefore, the rate at which immigrants find jobs in the high skill occupations is an important determinant of wage growth. Because of market frictions, lack of information, knowledge of Hebrew, the need for skill adjustments and learning, immigrants do not immediately find jobs which match their qualifications and skills. Instead, they may start at the bottom of the occupational ladder and gradually climb up.

Table 4 shows the occupational distribution of immigrants, by years in Israel, for two age groups; those who arrived at age $26-40$ and those who arrived at age $41-55$. The figures show an increase in the proportion employed in occupation 1, especially among immigrants who arrived at a young age. Among those with more than 16 years of schooling, only 21

[18] We thus abstract from the choice of search intensity and acceptance rules, which are likely to be affected by the wage process Weiss et. al. (2003) and Cohen and Eckstien (2002) estimate structural models which incorporate these decisions.

percent are employed in occupation 1 upon arrival. After 4 years in Israel, this percentage rises to 34% and 24% among the young and old, respectively. Among those who had been in Israel for 5 to 15 years, the corresponding figures are 45% and 30%. By way of comparison, the percentage of natives with 16+ years of schooling who work in occupation 1 is 62% (see Appendix Table A3).

The proportion of immigrants not working declines sharply with time in Israel. Of those who have 16+ years of schooling, 21 percent of the young and 32 percent of the old did not work upon arrival. After 4 years in Israel, these proportions went down to 5 and 12 percent, respectively. The proportion not working among those with 16+ years of schooling is initially higher than for immigrants of all levels of schooling,. However, the rate of decline in non-employment is sharper for the 16+ group and after 15 years in Israel, the highly educated who were young on arrival have a lower non-employment rate. This pattern is consistent with the idea that highly educated immigrants adopt a more selective search strategy, that is, the evidence supports the notion that non-employed job search is more productive than employed job search (see Weiss et. al., 2003).

A similar pattern of a quick rise in the proportion of immigrants employed in occupation 1 is observed in Table 7, which displays the change in occupational distribution during the first 5 years in Israel for the recent wave of immigrants, using Brookdale's Survey of Engineers. The different sources tell the same story; initially, only about 20 percent of the qualified immigrants found a high skilled job, while after 4 or 5 years this proportion rises to about 40 percent.

The retrospective data in Brookdale's Survey of Engineers allows us to calculate annual transition matrices for immigrants during their first years in Israel.[19] Using monthly data, we calculate for each month the annual transition rate (12 months ahead) and then take monthly average for immigrant-engineers who were in Israel between 30 to 42 months. Table 8 presents these average transition rates for male immigrants who were $25-45$ years old upon

[19]We have two other panels which can be used for the same purpose. The two panels are the CBS panel of immigrants who arrived in 1990 and surveyed four times in 1991-1994 and the Brookdale Survey which in summer 1992 interviewed a random sample of 1200 immigrants and then again 900 of these immigrants in 1995. The patterns in these data, unconditional on education, are similar to what we present here, but because of small sample size, these sources are not directly useful for the calculation of transitions conditioned on sex schooling and age.

arrival to Israel.[20] As seen, the probability of leaving occupation 1 within a year is less than 4 percent. More than 21 percent of the non-working men go directly to occupation 1 within a year. In contrast, the rates of upward mobility from occupation 2 and 3 to occupation 1 are only 9 and 6 percent, respectively. Initially, the entry into occupation 1 is mainly from non-employment, which includes training and unemployment. Later on, as most immigrants are employed, the main source of entry into occupation 1 is occupation 3, although most the transitions from occupation 3 to occupation 1 are mainly through unemployment.

Under the strong assumption of stationary transition rates, we can use the transition probabilities matrix of Table 8 to forecast the future occupational distribution of the immigrant engineers.[21] Such out of sample forecasts are presented in Table 7 for some selected years. The prediction of 64 percent employment in occupation 1 after a stay of 20 years in Israel is not far from the observed 59 percent, reported in Table 4, for immigrants with 16+ years of schooling, who arrived at age $26-40$ and who have been in Israel for more than 15 years. It is also close to the observed average of 62 percent, reported in Appendix Table A3, for Israelis with 16+ years of schooling.

Similar comparisons, based on simple Logit estimation of the proportion of immigrants who work in occupations 1, 2 and 3, conditioned on working, are presented in Figure 1.[22] As seen, the proportion of Israeli workers, with 16+ years of schooling, who actually work in occupation 1, rises from about 60 percent at age 30 to about 80 percent at age 50. It is forecasted that, over the same age (time) interval, the proportion of immigrants who work in occupation 1, from the recent wave who entered Israel at age 30 with 16+ years of schooling, will rise rises from about 30 percent to about 70 percent. In other words, based on the

[20]The transitions reported in Table 8 are the average for immigrants who have been more than two and a half years in Israel, so that most of the people who are not working are unemployed and only few are in training programs.

[21]Because the transition matrix in Table 8 is from the early period in Israel and is assumed to be fixed over time, the figures in Table 7 may be imprecise. However, the structural model of Weiss et. al.(2003), which allows transitions to vary with time as the wage rises, yields similar predictions. For instance, the proportion of immigrant-engineers in occupation 1, after 20 years in Israel is predicted to be 60 percent.

[22]The Logits are estimated from the Labor Force Surveys, 1991-2000. For male Israelis, we control for schooling and age. For male immigrants, we control for schooling, age at arrival and cohort (see appendix Tables A4 and A5).

available information, it is expected that the occupational gap between recent immigrants and comparable Israelis will narrow substantially, but not completely, with time spent in Israel. The agreement of the predictions from the retrospective Survey of Engineers with the observed proportions in the pooled cross sections suggests that we can use, with some confidence, the occupational state probabilities in Table 8 to generate an expected wage profiles which are not conditioned on occupation.

7. A Decomposition of Wage Growth

The purpose of this section is to use the estimated earning equation in order to decompose the wage assimilation process into the four sources of the immigrants' earning growth after ten years in Israel. In particular, we assess the relative importance of the price change of imported skills, local experience, occupational change and the time effect on the wage growth of the first large cohort of immigrants. Table 9 provides a partition of the wage growth of immigrants in a synthetic cohort into four components: time, experience, price effects and occupational changes. Specifically, we select from the 1991 and 2000 cross sections immigrants who entered Israel in 1990. Averaging log wages for each cross section and taking the difference (divided by 10) yields the "average annual growth rate" for the 1990 synthetic cohort during the period 1991-2000. For each person in these two cross sections we can create a prediction based on *his* characteristics and occupation and generate the "average predicted growth rate". We then partition this prediction using the estimated coefficients in Tables 5 and 6. This exercise is performed for the whole sample of entrants in 1990 and to subsamples classified by schooling and age at arrival.

The time effect is derived directly from the 1991 year effect in Table 5. The experience effect is the average "true" experience in Israel, accumulated between 1991 and 2000, by members of the 1991 cross section. The price effect is defined as the average change in predicted residuals, *holding occupation constant* at the 1991 level. The occupation effect is the difference in the predicted residuals, in 2000, for the 1991 and 2000 cross sections. Since time in Israel is held constant in this comparison, the experience and price effects are accounted for and the remaining factor is the difference in occupational choices.[23]

[23]In the 1991 cross section, 12.8 percent worked in occupation 1, 12.0 per cent worked in occupation 2 and

The results in Table 9 show that increasing prices of skills are the most important factor in explaining wage growth during the initial five years following immigration. Of an average annual wage growth of 6.6 percent, 40% half is due to rising imported skill prices. Of course, this factor is more important the more schooling or experience the immigrant has. Changing occupation contributes 1.1 percent, general growth contributes 1.4 percent to wage growth and accumulation of experience contribute 1.4 percent to wage growth. As expected, occupational change is more important for immigrants with higher amount of imported schooling, and experience effects are more important for younger immigrants. The results show that the model under (over) predicts the wage growth of young (old) immigrants. This evidence suggests that age plays an independent role which is not captured by investment and accumulation of experience.[24]

We thus see that in the first ten years, rising prices of skills are the main cause for immigrant wage growth, and acquired skills and occupational transitions are of secondary importance. However, our specification of the wage dynamics implies that as the immigrant spends more time in Israel the rate increase in the price of skill declines. Meanwhile, the wage increase associated with occupational switches from occupations 3 and 2 into occupation 1 rises. This is seen from the increased distance between the predictions for immigrants in figures 2a, 2b and 2c below. This implies that occupational transitions become increasingly important.[25]

8. Convergence of Wages

A separate question from whether immigrants assimilate in the host country labor market is do their wages converge, overtake, or fall short of the wage of comparable natives? To answer this question, we now turn to study the long run behavior of immigrant wages. We first study the convergence within occupation, then we study the wage residual dynamics

75.2 percent worked in occupation 3. The corresponding figures in 1995 were 20.4, 13.8 and 65.7.

