UNIVERSIDAD DE SAN ANDRES

Seminario del Departamento de Economía

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

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Martes 25 de agosto de 1998
11:00 hrs
Aula Chica de Planta Baja

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Revised, June 1998

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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. We formulate a non-linear model which is estimated, 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 4.3, 1.4, 1.2 and 1.2 percent each. In the long run, the return for schooling converges to 0.044 and 0.027 for immigrants in high and low skill occupations, respectively, substantially below the .073 for natives. The return for experience converges to that of Israelis, and immigrants receive higher return for their unmeasured skills. The average wages of immigrants approach but do not converge to the wages of comparable Israelis.

*We would like to thank Joseph Altonji, Gary Becker, Thomas MaCurdy, Sherwin Rosen, Mark Rosenzweig, Robert Willis, Michael Waldman and Kenneth Wolpin for their comments. Sarit Cohen, Chemi Gotlibovski and Giovanni Oppenheim provided excellent research assistance and many important suggestions and comments on this work. We obtained financial support from the John M. Olin Foundation through a grant to the George J. Stigler Center for the Study of the Economy and State at the University of Chicago and from the GIF grant No I-084-118.02/95.

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1 Introduction

Immigration is an important part of the adjustment of labor markets to varying economic circumstances, as individuals try to move to where they can get the highest rewards for their skills. Typically, immigrants start at a low wage and then experience a relatively fast earning growth (see the surveys by Borjas, 1994 and Lalonde and Topel, 1997). The rise in earnings is an outcome of several complementary forces. First, immigrants learn the local language and become familiar with local institutions and local market conditions as a by-product of spending time in the new country and, at the same time, employers become less uncertain of the immigrant's quality (see Chiswick, 1978). Second, as time passes immigrants find a better match with local employers (see Weiss and Gotlibovski, 1995). These two processes combine to provide immigrants with rising rewards for their imported skills. In addition, immigrants invest in the acquisition of local skills, through schooling and on the job training. Expecting wages to grow, they have special incentive to invest in human capital and to "try harder". Consequently, immigrants may overtake natives of comparable skills, who have a weaker incentive to invest.

In this paper we develope a descriptive methodology of analyzing the wage growth of immigrants. We implement this methodology, using data on a large wave of immigration from the former Soviet Union to Israel. This group of immigrants is of particular interest, because of its relative magnitude (about 13 percent of the labor force) and high level of skill (14.5 years of schooling, on the average). This paper studies the wage growth of male immigrants, because the patterns among women are different and require a separate analysis.

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.[1] We provide a simple framework, based on human capital theory, to explain the connections between rising prices of skills and investment in human capital and describe the conditions under which the earnings of immigrants will convergence to the earnings of comparable natives. Based on this framework, we formulate a non-linear model which is estimated, using repeated cross section

[1] We use three occupations as follows: 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 occupations.

data that includes immigrants with different durations of time in Israel, observed in the years 1991 to 1995. The estimation is done in two steps: First, a wage equation is estimated for Israelis and the estimated coefficients are used to predict earnings for immigrants. Then, the difference between actual and predicted earnings for immigrants is explained by imported skills and their interaction with time spent in Israel.

We find 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, 0.044 and 0.027 for immigrants in high and low skill occupations, respectively, substantially below the .073 for natives (Freidberg, 1992, reports a similar finding). Immigrants eventually obtain the same return on experience as natives, but the convergence is slow. The market "penalty" on observed imported skills is partially compensated by a premium on the unobserved characteristics of immigrants. The importance of unobserved skills declines sharply with time spent in Israel, but even in the long run, a large gap remains in favor of immigrants.

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 convergence of wages of immigrants to natives. In academic 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.

We use retrospective data from a sample of immigrant engineers from the former USSR to examine the process of occupational transitions in the early phase of the absorption process. Extrapolating the transition matrices from this panel of engineers, we can predict quite well the occupational distribution for different age groups in the pooled cross sections. We find that, conditional of schooling, the occupational distribution of immigrants approaches that of comparable Israeli workers. After 20 years in Israel, about 55 percent of the immigrants who entered Israel at age less than 40, with more than 16 years of schooling, are expected to work in academic occupations, compared with 63 percent among equally qualified Israelis.

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 academic degree). Half of this growth can be ascribed to rising prices of skills. Occupational transitions account for a growth of 1.4 percent per year among immigrants with 16+ years of schooling. For these immigrants, accumulated experience in Israel and the economy wide rise in wages account for about 1.2 percent, each, per year. In the long run, the price effects are expected to decline and the main vehicle for wage growth are occupational transitions.

The wage differential between immigrants and comparable native Israelis narrows substantially with time spent in Israel. An immigrant who arrives at age 30 with 16+ years of schooling earns, on the average, only 52 percent of the wage of a comparable Israeli. After 5 years in Israel, the same immigrant earns a wage which is 62 percent of the wage of a comparable Israeli and after 20 years this proportion rises to 80 percent. However, convergence is not attained, because of incomplete convergence in the occupational structure and the lack of convergence within occupations.

2 Background

The mass immigration of Jews from the former Soviet Union to Israel which started towards the end of 1989, amounted to a total of about 600 thousand immigrants between 1990 and the end of 1995 (see Table 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. The reduced immigration flow between 1992 and 1995 has contributed about 1.3 percent a year in population growth. By the end of 1995, the recent immigrants from the USSR constitute about 11% of the total population and 12.1% of the population of age 15 and above. Compared with the immigration into the US and other receiving countries, this wave stands out in its magnitude.

While the flow of new workers from the Israeli established population is mainly comprised of young inexperienced workers, the flow of immigrants is of workers of all ages, who acquired some work experience in their home country. On the average, immigrants are older than Israeli workers by four years. This is contrast to most immigrations, where immigrants tend to be relatively young. This feature reflects the exogenous relaxation of emigration from

the USSR and the free entry to Israel. Thus, this immigration wave is less governed by self-selection.

Another important feature of this wave of immigration is the exceptionally high level of education and the prior experience in academic jobs (see Table 2). Those who arrived during 1989-1991 possessed an average of 14.5 years of schooling, compared with 12.6 years among Israeli workers in 1991[2]. Fifty nine percent of the men and 55 percent of the women held academic and managerial positions in the former USSR, compared with 18 and 11 percent, respectively, among Israeli workers. 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. Under these circumstances, it is not surprising that many highly skilled immigrants work in Israel in occupations that require less skill than they possess. Of the 333,000 immigrants who arrived during 1990-91, 75 percent worked in low-skill occupations, and only 13 percent found jobs in high-skill occupations within their initial stay in Israel (2.9 years on the average).

Occupational downgrading is sharper for women, reflecting the larger discrepancy between Israeli and immigrant women in the proportions of workers in academic jobs (see Table 2). The subsequent process of occupational upgrading and wage growth has been slower. Consequently, male and female immigrants require a separate analysis. This study will focus on the wage and employment dynamics of male immigrants.

The basic features of the occupational dynamics can be seen in Table 3, which describes the occupational and employment status of male immigrants from a cohort which arrived in 1990. by their occupation in the former USSR. As seen, among the immigrants who were employed in high-skill occupations (occupation 1) in the former USSR, only 27.4 percent found jobs at the same occupational level, after 3 years in Israel. Immigrants gradually improve their occupational standing. Initially, the main inflow into the high skill occupations is from the ranks of unemployed. Later, the main inflow is from those who first found jobs at low-skill occupations.

