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Immigrants in the Hi-Tech Sector: Comparison to Natives and the Effect of Training

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Immigrants in the Hi-Tech Sector: Comparison to Natives and the Effect of Training*

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Abstract

During the decade that started in 1990 the Israeli economy experienced two major events. First, starting in the fall of 1989 a large wave of relatively highly skilled immigrants arrived from the former Soviet Union (CIS) increasing the population and the labor force by considerable magnitude. Second, the hi-tech sector has grown substantially and reached a peak in growth and level in 2000.

This paper provides a descriptive analysis of the integration of the immigrants from the CIS in the Israeli labor market and, specifically, in the hi-tech sector. Based on unique panel data that follows immigrants for up to twelve years we find a significant positive correlation between immigrants' participation in government-provided training programs and the propensity to work in hi-tech and white-collar jobs. However, this correlation diminishes with time since participation such that 'fresh' participants face a higher probability to work in hi-tech and white-collar jobs than those who participated years ago.

Key words: Training, Immigrants' assimilation, Occupational-choice

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Non-technical Summary

During the decade that started in 1990 the Israeli economy experienced two major events. First, starting in the fall of 1989 a large wave of relatively highly skilled immigrants arrived from the former Soviet Union (CIS) increasing the population and the labor force by considerable magnitude. Second, the hi-tech sector has grown substantially and reached a peak in growth and level in 2000.

This paper provides a descriptive analysis of the integration of the immigrants from the CIS in the Israeli labor market and, specifically, in the hi-tech sector. Based on unique panel data that follows immigrants for up to twelve years we find a significant positive correlation between immigrants' participation in government-provided training programs and the propensity to work in hi-tech and white-collar jobs. However, this correlation diminishes with time since participation such that 'fresh' participants face a higher probability to work in hi-tech and white-collar jobs than those who participated years ago.

1. Introduction

During the decade that started in 1990 the Israeli economy experienced two major events. First, starting in the fall of 1989 a large wave of relatively highly skilled immigrants arrived from the former Soviet Union (CIS) increasing the population and the labor force by considerable magnitude. Second, the hi-tech sector has grown substantially and reached a peak in growth and level in 2000. In this study we try to explore the interaction between the growth of the hi-tech sector and the integration of the immigrants from the CIS in the Israeli economy and, specifically, in the hi-tech sector. In particular, we compare the integration of immigrants in hi-tech to their integration in other sectors as well as to the presence of natives in this sector. Furthermore, we study the role of training in the process of labor market employment and occupational dynamics of the immigrants.

The analysis is based on two sources of data that provide the best description of the labor market dynamics. First, we use the annual cross-sectional Labor Force Survey (LFS) conducted by the Israeli Central Bureau of Statistics (CBS). This survey provided a very good aggregate description of the labor force distribution by occupation, industry, years since arrival, country of birth, gender and age. In addition, we first to use a unique panel data that follows a sample of immigrants for a period of up to twelve years since arrival.

Based on the cross sectional data we find that unlike the slow integration of immigrants in white-collar jobs, compared to natives, the integration of immigrants in the hi-tech sector, as well as their occupational distribution in this sector, is similar to that of native Israelis. One of the explanations to this phenomenon is that the Israeli hi-tech industry grew parallel to the arrival of immigrants in the 1990s, such that it absorbed new workers both among natives and immigrants. Yet, it is not clear whether this observation implies that immigrants' integration in the hi-tech sector was due to a good match between their human capital and the skills demanded by this specific sector.

In Cohen-Goldner and Eckstein (2002, 2004) we find that training has a substantial impact on the slow transition of immigrants to white-collar jobs. Based on the panel data, that currently includes only immigrants who declared to be engineers, we find that about 40% of the males have participated in government-subsidized vocational training since their arrival. These participants are, on average, younger at arrival and a higher share of

them worked in white-collar jobs in CIS. In addition, females' participation rate in training was 38%, and similar to males, female participants were, on average, younger at arrival and most of them worked in the CIS in white-collar or hi-tech occupations.

We estimate a hazard regression for the duration to training and find that there is no significant difference in the duration to training of males and females. For males, the duration to training increases with age at arrival while the knowledge of Hebrew and work in white-collar occupation before migration lead to a shorter duration. For females, the duration to training decreases with the knowledge of Hebrew and with the number of children under 18. The most striking effects on the duration to training are the changes in previous labor market states. For example, immigrants who moved from employment to unemployment during the 6 months prior to the program have a substantial shorter duration to training.

A Multinimial-Logit analysis for the occupational choice shows that training significantly (at 10% level) increases the propensity to work in hi-tech and white-collar jobs, but this effect declines with time since participation, such that 'fresh' participants face a higher probability than participants who participated years ago. This result suggests that the knowledge which is accumulated in the training programs is subject to depreciation and, therefore, before-after estimates for the impact of training are sensitive to the time chosen.

The rest of the paper is organized as follows. In the next section we provide the cross-sectional descriptive analysis and in the third section we analyze the panel data. Section 4 concludes.

2. Immigrants and Natives in the labor market: Cross-Section data

In this section we describe the labor market characteristics of immigrants who arrived in Israel in 1989-1994 and the native Israelis with focus on the hi-tech (HT) industry.[1] The analysis is based on the Israeli national cross-section labor force survey (LFS), which is conducted annually by the Israeli Central Bureau of Statistics (CBS)

[1] We define *immigrant* as a person who was born in the former USSR and arrived in Israel after 1989 at the age of 14 or above. *Native* is defined as a person who was born in Israel or immigrated to Israel before age 14 prior to 1989.

among 25,000 households.[2] Eckstein and Weiss (2002, 2004) and Cohen-Goldner and Eckstein (2002, 2004) provide an extensive analysis of the integration process of the immigrants and a comparison to native Israelis. Here we build on the above papers and extend it to the HT sector.

Figure 1 presents the aggregate proportion of immigrants' employment in white-collar (WC), hi-tech (HT) and blue-collar (BC) occupations and of immigrants' unemployment.[3] The figure demonstrates the rapid decline in unemployment and the fast increase in employment in BC jobs. Furthermore, after five years there is a gradual shift from employment in BC jobs to WC jobs. These transitions are explained by Cohen-Goldner and Eckstein (2002, 2004) who showed that as immigrants accumulate Israeli human capital via language acquisition, training and on the job learning they are able to shift to better jobs. Figure 1 indicates that there is no substantial difference in the integration of male and female immigrants in WC jobs. After 10 years in Israel 32 (34) percent of male immigrants (females) work in WC jobs. The integration of immigrants in WC occupations is a gradual process and the share of immigrants in these occupations was substantially lower than that of native Israelis during the 1990s (Eckstein and Weiss (2004)). Cohen-Goldner and Eckstein (2002, 2004) found that the slow and low entrance of immigrants to WC is due to low availability of job offers in these occupations. Participation in training, however, was found to have a considerable impact on WC offer probabilities. In the next section we investigate the role of training in the integration of immigrant engineers in the HT industry.

The rapid growth of the HT industry occurred almost parallel to the arrival of immigrants from the CIS. During 1995-2000 two main factors led to the growth of employment in the Hi-tech industry: new entrants to the labor market (post scholars) and immigrants. As most of these immigrants were college graduates and a sizable share of them worked in the CIS as engineers, it is challenging to question whether this population contributed significantly to the growing hi-tech industry.

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[2] See Appendix for further description of the LFS.

[3] White-collar occupations are coded 0-300 in the occupational classification. Blue-collar occupations are coded as 301-999. High-Tech in Figure 1 is defined as HT occupations within the HT industry (see more details at the Appendix). Our analysis and definitions of hi-tech are based on Feldman and Abouganem, (2002).

Figure 2 presents the share of employed in the HT industry among the general population (natives and immigrants) and among natives and immigrants, separately. The figure demonstrates that until 1996 there were minor differences between immigrants and natives, while during the HT boom (1996-2000) employment in HT was identical share from the reference groups. Furthermore, Figure 3 shows that the share of male immigrants in HT is roughly the same as that of natives, while the share of female immigrants is higher than that of female natives[4].

