The Absorption of Highly Skilled Immigrants: Israel, 1990-1995*

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Abstract

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 five years following arrival, wages of highly skilled immigrants grow at 8.1% a year. Rising prices of skills, occupational transitions, accumulated experience in Israel and economy-wide rise in wages account for 4.4, 1.4, 1.3 and 1.1 percent each. In the long run, the return for schooling converges to 0.03, substantially below the .073 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 the occupational distribution of immigrants converges to that of natives, however, 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.

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, 2000). 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, and overtime 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. 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 five years following entry. The annual income surveys from 1991 to 1995 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 five years, the wage for immigrants with at least 16 years of schooling increases by 71% and for immigrants with at most 12 years of schooling the wage increases only by 23%, 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 earning distribution is relatively equal and independent of imported skills. Overtime, 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 (1999) and Cohen and Hsieh (2000) for the possible explanations for this, somewhat surprising, outcome.

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, 0.03 for immigrants, substantially below the .073 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 five years following arrival, wages of immigrants grow at a fast rate of 6.4 percent a year (8.13 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 1.4 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 1.2 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 40 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 ethenicity. 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 Human Capital Model for Earning Equations

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 effects that influence 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. We assume that this aggregate may be represented as

$$K = F(\sum \theta_s x_s), \tag{1}$$

where θ_s are non negative parameters and $F(.)$ is an increasing function. Firms reward individual skills indirectly by renting human capital at the market determined rental rate, R. The earning capacity of a worker is given by

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

When skills are measured in terms of the time spent acquiring them, then an exponential specification for $F(.)$, such that $K = \exp(\sum \theta_s x_s)$, seems consistent with the observed relation between earning and skills. In this case, the parameter θ_s is the proportional increase in earning capacity associated with a unit increase in skill x_s. Because θ_s is independent of skill acquisition, each individual may view it as the implicit "price" (or "rate of return") of skill s.[3]

A worker can augment his skills by training in school or on the job. Let ι_s and ω_s be the proportions of available time (which is normalized to 1) spent learning skill s in school and on the job, respectively. Then

$$\dot{x}_s = \beta_s \iota_s + \gamma_s \omega_s - \delta, \tag{3}$$

[3] If we normalize the price of one skill to unity then θ_s is the price of skill s in terms of this numeraire. Under the exponential assumption, θ_s also equals, or is proportional to, the ratio between sacrificed earning and additional earning associated with an increase in x_s, which is a rate of return. 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).

where β_s and γ_s are learning coefficients, $\beta_s > \gamma_s$, and δ is a depreciation rate. Time spent on training is withdrawn from working time and involves a loss of earnings. In the case of schooling or formal training, each hour of training causes a corresponding loss of an hour of work. In training on the job, the loss is smaller (as some learning is joint with work) but the learning coefficient is likely smaller. The actual earning of the individual, y, equals to his earning capacity, Y, multiplied by "effective" working time, h. That is,

$$y = Yh = Y(1 - T_s - c(T_w)), \tag{4}$$

where $T_s = \sum \iota_s$ is the proportion of total time spent in school, $T_w = \sum \omega_s$ is the proportion of time spent training on the job and $c(.)$ is a convex increasing function with $c(0) = 0$ and $c(1) \leq 1$.

Individuals maximize their life-time earnings. In each point in time, a worker must decide which skill to augment and how much of it to acquire. Because all schooling activities are equally costly, an individual who invests in schooling will augment only the skill with the highest contribution to the growth of human capital (i.e., the highest $\theta_s \beta_s$). Similarly, because all training activities are equally costly, an individual who invests in training on the job will augment only the skill with the highest $\theta_s \gamma_s$.

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.[4]

[4] In this paper, we focus on investment decisions and assume that occupational transitions are exogenous. The analysis can be extended to incorporate occupation specific capital stocks, $K_j = F(\sum \theta_{sj} x_s)$, where θ_{sj} is the price of skill x_s in occupation j, allowing immigrants to change occupation when a suitable job offer arrives. The prospect of the arrival of job offers with higher wages also influence current investments in human capital. In general, occupational switches and investment decisions interact. For a model with joint determination of investment and job transitions, see Cohen and Eckstein (2000).

We denote the subsets of skills acquired abroad and in Israel by S_1 and S_2, respectively, and assume that for all $s \in S_1$, the quantities x_s are fixed at $x_s(0)$, but prices are allowed to vary with time in Israel, while for all $s \in S_2$, prices are fixed but quantities can vary. In fact, each immigrant will choose to invest only in that member of S_2 which maximizes the growth rate. We denote this maximal element, which may vary across immigrants, by x and its price by θ. Based on these definition and the exponential aggregation assumption we can partition the growth rate in human capital into the change arising from local investment decisions, and the change due the rising prices of imported skills. That is,

$$\frac{\dot{K}}{K} = \theta\dot{x} + \sum_{s \in S_1} x_s(0)\dot{\theta}_s. \tag{5}$$

Following the explicit derivation in appendix we may approximate the optimal local investment pattern for an immigrant by

$$\theta\dot{x} \simeq a\Big(\sum_{s \in S_1} x_s(0)\dot{\theta}_s + \frac{\dot{R}}{R}\Big) + b - c(\tau_0 + t - t_0), \tag{6}$$

where, t is calendar time, t_0 is date of arrival, τ_0 is the immigrant's age (or work experience) upon arrival and a, b and c are some fixed positive parameters. The earning of an Israeli born worker follows a similar process, except that he has no imported skills and the date and age of leaving school replace the date and age of arrival. Equation (6) captures two basic results from human capital theory: investment declines as the individual becomes older and approaches the end of his working career, and current investment is higher if the individual expects an increase in the price of skills. The first result follows from the fact that value of human capital depends on the expected period of utilization. The second result follows from the observation that investment in human capital involves a sacrifice of current earning capacity in favor of increased future earning capacity.

The amount of effective hours, h, is a function of the amount of local investment $\theta\dot{x}$ which is obtained by inverting $c(T_w)$. We shall approximate this relationship by

$$\ln h \simeq \xi\theta\dot{x}, \tag{7}$$

where ξ is a negative parameter which depends on the function $c(T^w)$. Equations (5) (6) and (7) together determine the effect of investment on earning.[5]

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. As time passes the imported skills become more valuable as immigrants adopt to local market conditions and find better job matches. Thus, at the early stage of stay in Israel, immigrants display higher growth in earnings than similar natives. Assuming that after sufficient time the host country, prices of imported skill converge to some constant values, the earnings growth rates of immigrants and natives will eventually converge. However, convergence in growth rates does not necessarily imply convergence in levels. Earnings of immigrants will 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 imply higher investments. However, if imported skills are of inherently lower quality, and their long run price falls short of the price of locally acquired skills, then earnings of immigrants may never catch up with those of natives.

A simple parameterization for the behavior of prices helps to illustrate the general point. Let $t - t_0$ be the duration of time that the immigrant has been in the host country. Then the market value of imported skill s at time t is $\theta_s(t - t_0)$. We assume that

$$\dot{\theta}_s = \lambda(\overline{\theta}_s - \theta_s(t - t_0)), \tag{8}$$

where $\overline{\theta}_s$ is the long run value of $\theta_s(t - t_0)$ and λ is a parameter indicating the speed of adjustment.[6] If $\lambda > 0$ then, as the immigrant spends more time in the host country, the price of each imported skill component approaches $\overline{\theta}_s$. In contrast, skills acquired in Israel by natives or immigrants, have constant value, θ_s.

Recall that different immigrants arrive in different dates, at different ages and with different market skills. Consider an immigrant who is observed in year t and at age τ and

[5] The approximations in (6) and (7) have been used by Mincer (1974) to derive the quadratic earning function. We extend his analysis by adding time effects into the investment decision.

[6] The model can easily accommodate different λ for different skills. However, for the estimation it is useful to impose the constraint of uniform λ. To simplify the exposition we impose this constraint at the outset.

who arrivals at date t_0. Assuming that $F(.)$ is exponential, so that $lnK = \sum \theta_s x_s$, the immigrant's level of earnings, implied by equations (5) to (8), is given by:

$$\begin{aligned} \ln(y_{im}(\tau,t)) &= \sum \theta_s(0)x_s(0) + (1+a)\sum(\bar{\theta}_s - \theta_s(0))(1-e^{-\lambda(t-t_0)})x_s(0) \\ &+(b\tau - \frac{c\tau^2}{2}) - (b\tau_0 - \frac{c\tau_0^2}{2}) + a(\ln R(t) - \ln R(t-t_0)) \\ &+ \ln R(t) + \ln(h_{im}(\tau,t)). \end{aligned} \tag{9}$$

The earnings of a comparable native, who is observed in year t and age τ, and had the same bundle of skills (including the same level of completed schooling) when he left school at age τ_s, is given by:

$$\begin{aligned} \ln(y_n(\tau,t)) &= \sum \theta_s x_s(0) + (b\tau - \frac{c\tau^2}{2}) - (b\tau_s - \frac{c\tau_s^2}{2}) \\ &+a[\ln R(t) - \ln R(t-t_s)] + \ln R(t) + \ln(h_n(\tau,t)), \end{aligned} \tag{10}$$

where, t_s and τ_s are, respectively, the time and age of leaving school.[7] Taking the difference between (9) and (10), using (6), we obtain

$$\begin{aligned} \ln(Y_{im}(\tau,t)) - \ln(Y_n(\tau,t)) &= \sum[(\bar{\theta}_s - \theta_s) + a(\bar{\theta}_s - \theta_s(0))]x_s(0) \\ &+(1+a+\lambda\xi)\sum(\bar{\theta}_s - \theta_s(0))e^{-\lambda(t-t_0)}x_s(0) \\ &+[(b\tau_0 - \frac{c\tau_0^2}{2}) - (b\tau_s - \frac{c\tau_s^2}{2})] \\ &+a[\ln R(t-t_0)) - \ln R(t-t_s)]. \end{aligned} \tag{11}$$

