ON THE WAGE GROWTH OF IMMIGRANTS: ISRAEL, 1990–2000

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Abstract
This paper develops a descriptive methodology for the analysis of wage growth of immigrants that is, based on human capital theory. The sources of the wage growth are (1) the rise of the return to imported human capital, (2) the impact of accumulated experience in the host country, and (3) the mobility up the occupational ladder in the host country. The model implies a nonlinear wage function that includes interactions between imported skills and local wage growth. using data on native Israelis and immigrants from the former Soviet Union of Israel, we estimate wage equations jointly for the two groups. We find that, upon arrival, immigrants receive non return for imported skills. In the ten years following arrival, wages of highly skilled immigrants grow at 8 percent a year. Rising prices of skills, occupational transitions, accumulated experience in Israel, and an economy-wide rise in wages account for 3.4, 1.1, 1.5, and 1.5 percent each. In the long run, the return for schooling converges to 0.027, substantially below the 0.069 return for natives. We do not reject the hypothesis that the return for experience converges to that of natives and that immigrants receive a higher return for their unmeasured skills. We find that there is some downgrading in the occupational distribution of immigrants relative to that of natives. Moreover, the average wages of immigrants approach but do not converge to the wages of comparable natives. The main reason for this is the low return to their imported skills. (JEL: J24, J31, J60)

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

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highest rewards for their skills. Typically, immigrants start at a low common wage and then experience a relatively fast earning growth. With the passage of time in the host country, immigrants invest in local human capital and search for better matches with local employers, and employers become less uncertain of the immigrant's potential and realized quality.[1] These processes combine to provide immigrants with increasing returns of their imported skills. We derive the implications of such a trend for the investment behavior of immigrants in the host country and for the specification and estimation of earning equations of immigrants and natives.

We present a simple human capital model that explains the connections between rising prices of skills and investment in human capital and also describes the dynamics of the earnings of immigrants vis-à-vis the earnings of comparable natives. In that model, the rising prices of skills and occupational transitions are given exogenously but the investment in local skills is endogenous. We use the theoretical model to specify the wage equations for natives and immigrants, which are jointly estimated using the restrictions implied by the theoretical analysis. Using the estimated wage functions, we analyze the sources of wage growth and the assimilation of immigrants from the former USSR and natives in Israel. In particular, we distinguish three sources of wage growth for immigrants and estimate their relative importance: (1) the rise of the return to imported human capital; (2) the impact of accumulated experience in the host country; and (3) mobility up the occupational ladder in the host country.

The mass immigration of Jews from the former Soviet Union to Israel, which started toward the end of 1989, is characterized by high levels of education and prior experience in high-skilled jobs (see Table 1). The unexpected change in the emigration policy of the former USSR and the policy of Israel to accept all Jews and to subsidize immigration[3] combined to create a large wave that is almost free of selection.[4] Despite its large size and high level

1. See the surveys by Borjas (1994, 2000) and LaLonde and Topel (1997) as well as Chiswick (1978).

2. This paper contributes to the literature on the investment in human capital, developed by Becker (1975) and Mincer (1974), by introducing explicit time trends that reflects the rising market returns to imported schooling and experience with time in the host country.

3. The Israeli government provides immigrants with six months of basic training in Hebrew and one free job training program of about six months that is the same as that offered to unemployed Israeli natives. In addition, each immigrant receives lump-sum financial support for the first year and housing subsidies for three years.

4. The average level of experience and age of immigrants who arrived in 1990–1991 are about the same as those of native Israelis in 1991. This feature is in contrast to most immigrations, where immigrants tend to be relatively younger than the local population, and reflects the exogenous relaxation of emigration from the USSR and the free entry to Israel of Jewish immigrants from the USSR.

TABLE 1. Occupation, schooling, and experience of male native Israelis and immigrants who arrived in 1990–1991, aged 25–65 (percent).

Occupation[a]	*HP*	*LP*	*BC*
Israelis,[b] 1991	18.5	12.9	68.6
Immigrants in the USSR[c]	58.6	12.2	29.2
Immigrants in Israel, 1991–1995	14.6	9.3	76.1
Immigrants in Israel, 1996–2000	19.1	10.0	70.9

Schooling	0–12	13–15	16+	Mean
Israelis,[b] 1991	65.6	17.2	17.1	12.3
Immigrants at arrival	32.0	37.5	30.5	14.1

Experience[d]	0–5	6–15	16–24	25+	Mean
Israelis,[b] 1991	9.8	38.7	29.7	21.8	17.0
Immigrants at arrival	11.75	34.3	31.8	22.1	17.1

[a] High-paid professionals, denoted by *HP,* include engineers, physicians, professors, other professionals with an academic degree, and managers. Low-paid professionals, denoted by *LP,* include teachers, technicians, nurses, artists, and other professionals. Blue-collar and unskilled workers are denoted by *BC.*

[b] Source: Income Survey, 1991.

[c] Source: Brookdale 1991 representative sample that includes 389 male immigrants who arrived in 1989–1991, whose age at arrival is 25+, and whose age at the time of interview 65 or less. We exclude immigrants who did not work in the USSR and did not search for a job in Israel since arrival. Occupation in the USSR is based on the last job the immigrant held in the USSR.

[d] Experience for Israelis is defined as age—years of schooling—3 years of army service—6 (children start studying at age 6). For immigrants, year of entry into school is replaced by 7 and military service by 2 for levels of schooling below 11 and by 0 otherwise.

of skills,[5] this wave had almost no impact on the ages or employment of native Israelis.[6] Fn5 Fn6

The focus of this paper, however, is on the dynamics of the wages of immigrants in the first ten years following entry. On arrival to Israel, immigrants start at low-skill occupations receiving low wages that do not differ by imported schooling. As time passes they move into high-skill occupations with a corresponding rise in wages, creating disparity by imported schooling (see Tables 2 and 3). In each occupation, immigrants receive initial wages that are below the wages of natives, and the gap closes with time spent in Israel (see Table 4). Wage growth is closely linked to changes in occupation. The occupational T2 T3 T4

5. The Israeli population at the end of 1989 was 4.56 million, and the premigration population growth rate during the 1980s was between 1.4 percent and 1.8 percent per annum. The 1990–1991 wave of immigration increased the population by 7.6 percent, in 2 years, which is more than twice the normal population growth. From 1995 until 2000, the flow of immigrants was about 55,000 to 65,000 a year. In some high-skill occupations, the stocks doubled within a short period. Thus, about 57,400 of those who arrived by 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.

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

TABLE 2. Monthly wages of immigrants by schooling and years since arrival in Israel, males, age at arrival > 25.

	Schooling ≤ 12		Schooling = 13–15		Schooling ≥ 16	
Year	Wage	Standard deviation	Wage	Standard deviation	Wage	Standard deviation
1	1688	681	1717	551	1875	1016
2	1922	612	2070	919	2249	1061
3	1994	795	2188	716	2376	1377
4	2014	715	2385	1244	3142	1764
5	2233	762	2503	1018	3495	2071
6	2299	821	2686	1340	3548	2132
7	2449	884	2905	1222	4232	2575
8	2380	693	3078	1501	3812	1948
9	2448	843	3161	1575	3531	2095
10	2925	1034	3647	2289	4516	2034
Annual growth	6.50%		8.86%		11.16%	

Source: Income Surveys, 1991–2000.

distribution of first jobs among immigrants is similar to the distribution of jobs in the Israeli economy, implying a substantial occupational downgrading. In the second phase, the highly educated immigrants climb up the occupational scale, obtaining better jobs and higher wages in each job. Thus, the basic picture in the raw data is of substantial wage growth both within and across occupations. An important goal of this paper is to assess the importance of these two channels of wage growth.

TABLE 3. Occupational distribution of male immigrants (percent).

