Age at immigration and high school dropouts

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Abstract

We focus on high school dropout rates among male and female immigrant children. We consider the relationship between the dropout rate and age at arrival of the immigrants. Using repeated cross sectional data from the Israeli Labor Force Surveys of 1996-2011 we show that the share of high school dropouts among immigrant children who arrived from the Former Soviet Union during 1989-1994 is at least *double* that of natives in the same age group. Further, we show that among immigrant youth there is a negative relation between age at arrival and the share of high school dropouts. To understand our results we present a theoretical framework that links between age at arrival in the host country, language proficiency, quality of education and wages.

Jel codes: I21, J24, J61

Keywords: Immigrants; Age at arrival; High-school dropouts

Introduction

In this paper, we consider the relationship between age at arrival to the host county of immigrant children and the probability of dropping out from high school. We start by presenting the phenomena using data from the Israeli Labor Force Surveys of 1996-2011, and we show that the share of high school dropouts among immigrant children who arrived from the Former Soviet Union during 1989-1994 and were 6-18 years old at arrival is at least double that of natives in the same age group. We then offer a theoretical explanation for our findings in a framework that links between wages, age of arrival and language skills.

The educational outcomes of immigrants and their correlation with age at arrival have been studied extensively by anthropologists and sociologists and more recently also by economists. In the sociological literature, Inbar and Adler (1976) were the first to empirically study the relationship between age at arrival and scholastic achievement, defined as acceptance to institutions of higher education. They used a sample that included 212 Moroccan youths who had immigrated with their families to either France or Israel. Given the small sample, age at arrival was grouped into four categories (0-5, 6-11, 12-15, 16+). They found an unexpected curvilinear (U shape) relationship, with the dip in achievement falling in the 6-11 age group. The percentage of immigrant students attaining higher education in this age group was considerably lower than that of respondents who immigrated at an older or younger age. A similar trend was later found by Inbar (1977), using the same definition of achievement, among native English speaker immigrant males to Canada. This finding led to the "Vulnerable Age Hypothesis"

which states that the discrepancy between the pressure that children face and the resources at their disposal to cope with that pressure is largest at the elementary school level (as opposed to older and younger age levels). Hence, children who immigrate at that age are particularly vulnerable, and this vulnerability is likely to be expressed by a lower level of scholastic achievement and later in their labor market performance.

From an economic point of view, immigration at an early age is usually perceived to be more beneficial due to the belief that younger immigrants are more able to adjust to linguistic and cultural challenges associated with migration. Moreover, the complementarity between destination language and other forms of human capital (schooling) also suggests that youth will accrue more benefits from undertaking any destination specific investment.

However, like in the sociological literature, the economic literature also finds some evidence that those immigrating in their late teens obtain lower schooling in comparison to those immigrating at a slightly younger or older age. Thus, the relationship between scholarly and economic outcomes and age at arrival is not monotonic all throughout the interval of age at arrival.

In general, the economic literature on immigrant educational attainment focuses on post-migration schooling, pre-migration schooling and total attainment of schooling which equals the sum of pre- and post- migration schooling. The key finding that emerged from the post-migration schooling literature is that age at immigration coupled with duration of residence in the host country is a primary determinant of investment in schooling[1].

Education attainment of immigrants has been studied recently in several countries. In Germany, Gang and Zimmerman (2000) indicate that the gap in educational attainment between immigrants and their comparable German-born cohort is much smaller in the second generation compared to the gap in the first-generation, implying that assimilation exists in the acquisition of education. This finding is in line with Schultz (1984) and Betts and Lofstrom (2000), who found that the schooling level of children of immigrants in the US converges toward that of the children of natives.

Schaafsma and Sweetman (2001) use Canadian data and find three channels which generate the negative correlation between age at arrival and earnings. The first source is that work experience in the source country yields no return in the host country. The second is that except for immigrants who arrive as young children who have a return to education similar to that of the Canadian born, the return to education declines with age at immigration, such that those who arrive as older adults have quite low returns. The third channel is that for visible minorities and for those whose mother tongue is not English, age at arrival has an economic impact that may be thought of as an 'acculturation' effect.

Another notable finding in Schaafsma and Sweetman (2001) is that immigrants who arrive in their late teens (ages 15-18), near the high school to post-secondary transition, have lower earnings than those who arrive either slightly earlier or later. Further examination shows that this age at immigration group appears to obtain less education than surrounding groups. The authors conclude that it is plausible that entering a new society near this crucial transition induces acquisition of less schooling and that this has a life-long earnings impact.

Gonzalez (2003) finds that age at arrival is an important determinant of the educational attainment in the US among immigrants from Mexico. For Mexicans, each year of delayed entry results in about 0.25 to 0.30 less years of school. He shows that in some cases delayed entry not only results in lower total education, but also a lower percentage of US-specific (post-migration) education and consequently wages.

Chiswick and DebBurman (2004) use US data to analyze the determinants of total educational attainment, which is the sum of pre- and post migration schooling, by immigrant generation.[2] Using Current Population Survey (CPS) data, they analyze differences in educational attainment by immigrant generation (first, second, and higher order generations) and among the foreign born, by country of birth and age at immigration. They find that second-generation American adults have the highest level of schooling, exceeding that of the foreign born and of the native born with native-born parents. Similar to the findings of Schaafsma and Sweetman (2001) for Canada, they find that teenage immigration to the US is associated with fewer years of schooling compared to those who immigrated at pre-teen or post-teen ages. Specifically, using categorical groups of age at arrival, they observe a dip at age at immigration 13—19. That is, immigrating during the secondary school years is associated with a greater disadvantage than if the immigration took place a few years earlier or later.

While most of the aforementioned studies included in their analysis also immigrants who arrived to their destination country as adults, Bleakley and Chin (2004) focus, as we do in this paper, on immigrants who immigrated as children. Specifically, they show there is a powerful association between immigrants' age at arrival and language skills in the 1990 U.S. Census. In order to control for other channels than language and through which age at arrival affects immigrant earnings, they use immigrants from English-speaking countries to control for non language effects of age at arrival. Thus, they use age at arrival interacted with a dummy for non-English-speaking country as an instrumental variable (IV) for the measurement of the impact of language skills on earnings. They find that much of the effect of English-language skills on earnings appears to be mediated by years of schooling. Better English-language skills induce immigrants who would otherwise drop out with the equivalent of junior high or some high school education to at least complete their high school degree.

In our Israeli case study, we focus on immigrant children who arrived in Israel from the Former Soviet Union (FSU). Most of these immigrants spoke Russian and were not familiar with Hebrew, which is the spoken language in Israel. While the vast majority of adult immigrants from the FSU participated in government provided Hebrew classes (Ulpan), immigrant children had to study the new language at school.[3] However, there is some evidence that the sheer size of this wave enabled the immigrants to continue using the Russian language and to maintain cultural traditions, hereby lowering the incentive of immigrants to invest in acquisition of Hebrew and local skills (Cohen Goldner et al. 2014).[4] Since we follow immigrant children who arrived about 20 years ago we are not able to fully observe their wages (some of them have not joined the labor force yet), and thus we focus on the education achievements and not on wages.

We start by presenting the data and statistical analysis and then turn to consider a theoretical explanation of our findings. The main result we obtain is that among immigrant children, age at arrival plays an important role in education achievements and

specifically in the decision to drop out of high-school, probably through the effect of age at arrival on language acquisition. Since it takes time to learn the local language, young immigrants who arrive in the new country around the ninth to eleventh grade may not have enough time to study the language before the completion of high-school.

Another interesting result is that while age at arrival lowers the probability to graduate high school for both young immigrant males and females, it does not significantly affect the likelihood of obtaining post secondary education among males. But it lowers significantly the probability of female immigrants to obtain such education.

Despite the notion that it is better to immigrate at younger ages, our theory suggests that if age of arrival is sufficiently high such that the immigrant arrives after the completion of his education, or at least the completion of high school in his source country, then his wage is expected to be higher than that of an immigrant who was younger at arrival but dropped out of high school in the destination country. In addition, our theory allows the effect of age of arrival on wages to be also a function of the relative quality of education in the two countries.

One important implication of our study is that when studying immigrants' outcomes in the destination country using a wide range of ages, one should enable a flexible polynomial effect of age at arrival rather than restricting the impact of age at arrival on the desired outcome to be monotonic.

