Immigration, Search and Loss of Skill*

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Revised, October 2000

Abstract

This paper analyzes the process of entry of highly skilled immigrants into the Israeli labor market, using panel data on several cohorts of recent immigrants from the former USSR. The study develops and estimates an on-the-job search model, cast as a finite horizon, discrete choice dynamic programming problem under uncertainty, that is capable of capturing the main features of this process; a speedy entry into the labor force, an initial phase of work at low skill occupations, a gradual occupational upgrading and a sharp increase in wages. The estimated parameters of the model, together with information on the wages of immigrants from earlier waves, allow the simulation of an occupational path and associated wages, for each new immigrant, from the time of arrival until retirement. The predicted lifetime earnings at the time of arrival are compared to the hypothetical lifetime earnings immigrants would have obtained had their imported observable skills been valued in the same way as comparable Israelis. The results of the study suggest that, on average, immigrants can expect lifetime earnings to fall short of the lifetime earnings of comparable Israelis by 57 percent. Of this figure, 14 percentage points reflect frictions associated with nonemployment and job distribution mismatch and 43 percentage points reflect the gradual adaptation of imported schooling and experience to the local labor market.

*Financial support for this project was received from NICHD Grant Number 5 R01 HD34761-03.

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1 Introduction

Starting in late 1989, Israel has experienced a major immigration wave of highly skilled workers from the former Soviet Union. About $600,000$ immigrants entered Israel during the period $1990-1995$. The average level of schooling of these immigrants is high, 14.7 years of schooling for males and 14.3 for females. This wave is without precedent in terms of the imbalances it created in some high skill occupations. As a result of the large scale immigration, the stock of physicians and engineers in Israel almost doubled during the period $1990-1993$. Under these circumstances, it is not surprising that many highly skilled immigrants were forced into low skill occupations. Among males who were 25 to 55 years old upon arrival, only 26 percent of those who worked as scientists or engineers in the former USSR found similar jobs within the first three years of their stay. The extent of occupational downgrading among females and older males was even higher.[1]

The purpose of this paper is to investigate the observed short-run adjustment process in immigrant occupational choices and wages and to infer some long-run implications. The main focus is on the loss of human capital suffered by the immigrants and the implications of this loss to the immigrants themselves and to the Israeli economy. With this purpose in mind, a model of on-the-job search is constructed and estimated, using panel data on $1,086$ male immigrants that reported their labor market experience during the period $1990-1995$. The model is designed to describe the process of matching immigrants with jobs in Israel, where workers differ in skills and jobs vary by skill requirements. The various jobs in the economy are considered to be arranged in a "job hierarchy"[2] where, in each occupation, jobs can be ranked according to the **minimal** level of schooling required to perform the job. Finding a suitable job, which maximizes the immigrant's output (and wages) given his schooling endowment, requires search. An immigrant who meets a particular employer will be qualified for the job only if his schooling exceeds the minimal requirement. A highly skilled immigrant may accept job offers in low skill occupations because offers in high skill occupations are more rare, and he can continue to search on the job. Generally, workers will select occupations and job acceptance rules which do not fully exploit their formal schooling. However, with time, immigrants find better matches and their wages rise.

The panel data on the recently arrived immigrants from the former Soviet Union

[1] A downgrading of skills was also observed among immigrants who came from the USSR during the years $1970-1980$. The skills and occupational composition of these immigrants were similar to the current wave, but their number was smaller, about $150,000$ (see Flug, Kasir and Ofer, 1992).

[2] The approach was suggested by M. Reder, 1957, pp. 291-295. In his view, jobs are arranged in a "job hierarchy", in which workers search for the best jobs for which they are qualified but, failing to find them, may end up in a less preferred job. In a favorable labor market (for workers), job seekers find it relatively easy to move up the job hierarchy towards better jobs and vice versa. This occurs because fewer workers compete for the good jobs and also because firms relax their hiring standards.

are used to estimate the distribution of wage offers and job offer arrival rates in different occupations in Israel, assuming that immigrants choose jobs according to the optimal solution of a dynamic programming problem under uncertainty. Based on the estimates, the loss of human capital is computed, where loss is defined as the difference between the expected actual lifetime earnings and the expected potential lifetime earnings that the immigrant would have obtained had he been employed at the same jobs and earned the same wages as comparable Israelis. The expected discounted present value of the difference between actual earnings and potential earnings is, on average, 253,200 US Dollars, which constitutes 57 percent of the present value of potential earnings over the remaining working life (25 years, on average). Nearly 75 percent of this estimated loss, 190,900 US Dollars, can be attributed to the fact that in each job immigrants initially earn wages which are about a third of the wages of comparable Israelis. Wages of immigrants rise sharply with time in Israel but do not fully catch up with the wages of natives (after 30 years in Israel immigrants are predicted to earn 15 percent less on the same jobs). The remaining 25 percent of the loss, 62,300 US Dollars, can be attributed to frictions associated with nonemployment and job distribution mismatch. The estimated loss is probably an upper bound estimate of the social loss associated with the transfer of human capital, because differences in the quality of schooling and macro effects can cause the potential earnings of immigrants to fall short of the earnings of comparable natives.[3]

While the focus of this paper is on a particular episode - recent immigration to Israel - the methods which are developed can be applied to other situations in which there is a major occupational restructuring, resulting from aggregate labor market shocks such as technological innovations and changing trade patterns.[4] In the model, losses in human capital occur as workers with a predetermined level of schooling find themselves with no jobs and are willing to compromise and accept jobs with schooling requirements below their schooling endowment. Even in a smoothly operating economy, in which individuals can select their schooling and firms can choose their job offers, the model predicts some "natural" loss of skills, akin to the natural rate of unemployment.[5]

[3]The model does, however, include an explicit adjustment for quality differences in schooling between the two countries.

[4]Several recent studies analyze the unemployment spells and wage losses following displacement due to plant closure. See, for instance, Jacobson et al.,1993, Carrington and Zaman, 1994 and Neal, 1995. These studies find a substantial and long-lasting loss of wages.

[5]Sicherman, 1990, noted the prevalence of over-education in a sample of American workers (the Panel Study of Income Dynamics). When asked "How much formal education is required to get a job like yours?" about 40% of the respondents reported a number which was lower than their own schooling attainment (only 16% of the respondents reported a higher number). The author ascribes this discrepancy to a variety of reasons, including temporary mismatching and career mobility.

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 600,000 immigrants by the end of 1995. The Israeli population at the end of 1989 was 4.56 million and the pre-migration population growth rate during the 1980s was between 1.4% and 1.8% per annum. The $1990-1991$ wave of immigration increased the population by 7.6%, in two years, which is more than twice the normal population growth. The slower immigration flow between 1992 and 1995 contributed 1.3 percent a year in population growth. By the end of 1995, the recent immigrants from the former USSR constituted 11% of the total population and 12.1% of the population aged 15 and above. Compared with immigration to 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 from the former Soviet Union is comprised of experienced workers of all ages. On average, immigrants are older than Israeli workers by four years. This is in 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 of Diaspora Jews to Israel. Thus, this immigration wave is less governed by self-selection.

Another important feature of this wave of immigration is the immigrants' exceptionally high level of education and prior experience in academic jobs. Those who arrived during $1989-1991$ possessed an average of 14.5 years of schooling, compared to 12.6 years among Israeli workers in 1991. About 70 percent of the immigrants worked in high skill and medium skill occupations in the USSR, compared to only 30 percent among Israeli workers. Of those immigrants that arrived between the end of 1989 and the end of 1993, 57,400 defined themselves as engineers and 12,200 as medical doctors. This is compared to 30,200 native engineers and 15,600 native physicians working in Israel in 1989. Many highly skilled immigrants were thus forced into occupations that require less skill than they possess. Of the 112,000 immigrants who arrived during $1990-1991$, with 16 or more years of schooling, 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 average).

Immigrants from the former USSR entered the Israeli labor force quickly, willing to accept almost 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 high-ranked occupations. There is a rather sharp increase in wages as a function of time spent in Israel. During the period $1990-1995$, the annual growth rate in real wages

among immigrants was 6.4 percent.[6] 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 (see Eckstein and Weiss, 1998 and Freidberg, 2000). This process has occurred without much effect on the employment and wages of natives (see Friedberg, 1999 and Eckstein and Weiss,1998), because of inflows of capital and increased exports.[7] In some professions, such as medicine, collective wage bargaining yielded substantial wage hikes for natives, despite the sharp increase in supply (see Sussman and Zakai, 1998).

3 Data

The data sources for this study are two surveys conducted by the Brookdale Institute. The first survey, conducted in April-August 1992, interviewed a random sample of 1,118 immigrants that had arrived from the former Soviet Union after 1989. Of this representative sample, 910 immigrants were surveyed again during 1994. The second survey, conducted in June-December 1995, consists of a random sample of 1,432 immigrants that arrived after 1989 and that reported being engineers in the former Soviet Union. The two samples are pooled and the analysis is restricted to males between the ages of 25 and 55 at the time of arrival, yielding a sample of 1,086 immigrants. The respondents' length of stay in Israel ranges from 6 to 77 months. Each immigrant supplied information on his occupational and educational background in the former Soviet Union and a detailed history of his work experience in Israel. Average sample values for the variables used in the analysis are presented in Appendix Table *A*1.

The possible occupations in Israel and the USSR are classified into 3 broad categories, based on their schooling requirements: 1) scientific and academic occupations, including government officials; 2) other professional occupations, including technical workers, teachers, nurses and artists; 3) all others. Tables 1 and 2 describe the occupational distribution of immigrants in the sample, in the former USSR and in Israel. The basic pattern in these tables is an initial transition by many immigrants down the occupational ladder from occupations 1 and 2 in the former Soviet Union to occupation 3 in Israel, followed by a gradual recovery. About 89 percent of the immigrants in the combined sample worked in occupations 1 and 2 in the former USSR (see Table 2) but only 20 percent of them found a first job in these occupations in Israel. Most of the immigrants, 75 percent, started their work career in Israel as unskilled workers

[6] A sharp increase of wages among immigrants is a common finding in most studies of immigration, although the reasons are not always clear. See Chiswick, 1978, and the surveys by Topel and Lalonde, 1997, and Borjas, 1994. Green, 1999, discribes the process of occupational upgrading among immigrants to Canada.

[7] Weak effects of immigration on the wages of natives have also been found in the US. See Altonji and Card, 1991, and Card, 1999.

(see Table 1). However, with the passage of time, the percentage of immigrants who work in occupation 1 rises sharply from 11.6 in month 12 to 36.7 percent in month 60. Nonemployment declines sharply from 26.2 percent in month 12 to 7.8 percent in month 60.

Within each broad occupational category, immigrants hold jobs that require some minimal level of schooling. The minimum schooling requirement on a reported two digit occupation is defined as the second decile of the native Israeli distribution of completed schooling levels in that same two digit occupation. Table 3 shows the schooling requirements of the jobs that immigrants hold, in comparison to their imported schooling endowment and the schooling requirements of jobs held by Israelis with the same schooling. The figures indicate that immigrants improve their jobs steadily, and after 6 years in Israel, the average requirement of their jobs is similar to the jobs held by comparable Israelis, except for immigrants with $17-22$ years of schooling. These latter immigrants hold jobs that require less schooling than comparable Israelis.

Althogh immigrants change jobs quite frequently, most of the immigrants reported an accepted wage only once in their employment history.[8] Of the 697 immigrants in the engineers sample, 571 reported wages at the survey date. Of the 389 immigrants in the representative sample, 102 reported wages once and 233 reported their accepted wages twice or more, yielding another 646 wage observations. The total number of wage observations is $1,217$. Approximately 45 percent of the reported wages are net of taxes.[9] Mean wages, by years of stay in Israel, are displayed in Table 4. The figures show that immigrants that work in occupations 1 and 2 obtain higher wages than those that work in occupation 3. There is a sharp increase in real wages within the sample period. Immigrants that reported wages during their sixth year in Israel have an average real wage which is higher by 78 percent than the average wage reported during the first year. This growth reflects the wage growth within jobs (58 percent in occupation 3) and the gradual shift to higher paying jobs and occupations.

