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Autor: Neuman, Shoshana

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Education and Earnings: Methodological Considerations and Two Israeli Case Studies

Shoshana Neuman

The disciplines of education and economics intersect and overlap. Economic models and analyses are used to evaluate educational systems in general and labor market outcomes of investments in human capital in particular.

The case studies presented in this paper, based on data from the 1983 Israeli census, use regression analysis to evaluate two aspects of the education-earnings relationship: 1. Vocational schooling as compared to academic secondary schooling. 2. Experience-earnings profiles, by educational attainment, for high-tech versus low-tech workers.

1. Vocational schooling in Israel has proven more cost-effective than general academic schooling. In particular, vocational school attenders who later worked in occupations related to their course of study earned more. Their wages were up to 10 percent more per month than the wages of their peers who studied at academic secondary schools and those who attended vocational schools but found employment in occupations not related to the subjects they studied.

Another factor is the national consensus in Israel favoring education designed to equip young people for the social and cultural role of integrating into the country's heterogenous, largely immigrant population. This consensus acts as a major constraint on the development of training alternatives such as the apprenticeship and factory-based vocational programs.

2. An examination of experience-earnings profiles (by education) of workers in high-tech compared to low-tech industries reveals that profiles of the two sets have the standard concave shapes. However, they differ significantly in terms of the age (working age) at which earnings peak. In both industries the peak shifts to the left for the more educated, but the shift is much more pronounced for those in high-tech industries. This fact is a result of obsolescence of human capital, which is subject to greater obsolescence and vintage effects in high-tech industries. This obsolescence phenomenon is incorporated into the theory by modifying of the standard Mincerian model.

Introduction

The disciplines of education and economics intersect and overlap. The labor market and the market for education and training are interrelated. In the labor market, the demand for workers interacts with the existing supply to determine wages and to allocate available workers among enterprises. In the market for education and training, individuals, who are suppliers in the labor market, demand education and training from a variety of institutions: the formal educational system, private technical training schools, employers with on-the-job training programs, and apprenticeship programs.

Theodore Schultz (1960), Jacob Mincer (1962) and Gary Becker (1975) were the first to coin the term «human capital» and to speak about investments in human capital as analogous to investments in physical capital. Firms invest in machinery, equipment, and other types of physical capital in order to augment the firm's productivity and increase output in future years. They make such decisions based on a comparison of expected costs and benefits. In a similar manner, individuals (or their families or society at large) make decisions regarding human capital investments. In this case, resources are invested in an individual today in order to provide him with education and training, so that his or her knowledge and skills, and therefore future earnings, will be enhanced. The main examples of human capital investments include investments in formal education and in on-the-job training. Other examples are job search, migration, language proficiency and even good health.

To decide whether to invest in some type of education or training, a cost-benefit analysis is used. The most important economic variable in career decisions is wages or earnings. In evaluating the economic worth of an investment in human capital, the individual will estimate the incremental earnings to be earned over the entire work life, discounted at a suitable rate of interest. Discounting to the present value enters the economic calculation because of the need to compare dollars received (or spent) today with dollars received in the future. The increased earnings, brought about by education or training, are the returns on the investment. The cost of the investment is the sum of all direct expenses, such as tuition fees, and opportunity costs, mainly foregone earnings during the time of schooling or training.

The flow of earnings can be estimated using *age-earnings or experience-earnings profiles* of workers who have attained various educational levels. Both theory and empirical studies demonstrate the following properties of age-earnings profiles by education: for each age group the average incomes of better educated workers exceed those of less educated workers; closer scrutiny reveals that the earnings profiles of better educated workers rise more rapidly than those of the less educated, which means that differences in the earnings widen as workers get older; age-earnings profiles have a parabolic shape with a peak at the age of forty or fifty. It is believed that the peak is at a more advanced age for the group of better educated workers.

In this paper we deal with two aspects of the education-earnings interrelationship, each followed by a case study based on the Israeli experience. The first

is a comparison of two types of secondary education, namely academic versus vocational educational systems. A cost-benefit analysis is performed, using data from the Israeli labor market and educational systems. The bottom line is that the vocational system is more cost effective. The second aspect deals with obsolescence of human capital claiming that education and training acquired many years ago become obsolete because they are outdated. The result would be a shift of the peak to the left. In particular, workers in high-tech industries, where updated information is essential, suffer more from this type of obsolescence, and as a result the peaks of age-earnings profiles relating to workers in high-tech industries will shift to the left to younger ages. A case study using data from the last 1983 census confirms this hypothesis.