	Age at arrival 25–40					Age at arrival 41–55				
Year 1	*HP*	*LP*	*BC*	Unemp.	Obs	*HP*	*LP*	*BC*	Unemp.	Obs.
All	6.5	5.6	69.2	18.7	1,226	5.7	2.9	67.9	23.5	936
Sch. 16+	21.5	8.8	48.3	21.5	228	16.0	3.0	49.3	31.7	268
Year 2										
All	10.1	7.8	71.1	11.1	1,290	8.3	5.2	69.9	16.6	872
Sch. 16+	22.8	9.7	54.1	13.5	290	17.1	5.6	56.7	20.6	321
Year 3										
All	13.5	8.4	69.3	8.8	1,200	9.7	6.6	72.5	11.2	859
Sch. 16+	32.3	10.1	47.5	10.1	297	20.8	8.4	58.1	12.8	298
Year 4										
All	15.2	10.2	68.0	6.59	1,078	11.2	8.1	71.5	9.3	807
Sch. 16+	33.6	12.9	48.3	5.24	286	23.9	10.8	53.5	11.8	297
Years 5–10										
All	20.1	11.3	63.0	5.5	4,433	15.5	8.6	68.4	7.5	3,120
Sch. 16+	43.6	14.1	38.4	3.9	1,299	29.7	11.9	51.6	6.8	1,282
Years 11–15										
All	19.8	10.31	65.7	4.2	359	27.3	11.2	55.9	5.6	143
Sch. 16+	58.3	3.88	33.9	3.9	103	48.2	10.7	33.9	7.1	56

Source: Labor Force Survey, 1991–2000.

TABLE 4. Wages of immigrants and natives by work experience in Israel, males aged 25–55.

	All workers		Work experience ≤ 5		Work experience > 5	
Years of Schooling	Israelis	Immig.	Israelis	Immig.	Israelis	Immig.
0–12	3,3334	2,290	2,252	1,947	3,387	2,785
13–15	4,711	2,717	2,752	2,201	5,046	3,541
16+	6,377	3,727	4,026	2,726	6,926	5,006
Occupation in Israel						
HP	6,512	4,717	4,181	3,489	6,834	5,795
LP	4,555	3,574	3,185	2,857	4,791	4,303
BC	3,398	2,290	2,545	1,959	3,471	2,862

Source: CBS Income Survey, 1991–2000. No restriction on age at arrival.

The estimated earning function confirms 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) 0.027 for immigrants, substantially below the 0.069 return for natives (a similar finding is reported in Friedberg 2000). We cannot reject the hypothesis that immigrants eventually obtain the same return on experience as natives, and the importance of the unobserved part of earnings does decline sharply with the time spent in Israel. In the initial ten years following arrival, wages of immigrants who arrived in 1990 grew at the rapid rate of 6.6 percent a year (8.0 percent for immigrants with more than 16 years of schooling). Using the estimated wage equations, we find that *half* of this growth can be ascribed to a rising return to imported skills. Occupational transitions account for a growth of 1.1 percent per year among immigrants with 16+ years of schooling, and accumulated experience in Israel and the economywide rise in wages account for about 1.5 percent each per year. During that same period, the proportion of skilled immigrants (16+ years of schooling) who work in high-skill occupations in Israel rose from 21 percent to 44 percent.

We find evidence of reduced quality for more recent cohorts of immigrants from the former USSR. This trend holds both for observable skills (such as schooling and occupation) and for unobservable aspects of the wage. Accounting for this effect, we find that conditional on occupation, there is no long-run convergence of wages of immigrants to natives. In high-skill occupations the final gap is small, but immigrants who remain in unskilled jobs receive lower wages than comparable Israelis even after a long stay in Israel.

Most existing studies on wages of immigrants in the United States focus on the rather speedy assimilation rate to the wage of comparable natives of the same ethnicity. For instance, LaLonde and Topel (1997) report rates of assim-

ilation, i.e., changes in the wage difference rate between comparable workers, that range from 8 percent among Europeans to 24 percent among Asians. (Borjas 1985 reports similar results). We find that immigrants from the USSR to Israel assimilate at a rate of about 20 percent during the first 10 years, which is similar to the rate of assimilation of Asian immigrants in the United States during the 1970s who also had a high level of schooling.[7] Fn7

The rest of the paper is organized as follows. In Section 2, we analyze a human capital model that justifies the wage equations that are derived in Section 3. In Section 4 we describe the data, and in Section 5 we present the estimation results. Section 6 describes the decomposition of the wage growth. Section 7 describes the occupational dynamics of immigrants and natives. Section 8 describes convergence of wages, and Section 9 concludes.

2. A Model for Earning Equations of Immigrants

We now present a simple human capital model that allows us to compare the patterns of earning functions for immigrants and natives. The model describes the investment decisions of immigrants and natives and derives the implications for wage growth. The new feature in this analysis is the explicit introduction of a time-since-arrival effects on prices of skills that influence the immigrants' investment decisions. The acquisition of new skills requires some sacrifice of current earnings. The investment decisions interact with the changes in the market value of the immigrant's skills and together determine his earning growth. In particular, rising prices for imported skills provide an added incentive for investment because the sacrifice of current earnings is low relative to the growth in future earning capacity. A native faces a similar investment problem, except that he does not have skills that were acquired abroad and are being adapted to the host country's labor market.

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

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

where the θ_{sj} are nonnegative parameters representing the contribution of skill s in occupation j (see Welch 1969). Firms reward individual skills indirectly by

7. This result may suggest that the large government assistance for immigrants in Israel did not affect the rate of assimilation into the labor market. However, the inflow of skilled immigrants relative to the existing stocks was much smaller in the United States.

renting human capital at the market-determined rental rate R. Thus, the parameter θ_{sj} is the proportional increase in earning capacity associated with a unit increase in skill x_s if the individual works in occupation j. Because θ_{sj} is independent of skill acquisition, each individual may view it as the implicit "price" (or "rate of return") of skill s.[8] In a frictionless economy, each worker will apply his human capital to the occupation in which his bundle of skills yields the highest reward. However, we allow here for the possibility that occupational assignments are the outcome of a two-sided search process whereby individuals may not end up in their most preferred occupation. Earning capacity is then

Fn8

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

where K is the worker's human capital in the chosen or assigned occupation. To simplify our analysis, we assume here that the transitions up the occupational scale occur exogenously and are fully anticipated.[9]

Fn9

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 here is that the prices of imported skills rise with time spent in the host country, unlike the prices of locally acquired skills.

We denote the subsets of skills acquired abroad and in Israel by S_0 and S_1, respectively. We assume that, for all $s \in S_0$, the quantities x_s are fixed at $x_s(0)$ but prices are allowed to vary with time in Israel; for all $s \in S_1$, prices are fixed but quantities can vary. Correspondingly, we define $K_{0j}(t) = \exp(\sum_{s\in S_0} \theta_{sj}(t)x_2)$, and $K_{1j}(t) = \exp(\sum_{s\in S_1} \theta_{sj}x_s(t))$. An immigrant can augment his local skills by training in school or on the job in the new country. We shall focus here on investments on the job. Assuming that investment in any skill requires the sacrifice of earnings, and because prices of local skill are fixed, each immigrant will choose to invest only in the skill that maximizes his lifetime earnings. We

8. 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, that 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 values of 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).

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

denote the resulting value of local human capital by $K_1(t)$. In short, the immigrant's earning capacity is given by

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

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

Using a specification suggested by Ben-Porath (1967), we can characterize the investment policy in the following manner. The local current earnings of the immigrant can be written as

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

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

$$\dot{K}_1(t) = f(I(t)) - \delta K_1(t). \tag{5}$$

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

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

where T is the end of the work period, if we assume an interior solution for the rate of investment. Condition (6) equates the marginal cost of an additional unit of K_1 in time t to the expected additional earnings that this unit will provide throughout the remaining work period. The current value of the imported human capital $K_0(t)$ influences the marginal cost of investment, while the future value of imported capital $K_0(t + \tau)$ influences the future benefits. Assuming that the local value of the imported skills is rising, $K_0(t + \tau) > K_0(t)$, yields an additional incentive for investment to immigrants. To ensure that investment declines with experience, we shall assume that the growth rate in imported human capital, $\dot{K}_0/K_0$, declines with time spent in the new country.

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

$$\frac{\dot{K}_1(t)}{K_1(t)} = g(x(t)) - \delta, \tag{5'}$$

where $g(x(t))$ is increasing and concave, with $g(0) = 0$.[10] If we parameterize this function as Fn10

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

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

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

Thus, the growth rate of earnings is a simple piecewise *linear* function of the growth rate in the value of imported skills. When the worker does not invest in local skills, the change in prices translates into a change in earnings on a one-to-one basis. However, when the worker also acquires local skills, there is a "multiplier effect," given by $1/(1 - \alpha)$, that reflects the impact of increasing prices of imported skills on the investment in local skills.[11] Fn11

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

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

10. The two "production functions" (5) and (5′) share the crucial simplification that the value of human capital depends only on the remaining work horizon and is thus independent of the current stock (see Weiss 1986). The difference between the two specifications is that in (5), local and imported capital enter symmetrically into the production of local human capital whereas, in (5′), local human capital is produced by local capital and local time. Thus, imported skills enter only through their effect on local earnings.