Before specifying the model and estimation procedure, it is useful to present descriptive regressions that illustrate some important features of the data. The first feature is that imported skills, such as schooling and work experience, have virtually no effect on wage outcomes during the early years in Israel. Instead, the determining factors are the occupation and job that the immigrant holds while in Israel (see Columns 1 and 2 in Table 5). It is, therefore, important to explicitly model the process by which immigrants find jobs as well as the decision to accept job offers. The second feature is that if one controls for the (endogenous) occupational variables,

[8] This reflects the nature of the questionaires. In the engineers sample, immigrants were asked to report wages only at survey year, 1995. The representative sample was surveyed twice, in 1992 and 1995. The second wave includes retrospective wage data.

[9] The questions in each survey slightly differed. Consequently, 26% of the reported wages in the engineers sample are net of taxes, while in the representative sample 61% of the reported wages are net of taxes.

knowledge of Hebrew[10] has a small and insignificant effect on wages.[11] Moreover, knowledge of Hebrew is highly correlated with occupational history in Israel suggesting that language acquisition might also be endogenous (see columns 2 and 3 of Table 5). Thus, given the lack of sufficient information on changes in knowledge of Hebrew, the information on language ability is not incorporated into the analysis.

4 The Model

In order to describe the process by which immigrants gradually find a proper use for their imported skills, a model of on-the-job search is developed. The search model is cast as a finite horizon discrete choice dynamic programming problem under uncertainty and corresponds to the decision problem of a single individual. Individuals are allowed to be heterogenous, however, in both observed and unobserved dimensions.

Suppose that immigrants vary in their skill endowments and local jobs vary in their **minimal** skill requirements. The output achieved by employing a particular worker on a particular job depends on the match between the worker and the job. Specifically, a worker with less skill than the required minimum cannot perform the job. A worker with more than the required minimum can perform the job and receives a wage that depends both on the minimal requirement and the worker's skill level.

Workers meet employers randomly and receive job offers. The arrival rate of job offers and the distribution of jobs by skill requirements differ across occupations. Jobs within each occupation j are ranked according to the job's minimal skill requirement, s, where $s = 0, 1, ...S$. Occupations are also ranked from 1 to J, based on the frequency distribution of jobs by skill requirements, where 1 is the occupation containing the highest frequency of jobs with the highest minimal skill requirements. J is the occupation with no skill requirements and a single wage, interpreted as the nonemployment state. Firms in different occupations offer a different wage for a given s, depending on technology and demand conditions. A local employer in occupation j with job s who meets a worker with skill s^* extends a job offer if and only if $s^* \geq s$. If the worker is acceptable to the firm, the worker may choose whether or not to accept the offer.

Workers have a finite working life, T, and time is discrete, $t = 1, 2...T$. In any period, a worker can be in one of $J * S$ states. In any given state, the worker receives

[10] Immigrants reported wether they can understand, speak, write, and read professional material. The possibilities for each item are: freely, with little difficulty, with much difficulty, and not at all. Knowledge of Hebrew is defined as answering "freely" or "with little difficulty" on all four items. Knowledge of Hebrew is reported at the time of survey in both samples. The representative sample also reports speaking ability upon arrival. There is no effect of such ability on wage outcomes.

[11] The knowledge of Hebrew variable does not distinguish much between immigrants because of the availability of publicly provided language courses. About 85% of the sample finished a half year program in a language school and, at the time of the survey, 75% reported having knowledge of Hebrew.

a flow of wages and nonmonetary returns. He may also receive an alternative job offer and/or a notice of immediate job termination. It is assumed that, at most, one job offer arrives each period. This offer may be from any one of the $J * S$ jobs. The probability of receiving a job offer in any period t is modeled as the product of three components, λ_{jkt}, $P_k(s)$, and $\Phi_k(s^* \geq s)$. λ_{jkt} is the probability of meeting an employer in occupation k, given the current state is in a job in occupation j. Specifying the probability of meeting an employer in occupation k as a function of the previous occupation j allows for state-dependence and choice of search intensity. When $j = k$, λ_{jkt} is the probability of meeting a different employer in the same occupation. An immigrant may be more likely to meet a new employer in the same occupation in which he currently works. There is also a positive probability, given by $1 - \sum_{j=1}^{J} \lambda_{jkt}$, that a person in occupation j receives no job offer in period t. Given that a worker meets an employer in occupation k, the probability that the minimal skill requirement for the job is s, is denoted as $P_k(s)$.[12] The last component of the job offer probability $\Phi_k(s^* \geq s)$ denotes the probability that the worker is acceptable to the firm, or $s^* \geq s$. If a job offer arrives, which occurs with probability $\lambda_{jkt} P_k(s) \Phi_k(s^* \geq s)$, the individual decides whether or not to accept the offer by comparing its discounted present value to the discounted present value of other feasible alternatives. The other feasible alternatives are nonemployment and the current job, unless terminated. Termination of the current job is also stochastic and occupation-specific. The job termination probability is denoted as δ_j.

The current period returns on each job are specified as the sum of a job-specific wage w_{sjt} and a job-specific monetary equivalent of nonmonetary returns n_{sjt}. The value of future wages plus nonmonetary returns is not known at time t, only the distribution of possible realizations is known. The worker thus faces a problem of decision under uncertainty in several dimensions. It is assumed that in each period the worker seeks to maximize his remaining expected lifetime income, inclusive of the nonmonetary value of nonmonetary returns.

The remaining expected lifetime income of the individual, in each state at time t, can be calculated recursively, using the following system of Bellman (1957) equations

$$
\begin{aligned}
V_{sjt} \;=\; & w_{sjt} + n_{sjt} + \Delta(1-\delta_j) \\
& \left\{ \begin{array}{l}
\sum_{k=1}^{J-1} \lambda_{jk,t+1} \sum_{s^{\emptyset}=0}^{S} P_k(s') \left\{ \Phi_k(s^* \geq s') \, E_t max\left[V_{sj,t+1}, V_{s^{\emptyset}k,t+1}, V_{J,t+1}\right] \right. \\
\qquad\qquad + \left(1 - \Phi_k(s^* \geq s')\right) E_t max\left[V_{sj,t+1}, V_{J,t+1}\right] \left. \right\} \\
\qquad\qquad + \left(1 - \sum_{k=1}^{J-1} \lambda_{jk,t+1}\right) E_t max\left[V_{sj,t+1}, V_{J,t+1}\right]
\end{array} \right\} \qquad (1)
\end{aligned}
$$

[12] $\lambda_{jkt} * P_k(s)$ could be collapsed into one term, say $\lambda_{sjs^{\emptyset}kt}$. For reasons of computational tractability, parsimony and identification, the former specification is adopted.

$$+\Delta\delta_j \left\{ \begin{array}{c} \sum_{k=1}^{J-1} \lambda_{jk,t+1} \sum_{s^{\emptyset}=0}^{S} P_k(s') \{\Phi_k(s^* \geq s') E_t max[V_{s^{\emptyset}k,t+1}, V_{J,t+1}] \\ + (1 - \Phi_k(s^* \geq s')) E_t[V_{J,t+1}]\} + \left(1 - \sum_{k=1}^{J-1} \lambda_{jk,t+1}\right) E_t[V_{J,t+1}]. \end{array} \right\}$$

V_{sjt} denotes the discounted present value of remaining lifetime income in job s in occupation j in month t. $\Delta = \frac{1}{1+r}$ is the discount factor and r is the monthly interest rate. The first term in brackets is the value of expected future returns given the current job has not been terminated and the second term in brackets is the value of expected future returns given the current job has been terminated.

The process of transitions from the initial state of unemployment to subsequent jobs, implied by the dynamic optimization problem, has several salient features. The first feature is that transitions lead to improvements in income (broadly defined to include both wages and nonmonetary returns) as long as the worker can maintain his current state. The second feature is that it is possible for a worker to accept a job with a lower wage and/or nonmonetary returns if he is compensated in terms of expected future income. In choosing jobs, workers examine not only current income, but also future income prospects which depend on wage growth and alternative job offer and layoff probabilities. Finally, because of the frictions embedded in the model, and the possibility of on-the-job search, a worker will usually not wait until he gets the best job for which he is qualified, but will accept jobs for which he is overqualified. Thus, the model naturally captures the phenomenon of occupational downgrading and loss of skill, but in a dynamic context, allowing for a gradual climb up the occupational ladder.

It should be noted that the model is non-stationary, since wages rise with time and there is a finite-horizon.[13] These features are crucial for the understanding of the behavior of immigrants who arrive in Israel with different skills and at different stages of their life cycle. The rewards that immigrants obtain for their imported skills are initially very low but then rise as immigrants adapt to the new labor market.

5 Implementation of the Model

For the purpose of empirical implementation of the model, the length of each period t is assumed to be a month. This implies that job offers and job terminations occur at the beginning of each month, and wages adjust monthly. The length of the planning period is assumed to be the remainder of the immigrant's working life (65-age at immigration). However, the model is solved for each individual, for only the first 72 months since arrival in Israel. Terminal values at month 73 are specified to approximate the value of anticipated events in subsequent periods. Since it is difficult, in

[13] Traditional models of search assume stationarity and an infinite horizon. See Mortensen, 1986, Burdett, 1978 and the application by Flinn and Heckman, 1982. Recent applications of search models in a nonstationary environment include Miller, 1984, Wolpin, 1992, and Sauer, 1998.

general, to find analytical solutions to dynamic programs of this type, the model is solved numerically by backward recursion, starting with the terminal value functions in month 73.

In each month, the immigrant can hold a job in one of four broad occupational categories. The four occupational categories are defined as: academic ($j = 1$), technical ($j = 2$), blue-collar ($j = 3$) and nonemployment ($j = 4$). The first component of the job offer probability λ_{jkt} is specified to be

$$\lambda_{jkt} = \frac{exp(a_{jk}x_{it})}{1 + \sum_{k=1}^{3} exp(a_{jk}x_{it})} \tag{2}$$

for $j = 1, 2, 3, 4$ and $k = 1, 2, 3$, where x_{it} is a vector of individual characteristics and a_{jk} is a vector of parameters. The measured characteristics in x_{it} are: occupation in the former USSR, whether an engineer in the USSR, whether a physician in the USSR, age at arrival in Israel, and year of arrival in Israel (cohorts $1989-1990$, 1991 and $1992-1995$).

Schooling is used as the skill relevant to employers for assessing the quality of the job-worker match. Each broad occupational category thus includes a hierarchy of jobs indexed by their minimal schooling requirement, s, where s is assumed to range from 0 to 21. As noted earlier, the second decile of the native Israeli distribution of completed schooling levels within each two digit occupation in Israel determines the minimum schooling requirement for that two digit occupation.[14] The resulting empirical frequency of minimum schooling requirements, ranging from 0 to 21, varies greatly by broad occupational category j. The second component of the job offer probability $P_j(s)$ is defined as this latter empirical distribution. $P_j(s)$ is thus estimated separately from the model.[15]

The third component of the job offer probability $\Phi_j(s^* \geq s)$ is the probability that the immigrant's "true" schooling endowment of s^* exceeds the required minimum s of the local employer in occupation j. Each employer's assessment of the immigrant's "true" schooling level is idiosyncratic, time-varying, and assumed to be a linear function of the immigrant's imported schooling s_0.[16] That is,

[14] We attempted to estimate the model without assigning an empirically defined minimum schooling requirement to the two digit occupation in which the immigrant works. However, this introduces a form of serial correlation which, when faced with many job transitions in the data, necessitates high dimensional integrations.

[15] It is not possible to identify $P_j(s)$ jointly with the other two components of the job offer probability. It is also reasonable to assume that the proportion of jobs that require s in occupation j is correlated with the arrival rate of job offers. The empirically defined $P_j(s)$ distributions are described in Appendix Table A2.