Equation (11) allows us to describe the parameters governing the convergence of immigrants to natives. The terms in the first sum determine the long term differences in the level of earnings. As seen, for $a > 0$, convergence in prices (i.e., $\bar{\theta}_s = \theta_s$) would imply that the earning level of immigrants will eventually exceed the earnings of comparable native Israelis. This is a consequence of the added incentive to acquire local human capital, caused by the rising prices of imported skills. However, to the extent that an imported skill is of

[7] Using the approximation in (7), we can eliminate $\ln(h_n(\tau,t))$ from equation (10), yielding, $\ln(y_n(\tau,t)) = \sum \theta_s x_s(0) + (b\tau - \frac{c\tau^2}{2}) - (b\tau_s - \frac{c\tau_s^2}{2}) + \xi(b-c\tau) + a[\ln R(t) - \ln R(t-(\tau-\tau_s))] + a\xi\frac{\dot{R}(t)}{R(t)} + \ln R(t)$.

inherently lower quality and a is not too large (i.e., $(1 + a)\overline{\theta}_s < \theta_s$), it's long term value will be lower for immigrants and their earning level may be lower in the long run. The terms in the second sum determine the speed of convergence, where higher values of λ indicate a faster adjustment. Clearly, if the adjustment 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 convergence but does not impose it.

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.[8]

3. Data

The main source of data for this paper are the Central Bureau of Statistics (CBS) income and labor force surveys for the years 1991-1995. The descriptive statistics for these data are displayed in Appendix Table A1.

On the average, immigrants are 4 years older than native workers[9], have one more year of schooling (13.6 for immigrants vs. 12.6 years for natives) and earn about 64 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

[8] It should be noted that this result depends on the functional form assumptions. Alternative specifications yield different conclusions concerning overtaking. For instance, if one adopts a Ben-Porath specification, where $F(.)$ and $C(.)$ are linear and $\dot{x}_s = g(K(\beta_s \iota_s + \gamma_s \omega_s))$, where $g(.)$ is increasing and concave, the local investment policy is independent of prices, so that there is convergence, but no overtaking. It seems that some degree of complementarity, or non-neutrality, is required for overtaking (see Borjas , 2000 and Duleep and Regget, 1997). Related results on overtaking appear in the literature on endogenous growth with both physical and human capital (See Caballe and Santos, 1993, and Brezis et al, 1993).

[9] 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

(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.[10] During the first five years in Israel more than 65 percent of the male immigrants work in blue-collar occupations (see Table 6).

For the analysis of wage assimilation, we use the CBS income surveys for the years 1991 to 1995. These data are annual random samples of the whole Israeli population. We construct two sub-samples of native born Israelis and immigrants from the former USSR who were older than 13 upon arrival.[11] 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 10,000 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.[12] To analyze occupational transitions in Israel, we define three broad occupational categories: occupation 1 (*occ*1) includes engineers, physicians, professors, other professionals with an academic degree and managers; occupation 2 (*occ*2) includes teachers, technicians, nurses, artists and other professionals; occupation 3 (*occ*3) 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 20 percent of the immigrants, observed in 1991-1995 arrived in the early wave of 1970-79 and 62 percent arrived in the recent wave of 1989-1992. Seventy five percent the

[10] 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.

[11] 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.

[12] 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.

immigrants in the sample are newly arrived and have been in Israel for less than 6 years.

4. Estimation of the Wage Equation

To estimate the parameters of the wage equations of immigrants and natives as specified in (9) and (10), we pool the two groups and jointly estimate

$$\begin{aligned}
\ln y \;=\; & b^{IS} + b_{91}c_{91} + b_{92}c_{92} + b_{93}c_{93} + b_{94}c_{94} \\
& + b^{IS}_{occ1}occ1 + b^{IS}_{occ2}occ2 + (b - \frac{c}{2}\exp^{IS})\exp^{IS} + b^{IS}_{s}s \\
& + D(IM)\{b + b_{<90}c_{<90} + b_{92-95}c_{92-95} + de^{-\lambda(t-t_0)} \\
& + [(b_{occ1} + d_{occ1}e^{-\lambda(t-t_{0i})}]occ1 + [b_{occ2} + d_{occ2}e^{-\lambda(t-t_0)}]occ2 \\
& + [b_{\exp} + d_{\exp}e^{-\lambda(t-t_{0i})}][(b - \frac{c}{2}\exp_0)\exp_0] \\
& + [(b_s + d_s e^{-\lambda(t-t_{0i})}]s_0\} + \varepsilon,
\end{aligned} \tag{12}$$

where $D(IM) = 1$ is equal to one if the observation is of an immigrant and zero otherwise. In (12) c_{91} to $c_{94}$are the year dummies, $t-t_0$ is potential experience in Israel, $\exp_0$ is potential experience in former USSR, s_0 is the number of years of schooling in the USSR, $occ1$, and $occ2$ are dummies that take the value 1 if the individual works in occupations 1 or 2 in Israel, respectively, (occupation 3 is the reference group) and $c_{<90}$ and c_{92-95} are dummy variables that take the value 1 if the immigrant entered Israel, before 1990 and between 1992 and 1995, respectively. s is the number of years of schooling for a native Israeli. The value of $[(a-\frac{c}{2}\exp_0)\exp_0]$ is the accumulated human capital associated with the market labor experience that the immigrant imported, using the same coefficients as for experience and experience squared for Israelis, and $\exp^{IS}$ is the experience accumulated in Israel both by natives and immigrants. We restrict the speed of convergence of the coefficients of the human capital indicators, λ, to be the same for all the parameters.[13] The sum $b_k + d_k$ measures

[13]The coefficients b_s and d_s in the estimated equation (12) are related to the structural parameters in equation (11) through the definitions $b_s = [(\overline{\theta}_s - \theta_s) + a(\overline{\theta}_s - \theta_s(0))]$ and $d_s = (1 + a + a\lambda\xi)(\overline{\theta}_s - \theta_s(0))$. The parameters θ_s, b, c and ξ can be identified from the regression for Israelis. The parameter λ can be estimated directly from the residual equation. A sufficient condition for identification is that the price that

the difference in the rate of return (price) for skill k ($k = s, \mathrm{exp}$, and constants) by native Israelis and immigrants at the first year of their arrival and b_k is the long run difference in the rate of return.

It should be noted that the observed imported skills in (12) are schooling and experience acquired abroad. Schooling is measured simply by years spent in school. However, experience is 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 $[b\,\mathrm{exp} - \frac{c\,\mathrm{exp}^2}{2}]$, 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 immigrant imports as $[b\,\mathrm{exp}_0 - \frac{c\,\mathrm{exp}_0{}^2}{2}]$, using the same values for b and c as for Israelis.[14] We then estimate the time pattern of the price that immigrants receive for this quantity. The prices of unobserved skills are represented by the time patterns of the occupational specific constants. Equation (12) is nonlinear in the parameters and we estimate it by nonlinear least squares.[15]

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.[16]

immigrants receive for some skill, s, say experience, converges to the price that native Israelis obtain, so that $\overline{\theta}_s = \theta_s$. We can then identify a and $\theta_s(0)$ for imported experience from the estimates of b_{exp} and d_{exp}. Having an estimate for a, λ and ξ, we can then obtain $\overline{\theta}_s$ and $\theta_s(0)$ for schooling from the estimates of b_{school} and d_{school}.

[14] 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.

[15] We implicitly assume that the variance of the errors on (9) and (10) are the same. We later empirically analyses this assumption. It should be noted that we estimated the model by a two stage method and the results turned out to be almost the same.

[16] The parameters a, b, c and $\theta_s(0)$ appear in both (9)and (10) and, therefore, joint estimation improve efficiency relative to a two stage method. The 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.

4.1. Results for Natives

The estimates of the model for native Israelis (presented in Table 4) 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 .0729 to .0970 when occupation is omitted. The wages in occupation 1 and occupation 2 are, respectively, about 27 and 21 percent higher than in occupation 3. There is a 4.5 percent increase of the hourly wage with the first year of experience and about 7.3 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 six percent lower than in 1995 (1992 is an exception where wage per hour is almost as that of 1995). In particular, the large wave of immigration had no short run negative affect on the wage rate of natives in our sample.