11. The time at which investment stops, t_1, is determined endogenously by the condition

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

The formal derivation of Equation (8) is given in the appendix of Eckstein and Weiss (2003).

where m denotes an immigrant and n a native, $K_0(0)$ is the initial local value of the immigrant's imported skills, and $K_1(0)$ is the initial human capital of the native. In the early stage of their stay in Israel, immigrants are paid lower prices for their skills. Hence, $K_0(0) < K_1(0)$. In addition, because the immigrant expects a rise in these prices, he invests more in local human capital and, thus $x_m(0) > x_n(0)$. Together, these facts imply that the initial observed earnings, $y(0) = K(0)(1 - x(0))$, are lower for the immigrant. However, because of the rise in the prices of imported skills and the higher investment, the immigrant's earnings grow faster. After sufficient time in the host country, the prices of imported skill may converge to the prices that the native obtains so that $K_0(t)$ converges to $K_1(0)$. If this happens, $y_m(t)$ can exceed $y_n(t)$ because

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

Thus, earning of immigrants can *overtake* the earnings of natives if the prices of imported skills converge to the *same* price as that obtained by natives for locally produced skills, because increasing prices on imported human capital imply higher investments by immigrants. However, if imported skills are of lower quality and so their long-run price falls short of the value of locally acquired skills, then earnings of immigrants may never catch up with those of natives. The latter case is likely when immigrants arrive from a less advanced country to a much more advanced market, as is the case of immigrants from the former Soviet Union to Israel this is an empirical issue that we investigate this study.[12] Fn12

3. The Empirical Earning Function

The empirical earning function suggested by Mincer (1974) assumes static conditions and that investment declines linearly with the remaining working time. The model in this paper implies that (a) investment is done under time-varying conditions and (b) the investment rule is influenced not only by the remaining work time but also by the behavior of the local value of imported skills.

12. The model just described provides a simple answer to a query raised by Borjas (1994, p. 1672): Why would immigrants accumulate more human capital than natives? There is no need to rely on heterogeneity or self-selection to explain overtaking. The same principle applies to any group that has a lower rental rate for human capital and expects it to rise with time. Racial discrimination is a possible example.

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

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

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

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

where θ_s and $\tilde{\theta}_s$ can be interpreted as the prices that the immigrant receives upon reaching his "final" occupation (i.e., when his skills are well matched with the occupational requirements) and d_{sj} is a constant that represents the initial difference between the prices of skill s in the first and final occupations. The parameter $\lambda > 0$ controls the speed of adjustment, which is given by

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

An important feature that is captured by these assumptions is that the value of imported capital $K_0(t - t_0)$ of an immigrant may follow a different time path in the new country, depending on the *composition* of skills that he brings and his success in climbing up the occupational scale in the host country. Although we assume a common rate of adjustment, the change in the price of each skill may differ, as a function of the distance between the current price and the long-term price. The value of the immigrant's imported skills rises continuously within each occupation and may jump up when he switches occupations. By construction, the rate of increase in the price of each skill declines with its current level, implying that $\dot{K}_0/K_0$ declines with the time spent in the new country.

It remains to specify the impact of age (or the remaining work horizon) of the immigrant on his earnings. Equation (8) implies that, if prices are fixed, log earnings rise at a fixed rate until they reach a peak and then decline at a fixed rate, when investment stops. Because workers switch jobs and reach the peak at different ages, we shall assume (as an approximation) that earnings grow according to

$$\frac{\dot{y}}{y} = a\frac{\dot{K}_0}{K_0} + b - ct, \tag{8'}$$

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

$$\begin{aligned}\ln y = {} & b + \sum b_t \text{year}_t + b_{HP}HP + b_{LP}LP + \left(b - \frac{c}{2}\exp_1\right)\exp_1 + b_s(s_1 + s_0) \\ & + D(IM)\Big\{[b' + de^{-\lambda \exp_1}] + [b_{<1990}C_{<1990} + b_{1992\text{–}2000}C_{1992\text{–}2000}] \\ & + [b'_{HP} + d_{HP}e^{-\lambda \exp_1}]HP + [b'_{LP} + d_{LP}e^{-\lambda \exp_1}]LP \\ & + [b'_{\exp} + d_{\exp}e^{-\lambda \exp_1}]\left[\left(b - \frac{c}{2}\exp_0\right)\exp_0\right] + [b'_s + d_s e^{-\lambda \exp_1}]s_0\Big\} + \varepsilon,\end{aligned} \tag{12}$$

where $D(IM)$ is equal to 1 if the observation is of an immigrant and is equal to 0 otherwise. Potential experience in Israel is denoted by $\exp_1$, and $\exp_0$ is potential experience in the former USSR. The number of years of schooling in the USSR are denoted by s_0, and s_1 is the number of years of schooling acquired in Israel. The occupational dummies *HP* and *LP* indicate if the individual works in high-paid professional occupations or low-paid professional occupations in Israel, respectively. (Blue-collar and low-skill occupations are the reference group.)[13] The year dummies indicate the year of observation which ranges from 1991 to 2000. The cohort dummies $C_{<1990}$ and $C_{1992\text{–}2000}$ indicate if the immigrant entered Israel before 1990 or between 1992 and 2000, respectively.[14] Fn13 Fn14

The observed imported skills in Equation (12) are schooling and experience acquired abroad. Schooling is measured simply by years spent in school. However, experience is not simply potential or actual work experience, instead, it is the amount of human capital or skills accumulated in work. We measure this quantity by the expression $[b \exp - (c \exp^2/2)]$, where exp denotes experience, defined in the usual way (age minus years of schooling minus age of entry into school minus years of military service). We normalize by setting to unity the price (in terms of log earnings) paid to Israelis for their "true" experience. We shall define the "true" work experience that immigrants import as $[b \exp_0 - (c \exp_0^2/2)]$, using the *same* values for b and c as for Israelis. We then estimate the time pattern of the price that immigrants receive for this quantity. Since we have no data on wages in the former USSR, we cannot estimate these parameters

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

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

directly. If both the parameters b and c differ between Israelis and immigrants, then one cannot separate "quantity" from "price." Our specifications imply that the restriction on the "true" work experience is not binding and that the parameters b'_{exp} and d_{exp} measure (respectively) the initial difference between the experience accumulated in Israel by natives and the experience accumulated by immigrants from the former USSR. It is possible, however, for one parameter to differ across these groups. Hence, we have also estimated the model while allowing the coefficient c to differ. We found that this coefficient was -0.00061 for immigrants and -0.00066 for Israelis. The difference between the two estimates is statistically insignificant.

It should be emphasized that we do not restrict the returns for imported schooling and experience of immigrants to be equal to those of Israelis. We estimate all the human capital parameters for the earning equation for immigrants as deviations from the return on these indicators for Israelis. Specifically, the sum of the coefficients $b'_s + d_s$ measures the initial difference (at the time of arrival) between the rate of return (price) that immigrants get for their imported schooling and the rate of return that Israelis (and immigrants) receive for locally acquired schooling, b_s. The coefficient b'_s is the long-run difference in the rates of return. Similarly, the sum of the coefficients $b'_{\text{exp}} + d_{\text{exp}}$ measures the initial difference between the rate of return (price) that immigrants get for their imported experience and the rate of return that Israelis (and immigrants) receive for locally acquired experience. The parameter λ describes the speed of adjustment between these short-term and long-term effects. The coefficients b' and d associated with the immigrant's occupation in Israel capture the different evaluation of the immigrant skills in different occupations, which may also vary with time since arrival. Finally, the coefficients b' and d associated with the immigrants dummy itself capture the effect of unmeasured skills of the immigrants on the adjustment process.