Data

We use repeated cross sectional data from the Israeli Labor Force Surveys of 1996-2011. In order to study the impact of age at arrival on total schooling outcomes of immigrant children, we restrict the analysis to FSU immigrants who arrived at ages 6-18.[5] The comparable native sample includes Jews who were born in Israel or migrated to Israel prior to 1970 and were 6-18 years old during 1989-1994 (i.e. born during 1971-1985). Since we are interested in completed years of schooling, we include only those who were 25 years old or older at the year they were surveyed and stated they were not currently studying.[6] We restrict the sample to FSU immigrants who arrived in Israel during 1989-1994 and exclude Israeli Arabs and other non-Jewish individuals.

Tables 1 and 2 present selected summary statistics of our sample for males and females, respectively. The average age of native males in our sample is 30 (Table 1). Immigrants are slightly younger, and their average age at arrival is around 14. Of those who arrived between 1989 and 1992, less than 12% were 6-9 years old at arrival, 28% were 10-13 years old at arrival, 21% were aged 14-15 at arrival and nearly 39% were 16-18 years old at arrival. Immigrant boys who arrived during 1992-1994 were slightly older at arrival, on average, than those who arrived in 1989-1991, and almost half of them were 16-18 years old at arrival. The average length of residence in Israel is 16.7 years for those who arrived during 1989-1992 and 15.3 years for those who arrived during 1992-1994.

The average years of schooling of the two cohorts of male immigrants (13-13.4) is remarkably similar to that of male natives (13.66). However, this resemblance masks significant differences in the distribution of schooling between native and immigrant males. Among native males, less than 10% are high school dropouts (0-11 years of schooling), more than 38% are high school graduates (12 years of schooling) and 51.7%

Table 1 Summary statistics - young males*, 1996-2011

Variable	Natives**	1989-91 immigrants	1992-94 immigrants
Age	30.2 (3.89)	29.64 (3.52)	28.97 (3.07)
Age at Arrival		13.9 (3.2)	14.65 (2.82)
6-9		11.64%	5.38%
10-13		28.37%	27.47%
14-15		21.28%	20.39%
16-18		38.72%	46.76%
Time in Israel		16.74 (3.65)	15.32 (2.97)
Years of Schooling	13.66 (2.64)	13.4 (2.66)	12.58 (2.44)
HSD (0-11 years)	9.88%	19.75%	29.52%
HSG (12 years)	38.42%	23.04%	28.75%
ACD (13+ years)	51.70%	57.21%	41.72%
Labor Market Status:			
Employed	76.57%	82.86%	82.68%
Unemployed	6.94%	5.80%	6.66%
Out of the Labor Force	16.49%	11.33%	10.67%
Residence:			
Tel Aviv	9.64%	6.38%	4.27%
Haifa	3.40%	5.50%	6.14%
Jerusalem	6.24%	4.04%	3.50%
North	17.02%	22.09%	19.20%
Center	46.52%	38.14%	40.53%
South	12.54%	21.38%	23.89%
Judea, Samaria and Gaza	4.64%	2.48%	2.47%
Father's Birthplace:			
Israel	39.96%		
FSU	3.26%		
Europe/America/Oceania	14.42%		
Asia/Africa	41.86%		
Unknown	0.52%		
Number of Observations	51,650	2,947	1,172

*Ages at arrival 6-18 for immigrants, ages 6-18 in 1989-91 for natives (cohorts 1971-85). Aged 25+ in the survey year.
Conditonal on not studying at the time of the survey.
**Born in Israel or immigrated prior to 1970, excluding Arabs and non-Jews.
Dropped observations: Institutions and Bedouins, people with schooling over 30 or with missing schooling.
Source: CBS Labor Force Surveys 1996-2011.

have at least 13 years of education. In contrast, almost 20% of the immigrants who arrived during 1989-1991 and nearly 30% of those who arrived in 1992-1994 are high school dropouts.

The summary statistics for females (Table 2) tell the same story as for males. The difference in the average years of schooling between natives and immigrants is minor but the differences in the distribution of schooling between native and immigrant is huge. The share of high school dropouts is less than 5% among female natives, 12.5% among female immigrants who arrived in 1989-1991 and more than 20% among females who arrived in 1992-1994. These differences are further illustrated in Figures 1a (males) and

Table 2 Summary statistics - young females*, 1996-2011

Variable	Natives**	1989-91 immigrants	1992-94 immigrants
Age	30.2 (3.86)	29.7 (3.56)	28.85 (2.92)
Age at Arrival		13.84 (3.27)	14.61 (2.83)
6-9		12.39%	5.80%
10-13		29.19%	27.02%
14-15		20.16%	21.30%
16-18		38.25%	45.88%
Time in Israel		16.86 (3.58)	15.24 (3.16)
Years of Schooling	14.05 (2.45)	13.95 (2.54)	13.22 (2.74)
HSD (0-11 years)	4.73%	12.49%	20.69%
HSG (12 years)	36.39%	24.09%	29.24%
ACD (13+ years)	58.88%	63.43%	50.08%
Labor Market Status:			
Employed	73.89%	80.16%	81.37%
Unemployed	7.22%	6.13%	5.88%
Out of the Labor Force	18.89%	13.71%	12.75%
Residence:			
Tel Aviv	8.73%	5.60%	4.81%
Haifa	3.49%	5.73%	4.05%
Jerusalem	7.36%	4.09%	3.28%
North	16.22%	23.16%	21.98%
Center	46.31%	37.92%	40.31%
South	12.71%	20.23%	22.67%
Judea, Samaria and Gaza	5.19%	3.26%	2.90%
Father's Birthplace:			
Israel	39.68%		
FSU	3.64%		
Europe/America/Oceania	14.60%		
Asia/Africa	41.68%		
Unknown	0.40%		
Number of Observations	56,478	3,035	1,310

*Ages at arrival 6-18 for immigrants, ages 6-18 in 1989-91 for natives (cohorts 1971-85). Aged 25+ in the survey year.
Conditonal on not studying at the time of the survey.
**Born in Israel or immigrated prior to 1970, excluding Arabs and non-Jews.
Dropped observations: Institutions and Bedouins, people with schooling over 30 or with missing schooling.
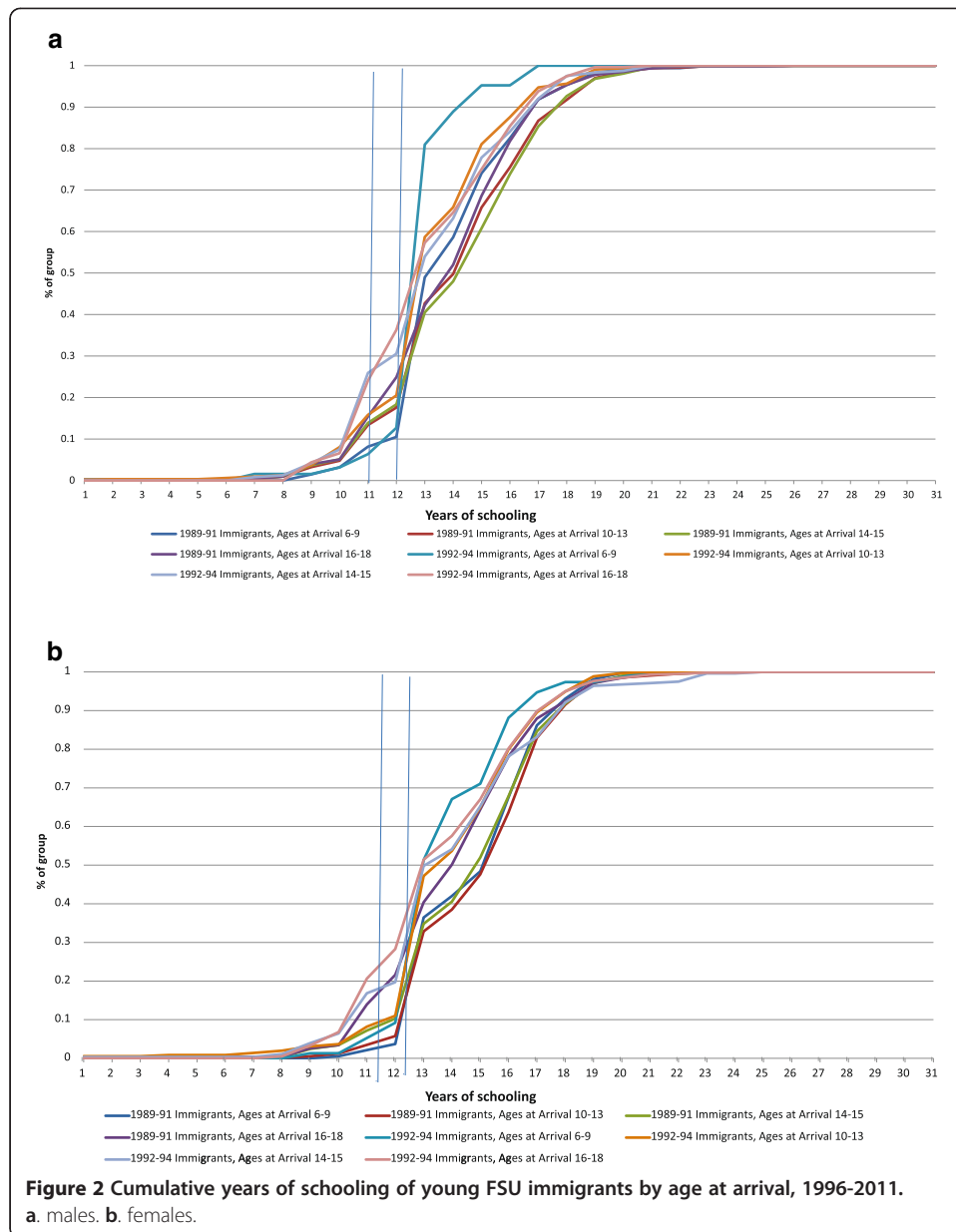Source: CBS Labor Force Surveys 1996-2011.