[24] A possible explanation is that employers are reluctant to hire and test old immigrants. Therefore, the probability of receiving wage offers in occupation 1 is lower for such workers (see Weiss et al., 2003).

[25] This interpretation is somewhat tentative, because the increasing discrepancy between occupations may reflect self selection. To address self selection, one must extend the model to allow for endogenous occupational mobility, as in Weiss et al. (2003).and in Cohen and Eckstein (2002).

and finally we look at the convergence wages averaged of across occupations.

As noted before, time spent in Israel, has a different impact on observed and unobserved skills. The average impact of unobserved skills declines with time spent in Israel while the average impact of observed skills rises, reflecting the rise in the price of these skills. We now consider the combined impact of these factors and ask whether or not the average wage of immigrants converges to the average wage of comparable natives, who work in the same occupation. Figures 2a to 2c show the predicted wage-age profiles for an immigrant with 16 years of schooling who arrived to Israel, during the period 1990-1991 at the age of 30, and for an equivalent native. We consider three such comparisons, one for each occupational category.

As seen in these figures, the immigrant's wage-age profile are generally below those of the natives. In occupations 1, convergence is predicted for the *average* immigrant, but not for members of the recent immigration wave. In occupations 2 and 3 wages of immigrants with 16 years of schooling do not converge to those of a comparable native, but rather to the wages of a native with the average level of schooling in these occupations, 14 and 12 years, respectively.[26] The predicted wage gaps between immigrants and native with 16 years schooling at age 55, for the 1990-1991 cohort, are 5%, 24% and 45% in occupations 1,2, and 3, respectively.

8.1. Convergence of residual distributions

The increasing price of measured characteristics implies that, with the passage of time, immigrants become more distinct, based on their imported skills, and, consequently, wage inequality rises. An interesting question is whether the same patterns apply to unobserved skills. We have seen that the *average* impact of unobserved skills declines as immigrants spend more time in Israel, we shall now show that the *variability* of unmeasured individual characteristics of immigrants rises with time spent in Israel, as the distribution of their residuals converges to that of natives.

The residuals for natives are based on the regression coefficients in Table 5. The residuals

[26] The widening gap in occupation 3 between immigrants and Israelis with 16 years schooling suggests that immigrants who stay in occupation 3 for a long time are of increasingly lower quality, compared with the Israelis who stay.

for immigrants are based on the coefficients in Table 6. To examine the role of time in Israel on immigrants, we divide the sample into two subsamples, based on their experience in the Israeli labor market, those with five years or less, and those with more than five years. The residual distributions in figures 3 and 4 show the residual distributions for immigrants and natives in the two experience groups. We can observe that among the less experienced, the residual distribution of immigrants is steeper, suggesting a lower variance, but among those who have been in the Israeli labor market for more than 5 years the residual distributions of immigrants and natives are very close[27].

The declining mean and rising variability in residuals among immigrants, with the passage of time spent in Israel, reflects the presence of two types of learning about immigrant skills. The learning about the measured characteristics of immigrants, reduces the *average* role of unmeasured attributes. At the same time, as more is learned about each individual immigrant, immigrants are sorted out and variability rises (see Farber and Gibbons, 1996). The outcome is that as immigrants arrive, their wages are (relatively) equally distributed, but later on the wage distribution become more dispersed, reflecting the higher rewards to measured skills and a more precise evaluation of individual ability.

8.2. Convergence of Average Wages

The analysis of wage dynamics has shown that, there is a substantial wage growth within occupations, especially in occupation 1, however, convergence is not attained. The analysis of occupations have shown that the occupational distribution of immigrants approaches that of Israelis, but, again, convergence is not attained. We now bring together our results on wage dynamics and the dynamics of occupational transitions by immigrants, and examine the convergence of the average wage, unconditioned on occupation.

Figure 5 presents wage-age profiles, averaged over occupations, for an immigrant with 16

[27]Using the Kolmogorov-Smirnov (K-S) and Kruskal-Wallis (K-W) tests, the null hypothesis of equality of distribution is strongly rejected for the low experience group of less than 5 years in Israel. The p value is zero for K-S test and p value of 0.003 for K-W test. For the immigrants who are more than 5 years in the Israeli in the labor market the p value is .016 for K-S test and the p value is 0.988 for K-W test. It is safe to say that the results do not reject the hypothesis that the residuals distribution on immigrants converges to that of natives after 5 years since migration.

years of schooling, who arrived to Israel at age 30 and a comparable native. For immigrants, we combine here the dynamic effects from the estimated wage equations reported in Tables 5 and 6 with the occupational distribution predicted from Table 8. We use the predicted occupational probabilities, conditioned on working (excluding non-employment). For the average wage of Israelis with 16+ years of schooling, we use the proportions predicted from the CBS labor force surveys. Figure 5 shows that the wage differential between immigrants and comparable natives narrows substantially with time spent in Israel. An immigrant who arrives at age 30 with 16+ years of schooling earns, on the average, only 53 percent (58 percent for the 90-91 cohort) of the wage of a comparable Israeli. After 5 years in Israel, the same immigrant earns a wage which is 61 percent (67 percent for the 90-91 cohort) of the wage of a comparable native and after 20 years this proportion rises to 81 percent (89 percent for the 90-91 cohort). As explained above, the growth in early years is mainly due to the rise in the returns for imported skills. The growth in later years is mainly due to occupational switches, reflected in the narrowing of the occupational differences between immigrants and native Israelis. However, convergence is not attained, because of incomplete convergence in the occupational structure and the lack of convergence within occupations.

Comparison to findings from the US Studies on immigration to the US during the 1970's show rapid rates of assimilation to natives of the same ethnicity (see, for example, Chiswick, 1978, Borjas, 1985 and Lalonde and Topel, 1991). These studies defined the assimilation rate of immigrants, during the first decade in the US, as the reduction of the percentage difference of the wages between immigrants and equivalent natives of the same ethnicity. Lalonde and Topel(1991) found that the initial gaps between newly arrived immigrants and natives of the same ethnicity ranged between $-.05$ for Europeans to $-.33$ for Asians, while the assimilation rates ranged between .05 for European to .24 among Asian during the decade 1970-1980 . These studies use census data and estimate separate regressions for immigrants and natives, without occupational dummies.

Using Figure 5, we find that the initial gap between an immigrant and a native at arrival is $-.45$, where a 31 years old native with 16 years of education earns 20 NIS and the equivalent immigrant earned 11 NIS, on average. After ten years, at age 41, the difference is reduced to -0.26 , where a 41 years old native with 16 years of schooling earns 27 NIS and the

equivalent immigrant earned 20 NIS, on average. Based on these findings, an immigrant from the USSR to Israel assimilate at a rate of 19 percent during the first ten years. This rate is similar to the rate of assimilation of Asian immigrants in the US during the 1970's who also had a high level of schooling, about 14 years on the average.

To further facilitate a comparison with these studies, we use simple descriptive regressions for immigrants and natives, without occupational dummies and imposing no restrictions of equal coefficients in the two equations.[28] However, we allow for the "years since migration" (ysm) to have a different slope after five years in the host country and to interact with schooling, as our theory suggests. According to these regressions, the initial gap between immigrants and natives with comparable schooling and work experience (16, and 6 years, respectively) is -37 percent. The annual growth rate for immigrants, evaluated at 16 years of schooling, is .096 per year during the first five years since migration. In later years, this growth rate drops down to .029, yielding a wage increase of 69 percent during the first ten years in Israel. The comparable growth rate for native Israelis is 39 percent, such that the gap after 10 years is reduced to 23 percent and we get an assimilation rate of 14 percent during the first decade after ten years since migration. These results are very similar to the results based on the model estimated in this paper which we described above.