Since not all workers in the HT industry work in high skilled occupations, we divide the HT workers between HT occupations (e.g., physicists, system analysts, electronic engineers etc.) and non-HT occupations (see Appendix for further details on HT related occupations). The majority of the workers in the HT industry work in non-HT occupations; however, during the 1990's the total share of workers in HT occupations grew from 35% to 48%. Furthermore, Figure 4 shows that the share and trend of immigrants who work in HT occupations within the industry is roughly the same as the share among natives. The overall composition of employment in the HT industry by occupation and origin is presented in Figure 5. We see that immigrants are about 20% of the industry labor force in 2000 and that the industry labor composition has changed as the share of workers in HT occupations increases.

We can summarize that unlike the slow integration of immigrants in WC jobs, compared to natives, the integration of immigrants in the HT sector as well as their occupational distribution in this sector is similar to that of native Israelis. One of the explanations to this phenomenon is that the Israeli HT industry grew parallel to the arrival of immigrants in the 1990s, such that it absorbed new workers both among natives and immigrants. Yet, it is not clear whether this observation implies that immigrants' integration in the HT sector was due to a good match between their human capital and the skills demanded by the HT sector.

One can claim that given that immigrants were about 50% of the new workers in the Israeli labor market in 1990-92, and the rapid growth of this sector should have led to a larger share of immigrant in HT sector. On the other hand, the immigrants' relatively

[4] Immigrants in HT are, on average, older than natives and have more years of schooling.

higher rate of integration into the HT sector and HT occupations indicates that there was a positive match between the immigrants and the sector demand for labor. The question we face now is whether government- sponsored training had any influence on these observations. In Cohen-Goldner and Eckstein (2002, 2004) we find that training has a substantial impact on the slow transition of immigrants to WC jobs.

3. Occupational Distribution and Training of Engineers: Panel Data

In order to investigate the role of training in the integration of immigrants in HT, we use a unique panel data on immigrant engineers who arrived in Israel during 1989-1994 (hereafter engineers' surveys). [5] The engineers' survey is based on two interviews. The Brookdale Institute conducted the first interview in 1995, and the second interview of the same sample was conducted in 2001-2.[6] The surveys included men and women who had immigrated during 1989-1994 from CIS, and reported that they have an engineering diploma when entering Israel. 1432 individuals (824 males and 608 females) were interviewed in 1995, and 773 of the original sample (453 males and 320 females) were interviewed in the 2001-2. The surveys include information on: age, years of schooling, country of origin, occupation in the country of origin, knowledge of Hebrew before immigration, Hebrew training (intensive Hebrew course – "Ulpan"), marital status, size of family, etc.

The two interviews enable us to construct a work history profile of immigrants from time of arrival in Israel until the date of the second interview (2001-2), that is, a period of up to twelve years. For each job that the immigrant worked in Israel information is available on wages, starting and ending dates, the weekly working hours, occupation and industry.[7] The surveys also provide information on immigrants' participation in government provided training classes that lasted for at least one month. The current study

[5] No data on training is available from the LFS cross section. Therefore, the analysis is based only on the Engineers' surveys. In this section we use a broader definition for HT occupations than the one we used in the previous sections. HT occupations here are WC occupations in the HT industry. The change in definition is due to the lack of 3 digits occupation classification in the engineers' surveys.

[6] The 2001-2 survey was conducted by the PORI survey company under the supervision of Sarit Cohen-Goldner and Zvi Eckstein.

[7] The first survey does not provide wage data. Not all individuals reported their wages in the second survey.

focuses on 446 men and 304 women aged between 24 and 60 years at arrival in Israel who actively looked for a job at some stage since arrival.[8]

Participation in Training

Figure 6 describes the dynamics of immigrants' employment by occupations, unemployment and participation in training for males (Figure 6a) and females (Figure 6b). The general trends derived from the engineers' panel data are not much different from those obtained from the cross sectional LFS (Figure 1), though the levels are different. Unemployment declines sharply and employment in BC jobs increases rapidly during the first two years since arrival. The transition to WC jobs is gradual and steady since arrival and up to ten years later. The shift of male engineers to WC jobs is more rapid and occurs earlier than the shift of female engineers, while according to the cross sectional data there is no substantial difference in the integration of male and female immigrants in WC jobs. The share of male (female) engineers in HT occupations grows slowly and reaches 7 (5) percent after 10 years.

The occupational integration of engineers in the labor market is faster and different than that of the general population of immigrants of the same cohort: After 10 years in Israel 50 (35) percent of engineer males (females) work in WC jobs, compared to 32 (34) percent among the general population of male (female) immigrants. On the other hand, the unemployment rate of engineers is higher than the unemployment rate of the immigrants' population, especially among females.[9] This may indicate that immigrant engineers are more selective than the general population of immigrants comparable to the finding of Cohen-Goldner and Eckstein (2002, 2004) for highly educated immigrants.

Figure 6 also shows that there is no trend in the participation of male engineers in training programs. However, the patterns of training attendance of females is consistent

[8] The integration of engineers in HT is similar to the integration of immigrants in general. However, within the HT industry, there is a difference between the occupational distribution of engineers and the general population of immigrants. In particular, the vast majority of engineers work in HT occupations in the HT industry. For example, in 2000, more than 80% of male and female engineers worked in these occupations. In contrast, among the general population of male (female) immigrants the share of employed in HT occupations in the HT industry reached 60% (40%) in 2000.

[9] Individuals who attend training programs are considered as unemployed in Figure 1.

with the theory of investment in human capital, as they have higher participation rates in training close to their arrival in Israel and these rates decline with time spent in Israel.

Each immigrant who arrived in the last wave from the CIS received an "absorption package" that included a set of monetary and non-monetary benefits. One of these benefits is the eligibility to participate in a government-sponsored vocational training program. Due to the high share of engineers among the immigrants, many of the programs were retraining programs especially designed for this specific highly skilled population. The courses were offered in software engineering, programming, electronic engineering, computers etc. Most of the male and female immigrants who participated in training, attended courses which lasted 4 months or more. The average weekly-hours of these programs was about 22 hours.

Table 1 provides summary statistics of the engineers' survey for males and females. The average age at arrival of males (Panel A, col. 1) was almost 42 and the average years of schooling was 16.3 (note the low variance of education). About 39% of the males worked in WC jobs prior to immigration and 16% were employed in HT occupations in the HT industry. The mean duration to first job was 7.5 months. Only 0.2% of the male engineers were unemployed through the entire sample period, and all of them have participated in training. Around 40% of the males have participated in government-subsidized vocational training since their arrival. These participants are, on average, younger at arrival and a higher share of them worked in WC in CIS (Panel A, col 2-3). The average age on arrival of females (Panel B) was 41.3 and the average years of schooling was 16.1. Almost 39% of the females were employed in WC occupations in the CIS, and 24% were employed in HT occupations. The average duration of females to first job was 15 months, which was twice the duration of males. Females' participation rate in training was 38%. Similar to males, female participants were, on average, younger at arrival and most of them worked in the CIS in WC or HT occupations.[10]

Table 2 presents the number of participants in training by occupation in the CIS and by occupation in the training programs. Depending on the occupation that the immigrant studied in the program, we distinct between HT-related training and non-HT-related training (see appendix for the list of training occupations which are HT-related). The table

[10] Logit estimates for participation in training confirm these effects, although only age at arrival has a significant negative effect on participation.

shows that both among males and females, occupation in CIS has no significant impact on training attendance. However, among immigrants who worked in BC jobs before migration, there is a higher tendency to attend non-HT training programs.

In Table 3 we present the number of transitions between the occupation in the job prior to training and the occupation in the first job following training. It is interesting to note that for both males and females, everyone who was unemployed before training, found a job after the course. However, most of these jobs were in BC occupations. Among the training participants, the share of males employed in BC jobs declined from 56.4% before training to 49.7% in the first job after training, while the share of employed in WC jobs grew from 28.5% to 44%. Among females participants, the share of employed in BC jobs did not change due to participation, but the share of employed in WC jobs doubled from 15.5% before participation to 32.8% afterwards. This increase is mainly due to the reduction of unemployed females after training.