b (females) which present the distribution of *continuous* years of schooling for natives and for the two cohorts of immigrants.

In addition to the differences between the schooling distribution of natives and immigrants, there is a substantial disparity in the schooling distribution of immigrants by age at arrival. This disparity is illustrated in Figure 2a for males and in Figure 2b for females. The figures present the cumulative distribution of completed years of schooling of immigrant children by cohort (1989-1991, 1992-1994) and four groups of age at arrival: 6-9, 10-13, 14-15 and 16-18.

Both figures clearly illustrate that within cohorts, there is a monotonic negative relation between age at arrival and the share of high school dropouts (0-11 years of

a

b

Figure 1 Schooling distributions of young FSU immigrants 1996-2011. a. males. **b**. females.
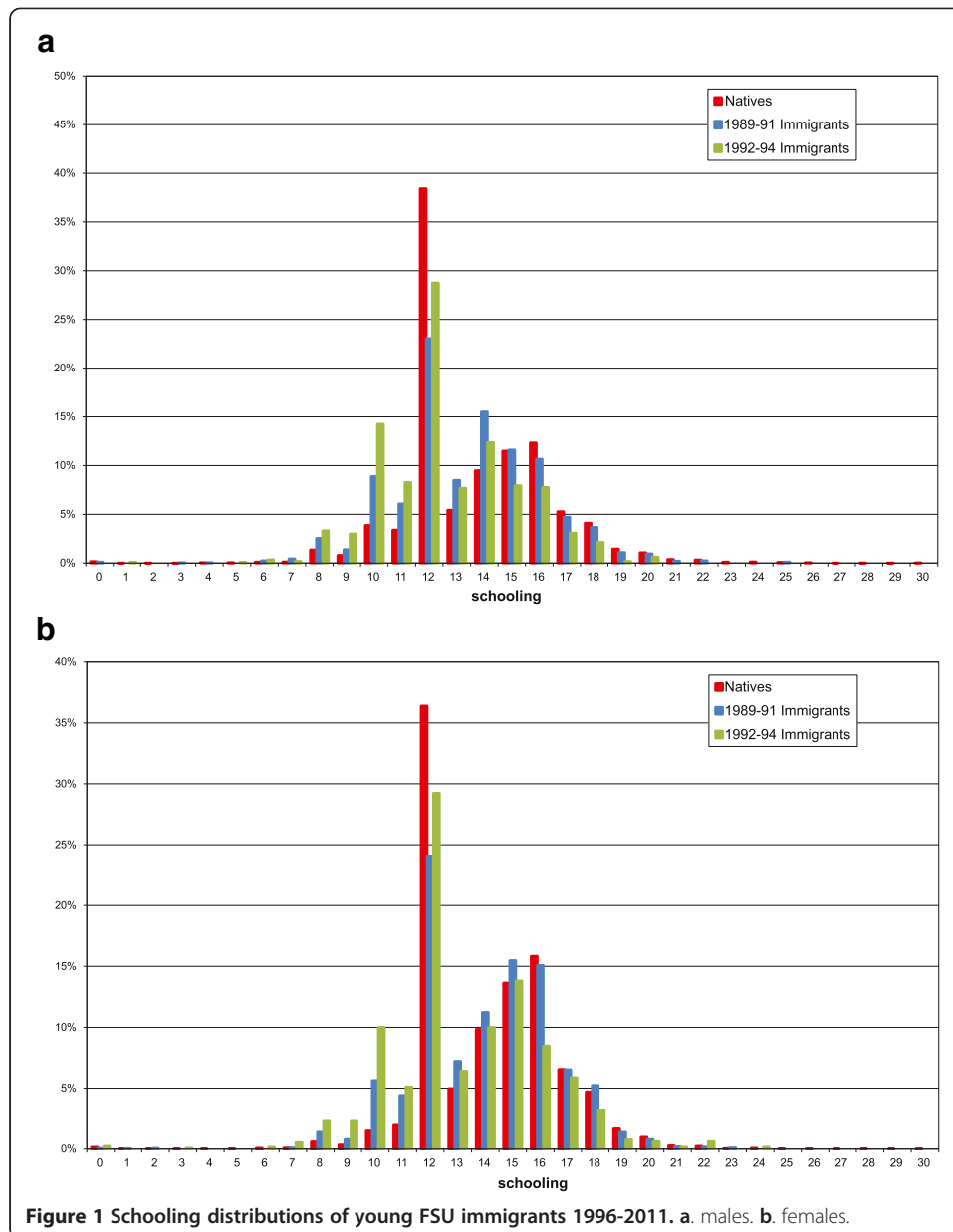
schooling), such that immigrants who arrived in their late teens (16-18) have the highest dropout rate. In addition, conditional on age at arrival, the later cohort (1992-1994) has a higher probability to drop out of high school than the earlier cohort. For example, according to Figure 2a, 24.9% (36.3%) of the boys who arrived during 1989-1991 (1992-1994) and were 16-18 years old at arrival possess at most 11 years of education. The corresponding percentages for boys who were 6-9 years old at arrival are 10.5% for the 1989-1991 cohort and 12.7% for the 1992-1994 cohort. The share of high school dropouts among females is lower and follows the same pattern as for boys (Figure 2b). While 21.6% (28.3%) of the girls who arrived during 1989-1991 (1992-1994) and were 16-18 years old at arrival possess at most 11 years of education, the corresponding percentages for girls who were 6-9 years old at arrival are 3.7% for the 1989-1991 cohort and 9.2% for the 1992-1994 cohort[7].

Figure 2 Cumulative years of schooling of young FSU immigrants by age at arrival, 1996-2011.
a. males. **b**. females.