There is a rather sharp increase in wages as a function of time spent in Israel. The figures

[2]The average schooling differences are slightly higher for men. Among immigrants, the average years of schooling are 14.6 for men and 14.4 for women. Among Israeli workers, the average years of schooling are 12.3 for men and 13.0 for women.

in Table 4 show that recent immigrants, with experience in Israel of 5 years or less, earn less than Israeli 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 the average, about the same wage as native Israelis with the same experience in Israel (who are, on the average, 8 years younger). As immigrants spend more time in Israel, the variability in wages across schooling groups and occupations rises, suggesting improved matching of workers to positions and rising returns for skills acquired abroad.

To summarize, 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. Following this initial phase, there is a second phase in which the highly educated immigrants gradually upgrade their positions by finding better jobs within the low-ranked occupations or move to jobs within a high-ranked occupations. As a result, there is a substantial wage growth and inequality among immigrants rises, as they obtain higher returns for their imported skills.

3 A Framework for Analysis

We now present a simple human capital model which describes the development of earnings for immigrants and natives and allows us to compare their patterns. In particular, we are interested in the forces which determine the convergence of the earnings of immigrants to those of Israelis.

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 Israeli market, and their quality and market value rises. The immigrant may also augment his skills or acquire new skills in Israel. The acquisition of new skills requires some sacrifice of current earning. Thus, each immigrant is faced with an investment problem in which he compares the benefits from investment in terms of higher future earnings to the costs in terms of forgone current earnings. The investment decisions interact with the changes in the market value of the immigrant's skills and together determine his earning

growth. An Israeli worker faces a similar investment problem, except that he does not have skills which were acquired abroad.

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. The marginal rate of substitution in production between any two skills r and s is given by $\frac{\theta_s}{\theta_r}$. The concavity of $F(.)$ determines whether skills are gross substitutes or complements.[3]

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

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

Thus, $\frac{\theta_s}{\theta_r}$ also represents the relative price of skills in the market. 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.[4]

[3] The cross partial derivatives are $F''(.)\theta_s\theta_r$.

[4] 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).

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

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

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 usually smaller. The actual earning of the individual, y, equal 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 Israel, relative to the prices of locally acquired skills. This rise in prices, which reflects gradual adoption of imported skills to local market conditions, may influence the local investment decisions.

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 definitions, and assuming an exponential aggregation rule, $K = \exp(\sum \theta_s x_s)$, the growth rate in human capital can be partitioned into the change arising from local investment decisions, and the change due the rising prices of imported skills. That is,

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

We may approximate the optimal local investment pattern for an immigrant by

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

where, t is calendar time, t_0 is time of arrival, τ_0 is the immigrant's age (or work experience) upon arrival and a, b and c are some fixed positive parameters.[5] 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.

[5] Approximation is required because in general there is no closed form solution for the optimization problem. An exception is when $F(.)$ is exponential and $c(T_w) = 1 - (1 - T_w)^\alpha$, where $0 < \alpha < 1$. In this case, the investment policy can be derived explicitly as a function of the future prices relative to their current values. Earning growth assumes a very simple piecewise constant form : $\frac{\dot{y}}{y} = 0$ when the individual specializes in schooling, $\frac{\dot{y}}{y} = \frac{\rho+\theta\gamma-r\alpha-\delta}{1-\alpha}$ when he invests on the job, and $\frac{\dot{y}}{y} = g - \delta$ in the last phase of no investment, where $g = \sum x_s(0)\dot{\theta}_s + \frac{\dot{R}}{R}$ is the change in prices, $\theta\gamma$ is the maximal learning coefficient (on the job) and r and δ are the depreciation and interest rates, respectively The duration of each phase is determined endogenously. These results are derived in the Appendix.

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.[6]

We can now compare the earning paths of immigrants and native Israelis. 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. Thus, at the early stage of stay in Israel, immigrants display higher growth in earnings than similar Israelis. Assuming that after sufficient time in Israel, prices of imported skill converge to some constant values, the earning 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 will help to illustrate the general point. Let $t - t_0$ be the duration of time that the immigrant has been in Israel, then the market value of imported skill s at time t is $\theta_s(t - t_0)$. We assume that

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

where $\bar{\theta}_s$ is the long run value of $\theta_s(t - t_0)$ and λ is a parameter indicating the speed of adjustment.[7] If $\lambda > 0$ then, as the immigrant spends more time in Israel, the price of each imported skill component approaches $\bar{\theta}_s$. In contrast, skills acquired in Israel by natives or immigrants, have constant value, θ_s.

[6] 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.

[7] 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.

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. Let us denote the date of arrival by t_0, the age (or experience) on arrival by τ_0 and the imported quantity of skill s by $x_s(0)$. 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

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

The earnings of a comparable native Israeli, 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 on age τ_s be written as

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

where, t_s and τ_s are, respectively, the time and age of leaving school.[8] 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

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

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 inherently lower quality and a is not too large (i.e., $(1+a)\bar{\theta}_s < \theta_s$), 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.[9]

An important source of earning growth of immigrants, which we have not discussed yet, is their gradual climb up the occupational scale. 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 the arrival rate of jobs offers depends on the individual's search effort and skills, and on market conditions (see, e.g., Weiss and Gotlibovski (1995)). However, in this paper we focus on investment decisions and assume that occupational transitions are exogenous.

[9] 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. 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).

4 Data on Earnings

For the analysis of earning, we use the CBS income surveys for the years 1991 to 1995, which are random annual surveys of the whole Israeli population. Using these data we construct two subsamples sample of native born Israelis and a sample of immigrants from the former USSR who were older than 13 upon arrival. The two subsamples include only Jewish men of ages 26 to 65 who worked more than two weeks during the last month and more than 25 hours per week. We also exclude all individuals with no information on age, no information 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 several weeks before the survey. For immigrants, we can separate the number of years of schooling and experience of work between those acquired in the former Soviet Union and those accumulated in Israel.

Summary statistics for the two sub-samples from the Income Survey are presented in Appendix Table A1. On the average, immigrants earn about 64 percent of the monthly wage of Israelis (and 66 percent of their hourly wage). Immigrants are about 3 years older than Israelis and have one year more of education. 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 immigrants in the sample are newly arrived and have been in Israel for less than 6 years.

5 Implementation and Results on Wage Convergence

We follow a simple two stage estimation procedure. We first use a sample of Israeli natives to estimate a wage equation for Israeli workers. We use these estimates to predict what each immigrant would earn in Israel if he could sell his observed skills for the same prices as native Israelis. We then form the differences between actual and predicted earning for immigrants and estimate equation (11), with the objective of identifying the effect of changing prices of skills, as a function of time spent in Israel.[10] We allow for cohort effects and for the

[10] The two stage procedures allows us to incorporate in a simple way the identifying restriction that the time effects, reflecting a common rental rate for human capital which may vary over time, are the same for

possibility that immigrants who are "trapped" in low skill occupations, receive a lower return for schooling acquired abroad

The observed imported skills in this analysis are schooling and experience acquired abroad. Schooling is measured simply by the total time spent in school. However, experience is not simply the accumulated time spent at work, but rather the amount of human capital or skills accumulated in work. This quantity is given by the expression $[b \exp - \frac{c \exp^2}{2}]$, 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 import as $[b \exp_0 - \frac{c \exp_0{}^2}{2}]$, using the *same* values for b and c as for Israelis.[11] We then estimate the time pattern of the price which immigrants receive for this quantity. The prices of unobserved skills are represented by the time patterns of the occupational specific constants.

5.1 Regression Results for Israelis

Table 5 presents the estimation results of the wage equation for Israelis. The yearly dummies represent the difference from the wage in 1995. We find 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). The wages in occupation 1 and occupation 2 are, respectively, about 27 and 22 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 percent increase of the hourly wage with a year of education. These estimates and the fit ($R^2 = 0.32$) of the model are similar to those obtained in other application of Mincer's wage function[12]. We use this equation as the benchmark for studying the convergence of the

immigrants and natives.

[11] 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.

[12] 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.

wages of immigrants to native Israelis, as described in the model above.