4.2. 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 5. 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 .0985 per year, implying that within a period of five years each skill price is adjusted by 39 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.[17]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

[17]Under our assumptions, the difference in the prices that Israelis and immigrants obtain for skill s after $(t-t_0)$ years in Israel is $\theta_s - \theta_s(t-t_0) = (\theta_s - \overline{\theta}_s) + (\overline{\theta}_s - \theta_s(0))\lambda e^{-\lambda(t-t_0)}$.

immigrants and Israelis is $b_s + d_s = -.0430 - .0366 = -.0796$. Given the estimated rate of return of .0729 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 $b_s = -.0430$, and the rate of return that immigrants can expect in the long run is only $.0729 - .0430 = .0299$. 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., 2000). The rate of increase in the return that immigrants obtain for their schooling is such that, after five years, the rate of return reaches .0072 which is about 23 percent of its long run value.[18]

The initial difference, upon arrival, in the value of experience acquired abroad is $b_{\text{exp}} + d_{\text{exp}} = -.269 - .972 = -1.241$. Since the price of accumulated experience that Israelis obtain is normalized to one, this means that the initial return for accumulated experience is $1 - 1.241 = -.241$. 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 $1 - b_{\text{exp}} = 1 - .269 = .731$, 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 adjustment, is rather slow and within 10 years this price attains 48 percent of its long run value.

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: $(.272 + (.364 - .241)) = .397$, and for occupation 2 it is: $(.215 + (.211 - .157) = .269$. In the long run, these premia are even higher: $.272 + .364 = .636$ and $.215 + .211 = .426$, respectively. However, a large part of these occupational effects is a consequence of the lower rate of return for schooling in occupation 3.

[18] 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.

We now turn to the discussion of the constant terms which summarize the average impact of unmeasured characteristics (and their prices) of immigrants. As seen in Table 5, 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 5.9 percent more than immigrants who came in 1990-1991 (the omitted group), who earn 5.4 percent more than immigrants who came in 1992-1995. 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.

5. Occupational Distribution and Transitions

As we have shown in the previous section, 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 suit their qualifications and skills. Instead, they start at the bottom of the occupational ladder and gradually climb up. 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.[19]

Table 6 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

[19] 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. (2000) and Cohen and Eckstien (2000) estimate structural models which incorporate these decisions.

who arrived at a young age. Among those with more than 16 years of schooling, only 20 percent are employed in occupation 1 upon arrival. After 4 years in Israel, this percentage rises to 36% and 28% among the young and old, respectively. Among those who had been in Israel for 5 to 15 years, the corresponding figures are 54% and 37%. By way of comparison, the percentage of natives with 16+ years of schooling who work in occupation 1 is 63% (see Appendix Table A3).

The proportion of immigrants not working declines sharply with time in Israel. Of those who have 16+ years of schooling, 24 percent of the young and 30 percent of the old did not work upon arrival. After 4 years in Israel, these proportions went down to 4 and 10 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, 2000).

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.[20] 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

[20] 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.

9 presents these average transition for male immigrants who were $25-45$ years old upon arrival to Israel.[21] 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.[22] 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 58 percent, reported in Table 6, 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 63 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.[23] As seen, the proportion of Israeli workers, with 16+ years of schooling, who actually work in occupation 1, rises from about 50 percent at age 30 to about 60 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,

[21] The transitions reported in Table 9 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.

[22] 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.(2000), 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.

[23] The Logits are estimated from the Labor Force Surveys. 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).

will rise rises from about 25 percent to about 55 percent. In other words, based on the available information, it is expected that the occupational gap between recent immigrants and comparable Israelis will narrow substantially 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 9 to generate an expected wage profiles which are not conditioned on occupation.

6. Short Run 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 five 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 1995 cross sections immigrants who entered Israel in 1990. Averaging log wages for each cross section and taking the difference (divided by 5) yields the "average annual growth rate" for the 1990 synthetic cohort during the period 1991-1995. 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 4. The experience effect is the average "true" experience in Israel, accumulated between 1991 and 1995, 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 1995, for the 1991 and 1995 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.[24]

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 6.4 percent, 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 and general growth contribute each about 1.1 percent to wage growth and accumulation of experience contribute 1.2 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.[25]

We thus see that in the short run, the first five 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.[26]

7. 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

[24] In the 1991 cross section, 12.8 percent worked in occupation 1, 12.0 per cent worked in occupation 2 and 75.2 percent worked in occupation 3. The corresponding figures in 1995 were 20.4, 13.8 and 65.7.

[25] 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., 2000).

[26] 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. (2000).and in Cohen and Eckstein (2000).

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 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.[27] The predicted wage gaps between immigrants and native with 16 years schooling at age 55, for the 1990-1991 cohort, are 7%, 19% and 34% in occupations 1,2, and 3, respectively.

7.1. 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

[27] 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.

residuals converges to that of natives.

The residuals for natives are based on the regression coefficients in Table 4. The residuals for immigrants are based on the coefficients in Table 5. To examine the role of time in Israel, 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[28].

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 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.

7.2. 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

[28] 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 (p value of zero for K-S test and p value of 0.0067 for K-W test), but is not rejected for those more than 5 years in the Israeli labor market (p value of 0.814 for K-S test and p value of 0.678 for K-W test).

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 4 and 5 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 of the wage of a comparable Israeli. After 5 years in Israel, the same immigrant earns a wage which is 64 percent of the wage of a comparable native and after 20 years this proportion rises to 80 percent. 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 $-.44$, where a 31 years old native with 16 years of education earns 18 NIS and the equivalent immigrant earned 10 NIS, on average. After ten years, at age 41, the difference is reduced to $-.25$, where a 41 years old native with 16 years of schooling earns 24.5 NIS and the equivalent immigrant earned 18.7 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.[29] 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 -45 percent. The annual growth rate for immigrants, evaluated at 16 years of schooling, is .083 per year during the first five years since migration. In later years, this growth rate drops down to .027, yielding a wage increase of 73 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 25 percent and we get an assimilation rate of 20 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.

8. 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 growth where the human capital model imposes restrictions across the earning equations of natives

[29] We use conventional specifications for these descriptive regressions. The regression for natives is reported in the last two columns of Table 4. The regression for immigrants is

$$\begin{aligned} \ln y &= 2.052 + .195c_{<90} - .058c_{92-95} + .0173s - .006age_{arr} + .0347ysm \\ &\quad -.056((ysm-5)*d_{ysm>5}) + .003(ysm*s), \end{aligned}$$

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.

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 6.4 annual wage growth during the first five years. Occupational transitions are important only for the high skill immigrants who came with academic degrees, accounting for about 1.4 percent out of an annual wage growth of 8.2 percent. For these immigrants experience in the host country accounts for 1.2 percent annual growth and aggregate wage growth accounts for about 1.2 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 only 28 percent of the male immigrants with more than 16 years of schooling found a job in occupation 1, within 3 years. However, 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. Despite this tendency towards occupational convergence, 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, 3 percent, is substantially lower than the return that natives obtain for their locally acquired schooling, 7.2 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

Now we present the solution of the optimal investment problem, using specific functional form for the time costs of investment on the job. Let

$$c(T_w) = 1 - (1 - T_w)^\alpha, \tag{A1}$$

where $0 < \alpha < 1$. Equations (1) and (2) in the text imply that

$$\frac{\dot{K}}{K} = \sum (\theta_s(\beta_s \iota_s + \gamma_s \tau_s - \delta). \tag{A2}$$

We may normalize by setting $\sum \theta_s = 1$. The Hamiltonian function is

$$H = e^{-rt} K\{R(-\sum \iota_s + (1 - \sum \tau_s)^\alpha) + \psi(\sum \theta_s(\beta_s \iota_s + \gamma_s \tau_s - \delta)\}, \tag{A3}$$

where ψ, represents the value of an additional unit of human capital. This shadow price evolves according to

$$\dot{\psi} = (r + \delta)\psi - [R(-\sum \iota_s + (1 - \sum \tau_s)^\alpha) + \psi(\sum \theta_s(\beta_s \iota_s + \gamma_s \tau_s)] \tag{A4}$$

and satisfies

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

The control variables, ι_s and τ_s, satisfy the constraints

$$\iota_s, \tau_s \geq 0, \tag{A6}$$

and

$$\sum \iota_s + \sum \tau_s \leq 1, \tag{A7}$$

Maximizing the Hamiltonian function with respect to the control variables, yields the following first order conditions:

$$
\begin{aligned}
&-R + \psi\theta_s\beta_s \leq 0, \; if \; \iota_s = 0, \\
&-R + \psi\theta_s\beta_s = 0, \; if \; 0 < \iota_s < 1, \\
&-R + \psi\theta_s\beta_s \geq 0, \; if \; \iota_s = 1.
\end{aligned}
\tag{A8}
$$

and

$$
\begin{aligned}
&-R\alpha(1 - \sum \tau_s)^{\alpha-1} + \psi\theta_s\gamma_s \leq 0, \; if \; \tau_s = 0, \\
&-R\alpha(1 - \sum \tau_s)^{\alpha-1} + \psi\theta_s\gamma_s = 0, \; if \; 0 < \tau_s < 1,
\end{aligned}
\tag{A9}
$$

The marginal benefit from training in equations (A8) and (A9) it is seen to equal the contribution of training time to a particular skill (given by β_s or γ_s) multiplied by the contribution skill acquisition to human capital, θ_s, multiplied by the value of human capital, ψ. The marginal opportunity costs of training time is given by R in the case of schooling and by $R\alpha(1 - \sum \tau_s)^{\alpha-1}$ in the case of on the job training. The worker never specializes in on the job training because the marginal costs become infinitely high when τ_s approaches 1.