In order to measure the impact of age at arrival on educational attainment of children immigrants, we run multinomial logit regressions for the three education outcomes: 0-11 (HSD), 12 (HSG) and 13+ (ACD) years of schooling with age at arrival categorical dummies as well as with continuous age at arrival high-order polynomial. We also run multinomial Ordered Logit regressions for the three education outcomes. The results and the discussion of this specification are presented in Appendix A. The results are presented in Table 3 for males and Table 4 for females. The figures in the table are the estimated coefficients such that a positive (negative) number implies the explanatory variable increases (decreases) the probability to be a high school graduate (HSG) or obtain academic education (ACD) compared to the omitted category (high school dropout-HSD).[8] In the results from the first specification, we find that boys who arrived at the age group of 16-18 have a lower probability to graduate high school in

Table 3 Multinomial logit regression for schooling, young males*

Variable	FSU immigrants 1989-1994		FSU immigrants 1989-1994	
	HSG (12 years)	ACD (13+ years)	HSG (12 years)	ACD (13+ years)
Age				
Tel Aviv	-0.7002* (0.2104)	-0.4763* (0.1752)	-0.676* (0.211)	-0.4611* (0.1754)
Haifa	0.6331* (0.2787)	1.4085* (0.2412)	0.6361* (0.2792)	1.4237* (0.2416)
Jerusalem	0.5754* (0.2907)	0.9559* (0.2529)	0.5698* (0.2913)	0.965* (0.253)
North	0.0566 (0.1365)	0.0429 (0.121)	0.0816 (0.137)	0.0521 (0.1212)
Center	0.0059 (0.122)	0.2982* (0.1065)	0.0277 (0.1222)	0.3074* (0.1065)
Judea, Samaria and Gaza	0.6756* (0.3272)	0.5769** (0.3053)	0.6771* (0.3275)	0.5947** (0.3052)
Time in Israel	0.0939 (0.0721)	0.0894 (0.0631)	0.0839 (0.0724)	0.0902 (0.0633)
1992-94 Immigrant	-0.5848 (0.5516)	-0.9639* (0.4915)	-0.5298 (0.5556)	-0.9541** (0.4937)
Time in Israel for 1992-94 Immigrants	0.0444 (0.0324)	0.0205 (0.0293)	0.0405 (0.0327)	0.0195 (0.0294)
Ages at arrival 6-9	1.6642* (0.2029)	0.3005 (0.1917)		
Ages at arrival 10-13	0.7697* (0.1276)	0.1217 (0.1097)		
Ages at arrival 14-15	0.3873* (0.132)	0.1091 (0.1103)		
Age at arrival			5.9602** (3.2104)	1.0652 (2.9774)
Age at arrival^2			-0.7415** (0.4121)	-0.0917 (0.3791)
Age at arrival^3			0.038** (0.0227)	0.0026 (0.0207)
Age at arrival^4			-0.0007 (0.0005)	0 (0.0004)
Constant	-2.2874 (1.5528)	-0.84 (1.3609)	-17.2312** (9.1753)	-4.538 (8.5432)
Year Fixed Effect	Yes	Yes	Yes	Yes
Number of Observations	4,119		4,119	
Log Likelihood	-3970.7007		-3960.8456	
Pseudo R^2	0.0533		0.0556	

*Ages at arrival 6-18. Aged 25+ in the survey year. Conditonal on not studying at the time of the survey.
Omitted categories: South, Year 2011, Ages at arrival 16-18. Comparison group: HSD (0-11 years).
Standard errors appear in parentheses. *Significant at 5% level. **Significant at 10% level.
Source: CBS Labor Force Surveys 1996-2011.

comparison to all the other categories of age at arrival. However, there is no significant difference in the likelihood to obtain 13+ years of schooling between the four categories of age at arrival. The specification of continuous age at arrival polynomial also suggests that age at arrival affects the probability of young males to obtain 12 years of schooling in comparison to 0-11 years of schooling, but it has no significant effect on the likelihood to obtain 13+ years of schooling.

For girls, both specifications suggest that age at arrival adversely affects both the propensity to obtain 12 years of schooling as well as 13+ years of schooling, in comparison to 0-11 years of schooling. That is, girls who were 16-18 years old at arrival to Israel have a lower probability to graduate from high school or to obtain higher education in comparison to those who were younger at arrival.

The predictions of multinomial regressions for males are illustrated in Figure 3 for an immigrant who lives in the Center and arrived in Israel 20 years ago (Years since migration=20). Figure 3a presents the prediction from the specification with age at arrival categories, while Figure 3b presents the prediction from the specification with continuous age polynomials. Both specifications have similar predictions. Conditional on cohort of arrival to Israel, the predicted probability of immigrant boys who arrived

Table 4 Multinomial logit regression for schooling, young females*

Variable	FSU immigrants 1989-1994		FSU immigrants 1989-1994	
	HSG (12 years)	ACD (13+ years)	HSG (12 years)	ACD (13+ years)
Age				
Tel Aviv	0.0957 (0.2292)	0.0676 (0.2057)	0.0617 (0.2295)	0.0686 (0.2057)
Haifa	0.8171* (0.3321)	1.5462* (0.2987)	0.7712* (0.3322)	1.5254* (0.2989)
Jerusalem	0.1527 (0.32)	0.9726* (0.2639)	0.0895 (0.3201)	0.9594* (0.2638)
North	0.2904* (0.1454)	0.3037* (0.1305)	0.278** (0.1453)	0.306* (0.1304)
Center	0.389* (0.1336)	0.6262* (0.1191)	0.3689* (0.1338)	0.6265* (0.1192)
Judea, Samaria and Gaza	1.1891* (0.3489)	1.0399* (0.3314)	1.1521* (0.3485)	1.0312* (0.3313)
Time in Israel	0.024 (0.0786)	0.0446 (0.0707)	0.0278 (0.0784)	0.0497 (0.0705)
1992-94 Immigrant	-0.0752 (0.5824)	-0.3221 (0.5135)	-0.2095 (0.5846)	-0.3851 (0.5171)
Time in Israel for 1992-94 Immigrants	-0.0079 (0.0341)	-0.0222 (0.0303)	0.0019 (0.0343)	-0.0169 (0.0306)
Ages at arrival 6-9	2.0452* (0.2598)	1.3203* (0.2472)		
Ages at arrival 10-13	1.4919* (0.1488)	1.1115* (0.1352)		
Ages at arrival 14-15	0.8313* (0.1396)	0.617* (0.1232)		
Age at arrival			-6.2381 (4.802)	-9.5815* (4.5781)
Age at arrival^2			0.8597 (0.5909)	1.2479* (0.5606)
Age at arrival^3			-0.0515** (0.0314)	-0.07* (0.0296)
Age at arrival^4			0.0011** (0.0006)	0.0014* (0.0006)
Constant	-0.5088 (1.6849)	0.2236 (1.5174)	18.2017 (14.2412)	28.1641* (13.6281)
Year Fixed Effect	Yes	Yes	Yes	Yes
Number of Observations	4,345		4,345	
Log Likelihood	-3873.1296		-3868.7642	
Pseudo R^2	0.0543		0.0553	

*Ages at arrival 6-18. Aged 25+ in the survey year. Conditonal on not studying at the time of the survey.
Dropped observations: Institutions and Bedouins, people with schooling over 30 or with missing schooling.
Omitted categories: South, Year 2011, Ages at arrival 16-18. Comparison group: HSD (0-11 years).
Standard errors appear in parentheses. *Significant at 5% level. **Significant at 10% level.
Source: CBS Labor Force Surveys 1996-2011.

in their late teens to drop out of high school is about double the probability of those who arrived in early childhood (ages 6-9). After 20 years in Israel, the predicted probability of boys who arrived at ages 16-18 during 1989-1991 to drop out of high-school is 17% in both specifications, while this probability for boys who arrived at ages 6-9 is 10% in both specifications. The corresponding predicted probabilities to be a high school drop out for the 1992-1994 cohort are 26% for those who were 16-18 years old at arrival versus 12-13% for those who were 6-9 years old at arrival (Figures 3a and b)[9].

The predictions for girls are presented in Figures 3c and 3d. For girls the impact of age at arrival on dropout rates is even stronger such that after 20 years in Israel the predicted probability of a girl who was 6-9 years at arrival is about 4%-6% depending on the specification and cohort; while this probability for girls who were 16-18 years at arrival is 20%-26% (Figures 3c and d).