[16] For analytical simplification, employers do not update their beliefs regarding true schooling levels.

$$\Phi_j(s^* \geq s) = \Pr(\alpha + \beta_j s_0 + u \geq s) = \frac{\exp\left(\frac{\beta_j s_0}{\upsilon} - \frac{s}{\upsilon} + \frac{\alpha}{\upsilon}\right)}{1 + \exp\left(\frac{\beta_j s_0}{\upsilon} - \frac{s}{\upsilon} + \frac{\alpha}{\upsilon}\right)}, \tag{3}$$

where u is assumed to be logistically distributed with zero mean and variance $\upsilon^2\pi^2/3$. The parameters α and β_j provide a simple linear translation of schooling acquired abroad into equivalent local units. Thus, the expected "true" schooling of an immigrant who acquired s_0 in the former USSR, and who meets an Israeli employer in occupation j, is given by

$$s^* = \alpha + \beta_j s_0 \tag{4}$$

years. The translation parameters α and β_j are identified from the acceptance rates of immigrants with imported schooling level s_0 into jobs with minimal schooling requirement s.[17]

The wage offer in a job requiring a minimum of s years of schooling, in occupation j at month t,is given by

$$w_{sjt} = \exp(\gamma_{0j} s + \gamma_{1j} x_t), \tag{5}$$

where γ_{0j} is the impact of the minimal schooling requirement on output in occupation j, x_t is a vector of individual characteristics and γ_{1j} is a vector of coefficients. The measured characteristics in the wage offer function are schooling and experience acquired in the former USSR, occupational category in the former USSR, whether an engineer in the USSR, whether a physician in the USSR, year of arrival in Israel (cohorts $1989-1990$, 1991 and $1992-1995$) and time (months) since arrival.

The wage offer functions are assumed to follow a deterministic path on a given job, however, the estimation procedure does incorporate measurement error in observed wages. The measurement error is assumed to be normally distributed with variance σ^2. The mean of the measurement error is specified as a linear function (with interactions) of the subsample from which the observation was taken (engineer or representative), and whether the reported wage is net of taxes.[18]

The model also incorporates unobserved heterogeneity among individuals. Each immigrant can be of one of three discrete types where the distribution of types in the population can differ between the two subsamples (engineer and representative), thus allowing for heteroscedasticity in the distribution of unobserved heterogeneity. The conditional distributions of types along with the impact of type on wages and arrival rate of job offers is estimated jointly with the other parameters of the model. The use of three types is sufficient to distinguish between absolute and comparative

[17] The intercepts of the linear translations were restricted to be equal across occupations for identification purposes.

[18] The subsample indicator and the net wage indicator thus appear in the density of the measurement error, not in the wage offer functions.

advantages in the unobserved ability of immigrants in different occupations.[19]

An additional source of uncertainty in the model arises from *iid* shocks to the nonmonetary returns on each job, given by

$$n_{sjt} = b_{jt} + \nu\varepsilon_{sjt} \tag{6}$$

where $b_{jt} = (e^{k_j} - 1)w_{sjt}$ in occupations, 1, 2 and 3. b_{jt} is specified in this way so that nonmonetary returns remain a fixed proportion of the wage in any period t. b_{4t} is assumed to be constant and normalized to 580 New Israeli Shekels (NIS) per month for identification purposes.[20] However, only low skill immigrants that worked in occupation 3 in the former USSR, receive this level of benefits when nonemployed. Immigrants with more skills may have a higher value of nonemployment, mainly because they can exploit the period of nonemployment for training. Nonemployment benefits are thus specified as $b_{4t} = 580e^{k_{41}occ_0\ 1 + k_{42}occ_0\ 2}$ allowing estimation of the implicit average value of training for immigrants that worked in occupations 1 and 2 in the former USSR.[21]

The error term ε_{sjt} in (6) , takes a different value in each of the 19 $(J * S)$ elements of the choice set in month t, enters linearly in the value functions, and is assumed to follow the type I extreme value distribution, with zero mean and variance $\pi^2/6$. These assumptions enable the use of a closed-form expression for expected maximum future returns. In particular,

$$\begin{aligned} & E_t \max\left[V_{sj,t+1}, V_{s^0k,t+1}, V_{4,t+1}\right] \\ = \ & \nu \ln\left\{\exp\left(\frac{\overline{V}_{sj,t+1}}{\nu}\right) + \exp\left(\frac{\overline{V}_{s^0k,t+1}}{\nu}\right) + \exp\left(\frac{\overline{V}_{4,t+1}}{\nu}\right)\right\} \end{aligned} \tag{7}$$

where $\overline{V}_{sjt}$ denotes the mean value of being in job s in occupation j at period t, and ν is a parameter which regulates the relative importance of nonmonetary returns, or the variance of the shocks (see Rust, 1994).

For reasons of parsimony, the terminal value functions for each element in the choice set are assumed to be proportional to the current period returns in month 73, with a correction for finite life, or retirement at age 65. Specifically,

$$V_{sj73} = \frac{1 + q^T}{1 - q}\left(w_{sj73} + n_{sj73}\right)\exp(\gamma_j) \tag{8}$$

for $j = 1, 2, 3$, where $q = \frac{1}{1+r}$, $\frac{1+q^T}{1-q} = \sum_{t=1}^{T}(1+r)^{t-1}$ and $T = 65-$ age at immigration. The monthly interest rate is fixed at 6 percent. This relatively high rate is chosen

[19] Type 0 is used as a benchmark and we estimate the effects of being type 1 or type 2 relative to this benchmark.

[20] 580 NIS is the average level of unemployment benefits received by the immigrants during the sample period.

[21] Eckstein and Cohen, 2000, focus on the decision to participate in immigrant training programs and estimate the effect on wages and offer probabilities.

to reflect the fact that immigrants had almost no initial assets and face borrowing constraints.[22] The proportionality constants γ_j, $j = 1, 2, 3$ are estimable parameters and capture the implicit value of future events.

The model is estimated using full information maximum likelihood. For a given vector of trial parameters, the dynamic program is solved by backward recursion for each immigrant and for each unobserved type, starting with the terminal value functions in month 73. Given the type-specific expected value functions for each individual, in every state in each month, the estimation problem is reduced to a static panel data multinomial logit with unobserved heterogeneity. That is, given the assumptions on the shock to nonmonetary returns, the choice probabilities can be calculated according to the closed form

$$\Pr\left(V_{s^0kt} \geq V_{sjt}, V_{s^0kt} \geq V_{4t}\right) = \left(\frac{\exp(\frac{\overline{V}_{s^0kt} - \overline{V}_{4t}}{\nu})}{1 + \exp(\frac{\overline{V}_{sjt} - \overline{V}_{4t}}{\nu}) + \exp(\frac{\overline{V}_{s^0kt} - \overline{V}_{4t}}{\nu})}\right). \tag{9}$$

Observed wages, on accepted jobs, are incorporated into estimation by multiplying the choice probability in month t by the measurement error density in the reported wage. The choice probability is thus conditional on the true wage. If no wage is observed, only the choice probability enters the type-specific likelihood contribution.

The unconditional likelihood contribution of each individual is constructed by taking a weighted average over the three type-specific likelihood contributions (see Heckman and Singer (1984)). The weights are specified to be a (logistic) function of the subsample indicator. The parameters of the model are recovered by re-solving the dynamic program and re-constructing the likelihood contributions for each iteration of the optimization algorithm. The solution to the dynamic program, the inclusion of permanent unobserved heterogeneity and the joint estimation of the wage functions and choice probabilities correct the wage function estimates for biases due to self-selection.[23]

6 Results

This section discusses specific parameter estimates of interest only, since there are a total of 104 estimated parameters, and highlights the main features of the model. The parameter estimates and their associated standard errors are presented in Appendix Table *A*3.[24]

[22] We attempted to estimate the interest rate along with the other parameters of the model but were not successful. The interest rate could not be separated from the arrival rates of job offers.

[23] The state space is small enough to enable a full solution to the dynamic program. The incorporation of endogenously accumulated job and/or occupation-specific work experience in the model would increase the size of the state space to an extent that would require approximate solution techniques (see Keane and Wolpin, 1994, for further discussion).

[24] Standard errors are calculated by using numerical derivatives and the outer product approximation to the Hessian.

6.1 Wages

The estimated parameters of the wage offer functions show that the returns immigrants obtain in Israel for potential work experience in the USSR are very small in occupations 1 and 3. In occupation 2, returns are relatively higher but still small in magnitude. In contrast, experience accumulated in Israel during the first 6 years, as proxied by time in Israel, has a substantial positive effect of .00665 per month, (8.0 percent annually) in occupations 1 and 2. In occupation 3, experience accumulated in Israel has a slightly smaller but still substantial positive effect of .00649 per month (7.8 percent annually). The impact of imported schooling on wages, on any given job for which schooling exceeds the minimal requirement, is negligible in occupation 3, slightly negative in occupation 1 and somewhat more negative in occupation 2. However, higher imported schooling levels are associated with a higher probability of obtaining a job with a greater minimal schooling requirement. Immigrants that find jobs with higher schooling requirements, obtain a wage increase of 3.3 percent per year of required schooling in occupations 1 and 2, and 1.1 percent in occupation 3. The model thus captures the two main features of the wage data; increasing mean wages over time and rising inequality. The rising inequality is due to the gradual move of immigrants with higher schooling levels into jobs that have higher minimal schooling requirements.

The effects of other imported characteristics on wage offers are generally not statistically significant. The exceptions are the significant positive effect in occupation 2 of having been an engineer, and the significant negative effect in of having been a physician in occupations 1 and 3. . The results also indicate that unobserved types 1 and 2 obtain substantially lower wages than unobserved type 0 in all occupations. Type 1 is penalized mainly in occupations 2 and 3, while type 2 is penalized mainly in occupations 1 and 3.

6.2 Nonmonetary Returns

The variance component v of nonmonetary returns is estimated to be 3267 NIS. Thus, a nonmonetary shock of one standard deviation, which under the extreme value distribution occurs with a probability of about 13 percent, has an effect which is approximately equal to the mean wage in the sample, 3304 NIS. This suggests that nonmonetary shocks can play an important role. One feature of the data which influences this result is the presence of transitions, mainly within occupation 3, into jobs with lower minimal schooling requirements and lower wages.

The estimates of the systematic components of nonmonetary returns, k_j, $j = 1, 2, 3$ imply that mean nonmonetary benefits are zero for jobs in occupation 1. In occupation 2, nonmonetary benefits increase current period returns by 16 percent of the wage, and in occupation 3, nonmonetary benefits increase current period returns by 18 percent of the wage. The estimates of mean nonmonetary returns are not

significantly different from zero.[25] The estimate of the nonemployment benefit shifter k_{41} implies that immigrants that worked in occupation 1 in the former USSR value current nonemployment benefits by 45 percent more than unskilled immigrants from occupation 3 in the former USSR. The estimate of k_{42} implies that immigrants from occupation 2 value current nonemployment benefits by only 5.3 percent more than unskilled immigrants. The additional benefit among skilled immigrants may reflect the value of training programs in which many of these workers participate.[26]

6.3 Job Offer and Job Termination Probabilities

Table 6 presents the estimated values of λ_{jkt}, for each of the three unobserved types of immigrants. There are large differences in these probabilities between the three unobserved types. The estimates imply that type 0 immigrants meet substantially more employers in occupation 1. Type 1 immigrants meet very few employers outside of occupation 3. Type 2 immigrants meet more employers in occupation 3 than both type 0 and type 1 immigrants.

The table also shows that λ_{jkt} is generally higher when in nonemployment. For example, the probability of meeting an employer in occupation 1 is higher from nonemployment than from jobs in occupation 3 and occupation 2, for all types $\left(\widehat{\lambda}_{41t} > \widehat{\lambda}_{31t} > \widehat{\lambda}_{21t}\right)$. However, being already employed in occupation 1 and being in nonemployment yield similar estimated probabilities $\left(\widehat{\lambda}_{41t} \cong \widehat{\lambda}_{11t}\right)$. An exception to this latter pattern occurs when employed in occupation 3. The probability of meeting an employer in occupation 3 is higher in nonemployment.

The estimated values of λ_{41t} for types 0, 1 and 2 are .032, .002 and .011, respectively. The estimated values of λ_{43t} are much higher, .129, .029 and .165 for the three types, respectively. Thus, from nonemployment, a type 0 immigrant's expected waiting time to meet an employer in occupation 1 is 29 months, while his expected waiting time to meet an employer in occupation 3 is only 8 months. These estimates reflect the market conditions that immigrants face upon entry. It is much easier for them to find jobs as unskilled workers.