The paper is organized as follows: The next section briefly describes the data used for the analysis of the two case studies. Section III begins with a presentation of some stylized facts regarding the Israeli high school educational systems, followed by a comparison of academic versus vocational schools, in a cost-benefit context. Section IV deals with experience-earnings profiles of workers in high-tech versus low-tech industries in Israel and the last section summarizes and concludes.

Data

The two studies draw upon individual data records from the 1983 Census of Population and Housing 20 percent sample. This is the most recent census conducted by the Israeli Bureau of Statistics. Each respondent answered a series of questions including many relating to labor market and human capital variables. These included: average monthly earnings, years of schooling, type of school terminated, type of school certificate obtained, country of origin, period of immigration to Israel, number of hours worked per week, number of weeks worked per year, employment status, industry and occupation of employment, and age (which can be used to estimate labor market experience).

The subsamples used for the two case studies were a bit different, due to the different issues that they are addressing.

The comparative study on vocational versus academic high schools relates to the sub-set of individuals aged 25–49 at the time of the census. The upper age limit was set in order to exclude individuals who had attended secondary school before 1948, the year of statehood; the lower, to allow at least three years of possible labor market experience, following three years of compulsory military service at age 18. Since our concern is with the Israeli education system, we excluded (on the basis of information on age and year of migration) the large number of immigrants who attended high school abroad. Finally, only male Jewish full-time workers (a worker is considered «full-time» if he worked at least 35 hours in the week prior to the census) are included. In all, the sample comprised some 14,000 individuals, nearly 10,000 former vocational school attenders[1] and some 4,000 individuals who had attended a general secondary

school. For secondary school completers who went on to post-secondary education, it was not possible to identify the type of secondary school attended; so they are not included in the present analysis. In addition, the census questionnaire was unusual in addressing a specific question to those individuals whose formal education terminated at the agricultural or vocational secondary school, concerning the major vocational subject of study. This information was used in the present study to probe two central issues relating to vocational schooling: to what extent are former vocational school attenders employed in occupations related to the main subject area studied at school?; and are there significant differences in the earnings of those employed in jobs related to the subject studied at school and those not working in subject-related occupations?

For the second case study which relates to experience-earnings profiles of workers in high- tech versus low-tech industries, we used a different sub-sample from the same 1983 census. We used records of married, Jewish males, 21–65 years of age, who work full time in manufacturing in either high-tech or low-tech industries. The distinction between the two types of industries was made using a «High-Tech Indicator» suggested by Bregmann, Fuss and Regev (1989). This «High- Tech Indicator» is composed of three factors: the technical quality of labor, i.e., the proportion of engineers and technicians in the labor force; the quality of capital, i.e., the proportion of capital that is less than six years old; and an index of Research and Development activity. Once this is done, they categorize the firms by industry and calculate what percentage of production is produced by «high-tech» firms in each industry.

For our purposes we divided the industries into those in which more than 50% of production is produced by high-tech firms, and which are therefore considered high-tech oriented, and those in which a third or less of the production is produced by high-tech firms (which we call low-tech industries), and all others which were not included in our analysis. The first group includes workers in the branches of Electronics and Transport Equipment (79% of production produced by high-tech firms), Chemical and Minerals (60%) and Metals (55%). The «low-tech» group includes Textiles and Clothing (8%), Light Industries (wood, paper, printing, rubber and plastics – 17%) and Food, Beverages and Tobacco (33%).

We were left with a sample of 12,444 high-tech workers and 7,305 low-tech workers. High- tech workers tend to be younger (less experienced), better educated and more highly concentrated in scientific and professional occupations.

Vocational Schooling in Israel
Size, Growth, Structure and Cost-Effectiveness [2]

Although vocational schooling in Israel has a long history – the first vocational school was established over a century ago – most secondary schooling in Israel at the time of independence in 1948 was of the traditional, academic kind, with less than one-fifth of all secondary school pupils enrolled in vocational schools;

a similar ratio persisted for the next 15 years. Subsequently, the development of vocational schooling was rapid: it constituted some 38% of secondary school pupils by 1970, and by the end of that decade has exceeded the 50% mark. However since the beginning of the 1990s the trend has slightly changed – the number of both vocational schools and students is now smaller than the respective numbers in the general system. Table 1 and Figures 1 and 2 review the main development of vocational schooling since 1948, in terms of numbers of schools and pupils.

This rise in the relative importance of vocational schools in Israel, and (as will be shown) its changing structure, must be viewed against the background of the dilemma facing the authorities in early years. The central issue was how to integrate into the dominant framework of society the large numbers of youth of eastern origin (stemming from North Africa, the Middle East and Yemen) with low academic ability and socio-economic status, while at the same time both maintaining the academic standards of the general secondary school system and meeting the country's needs for high level technical manpower as dictated by imperatives of defence and the development of the economy. No major role was accorded to apprenticeship or education and training with a strong job market orientation. The need for a unifying, integrating framework as well as Jewish cultural norms established over the centuries required that the dilemma be resolved within the framework of the full-time school system itself. Indeed, the educational system soon became the main framework for social and cultural integration.