In order to describe the dynamic decision to participate in training, conditional of observed state variables, we run a Cox hazard rate regression for the duration to training. The hazard function has the form:

$$H(t)=H_0(t)exp(x'\beta),$$

where the dependent variable $H(t)$ is duration in Israel until training (in months), $H_0(t)$ is the baseline hazard and x is a vector of the state variables. This regression corrects for right censoring, as not all the immigrants have participated in training during the sample period. The results of the regressions for male and female immigrants are presented in Table 4.[11] The panel structure of our data allows us to study the interactions between the dynamic decisions if and when to attend training and the dynamic employment decisions.

To capture the possibility that the timing of training attendance is closely related to several labor market transitions between states, we include in x indicators related to transitions between different labor market states prior to training. The variable *Employ - Unemployed* equals 1 if the immigrant has moved from employment to unemployment during the 6 months prior to training, and 0 otherwise. Similarly, the variable *Unemploye-*

[11] Table 4 reports hazard ratios such that a coefficient greater than 1 indicates that the variable shortens the duration to training and a coefficient lower than 1 means that the variable leads to a longer duration to training.

Employed equals 1 if the immigrant moved from unemployment to employment during the 6 months prior to training, and 0 otherwise. The variable *Unemployed-Unemployed* indicates that the immigrant was unemployed all through the 6 months prior to training. Hence, the reference group is of immigrants who were employed all through the 6 months.[12]

According to the joint regression there is no significant difference in the duration to training of males and females. For males, the duration to training increases with age at arrival while the knowledge of Hebrew and work in WC occupation before migration lead to a shorter duration to training. For females, the duration to training decreases with the knowledge of Hebrew and with the number of children under 18. The most striking effect on the duration to training is the impact of previous labor market states. Immigrants (males and females) who moved from employment to unemployment during the 6 months prior to the program have a substantial shorter duration to training. The same holds for immigrants who were constantly unemployed during the 6 months prior to the program. On the other hand, immigrants who moved from unemployment to employment during this period have a longer duration to training, though this effect is not significant. These results suggest that the changes in the labor market state provide the strongest predictors for the timing of training. Note that previous occupation-specific accumulated experience does not significantly affect duration to training.

The Entry of Immigrants to Hi-Tech

Table 5 presents the estimates from a Cox hazard regression for the duration until the first entry to HT. The dependent variable is time in Israel until HT (in months) and the regression corrects for right censoring. The hazard model is estimated for male and female immigrants separately and jointly. From the joint regression it turns that females face a significantly longer duration to HT. English proficiency leads to a shorter duration to HT, while the knowledge of Hebrew ha no significant effect. These results reflect the fact that many Israeli HT companies have international orientation and some of them work closely

[12] Heckman and Smith (1999) studied the role of these variables as predictors in the static decision to participate in training, while we study their effect on the decision *when* to participate.

with HT companies in the US. Years of schooling also do not significantly affect the duration to HT.

Surprisingly, immigrants who were younger at arrival and immigrants who worked in WC jobs in the CIS prior to migration have a longer duration to HT. This might result from the fact that those immigrants (i.e. younger and those who worked in WC in the CIS) tend to first participate in training and only later are integrated in high-skilled WC and HT occupations. Work in HT occupation in the CIS and participation in training shorten the duration to HT.

Training and the Occupational Choice of Immigrant Engineers

To study the role of imported and local human capital, and specifically of training on the labor market absorption of immigrant engineers, we run multinomial-logit regressions for the 3 occupational employment states (BC, WC and HT) and unemployment as a function of various human capital variables. As the decision to participate in training is interrelated with the occupational choice, the multinomial-logit regressions provide correlation between the explanatory variable (i.e. training) and the occupational choices of the immigrants. Hence, one should not interpret the results as causal effects. In order to study the causal effect of training on occupational choices one needs to specify a model for the decision to participate in training and its affect on the occupation chosen. Our previous work (Cohen-Goldner and Eckstein (2002, 2004)) suggests that the simple correlations obtained from simple multinomial logit regression retained after controlling for the selectivity to training and occupations.

Table 6 presents the estimates obtained from two specifications of the explanatory variables. The regressions are pooled over time, such that each immigrant appears in each regression the number of months s/he appears in the sample.[13] The comparison group is employment in BC jobs. Both specifications include indicator for females, years of schooling and age at arrival. The level of Hebrew and English proficiency, each range between 1 (no knowledge) to 4 (perfect knowledge). To capture the possibility that the impact of training on the 4 potential outcomes changes over time, the regressions include the indicator for training participation as well as the interaction of training participation

[13] Standard errors are clustered for each individual.

with years after training. In the first regression we also include variables for the accumulated experience in HT and WC occupations, but as these variables are likely to be endogenous, we replace them in the second specification with the time in Israel (since arrival).

According to the first specification, the propensity to work in HT occupations (within HT industry) significantly decreases with age at arrival and increases with previous accumulated experience in HT or WC jobs. There is no significant difference in the propensity of females to work in HT compared to that of males. Hebrew proficiency does not appear to have a significant effect on work in HT, but proficiency in English does increase the propensity to work in HT significantly.

Training significantly (at 10% level) increases the propensity to work in HT jobs, but this effect declines with time since participation, such that 'fresh' participants face a higher probability than participants who participated years ago. This result suggests that the knowledge which is accumulated in the training programs is subject to depreciation and, therefore, before-after estimates for the impact of training are sensitive to the time chosen.

The probability to work in WC jobs also increases with accumulated experience in HT or WC jobs. Hebrew knowledge also has a positive significant effect on work in WC jobs. Like in HT, training has a positive impact on work in WC and this impact decreases with time since participation in the training program. Last, the probability of being unemployed also increases with accumulated experience in WC and HT, which suggest that immigrants with higher levels of human capital invest more in search from unemployment. Proficiency in Hebrew lowers the probability to be unemployed (compared to work in BC jobs). Females are found to have a significantly higher propensity than males to be unemployed. As in previous studies on Russian immigrants in Israel (Eckstein and Weiss (2004), Cohen-Goldner and Eckstein (2002, 2004), Weiss, Gotlibovsky and Sauer (2003)), we find that conditional on local accumulated human-capital, imported schooling has no significant impact on labor market activities of Russian immigrants.

To illustrate the impact of training on the probability to work in HT, we present in Figure 7 this probability conditional on the participation in training in the first year in

Israel, and as a function of experience in HT for an average male/female.[14] The result is that the impact of training on the probability to work in HT is substantial. The probability to work in HT is doubled for those that participated in training during the last 12 months.

The results from the second specification suggest that only age at arrival and time in Israel significantly affect the probability to work in HT, such that this probability decreases with age at arrival, as in the first specification, and it increases with time spent in Israel. The probability to work in WC is significantly lower for females than for males. Knowledge of Hebrew and English and time in Israel increases the probability to work in WC. Training also significantly increases the probability to work in WC jobs and its effect is independent of time since participation in the program. Like in the first specification, females face a higher probability to be unemployed, however, their Hebrew knowledge led to a lower probability of unemployment. As expected, the probability to be unemployed, compared to work in BC jobs, significantly declines with time in Israel. Training also has a negative impact on the probability to be unemployed, though the effect is not significant.