5.2 Regression Results for Immigrants

To estimate equation (11) we use the data for immigrants only. The dependent variable is the difference between the observed log wage of each immigrant and his predicted log wage, using the estimated parameters in Table 5. The explanatory variables are schooling acquired abroad (interacted with occupation), experience acquired abroad and occupation in Israel. The effect of each these variables (including the constant) is allowed to interact with time since arrival to Israel. To isolate the impact of mass immigration in 1990-1991, we distinguish three cohorts: immigrants who arrived before 1990, during 1990-1991 and during 1992-1995, and allow them to affect the constant. Specifically, we estimate the nonlinear regression

$$\begin{aligned} D_i &= b + b_{<90}c_{<90} + b_{92-95}c_{92-95} + de^{-\lambda(t-t_{0i})} \\ &+[(b_{occ1} + d_{occ1}e^{-\lambda(t-t_{0i})}]occ1 + [b_{occ2} + d_{occ2}e^{-\lambda(t-t_{0i})}]occ2 \\ &+[b_{exp} + d_{exp}e^{-\lambda(t-t_{0i})}][(.045 - .0007\,exp_{0i})\,exp_{0i}] \\ &+[(b_{s\_occ1\&2}(occ1 + occ2) + b_{s\_occ3}occ3 + d_s e^{-\lambda(t-t_{0i})}]s_{0i} + \varepsilon_i, \end{aligned} \tag{12}$$

where D_i is the residual from the first stage, $t - t_{0i}$ is potential experience in Israel, exp_{0i} is potential experience in former USSR, s_{0i} is the number of years of schooling in the USSR, $occ1_i$, and $occ2_i$ are dummies that take the value 1 if immigrant works in occupations 1 or 2, 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. The value of $[(.045 - .0007\,exp_{0i})\,exp_{0i}]$ is the accumulated human capital associated with the market labor experience that the immigrant imported, using the estimated coefficients for experience and experience squared for Israelis in Table 5. Note that we restrict the speed of convergence of the coefficients of the human capital indicators, λ, to be the same for all the parameters.[13]

[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 $b_s = [(\bar{\theta}_s - \theta_s) + a(\bar{\theta}_s - \theta_s(0))]$ and $d_s = (1 + a + a\lambda\xi)(\bar{\theta}_s - \theta_s(0))$. 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

In Table 6, we present two alternative versions of equation (12), without and with schooling-occupation interaction. The basic logic of compensating wage differentials would suggest that, the return for schooling is the same wherever a person works. However, immigrants have not chosen their schooling based on market conditions in Israel. The return which they receive in the Israeli market is, therefore, affected by demand conditions, and immigrants who cannot find high skill jobs are less likely to receive full reward on their schooling endowment. In describing our results, we shall mainly rely on the specification with a schooling-occupation interaction.

The estimated speed of adjustment, λ, is .0953 per year, implying that within a period of ten years each price is adjusted by 62 percent of the initial distance from it's long run value. However, convergence also depends on the long term difference between the prices that Israelis and immigrants obtain for their skills.[14] We shall, therefore, 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 immigrants and Israeli is $b_{s\_occ1\&2} + d_s = -.0290 - .0359 = -.0649$ in occupations 1 and 2 and $b_{s\_occ3} + d_s = -.0455 - .0359 = -.0814$ in occupation 3. Given the estimated rate of return of .0728 for native Israelis, the initial reward for schooling is slightly positive for an immigrant working in occupation 1 or 2 and slightly negative (but not significantly different from zero) for an immigrant working in occupation 3. The long run difference in the rate of return for schooling in occupations 1 and 2 is $b_{s\_occ1\&2} = -.0290$ and $b_{s\_occ3} = -.0455$ in occupation 3. Hence, the rate of return that immigrants can expect in the long run is only $.0728 - .0290 = .0438$ in occupations 1 and 2 and $.0728 - .0455 = .0273$ in occupation 3. 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 and Gotlibovski, 1995). The rate of increase in the return that immigrants in

immigrants receive for *some* skill, s, say experience, converges to the price that native Israelis obtain, so that $\bar{\theta}_s = \theta_s$. 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 $\bar{\theta}_s$ and $\theta_s(0)$ for schooling from the estimates of b_{school} and d_{school}.

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

occupations 1 and 2 (occupation 3) obtain for their schooling is such that, after ten years, the rate of return reaches .0299 (.0134) which is about 68 (49) percent of its long run value.

The initial difference, upon arrival, in the value of experience acquired abroad is $b_{exp} + d_{exp} = -.233 - 1.014 = -1.247$. Since the price of accumulated experience that Israelis obtain is normalized to one, this means that the initial return for accumulated experience is $1 - 1.247 = -.247$. This means that, initially, experience accumulated in the former USSR has negative value in the Israeli labor market. With time, however, the price rises to $1 - b_{exp} = 1 - .233 = .767$, 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 49 percent of its long run value.[15]

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. Using the specification without a schooling-occupation interaction, these premia are, in the short run, $.272 + (.368 - .242) = .398$ and $.215 + (.212 - .155) = .272$, in occupations 1 and 2, respectively. In the long run, these premia are even higher: $.272 + .368 = .640$ and $.215 + .212 = .427$. However, a large part of these occupational effects is a consequence of the lower rate of return for schooling in occupation 3. When a schooling-occupation interaction is added, it is seen that the occupational effects are reduced to .127 and .0 21, in the short run, and to .378 and .194 in the long run. The remaining occupational effects suggest that, in the long run, workers who were lucky to find jobs in the high skill occupations, or had some unobserved characteristic which made them more suitable for employment there, given their experience in schooling, fare substantially better than those immigrants who remain in the low skill occupation.

We now turn to the discussion of the constant terms which summarize the *average* impact of unmeasured characteristics of immigrants. As seen in Table 6, for both specification, 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

[15] If we allow for a different values of c in the definition of "true" experience, yielding $c = -.00066$ for natives and $c = -.00061$ for immigrants, we obtain essentially the same patterns for the price of experience.. The only difference is that, in this case, the initial price effect, given by $1 - b_{\exp} - d_{\exp} = -0.148$, is not significantly different from zero.

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 6.2 percent more than immigrants who came in 1990-1991 (the omitted group), who earn 5.7 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.

5.3 Convergence of wages within occupations

As noted above, 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 native Israelis, who work in the same occupation. Figures 1a to 1c 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 Israeli. 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 native Israeli. 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 Israeli, but rather to the wages of an Israeli with the average level of schooling in these occupations, 14 and 12 years, respectively.[16] The predicted wage gaps between immigrants and Israelis with 16 years schooling at age 55, for the 1990-1991 cohort, are 8%, 20% and 34% in occupations 1,2, and 3, respectively.

[16] 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.

5.4 Convergence of residual distributions

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

The residuals for Israelis are based on the regression coefficients in Table 5. The residuals for immigrants are based on the coefficients in Tables 5 and 6. 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 2 and 3 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 native Israelis are very close[17].

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.

[17] 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 0.0077 for K-W test), but is not rejected for those more than 5 years in the Israeli labor market (p value of 0.811 for K-S test and p value of 0.758 for K-W test).

6 Occupational Distribution and Transitions

As we have shown in the previous section, the occupation at 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 and lack of information, 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.[18]

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.[19]

Table 7 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 academic jobs, especially among immigrants who arrived at a young age. Among those with more than 16 years of schooling, only 20 percent are employed in academic jobs 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 Israelis 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

[18] We thus abstract from the individual choice of search intensity and acceptance rules, which are likely to be affected by the wage process. We are now in the process of estimating a structural model in which search and investment decisions are jointly determined.

[19] 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.

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 is 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 (see Weiss-Gotlibovski, 1995).