9. Summary and Conclusions

It is well known that immigrants enjoy a high wage growth during the initial phase after arrival. The novel aspect of this work is the attempt to identify the sources of this wage

[28] We use conventional specifications for these descriptive regressions.. The regression for natives is reported in the last two columns of Table 5. The regression for immigrants is

$$\begin{aligned}\ln y \;=\; & 2.100 + .109c_{<90} - .032c_{92-95} + 0.047\, c_{96-2000} + 0.022s - 0.009age_{arr} + .048ysm \\ & -.067((ysm-5)*d_{ysm>5}) + .003(ysm*s),\end{aligned}$$

where ysm is years since migration, $d_{ysm>5}$ is a dummy variable that is equal to 1 if $ysm > 5$. All coefficients are significant at 5% significance level. An important feature of our data, which is reflected in the descriptive regression for immigrants, is the strong positive interaction between schooling and time since arrival, with a low initial return for schooling.

growth and the use of a human capital model to imposes restriction across the earning equations of natives and immigrants. We distinguish between three sources of wage growth for immigrants: (i) the rise of the return to imported human capital; (ii) the impact of accumulated experience in the host country; and, (iii) the mobility up the occupational ladder in the host country. We find that increased price of imported skills accounts for about half of the unconditional 6.6 annual wage growth during the first ten years. Occupational transitions are important only for the high skill immigrants who came with academic degrees, accounting for about 1.1 percent out of an annual wage growth of 7.5 percent. For these immigrants, experience in the host country accounts for 1.5 percent annual growth and aggregate wage growth accounts for about 1.5 percent.

The prices that immigrants receive for their imported schooling and experience are initially zero or negative. These prices rise with time spent in the host country, but never reach the prices obtained by natives. The market "penalty" on observed imported skills is partially compensated by a premium on the unobserved characteristics of these immigrants.

As immigrants spend more time in the host country, the increase in prices of skill slows down and occupational transitions become more important. Initially, there is a substantial occupational downgrading and about 26 percent of the male immigrants with more than 16 years of schooling found a job in occupation 1, within 3 years. Based on the observed transition rates in the initial phase, the occupational distribution of immigrants is, expected to approach the distribution of comparable natives, within a period of 15 years. Using the ten years data we find some occupational downgrading of immigrants after 20 years in Israel (Figure 1). Furthermore, wages of immigrants are not expected to converge to the wages of comparable natives, mainly because the long run return that immigrants obtain for their imported schooling, 2.8 percent, is substantially lower than the return that natives obtain for their locally acquired schooling, 6.9 percent. This large gap in the returns for schooling, which was also documented by Friedberg (1999), may reflect either an inherent difference in quality of schooling or frictions in the labor market, which cause qualified immigrants to "give up" in their search for suitable jobs.

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Appendix: A Model of Human Capital Investment with Price Dynamics

We now present the solution of the optimal investment problem, assuming that a person does not switch occupations. We can unify the exposition by disposing of the distinction between K_0 and K_1 and assume that

$$y(t) = R(t)K(t)(1 - x(t)), \tag{A1}$$

where $R(t)$ is an increasing and concave function of time and

$$\dot{K}(t) = f(K(t), x(t)), \tag{A2}$$

where $f(...)$ can assume the special forms given in (5) or (5'). The Hamiltonian function associated with the maximization of life time earnings is is

$$H = R(t)K(t)(1 - x(t)) + \psi(t)f(K(t), x(t)), \tag{A3}$$

where $\psi(t)$, represents the value of an additional unit of human capital. This shadow price evolves according to

$$\dot{\psi} = r\psi(t) - \frac{\partial H}{\partial K} \tag{A4}$$

and satisfies

$$\psi(T) = 0. \tag{A5}$$

The first order conditions for the maximizing the Hamiltonian function with respect to $x(t)$ yields the following first order conditions:

$$\begin{aligned} &-R(t)K(t) + \psi(t)f_x(K(t), x(t)) \leq 0, \; if \; x(t) = 0, \\ &-R(t)K(t) + \psi(t)f_x(K(t), x(t)) = 0, \; if \; if \; 0 < x(t) < 1, \\ &-R(t)K(t) + \psi(t)f_x(K(t), x(t)) \geq 0, \; if \; x(t) = 1. \end{aligned} \tag{A6}$$

Under specification (5), the first order condition for an interior solution becomes

$$R(t) = \psi(t)f'(K(t)x(t)) \tag{A7}$$

and, therefore,

$$\begin{aligned}\frac{\partial H}{\partial K} &= R(t)(1-x(t)) + \psi(t)(x(t))f'(K(t)x(t)) - \delta) \\ &= R(t) - \delta\psi(t),\end{aligned} \tag{A8}$$

implying that

$$\dot{\psi} = R(t) - (r+\delta)\psi(t). \tag{A9}$$

Solving this differential equation, using $\psi(T) = 0$, we obtain

$$\psi(t) = \int_0^{T-t} e^{-(r+\delta)\tau} R(t+\tau)d\tau \tag{A10}$$

and

$$\frac{R(t)}{f'(x(t)Y(t)))} = \int_0^{T-t} e^{-(r+\delta)\tau} R(t+\tau)d\tau, \tag{A11}$$

which is equivalent to equation (6) in the text. Dividing both sides of (A11) by $R(t)$,we see that $\psi(t)/R(t)$ must decrease with time because the horizon, $T-t$ gets shorter and, under the assumption that $\frac{\dot{R}}{R}$ is non increasing, $R(t+\tau)/R(t)$ declines in t (or remains constant) for every τ.

Under specification (5'), the first order condition for an interior solution becomes

$$R(t) = \psi(t)g'(x(t)) \tag{A12}$$

and

$$\frac{\partial H}{\partial K} = R(t)(1-x(t)) + \psi(t)(g(x(t)) - \delta), \tag{A13}$$

implying that

$$\frac{\dot{\psi}}{\psi(t)} = r + \delta - g(x(t)) - \frac{R(t)}{\psi(t)}(1-x(t)). \tag{14}$$

Assuming

$$g(x(t)) = \gamma - \gamma(1-x)^{\frac{1}{\alpha}}, \tag{A15}$$

we get in an interior solution that

$$\frac{\gamma}{\alpha}(1-x)^{\frac{1}{\alpha}-1} = \frac{R(t)}{\psi(t)}, \tag{A16}$$

and, therefore,

$$\begin{aligned}\frac{\dot{y}}{y(t)} &= \frac{\dot{R}}{R(t)} + \frac{\dot{K}}{K(t)} + \frac{\alpha}{1-\alpha}\left(\frac{\dot{R}}{R(t)} - \frac{\dot{\psi}}{\psi(t)}\right) \qquad \text{(A17)}\\ &= \frac{1}{1-\alpha}\frac{\dot{R}}{R(t)} + \gamma - \delta - \gamma(1-x)^{\frac{1}{\alpha}} - \frac{\alpha}{1-\alpha}\left(r + \delta - g(x(t)) - \frac{R(t)}{\psi(t)}(1-x(t))\right)\\ &= \frac{1}{1-\alpha}\left(\frac{\dot{R}}{R(t)} + \gamma - \delta - \alpha r\right).\end{aligned}$$

Under the specification (7) $g\prime(0) = \frac{\gamma}{\alpha}$, and there must be an interval in which the worker does not invest, $x = 0$. During this interval, equations (A9) and (A10) hold so that the switching point occurs when

$$\frac{\int_0^{T-t_1} e^{-(r+\delta)\tau} R(t_1+\tau)d\tau}{R(t_1)} = \frac{\alpha}{\gamma}. \qquad \text{(A18)}$$

Equations (A17) and (A18) imply equation(8) in the text.

Observe that, at an interior solution

$$\frac{\dot{\psi}}{\psi(t)} = r + \delta - \gamma - (1-\alpha)\left(\frac{\alpha}{\gamma}\right)^{\frac{\alpha}{1-\alpha}}\left(\frac{R(t)}{\psi(t)}\right)^{\frac{1}{1-\alpha}} < 0, \qquad \text{(A19)}$$

implying that the rate of investment $x(t)$ is decreasing in t.

The model can incorporate exogenous and fully anticipated occupational switches. Using the assumptions on prices of skills in the text, we can translate such switches into a path of the anticipated rental rate. Although this function will have discontinuities, at the points of an occupational switch, all the results continue to hold as long as the worker remains in a given occupation. One can connect the different pieces by solving equation (A19) piece by piece, staring from the end, and then derive the optimal investment policy. The resulting earning path will have jumps at the points of occupational switches.

Table 1: Occupation and Schooling of Native Israeli and Immigrants, aged 25-65, Males (percent)

	Occupation[1]			Schooling		
	1	2	3	0-12	13-15	16+
Israelis[2], 1991	18.5	12.9	68.6	65.6	17.2	17.1
Immigrants in the USSR[3]	58.6	12.2	29.2	21.5	42.3	36.2
Immigrants in Israel[4], 1991-1995	14.6	9.3	76.1	33.1	37.9	28.9
Immigrants in Israel[5], 1991-2000	16.4	9.6	73.9	31.3	37.7	30.9

1. Occupation 1 includes engineers, physicians, professors, other professionals with an academic degree and managers; Occupation 2 includes teachers, technicians, nurses, artists and other professionals; Occupation 3 includes blue collar and unskilled workers.