Based on the estimated parameters of λ_{jkt}, it is further noted that older individuals, and those who arrived in Israel in later years, have lower probabilities to meet employers in occupations 1 and 2. This reflects possible changes in cohort quality and "congestion" effects in Israel. As expected, the occupational category in the former USSR is an important signal for Israeli employers. Immigrants that worked in occupation 1 in the former USSR meet substantially more employers in occupation 1 in

[25] This is due to correlation with the terminal value parameters, which also influence the value of a job within the sample period. The terminal value parameters, however, are highly significant.

[26] Approximately 60 percent of skilled male immigrants (immigrants from occupations 1 and 2 in the former USSR) participate in job training programs, for 6 months on average. Job training is provided by the government and is conditioned on a prior course in Hebrew language proficiency, lasting 4 months on average. See Eckstein and Cohen, 2000.

Israel. In comparison to all others that worked in occupation 1 in the former USSR, engineers meet fewer employers in occupation 1 while physicians meet more.

The estimated coefficient for $\Phi_j(s^* \geq s)$, the probability of being accepted to a job having already met an employer, yield the following quality adjustment for imported schooling

$$\begin{aligned} s_1^* &= 10.072 + .456 s_0 \\ s_2^* &= 10.072 + .270 s_0 \\ s_3^* &= 10.072 + .080 s_0. \end{aligned} \tag{10}$$

The marginal effects of imported schooling are thus .456 in occupation 1, .270 in occupation 2 and .080 in occupation 3. The corresponding "break even" levels are 19, 14 and 11 years of schooling , in occupations 1, 2 and 3, respectively. For comparability with Israelis, imported schooling is adjusted downwards (upwards) if it is above (below) the break even level.

The acceptance probabilities, which depend also on the estimated variances, are displayed in Figure 1. In occupation 1, immigrants are accepted with probability close to 1 to jobs that require less than their imported schooling, s_0. They are also accepted with a positive probability into jobs requiring slightly more schooling than they posses. For example, an immigrant with 15 years of imported schooling is accepted with probabilities of .909, .451 and .063 to jobs requiring 16, 17 and 18 years of schooling, respectively.

These results reflect the fact that, in the former USSR, one could become an engineer (physician) by going to elementary and high school for 10 years, followed by 5 (6) years of university training. Immigrants that find jobs in occupation 1 as doctors or engineers, are treated as if they have schooling comparable to Israelis, that is, 16 (18) years of schooling. In occupation 3, practically everyone is accepted to jobs requiring 10 years or less, but the best jobs in this occupation, requiring 12 years of schooling, are generally not available to immigrants, even with a high level of schooling. Similarly, immigrants with a high level of schooling have only a small probability to be accepted into jobs requiring 16 years of schooling in occupation 2. Stated differently, immigrants have a lower probability than Israelis to receive the top offers in occupations 2 and 3.

The model also allows for involuntary separations due to job termination. The estimates of δ_j are .0035 .0081 and .0052 in occupations, 1, 2 and 3, respectively. The termination probability estimates are small but highly significant. The estimates imply that immigrants can hold on to their jobs for long periods of time (24, 10 and 16 years, respectively) unless they decide to quit.

6.4 Choice Probabilities and Types

Table 7 presents the predicted occupational choice distribution by unobserved type for selected months after immigration. The choice frequencies are calculated by drawing

from the distributions of the random elements of the model, simulating choice histories for each individual 10,000 times, and averaging over all simulations and individuals.

The figures show that the proportion of each type of immigrant in occupation 1 grows over time but that there is a much higher proportion of type 0 immigrants in this occupation in each month. Moreover, the proportion of type 0 immigrants in occupation 1 increases at a much faster rate. The proportion of each type of immigrant in occupation 2 is also nondecreasing. Type 2 immigrants have the highest proportion in occupation 2 as well as the fastest rate of increase. In occupation 3, the proportion of each type of immigrant rises to a peak and subsequently falls. The peak occurs earlier for type 0 and type 2 immigrants. In nonemployment, the proportion of type 1 immigrants is clearly the highest. Nonemployment falls sharply for types 0 and 2 and only gradually for type 1 immigrants.

The choice frequency patterns in Table 7 can be explained by the fact that a nonemployed type 0 immigrant accepts almost any job offer in the early months after arrival. However, as his occupational status in Israel improves, he accepts fewer offers outside of occupation 1. A type 1 immigrant is reluctant to accept offers from occupation 3 in which his wage penalty is highest. A type 1 immigrant waits for offers in occupation 1, but these offers arrive with a very low frequency. In contrast, a type 2 immigrant accepts offers mainly from occupation 2 in which his wage penalty is the lowest.

Based on the sign patterns of the estimated parameters in the wage offer functions and job offer probabilities for each type, type 0 may be considered the type with the highest ability, type 1 as the type with the lowest ability and type 2 as the type with intermediate ability. Type 0 immigrants obtain higher wages and receive more job offers in occupation 1. The penalties for lower ability, in terms of lower wages and/or fewer job offers are substantial. Despite an absolute disadvantage in occupation 1, type 1 has a comparative advantage in this occupation, while type 2 has a comparative advantage in occupation 2. The estimated probabilities of being types, 0, 1 and 2 in the representative sample are .55, .04 and .41, respectively. The corresponding probabilities in the engineers sample are .76, .07 and .17, for types 0, 1 and 2, respectively.

7 Model Fit

Figures 2*a*-2*d* display the actual and predicted choice frequencies in the four occupational alternatives over the first 60 months since arrival.[27] The model tracks the dynamics of occupational choice quite well. The sharp decline in unemployment, the rise and fall in the proportion of workers in unskilled jobs, and the gradual increase in the proportion of skilled workers are all captured by the model. In the later months,

[27] The predicted quantities in this section are also calculated by simulating 10,000 choice histories for each individual in the sample.

in which there are fewer observations, there is a mild underprediction of the proportion in occupation 1 and an overprediction of the proportion in occupation 3. On the basis of a chi-square test which compares the actual and predicted choice distributions in each month, the hypothesis of identical actual and predicted choice distributions is not rejected in 54 out of 72 months.[28]

Table 8 presents the actual and predicted monthly transitions across occupations, averaged over the sample period. The fit is quite good. On the basis of a chi-square test, the hypothesis that the actual and predicted transition matrices are identical is not rejected. The matrix shows that entry into occupation 1 occurs most often from nonemployment. Workers in occupations 2 and 3 enter occupation 1 indirectly, through nonemployment. Voluntary transitions into nonemployment occur when there are large random shocks to nonmonetary returns. However, these shocks mainly influence mismatches, i.e., type 2 immigrants that work in occupation 1 and type 1 immigrants that work in occupation 3. These movements also reflect, in part, participation in training programs.

The model is also capable of capturing the time patterns in transitions during the sample period. In Figures $3a$ and $3b$, the actual and predicted transition rates between employment and nonemployment during the first 60 months are displayed. The model reproduces the decline in the exit rate from nonemployment and the decline in the re-entry rate into nonemployment without reliance on time effects in the arrival rate of job offers. The decline in the re-entry rate into nonemployment occurs as wages rise sharply over time. The opportunity cost of voluntarily separating and searching efficiently in nonemployment rises, thus discouraging these types of transitions. The decline in the exit rate from nonemployment is explained by the changing mix of unobserved types in the population of the nonemployed over time. Type 0 and type 2 immigrants constitute the majority of the nonemployed in the early months and these immigrants have relatively high exit rates. In the later months, the population of the nonemployed consists mainly of type 1 immigrants. Type 1 immigrants have very poor employment prospects and thus low exit rates from nonemployment. On the basis of a chi-square test in each month, the hypothesis of identical actual and predicted exit rates from nonemployment is not rejected in 66 out of 72 months. Similarly, the hypothesis of identical actual and predicted entry rates into nonemployment is not rejected in 68 out of 72 months.

Table 9 presents the actual and predicted mean accepted wages in each occupation-job category in which there are wage observations. As shown in the table, predicted wages track observed wages quite well for the cells in which there are a substantial number of wage observations. Examining the fit for all immigrants with wages, the simple correlations between actual and predicted wages is .602 in logs. Although the maximum likelihood estimation adjusts the coefficients of the wage functions to fit both wages and occupational choices, it yields a wage fit that exceeds the fit of

[28] The chi-square statistics are not adjusted for the fact that the parameters of the model have been estimated. Rejection of the null hypothesis is at the 5 percent level of significance.

a reduced form log-linear regression of wages on the same exogenous variables that appear in the structural model (.519 in logs). For comparison purposes the predicted values from the second OLS regression specification in Table 5, which includes the endogenous job choice variables, are also displayed.[29]

Table 9 also reveals large differences in predicted wages by type. A type 1 immigrant earns very low wages in occupation 3, while his wages in occupation 1, in the rare case that he finds a job in occupation 1, are substantially higher. A type 2 immigrant obtains the highest wages in occupation 2. A type 0 immigrant obtains the highest wages in occupation 1.

Table 10 illustrates the impact of job transitions on wage growth. Employed workers are classified into stayers and movers. Stayers are immigrants that do not change their job from period t to period $t+1$. Movers, from period t to period $t+1$, are subdivided into job changers within and across occupations. The table presents the actual and simulated proportions of such transitions and the associated predicted wage changes[30], averaged over individuals and sample months. The model mimics the sample proportions of movers and stayers quite well. The predicted wage growth among stayers is a weighted average of the estimated monthly wage growth parameters in occupations 1, 2 and 3. Movers within occupations have a predicted average monthly wage growth of 2 percent and movers across occupations have a substantial average wage growth of 18.3 percent. The predicted impact of job changes on wage growth is thus quite large. However, such switches are rare and occur in only 1.1 percent of the time periods. The majority of transitions are to nonemployment and from nonemployment. Ignoring the impact of these latter transitions on wages, which occur 25.6 percent of the time, the average annual growth rate in wages for employed workers is 8.82 percent a year. Approximately 18 percent of the annual wage growth (1.32 percentage points) can be attributed to job switches. These results are similar to the reduced form estimates, based on pooled cross section data for the period $1991-1995$, presented in Eckstein and Weiss, 1998. In this latter study, 17 percent (1.13 percentage points) of a predicted annual wage growth of 6.71 percent can be attributed to occupational switches. Among immigrants with 16+ years of schooling, 17 percent (1.44 percentage points) of a predicted annual wage growth of 8.28% can be attributed to occupational switches. Apart from the differences in the samples, the main methodological difference in the study presented here is that occupational switches are endogenously determined.

[29] The OLS regression is similar but not identical to the wage functions estimated in the model. For example, the regression is not estimated separately for each occupation and does not include controls for unobserved heterogeneity. The corresponding measure of fit is .592 in logs.

[30] The data on wages in the sample is very sparse and there are no observations of wage changes among stayers or movers in adjacent months. Therefore, we cannot present the corresponding actual wage changes.

8 Loss of Human Capital

Immigration entails the transfer of human capital from one labor market to another. Human capital is to some extent country-specific. That is, skills acquired abroad are valued differently from skills acquired locally, both because immigrants have limited information on local market conditions and the location of jobs, and because employers are uncertain about the attributes of the newcomers. As a consequence, immigrants do not immediately find the jobs for which they are most suitable, nor do they immediately receive the same wages as natives on the same job. Instead, there is a gradual process of adjustment in which immigrants start at low wage jobs at the lower part of the occupational scale. This is followed by a sequence of job transitions which lead to rising wages. In addition, the wage within each job rises. The speed of the adjustment depends on market conditions, especially the number of jobs in relation to the number of workers looking for them, which affects the speed at which immigrants meet local employers. It also depends on the choices that immigrants make, especially which job offers the immigrants decide to accept and how long they are willing to wait for a suitable job.