Because all schooling activities are equally costly, an individual who invests in schooling will augment only the skill with the highest contribution to the growth of human capital (i.e., the highest $\theta_s\beta_s$). Similarly, because all training activities are equally costly, an individual who invests in training on the job will augment only the skill with the highest $\theta_s\gamma_s$. Without loss of generality, let us assume that $\theta_s\beta_s$ is highest for $s = 1$ and that $\theta_s\gamma_s$ is highest for $s = 2$. The assumption that $\beta_s > \gamma_s$ for all s implies that $\theta_1\beta_1 > \theta_2\gamma_2$.

The decision whether to acquire schooling or training and at what intensity depends on the ratio ψ/R which determines the value of human capital in relation to the opportunity costs. Comparing the value of the Hamiltonian function under the alternative policies of schooling acquisition and on the job training, we see that these two options are equivalent if

$$
\psi\theta_1\beta_1 = R(1 - \tau_2)^{\alpha} + \psi\theta_2\gamma_2\tau_2. \tag{A10}
$$

Using (A9) to determine the maximizing value of τ_2, condition (A10) may be rewritten as

$$(1-\tau_2) = \frac{\theta_1\beta_1 - \theta_2\gamma_2}{\theta_2\gamma_2}\frac{\alpha}{1-\alpha} = \left(\frac{\psi\theta_2\gamma_2}{\alpha R}\right)^{\frac{1}{\alpha-1}}. \tag{A11}$$

Condition (A11) determines a unique value of $\psi/R, \psi_c/R_c$, such that for $\psi/R > \psi_c/R_c$ the individual specializes in schooling, for $\alpha/\theta_2\gamma_2 \leq \psi/R \leq \psi_c/R_c$ the individual acquires some on the job training and for $\psi/R < \alpha/\theta_2\gamma_2$ he acquires or no training at all.

A necessary condition for indifference is that $\alpha\theta_1\beta 1 < \theta_2\gamma_2$, which means that the ratio of marginal benefits to marginal costs is higher for on the job training than for schooling, when the level of investment is sufficiently small. Also, since $\tau_2 = 0$ is a feasible choice, the maximizing value of τ_2 must yield a value for the RHS of (A10) which exceeds R. Therefore, at the point of indifference, we have $\psi\theta_1\beta 1 > R$ and the individual specializes in schooling.

The time pattern of the shadow price of human capital, ψ, is determined endogenously and depends on the time pattern of R. The time pattern of the rental rate, R, is exogenous, and we assume that $\frac{\dot{R}}{R}$ is non negative and non increasing. We shall then prove that ψ/R must *decline* along the optimal path. The proof proceeds by assuming the pattern and proving that it satisfies all the necessary conditions.

Under the assumption that ψ/R declines, the life cycle is divided into 3 different phases: in the first phase, the individual invests only in schooling, in the second phase he invests in on the job training and in the last phase he does not invest at all.

Consider, first, the last phase with no investment in training. In this phase (A4) becomes

$$\dot{\psi} = (r+\delta))\psi - R. \tag{A12}$$

Using the boundary condition (A5), we can solve (A12) to obtain

$$\psi(t) = \int_0^{T-t} e^{-(r+\delta)x} R(t+x)dx. \tag{A13}$$

Dividing both sides of (A13) 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, $R(t+x)/R(t)$ declines in t (or remains constant) for every x.

Consider, next, the region with on the job training and let $z = (1 - \tau_2)$ be the share of earning capacity which the individual retain while he is training on the job. Differentiating (A9) with respect to t and using equation (A4), we obtain

$$\frac{\dot{z}}{z} = \frac{\dot{R}}{R}\frac{1}{1-\alpha} + \frac{\theta_2\gamma_2 - (r+\delta)}{1-\alpha} + \frac{\theta_2\gamma_2 z}{\alpha}. \tag{A14}$$

We assume that investment on the job can yield a growth in human capital which exceeds the interest rate, that is, $\theta_2\gamma_2 - (r + \delta) > 0$, (otherwise, such investment is not profitable). We also assume that $\frac{\dot{R}}{R} \geq 0$. Therefore, investment time declines and the share of retained earning rises when the individual invests in training on the job. Since, by (A9), $z(t)$ and $\psi(t)/R(t)$ are inversely related it follows that $\psi(t)/R(t)$ must also decline.

Consider, finally the region of specialization in schooling. In this phase we have

$$\dot{\psi} = (r + \delta - \theta_1\beta_1)\psi. \tag{A15}$$

Since schooling is more productive than training, our assumption that $\theta_2\gamma_2 - (r + \delta) > 0$ implies that $r + \delta - \theta_1\beta_1 < 0$. Hence ψ must decline during the schooling phase. Since $\frac{\dot{R}}{R} \geq 0$, $\psi(t)/R(t)$ must also decline.

We conclude that the incentive for investment, as represented by the ratio $\psi(t)/R(t)$, declines throughout the individual's career. This result reflects two basic forces: the usual effect of shortening the period over which human capital is utilized and the additional force of worsening terms of trade between current costs and future benefits, $R(t + x)/R(t)$, implied by the assumption that $\frac{\dot{R}}{R}$ is non negative and non increasing.

The model implies a very simple pattern of life time earnings. During the initial phase, the individual, specializes in schooling and his observed earnings are zero. His earning capacity, however grows at the constant $\theta_1\beta_1$. Earnings in the second phase are given by $y(t) = R(t)K(t)z(t)^{\alpha}$. Using (A11), we see that when the individual enters the second phase, at time t_0, his initial earnings are given by

$$y(t_0) = R(t_0)Ke^{\theta_1\beta_1 t_0}[\frac{\theta_1\beta_1 - \theta_2\gamma_2}{\theta_2\gamma_2}\frac{\alpha}{1-\alpha}]^{\alpha}. \tag{A16}$$

Differentiating $y(t)$ with respect to t, using (A2) and (A14), earnings during the second phase grow at the rate

$$\frac{\dot{y}}{y} = \frac{\frac{\dot{R}}{R} + \theta_2\gamma_2 - r\alpha - \delta}{1-\alpha} > 0. \tag{A17}$$

During last phase, which starts at t_1 and ends at T, investment is zero and earnings are given by $y(t) = R(t)K(t)$ implying a growth rate

$$\frac{\dot{y}}{y} = \frac{\dot{R}}{R} - \delta. \tag{A18}$$

One can also obtain an explicit solution for the investment path. In the initial schooling phase, $\frac{\dot{K}}{K} = \theta_1\beta_1 - \delta$. During the period of investment on the job, $\frac{\dot{K}}{K} = \theta_2\gamma_2\tau_s - \delta = \theta_2\gamma_2 - \delta - \theta_2\gamma_2 z$, where z is determined by the solution to the differential equation A14, that is,

$$z(t) = \frac{[\frac{R(t)}{R(t_0)}]^{\frac{1}{1-\alpha}} e^{a(t-t_0)}}{1 - b\int_0^{t-t_0} [\frac{R(t+x)}{R(t_0)}]^{\frac{1}{1-\alpha}} e^{ax} dx} z(t_0), \tag{A19}$$

where $a = \frac{\theta_2\gamma_2 - r - \delta}{1-\alpha}$, $b = \frac{\theta_2\gamma_2}{\alpha}$ and, by A11, $z(t_0) = \frac{\theta_1\beta_1 - \theta_2\gamma_2}{\theta_2\gamma_2}\frac{\alpha}{1-\alpha}$. During the last period of non investment, $\frac{\dot{K}}{K} = -\delta$. Note that the behavior of investment over time depends only on the *relative* values of $R(t)$ at different points in time

The length of each of there investment phases are easily determined. The entry date into the last phase, t_1, occurs when or $\psi(t)\theta_2\gamma_2 = \alpha R(t)$ or

$$\theta_2\gamma_2 \int_0^{T-t} e^{-(r+\delta)x} R(t+x) dx = \alpha R(t). \tag{A20}$$

For a sufficiently large T, this equation has a unique solution in t, t_1, which is *independent* of past history. Given t_1, we can calculate t_0, exploiting the fact that during the second phase $z(t)$ traverses from $z(t_0) = \frac{\theta_1\beta_1 - \theta_2\gamma_2}{\theta_2\gamma_2}\frac{\alpha}{1-\alpha}$ to $z(t_1) = 1$, satisfying the differential equation (A14). Using (A19) and (A14), we obtain

$$z(t_1) = \frac{[\frac{R(t_1)}{R(t_0)}]^{\frac{1}{1-\alpha}} e^{a(t_1-t_0)}}{1 - b\int_0^{t_1-t_0} [\frac{R(t+x)}{R(t_0)}]^{\frac{1}{1-\alpha}} e^{ax} dx} z(t_0) = 1. \tag{A21}$$

Given the solved values of t_1 and $z(t_0)$, one can solve for t_0 from equation A21. Note that the value of t_0 which solves (A21) is also independent of past history. This independence of the investment decisions from initial conditions is an outcome of the multiplicative form of the accumulation equation (A2) which allows us to factor K out of the Hamiltonian function (see Weiss, 1986).

This model can be applied to describe the accumulation of Human capital both in Israel by native Israeli and immigrants, but it is more appropriate for immigrants. In the case of native Israelis, the only source of exogenous variation is changes in R, due to changing market conditions, for instance. However, it is not clear why changing market conditions will satisfy the model's assumptions that $\frac{\dot{R}}{R}$ is non negative and non increasing (unless the economy is stationary with $\frac{\dot{R}}{R} = 0$). For immigrants, there is the additional change due to changing values of imported skills which we summarized by K_1, where we define $lnK_1 = \sum_{s \in S_1} \theta_s(t)x_s(0)$, and the summation is taken over the set of *fixed* imported characteristics. Using equation (4) in the text, we obtain

$$\frac{\dot{K}_1}{K_1} = \sum x_s\lambda_s(\overline{\theta}_s - \theta_s(t)), \tag{A22}$$

which is positive and non-increasing under our maintained assumptions that $\theta_s(0) < \overline{\theta}_s$ and $\lambda_s > 0$.