2. Source: Income Survey, 1991.

3. Source: Brookdale Survey, 1992. Immigrants include those who arrived between 1989-1991, whose age at arrival is 25+ and whose age at the time of interview is less or equal to 65. We exclude immigrants who did not work in the USSR and did not search for a job in Israel since arrival. Occupation in the USSR is based on the last job the immigrant held in the USSR.

4. Source: Income Surveys, 1991-1995. Included are immigrants who arrived during 1990-1991 and observed working in one of the five Income Surveys. The proportion of immigrants working in each occupation in Israel is the average over the five Income Surveys.

5. Source: Income Surveys, 1991-2000. Included are immigrants who arrived during 1990-1991 and observed working in one of the ten Income Surveys. The proportion of immigrants working in each occupation in Israel is the average over the ten Income Surveys.

Table 2: Monthly Wages of Immigrants by Schooling and Years since Arrival to Israel, Males, Aged 25-55[1]

	Schooling ≤ 12		Schooling = 13-15		Schooling $\geq$16	
Year	Wage	Std.	Wage	Std.	Wage	Std.
1	1688	681	1717	551	1874	1016
2	1922	612	2070	919	2248	1060
3	1993	795	2188	715	2376	1376
4	2014	715	2385	1244	3141	1764
5	2233	762	2503	1018	3494	2071
6	2298	821	2686	1340	3548	2131
7	2449	884	2905	1221	4231	2574
8	2380	693	3078	1501	4040	2527
9	2825	2499	3161	1575	3531	2094
10	2925	1034	3647	2289	4848	2805
mean % ∇	6.49%	-	8.86%	-	12.23%	-

1. Source: Income Surveys, 1991-2000.

Table 3: Wages of Immigrants and Natives by Work Experience in Israel, Males, Aged 25-55[1]

Years of Schooling	All Workers		Work Experience ≤ 5		Work Experience > 5	
	Israelis	Immigrants	Israelis	Immigrants	Israelis	Immigrants
0-12	3334	2290	2252	1947	3387	2785
13-15	4711	2717	2752	2201	5046	3541
16+	6377	3727	4026	2726	6926	5006
Occupation in Israel						
1	6512	4717	4181	3489	6834	5795
2	4555	3574	3185	2857	4791	4303
3	3398	2290	2545	1959	3471	2862

1. Source: CBS Income Surveys, 1991-2000.

Table 4: Occupational Distribution of Male Immigrants (percent)

Occupation	After 1 Year		After 2 Years		After 3 Years		After 4 Years		After 5-15 Years		After 15+ Years	
Age at Arrival 26-40	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+
1	6.53	21.49	10.09	22.76	13.50	32.32	15.21	33.57	20.12	44.65	24.56	58.99
2	5.55	8.77	7.78	9.66	8.42	10.10	10.20	12.94	11.23	13.34	12.05	12.92
3	69.24	48.25	71.05	54.14	69.33	47.47	68.00	48.25	63.23	38.09	57.10	24.65
Unemployed	18.68	21.49	11.08	13.45	8.75	10.11	6.59	5.24	5.42	3.92	6.29	3.44
Total Obs.	1226	228	1290	290	1200	297	1078	286	4792	1402	1543	495
Age at Arrival 41-55	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+
1	5.66	16.04	8.26	17.13	9.66	20.81	11.15	23.91	15.97	30.49	29.44	70.42
2	2.88	2.99	5.16	5.61	6.64	8.39	8.05	10.77	8.76	11.81	7.65	5.63
3	67.95	49.25	69.95	56.70	72.53	58.05	71.51	53.54	67.85	50.90	57.26	15.49
Unemployed	23.51	31.72	16.63	20.56	11.17	12.75	9.29	11.78	7.42	6.80	5.65	8.46
Total Obs.	936	268	872	321	859	298	807	297	3263	1338	248	71

Source: CBS Labor Force Surveys, 1991-2000.

Table 5: Wage Equation for Native Men (Aged 25-65, Years 1991-2000)[29]

Dependent Variable: Log Hourly Wage (1991 NIS)

	With Occupation		Without Occupation	
Variable	*Coefficient*	*St. Dev.*	*Coefficient*	*St. Dev.*
Constant	1.4431	0.0284	1.1707	0.0267
1991	-0.1455	0.0156	-0.1365	0.0160
1992	-0.0856	0.0158	-0.0764	0.0162
1993	-0.1243	0.0163	-0.1187	0.0167
1994	-0.0931	0.0158	-0.0906	0.0162
1996	-0.0473	0.0167	–0.0468	-0.0172
1997	-0.0395	0.0192	-0.0382	0.0197
1998	-0.0171	0.0188	-0.0156	0.0193
1999	-0.0782	0.0188	-0.0751	0.0193
2000	0.0041	0.0188	0.0042	0.0193
Occ1	0.2923	0.0122	-	-
Occ2	0.2056	0.0134	-	-
Experience	0.0418	0.0014	0.0433	0.0015
(Experience)^2	-0.0006	0.00003	-0.0006	0.00003
Schooling	0.0694	0.0017	0.0952	0.0014

[29]The yearly dummies represent the difference from the wage in 1995.

Table 6: Wage Equation for Immigrants
(Age at Arrival $>$ 25, Years 1991-2000)

	With Occupation		Without Occupation	
Coefficient	*Estimate*	*St.Dev.*	*Estimate*	*St.Dev.*
b_{cons}	0.4191	0.0143	0.3270	0.0091
$b_{cohort<90}$	0.0498	0.0052	0.1418	0.0103
$b_{cohort92-2000}$	-0.0468	0.0042	-0.0608	0.0045
d_{cons}	0.5136	0.0177	0.8834	0.0232
λ	0.0995	0.0031	0.1389	0.0033
b_{con_occ1}	0.3463	0.0318	-	-
d_{con_occ1}	-0.2530	0.0381	-	-
b_{con_occ2}	0.1682	0.0288	-	-
d_{con_occ2}	-0.1425	0.0351	-	-
b_{exp}	-0.3630	0.0258	-0.6391	0.0370
d_{exp}	-1.0104	0.0528	-0.8435	0.0558
b_{school}	-0.0429	0.0016	-0.0275	0.0014
d_{school}	-0.0288	0.0020	-0.0633	0.0028
Sum of Sq. Residuals	3062.606		3276.919	
No. of obs.	16047		16047	

Table 7: Actual and Forecasted Occupational Distribution of Immigrant-Engineers, by Length of Stay in Israel

	Number of Years in Israel								
Occupation (%)	1	2	3	4	5	7*	10*	15*	20*
1	14.4	20.8	27.9	31.2	37.1	45.0	52.1	59.7	64.0
2	3.9	6.3	7.3	7.6	6.2	9.5	8.7	8.0	7.8
3	58.4	56.1	53.3	49.9	48.3	41.6	35.7	29.1	25.2
Non-Work	23.4	16.8	11.5	11.3	8.4	3.9	3.5	3.2	3.0
Observations	694	619	505	397	178				

Source: Brookdale's Survey of Engineers.

*Forecasted. The data in the first five years are the sample means of the occupational status of engineers, aged 25-65, in the last month of each year. The forecasts are based on the transition matrix in Table 9.

Table 8: Average Transition Matrix[1] of Male Immigrants, Engineers, Age at arrival 26-45

Occupation	Occupation 1	Occupation 2	Occupation 3	Not Working
Occupation 1	96.4	1.4	1.2	1.0
Occupation 2	9.4	79.9	5.9	4.8
Occupation 3	6.0	1.7	88.6	3.7
Not Working	21.4	6.3	38.1	34.3

Source: Brookdale's Survey of Engineers, 1995.

1. Using monthly data, we calculate for each month the annual transition rate (12 months ahead) and then take monthly average for immigrant-engineers who were in Israel between 30 to 42 months.