In order to assess the magnitude of the costs of immigration associated with frictions and imperfect transferability of skills, the mean simulated earnings (actual earnings) of each immigrant, in each period, is compared to two hypothetical values. The first hypothetical value (potential1 earnings) is the mean potential earnings of the immigrant, in each period, over a counterfactual job distribution. The counterfactual job distribution is the distribution of minimal schooling requirements among native Israeli workers with the same years of schooling as the "true" schooling endowment of the immigrant, s^*. The predicted wages on each job in the counterfactual job distribution is computed according to the estimated immigrant wage offer functions.[31] The second hypothetical value (potential2 earnings) is the mean potential earnings of the immigrant, over the same counterfactual job distribution as in potential1 earnings, but with predicted wages on each job computed according to the parameters of a native Israeli wage regression.[32] The difference between potential1 earnings and actual earnings is a measure of earnings loss due to frictions (job distribution mismatch) and the difference between potential2 earnings and potential1 earnings is a measure

[31] Since s^* is occupation-specific, there is a counterfactual job distribution and corresponding mean wage in each occupation. The potential wage is thus defined as the maximum over the mean wages in each occupation. In order to not overstate this maximum, restrictions were imposed according to the occupation of the immigrant in the former USSR. Specifically, if the immigrant worked in occupation 3 in the former USSR, then the potential wage is the mean wage in occupation 3 in Israel. If the immigrant worked in occupation 2 in the former USSR, then the potential wage is the maximum over the mean wages in occupations 2 and 3 in Israel. If the immigrant worked in occupation 1 in the former USSR, then the potential wage is the maximum over the mean wages in occupations 1, 2 and 3 in Israel.

[32] The regression parameters are estimated by non-linear least squares using data on $8,178$ Israeli workers (selected from the Israel CBS Income Surveys $1991-1994$). The regression specification is described in Appendix Table $A4$.

of earnings loss due to a lower market valuation of imported skills.

For the purpose of assessing long-run outcomes, the actual and potential earnings of each immigrant are computed from the age at arrival until retirement at age 65. In order to calculate actual and potential earnings past month 72 in Israel (the horizon of the model) in a computationally practical way, a period length of one year is assumed in the simulation of the model beyond month 72. Further, since it is not possible to identify quadratic effects on wage growth within the sample period, and thus reliably predict wage offers beyond month 72, the wage offer functions in the yearly model are replaced by wage functions estimated separately, using data on the annual earnings of previous waves of immigrants from the Soviet Union.[33] However, the imported wage functions in the yearly model do not contaminate the simulated job choices in months. That is, the monthly model and the yearly model are disconnected by separate backward recursions. The backward recursion and subsequent simulation of the monthly model uses the terminal value functions, as in estimation.[34] The estimated monthly wage offer functions do, however, influence job choices in the yearly model. The ratio of the wage offer in each job in month 73, according the estimated monthly model, to the wage offer in each job in month 73, according to the out-of-sample regression, is used to adjust the yearly wage offers. Let this ratio be denoted by $\frac{w^m_{sj73}}{w^y_{sj73}}$. The yearly wage offers in each job, in each year, is multiplied by $\frac{w^m_{sj73}}{w^y_{sj73}}$.[35]

Figure 4*a* displays the time paths of simulated actual and potential earnings, averaged over immigrants that worked in occupation 1 in the former USSR and that were 40 years old or younger on arrival. Figure 4*b* displays the corresponding time paths for immigrants that were older than 40 on arrival. The simulated actual earnings of immigrants are always below their simulated potential earnings, but the gap closes with the duration of time in Israel. The change over time in potential2 earnings is driven by the immigrants' increase in local work experience, where the impact of total work experience (imported plus local) is evaluated using the native Israeli regression

[33] The regression specification, which is similar to that in Eckstein and Weiss 1998, is described in Appendix Table *A*4. In the out of sample predictions there are no pure time effects. The growth in wages is attributed to accumulation of experience and rising prices of imported skills.

[34] It is interesting to note that connecting the monthly and yearly models by a full backward recursion starting from age 65, does not substantially change the simulation results. The terminal value functions estimated in the model are thus consistent with the value functions generated using the imported wage functions.

[35] Estimated monthly job offer probabilities are also transformed into yearly equivalents. Let q be the probability of meeting an employer in a particular month where $q = 1 - \lambda_{\mathsf{j1t}} - \lambda_{\mathsf{j2t}} - \lambda_{\mathsf{j3t}}$. The probability that the person will meet an employer in occupation k once during the year (i.e., in one of n months) is $\lambda_{\mathsf{jkt}}\left[1 + q + q^2 + \cdots + q^{\mathsf{n}-1}\right] = \lambda_{\mathsf{jkt}}\left[\frac{1-q^{\mathsf{n}}}{1-q}\right]$ The probability that the person will receive no offer is q^{n}. Clearly, $\lambda_{\mathsf{j1t}}\left[\frac{1-q^{\mathsf{n}}}{1-q}\right] + \lambda_{\mathsf{j2t}}\left[\frac{1-q^{\mathsf{n}}}{1-q}\right] + \lambda_{\mathsf{j3t}}\left[\frac{1-q^{\mathsf{n}}}{1-q}\right] + q^{\mathsf{n}} = 1$, since $q = 1 - \lambda_{\mathsf{j1t}} - \lambda_{\mathsf{j2t}} - \lambda_{\mathsf{j3t}}$. The other two components of the job offer probability, $P_{\mathsf{j}}(s)$ and $\Phi_{\mathsf{j}}(s^* \geq s)$, are not dependent on the length of the period.

coefficients. The sharp rise in potential1 earnings reflects the higher return that immigrants obtain for local work experience using the coefficients of the immigrant wage functions. The higher return is mainly due to rising returns to imported skills and complementarity between local and imported human capital (see Eckstein and Weiss, 1998). The even sharper rise in simulated actual earnings occurs as the distribution of jobs that immigrants hold changes over time. That is, the strong wage growth is accompanied by a movement into higher paying jobs and occupations.

There are marked differences in the time paths of actual and potential earnings between the two age groups. Younger immigrants initially earn half of their potential, but gradually close the gap. After 25 years in Israel, younger immigrants earn 70 percent of what they would have earned as native Israelis. The gap in earnings in year 25 is evenly divided between job distribution mismatch and a lower market valuation of imported skills. Immigrants that arrived at an older age initially earn the same as younger immigrants, but these earnings constitute only a third of their potential, indicating negligible initial returns to imported work experience. As time since immigration advances, the rewards for imported skills rise for both younger and older immigrants, but the occupational status of older immigrants is substantially lower. Older immigrants remain locked in low skill occupations. After 10 years in Israel, older immigrants earn only half as much as comparable native Israelis. The different rates of occupational upgrading by age at arrival are shown in Table 11. Among immigrants that worked in occupation 1 in the former USSR and that were 40 years old or less on arrival, 60 percent are predicted to be employed in occupation 1 in Israel, 25 years after immigration. This is compared to 75 percent among similar immigrants from the USSR that arrived in Israel during the 1970s (see Eckstein and Weiss, 1998).

Because of the sharp changes in earnings with time in Israel and the endogeneity of wages and jobs, whereby currently low wages may be traded for higher wages in the future, the appropriate summary statistic of earnings loss is the difference in the expected discounted present value of actual and potential earnings over the immigrants remaining working life. Table 12 describes the main findings for this summary measure.[36] The estimated lifetime earnings loss (potential2-actual) is 253, 200 US Dollars. This loss constitutes 57 percent of the lifetime earnings that these immigrants would have obtained had they been native Israelis with the same measured attributes. The estimated lifetime loss is thus quite substantial.

Most of the loss, 190, 900 US Dollars, can be attributed to the fact that immigrants are paid lower wages than Israelis on the same jobs, especially in the early years after arrival. This loss constitutes 43 percent of total potential lifetime earnings. The lifetime loss of earnings due to frictions in the labor market (nonemployment and job distribution mismatch) is 62, 300 US Dollars, which constitutes 14 percent of total potential lifetime earnings.

[36] In the calculation of discounted lifetime earnings, zeros are included when the immigrant is simulated to be in nonemployment.

The estimated lifetime earnings loss varies substantially among immigrants. Immigrants with more schooling tend to have higher total losses. Given the strong correlation between schooling levels and occupation, immigrants who worked in occupations 1 and 2 in the former USSR also suffer higher total losses. The figures show that physicians have higher losses than engineers, older immigrants have higher losses than younger immigrants, losses increase with later arrival cohorts and type 1 immigrants suffer exceedingly large losses.

In order to gauge the relative importance of job distribution mismatch and a lower market valuation of imported skills, the table decomposes the total loss into the loss due to frictions and the loss due to prices. The estimates indicate that the loss due to prices is, generally, far more important. This is mainly due to the lower returns to imported schooling.[37] The difference between the loss due to frictions and the loss due to prices is greatest for physicians. Immigrants that were physicians in the USSR obtain jobs in the medical profession rather quickly in Israel but earn much lower wages than native physicians.[38] The smallest difference between the loss due to frictions and the loss due to prices is for engineers and type 1 immigrants. The large number of immigrants with engineering degrees nearly doubled the total stock of engineers in Israel. This group thus faces special difficulties obtaining engineering jobs in the Israeli labor market. Type 1 immigrants suffer a relatively large loss due to frictions since they constitute the permanently nonemployed. It should be noted that there is a discontinuity in the ranking of relative losses due to prices over schooling levels and occupations. Immigrants with 13-14 years suffer higher relative losses due to prices than immigrants with 15 years of schooling. Correspondingly, immigrants that worked in occupation 2 in the former USSR suffer higher relative losses due to prices than immigrants that worked in occupation 1 in the former USSR. This result is due to the relatively lower actual earnings of this group of immigrants in occupation 3, the occupation in which many of these immigrants find employment.

The lifetime earnings loss calculations aim at estimating the social loss of output to the receiving country associated with the movement of human capital across labor markets. For this reason, the loss calculations do not include the benefits that immigrants receive when nonemployed nor the monetary value of nonmonetary benefits when employed. Further, the wages of Israelis are used as a benchmark. Although the model contains an equivalence scale that transforms the schooling of immigrants to local schooling, there may still be unaccounted for differences in the quality of schooling acquired locally and abroad. Moreover, the counterfactual exercises do not account for possible macro effects on the Israeli labor market and wage structure. For these reasons, the potential earnings of the recent immigrants may be overstated when they are attributed the current earnings of Israelis with the same observable

[37] Other studies have also found a higher rate of return for locally acquired schooling, see Eckstein and Weiss, 1998, and Friedberg, 1999).

[38] The national health system considerably expanded in the wake of the mass immigration from the former USSR.

characteristics. Therefore, the estimated losses among the different groups are an upper bound on actual losses. Biases in the separately estimated immigrant and Israeli wage functions, due to sample selection and/or unmeasured characteristics, also reduce the accuracy of our estimates. We thus have more confidence in the ranking of the losses across groups of immigrants with different attributes than in the actual magnitude of the loss.

Recall that the model assumes a high annual real discount rate of 6 percent to capture the borrowing constraint facing immigrants that came to Israel with no assets. This fact should not prevent the use of an appropriate "social" discount rate to evaluate the social loss associated with immigration. As displayed in the last two rows of Table 12, the relative losses are only slightly affected by using an annual real discount rate of 3 percent to evaluate the discounted present value. Clearly, if immigrants had better access to the capital market and had faced an interest rate of 3 percent, there would have been a marked effect on their choices and the estimated parameters of the model.

9 Conclusion

This paper examines the process of entry of highly skilled immigrants into the Israeli labor market, using panel data on several cohorts of recent immigrants from the former USSR. The main emphasis in the paper is on the occupational choices of immigrants that arrive with different skills and at different points in their life-cycle. This study does not investigate the reasons for wage growth within occupations and jobs, but explicitly models how immigrants adjust their choices to the expected rise in their wages with the passage of time.

As has been demonstrated, a simple on-the-job search model, cast as a finite-horizon discrete choice dynamic programming problem under uncertainty, captures quite well the observed dynamics of occupational choice during the first six years in Israel. The dynamics consist of a speedy entry into the labor force, an initial phase of work at low skill occupations, followed by a gradual occupational upgrading. The model explains the changing proportions of immigrants working in different occupations in Israel without relying on time effects in job offer probabilities. The sharp increase in the proportion of immigrants working in low skill jobs is due to the willingness of immigrants with high schooling levels and previous work experience in high skill occupations in the USSR, to work in low skill jobs in Israel. The subsequent decrease in the proportion working in low skill jobs is due to the gradual transitions of these highly skilled immigrants to jobs in high skill occupations. Permanent unobserved heterogeneity among immigrants is shown to be important in explaining the observed declining exit rates from nonemployment. Immigrants with high exit rates from nonemployment constitute the majority without jobs in the early months after immigration. As these immigrants leave nonemployment, the population of the nonemployed is increasingly made up of immigrants with very poor employment

prospects. The model is also capable of explaining the declining re-entry rates into nonemployment. Nonemployment re-entry rates decline over time as wage growth on the job raises the opportunity cost of searching efficiently for better job opportunities from nonemployment.