We can use the model to compare two individuals with the same initial skills and the same learning abilities: A native who has a constant rental rate, R^1, and an immigrant who faces an exogenously rising rental rate converging to R^1 from below, some time before t_1. It is seen from equation (A14) that $\frac{\dot{z}}{z}$ is higher at any z for the person with $\frac{\dot{R}}{R} > 0$. Since the two individuals must reach the value $z = 1$ at the *same* time, t_1, and they both start investing with the same $z(t_0)$, it follows that the person with $\frac{\dot{R}}{R} > 0$ will start to training later (i.e., at a larger t_0), with a higher value of $K(t_0)$, and will have a lower value of $z(t)$ throughout this interval, implying a higher value of $\frac{\dot{K}}{K}$. Thus, this person will have a higher value of K throughout his career. From equation (A17), we see that he will also have a higher earning growth on the interval $[t_0, t_1]$. Therefore, his earning level will be higher some time before t_1, implying overtaking.

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	66.0	17.0	17.0
Immigrants in the USSR[3]	58.6	12.2	29.2	21.5	42.3	36.2
Immigrants in Israel[4], 1991-5	14.1	9.6	76.4			

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.

3. 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.

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

	Schooling $\leq$ 12		Schooling = 13-15		Schooling $\geq$16	
Year	Wage	Std.	Wage	Std.	Wage	Std.
1	2661	915	2798	950	2707	1058
2	2775	1018	3188	1618	3426	2083
3	2901	1126	3528	1692	3654	1839
4	3029	1304	3748	1816	4079	2311
5	3264	1390	4120	2129	4621	2729

1.Source: CBS, 1995 Census.

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

Years of Schooling	All Workers Israelis	All Workers Immigrants	Work Experience ≤ 5 Israelis	Work Experience ≤ 5 Immigrants	Work Experience > 5 Israelis	Work Experience > 5 Immigrants
0-12	3084	2095	2056	1782	3179	2841
13-15	4141	2401	2472	1954	4714	4322
16+	5556	3066	3379	2342	6400	5461
Occupation in Israel						
1	5949	3945	3717	2978	6394	5903
2	4246	3264	3060	2571	4548	4518
3	3050	2018	2183	1749	3195	3073
Age						
25-40	3276	2276	2698	2019	3441	3474
41+	4514	2663	2287	1980	4632	4218
All Ages	3759	2704	2645	2001	3965	3941

1. Source: CBS Income Surveys, 1991-95.

Table 4: Wage Equation for Native Men (Aged 25-65, Years 1991-1995)[30]

Dependent Variable: Log Hourly Wage (1991 NIS)

	With Occupation		Without Occupation	
Variable	*Coefficient*	*St. Dev.*	*Coefficient*	*St. Dev.*
Constant	1.2728	0.0345	1.0177	0.0321
1991	-0.0564	0.0147	-0.0455	0.0151
1992	-0.0047	0.0146	0.0055	0.0151
1993	-0.0461	0.0147	-0.0416	0.0151
1994	-0.0242	0.0141	-0.0223	0.0145
Occ1	0.2716	0.0159	-	-
Occ2	0.2148	0.0165	-	-
Experience	0.0448	0.0018	0.0459	0.0018
$(\text{Experience})^2$	-0.0007	0.00004	-0.0006	0.00004
Schooling	0.0729	0.0022	0.0970	0.0018

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

Table 5: Wage Equation for Immigrants
(Age at Arrival > 25, Years 1991-1995)

	With Occupation		Without Occupation	
Coefficient	*Estimate*	*St.Dev.*	*Estimate*	*St.Dev.*
b_{cons}	0.4125	0.2532	0.3354	0.2163
$b_{cohort<90}$	0.0592	0.0584	0.1517	0.0603
$b_{cohort92-95}$	-0.0535	0.0346	-0.0727	0.0356
d_{cons}	0.5528	0.3126	0.8842	0.2792
λ	0.0985	0.0436	0.1356	0.0477
b_{con_occ1}	0.3641	0.1035	-	-
d_{con_occ1}	-0.2407	0.1404	-	-
b_{con_occ2}	0.2110	0.1191	-	-
d_{con_occ2}	-0.1569	0.1655	-	-
b_{exp}	-0.2694	0.3170	-0.5211	0.2297
d_{exp}	-0.9721	0.3505	-0.8524	0.2791
b_{school}	-0.0430	0.0144	-0.0294	0.0121
d_{school}	-0.0366	0.0169	-0.0655	0.0136
Sum of Sq. Residuals	2040.155		2157.762	
R^2	0.3938		0.3603	
No. of obs.	9930		9930	

Table 6: 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	6.94	20.77	12.05	24.79	16.35	34.65	17.06	36.50	21.05	54.26	23.79	58.40
2	6.20	10.38	8.18	8.97	9.31	10.09	11.57	13.50	11.18	13.45	11.37	12.18
3	65.93	45.36	67.73	51.71	67.30	45.61	65.58	46.00	63.29	28.70	58.30	26.05
Not Working	20.93	23.50	12.05	14.53	7.04	9.65	5.79	4.00	4.47	3.59	6.54	3.36
Total Obs.	951	183	880	234	795	228	674	200	760	223	765	238
Age at Arrival 41-55	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+	All	Sch 16+
1	6.82	19.16	9.41	18.91	11.03	21.46	14.00	28.22	18.81	37.42	25.75	75.00
2	3.48	3.27	5.26	6.30	6.21	8.68	8.32	10.40	8.26	6.75	7.78	2.50
3	66.48	47.20	68.74	54.20	72.76	58.90	69.78	50.99	67.20	49.69	60.48	12.50
Not Working	23.23	30.37	16.59	20.59	10.00	10.96	7.91	10.40	5.73	6.13	5.99	10.00
Total Obs.	719	214	627	238	580	219	493	202	436	163	167	40

Source: CBS Labor Force Surveys, 1991-1995.

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 1991-1995 for the 1990 Cohort, Males, Age at Arrival>25

	All Imm.	Sch.13-15	Sch.16+	Age Arr. 25-40	Age Arr. 41+
Actual	0.0641	0.0566	0.0813	0.0822	0.0426
Predicted	0.0669	0.0642	0.0822	0.0660	0.0655
Time[1]	0.0113	0.0113	0.0113	0.0113	0.0113
Experience[2]	0.0121	0.0131	0.0128	0.0201	0.0040
Prices[3]	0.0328	0.0329	0.0445	0.0251	0.0406
Occupation[4]	0.0108	0.0069	0.0136	0.0096	0.0097
Sample size 1991	125	52	30	63	62
Sample size 1995	137	51	48	77	60

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

2. The experience effect is the difference in the average accumulated experience in Israel between 1991 and 1995 (averaged over members of the 1991 cross section and divided by 5). 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 5 in 1995 and and 1 in 1991. The coefficients b and c are taken from the wage equation for Israelis in Table 5 (i.e., $b = .0448$ and $c/2 = .0007$ and exp_0 is the experience accumulated abroad by the immigrant.

3. For each immigrant in the 1991 cross section, we form predicted wages for 1991 and 1995, *holding occupation constant* at the 1991 level. We then take averages of these two predictions (for 1995 and 1991) over all observations in the 1991 cross section and divide by 5.

4. For each immigrant in the 1995 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 1995, based on his 1991 occupation. We then take the difference in the average of these predictions and divide by 5.

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

	Male Natives		Male Immigrants	
	Income	Labour Force	Income	Labour Force
Monthly Wages	3,865.04 (2,894.88)	-	2,498.94 (1,719.02)	-
Hourly Wages	18.80 (12.98)	-	12.50 (8.38)	-
Experience (Total)	17.39 (9.74)	18.99 (9.21)	21.38 (10.32)	21.20 (10.50)
Experience Abroad	-	-	15.23 (10.48)	15.82 (10.12)
Experience in Israel	-	-	6.15 (6.86)	5.38 (6.56)
Age	39.06 (9.13)	38.09 (8.99)	42.74 (9.95)	43.79 (10.09)
Age at Arrival	-	-	36.18 (10.84)	38.41 (10.01)
Schooling	12.58 (3.15)	13.09 (3.09)	13.63 (3.31)	13.59 (3.27)
Schooling at Arrival	-		13.40 (3.37)	
Occuapation 1(%)	19.73	22.25	16.41	14.81
Occuapation 2(%)	12.72	13.18	10.19	8.83
Occuapation 3(%)	67.55	64.57	73.40	76.36
Arrival < 1960(%)	–	–	0.56	0.35
Arrival 60-69(%)	–	–	1.19	0.50
Arrival 70-79(%)	–	–	20.48	15.51
Arrival 80-88(%)	–	–	2.66	2.36
Arrival 89-91(%)	–	–	61.93	67.29
Arrival 92-95(%)	–	–	13.18	13.98
No. Obs. 1991	1731	7,585	283	1,488
No. Obs. 1992	1636	7,234	403	1,893
No. Obs.1993	1452	7,003	417	1,918
No. Obs.1994	1638	7,700	478	2,149
No. Obs.1995	1729	8,145	528	2,280
Total No. of Obs.	8,186	37,667	2,109	9,728

Source: CBS Income and Labor Force Surveys, 1991-1995. 1. Means and in parathesis 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	All Obs.
0-12	0.431	0.526	0.323	0.318	0.425	0.376
13-15	0.208	0.235	0.333	0.387	0.344	0.346
16 +	0.361	0.239	0.344	0.295	0.231	0.278

Source: CBS Labour Force Surveys, 1991-1995

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	10.6	17.8	21.8	26.3	35.6	35.3	36.3	24.2	22.7
2	13.0	14.3	14.1	12.7	10.4	9.3	10.1	7.6	12.7
3	76.4	67.9	64.1	61.0	54.0	55.3	53.6	68.2	64.5
Total Obs.	6356	7277	7093	6125	3524	2068	1829	516	34788
Schooling 16+									
1	46.8	56.8	59.8	64.0	72.5	71.7	74.0	71.8	62.7
2	24.0	22.0	20.1	15.4	9.0	8.7	13.0	12.7	16.8
3	29.2	21.2	20.1	20.6	18.5	19.6	13.0	15.5	20.4
Total Obs.	770	1465	1556	1507	1079	622	570	110	7679

Source: CBS Labour Force surveys, 1991-1995.