Since the traditional academic curriculum of the general secondary schools, with its orientation towards entry to tertiary education, was inappropriate for the large numbers of youth of eastern and low socio-economic background, the more practically oriented vocational schools expanded at a faster pace, in parallel with the growth in population and with the increasing proportion of 14- to 17-year olds (especially of eastern origin) staying on at school. Impetus was added to the expansion of vocational schools by the enactment in 1969/70 of compulsory education for youth aged 14 and 15, and of free secondary schooling, and more directly with the transfer of control of the system from the Ministry of Labor to that of the Education Ministry (and its reorganization within a vocational education department).

The transfer of vocational education to the Ministry of Education in the early 1960s has a serious impact on its content, as well as its quantity.[3] In the early years, the task of the vocational schools has been clearly defined as preparing youth for employment in the labor market in the manual trades, with emphasis in the curriculum on practical instruction. It represented more of a training than an educational system. With the transfer, more theoretical and academic subjects were introduced, and by the mid-1960s in response to the call emanating from the industry and the army for a more technologically oriented labor force, such specialties as electronics and electricity were facilitated by the introduction in 1969/70 of the vocational 'tracks', which now characterize the vocational schooling system.

Three main tracks were introduced, each leading to appropriate trade diplomas. The highest (*masmat*) track leads to matriculation (the *Bagrut* examina-

tion) and entry to higher education. There are two non-matriculation tracks, the regular and the practical (*masmam*); these more closely conform to the traditional training role. However, today over 50% of vocational school pupils study in the *masmat* track, compared with only one-third in the mid-1970s (Figure 3). It is normal practice for *masmat* students to present themselves for the *Bagrut* examinations, particularly for the technological specialization introduced towards the end of the 1970s (over 70% now do so, a dramatic change from the situation in the early 1970s when this was rather exceptional). The regular track has shown a steady decline in enrolment, from about half of all vocational school pupils 15 years ago to less than one-third today, while the *masmam* track (comparable with training modes offered by the Ministry of Labor) accounts for some 20% of the total.

The foregoing discussion has argued that the vocational school system in Israel is far broader in scope and aim than is typically the case in many other countries. Outside of the Eastern European countries, where national economic planning dictates that the education system at the secondary level is dominated by vocational schools, only a handful of countries exhibit as large a vocational secondary school sector. This small group of countries includes Belgium, the Netherlands, Argentina and El Salvador.

Moreover, evidence suggest that vocational schooling around the world is in retreat. Benavot (1983), on the basis of published UNESCO statistics, has pointed to a world-wide secular decline since the 1950s in the proportion of secondary school pupils attending vocational schools, while a recent survey of World Bank lending for vocationally-specific education and training has shown a clear and significant shift over the past two decades away from vocational secondary school projects towards various forms of non-formal training (Middleton, 1988).

In Israel vocational schooling is the country's main vehicle for technologically-oriented education and for the achievement of national policies of integration of diverse ethnic groups and equality of opportunity through universal secondary education. Yet a central objective of vocational schooling (though not necessarily the sole or even major one) is that of providing specific marketable skills to the labor force. A natural question would therefore be: do vocational school attenders take up employment in occupations that utilize the vocational skills learned at school, and if so, with what effect on labor market earnings? How do these earnings compare with those of individuals that studied at academic schools? Is vocational schooling cost-effective if we take into account costs as well?

Table 2 shows the proportion of matched workers, by field of study, according to direct and wider education-occupation matchings. For each vocational school attender, we compared subject studied with current job held (using two-digit occupational codes) to see if vocational education received was related to occupation. Two alternative matching procedures were employed, «direct» matchings and «wider» matchings. For direct matchings, a worker is defined as matched if he works in an occupation directly related to the subject studied; for example, the subject «Electricity» and the occupational category «Electricians/Electronic Fitters» constitute a direct match. In addition, wider

matchings include closely related occupations. In the latter case, we take into account the dynamics of career development; thus an individual who has studied Electricity might go on to become a Technical Salesman or open his own electrical business as a working proprietor in the retail trades. While admittedly judgmental, it is not thought that the procedures adopted would occasion any great dissent. Overall, 37 percent of vocational school attenders were employed in occupations related to the course of study pursued (47 percent on the basis of wider matchings). Leaving aside the categories Sewing and Fashion, and Hotel Management, where the number of observations are small, the proportion of matched workers does not differ markedly across subject of study categories (with the exception of Agriculture). Relative frequencies range from 38 to 51 percent for direct matchings and between 45 and 60 percent for wider matchings; ranking by subject differs somewhat for the two matching processes. Earnings functions are now estimated to examine whether there are significant differences between vocational school attenders who work in field of study related occupation (matched workers), those who do not, and academic school attenders, holding constant other variables that may affect earnings.