The estimated parameters of the behavioral model, together with information on the wages of immigrants from earlier waves, are used to examine the speed of wage convergence between immigrants and natives. The simulation of an occupational path and associated wages for each immigrant upon arrival to the host country and until retirement, suggests that the earnings of recently arrived immigrants will slowly approach the earnings of comparable natives. However, the sharp growth in earnings, combined with the heterogeneity in age at entry, suggest the use of the discounted present value of lifetime earnings as a better summary measure of economic performance in the new country. The lifetime earnings predicted by the model are thus compared to the hypothetical lifetime earnings that immigrants would have obtained had their imported observable skills been valued, from the time of arrival, in the same way as comparable natives with the same labor market experience and schooling. The results indicate a large gap between actual and potential lifetime earnings measures. On average, immigrants from the former USSR to Israel can expect lifetime earnings to fall short of the lifetime earnings of comparable natives by 57 percent. Of this figure, 14 percentage points reflect frictions associated with nonemployment and job distribution mismatch, and 43 percentage points reflect the gradual adaptation of schooling and experience imported from the former USSR to the Israeli labor market.

Our interpretation of these findings is that, because of lack of information by employers on the quality of newly arrived immigrants, and by immigrants of their opportunities in the new labor market, and because of the need for complementary local capital (such as, language, social connections and familiarity with local institutions), there is, necessarily, a gradual process of adjustment and adaptation. The speed of adjustment depends on market conditions and the choices made by the immigrants, which interact in a complicated way. It is not clear whether, and to what extent, there are market failures in this process and whether there is some policy that could reduce the social loss. It is possible that limited borrowing capacity prevents immigrants from making the required local investment in on the job training, which should be the main vehicle for the acquisition of local general human capital. There is, however, no way to ascertain the quantitative importance of this latter consideration.

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Table 1
First Occupation in Israel
by Occupation in the former USSR
Males Aged 25-55 on Arrival
(percent)

	First Occupation in Israel				
Occupation in USSR	Occ. 1	Occ. 2	Occ. 3	No Job	N
Representative Sample					
Occ. 1	18.7	10.0	66.7	4.6	219
Occ. 2	4.0	20.0	74.0	2.0	50
Occ. 3	0.0	5.8	89.2	5.0	120
All Occupations					
Representative Sample	11.0	10.0	74.6	4.4	389
Engineers Sample	15.4	4.9	76.3	3.4	697
Combined Sample	13.8	6.7	75.7	3.8	1086

Table 2

Yearly Occupational Distribution in Israel
Males Aged 25-55 on Arrival
(percent)

	Occ. 1	Occ. 2	Occ. 3	No Job	N
Occupation in Israel:					
Year 1	11.6	5.6	56.6	26.2	1058
Year 2	17.4	6.9	57.7	17.9	929
Year 3	22.3	7.2	57.5	13.0	793
Year 4	27.6	7.5	52.7	12.2	583
Year 5	36.7	7.8	47.7	7.8	218
Occupation in USSR:	84.3	4.6	11.0	0.0	1086

Table 3

Average Minimal Schooling Requirements of Jobs held by Immigrants by Year and Schooling Acquired in the USSR
Males Aged 25-55 on Arrival
(years)

	Schooling Acquired in USSR				
	5-12	13-14	15	16	17-22
Immigrants:					
Year 1	8.9	9.6	10.6	10.7	10.2
Year 2	9.0	9.8	11.3	11.5	10.7
Year 3	9.1	9.8	11.7	11.9	10.9
Year 4	9.2	10.0	12.1	12.5	11.4
Year 5	9.5	10.5	12.5	13.1	11.7
Year 6	-	11.3	12.3	13.7	12.8
Israelis:	9.9	11.4	12.0	13.3	14.4

Table 4

Average Monthly Reported Wages of Immigrants by Occupation and Years since Arrival Males Aged 25-55 on Arrival (1995 Israeli Shekels=.33 US Dollars)

	Occupation in Israel							
	Occ. 1		Occ. 2		Occ 3		All Occs.	
Year	N	Wage	N	Wage	N	Wage	N	Wage
1	6	3856	1	2764	71	2322	78	2445
2	26	3422	32	2764	189	2416	247	2567
3	33	3623	11	3288	155	2732	199	2911
4	41	4562	14	3337	163	2861	218	3211
5	92	5047	29	3575	202	3413	323	3893
6	57	5340	10	4263	83	3688	150	4354

Table 5

OLS Monthly Wage Regressions
and
Knowledge of Hebrew Logit

	Log Wage Regressions			
Variable Name	Coeff.	t-stat.	Coeff.	t-stat.
Constant	7.729	64.460	7.754	62.977
Months in Israel	.0058	8.322	.0056	7.897
Job Requirement	.0275	3.223	.0258	2.996
Occ.1	.1836	3.025	.1853	3.022
Occ.2	.0196	.445	.0155	.338
Schooling_0	-.0071	-1.484	-.0061	-1.227
Experience_0	.0006	.105	-.0024	-.044
Experience_0^2	-.0002	-1.418	-.0001	-.964
Physician_0	-.1586	-2.273	-.1755	-2.480
Engineer_0	.0129	.034	.0137	.377
Rep. Sample	-.0950	-2.547	-.0970	-2.506
Rep. Sample∗Net	-.1307	-4.274	-.1246	-4.016
Eng. Sample∗Net	-.2084	-6.328	-.2071	-6.307
Knowledge of Hebrew	-	-	.0172	.659
N	1217		1164	
Adj. R^2	.3548		.3503	

	Knowledge of Hebrew Logit	
	Coeff.	t-stat.
Constant	1.2390	1.793
Months in Occ.1	.0603	6.450
Months in Occ.2	.0623	3.844
Months in Occ.3	.0227	3.773
Months in No Job	.0246	2.937
Schooling_0	-.0336	.926
Experience_0	-.0130	-6.180
Hebrew Course	1.1635	5.541
N	990	
Pseudo R^2	.2310	

Note: A variable with a subscript of 0 indicates value on arrival. The variable Net indicates the reported wage is net of taxes.

Table 6

Predicted Monthly Job Offer Probabilities by Current Occupation and Type

	Offer in Occ. 1			Offer in Occ. 2			Offer in Occ. 3		
Current	Type			Type			Type		
Occupation	0	1	2	0	1	2	0	1	2
Occ. 1	.032	.002	.013	.003	.000	.002	.003	.001	.003
Occ. 2	.016	.001	.005	.023	.003	.019	.014	.003	.018
Occ. 3	.005	.000	.002	.004	.000	.003	.039	.008	.049
No Job	.032	.002	.011	.013	.002	.011	.125	.029	.158

Table 7

Predicted Occupational Distribution
by Type
(Selected Months)

	Occ. 1			Occ. 2			Occ. 3			No Job		
		Type			Type			Type			Type	
Month	0	1	2	0	1	2	0	1	2	0	1	2
12	.164	.017	.048	.055	.015	.060	.564	.168	.583	.216	.800	.309
24	.229	.034	.066	.060	.027	.092	.627	.245	.643	.085	.694	.200
36	.278	.050	.080	.058	.038	.115	.610	.298	.654	.054	.615	.151
48	.333	.067	.099	.056	.049	.147	.569	.321	.645	.042	.563	.109
60	.386	.083	.109	.056	.059	.175	.520	.301	.634	.037	.557	.081

Table 8

Actual and Predicted Monthly Transitions
Months 1-71

	Month $t+1$			
Month t	Occ. 1	Occ. 2	Occ. 3	No Job
Occ. 1				
Actual	.994	.000	.001	.005
Predicted	.992	.000	.001	.007
Occ. 2				
Actual	.006	.975	.003	.015
Predicted	.007	.973	.004	.017
Occ. 3				
Actual	.002	.001	.978	.019
Predicted	.002	.002	.979	.017
No Job				
Actual	.018	.009	.093	.881
Predicted	.018	.009	.101	.872

Table 9

Actual and Predicted Monthly Wages by Occupation, Job and Type (1995 Israeli Shekels=.33 US Dollars)

Occupation and Job	No. With Wages>0	Actual Wages	Predicted Wages				
			Type 0	Type 1	Type 2	All	OLS
3,2	5	2023	2920	1004	2070	2587	3047
3,6	3	2983	3093	1058	2193	2734	2538
3,8	294	2649	3193	1080	2250	2855	3043
3,9	126	3184	3252	1092	2287	2928	3353
3,10	304	2909	3315	1106	2329	2999	3308
3,11	116	3178	3377	1118	2374	3073	3472
3,12	15	3656	3429	1130	2419	3145	3818
2,12	82	3290	3521	1726	2996	3267	3517
2,14	14	3421	3857	1848	3227	3617	3120
2,16	1	2742	3983	1913	3323	3761	2871
1,12	12	3761	3861	3465	2568	3738	4314
1,15	11	3878	4355	3823	2957	4210	4125
1,16	209	4799	4568	3960	3107	4426	4485
1,17	6	4908	4752	4089	3216	4618	3606
1,18	17	3950	4850	4173	3269	4708	3496

Table 10

Predicted Wage Growth of Stayers and Movers Within and Across Occupations

	Stayers	Movers	
		Within Occupations	Across Occupations
Actual Proportion	.723	.004	.003
Predicted Proportion	.733	.008	.003
Predicted Wage Growth	.0065	.020	.183

Table 11

Occupational Choice Distribution
Immigrants from Occupation 1 in USSR
by Age at Arrival

	Younger than 40				Older than 40			
	Occ. 1	Occ. 2	Occ. 3	No Job	Occ. 1	Occ. 2	Occ. 3	No Job
Year								
1	.175	.069	.483	.273	.123	.039	.560	.277
2	.246	.087	.522	.145	.159	.043	.647	.150
3	.289	.092	.514	.105	.177	.042	.668	.113
4	.320	.090	.506	.084	.187	.040	.678	.094
5	.342	.086	.498	.073	.195	.038	.682	.085
6	.347	.085	.495	.073	.197	.038	.680	.085
7	.397	.087	.435	.081	.239	.048	.635	.078
8	.418	.088	.417	.076	.261	.052	.619	.069
9	.437	.089	.400	.073	.280	.055	.601	.064
10	.455	.088	.385	.071	.305	.058	.577	.061
11	.472	.087	.371	.070				
12	.487	.086	.359	.068				
13	.501	.084	.349	.066				
14	.514	.082	.339	.064				
15	.526	.081	.331	.063				
16	.536	.079	.324	.061				
17	.546	.077	.317	.060				
18	.554	.076	.311	.058				
19	.563	.074	.306	.057				
20	.570	.073	.302	.056				
21	.576	.071	.298	.055				
22	.582	.070	.295	.053				
23	.588	.068	.291	.053				
24	.593	.067	.289	.052				
25	.596	.066	.287	.051				

Table 12

Discounted Present Value of Lifetime Earnings Loss
Males Aged 25-55 on Arrival
(1995 Israeli Shekels=.33 US Dollars)