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}	-0.9087	0.1949	-0.9872	0.2101
b_{exp}	0.2361	0.0650	0.0849	0.0759
b_{exp^2}	-0.0057	0.0023	-0.0030	0.0047
$d_{cohort60-69}$	1.0005	1.5459	–	–
$d_{cohort70-79}$	-0.7462	0.5308	1.7992	0.9491
$d_{cohort80-88}$	-0.0451	0.4608	0.5982	0.5892
$d_{cohort92-95}$	-0.8263	0.2626	-0.7234	0.2982
Occupation 2				
b_{cons}	-2.1195	0.2932	-2.4401	0.3674
b_{exp}	0.3050	0.0937	0.1721	0.1395
b_{exp^2}	-0.0086	0.0031	-0.0012	0.0130
$d_{cohort60-69}$	2.4912	1.9122		
$d_{cohort70-79}$	-1.5561	0.8225	-2.5267	3.1011
$d_{cohort80-88}$	-2.5118	1.1515	-1.9330	1.6616
$d_{cohort92-95}$	-0.3351	0.3474	-0.5864	0.5011
Log-Likelihood	-1140.19		-765.49	
No. of obs.	1225		924	

Source: Labor Force Surveys, 1991-1995.

1. Occupation 3 is the reference group.

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

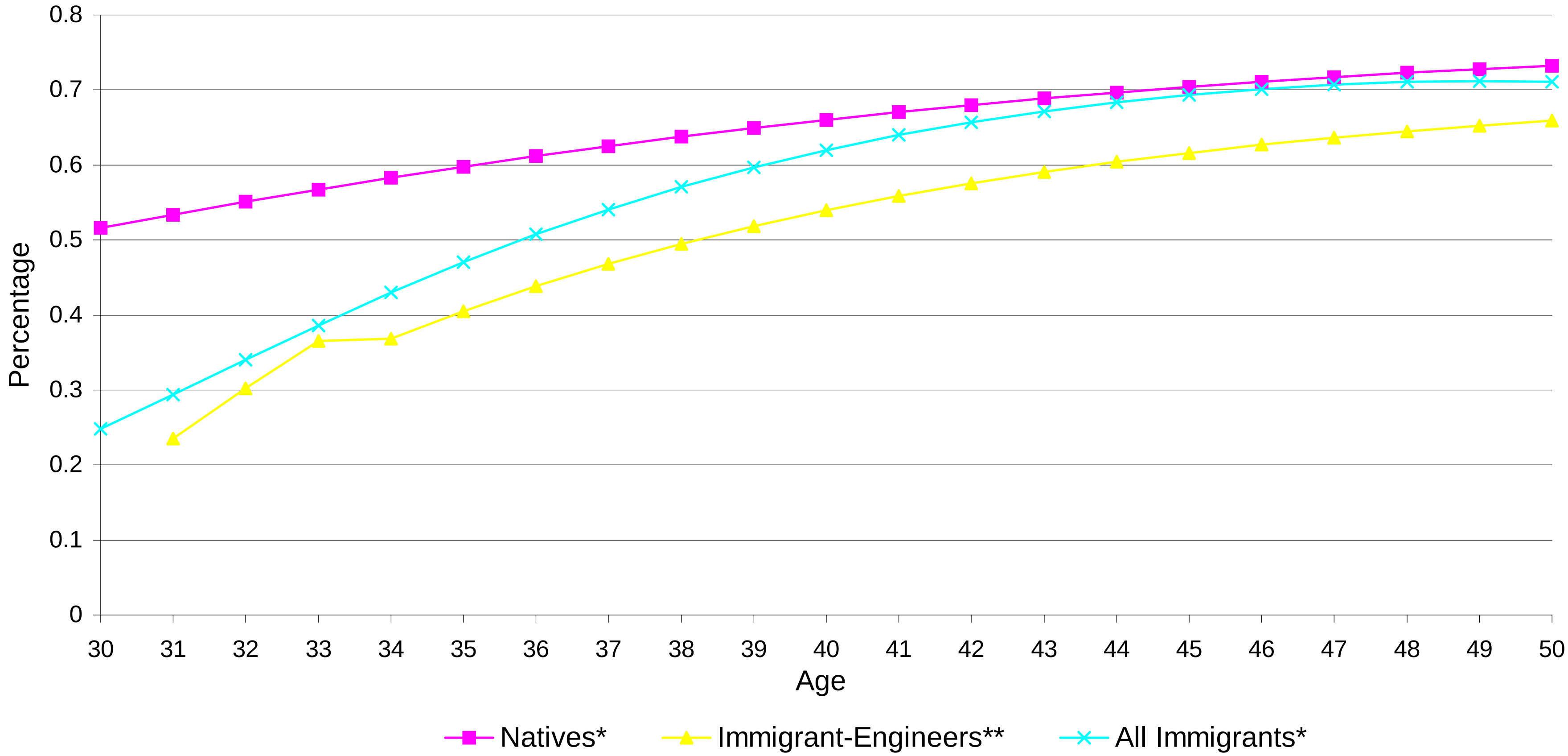
Dependent Variable: Occupation[1]

	LF Survey		Income Survey	
Coefficient	*Estimate*	*St.Dev.*	*Estimate*	*St.Dev*
Occupation 1				
b_{cons}	-1.0154	0.6081	-2.5940	1.4021
b_{age}	0.0740	0.0295	0.1521	0.0700
b_{age^2}	-0.0005	0.0003	-0.0013	0.0008
Occupation 2				
b_{cons}	1.5764	0.7517	-0.0178	1.6632
b_{age}	-0.0685	0.0372	0.0041	0.0838
b_{age^2}	0.0006	0.0004	-2.92e-06	0.0010
Log-Likelihood	-7039.61		-1343.01	
No. of obs.	7651		1504	

Source :Labor Force Surveys, 1991-1995.

1. Occupation 3 is the reference group.

Figure 1. Predicted Propotion of Workers with 16+ Years of Schooling Employed in Occupation 1