A similar pattern of a quick rise in the proportion of immigrants employed in occupation 1 is observed in Table 8, 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 matrixes 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 9 presents these average transition for male immigrants who were 25-45 years old upon arrival to Israel. 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. The transitions reported in Table 9 are the average for immigrants who have been more than two and a half

[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.

years in Israel, so that most of the people who are not working are unemployed and only few are in training programs.

Under the strong assumption of stationary transition rates, we can use the transition probabilities matrix of Table 9 to forecast the future occupational distribution of the immigrant engineers.[21] Such out of sample forecasts are presented in Table 8 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 7, 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 proportions who work in occupations 1, 2 and 3, conditioned on working, are presented in Figure 4.[22] 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, 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.

7 Convergence of Average Wages

Do wages of immigrants converge, overtake, or fall short of the wage of comparable Israelis? The analysis of wage dynamics has shown that, there is a substantial wage growth within

[21] Given that the transition matrix is from the early period in Israel, it is likely that the off diagonal probability of upwards mobility are biased upwards as estimates for the transitions in the later years.

[22] 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).

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.

Recalling that most of the immigrants in our sample have recently arrived and have been in Israel five years or less, we begin with an analysis of the short run predictions of our model concerning the relative importance of wage growth within and across occupations.

Table 10 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 5. 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.[23]

The results in Table 10 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 prices. Of course, this factor is more important the more schooling or experience the immigrant has. Changing

[23] 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.

occupation, accumulation of experience and general growth contribute each about 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 suggest that age plays an independent role which is not captured by investment and accumulation of experience.[24]

We thus see that in the short run, rising prices of skills are the main cause for wage growth, 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 1a 1b and 1c. This implies that occupational transitions become increasingly important.[25]

Figure 5 presents wage-age profiles, averaged over occupations, for an immigrant with 16 years of schooling, who arrived to Israel at age 30 and a comparable Israeli. For immigrants, we combine here the dynamic effects from the estimated wage equations reported in Tables 5 and 6 with the occupational distribution predicted from Table 9. 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 a Logit estimates.[26] Figure 5 shows that the wage differential between immigrants and comparable native Israelis narrows substantially with time spent in Israel. An immigrant who arrives at age 30 with 16+ years of schooling earns, on the average, only 52 percent of the wage of a comparable Israeli. After 5 years in Israel, the same immigrant earns a wage which is 62 percent of the wage of a comparable Israeli and after 20 years this proportion

[24] A possible explanation is that employers are reluctant to hire and test old immigrants. Therefore, the probability of receiving wage offers in occupation 1 is lower for such workers (see Weiss and Gotlibovski, 1995).

[25] This interpretation is somewhat tentative, because the increasing discrepancy between occupations may reflect self selection. To address self selection, one must extend the model to allow for endogenous occupational mobility.

[26] The Logit model uses the data from the Income Survey sample and controls for schooling and age (see Appendix Table A5).

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.

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. 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. We find that increased price of skills account for about half of the 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 8.1 percent. For these immigrants experience accounts for 1.3 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 Israel, but never reach the prices obtained by native Israelis. 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 Israel, 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 an academic job in Israel, 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 Israelis, within a period of 15 years. Despite this apparent tendency towards occupational convergence, wages of immigrants are not expected to converge to the wages of comparable Israelis, mainly because the long run price that immigrants obtain for their imported schooling a substantially lower return (0.044 and 0.027 for immi-

grants in high and low skill occupations, respectively) than that which Israelis obtain (7.2 percent).

The large gap in the "rates of return for schooling" between immigrants and native Israelis, which was also documented by Friedberg 1992, 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 (see Weiss and Gotlibovski, 1995).

The suggested partition of wage growth into within occupations and across occupations components cannot be accomplished with sufficient precision using only cross section data on wages, because we do not know where a particular immigrant who now works in, say, occupation 1, has worked in the past. Therefore, we used the retrospective data to form the estimates of the transition probabilities. However, even with panel data, it is not possible to provide a satisfactory partition without a structural model in which wage growth and occupational changes are jointly determined by local investments and the improved job matching. We are in the process of constructing such a model. The present framework is only a first step in this direction.

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Appendix

In this appendix 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

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

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,

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

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

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

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

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

which is positive and nonincreasing under our maintained assumptions that $\theta_s(0) < \bar{\theta}_s$ 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: Total Immigration and Immigration From the Former USSR, 1990-1995

(Thousands)

	1990		1991		1992		1993		1994		1995		Total 90-95	
Immigrants	Num.	% of Pop.	Num.	% of Pop.	Num.	% of Pop.	Num.	% of Pop.	Num.	% of Pop.	Num.	% of Pop.	Num.	% of Pop.
USSR.	185	3.84	148	2.92	65	1.25	66	1.24	68	1.24	65	1.15	597	10.6
All	200		176		77		77		80		76		686	
Age 15+														
USSR	143	4.47	117	3.43	52	1.46	53	1.43	55	1.44	52	1.34	472	12.1
All	153		134		60		61		64		61		533	

Source: Israeli Central Bureau of Statistics, *Statistical Abstracts*, 1990-1995.

Table 2: Occupation and Schooling of Israeli Workers and Immigrants, aged 25-65, by Sex (percent)

	Occupation[1]			Schooling		
	1	2	3	0-12	13-15	16+
MALES						
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			
FEMALES						
Israelis[2], 1991	11.4	24.2	64.4	57.9	23.6	18.5
Immigrants in the USSR[3]	55.2	24.6	20.2	22.3	46.3	31.4
Immigrants in Israel[4], 1991-5	11.0	15.9	73.1			

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 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 3: Employment Status of Immigrants (percent) by Year and Occupation in the former USSR 1990 Cohort, Males Aged 25-55[1]

		Work Status in Israel				
Occ. in the USSR	Sample Year	Emp. Occ. 1	Emp. Occ. 2	Emp. Occ. 3	Unemployed	Out of Labor Force
1	92	17.1	6.0	55.3	11.5	10.1
1	93	27.4	9.1	52.1	5.0	6.4
1	94	36.1	8.7	50.2	1.8	3.2
2	92	3.5	15.5	67.9	11.9	1.2
2	93	8.2	21.2	65.9	2.3	2.4
2	94	7.0	20.9	69.8	-	2.3
3	92	2.3	2.3	87.9	5.2	2.3
3	93	6.2	4.6	84.4	3.2	1.6
3	94	6.2	6.2	84.0	1.0	2.8

1. Source: CBS, the 1990 Panel of Immigrants, surveyed during 1991-1994.

Table 4: Wages of Immigrants and Israelis by Work Experience in Israel, Males, Aged 25-55[1]

Years of Schooling	All Workers		Work Experience ≤ 5		Work Experience > 5	
	Israelis	Immigrants	Israelis	Immigrants	Israelis	Immigrants
0-12	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 Imm.	3759	2704	2645	2001	3965	3941

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

Table 5: Wage Regression for Israeli Men, Aged 25-65, Years 1991-1995

Dependent Variable: Log Hourly Wage (1991 NIS)

Variable	*Coefficient*	*St. Dev.*
Constant	1.2726	0.0360
1991	-0.0614	0.0160
1992	-0.0083	0.0162
1993	-0.0437	0.0167
1994	-0.0223	0.0162
Occ1	0.2718	0.0165
Occ2	0.2150	0.0170
Experience	0.0451	0.0018
(Experience)^2	-0.0007	0.00004
Schooling	0.0728	0.0022
R^2	0.3215	
No. of obs.	8,186	

Table 6: Nonlinear Regression on Residuals for Male Immigrants, Age at Arrival > 25, Years 1991-1995