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

Equation (12) is nonlinear in the parameters, and there are cross-equation restrictions implied by the human capital model of Section 2 on the earnings functions of immigrants and Israelis. Therefore, we estimate it jointly by

nonlinear least squares (NLLS). In a previous draft we imposed the restrictions by using a two-step procedure, that yielded very similar results.[15] Fn15

4. Data

Although specification (12) is quite general, we shall discuss here only male immigrants. The interrupted careers of women imply a more complex process of investment on the job that requires an explicit analysis of labor supply.[16] For similar reasons, we will not discuss young immigrants who may acquire schooling in Israel. We thus focus on the interactions between imported skills and the investments of immigrants *on the job* in Israel. Fn16

The main sources of data for this paper are the Central Bureau of Statistics (CBS) Income and Labor Force Surveys for the years 1991–2000. These data are annual random samples of the entire Israeli population.[17] The descriptive statistics are displayed in Appendix Table A1.[18] On average, immigrants are four years older than native workers, have one more year of schooling (13.8 years of immigrants vs. 12.9 for natives) and earn about 65 percent of the monthly wage of native Israelis (and 66 percent of their hourly wage).[19] Fn17 Ta1 Fn19

For the analysis of wage assimilation, we further restrict the sample of male

15. The NLLS is equivalent to maximum likelihood assuming that the variance of the errors is the same for immigrants and natives. The main restrictions are that the time effects are the same for natives as immigrants, as in Borjas (1985), and that immigrants obtain the same reward as natives for locally acquired experience, implying common values for the parameters b and c. In the two-stage method, a standard earning function is estimated only for Israelis, and then the nonlinear earning function for immigrants is estimated as a deviation from that of Israelis. The results for the two methods (see Eckstein and Weiss 1998) turned out to be almost the same for the sample of 1990–1995. Moreover, the results for the extended data (1990–2000) are also similar.

16. In Eckstein and Weiss (2002) we examine the wages of female immigrants and the interactions between husbands and wives. We do not find much difference in wage growth of employed immigrants by gender, but female immigrants enter more slowly into the labor force. An interesting finding is that married male and female immigrants have higher wage growth than single immigrants of the same gender.

17. The income surveys from 1996 to 2000 report the year of arrival only in intervals of three years or more. We use only those observations that can be matched with the labor surveys, which do report this crucial variable on an annual basis. The matching is based on age, schooling, occupation, hours of work, and marital status.

18. The subsamples presented in Table A1 include only Jewish men, aged 25 to 65, who worked more than 25 hours per week for more than two weeks during the month prior to the survey data. We also exclude all individuals with no information on age or the number of years of schooling and as well as individuals with more than 31 years of schooling. The wage and hours of work are the average during the complete month before the survey. Wages are adjusted by the CPI and denominated in 1991 Israeli shekels.

19. In making these comparisons, however, it should be noted that most immigrants entered before 1993, whereas there is a continuous inflow of young Israelis with higher education into the Israelis sample. It is thus more instructive to compare immigrants who arrived in 1990–1991 to Israelis in 1991, as in Table 1.

immigrants to those who were older than 25 upon arrival[20] in order to ensure that their schooling was acquired abroad.[21] This means that the rates of return for locally acquired schooling will be estimated mainly from Israelis. Our data source for occupational transitions of immigrants is the CBS Labor Force Survey, from which the Income Survey is drawn. (Both surveys report occupation, but only the Income Survey has wage data.) This is relatively large sample with almost 15,000 observations (see Table A1). We also use retrospective data contained in the Brookdale Survey of Engineers, which reports detailed work histories for 714 male engineers from the former USSR who entered Israel in the recent wave, after 1989, and were surveyed in 1995.[22]

To analyze occupational transitions in Israel, we define three broad occupational categories: high-paid professional occupations (*HP*) which include engineers, physicians, professors, other professionals with an academic degree, and managers; low-paid professional occupations (*LP*) including teachers, technicians, nurses, artists, and other professionals; and blue-collar occupations (*BC*), which include blue-collar and unskilled workers. The occupational distribution of working immigrants is quite similar to the occupational distribution of working Israelis.

The immigration flows from the former USSR were concentrated in three time periods; about 16 percent of the immigrants observed in 1991–2000 arrived in the early wave of 1970–1979, about 18 percent arrived in 1992–1995, and 56 percent arrived in the more recent wave of 1989–1992. Seventy-nine percent of the immigrants in the sample are newly arrived and have been in Israel for less than 10 years.

5. Estimation Results

In this section we report the results from estimating Equation (12) using the data on natives and immigrants from 1991 to 2000.[23]

20. The descriptive statistics for this subsample are presented in the last two columns of Table A1. The immigrants in this subsample are older by 2 years than those in the unrestricted (age 25–65) sample of immigrants. Except for two observations, all schooling was acquired abroad.

21. The Income and Labor Force Surveys do not give direct information on the schooling accumulation of immigrants in Israel. We can infer it indirectly from age, total reported schooling and age at immigration, as we do with work experience. However, in the Brookdale data we do have direct report on schooling acquired abroad, and the distributions are quite similar when we truncate age at arrival to exceed 25.

22. The average schooling of these engineers is 16.4 years, with 36 percent having 15 years of schooling. This reflects conditions in the former USSR, where one could become an engineer by acquiring ten years of elementary and high school education plus five years of university education.

23. The estimation is done by NLLS on STATA using Equation (12) directly with the repeated cross-section data presented here. In a previous version of the paper, we estimated this equation using data from 1991–1995 only. The results using the extended sample reported in this paper are

TABLE 5. Wage equation for native men (age 25–65, years 1991–2000).

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

Notes: The dependent variable is the log of hourly wage (NIS 1991). The yearly dummies represent the real wage difference from 1995.

5.1. Results for Natives

The estimates of the model for native Israelis (presented in Table 5) are similar to those obtained in other applications of Mincer's wage function. The only nonstandard feature is that we allow occupation to have a separate effect (beyond schooling) on wages. This is done mainly to allow comparability with immigrants, for whom occupational transitions play an important role. The introduction of occupational dummies has little impact on the estimated coefficients, except for the schooling coefficient, which rises from 0.0694 to 0.0952 when occupation is omitted. The wages in *HP* occupations and *LP* occupations are (respectively) about 29 and 21 percent higher than in the *BC* occupations. There is a 4.2 percent increase of the hourly wage with the first year of experience and about a 6.9 percent increase of the hourly wage with a year of education. The yearly dummies represent the difference from the wage in 1995. The estimated yearly dummies show that, despite the mass immigration, the wage per hour of Israelis is *increasing* during the period. Controlling for schooling, occupation, and experience, the hourly wage in 1991 is about 14 percent lower than in 1995, and in all other years the real hourly wages of natives were lower than in 1995. We interpret the yearly dummies as macroeconomic effects that to some extent may be related to the aggregate number of immigrants.

extremely close to the earlier version (see Eckstein and Weiss 1998), where we used a two-step method. The joint estimation with the shorter sample is also very close to the results reported here.

TABLE 6. Wage equation for male immigrants (age at arrival > 25, years 1991–2000).

	With occupation		Without occupation	
Coefficient	Estimate	St. dev.	Estimate	St. dev.
b'	0.4191	0.0143	0.3270	0.0091
$b_{<1990}$	0.0498	0.0052	0.1418	0.0103
$b_{1992–2000}$	−0.0468	0.0042	−0.0608	0.0045
d	0.5136	0.0177	0.8834	0.0232
λ	0.0995	0.0031	0.1389	0.0033
b'_{HP}	0.3463	0.0318	—	—
d_{HP}	−0.2530	0.0381	—	—
b'_{LP}	0.1682	0.0288	—	—
d_{LP}	−0.1425	0.0351	—	—
b'_{exp}	−0.3630	0.0258	−0.6391	0.0370
d_{exp}	−1.0104	0.0528	−0.8435	0.0558
b'_s	−0.0429	0.0016	−0.0275	0.0014
d_s	−0.0288	0.0020	−0.0633	0.0028
Sum of (residuals)^2	3,062.606		3,276.919	
No. of obs.	16,045		16,045	

5.2. *Results for Immigrants*

As explained previously, the wage equation for immigrants is estimated jointly with that of Israelis, and the results are shown in Table 6. In this case, the addition of occupational dummies influences all the coefficients, and we shall discuss here the specification in which these effects are included. T6

The estimated speed of adjustment, λ, is 0.0995 per year; this implies that, within a period of 10 years, each skill price is adjusted by 63 percent of the initial distance from its long-run value. However, convergence in prices depends also on the initial and long-term differences between the prices that Israelis and immigrants obtain for their skills.[24] We discuss each of the prices for schooling, experience, and unobserved skills separately.[25] Fn24 Fn25

The initial difference, upon arrival, in the price (rate of return) of schooling between immigrants and Israelis is $b'_s + d_s = -0.0429 - 0.0288 = -0.0717$. Given the estimated rate of return of 0.0694 for native Israelis, the initial reward for schooling is slightly negative (but not significantly different from zero) for an average immigrant. The long-run difference in the rate of return for schooling $b^*_s = -0.0429$, and the rate of return that immigrants can expect in the long-run is only $0.0694 - 0.0429 = 0.0265$. This substantial gap between natives and immigrants suggests that schooling acquired in the former USSR is not fully

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

25. We could not estimate Equation (12) using different values for λ for each human capital variable, because the NLLS estimators failed to converge. In essens, this is a multicollinearity identification problem that should be expected without additional restrictions on the adjustment terms of each human capital indicator.

transferable to Israel. After 10 years the rate of return reaches 0.0158, which is about 60 percent of its long-run value.