Transitions between labor market states

In Table 7 we present the annual transitions between the three employment states (BC, WC and HT), training and unemployment separated to the period of the first five years and the next five years in Israel. The numbers in the table are the individuals' transitions between month 't' and month 't+12'. The table reveals substantial differences between the two sub-periods, mainly with respect to the transitions from unemployment. During the first five years in Israel, 48% (50%) of unemployed males (females) move to BC jobs, while 32% (24%) move to WC jobs and 14% (21%) stay unemployed. The transitions from unemployment to HT are minor for both males and females. In the second sub-period (5^{th} to the 10^{th} year), however, most of the unemployed immigrants stay unemployed. During the two periods, we find a high persistence in employment in WC jobs and a lower persistence in BC and in HT jobs. Among the three employment states, HT is found to be the less stable with persistence rate of 47% (59%) among males (females) in the first period and, respectively, 55%(68%) in the second period. The transitions from HT

[14] The characteristics of the average male/female immigrant are taken from Table 1).

to WC jobs in the two periods are also non-negligible and reflect the fluctuational nature of the HT industry during the 1990s.

The transitions from training to the three employment states are substantial but the transitions to unemployment are low. During the first period 51% (45%) of the males (females) who attended training moved to WC jobs, while 42% (40%) moved to BC jobs and 5%(5%) moved to HT. Only 2% (11%) of the males (females) moved from training to unemployment during the first period.

In the second period the transitions from training to WC declined to 36% (35%) among males (females) and the transitions to BC increased to 47% (46%). About 12% (8%) of the males (females) moved from training to HT during this period and 5% (11%) moved to unemployment. Overall, it seems that the transitions to low skill BC jobs occur mainly from unemployment, while the transitions to high-skill WC and HT jobs occur also through training and employment in BC jobs.

4. Concluding Remark

This paper provided a descriptive analysis of the integration of the immigrants from the CIS in the Israeli labor market in comparison to natives and with emphasis on their employment in the hi-tech sector. This description is informative for the researcher who is interested in evaluating the potential benefit for the growth of the Israeli hi-tech sector from the imported and locally accumulated human capital of the recent immigrants. However, to further understand the link between the skills of the immigrants and the growth of industry one would need to formulate and estimate a model that controls for the dynamic selection of choices made by workers and firms. This challenging research is left for the future.

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Appendix : Data definitions

The definition of the Hi-tech Industry in this paper is similar to the definition of American Electronic Association (AEA). We based our definition on the Standard Industrial Classification of All Economic Activities (SIC) (Central Bureau of Statistics [CBS],1993):

30 - Manufacture of office and accounting machinery and computers
32 - Manufacture of electronical components
33 - Manufacture of electronic communication equipment
34 - Manufacture of industrial equipment for control and supervision, medical and scientific equipment
66 – Telecommunications
72 - Computer and related services
73 - Research and development

The definition of Hi-tech Occupations (except for section 3) is based on the Standard Classification of Occupations (CBS,1994) and include:

001 –Biologists and related professionals
002 –Pharmacologists
010 –Chemists
011 –Physicists and astronomers
012 –Geologists and geophysicists
013 –Mathematicians and actuaries
015 –System analysts and related computer professionals
023 –Electrical and electronics engineers
024 –Mechanical engineers
027 –Computer engineers
101 –Physical engineering technicians
121 –Electronic engineering technicians
122 –Mechanical engineering
130 –Computer technicians and programmers
225 –Computer services managers

Hi-tech related training is defined based on the answer of the following question: "Which profession did you study in this course? (please provide as many details as possible)".

3 – Autocad
5 – "Year 2000" communications
6 – Optical fiber
7 – Electronics/Electricity and control/Electrician
14 – Technology and computer software/Software engineer/Computers/Programming
15 – Signal processing
31 – Computer technician/Computer maintenance
33 – Physics
34 – Practical computer engineer
51 – Programming languages
52 – Communication networks

64 – Chemistry/Chemistry retraining

The Labor Force Survey (CBS)

The LFS is an annual household survey conducted by the Israeli Central Bureau of Statistics (CBS), which collects data from roughly 25,000 household over four interviews conducted over a period of eighteen months. Each household is interviewed for two consecutive quarters, followed by a break for two quarters, and is interviewed again for two consecutive quarters. The LFS provides information on labor market participation, occupation, education, country of origin, year of immigration and other demographic variables as well as details on workplace.

Table 1: Summary Statistics – Engineers' Survey

Table 1A: Males

Variables	Entire sample	Participated in training course	Non-participants in training course
Number of observations	446	179	267
Age on arrival in Israel (years)	41.7 (8.9)	40.1 (8.2)	42.7 (9.1)
Education (years)	16.3 (1.7)	16.4 (1.6)	16.3 (1.7)
Worked in WC in CIS (%)	39.0	41.9	37.1
Worked in HT[1] in CIS (%)	16.6	16.2	16.9
Hebrew knowledge before immigration (%)	0.89	1.1	0.75
Number of children	0.65 (0.92)	0.72 (0.92)	0.60 (0.92)
Married (%)	91.0	89.4	92.1
Time in Israel at latest survey (months)	122.2 (16.5)	122.4 (16.8)	122.0 (16.3)
Number of jobs in Israel since arrival	2.9 (1.5)	3.5 (1.5)	2.5 (1.3)
Unemployed throughout entire sample period (%)	0.2	0.6	0.0
Time from arrival to first job (months)	7.5 (7.5)	8.2 (9.0)	7.1 (6.3)
Time from arrival to start of training course (months)	-	53.2 (34.3)	-

* Standard Deviation in parentheses.

[1] Hi-tech is defined as white collar occupations in the hi-tech industry

Table 1: Summary Statistics – Engineers' Survey

Table 1B: Females

Variables	Entire sample	Participated in training course	Non-participants in training course
Number of observations	304	116	188
Age on arrival in Israel (years)	41.3 (8.6)	39.8 (8.0)	42.2 (8.8)
Education (years)	16.0 (1.4)	15.9 (1.4)	16.1 (1.4)
Worked in WC in CIS (%)	38.8	41.4	37.2
Worked in HT[1] in CIS (%)	24.0	28.4	21.3
Hebrew knowledge before immigration (%)	0.66	0.86	0.53
Number of children	0.46 (0.7)	0.59 (0.8)	0.38 (0.7)
Married (%)	74.3	76.7	72.9
Time in Israel at latest survey (months)	120.9 (16.5)	120.7 (17.2)	121.0 (16.2)
Number of jobs in Israel since arrival	2.4 (1.4)	3.0 (1.5)	2.0 (1.1)
Unemployed throughout entire sample period (%)	2.0	0.0	3.2
Time from arrival to first job (months)	15.2 (15.2)	15.1 (14.2)	15.3 (15.9)
Time from arrival to start of training course (months)	-	43.7 (33.9)	-

* Standard Deviation in parentheses.

[1] Hi-tech is defined as white collar occupations in the hi-tech industry

Table 2: Participation in Training by Type and occupation in the CIS*

Table 2A: Males

	Type of course			
Type of occupation in CIS	Hi-tech	Non-Hi-tech	Did not participate in training course	Total
Hi-tech	15 (20.27)	14 (18.92)	45 (60.81)	74 (100)
White-collar (non-HT)	22 (22.0)	24 (24.0)	54 (54.0)	100 (100)
Blue-collar	41 (15.36)	62 (23.22)	164 (61.42)	267 (100)
Did not work in CIS	0 (0.0)	1 (20.0)	4 (80.0)	5 (100)

* Figures in parentheses are percent of the total in the row.

Table 2B: Females

	Type of course			
Type of occupation in CIS	Hi-tech	Non-Hi-tech	Did not participate in training course	Total
Hi-tech	17 (23.29)	16 (21.92)	40 (54.79)	73 (100)
White-collar (non-HT)	4 (8.89)	11 (24.44)	30 (66.67)	45 (100)
Blue-collar	21 (11.41)	46 (25.0)	117 (63.59)	184 (100)
Did not work in CIS	0 (0.0)	1 (50.0)	1 (50.0)	2 (100)

* Figures in parentheses are percent of the total in the row.

Table 3: Transitions of Occupations after Training*

Table 3A: Males

	Occupation in first-job after training				
	HT	White-collar (non HT)	Blue-collar	Unemployed after training	Total
Occupation in last job prior to training					
HT	0 (0.00)	3 (60.00)	1 (20.00)	1 (20.00)	5
White-collar (non HT)	2 (3.92)	45 (88.24)	3 (5.88)	1 (1.96)	51
Blue-collar	1 (0.99)	28 (27.72)	68 (67.33)	4 (3.96)	101
Unemployed before training	1 (4.55)	3 (13.64)	17 (77.26)	1 (4.55)	22
Total	4	79	89	7	179

* Actual numbers. Figures in parentheses are percent of the total in the row.