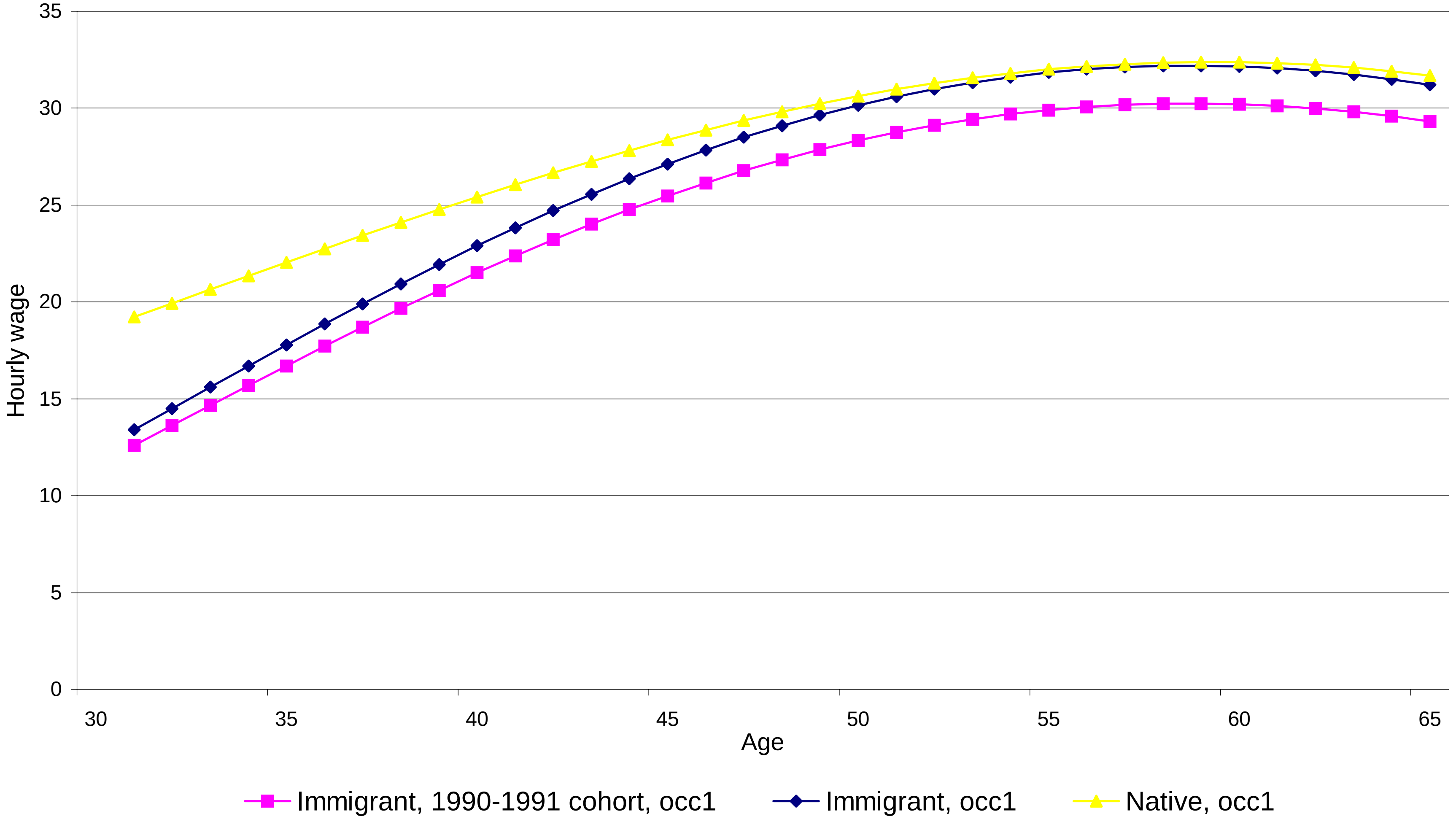


* Natives-based on Logit estimation (CBS, income surveys 1991-95).

* All Immigrants-based on Logit estimation (CBS, income surveys 1991-95).

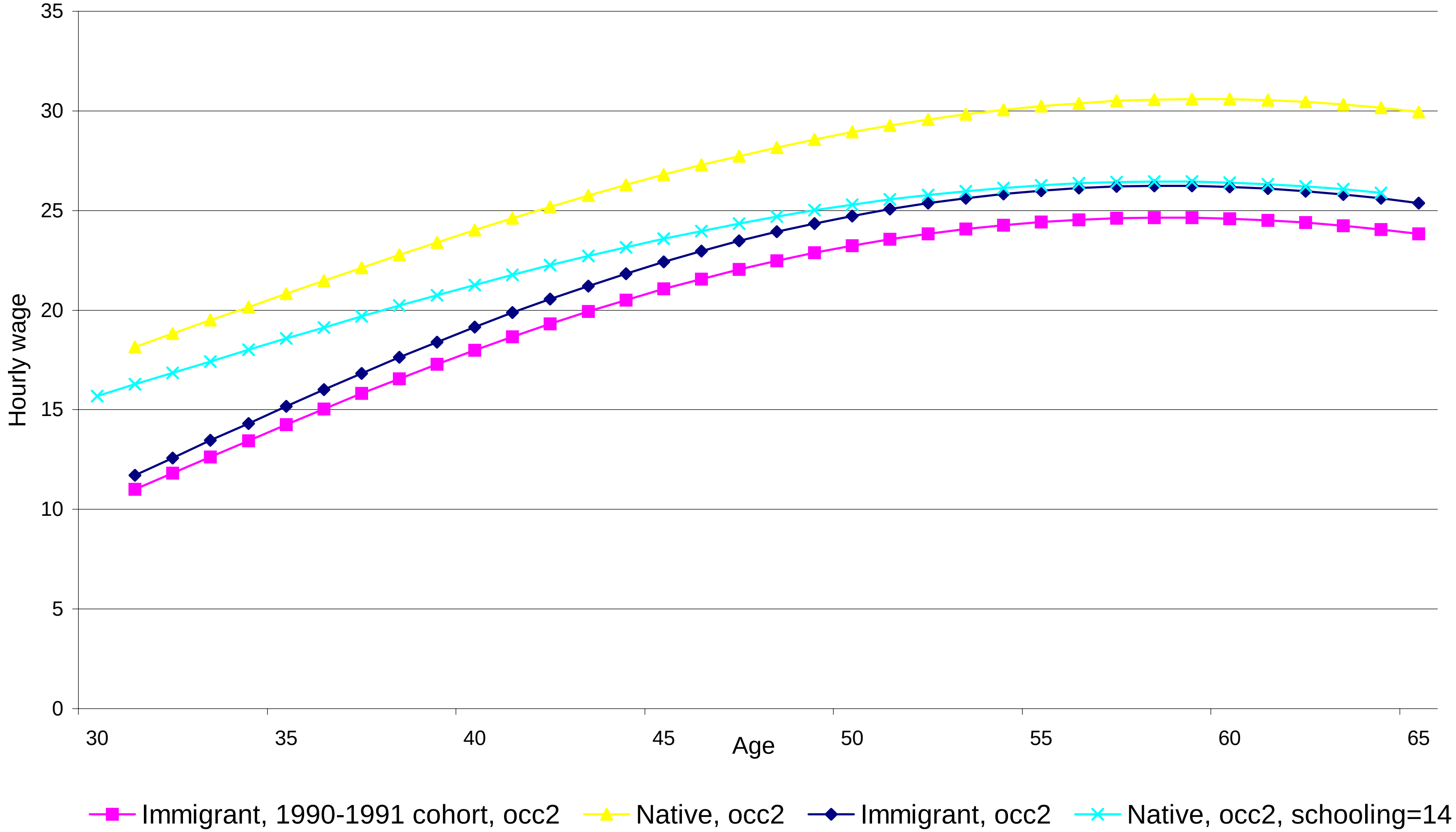
**Immigrant Engineers-based on the transition matrix in table 9.

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



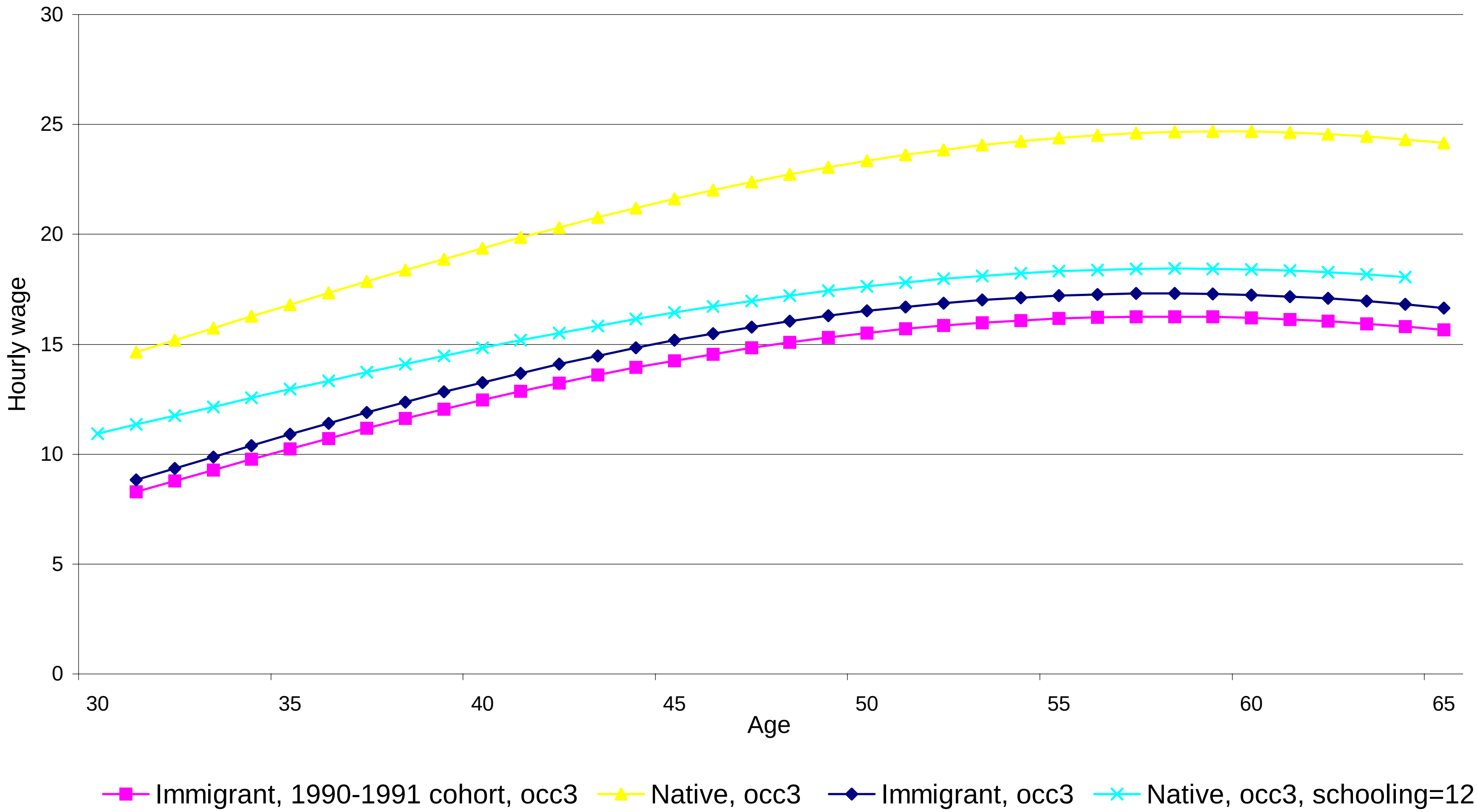
* Wage per hour in 1991 NIS. Based on the regressions in tables 5 and 6.