Upon an immigrant's arrival, the initial difference in the value of experience acquired abroad is $b'_{\text{exp}} + d_{\text{exp}} = -0.363 - 1.01 = -1.373$. Since the price of accumulated experience that Israelis obtain is normalized to unity, it follows that the initial return for accumulated experience is $1 - 1.373 = -0.373$. This means that, initially, experience accumulated in the former USSR actually has negative value in the Israeli labor market. With time, however, the price rises to $1 + b'_{\text{exp}} = 1 - 0.363 = 0.637$, which (given the high standard error on b'_{exp}) is not significantly different from 1. Thus, we cannot reject the hypothesis that, in the long-run, immigrants obtain the same rate of return on experience as native Israelis.

The occupational dummies show that immigrants who work in the high- and in low-paid professional occupations obtain higher premia (relative to blue-collar occupations) than comparable Israeli workers. In the short-run, the premium for high-paid occupations is $(0.292 + (0.346 - 0.253)) = 0.385$ and for low-paid occupations is $(0.206 + (0.168 - 0.142)) = 0.232$. In the long-run, these premia are even higher: $0.292 + 0.346 = 0.638$ and $0.206 + 0.168 = 0.374$, respectively. However, a large part of these occupational effects is a consequence of the lower rate of return for schooling in blue-collar occupations.

As seen in Table 6, the coefficients b' and d are positive and large for both specifications, indicating that (in the short-run) there is not much to distinguish between immigrants having different human capital indicators. With time, however, the constant term declines and more weight is shifted to observable characteristics, since their prices rise. Note that the cohort dummies indicate a reduction in the unmeasured quality of immigrants. Holding measured characteristics constant, immigrants who came before 1990 earn 4.99 percent more than immigrants who came in 1990–1991 (the omitted group), who earn 4.70 percent more than immigrants who came after 1992. This pattern is consistent with the observed deterioration (in terms of schooling) of later cohorts of immigrants, as noted by Borjas (1985) for the United States.

6. A Decomposition of Wage Growth

The purpose of this section is to use the estimated earning equation to decompose the wage assimilation process into the four sources the immigrants' earnings growth after 10 years in Israel. In particular, we assess the relative importance of the price change of imported skills, local experience, occupational change, and the time effect on the wage growth of the first large cohort of immigrants. Table 7 provides a partition of the wage growth of immigrants T7

TABLE 7. Components of annual wage growth rates during 1991–2000 and 1991–1995: 1990 cohort of male immigrants, age at arrival > 25 (percent).

	All Immig.		Sch. 13–15		Sch. 16+		Arr. age 25–40		Arr. age 41–55	
	91–00	91–95	91–00	91–95	91–00	91–95	91–00	91–95	91–00	91–95
Actual	6.62	7.99	4.82	7.02	8.03	10.96	7.18	9.62	5.96	6.79
Predicted	6.48	8.07	5.38	7.70	7.48	9.56	6.60	7.89	6.17	8.20
Time[a]	1.46	2.91	1.46	2.91	1.46	2.91	1.46	2.91	1.46	2.91
Exp.[b]	1.37	1.36	1.20	1.23	1.53	1.60	2.01	1.91	0.51	0.75
Prices[c]	2.52	2.84	2.51	2.83	3.42	3.84	1.88	2.10	3.18	3.51
Occ.[d]	1.13	0.96	0.21	0.73	1.07	1.21	1.25	0.98	1.02	1.03
Obs. 1991	119		50		29		60		59	
Obs. 1995	135		51		46		76		51	
Obs. 2000	64		19		30		36		28	

[a] The time effect is the difference between the 2000 (1995) year dummy and 1991 year dummy divided by 10 (5) in Table 5.

[b] The experience effect is the difference in the average accumulated experience in Israel between 1991 and 2000 (1995) (averaged over members of the 1991 cross-section and divided by 10 (5)). The accumulated experience is defined as $[b(\exp_0 + t - t_0) - (c/2)(\exp_0 + t - t_0)^2]$, where $t - t_0$ equals 10 in 2000 (5 in 1995) and 1 in 1991. The coefficients b and c are taken from the wage equation for Israelis in Table 5 (i.e., $b = 0.0418$ and $c/2 = 0.0006$), and $\exp_0$ is the experience accumulated abroad by the immigrant.

[c] For each immigrant in the 1991 cross-section, we form predicted wages for 1991 and 2000 (1995), holding occupation constant at the 1991 level. We then take averages of these two predictions (for 2000 (1995) and 1991) over all observations in the 1991 cross-section, divide by 10 (5), and the deduct the time and experience effects.

[d] For each immigrant in the 2000 (1995) cross-section, we predict this wage based on his observed occupation. For each immigrant in the 1991 cross-section, we form a predicted wage for 2000 (1995) based on his 1991 occupation. We then take the difference in the average of these predictions and divide by 10 (5).

in a synthetic cohort into four components: time, experience, price effects, and occupational changes. We do this for two periods: 1991–2000 and 1991–1995. Specifically, we select from the 1991 and 2000 (or 1995) cross-sections of immigrants who entered Israel in 1990. Averaging log wages for each cross section and taking the differnece (divided by 10 or 5) yields the "average annual growth rate" for the 1990 synthetic cohort during the period 1991–2000 (or 1995). For each person in these two cross-sections, we can create a prediction based on *his* characteristics and occupation and so generate an "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 effects are derived directly from the year dummies in Table 5. The experience effect is the average "true" experience in Israel, accumulated between 1991 and 2000 (or 1995), by members of the 1991 cross-section. The price effect is defined as the average change in predicted wages, net of year and experience effect, *holding occupation constant* at the 1991 level. To evaluate the occupation effect, we predict for each immigrant the wages in 1991 and 2000 (or 1995) based on his occupation in these years, take the difference in the average of these predictions, and then, divide by 10 (or 5). Because 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.[26] Fn26

The results in Table 7 show that the increasing prices of skills is the most important factor in explaining wage growth during the initial five years following immigration. Of an average annual wage growth of 6.6 percent during 1991–2000, 40 percent is due to rising imported skill prices. Of course, this factor is more important the more schooling or experience the immigrant has. Changing occupation contributes 1.1 percent to wage growth, general growth contributes 1.5 percent, and accumulation of experience contributes 1.4 percent. As expected, occupational change is more important for immigrants with a higher amount of imported schooling, and experience effects are more important for younger immigrants. It is quite interesting that these features are not much affected by macro effects, as captured by the year dummies. Thus, although the exogenous wage growth was mainly concentrated in 1991–1995 and was practically zero during 1996–2000, the price, experience, and occupation effects are quite stable.

We thus see that, in the first 10 years, rising prices of skills are the main cause for immigrant wage growth; and acquired skills and occupational transitions are of secondary importance. However, our specification of the wage dynamics implies that, as the immigrant spends more time in Israel, the rate increase in the price of skill declines. Meanwhile, the wage increase associated with occupational transitions becomes increasingly important, as can be seen from the comparisons of the 1991–1995 and 1991–2000 periods in Table 7.