Dependent Variable: Residuals from Wage Regression in Table

	Without occupation-schooling interaction		With occupation-schooling interaction	
Coefficient	*Estimate*	*St.Dev.*	*Estimate*	*St.Dev.*
b_{cons}	0.3917	0.2114	0.4233	0.2103
$b_{cohort<90}$	0.0625	0.0468	0.0621	0.0467
$b_{cohort92-95}$	-0.0562	0.0274	-0.0574	0.0274
d_{cons}	0.5743	0.2582	0.5766	0.2565
λ	0.0941	0.0344	0.0953	0.0348
b_{con_occ1}	0.3679	0.0851	0.1062	0.1595
d_{con_occ1}	-0.2426	0.1151	-0.2513	0.1146
b_{con_occ2}	0.2116	0.0980	-0.0209	0.1550
d_{con_occ2}	-0.1553	0.1359	-0.1734	0.1357
b_{exp}	-0.2372	0.2618	-0.2333	0.2605
d_{exp}	-1.0013	0.2876	-1.0142	0.2858
b_{school}	-0.0423	0.0119	–	–
$b_{school\_occ1\&occ2}$	–	–	-0.0290	0.0136
b_{school_occ3}	–	–	-.04554	0.0119
d_{school}	-0.0371	0.0141	-0.0359	0.0139
Mean Dependent Var.	-.6106	.4822	-.6106	.4822
Sum of Sq. Residuals	234.307		233.799	
Log-Likelihood	-724.262		-722.369	
R^2	0.7780		0.7767	
No. of obs.	1,744		1,744	

Table 7: 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 Observations	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 Observations	719	214	627	238	580	219	493	202	436	163	167	40

Source: CBS Labour Force Surveys, 1991-1995.

Table 8: Actual and Forcasted 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 enigineers, aged 25-65, in the last month of each year. The forecasts are based on the transition matrix in Table 9.

Table 9: 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 10: Components of Annual Wage Growth During 1991-1995 for the 1990 Cohort, Males, Age at Arrival>25

	All Immigrants	Schooling 13-15	Schooling 16+	Age at arrival 25-40	Age at arrival 41+
Actual	0.0641	0.0566	0.0813	0.0822	0.0426
Predicted	0.0674	0.0637	0.0828	0.0669	0.0658
Time[1]	0.0123	0.0123	0.0123	0.0123	0.0123
Experience[2]	0.0121	0.0130	0.0128	0.0201	0.0039
Prices[3]	0.0317	0.0318	0.0433	0.0240	0.0396
Occupation[4]	0.0113	0.0066	0.0144	0.0105	0.0100
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., $b = .0451$ 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 residuals 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: Variable Means and Standard Deviations for the Income and Labor Force Surveys, Males aged 25-65

	Israelis		*Immigrants*	
	Income survey	Labour Force	Income survey	Labour Force
Monthly Wages[1]	3,865.04	–	2,498.94	–
	(2,894.88)		(1,719.02)	
Hourly Wages[1]	18.80	–	12.50	–
	(12.98)		(8.38)	
Experience (Total)	17.39	18.99	21.38	22.02
	(9.74)	(9.21)	(10.32)	(10.41)
Experience Abroad	–	–	15.23	15.60
			(10.48)	(10.75)
Experience in Israel	–	–	6.15	6.42
			(6.86)	(7.59)
Age	39.06	38.09	42.74	43.31
	(9.13)	(8.99)	(9.95)	(10.13)
Age at Arrival	–	–	36.18	36.45
			(10.84)	(11.28)
Schooling	12.58	13.09	13.63	13.60
	(3.15)	(3.09)	(3.31)	(3.28)
Schooling at Arrival	–	–	13.40	13.35
			(3.37)	(3.37)
Occupations (%):				
Occupation 1	19.73	22.25	16.41	15.83
Occupation 2	12.72	13.18	10.19	9.68
Occupation 3	67.55	64.57	73.40	74.49
Cohort (% of sample):				
Before 1960	–	–	0.56	1.47
60-69	–	–	1.19	1.34
70-79	–	–	20.48	20.19
80-88	–	–	2.66	2.67
89-91	–	–	61.93	61.58
92-95	–	–	13.18	12.76
Year of Observation:				
1991	1731	7,585	283	1,685
1992	1636	7,234	403	2,072
1993	1452	7,003	417	2,098
1994	1638	7,700	478	2,349
1995	1729	8,145	528	2,574
Total No. of Obs.	8,186	37,667	2,109	10,778

Source: CBS Income and Labor Force Surveys, 1991-1995.

1. 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 Israeli 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 Israeli Men, with 16+ Years of Schooling, Aged 25+

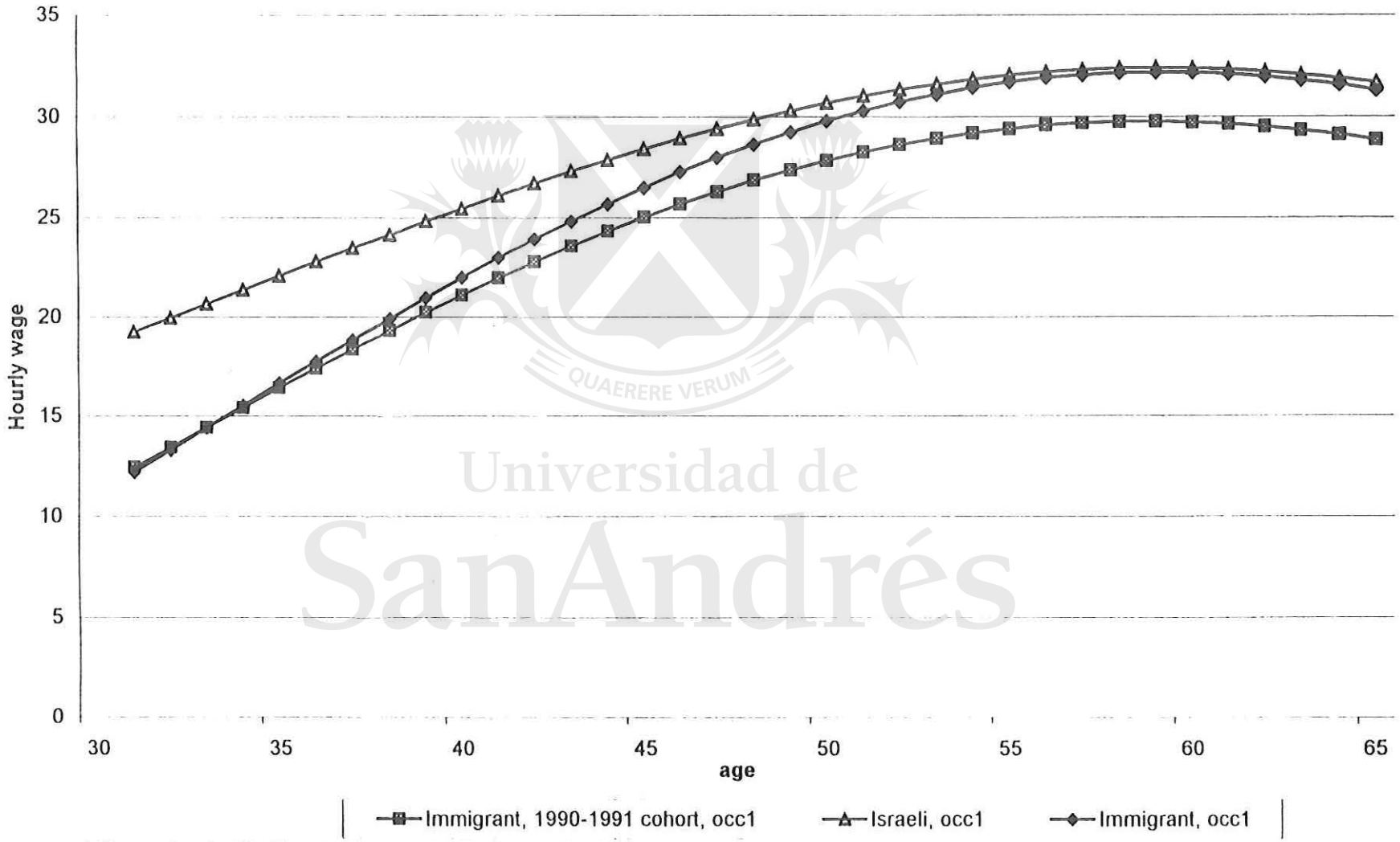
Dependent Variable: Occupation[1]

	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.