	Loss due to Frictions		Loss due to Prices		Total Loss	
Sample Attributes	Absolute	Relative	Absolute	Relative	Absolute	Relative
Schooling:						
5-12	95,478	12.09	199,138	25.22	294,616	37.31
13-14	107,339	10.71	388,671	38.77	496,010	49.48
15	217,551	16.16	463,901	34.47	681,452	50.63
16	201,460	14.44	597,821	42.85	799,281	57.29
17-22	191,544	12.38	797,774	51.54	989,318	63.92
Occ. in USSR:						
1	211,498	14.63	619,855	42.88	831,353	57.51
2	112,560	10.12	531,082	47.77	643,642	57.89
3	46,930	5.91	282,630	35.58	329,560	41.49
Engineer	215,763	14.94	606,737	42.01	822,500	56.95
Physician	150,934	9.46	880,462	55.18	1,031,396	64.64
Age on Arrival:						
<=40	219,501	15.35	445,472	31.15	664,973	46.50
40+	160,201	12.4	702,088	54.36	862,289	66.76
Year of Arrival:						
1989-90	184,479	13.39	564,693	40.99	749,172	54.38
1991	171,185	13.23	557,145	43.06	728,330	56.29
1992-95	214,196	15.44	625,247	45.07	839,443	60.51
Type:						
0	157,342	11.58	512,606	37.72	669,948	49.30
1	547,577	40.34	639,111	47.08	1,186,688	87.42
2	184,155	13.57	753,139	55.49	919,294	69.06
All:						
$r = .06$	188,759	13.89	578,506	42.59	767,265	56.48
$r = .03$	262,438	14.37	722,253	39.55	984,691	53.92

Table A1

Sample Means and Standard Deviations

	Represent. Sample		Sample of Engineers		Combined Sample	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Variable Name						
$Schooling_0$	14.6	2.7	16.4	1.6	15.8	2.2
$Experience_0$	16.6	8.3	18.6	8.4	17.8	8.4
Age_0	38.5	8.3	42.0	8.7	40.8	8.7
Age_0>40	40.1		58.4		51.8	
Occ_0 1	56.3		100.0		84.3	
Occ_0 2	12.9		0.0		4.6	
Occ_0 3	30.8		0.0		11.1	
$Engineer_0$	25.7		100.0		73.4	
$Physician_0$	5.7		0.0		2.0	
Cohort 1989-1990	59.4		41.5		47.9	
Cohort 1991	37.8		19.5		26.1	
Cohort 1992-1995	2.8		19.0		26.0	
Knowledge of Hebrew	76.8		69.3		71.5	
Months In Israel	41.4	14.6	46.7	16.5	44.8	16.0
Months No Job	11.7	10.3	11.4	10.9	11.5	10.7
Months in Occ. 1	5.1	12.4	9.3	18.1	7.8	16.4
Months in Occ. 2	3.0	9.3	2.5	9.3	2.7	9.3
Months in Occ. 3	21.6	18.0	23.5	19.3	22.8	18.8
Wage Obs.=0	54		126		180	
Wage Obs.=1	102		571		673	
Wage Obs.>1	233		0		233	
Avg. Monthly Wage	2919	1392	3740	1738	3305	1616
Wage Observations	646		571		1217	
% Net Wages	60.8		26.3		44.6	
No. of Immigrants	389		697		1086	

Note: A variable with a subscript of 0 indicates value on arrival.

Table A2

Distribution of Completed Schooling and Minimal Schooling Requirements by Occupation Male Israeli Workers Ages 25-55*

$(P_j(s))$

	% of Workers with Completed Schooling s				% of Jobs Requiring Completed Schooling s $P_j(s)$				Avg. Minimal Schooling Requirements among Workers with s			
	Occupation				Occupation				Occupation			
s	1	2	3	All	1	2	3	All	1	2	3	All
0-8	.005	.010	.158	.124	.000	.000	.225	.153	12.6	12.1	8.9	9.0
9	.000	.006	.029	.021	.000	.000	.251	.171	-	12.0	9.2	9.4
10	.009	.035	.148	.107	.000	.000	.245	.166	12.0	12.2	9.4	9.6
11	.007	.040	.116	.085	.000	.000	.118	.080	12.4	12.0	9.5	9.8
12	.032	.222	.362	.277	.107	.759	.162	.280	12.9	12.2	9.9	10.3
13	.020	.076	.036	.041	.000	.021	.000	.004	13.6	12.3	10.2	11.1
14	.027	.162	.048	.067	.000	.159	.000	.033	14.1	12.3	10.5	11.5
15	.070	.135	.046	.063	.151	.000	.000	.017	15.1	12.6	10.6	12.0
16	.246	.147	.028	.071	.545	.061	.000	.074	15.9	13.4	11.0	13.7
17	.162	.070	.012	.038	.040	.000	.000	.004	15.9	13.2	10.9	14.0
18	.132	.042	.009	.029	.157	.000	.000	.018	16.3	12.8	10.9	14.2
19	.082	.018	.003	.015	.000	.000	.000	.000	16.5	12.7	10.7	14.8
20	.098	.016	.003	.019	.000	.000	.000	.000	16.3	13.2	10.7	15.0
21+	.115	.021	.002	.043	.000	.000	.000	.000	16.6	12.8	10.8	14.9

* Source: Central Bureau of Statistics Income Surveys 1991-1994.

Table A3

Maximum Likelihood Estimates and Asymptotic t Values

Wage Offer Functions
Nonmonetary Returns
Terminal Value Functions
$(w_{sjt}, n_{sjt}, V_{sj73})$

	Occ. 1		Occ. 2		Occ. 3		No Job	
	Coeff.	t	Coeff.	t	Coeff.	t	Coeff.	t
$\ln w_{sjt}$:								
Constant	7.64762	13.13	7.70313	40.23	7.79090	76.02	-	-
Job (s)	0.03308	3.63	0.03308	-	0.01059	4.46	-	-
Month (t)	0.00665	4.93	0.00665	-	0.00649	7.52	-	-
Type 1	-0.15661	-0.42	-0.73910	-1.65	-1.12593	-11.41	-	-
Type 2	-0.38857	-10.00	-0.16286	-2.02	-0.35763	-13.07	-	-
Sch_0. (s_0)	-0.01363	-2.01	-0.02899	-2.58	-0.00540	-1.05	-	-
Exp_0	0.00370	0.58	0.01354	1.82	0.00190	0.35	-	-
Exp_0^2	-0.00037	-2.13	-0.00064	-2.83	-0.00023	-1.59	-	-
Occ_0. 1	0.19038	0.33	0.05910	0.90	0.06580	1.81	-	-
Occ_0. 2	0.03306	0.05	0.05190	0.64	-0.09450	-1.91	-	-
Engineer_0	0.05546	1.29	0.23359	3.79	0.06949	1.83	-	-
Physician_0	-0.21246	-1.94	0.02834	0.10	-0.24827	-2.42	-	-
1991_0	0.00117	0.05	0.00117	-	-0.00116	-0.05	-	-
$>1991_0$	0.00162	0.05	0.00162	-	0.01011	0.28	-	-
Rep.	0.08997	2.33	0.08997	-	0.08997	-	-	-
Rep.$*$Net	-0.13315	-3.86	-0.13315	-	-0.13315	-	-	-
Eng.$*$Net	-0.20042	-5.80	-0.20042	-	-0.20042	-	-	-
$ln(\sigma)$	-1.08153	-21.53	-1.32353	-12.79	-1.27618	-46.52	-	-
n_{sjt}:								
k_j	0.00387	0.01	0.15442	0.36	0.16576	0.40	-	-
k_{41}	-	-	-	-	-	-	0.36891	1.24
k_{42}	-	-	-	-	-	-	0.05173	0.12
ν	3267	2.03	3267	-	3267	-	3267	-
V_{sj73}:								
γ_j	-1.49330	-6.38	-1.51262	-5.85	-1.40043	-6.39	-	-

Note: Rep. and Eng. are indicators for the sample from which the wage observation was taken. Net indicates net of taxes. Rep., Eng. and Net appear in the measurement error density, not in w_{sjt}. $n_{sjt} = b_{jt} + \nu\varepsilon_{sjt}$, where $b_{jt} = (e^{k_j} - 1)w_{sjt}$, $j = 1, 2, 3$ and $b_{4t} = 580e^{k_{41}occ_0\ 1 + k_{42}occ_0\ 2}$. $V_{sj73} = \frac{1+q^T}{1-q}\left(w_{sj73} + n_{sj73}\right)\exp(\gamma_j)$.

Table A3

Maximum Likelihood Estimates and Asymptotic t Values (continued)

Job Offer Probabilities
Job Termination Probabilities
$(\lambda_{jkt}, \Phi_j(s^* \geq s), \delta_j)$

	Occ. 1		Occ. 2		Occ. 3	
	Coeff.	t	Coeff.	t	Coeff.	t
λ_{jkt}:						
No Job	-5.19917	-5.61	-3.84230	-9.86	-1.69416	-19.57
Occ. 1	-5.52473	-5.93	-5.51386	-8.88	-5.51386	-
Occ. 2	-6.10825	-6.68	-3.55543	-7.79	-3.94459	-8.83
Occ. 3	-7.19802	-7.66	-5.25765	-12.68	-3.01802	-33.34
Type 1	-2.83216	-2.85	-2.05430	-2.56	-1.60270	-9.15
Type 2	-1.02175	-3.05	-0.24861	-0.83	0.21600	2.62
Age_0>40	-0.27582	-2.57	-0.36479	-1.98	-0.02991	-0.56
Occ_0. 1	2.48364	2.65	-0.01723	-0.03	-0.28822	-2.90
Occ_0. 2	0.62551	0.51	0.52499	1.20	-0.04304	-0.36
Engineer_0	-0.27344	-1.40	0.00486	0.01	-0.15502	-1.83
Physician_0	0.12819	0.35	-0.05532	-0.09	-1.21266	-3.87
1991_0	0.00737	0.05	-0.40283	-1.86	0.33688	5.94
$>1991_0$	-0.28445	-1.79	-0.34133	-1.21	0.47355	6.60
$\Phi_j(s^* \geq s)$:						
α	10.07162	34.73	10.07162	-	10.07162	-
β_j	0.45638	22.26	0.27028	9.96	0.08005	4.28
$\sqrt{\nu}$	0.40057	4.85	0.40057	-	0.20905	10.68
δ_j:						
α_j	-5.62635	-24.63	-4.50681	-20.17	-5.14436	-22.72

Type Probabilities

	Type 1		Type 2	
	Coeff.	t	Coeff.	t
Constant	-2.43253	-10.28	-1.51139	-5.36
Rep.	-0.05924	-0.14	1.21765	3.77

Note: $\lambda_{jkt} = \frac{exp(a_{jk}x_{it})}{1+\sum_{k=1}^{3} exp(a_{jk}x_{it})}$, $\Phi_j(s^* \geq s) = \frac{\exp\left(\frac{\beta_j s_0}{\upsilon} - \frac{s}{\upsilon} + \frac{\alpha}{\upsilon}\right)}{1+\exp\left(\frac{\beta_j s_0}{\upsilon} - \frac{s}{\upsilon} + \frac{\alpha}{\upsilon}\right)}$, $\delta_j = \frac{\exp(\alpha_j)}{1+\exp(\alpha_j)}$ and the type probabilities are multinomial logit.

Table A4

Wage Regressions for Out of Sample Predictions

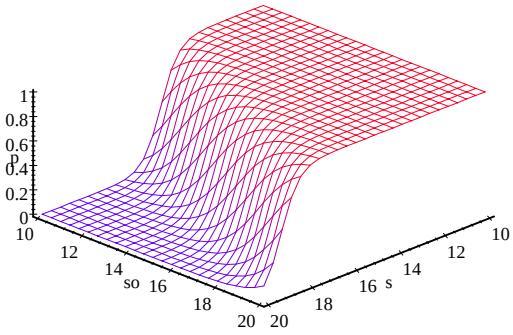
	Israelis		Immigrants	
Variable Name	Coeff.	Std.	Coeff.	Std.
A_{cons}	6.7286	0.0441		
A_{year91}	-0.0061	0.0159		
A_{year92}	0.0477	0.0158		
A_{year93}	0.0117	0.0158		
A_{year94}	0.0363	0.0151		
A_{occ1}	0.2663	0.0204		
A_{ooc2}	0.1380	0.0196		
$A_{\exp}$	0.0530	0.0019		
$A_{\exp sq}$	-0.0009	0.00005		
$A_{years\ schooling}$	0.0670	0.0026		
$A_{\min\ schooling\ requirement\ of\ job}$	0.02359	0.0036		
$B_{du\,mm\,y}$			0.3720	0.2234
λ			-0.1193	0.0365
B_{occ1}			0.0930	0.0739
B_{occ2}			0.0962	0.0569
$B_{cohort<89}$			0.0220	0.0626
$B_{cohort9295}$			-0.0131	0.0367
C_{λ}			0.6516	0.2743
$B_{\exp ussr}$			-0.1425	0.2320
$C_{\exp ussr}$			-1.0893	0.2714
$B_{years\ schooling}$			-0.0288	0.0118
$C_{years\ schooling}$			-0.0508	0.0140
$B_{s\,\min}$			-0.0062	0.0095
Mean Dep. Var.	8.0666		7.6160	
R^2	0.3892			
N. of obs.	8184		1818	

Note: The effect of variable j for immigrants is $A_j + B_j + (e^{-\lambda t} * C_j)$ and $\exp ussr = (A_{\exp} - (A_{\exp sq} * \exp_0)) * (\exp_0)$ where $\exp_0$ is the number of years worked in the former USSR.