7. Occupational Distribution and Transitions

In this section we focus on the occupational transitions of high-skilled immigrants in comparison to natives, where schooling is set to sixteen-plus years. We do this in order to better understand the role of the occupational transitions in the wage growth of immigrants and the potential wage convergence to Israelis. In interpreting the data, we assume that the occupation of an observed immigrant

26. The occupational distribution of the 1990 cohort moved over time as described in the following table.

	HP	*LP*	*BC*
1991	13.5	11.8	74.8
1995	22.3	11.9	65.2
2000	32.9	12.5	54.7

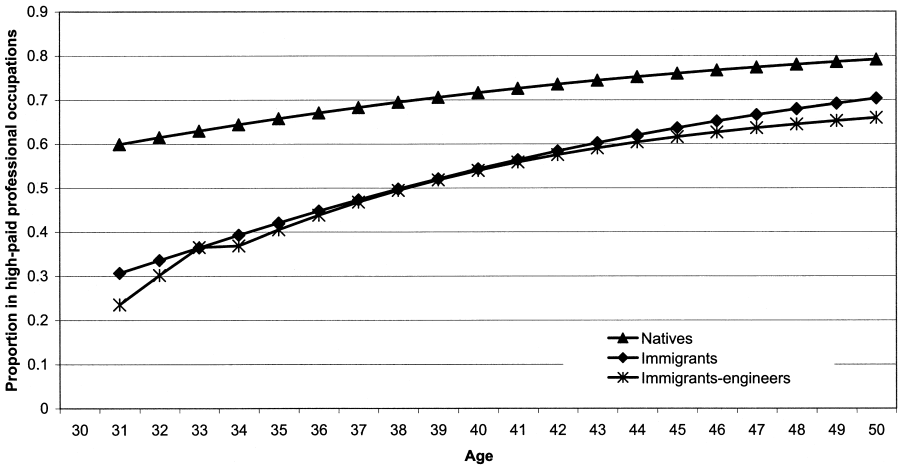

FIGURE 1. Predicted proportion of male workers with 16+ years of schooling employed in high-paid professional occupations

or native is an exogenous draw from a given probability distribution, as explained in Section 2.[27] Fn27

In Figure 1 we present the predicted results from a single logit regression of F1 the estimated probability of being employed in *HP* occupations (conditional on age) for an immigrant who arrived at age 30 with sixteen-plus years of schooling.[28] As seen, the proportion of Israeli workers with sixteen-plus years Fn28 of schooling who actually work in *HP* occupations rises from about 60 percent at age 30 to about 80 percent at age 50. It is forecast that, over the same age (time) interval, the proportion of recent-wave immigrants working in *HP* occupations who entered Israel at age 30 with sixteen-plus years of schooling will rise from about 30 percent to about 70 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 but not completely with time spent in Israel.

A similar pattern of a quick rise in the proportion of immigrants employed in *HP* occupations is observed in Figure 1, based on Brookdale's Survey of

27. We thus abstract from the choice of jobs and occupations that are likely to be affected by the wage process. Weiss et al. (2003) and Cohen and Eckstein (2002) estimate structural models that incorporate these decisions.

28. The logits are estimated from the Labor Force Surveys for 1991–2000. For male Israelis, we control for schooling (set at 16+) and age. For male immigrants, we control for schooling (set at 16+), age at arrival, and cohort. (See appendix Tables A4 and A5 in Eckstein and Weiss 2003.)

Engineers. These retrospective data allow us to calculate annual transition matrices for immigrants during their first years in Israel.[29] Using monthly data, we calculate for each month the annual transition rate (102 months ahead) and then take the monthly average for immigrant engineers who were in Israel for 30–42 months. We use the estimated transition matrix to forecast the future occupational distribution of the immigrant engineers, as we show in Figure 1.[30] Fn29 Fn30

The different sources tell the same story: initially, only about 20 percent of the qualified immigrants found a high-skilled job, but after four or five years this proportion rises to about 40 percent. The agreement of the predictions from the logit regressions based on the repeated cross-section data, the retrospective Survey of Engineers and the observed proportions in the pooled cross sections, suggests that we can use either (with some confidence) to calculate the occupational probabilities and so generate expected wage profiles that are not conditioned on occupation.

8. Convergence of Wages

To evaluate the assimilation rate of immigrants in the host country, it is common to ask whether their wages converge, overtake, or fall short of the wage of comparable natives. To answer this question, we now turn to study the long-run behavior of immigrant wages. We first study the convergence within occupation, we then examine the wage residual dynamics, and finally we look at the convergence of wages averaged across occupations.

As noted already, time spent in Israel has a different impact on observed skills and unobserved components of the wage (unobserved skills and other sources). The average impact of the unobserved part declines with time spent in Israel while the average impact of observed skills rises, reflecting the rise in the price of these skills. We now consider the combined impact of these factors and ask whether or not the average wage of immigrants converges to the average wage of comparable natives who work in the same occupation. Figures 2a to 2c show the predicted wage–age profiles for an immigrant with 16 years of schooling, who arrived in Israel during the period 1990–1991 at the age of 30, and for an F2a-c

29. We have two other panels that can be used for the same purpose: the CBS panel of immigrants who arrived in 1990 and were surveyed four times in 1991–1994; and the Brookdale survey, which in summer 1992 interviewed a random sample of 1,200 immigrants and then 900 of these immigrants again in 1995. The patterns in these data, unconditional on education, are similar to what we present here. However, owing to their small sample size, these sources are not directly useful for the calculation of transitions conditioned on sex, schooling; or age.

30. The prediction in the graph assumes that the transition matrix is stationary. However, the structural models of Weiss et al. (2003) and Cohen and Eckstein (2002), which allow the transition rates to vary with time, yield similar predictions.

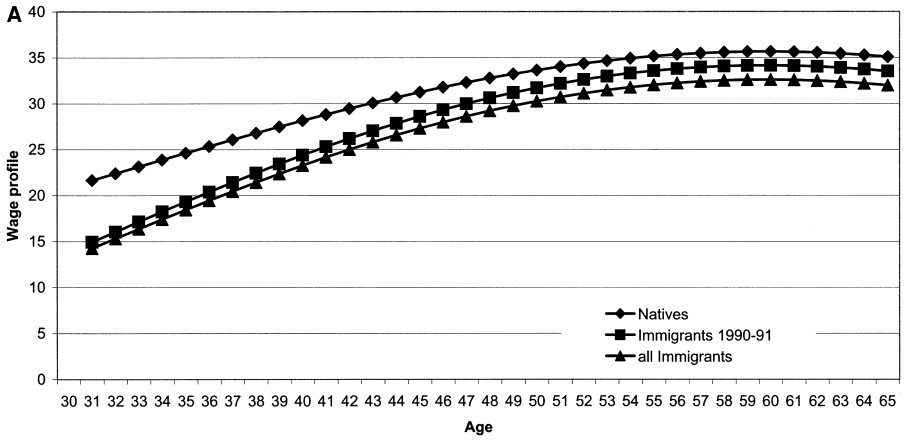

FIGURE 2A. Simulated wage–age profiles in high-paid professional occupations for a native and an immigrant males (schooling = 16, age at immigration = 30, NIS 1991)

equivalent native. We consider three such comparisons, one for each occupational category using the estimated parameters reported in Tables 5 and 6.

As seen in these figures, the immigrants' wage–age profiles are generally below those of the natives. In high-paid professional occupations, convergence is predicted for the *average* immigrant, but not for members of the recent immigration wave. In low-paid professional and blue-collar occupations, wages of immigrants with 16 years of schooling converge not to those of a comparable

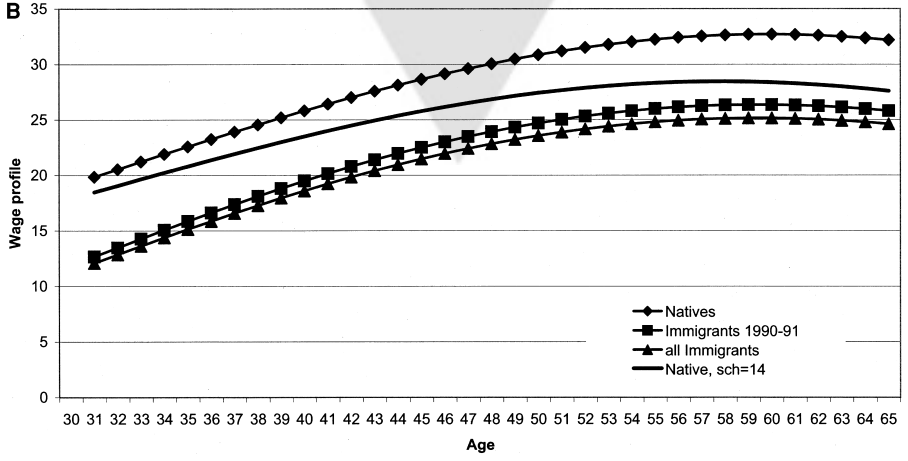

FIGURE 2B. Simulated wage–age profiles in low-paid professional occupations for a native and an immigrant males (schooling = 16, age at immigration = 30, NIS 1991)