The higher dropout rate among immigrant girls who arrived in their late teens in comparison to immigrant boys at the same age group may result from the fact that immigrant females tend to get married earlier than immigrant males thus making the
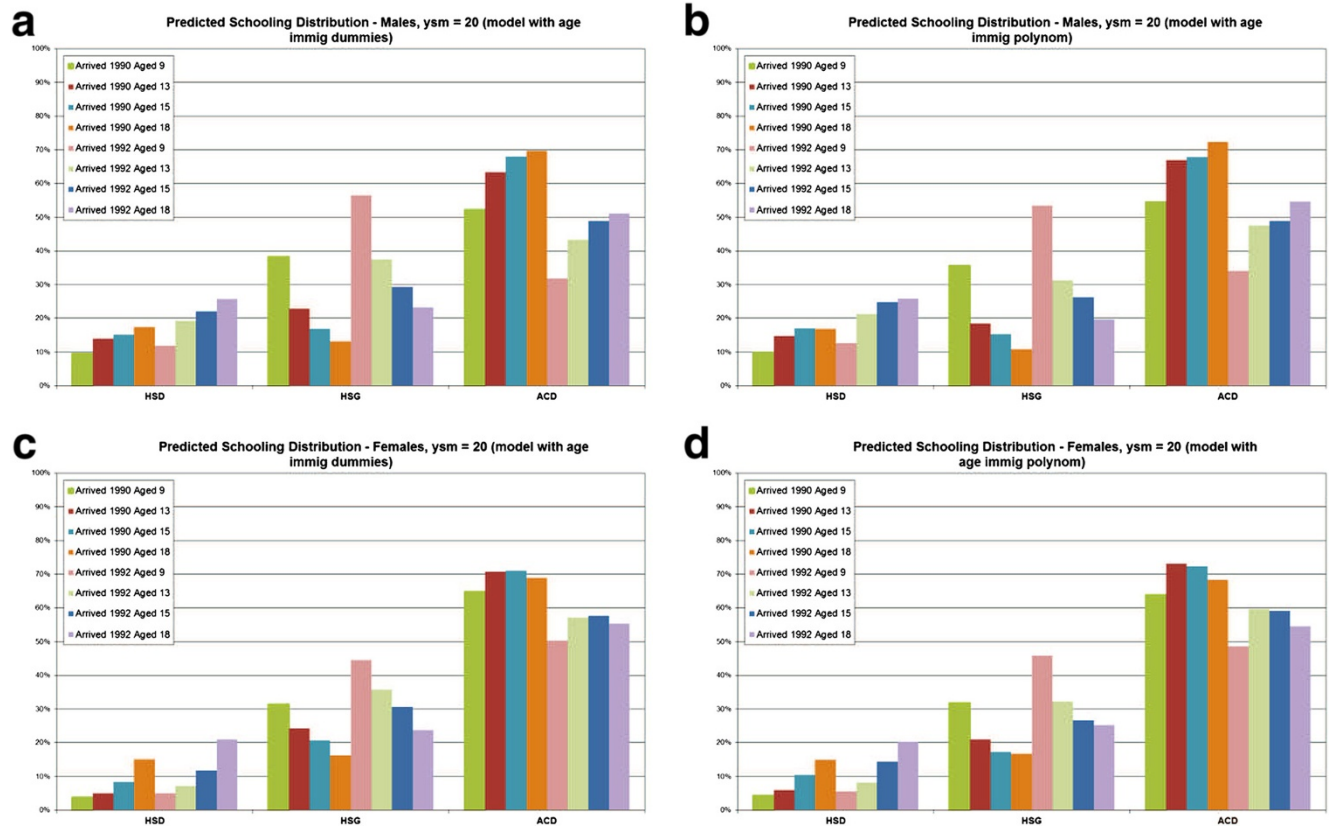
Figure 3 Predicted schooling distribution Multinomial Logit Model. a. males, YSM=20, model with age at arrival dummies, **b**. males, YSM=20, model with age at arrival polynomial, **c**. females, YSM=20, model with age at arrival dummies, **d**. females, YSM=20, model with age at arrival polynomial.

investment to acquire education less attractive for female teenagers who are close to marriage ages [10].

A possible theoretical explanation

Age on arrival may affect immigrants' wages in the destination country through several channels as it affects both the human capital the immigrant acquired in the destination country and the ability of the immigrant to acquire local capital in the destination country. For example, for immigrants who migrated as adults after the completion of their education, age at arrival can serve as a proxy for work experience in the home country.[11] Nonetheless, the ability and profitability of immigrants who were older at arrival to learn the new language and other new skills might be limited. For younger immigrants who have not yet completed their schooling prior to immigration, age at arrival can affect the acquisition of local human capital as language and schooling attainment, which in turn, affect wages.

In this section, we consider the impact of age at arrival on wages through its effect on language proficiency and the level of education.

Assume that wage is an increasing function of two main components: 1) language proficiency (Chiswick and Miller, 1995); and 2) the level (years of schooling) and/or the quality of education. However, the language proficiency is a function of the age at arrival. As an immigrant arrives at a younger age, especially at the ages of childhood, his ability and profitability to learn the local language are higher, and thus his proficiency in the local language is higher (Bleakley and Chin, 2004). Other things being equal, an immigrant's ability (and profitability) to obtain a higher level of education increases with the proficiency of the local language. Thus, those who have better language proficiency will be able to obtain a better quality and more years of education. A better quality of education means that given the same set of classes and all other things given, those with the higher language proficiency will do better at their studies and will benefit more from their education.

For simplification, we assume that all immigrants can obtain higher education at the same age. An immigrant can obtain his higher education either in the host country, if he arrived at a young age, or at his home country if he arrived at an older age. Immigrants who arrived in the age interval of 6 - 18 have started acquiring their education in their home country and may continue and complete their education in the destination country. If an immigrant completed his education at the home country, then language proficiency will have only a direct effect on wages and will not affect the level of (imported) education.

Formally, denote by w_i the wage of an immigrant i. Wage is an increasing function of language proficiency, denoted by L_i, and the number of years of education, denoted by E_i, implying $\frac{\partial w_i(L_i,E_i)}{\partial L_i} > 0$ *and* $\frac{\partial w_i(L_i,E_i)}{\partial E_i} > 0$. Up to a certain age at arrival, $\bar{A}$, the level of education is a function of language proficiency, and language proficiency is a function of age at arrival. Thus, the wage of an immigrant i whose age at arrival satisfies $Age_i \leq \bar{A}$ can be written as: $w_i(L_i(Age_i), E_i(L_i(Age_i)))$ such that $\frac{\partial L_i(Age_i)}{\partial Age_i} < 0$ and $\frac{\partial E_i(L_i,Age_i)}{\partial L_i} > 0$. In addition, as long as $Age_i \leq \bar{A}$, increasing the age at arrival decreases level of education, implying $\frac{\partial E_i(L_i)}{\partial L_l} \frac{\partial L_i}{\partial Age_i} < 0$.

However, if the age of arrival is sufficiently high, $Age_i > \bar{A}$, such that the immigrant has completed his education at the home country, it holds that the level of education E_i is independent of the language proficiency and is constant at a level obtained in the host country, E_f.

Another key issue in determining the effect education has on wages is in which country (i.e. home country or host country) the individual acquired his education. Heath and Kilpi-Jakonen (2012) conduct a cross-country analysis to study whether the effect of age at arrival on the performance of immigrant students in the PISA tests of literacy varies across origin or destination countries. They find that the later the arrival, the greater the penalty. However, their results vary according to other factors, including language differences and whether the country of origin had higher or lower educational standards.[12] Moreover, Li and Sweetman (2014) use international test scores to proxy the quality of source country educational outcomes and explain differences in the rate of return to schooling among immigrants in Canada. The average quality of educational outcomes in an immigrant's source country and the rate of return to schooling in the host country labor market are found to have a strong and positive association. However, in contrast to those who completed their education prior to immigration, immigrants who arrived at a young age are not influenced by this educational quality measure. Further, the return to education observed for those immigrants who arrive before age 10 is not a function of their source country *quality of educational outcome*. This reinforces the idea that it is the quality of educational outcomes, and not source country effects per se, that is correlated with the return to education [13].

Therefore, the effect years of education have on wages is a function of the quality of education in the host county relative to the quality education in the home country. Denote this ratio by γ such that $\gamma = 1$ implies that the quality of education in both countries is identical, $\gamma < 1$ implies the quality of education in the host country is lower than that of the home country and finally, if $\gamma > 1$ the quality of education in the host country is higher than that of the home country.