Table 9: Components of Annual Wage Growth During 1991-2000 for the 1990 Cohort, Males, Age at Arrival>25

	All Imm.	Sch.13-15	Sch.16+	Age Arr. 25-40	Age Arr. 41+
Actual	0.0662	0.0482	0.0803	0.0718	0.0596
Predicted	0.0648	0.0538	0.0748	0.0660	0.0617
Time[1]	0.0146	0.0146	0.0146	0.0146	0.0146
Experience[2]	0.0137	0.0120	0.0153	0.0201	0.0051
Prices[3]	0.0252	0.0251	0.0342	0.0188	0.0318
Occupation[4]	0.0113	0.0021	0.0107	0.0125	0.0102
Sample size 1991	119	50	29	60	59
Sample size 1995	64	19	30	36	28

1. The time effect is the 1991 dummy in Table 5, divided by 10.

2. The experience effect is the difference in the average accumulated experience in Israel between 1991 and 2000 (averaged over members of the 1991 cross section and divided by 10). The accumulated experience is defined as $[b(\exp_0 + t - t_0) - \frac{c}{2}(\exp_0 + t - t_0)^2]$, where $t - t_0$ equals 10 in 2000 and and 1 in 1991. The coefficients b and c are taken from the wage equation for Israelis in Table 5 (i.e., $b = .0418$ and $c/2 = .0006$ and exp_0 is the experience accumulated abroad by the immigrant.

3. For each immigrant in the 1991 cross section, we form predicted residuals for 1991 and 2000, *holding occupation constant* at the 1991 level. We then take averages of these two predictions (for 2000 and 1991) over all observations in the 1991 cross section and divide by 10.

4. For each immigrant in the 2000 cross section we predict his wage, based on his observed occupation. For each immigrant in the 1991 cross section we form a predicted wage for 2000, based on his 1991 occupation. We then take the difference in the average of these predictions and divide by 10.

Table A1: Summary Statistics for the Income and Labor Force Surveys, Males aged 25-65[1](mean and standard deviation)

	Male Native		Male Immigrants	
	Income	Labour Force	Income	Labour Force
Monthly Wages	4,308.818 (3,012.27)	-	2,814.37 (1,856.63)	-
Hourly Wages	20.70 (13.66)	-	13.76 (8.88)	-
Experience (Total)	18.58 (9.99)	16.49 (9.55)	22.18 (10.07)	21.92 (10.17)
Experience Abroad	-	-	15.09 (10.12)	14.11 (10.14)
Experience in Israel	-	-	7.08 (6.75)	7.80 (7.43)
Age	40.45 (9.37)	38.81 (9.33)	43.56 (9.90)	43.31 (10.04)
Age at Arrival	-	-	36.11 (10.54)	35.01 (10.77)
Schooling	12.87 (3.23)	13.32 (3.09)	13.75 (3.21)	13.73 (3.16)
Schooling at Arrival	-		13.52 (3.25)	
Occuapation 1(%)	23.14	23.74	17.24	16.35
Occupation 2(%)	11.90	13.21	9.66	10.75
Occupation 3(%)	64.96	63.05	73.10	72.89
Arrival $<$ 1960(%)	–	–	0.58	1.49
Arrival 60-69(%)	–	–	1.06	1.34
Arrival 70-79(%)	–	–	16.55	15.72
Arrival 80-88(%)	–	–	2.45	2.47
Arrival 89-91(%)	–	–	56.10	53.61
Arrival 92-95(%)	–	–	18.19	20.62
Arrival 96-2000(%)	–	–	4.26	4.75
No. Obs. 1991	1704	7073	276	1319
No. Obs. 1992	1606	6742	386	1686
No. Obs.1993	1432	6584	402	1793
No. Obs.1994	1608	7347	459	2148
No. Obs.1995	1709	7680	513	2453
No. Obs.1996	1313	7848	437	2485
No. Obs.1997	847	7710	333	2482
No. Obs.1998	897	7867	335	2518
No. Obs.1999	900	7748	336	2549
No. Obs.2000	911	7887	282	2526
Total No. of Obs.	12927	74486	3759	21959

Source: CBS Income and Labor Force Surveys, 1991-2000. 1. Means and in parenthesis standard deviations . Wages in 1991 NIS.

Table A2: Distribution of Male Immigrants from the former USSR, Aged 25-65, by Schooling and Cohort (percent)

Years of Schooling	1960-1969	1970-1979	1980-1988	1989-1991	1992-1995	1996-2000	All Obs.
0-12	0.47	0.49	0.34	0.31	0.41	0.42	0.37
13-15	0.22	0.25	0.33	0.38	0.36	0.35	0.35
16 +	0.31	0.26	0.33	0.31	0.23	0.23	0.28

Source: CBS Labour Force Surveys, 1991-2000

Table A3: Occupational Distribution of Native Males

(percents)

	Age Groups								
	25-29	30-34	35-39	40-44	45-49	50-54	55-60	61-64	Total
All Israelis									
1	12.37	19.75	23.17	25.78	31.99	35.47	36.10	32.15	23.74
2	15.11	14.63	13.61	12.69	10.94	10.58	11.90	8.99	13.21
3	72.52	65.62	63.22	61.54	57.07	53.94	52.00	58.87	63.05
Total Obs.	13384	14527	13313	12477	8987	4970	3773	1291	72193
Schooling 16+									
1	47.77	57.32	60.28	61.19	68.86	69.85	69.76	75.07	61.76
2	27.94	22.14	20.22	17.67	12.34	12.25	13.78	10.99	18.33
3	24.28	20.55	19.50	21.14	18.80	17.91	16.46	13.94	19.91
Total Obs.	1886	3212	3036	3084	2553	1625	1270	373	17094

Source: CBS Labour Force surveys, 1991-2000.

Table A4: Multinomial Logit Estimates for Male Immigrants, with 16+ Years of Schooling, by Age at Arrival

Dependent Variable: Occupation in Israel[1]

	age at arrival 25-40		age at arrival 41-55	
Coefficient	*Estimate*	*St.Dev.*	*Estimate*	*St.Dev*
Occupation 1				
b_{cons}	-0.7881	0.1249	-1.0816	0.1515
b_{exp}	0.1652	0.0257	0.0998	0.0441
b_{exp^2}	-0.0030	0.0009	-0.0027	0.0034
$d_{cohort60-69}$	0.8906	1.1321		
$d_{cohort70-79}$	-0.4924	0.2372	1.6197	0.6277
$d_{cohort80-88}$	0.3257	0.2781	0.7081	0.3573
$d_{cohort92-95}$	-0.6009	0.1199	-0.3766	0.1382
$d_{cohort96-2000}$	-0.5488	0.2632	-1.5195	0.3595
Occupation 2				
b_{cons}	-1.6976	0.1775	-2.5945	0.2548
b_{exp}	0.1349	0.0368	0.2616	0.0782
b_{exp^2}	-0.0039	0.0015	-0.0131	0.0062
$d_{cohort60-69}$	3.0695	1.2707		
$d_{cohort70-79}$	-0.2826	0.3618	0.9122	0.9946
$d_{cohort80-88}$	-0.9071	0.5663	0.1428	0.5922
$d_{cohort92-95}$	-0.3066	0.1623	-0.0584	0.1909
$d_{cohort96-2000}$	-1.0518	0.4805	-0.7046	0.4434
Log-Likelihood	-2758.5312		-2014.4886	
No. of obs.	2921		2304	

Source: Labor Force Surveys, 1991-2000.

1. Occupation 3 is the reference group.

Table A5: Multinomial Logit Estimates for Native Men, with 16+ Years of Schooling, Aged 25+

Dependent Variable: Occupation[1]

	LF Survey		Income Survey	
Coefficient	*Estimate*	*St.Dev.*	*Estimate*	*St.Dev*
Occupation 1				
b_{cons}	-0.4655	0.3753	-1.7359	1.0425
b_{age}	0.0556	0.0181	0.1185	0.0506
b_{age^2}	-0.00039	0.00021	-0.0009	0.0005
Occupation 2				
b_{cons}	1.5872	0.4637	0.2031	1.3353
b_{age}	-0.0664	0.0228	-0.0085	0.0658
b_{age^2}	0.00057	0.00027	0.000013	0.0780
Log-Likelihood	-15702.645		-2264.5434	
No. of obs.	17094		2706	

Source :Labor Force Surveys, 1991-2000.