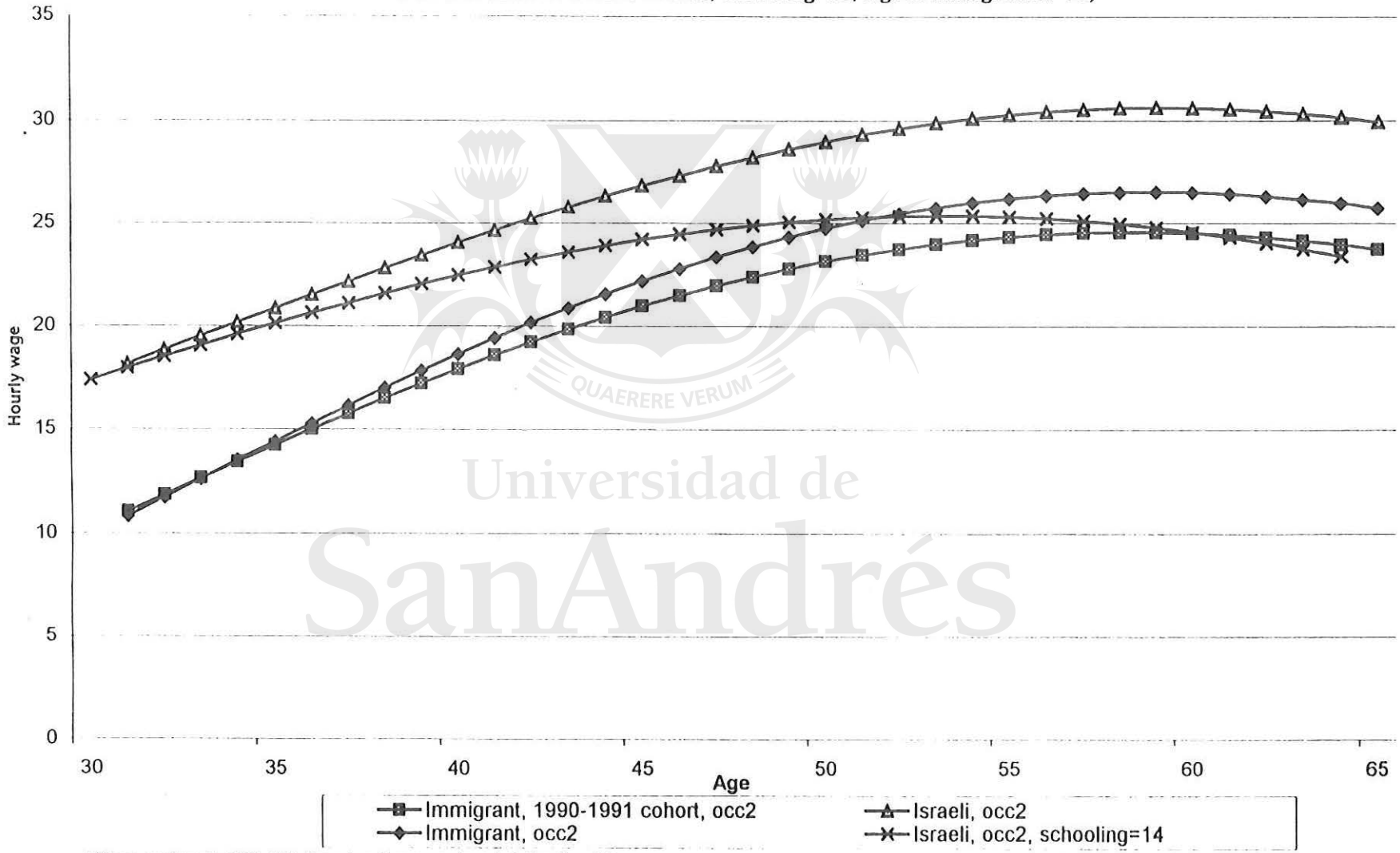
1. Occupation 3 is the reference group.

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



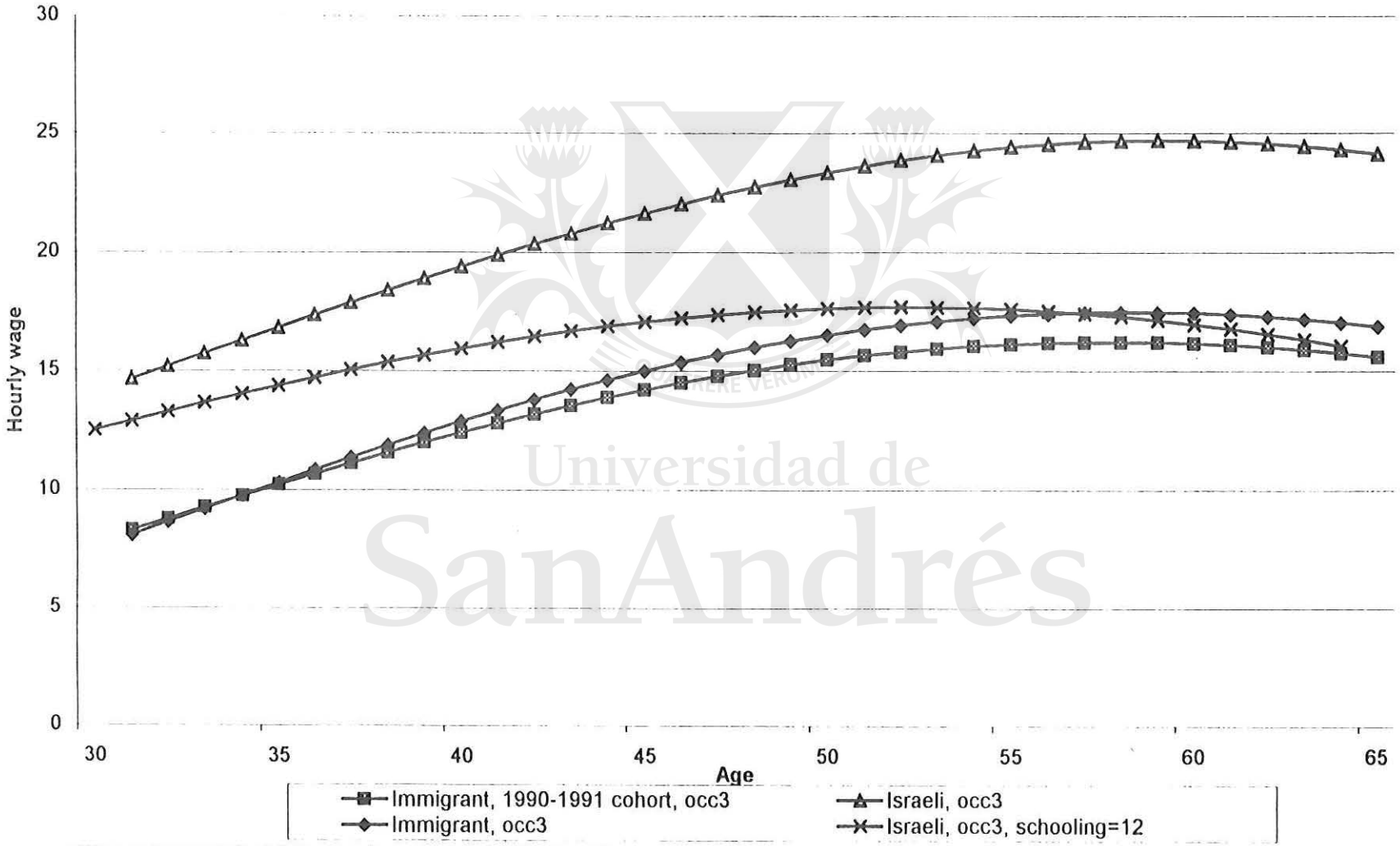
* Wage per hour in 1991 NIS. Based on the regressions in tables 5 and 6.