For a given wage level, an iso-wage locus (indifference curve) is described by the following:

$$dw_i(L_i, E_i) = \frac{\partial w_i(L_i, E_i)}{\partial L_i} \, dL_i + \frac{\partial w_i(L_i, E_i)}{\partial E_i} \, dE_i = 0 \tag{1}$$

which has a negative slope as there is a trade-off between the language proficiency and the level/quality of education:

$$\frac{dL_i}{dE_i} = -\frac{\frac{\partial w_i(L_i, E_i)}{\partial E_i}}{\frac{\partial w_i(L_i, E_i)}{\partial L_i}} < 0 \tag{2}$$

In other words, the iso-wage is downward sloping. Moreover, as we increase the language proficiency we can decrease years of education to obtain the same wage level.

Now let us consider the affect of a change in the age at arrival on the wage:

$$\frac{\partial w_i(L_i(Age,), E_i(L_i(Age_i)))}{\partial Age_i} = \frac{\partial w_i(L_i, E_i)}{\partial L_i} \frac{\partial L_i}{\partial Age_i} + \frac{\partial w_i(L_i, E_i)}{\partial E_i} \frac{\partial E_i}{\partial L_i} \frac{\partial L_i}{\partial Age_i} \tag{3}$$

Given that $\frac{\partial w_i(L_i,E_i)}{\partial L_i} > 0$, $\frac{\partial L_i}{\partial Age_i} < 0$, $\frac{\partial w_i(L_i,E_i)}{\partial E_i} > 0$ *and* $\frac{\partial E_i}{\partial L_i} \frac{\partial L_i}{\partial Age_i} < 0$ and $Age_i \leq \bar{A}$ we obtain that if

$$\frac{\partial w_i(L_i(Age,),E_i(L_i(Age_i)))}{\partial Age_i}\Big|_{Age_i \leq \bar{A}} < 0 \tag{4}$$

If the migrant arrived at an older age such that he obtained his education in the home country, $Age_i > \bar{A}$, we also obtain $\frac{\partial w_i\left(L_i(Age,),E_f\right)}{\partial Age_i}\big|_{Age_i > \bar{A}} < 0$.

However,

$$w_i(L_i(Age_i),E_i(L_i(Age_i)))|_{Age_i=\bar{A}} < w_i\left(L_i(Age_i),E_f\right)|_{Age_i=\bar{A}} \tag{5}$$

The reason for this is that a migrant who arrives older to the home country would have difficulties obtaining the language and, thus, would not obtain a good education. On the other hand, a migrant that came at a similar age with a high education does not need the acquisition of local language to obtain this level of education and, thus, language would only affect his wage directly. Thus, we obtain the flowing relationship between age at arrival and the migrant's wages:

Since there is a direct relationship between wages and education for those arriving at age below $\bar{A}$, one could also write on the vertical axes of Figure 4 education achievements for these immigrants. Thus, up to the age of arrival of $\bar{A}$, education achievements decrease, and high school dropout rates increase with age of arrival, as our data in Data section shows. At age at arrival $\bar{A}$, we have a non-continuous jump in the wages since migrants' have already established a solid education achievement in the home country before arriving at the destination.

Now let us consider the effect of the quality of education in the host country relative to that of the home country (γ). The iso-wage as described in (2) is a function of γ such that as γ increases, the slope of the iso-wage is steeper. For example, an individual moving from low quality education country to a higher one, implying $\gamma > 1$, will have a steeper slope in the iso-wage function than when both countries have the same education level and will have lower wage conditional on arriving at age greater than $\bar{A}$. This can be seen in Figure 5 [14].

Conclusions

Both our theoretical and empirical analysis suggests that age at arrival is critical for education achievement of immigrant children and specifically on high school graduation. Since education affects a variety of important outcomes, such as wages, parents should be cognizant of this when making their immigration choices. Policymakers should also be aware of the negative association between age at arrival and the likelihood to drop out of high-school at late-teen ages. If this negative correlation results from difficulties to acquire the local language especially among immigrants who arrived in their late-teens, as was found in Canada and the U.S. among immigrants from non English speaking countries, then special language programs aimed at youth should be considered. Unfortunately, the current Israeli data we use does not include data on language skills, and other data sources should be used to investigate the link between age at arrival, language and education. Future work should also explore the impact of family background on the incident of dropping out of high-school.

Figure 4 Age at arrival-wage profile.
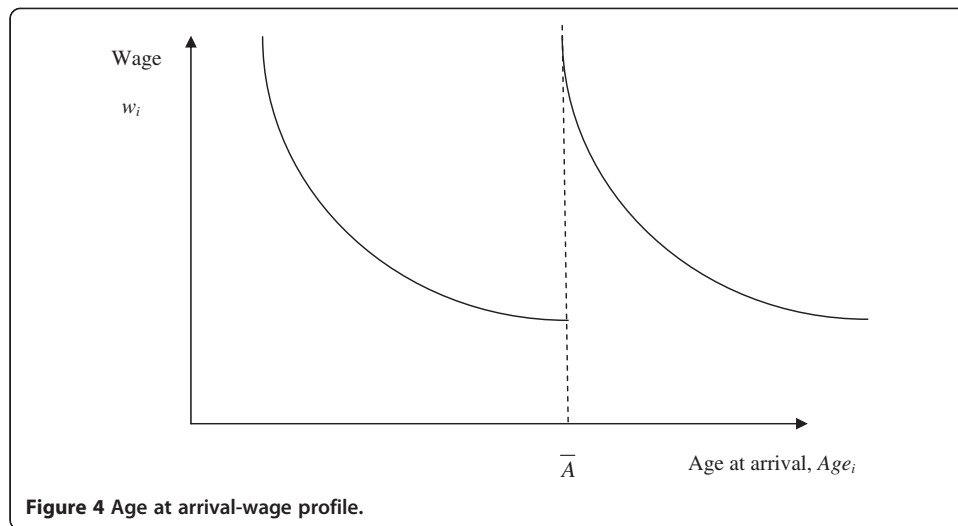
Appendix A: Ordered Logit Estimation for HSD, HSG and ACD

While it is not clear that from the individual point of view academic education (ACD) is superior to high school graduation (HSG), which is in turn superior to being a high school dropout (HSD), from the society point of view there is a clear order between the three educational categories. Thus, in this appendix we present and discuss the results obtained from Ordered Logit regression for HSD, HSG and ACD.

In comparing the results of the Ordered Logit to the 'standard' Multinomial Logit which we discuss in Section 1, one should keep in mind that one of the assumptions underlying ordered logistic regression is that the relationship between each pair of outcome groups is the same (proportional odds assumption). Thus, for example, the coefficients that describe the relationship between the lowest versus all higher categories of the dependent variable are the same as those that describe the relationship between the next lowest category and all higher categories, etc. As a result, it gives only one set of coefficients regardless of the discrete number of outcomes of the dependent variable, while the multinomial Logit Regression gives N-1 sets of coefficients, where N is the number of outcomes of the dependent variable [15].

Figure 5 The impact of relative quality of education on age at arrival-wage profile.
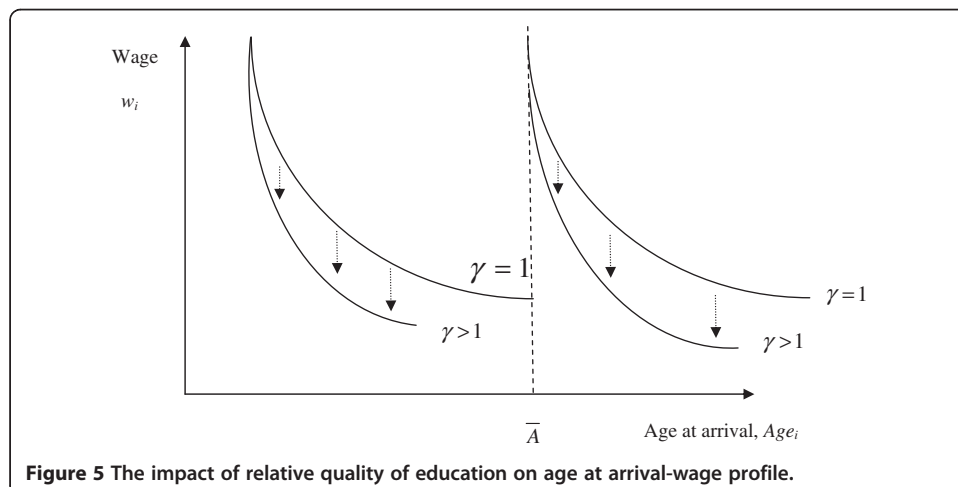
The results of the Ordered Logit model with age at arrival categorical dummies as well as with continuous age at arrival high-order polynomial are presented in Tables 5 and 6 for males and females, respectively. For males we find that in the specification with age at arrival dummies, only age at arrival 6-9 is significant such that young boys who were 6-9 years old at arrival decrease the log odds of being in a higher level of schooling by 0.33, given all of the other variables in the model are held constant. Thus, those who were at this age range at arrival have a lower probability to obtain more education. In the specification with continuous age at arrival, none of the age at arrival polynomials was significant.