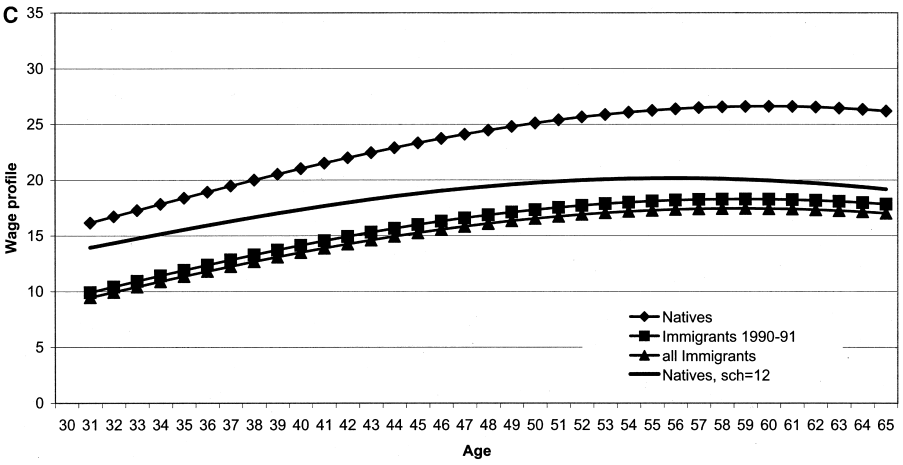

FIGURE 2C. Simulated wage–age profiles in blue-collar occupations for a native and an immigrant males (schooling = 16, age at immigration = 30, NIS 1991)

native but rather to the wages of a native with the average level of schooling in these occupations (14 and 12 years of schooling, respectively).[31] For the 1990–1991 cohort, the predicted wage gaps between immigrants and natives with 16 years of schooling at age 55 are 5 percent, 24 percent, and 45 percent in *HP, LP,* and *BC* occupations, respectively. Fn31

8.1. Convergence of Residual Distributions

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

The residuals for natives are based on the regression coefficients in Table 5, and the residuals for immigrants are based on the coefficients in Table 6. To

31. The widening gap in blue-collar occupations between immigrants and Israelis with 16 years of schooling suggests that immigrants who stay in blue-collar occupations for a long time are of increasingly lower quality when comared with the Israelis who stay.

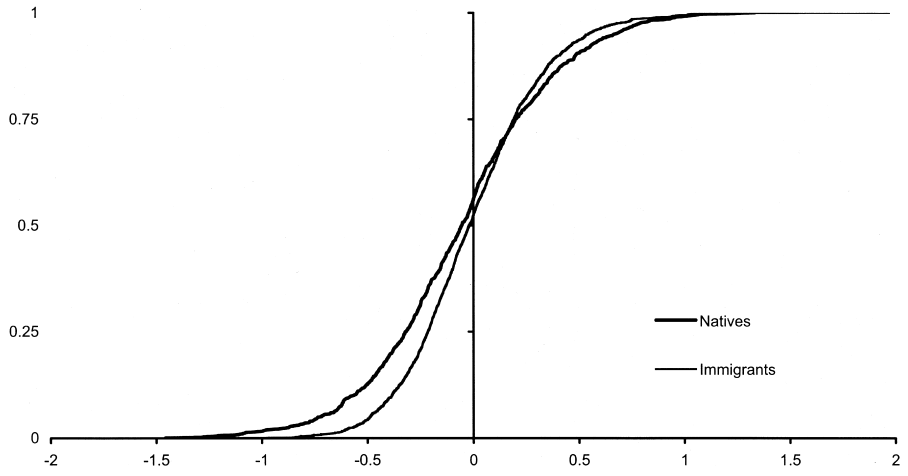

FIGURE 3. Residual distributions for natives and immigrants with 5 or fewer years of experience

examine the role of time in Israel on immigrants, we divide the sample into two subsample, based on their experience in the Israeli labor market: those with five years or less and those with more than five years. The residual distributions in Figures 3 and 4 show the residual distributions for immigrants and natives in the two experience groups. We can observe that among the less experienced, the residual distribution of immigrants is steeper, suggesting a lower variance, but F3 4

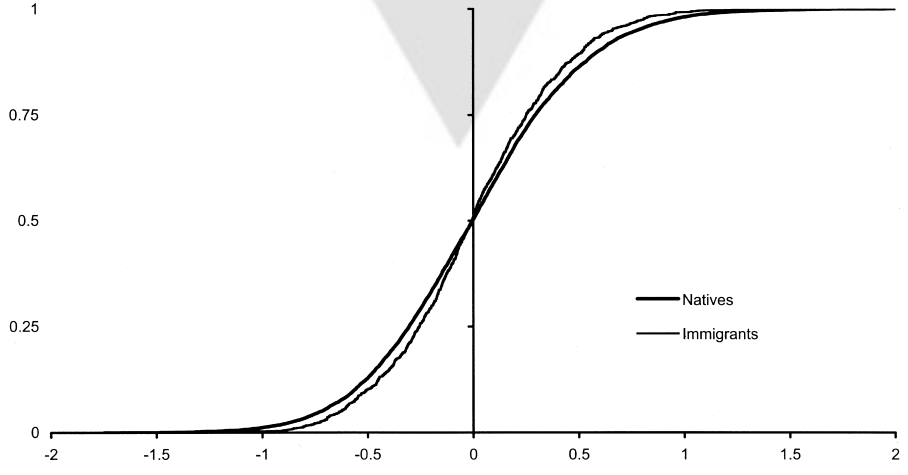

FIGURE 4. Residual distributions for natives and immigrants with 6 or more years of experience

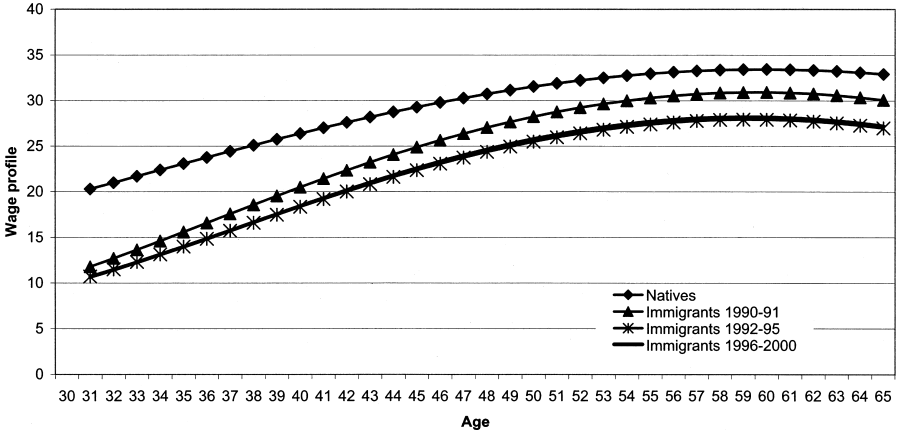

FIGURE 5. Simulated wage–age profiles, averaged over occupations, for a native and an immigrant males (schooling = 16, age at immigration = 30, NIS 1991)

among those who have been in the Israeli labor market for more than 5 years, the residual distributions of immigrants and natives are very close.[32] Fn32

The declining mean and rising variability in residuals among immigrants—with the passage of time spent in Israel—reflects the presence of two types of learning about immigrant skills. The learning about the measured characteristics of immigrants reduces the *average* role of unmeasured attributes. At the same time, as more is learned about each individual immigrant, immigrants are sorted out and variability rises (see Farber and Gibbons 1996).