1. Occupation 3 is the reference group.

Figure 1: Predicted Proportion of Workers with 16+ Years of Schooling Employed in Occupation 1

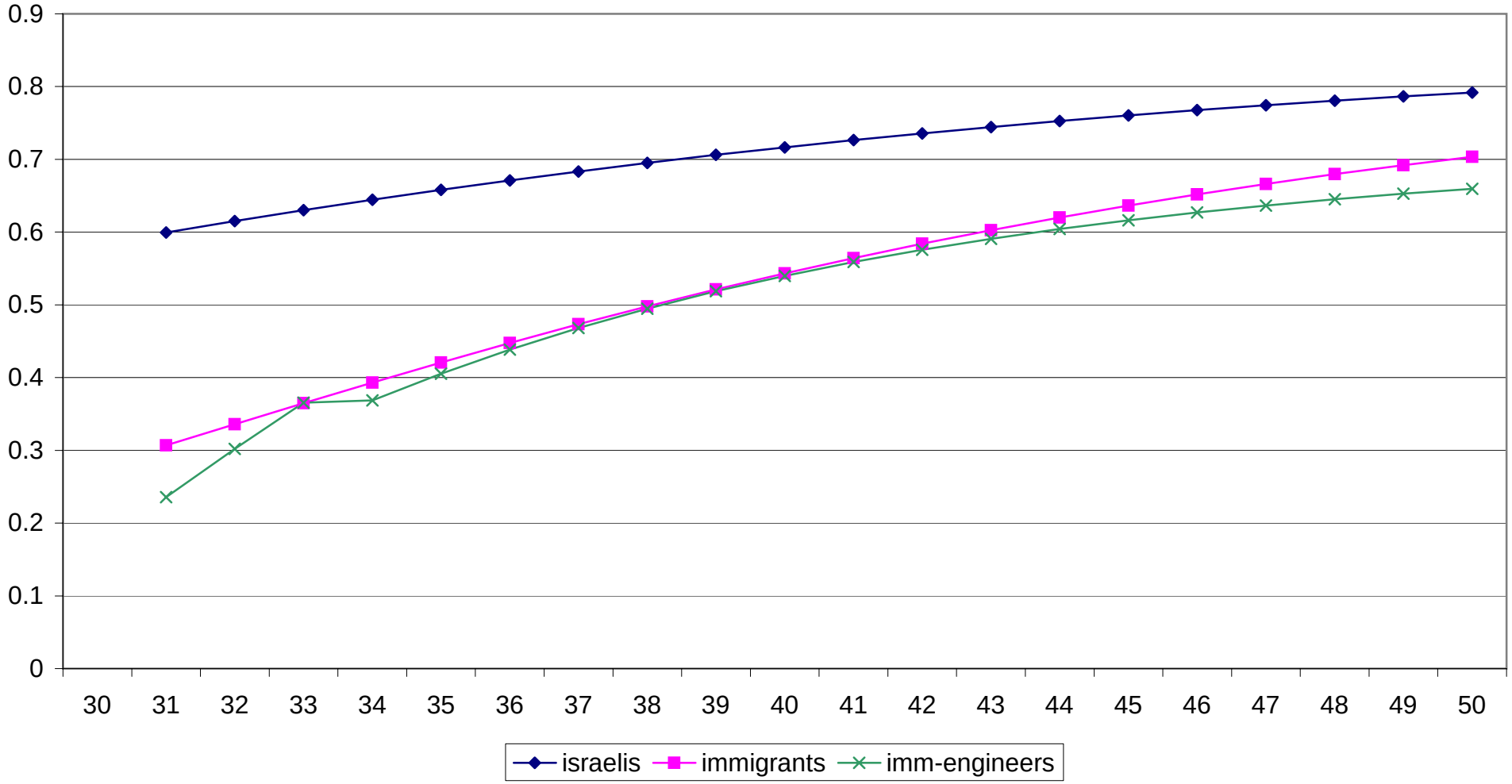


Figure 2a. Simulated Wage-Age Profiles in Occupation 1 for a Native and an Immigrant, with and without Cohort Effects, Schoiling=16, Age at immigration==30

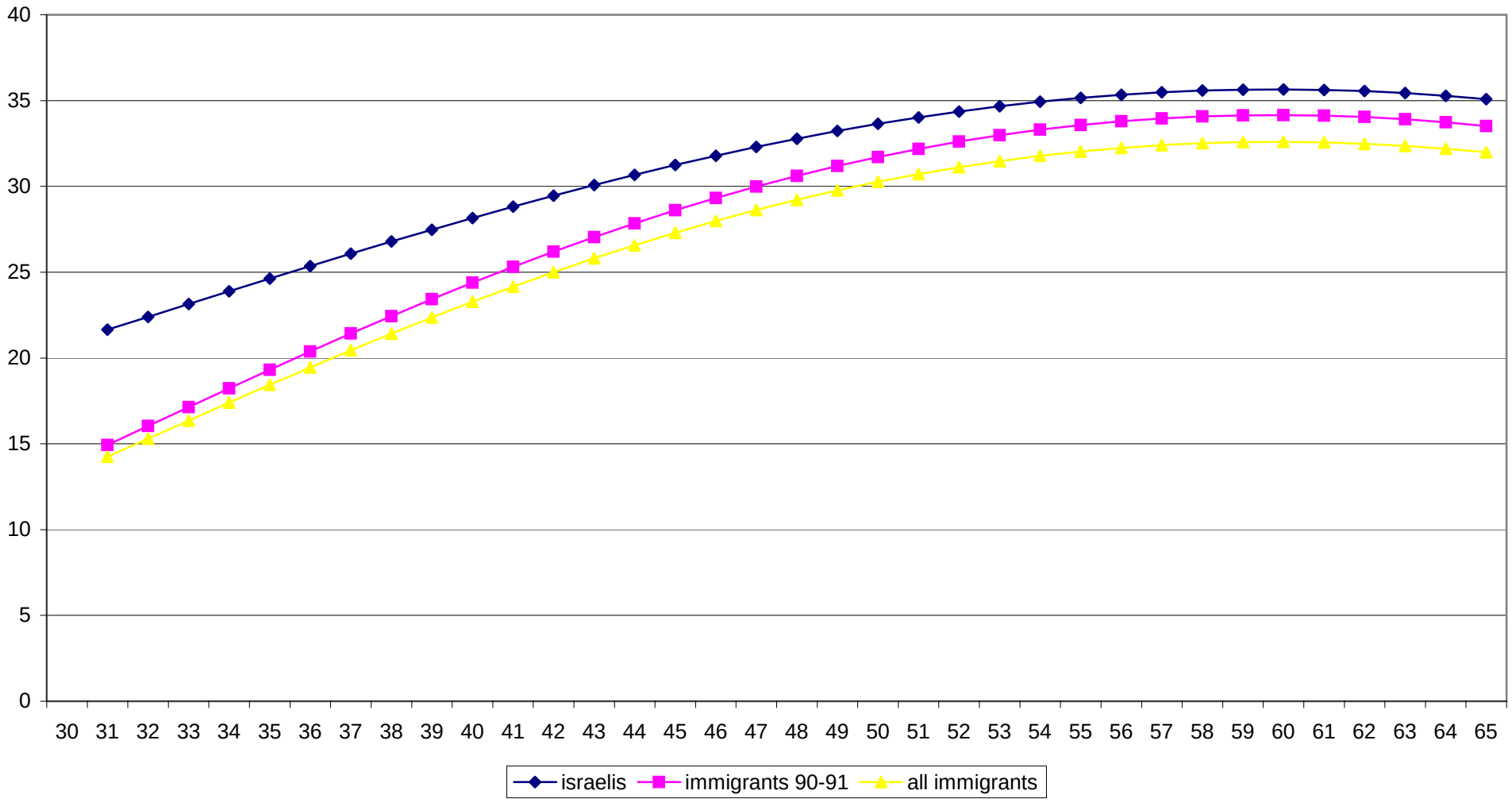


Figure 2b. Simulated Wage-Age Profiles in Occupation 2 for a Native and an Immigrant, with and without Cohort Effects, Schooling=16, Age at immigration=30