Table 3B: Females

	Occupation in first-job after training				
	HT	White-collar (non HT)	Blue-collar	Unemployed after training	Total
Occupation in last job prior to training					
HT	0 (0.00)	1 (50.00)	1 (50.00)	0 (0.00)	2
White-collar (non HT)	0 (0.00)	12 (66.66)	5 (27.78)	1 (5.56)	18
Blue-collar	4 (5.97)	15 (22.39)	45 (67.16)	3 (4.48)	67
Unemployed before training	1 (3.45)	10 (34.48)	18 (62.07)	0 (0.00)	29
Total	5	38	69	4	116

* Actual numbers. Figures in parentheses are percent of the total in the row.

Table 4: Cox regression for Training

	Males	Females	Together
Dummy for females			0.842 (0.105)
Hebrew	1.325* (0.153)	1.582* (0.269)	1.408* (0.130)
Number of children		1.367* (0.212)	
Years of schooling	1.037 (0.047)	0.936 (0.076)	1.012 (0.039)
Age on arrival	0.984** (0.009)	1.018 (0.018)	0.988 (0.008)
Worked in WC in CIS	1.432* (0.247)	0.852 (0.238)	1.187 (0.169)
Experience in WC	1.002 (0.008)	1.001 (0.009)	1.005 (0.005)
Experience in HT	0.999 (0.012)	1.001 (0.015)	1.004 (0.009)
Experience in BC	1.008 (0.007)	1.008 (0.007)	1.011* (0.005)
Employed – Unemployed	6.265* (1.601)	4.908* (1.596)	5.901* (1.193)
Unemployed – Employed	0.698 (0.339)	0.606 (0.313)	0.728 (0.248)
Unemployed - Unemployed	3.185* (0.972)	1.721** (0.544)	2.689* (0.584)
Log Likelihood	-990.454	-572.115	-1794.189

* significant at 95% level
** significant at 90% level

Table 5: Cox regression for Hi-Tech

	Males	Females	Together
Dummy for females			0.596** (0.168)
Hebrew	1.233 (0.407)	2.168 (1.135)	1.542 (0.450)
English	1.777* (0.385)	0.890 (0.239)	1.387* (0.211)
Years of schooling	1.041 (0.094)	1.078 (0.216)	1.036 (0.087)
Age on arrival	0.934* (0.022)	0.963 (0.031)	0.939* (0.017)
Worked in WC in CIS	0.255** (0.188)	0.526 (0.586)	0.260* (0.158)
Worked in HT in CIS	1.542 (0.608)	2.451** (1.304)	1.904* (0.574)
Training	2.069 (1.124)	12.406* (8.572)	4.294* (1.656)
Log Likelihood	-180.994	-80.846	-300.868

* significant at 95% level
** significant at 90% level

Table 6: Multinomial regression

First Specification

	Hi Tech	**White Collar**	**Unemployed**
Dummy for females	0.248 (0.316)	-0.163 (0.147)	0.631 (0.122)
Hebrew	0.182 (0.252)	0.358 (0.122)	-0.17 (0.09)
English	0.36 (0.153)	0.062 (0.074)	0.021 (0.066)
Age on arrival	-0.1 (0.025)	-0.016 (0.01)	0.001 (0.009)
Years of schooling	0.074 (0.107)	-0.037 (0.045)	0.017 (0.041)
Training	1.299 (0.798)	1.353 (0.247)	-0.178 (0.191)
Years since Training	-0.433 (0.182)	-0.406 (0.072)	-0.07 (0.048)
Experience in HT	0.292 (0.041)	0.109 (0.038)	0.076 (0.035)
Squared experience in HT	-0.002 (0.0003)	-0.001 (0.0003)	-0.001 (0.0002)
Experience in WC	0.156 (0.027)	0.263 (0.022)	0.089 (0.02)
Squared experience in WC	-0.001 (0.0002)	-0.002 (-0.0002)	-0.001 (0.0001)
Constant	-3.495 (2.041)	-2.514 (0.866)	-0.946 (0.797)

Log likelihood : -59410.455

Second Specification

	Hi Tech	**White Collar**	**Unemployed**
Dummy for females	-0.312 (0.36)	-0.447 (0.163)	0.607 (0.123)
Hebrew	0.443 (0.327)	0.455 (0.119)	-0.15 (0.088)
English	0.243 (0.2)	0.146 (0.081)	0.038 (0.068)
Age on arrival	-0.089 (0.025)	-0.039 (0.01)	-0.0002 (0.009)
Years of schooling	0.081 (0.105)	0.005 (0.049)	0.024 (0.042)
Training	0.197 (0.447)	0.446 (0.175)	-0.243 (0.201)
Years since Training	-0.031 (0.092)	-0.016 (0.037)	0.034 (0.053)
Time in Israel	0.011 (0.003)	0.012 (0.001)	-0.008 (0.002)
Constant	-3.148 (1.852)	-1.37 (0.954)	-0.59 (0.823)

Log likelihood : -93965.019

Table 7: Number of Annual Transitions between Labor Market States

A. Males – first 5 Years

	TO	Hi Tech	White Collar	Blue Collar	Training	Unemployed
FROM						
Hi Tech		28	17	9	0	5
		47%	29%	15%	0%	8%
White Collar		5	405	29	9	26
		1%	85%	6%	2%	5%
Blue Collar		39	612	1280	59	312
		2%	27%	56%	3%	14%
Training		6	57	47	0	2
		5%	51%	42%	0%	2%
Unemployed		71	771	1144	71	348
		3%	32%	48%	3%	14%

* Actual number of individuals' transitions between month't' and month't+12' and row percentage

A. Males – second 5 Years

	TO	Hi Tech	White Collar	Blue Collar	Training	Unemployed
FROM						
Hi Tech		71	26	23	2	7
		55%	20%	18%	2%	5%
White Collar		29	1183	84	23	45
		2%	87%	6%	2%	3%
Blue Collar		56	409	975	26	145
		3%	25%	61%	2%	9%
Training		13	39	51	0	5
		12%	36%	47%	0%	5%
Unemployed		15	87	63	5	198
		4%	24%	17%	1%	54%

* Actual number of individuals' transitions between month't' and month't+12' and row percentage

Table 7: Number of Annual Transitions between Labor Market States

B. Females – first 5 Years

	TO	Hi Tech	White Collar	Blue Collar	Training	Unemployed
FROM						
Hi Tech		13	3	6	0	0
		59%	14%	27%	0%	0%
White Collar		0	111	20	0	6
		0%	81%	15%	0%	4%
Blue Collar		2	170	492	7	166
		0%	20%	59%	1%	20%
Training		6	59	52	0	14
		5%	45%	40%	0%	11%
Unemployed		80	596	1272	34	539
		3%	24%	50%	1%	21%