8.2. Convergence of Average Wages

We now bring together our results on wage dynamics and the dynamics of occupational transitions by immigrants and examine the convergence of the average wage, unconditioned on occupation. Figure 5 presents wage–age pro- F5
files, averaged over occupations, for an immigrant with 16 years of schooling who arrived in Israel at age 30 and for a comparable native. For immigrants, we

32. Using the Kolmogorov-Smirnov (K-S) and Kruskal-Wallis (K-W) tests, the null hypothesis of equality of distribution is strongly rejected for the low-experience group of less than five years in Israel. The p value is zero for the K-S test and is 0.003 for the K-W test. For the immigrants who are in the Israeli labor market more than five years, the p value is 0.016 for the K-S test and is 0.988 for the K-W test. It is safe to say that these results do not reject the hypothesis that the residuals distribution on immigrants converges to that of natives after five years since migration.

combine here the dynamic effects from the estimated wage equations reported in Tables 5 and 6 with the occupational distribution predicted by the logit regressions (see Eckstein and Weiss 2003).[33] Figure 5 shows that the wage differential between immigrants and comparable natives narrows substantially with time spent in Israel. An immigrant who arrives at age 30 with over sixteen years of schooling earns, on the average, only 53 percent (58 percent for the 1990–1991 cohort) of the wage of a comparable Israeli. After five years in Israel, the same immigrant earns a wage that is 61 percent (67 percent for the 1990–1991 cohort) of the wage of a comparable native, and after 20 years this proportion rises to 81 percent (89 percent for the 1990–1991 cohort). As explained previously, the growth in early years is due mainly to the rise in the returns for imported skills; the growth in later years is due mainly to occupational switches, as reflected in the narrowing of the occupational differences between immigrants and native Israelis. However, convergence is not attained, due to incomplete convergence in the occupational structure and the lack of convergence within occupations. Fn33

8.2.1. Comparison to Findings from the United States. Studies on immigration to the United States during the 1970s show rapid rates of assimilation to natives of the same ethnicity. (See for example, Chiswick 1978, Borjas 1985, and LaLonde and Topel 1991.) These studies define the assimilation rate of immigrants, during the first decade in the United States, as the reduction of the percentage difference of the wages between immigrants and equivalent natives of the same ethnicity. Lalonde and Topel (1991) find that the initial gaps between newly arrived immigrants and natives of the same ethnicity ranged between −0.05 for Europeans to −0.33 for Asians, whereas the 10-year assimilation rates ranged between 0.05 for Europeans and 0.24 for Asians during the decade 1970–1980. These studies use census data and estimate separate regressions for immigrants and natives, without occupational dummies.

Using Figure 5, we find that the initial gap between an immigrant and a native at arrival is −0.45, where a 31-year-old native with 16 years of education earns 20 new Israeli sheckels (NIS) and the equivalent immigrant earns 11 NIS, on average. After 10 years, at age 41, the difference is reduced to −0.26, where a 41-year-old native with 16 years of schooling earns 27 NIS and the equivalent immigrant earns 20 NIS, on average. Based on these findings, an immigrant from the USSR to Israel assimilates at a rate of 19 percent during the first 10 years. This rate is similar to the rate of assimilation of Asian immigrants in the

33. For Israelis we use the actual observed proportion by occupation (for the group with 16+ years of schooling) using the Labor Force Surveys for 1991–2000.

United States during the 1970s, who also had a high level of schooling—about 14 years on average.

To further facilitate a comparison with these studies, we use simple descriptive regressions for immigrants and natives, without occupational dummies and imposing no restrictions of equal coefficients in the two equations.[34] However, we allow for the "years since migration" (ysm) to have a different slope after 5 years in the host country and to interact with schooling, as our theory suggests. According to these regressions, the initial gap between immigrants and natives with comparable schooling and work experience (sixteen and six years, respectively) is −47 percent. The annual growth rate for immigrants, evaluated at sixteen years of schooling, is 0.093 per year during the first 5 years since migration. In later years, this growth rate drops down to 0.025, yielding a wage increase of 77 percent during the first 10 years in Israel. The comparable growth rate for native Israelis is 37 percent, so that the gap after ten years is reduced to −32 percent and we obtain an assimilation rate of 15 percent since migration. These results are similar to the results based on the model estimated in this paper. Fn34

9. Summary and Conclusions

It is well known that immigrants enjoy a high wage growth during the initial phase after arrival. The novel aspect of this paper is the attempt to identify the sources of that wage growth. We distinguish between three sources of wage growth for immigrants: (1) the rise of the return to imported human capital; (2) the impact of accumulated experience in the host country; and (3) the mobility up the occupational ladder in the host country. We find that increased price of imported skills accounts for about half of the unconditional 6.6 annual wage growth during the first ten years. Occupational transitions are important mainly for the high-skill immigrants who came with academic degrees and for immigrants who arrived at a young age (accounting for 1.1 and 1.3 out of the 7.5 and 6.6 predicted growth rates, respectively). For the highly skilled immigrants, experience in the host country accounts for 1.5 percent annual growth and aggregate wage growth accounts for about 1.5 percent.

34. We use conventional specifications for these descriptive regressions for immigrants whose age at arrival is greater than 25. The regression for natives is reported in the last two columns of Table 5. The regression for immigrants is

$$\ln y = 2.100 + 0.109C_{<1990} - 0.032C_{1992-1995} + 0.047C_{1996-2000} + 0.022s - 0.009\text{age}_{\text{arr}} + 0.048\text{ysm} - 0.067((\text{ysm} - 5) * d_{\text{ysm}>5}) + 0.003(\text{ysm} * s),$$

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

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

As immigrants spend more time in the host country, the increase in prices of skill slows down and occupational transitions become more important. Initially, there is a substantial occupational downgrading and about half of the male immigrants with more than 16 years of schooling work in low-skill occupations during the first 3 years in Israel. However, immigrants who arrived at relatively young ages 25–40, move up the occupational scale, and about 60 percent of them work in the highly paid professional occupations, after being in Israel for 11 to 15 years. By way of comparison, the percentage of natives with more than sixteen years of schooling who work in *HP* occupations is 62 percent (see Eckstein and Weiss 2002, Appendix Table A3). We thus may conclude that the occupational opportunities of immigrants who arrived at a young age with a high level of schooling almost converge to those of comparable natives.

However, the wages of these immigrants are not expected to converge to the wages of comparable natives, mainly because the long-run return of 2.7 percent that immigrants obtain for their imported schooling is substantially lower than the 6.9 percent return that natives obtain for their locally acquired schooling. This large gap in the returns for schooling, which was also documented by Friedberg (2000), may reflect either an inherent difference in quality of schooling of frictions in the labor market that cause qualified immigrants to "give up" in their search for suitable jobs. The large windfall of human capital that Israel received is somewhat rare, yet it is an option for many developed countries to attract large inflows of skilled workers from less developed countries. In the European context, this is achieved partially by extending the borders of the European Union and partially by new immigration policies that emphasize skills (see Fertig and Schmidt 2002). The two main conclusions from the Israeli experience are that the absorption of high-skill immigrants takes a long time and might involve substantial loss of skills, due to the gradual process of matching between imported skills and local job opportunities. However, natives do not suffer a loss even when immigration is large.[35] Although one should be cautious from drawing general conclusions, the Israeli experience is suggestive of the large opportunities associated with more open immigration polices. Fn35

35. We cannot elaborate on these general findings here, but the interested reader is referred to our other work and to the summary in Weiss (2000).

TABLE A1. Summary statistics from Income and Labor Force Surveys, 1991–2000. AQ: 1

		Male natives age 25–65		Male immig. age 25–65		Male immig. age 25–65, age at arr. > 25	
		IS	LFS	IS	LFS	IS	LFS
Wage	Monthly	4309.1		2815.3		2663.2	
		(3012.4)		(1856.9)		(1701.6)	
	Hourly	20.7		13.8		13.0	
Exp.	Total	18.6	16.5	22.2	21.9	23.8	23.8
	Abroad			15.1	14.1	17.8	17.4
	In Israel	18.6	16.5	7.1	7.8	6.0	6.4
Age	Total at arrival	40.5	38.8	43.6	43.3	45.2	45.2
				36.1	35.0	39.2	38.9
Sch.	Total at arrival	12.9	13.3	13.8	13.7	13.9	13.9
				13.5	13.4	13.9	13.9
	HP (%)	23.14	23.74	17.25	16.4	17.08	16.61
	LP (%)	11.90	13.21	9.66	10.8	8.68	9.40
	BC (%)	64.96	63.05	73.09	72.9	74.23	73.99
Cohort %	Before 1960			0.58	1.49	0.03	0.02
	1960–69			1.06	1.34	0.22	0.32
	1970–79			16.55	15.72	10.96	10.17
	1980–88			2.45	2.47	2.28	2.32
	1989–91			56.10	53.61	61.73	59.85
	1992–95			18.99	20.62	20.16	21.90
	1996–2000			4.26	4.75	4.62	5.42
Year of Obs.	1991	1704	7073	276	1319	212	1031
	1992	1606	6742	386	1686	324	1421
	1993	1432	6584	402	1793	345	1513
	1994	1608	7347	459	2148	385	1765
	1995	1709	7680	513	2453	417	1942
	1996	1311	7848	434	2485	372	1990
	1997	847	7710	333	2482	270	1915
	1998	897	7867	335	2518	294	1941
	1999	900	7748	336	2549	268	196
	2000	911	7887	282	2566	233	1901
	Obs.	12,925	74,486	3,756	21,959	3,120	17,345

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