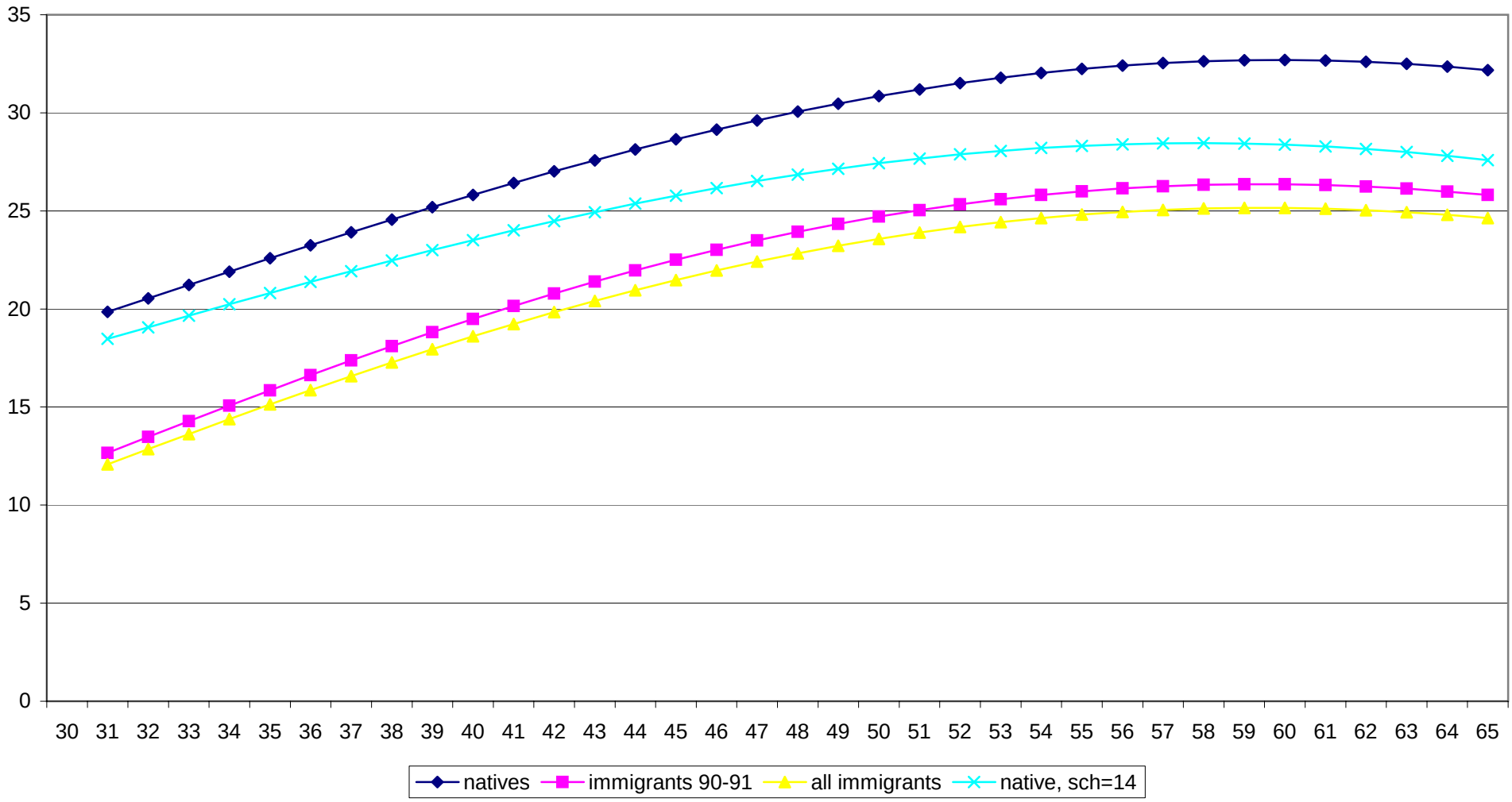
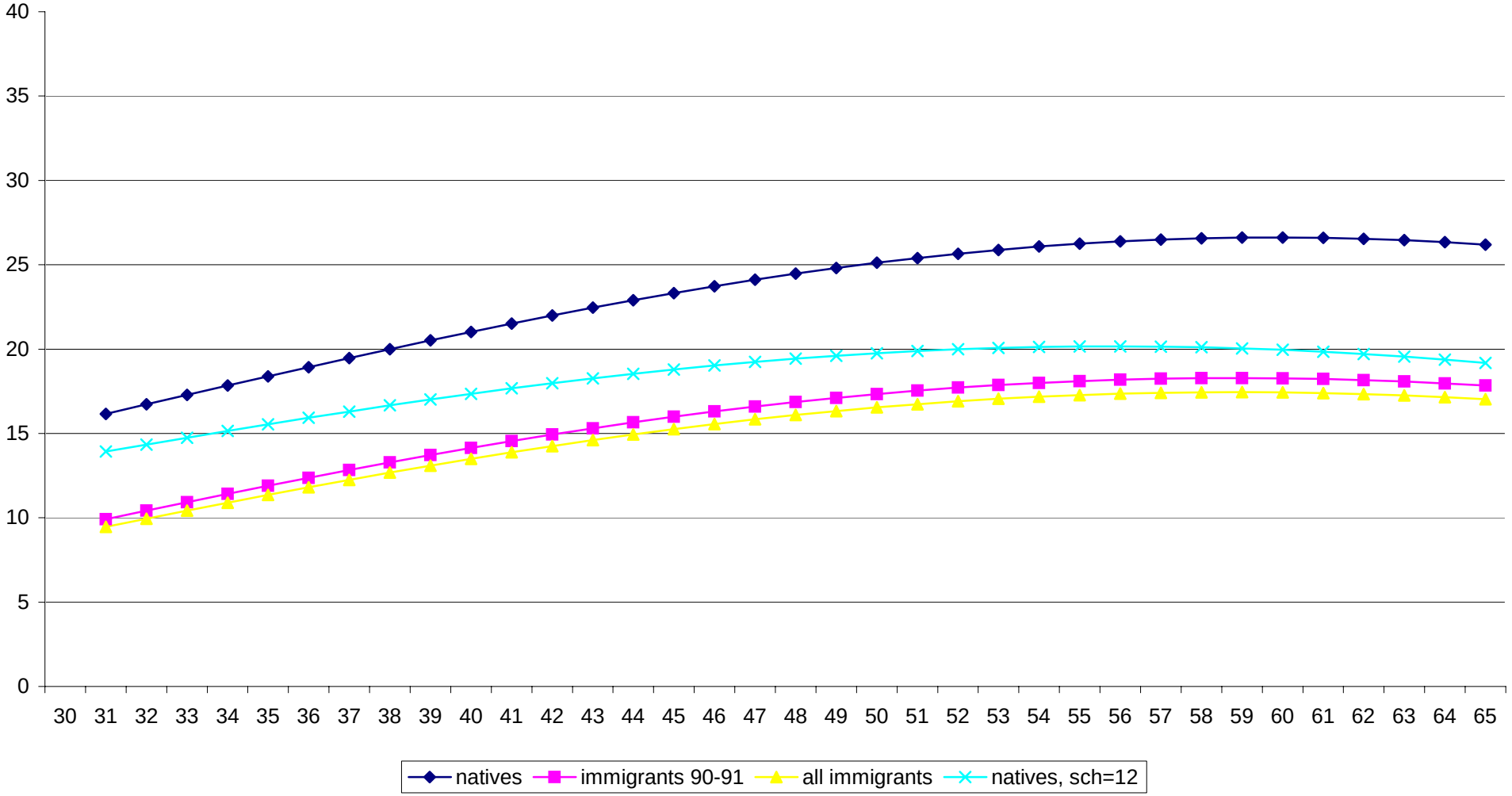
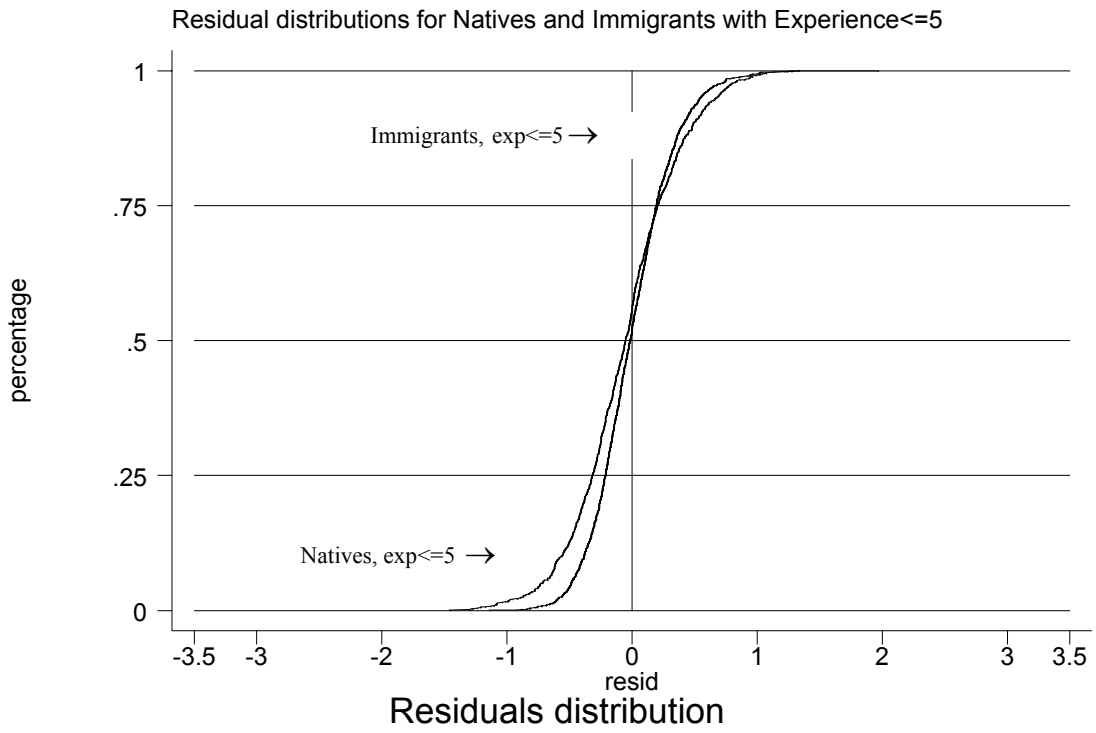