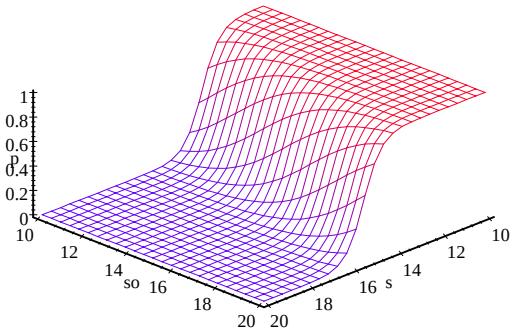
Figure 1

Acceptance Probabilities by Level of Schooling and Minimal Job Requirements

Occupation 1



Occupation 2



Occupation 3

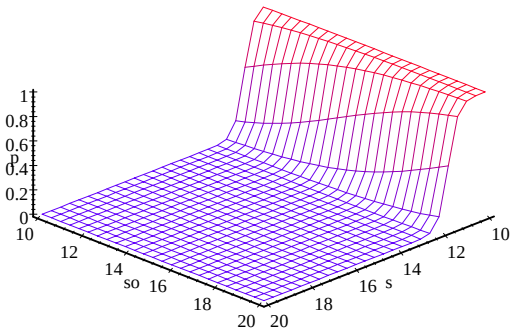


Figure 2a: Actual and Predicted Proportion of Immigrants in Occupation 1

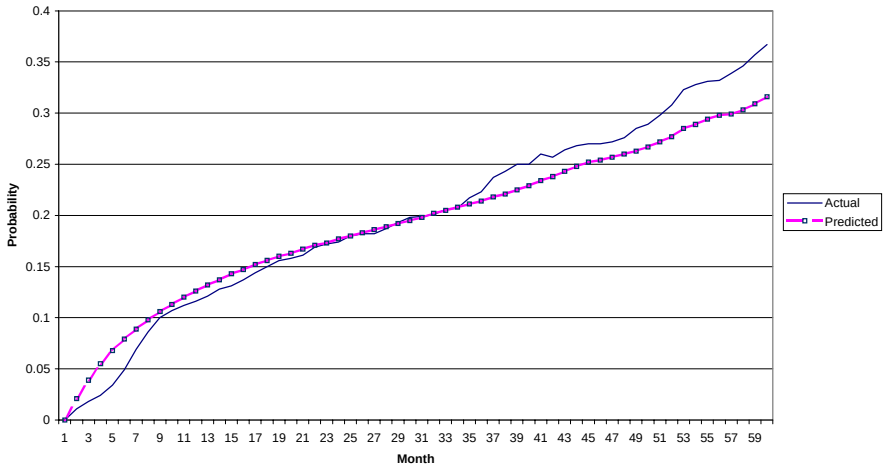


Figure 2b: Actual and Predicted Proportion of Immigrants in Occupation 2

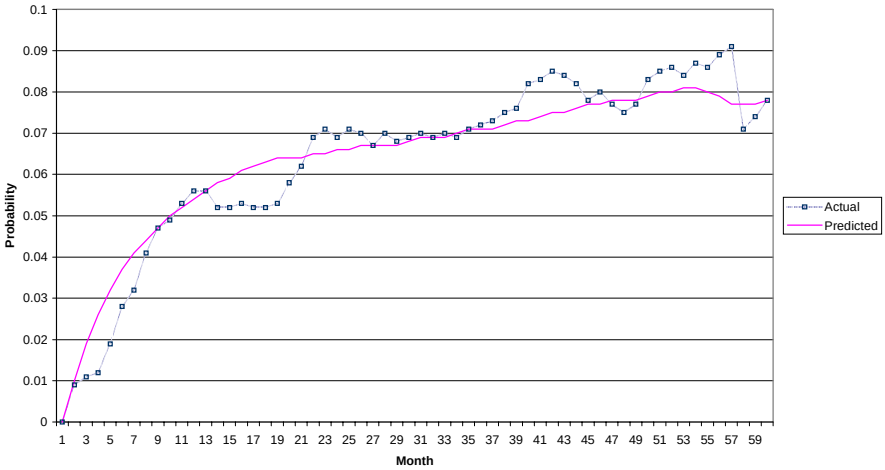


Figure 2c: Actual and Predicted Proportion of Immigrants in Occupation 3

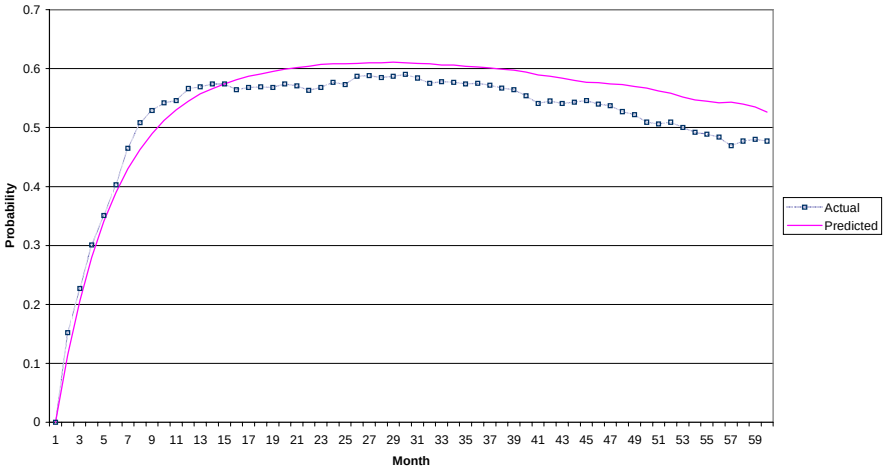


Figure 2d: Actual and Predicted Proportion of Immigrants in Unemployment

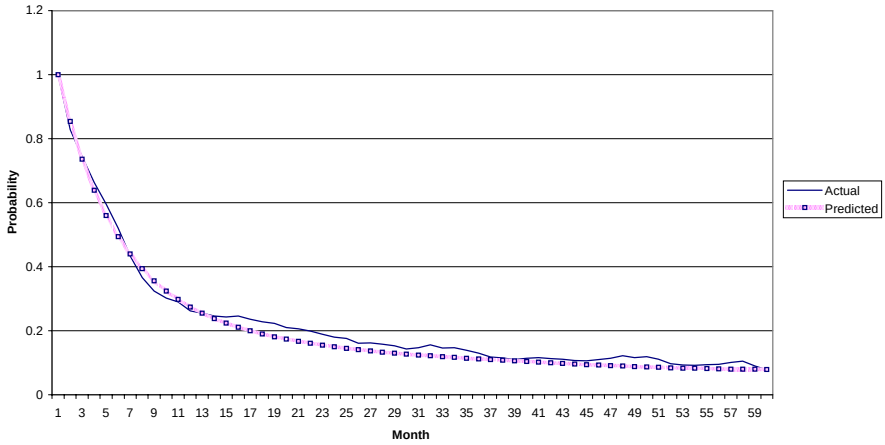


Figure 3a: Actual and Predicted Monthly Transition Probabilities from Unemployment to Employment

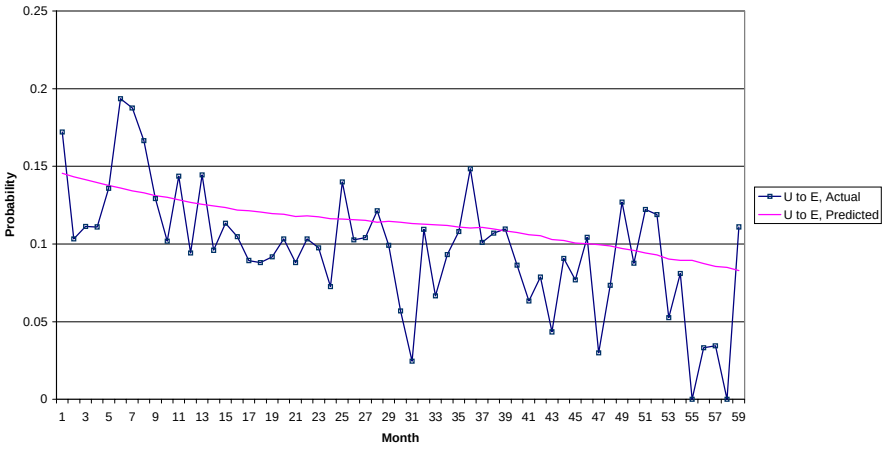


Figure 3b: Actual and Predicted Monthly Transition Probabilities from Employment to Unemployment

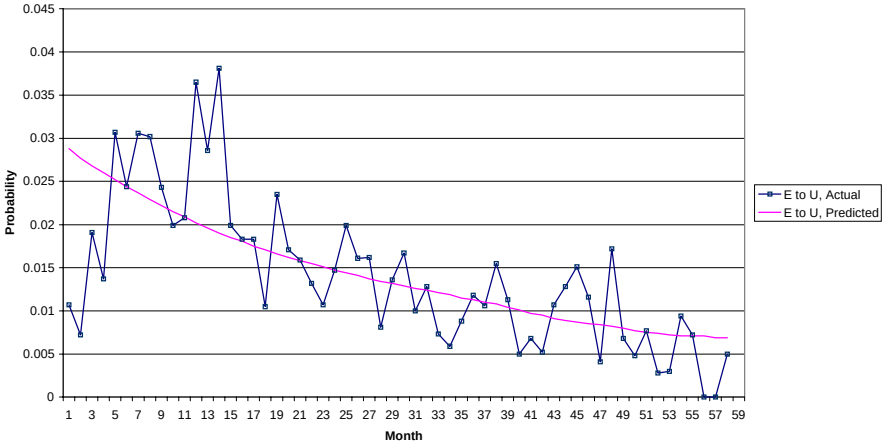


Figure 4a: Simulated Actual and Potential Annual Earnings of Immigrants From Occupation 1 in the USSR Younger than 40 on Arrival (1995 Israeli Shekels=.33 US Dollars)

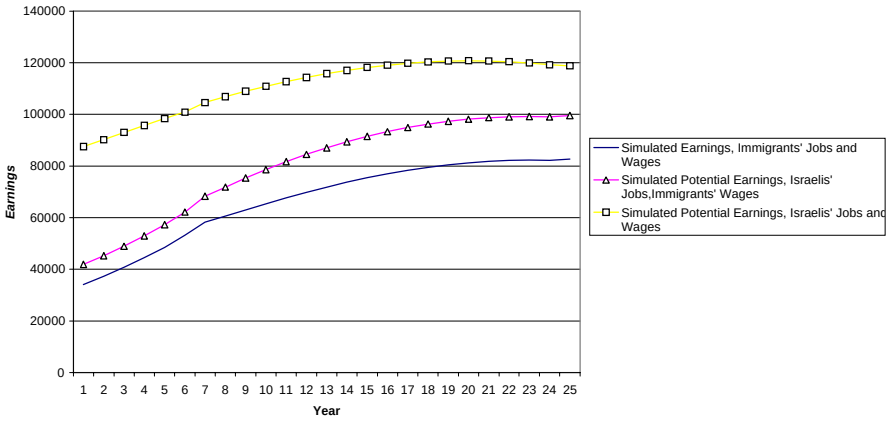


Figure 4b: Simulated Actual and Potential Annual Earnings of Immigrants From Occupation 1 in the USSR Older than 40 on Arrival (1995 Israeli Shekels=.33 US Dollars)