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*



* Wage per hour in 1991 NIS. Based on the regressions in tables 5 and 6.

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*



* Wage per hour in 1991 NIS. Based on the regressions in tables 5 and 6.

Figure 3. Residual Distributions for Natives and Immigtants with Experience <= 5

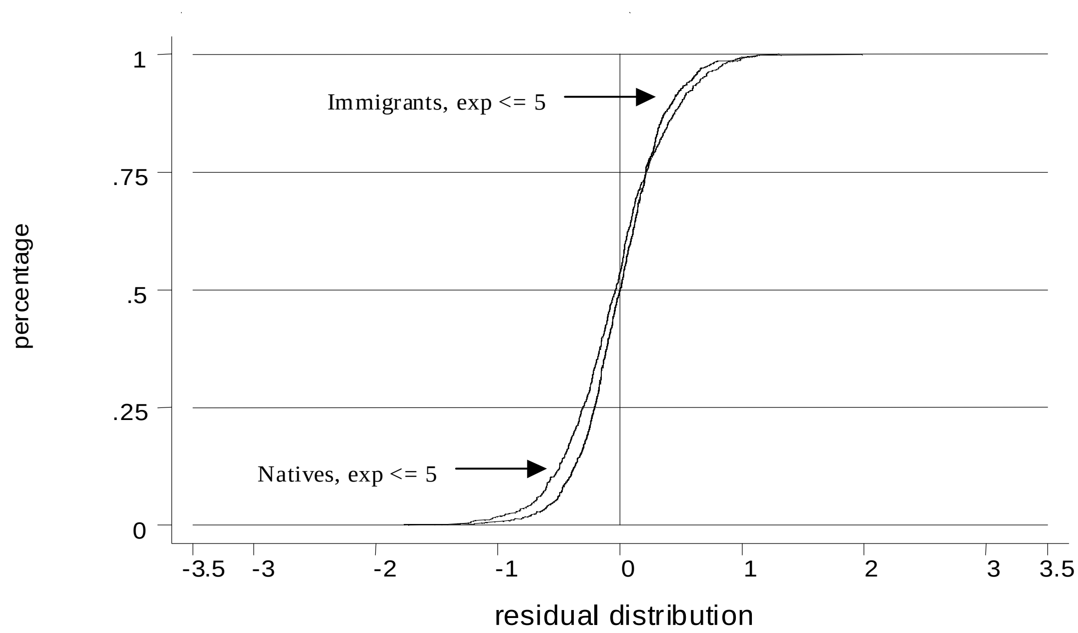


Figure 4. Residual Distributions for Natives and Immigtants with Experience > 5

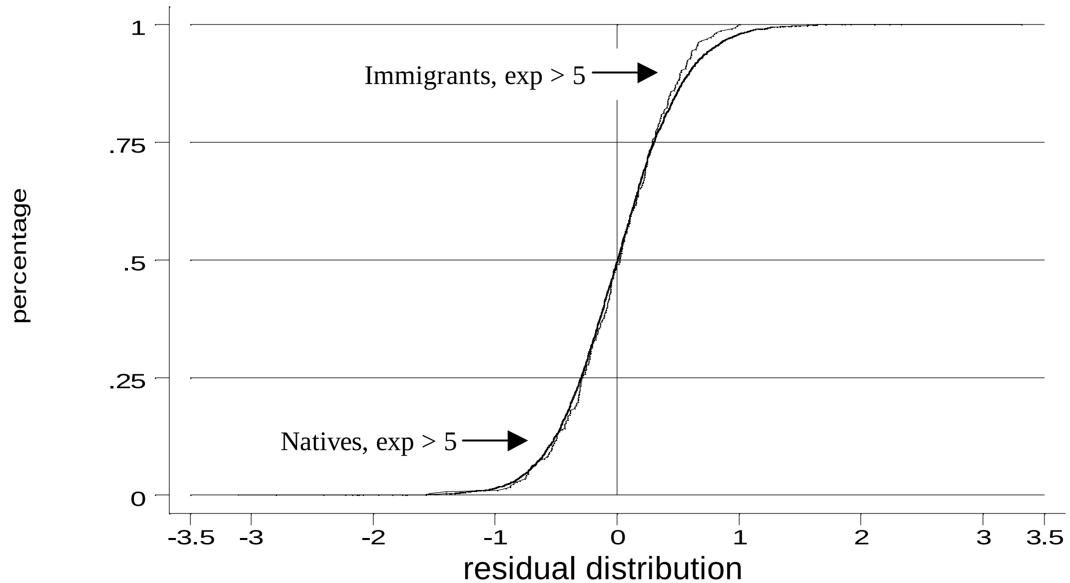
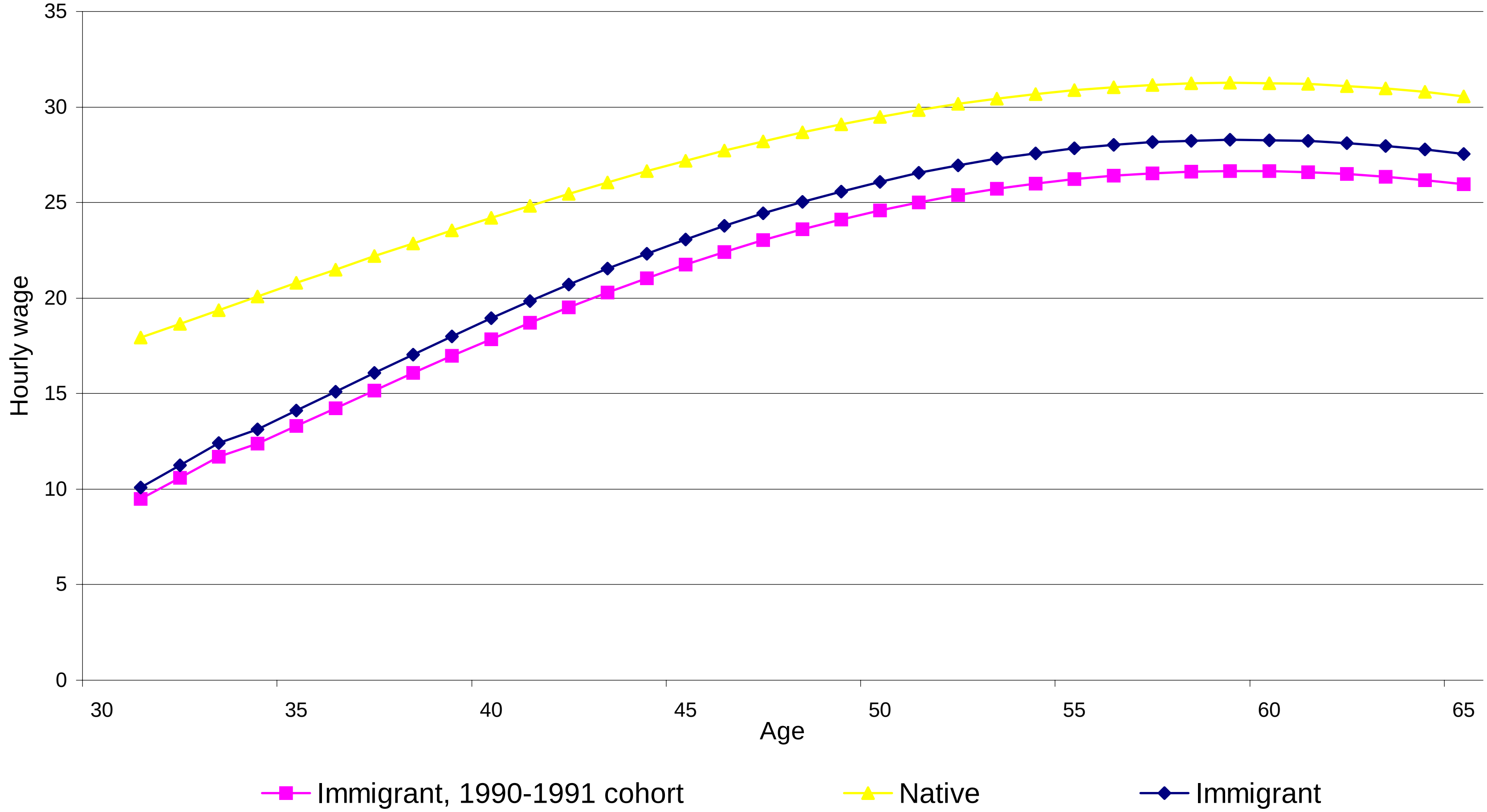


Figure 5. Simulated Wage-Age Profiles, Averaged over Occupations, for a Native and an Immigrant, with and without Cohort Effects (schooling=16, age at immigration=30)*



* Wage per hour in 1991 NIS. Simulations are based on the regressions in tables4 and 5. The occupational distribution for Natives is based on the Logit estimates in Table A5 (CBS Labor Force Surveys 1991-95). Occupational distribution for Immigrants is based on the transition matrix in table 9.