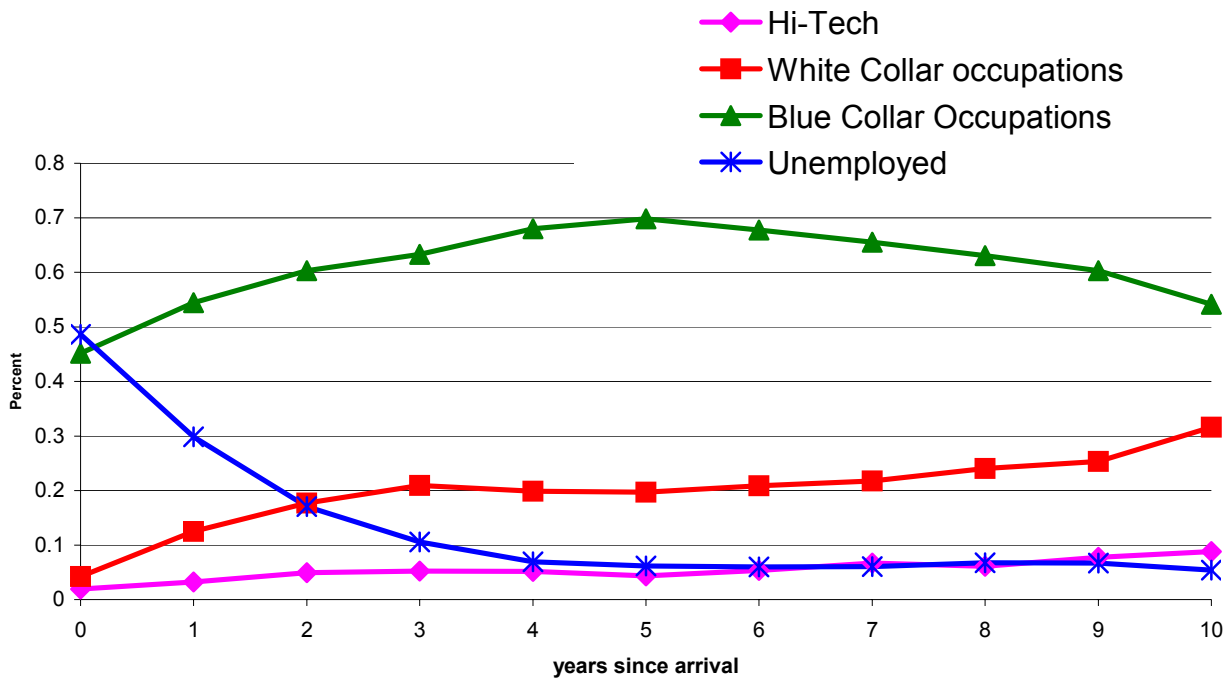
* Actual number of individuals' transitions between month't' and month't+12' and row percentage

B. Females – second 5 Years

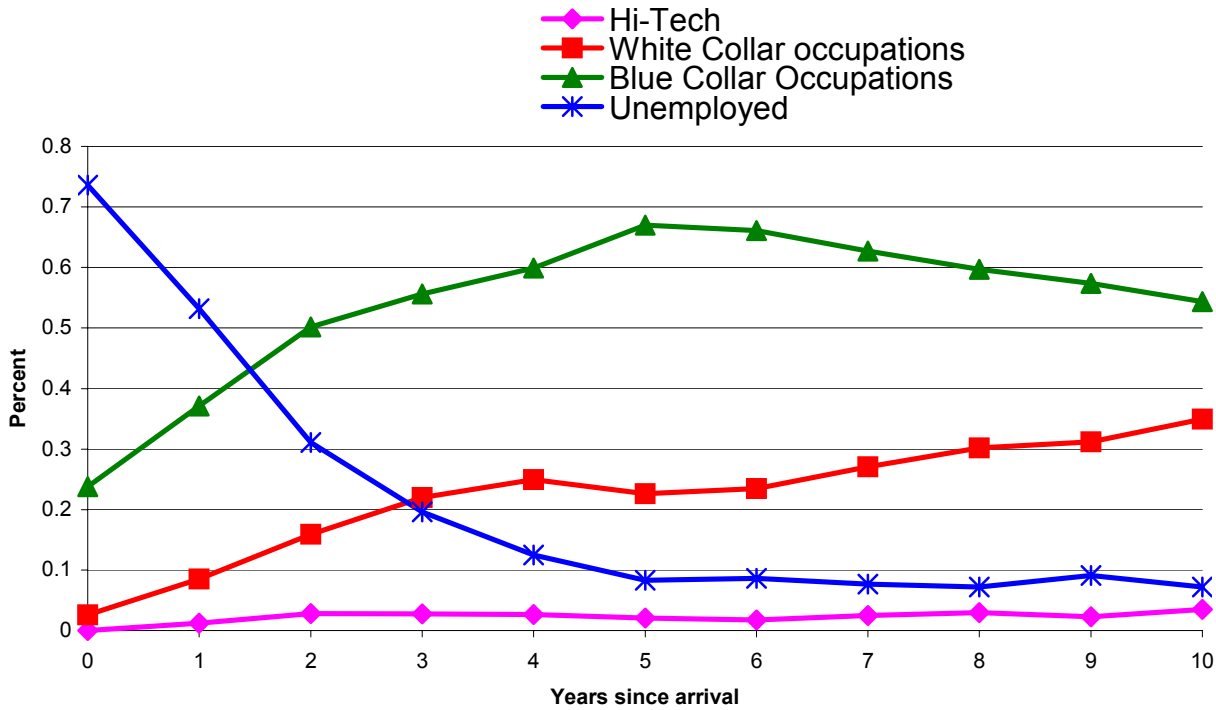
	TO	Hi Tech	White Collar	Blue Collar	Training	Unemployed
FROM						
Hi Tech		51	23	0	0	1
		68%	31%	0%	0%	1%
White Collar		19	545	26	16	36
		3%	85%	4%	2%	6%
Blue Collar		21	204	857	12	224
		2%	15%	65%	1%	17%
Training		3	13	17	0	4
		8%	35%	46%	0%	11%
Unemployed		9	59	117	0	247
		2%	14%	27%	0%	57%

* Actual number of individuals' transitions between month't' and month't+12' and row percentage