For females, the Ordered Logit implies that arriving at ages 10-13 or 14-15 increase the probability to obtain more education such that arriving at ages 10-13 (14-15) leads to an increase of 0.33 (0.27) in the log odds of being in a higher level of education. All the coefficients of the age at arrival polynomial are also significant in the females' regression.

The predictions of the Ordered Logit regressions are illustrated in Figure 6 for an immigrant who lives in the Center and arrived in Israel 20 years ago (Years since migration=20). Figure 6a presents the prediction from the males' regression with age at arrival categories, while Figure 6b presents the prediction from the males' regression with continuous age polynomials. Both specifications have similar predictions. In

Table 5 Ordered logit regression for schooling, young males*

Variable	FSU immigrants 1989-1994	FSU immigrants 1989-1994
Tel Aviv	−0.2812* (0.1409)	−0.2761* (0.141)
Haifa	1.0705* (0.1592)	1.08* (0.1596)
Jerusalem	0.6785* (0.1769)	0.6853* (0.1769)
North	0.0283 (0.0902)	0.0288 (0.0903)
Center	0.2764* (0.0801)	0.2761* (0.0801)
Judea, Samaria and Gaza	0.2933 (0.1977)	0.3097 (0.1978)
Time in Israel	0.0549 (0.0473)	0.0581 (0.0474)
1992-94 Immigrant	−0.9324* (0.3776)	−0.9259* (0.3795)
Time in Israel for 1992-94 Immigrants	0.021 (0.022)	0.0206 (0.0221)
Ages at arrival 6-9	−0.3306* (0.1135)	
Ages at arrival 10-13	−0.0912 (0.0815)	
Ages at arrival 14-15	0.005 (0.0859)	
Age at arrival		−1.3677 (1.9532)
Age at arrival^2		0.2093 (0.2524)
Age at arrival^3		−0.0127 (0.014)
Age at arrival^4		0.0003 (0.0003)
Cutpoint 1	−0.3785 (1.0175)	−2.926 (5.573)
Cutpoint 2	0.806 (1.0176)	−1.7413 (5.5729)
Year Fixed Effect	Yes	Yes
Number of Observations	4,119	4,119
Log Likelihood	−4058.2033	−4057.4067
Pseudo R^2	0.0324	0.0326

*Ages at arrival 6-18. Aged 25+ in the survey year. Conditional on not studying at the time of the survey.
Dropped observations: Institutions and Bedouins, people with schooling over 30 or with missing schooling.
Omitted categories: South, Year 2011, Ages at arrival 16-18. Comparison group: HSD (0-11 years).
Standard errors appear in parentheses. *Significant at 5% level. **Significant at 10% level.
Source: CBS Labor Force Surveys 1996-2011.

Table 6 Ordered logit regression for schooling, young females*

Variable	FSU immigrants 1989-1994	FSU immigrants 1989-1994
Tel Aviv	0.031 (0.1434)	0.0448 (0.1436)
Haifa	1.0623* (0.1689)	1.0622* (0.1692)
Jerusalem	0.8863* (0.1873)	0.9004* (0.1874)
North	0.1658** (0.0902)	0.1736** (0.0903)
Center	0.4221* (0.0819)	0.4283* (0.0822)
Judea, Samaria and Gaza	0.3429** (0.1805)	0.3425** (0.1805)
Time in Israel	0.0278 (0.0471)	0.0303 (0.0471)
1992-94 Immigrant	−0.3787 (0.3648)	−0.3693 (0.368)
Time in Israel for 1992-94 Immigrants	−0.0104 (0.021)	−0.0106 (0.0212)
Ages at arrival 6-9	0.1298 (0.1168)	
Ages at arrival 10-13	0.3337* (0.0818)	
Ages at arrival 14-15	0.2664* (0.0854)	
Age at arrival		−5.9657* (2.135)
Age at arrival^2		0.7685* (0.2723)
Age at arrival^3		−0.0418* (0.0149)
Age at arrival^4		0.0008* (0.0003)
Cutpoint 1	−1.1174 (1.0101)	−17.6903* (6.1142)
Cutpoint 2	0.2969 (1.0098)	−16.2751* (6.1135)
Year Fixed Effect	Yes	Yes
Number of Observations	4,345	4,345
Log Likelihood	−3975.7882	−3973.8167
Pseudo R^2	0.0292	0.0297

*Ages at arrival 6-18. Aged 25+ in the survey year. Conditional on not studying at the time of the survey.
Dropped observations: Institutions and Bedouins, people with schooling over 30 or with missing schooling.
Omitted categories: South, Year 2011, Ages at arrival 16-18. Comparison group: HSD (0-11 years).
Standard errors appear in parentheses. *Significant at 5% level. **Significant at 10% level.
Source: CBS Labor Force Surveys 1996-2011.

contrast to the predictions obtained from the multinomial Logit (Figure 3), where the probability of HSD increased with age at arrival and the probability of HSG decreased with age at arrival as the Ordered Logit estimates a joint coefficient for all the lower outcomes (due to the proportional odds assumption), it predicts that both the probabilities of HSD and HSG decrease with age at arrival. Dropout rates vary between 13%- 18% among boys who came in the early cohort of 1989-1991 and between 22%-29% among boys who came during 1992-1994.

The predictions of the Ordered Logit regressions for girls are presented in Figures 6c and d. For girls, the predictions for the impact of age at arrival on dropout rates are more in line with the predictions of the multinomial Logit, though here girls who were 6-9 years old at arrival are expected to have higher dropout rates than those who were 10-13 and 14-15 years old at arrival. Due to the proportional odds assumption, the impact of age at arrival on HSD and HSG is similar, and thus we get that age at arrival also increases the probability of HSG (except for the 6-9 age at arrival category), which is in contrast to the predictions from the multinomial Logit regression (Figures 3c and d). Dropout rates among immigrant girls are lower than among boys and vary between 8%-11% among girls who came in the early cohort of 1989-1991 and between 14%-18% among girls who came during 1992-1994.
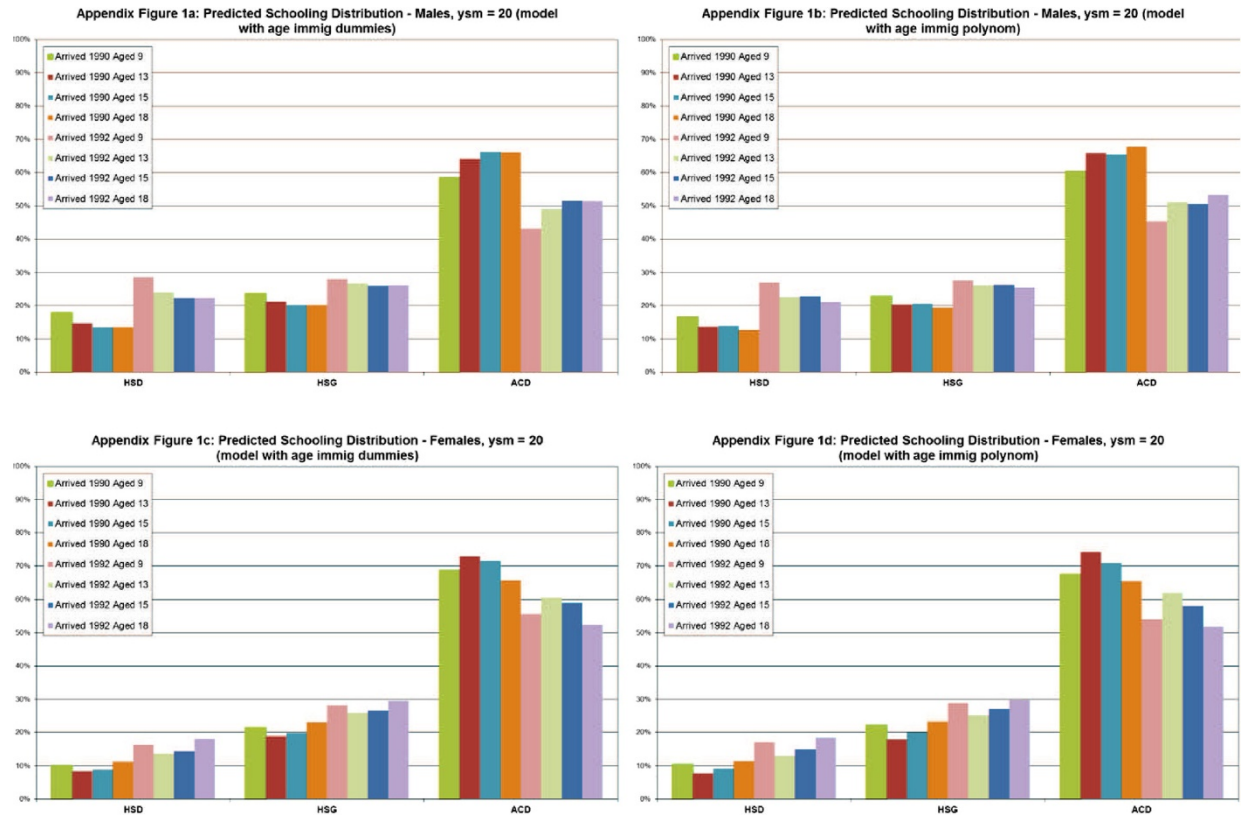
Figure 6 Predicted schooling distribution Ordered Logit Model. a. males, YSM=20, model with age at arrival dummies, **b**. males, YSM=20, model with age at arrival polynomial, **c**. females, YSM=20, model with age at arrival dummies, **d**. females, YSM=20, model with age at arrival polynomial.