Figure 1b
Simulated Wage-Age Profiles in Occupation 2 for an Israeli 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 1c
Simulated Wage-Age Profiles in Occupation 3 for an Israeli 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

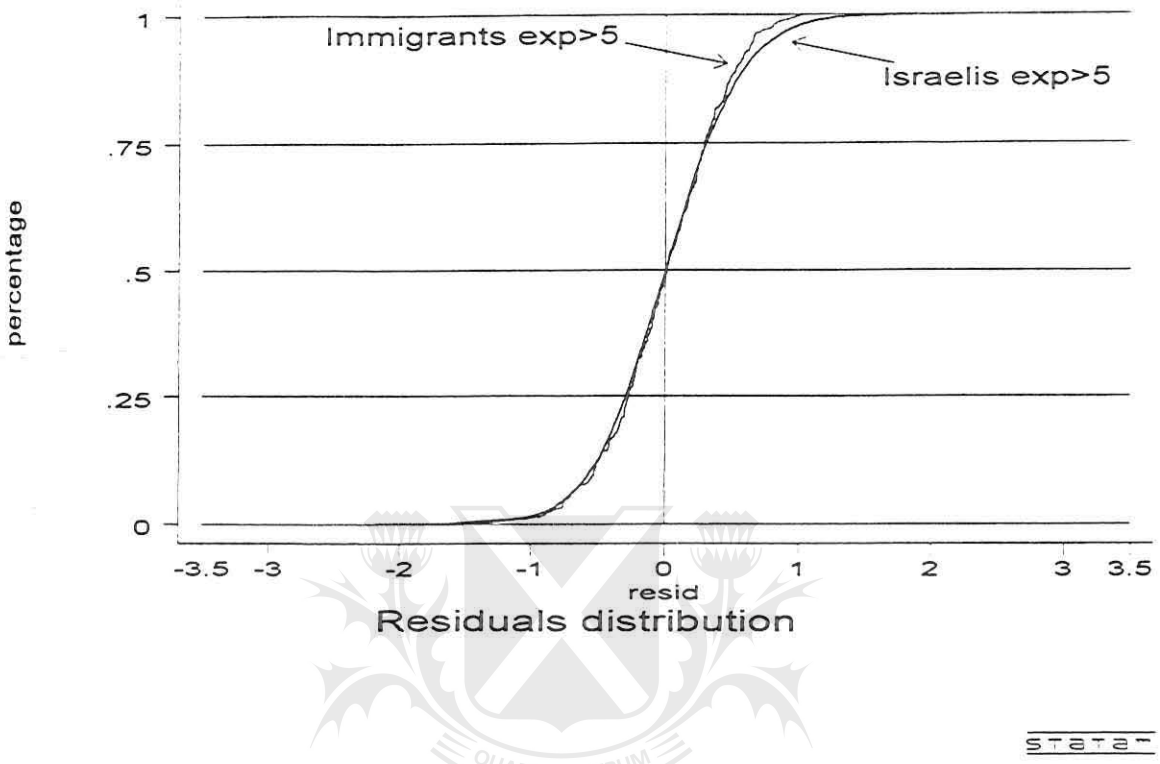


Figure 2

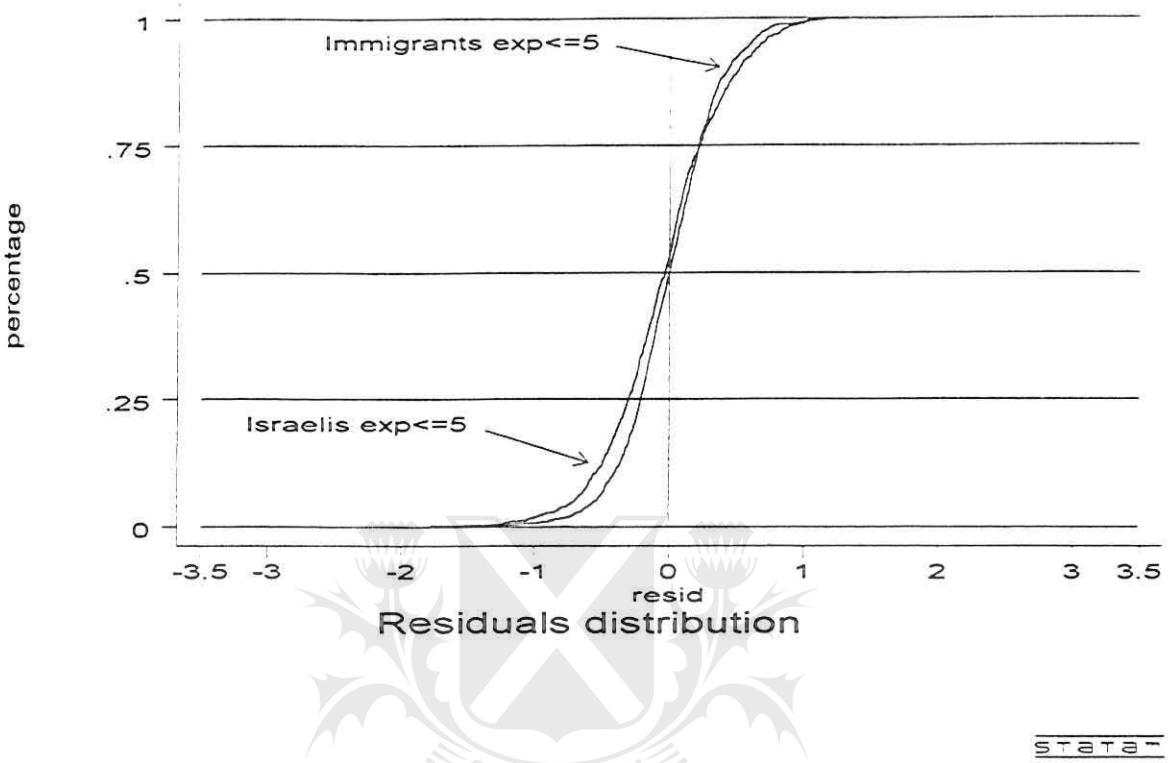
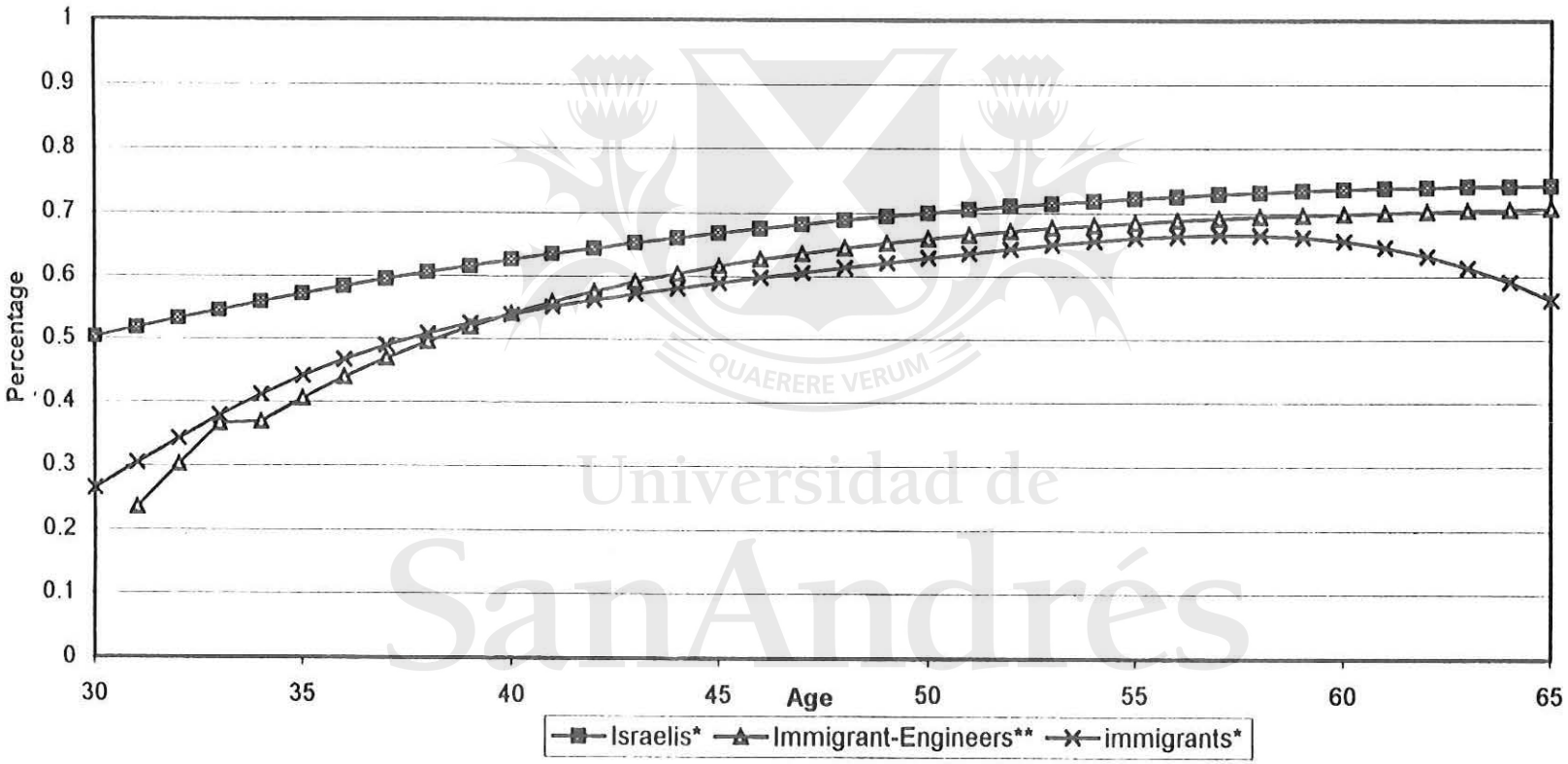
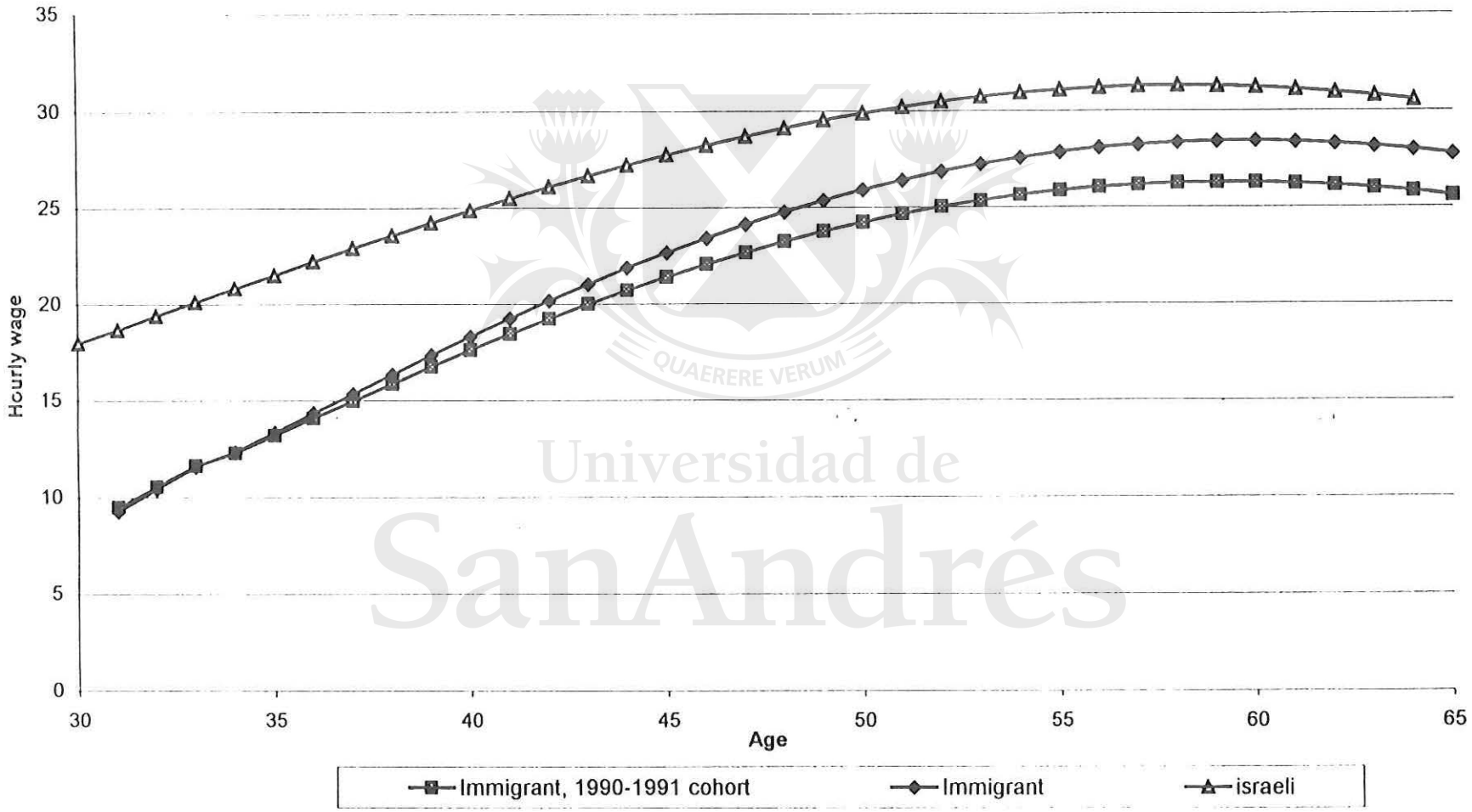


Figure 4
Predicted Propotion Employed in Occupation 1 for Workers with 16+ Years of Schooling, Israelis and Immigrants with Age at immigration 25-40



* Based on Logit estimation for Israelis in Table A5 (CBS, Labour Force Surveys 1991-95).
* Based on Logit estimation for immigrants, with age of arrival 25-40 in Table A5 (Labour Force Surveys 1991-95).
** Based on the transition matrix in Table A4 (Brookdale's Engineers sample).

Figure 5
Simulated Wage-Age Profiles, Averaged over Occupations, for an Israeli Worker and an Immigrant, with and without Cohort Effects, Schooling=16, Age at immigration=30*



* Wage per hour in 1991 NIS. The simulations are based on the regressions in tables 5 and 6. The occupational distribution for Israelis is based on the Logit estimates in Table A5 (CBS Income Surveys 1991-95). Occupational distribution for immigrants is based on the transition matrix in table A4.