Figure 1: Labor Force Employment and Unemployment of Immigrants
a. Males

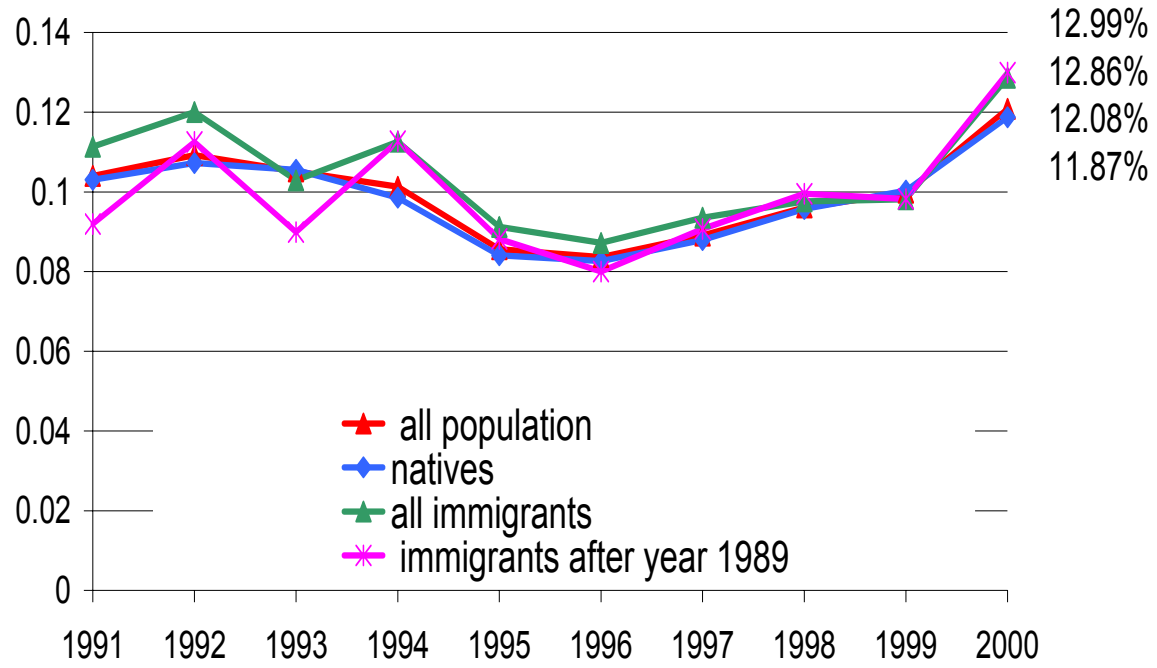


b. Females



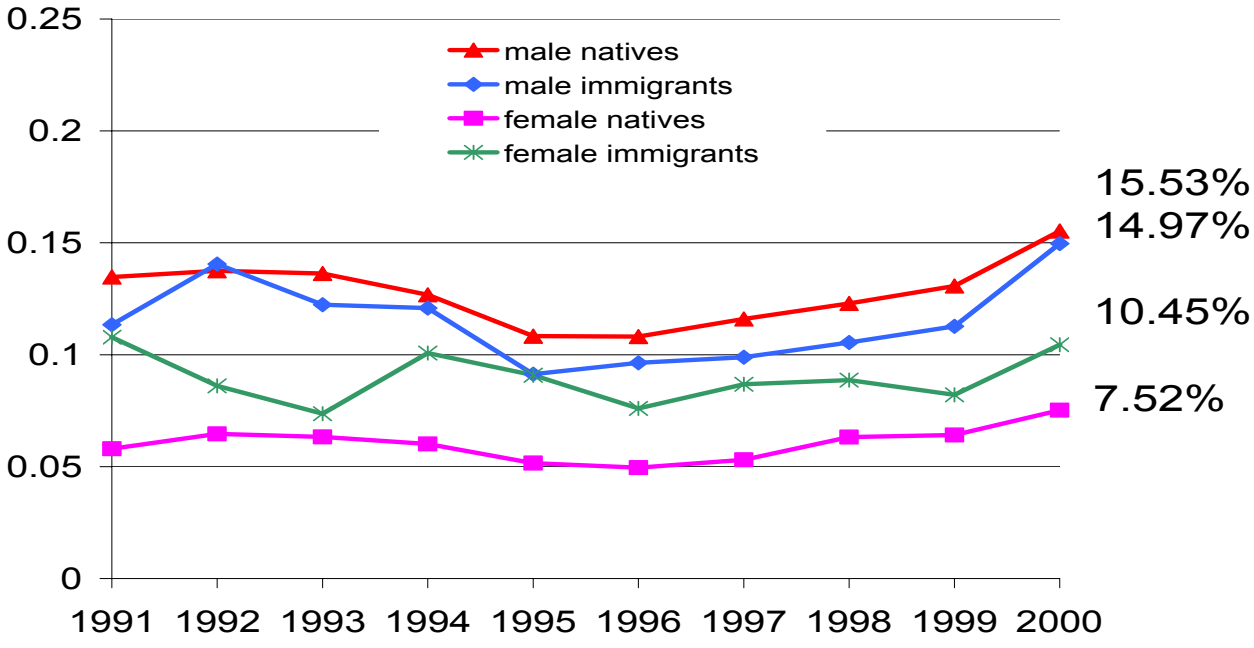
Source: LFS 1991-2000.

Figure 2: Employment in the Hi-tech Industry (Percent)



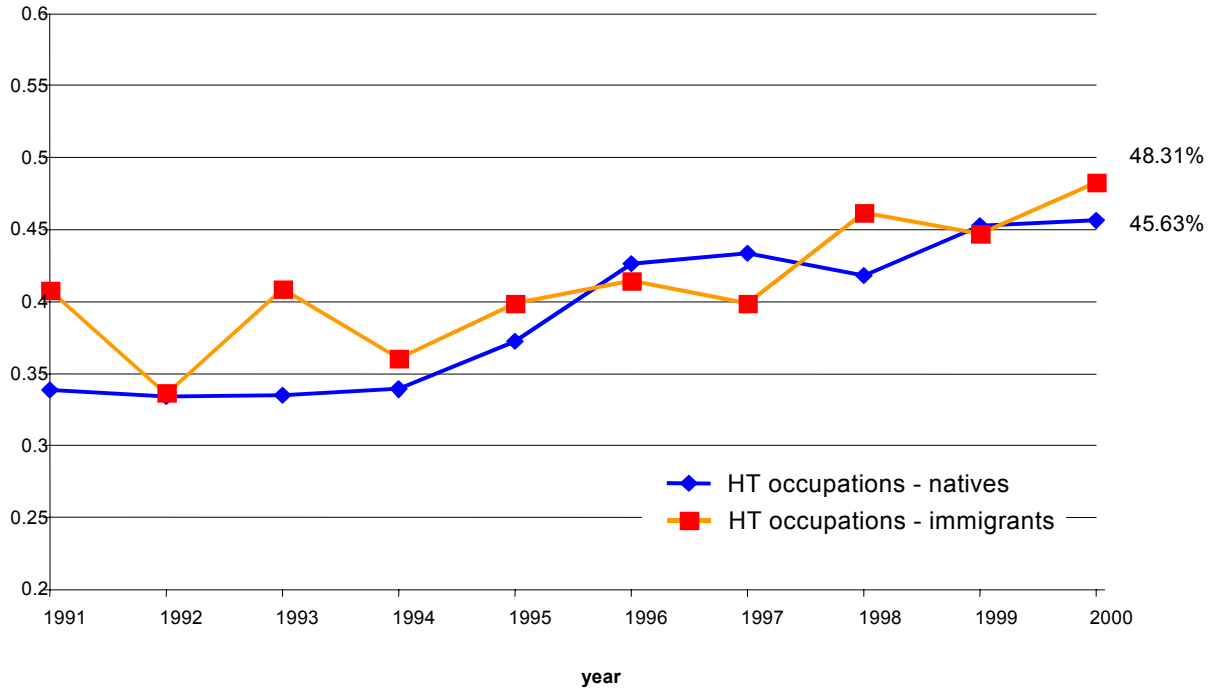
Source: LFS 1991-2000.

Figure 3: Employment in Hi-tech by Gender and Origin (Percent)



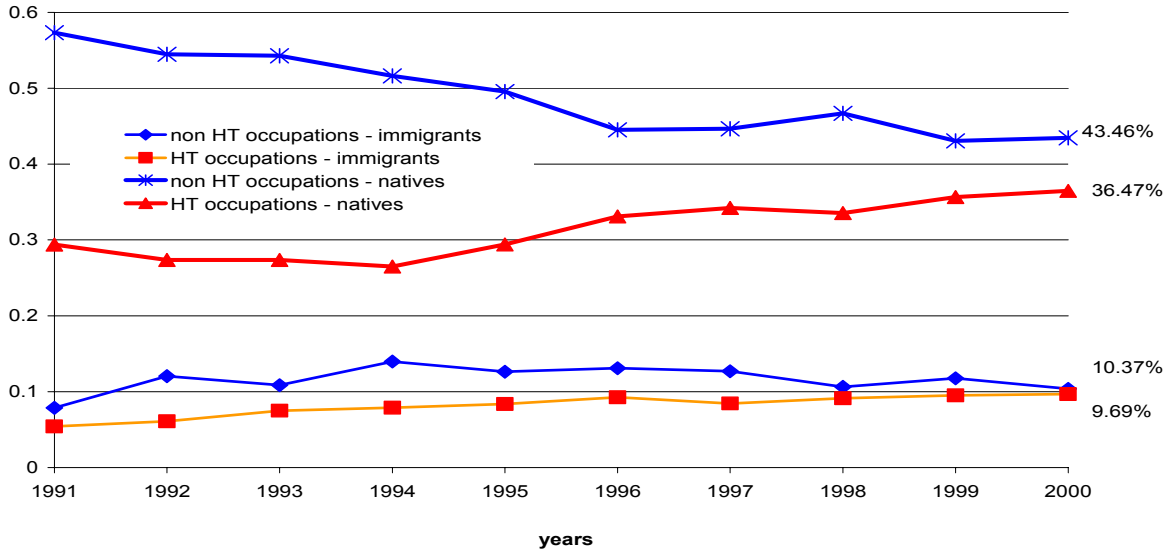
Source: LFS 1991-2000.