Endnotes

[1]For earlier studies, see, for example, Schultz (1984), Chiswick and Miller (1994) and Chiswick & Sullivan (1995).

[2]They focus on total schooling which is the sum of pre- and post-migration schooling.

[3]Immigrant children in Israel get assistance at schools and extra hours for vocational and language help.

[4]Borjas (2013) makes the same argument for the US on the impact of "immigrants' group size" on incentives to invest in English and U.S.-specific human capital. He finds that the rate of increase in English language proficiency is significantly slower for larger national origin groups and that the growth in the size of these groups accounts for about a quarter of the decline in the rates of human capital acquisition and economic assimilation.

[5]We omitted immigrant children who arrived at ages 0-5 due to their low number of observations.

[6]One should note that in Israel it is quite rare for a high school dropout over 25 to complete high school and there are almost no formal programs, like the GED in the US, for example. Thus, people over 25 may further acquire post secondary education, but if at the age of 25 they are classified as high school dropouts, the likelihood they would become high school graduates in the future is negligible.

[7]For comparison, among natives 9.9% of the boys and 4.7% of the girls possess 0-11 years of schooling.

[8]Since many of our explanatory variables of interest are dummy variables, we do not present the marginal effects at the means.

[9]Although we focus on the impact of age at arrival on dropout rates, the figures also show a remarkably high percentage of immigrants with academic education (ACD) among FSU immigrant children, in general, and among those who arrived in the early cohort of 1989-1991, in particular. This is also true for girls as seen in Figures 3c and d.

[10]The average age of male and female immigrants in our sample is virtually the same (Tables 1 and 2). Yet, 70% (65%) of the female immigrants who arrived in 1989-1991 (1992-1994) are married in comparison to 55% (49%) of the males, respectively. In addition, almost 8% of the female immigrants are divorced in comparison to less than 3% of the male immigrants. Thus, the share of single (never married) female immigrants is almost half of the share of single males.

[11]Note that due to different structure and technology of the Israeli and Russian economies, many papers found that the return to imported experience is virtually zero. See for example Cohen Goldner et al. (2012).

[12]Given these results they recommend that receiving countries should help young migrants with language difficulties as well as with the subsequent adverse effects of these difficulties.

[13]In the Israeli context, Friedberg (2000) used the 1983 Israeli census and finds that education and experience acquired abroad are less valued than domestic education and experience and that this difference almost fully explains wage differentials between native Israelis and immigrants. A few papers that studied the integration of adult immigrants from the FSU who arrived in Israel in the 1990s found that upon arrival, the return to imported education is close to zero, see for example (Cohen-Goldner and Eckstein 2008, 2010)

[14]Of course, we could have that $\gamma < 1$ in such a case the function would be higher and not lower than the original one.

[15]In our context, for example, in the standard multinomial Logit regression, the dummy variable 'age at arrival 6-9' can increase the probability of HSG and decrease the probability of ACD, in comparison to the omitted HSD category. In the Ordered Logit, on the other hand, the regression estimates a *joint* coefficient for the impact of the age at arrival 6-9 dummy.

Competing interests
The IZA Journal of Migration is committed to the IZA Guiding Principles of Research Integrity. The authors declare that they have observed these principles.

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References
Betts JR, Lofstrom M (2000) "The educational attainment of immigrants: trends and implications". In: Borjas GJ (ed) *Issues in the Economics of Immigration*. University of Chicago Press, Chicago, US
Bleakley H, Chin A (2004) Language Skills and Earnings: Evidence from Childhood Immigrants. The Review of Economics and Statistics 86(2):481–496
Borjas GJ (2013) "The Slowdown in the Economic Assimilation of Immigrants: Aging and Cohort Effects Revisited Again". NBER Working Paper No. 19116. Cambridge, MA, US
Chiswick BR, DebBurman N (2004) Educational attainment: analysis by immigrant generation". Economics of Education Review 23:361–379
Chiswick BR, Miller PW (1994) The determinants of post-immigration investments in education". Economics of Education Review 13(2):163–177
Chiswick BR, Miller PW (1995) The Endogeneity between Language and Earnings: International Analyses. Journal of Labor Economics 13(2):246–288
Chiswick BR, Sullivan TA (1995) The new immigrants". In: Farley R (ed) State of the Union: America in the 1990s. Russell Sage, New York
Cohen Goldner S, Eckstein Z, Weiss Y (2012) "Immigrants' Labor Market Mobility: The Large Wave of Immigration to Israel, 1990-2000". The MIT press, Cambridge, Massachusetts, US
Cohen Goldner S, Eckstein Z, Weiss Y (2014) "The Immigration from the former Soviet Union to Israel: Evidence and Interpretation" In: Christian D (ed) *"Migration – Economic Change, Social Challenge"*. Oxford University Press, Oxford, UK, forthcoming
Cohen-Goldner S, Eckstein Z (2008) Labour Mobility of Immigrants: Training, Experience, Language and opportunities". International Economic Review 49(3):837–872
Cohen-Goldner S, Eckstein Z (2010) Estimating the return to training and occupational experience: The case of female immigrants. Journal of Econometrics 156(1):86–105
Friedberg RM (2000) You Can't Take it With You? Immigrant Assimilation and the Portability of Human Capital. Journal of Labor Economics 18(2):221–251
Gang IN, Zimmerman KF (2000) Is child like parent? Educational attainment and ethnic origin. Journal of Human Resources 35(3):550–569
Gonzalez A (2003) The education and wages of immigrant children: the impact of age at arrival. Economics of Education Review 22(2):203–212
Heath A, Kilpi-Jakonen E (2012) "Immigrant Children's Age at Arrival and Assessment Results". OECD Education Working Papers, No. 75, OECD Publishing. doi: 10.1787/5k993zsz6g7h-en
Inbar M (1977) Immigration and Learning: The Vulnerable Age. The Canadian Review of Sociology and Anthropology 14:18–234
Inbar M, Adler C (1976) The Vulnerable Age: A Serendipitous Finding. Sociology of Education 49:193–200
Li Q, Sweetman A (2014) The quality of immigrant source country educational outcomes: Do they matter in the receiving country?". Labour Economics 26:81–93
Schaafsma J, Sweetman A (2001) Immigrant earnings: age at immigration matters". Canadian Journal of Economics 34(4):1066–1099
Schultz TP (1984) The schooling and health of children of US immigrants and natives". Research in Population Economics 5:251–288