Figure 2c. Simulated Wage-Age Profiles in Occupation 3 for a Native and an Immigrant, with and without Cohort Effects, Schooling=16, Age at immigration=30




Residual distributions for Natives and Immigrants with Experience<=5
percentage
1
.75
.5
.25
0
Immigrants, exp<=5 →
Natives, exp<=5 →
-3.5
-3
-2
-1
0
1
2
3
3.5
resid
Residuals distribution

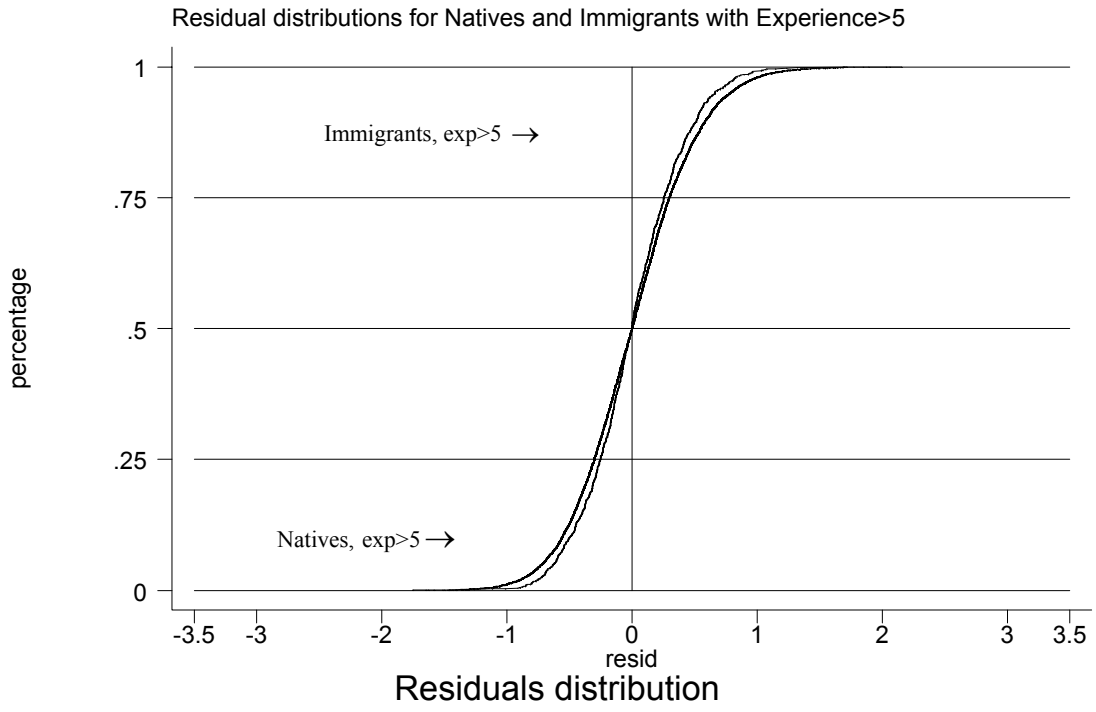
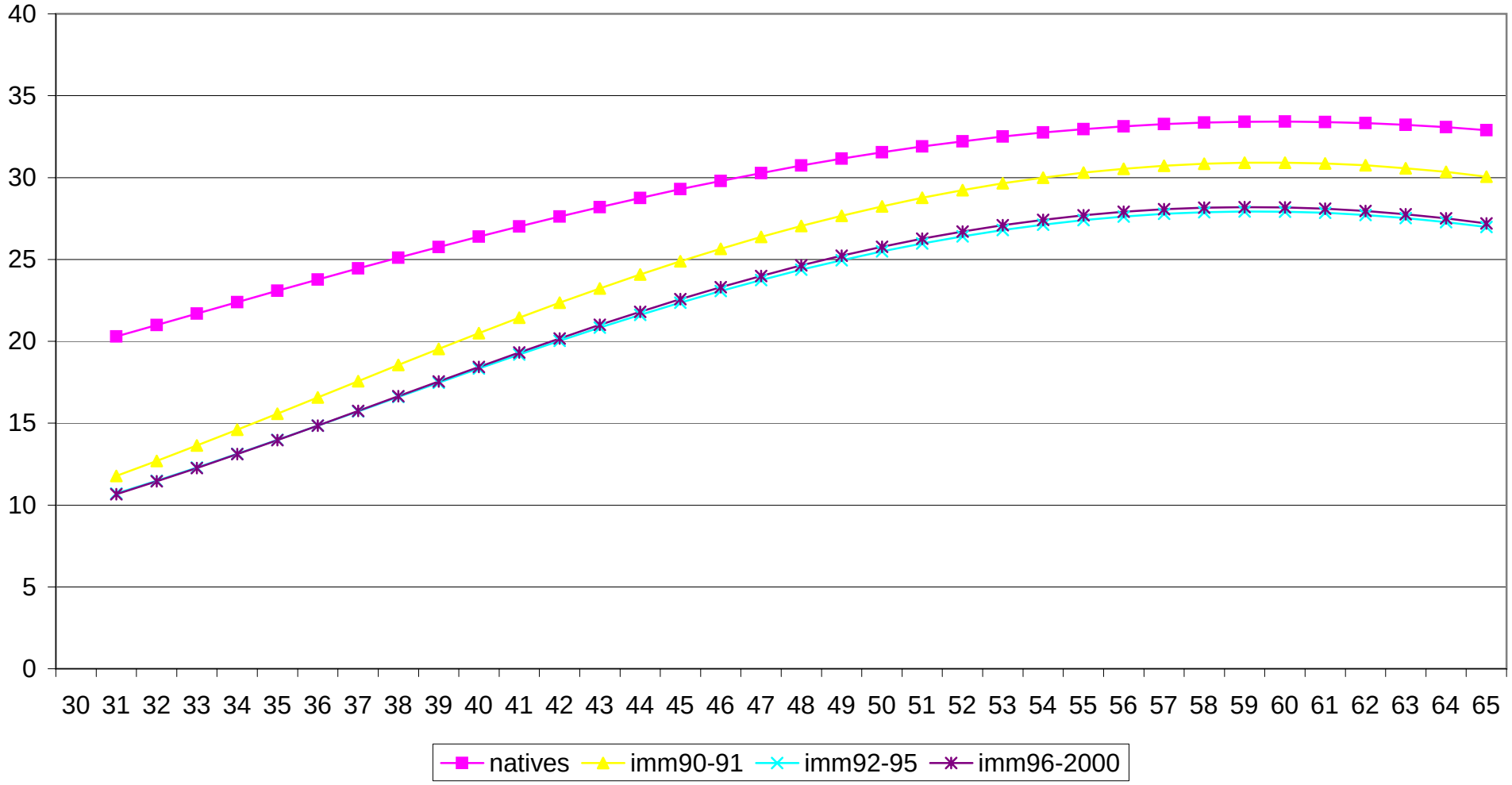

Residual distributions for Natives and Immigrants with Experience>5
percentage
1
.75
.5
.25
0
Immigrants, exp>5 →
Natives, exp>5 →
-3.5
-3
-2
-1
0
1
2
3
3.5
resid
Residuals distribution

Figure 5: Simulated Wage-Age Profiles, Averaged over Occupations, for a Native and an Immigrant, with and without Cohort Effects (schooling=16, age at immigration=30)



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