Figure 4: Employment in Hi-Tech Occupations



Source: LFS 1991-2000

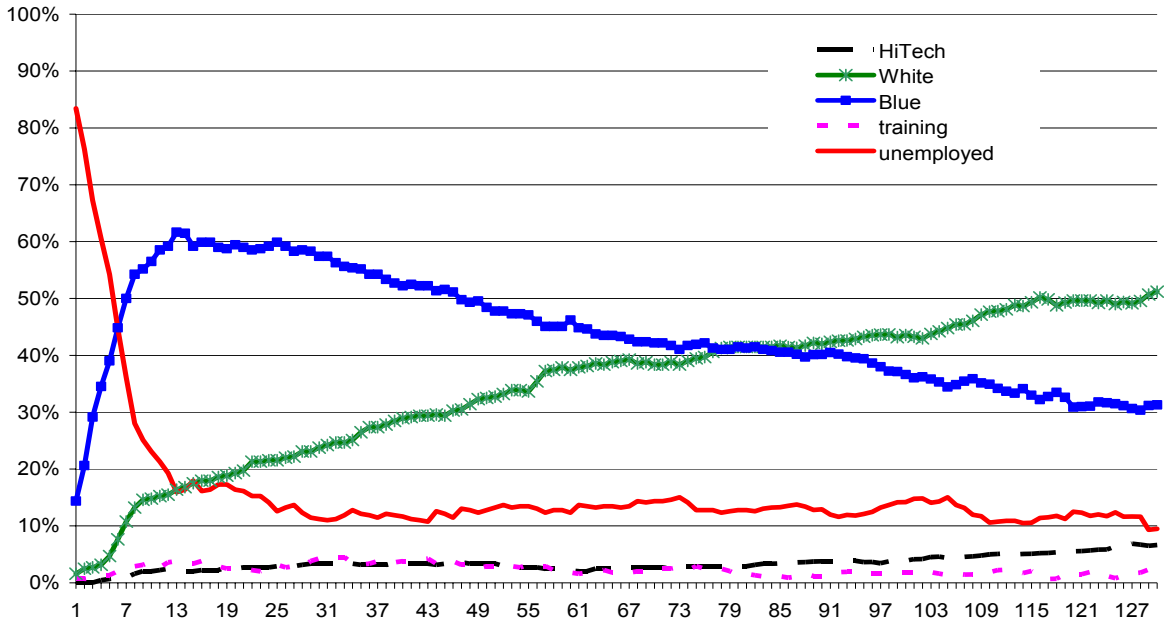
Figure 5: Composition of HT industry by occupation and origin (LFS)



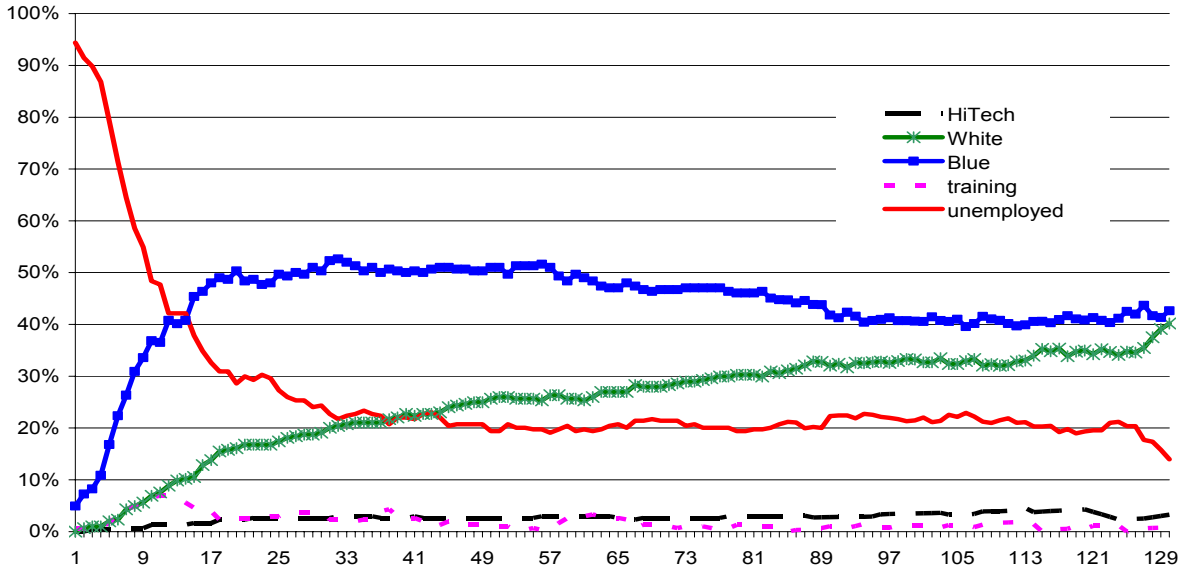
Source: LFS 1991-2000.

Figure 6: Labor Force Composition of Immigrant Engineers

A. Males

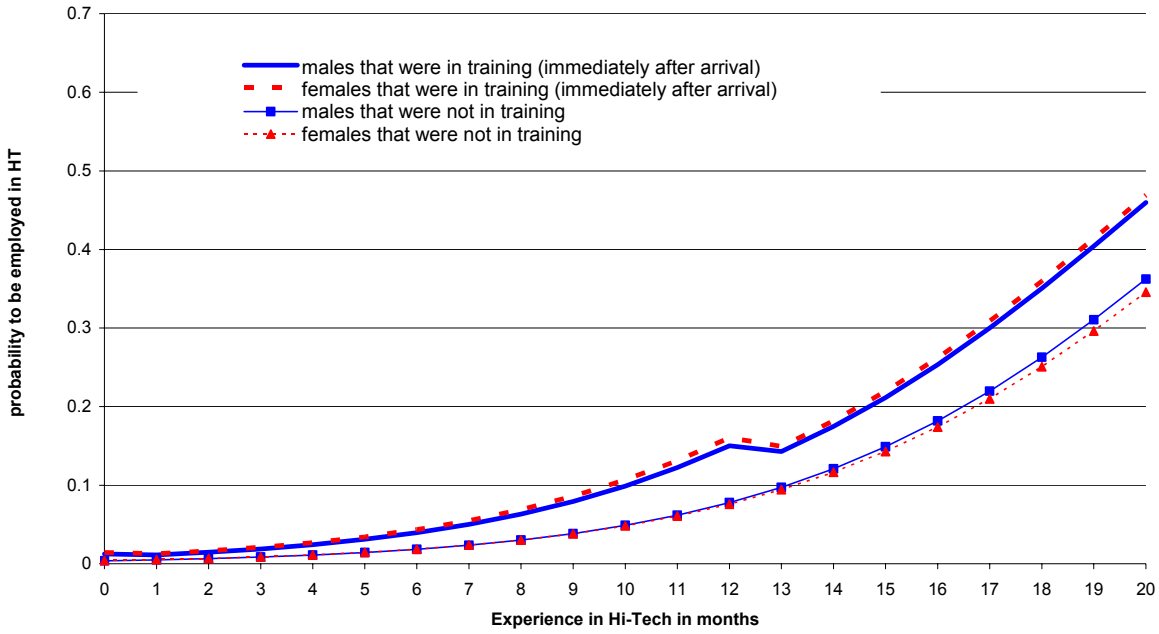


B. Females



Source: Brookdale Engineers surveys

Figure 7: Probability of immigrants to be employed in Hi-Tech by sex



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2) Trajtenberg, M., "R&D Policy in Israel: An Overview and Reassessment", Science, Technology and the Economy Program (STE) . Working Papers Series, March 2001.

3) Lichtenberg, F. R., "Sources of U.S. Longevity Increase, 1960-1997", Science, Technology and the Economy Program (STE) - Working Papers Series, November 2000.

4) Peled, D., "Defense R&D and Economic Growth in Israel: A Research Agenda", Science, Technology and the Economy Program (STE) - Working Papers Series, March 2001.

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20) Avnimelech, G., Teubal M., “Evolutionary Venture Capital Policies: Insights from a Product Life Cycle Analysis of Israel’s Venture Capital Industry”, Science, Technology and The Economy Program (STE) Working Papers Series STE-WP-20-2003, November 2003.

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