The specification of the earnings functions is of the traditional Mincer type. The log of monthly earnings is run against a series of human capital variables, including years of schooling, labor force experience, type of school certification obtained, economic sector, occupation and two dummy variables: VOC.M (= 1 if the worker is a matched vocational school attender, and =0 if otherwise) and VOC.U (= 1 if he is an unmatched vocational school attender and = 0 if otherwise). The reference group is thus workers who had attended general academic secondary schooling.

The reported coefficients on the VOC.M and VOC.U variables in the regressions in Table 3 are significantly positive and nonsignificant, respectively. The implication of these results is clear. They indicate that while there is no difference in earnings between academic school attenders and those vocational school attenders that work in occupations unrelated to vocational courses studied at school, the earnings of workers employed in matched occupations exceed those of workers who attended academic schools (by over 8 percent in the regression relating to wider matchings and by 9.6 percent for direct matchings).[4] It is only when vocational school attenders are employed in jobs unrelated to courses of study pursued at school, that earnings are broadly similar to those of workers who studied at academic secondary schools. For those vocational school attenders who work in study-related occupations, average earnings are significantly higher than those of workers who studied at academic secondary schools.

The regression analyses show that, given the higher earnings accruing to vocational school attenders working in matched occupations (i.e., occupations related to course of study), overall, terminal vocational secondary education yields higher monetary benefits than general academic education. However, the question of the efficacy of vocational schooling is one that relates not just to the relative benefits of vocational and academic schooling, but rather to benefits in relation to respective costs.

Are these higher vocational school unit costs sufficiently sizable to offset the earnings benefits of vocational education (as indicated by those working in matched occupations)? In order to test this, we compared benefits and costs in terms of an investment appraisal; we subjected our overall results to a series of sensitivity tests, by experimenting with alternative values of the parameters in the following equation:

$$\text{NPV} = \sum_{t=1}^{n} [m \, \nu \, Y_{At} \, (1+g)^t - c \, C_{At}] \, (1 \, i)_{-t}$$

where

- Y_A measures average income of academic school completers, in year t *is*
- ν the proportional earnings advantage of vocational school completers working in matched occupations
- m is the proportion of vocational school completers employed in matched occupations
- g secular growth of real incomes
- c relates to excess vocational schooling costs over academic school costs and is measured by the ratio $(C_V - C_A)/C_A$, where C_V and C_A measure annual costs per student in vocational and academic schools, respectively. Using official estimates of national expenditure per student this ratio for 1983 is 1.815.
- i is the discount rate, and
- n is the time horizon of the appraisal.

Results are presented in Table 4, assuming a 35 year post-schooling time horizon. Our central findings, with positive *NVP*s, are shown in bold print in the table. For direct matchings these relate to $\nu = 0.096$ and $m = 0.37$ (based on the matched percentages given in Table 2), and for wider matchings to $\nu = 0.081$ and $m = 0.47$. In both cases $c = 0.815$, $g = 0.02$ [5] and $i = 0.08$; three years of secondary schooling is assumed [6] and the values for ν are assumed to apply also to the three-year period of compulsory army service from age 18.

The table shows alternative *NPV* results, based on different combinations of alternative income growth rates, a higher discount rate, lower value for the mparameters, four years of secondary schooling and zero value for vduring army service. Only in some of the *worst* assumption cases are the *NPV*s negative and then only marginally so. We may conclude that terminal vocational schooling in Israel compares favorably with academic schooling in cost-benefit terms.

Our results are in line with recent studies for the US (Daymont and Rumberger, 1982; Campbell et al., 1986, 1987; Hotchkiss, 1989) who also focused on type of job held by vocational school completers. This «new wave» of research reached far more positive conclusions with regard to vocational schooling than the literature that did not pay attention to the matching issue (Zymelman, 1976; Grootaert, 1988; Moock and Bellew, 1988; Tilak, 1988).

Experience-Earnings Profiles
Workers in High-Tech versus Low-Tech Industries [7]

Based on regressions of the type described in the previous section, age-earnings profiles can be derived and drawn. They express the relationship between age and income, holding constant other human capital and control variables. This is done for each education level or education type separately, in order to examine differences in profiles of workers with different educational attainments. Mincer (1974) changed the emphasis from age to labor market experience, claiming that on-the-job investment is better indexed by market exposure than by age. Mincer estimated experience as age minus schooling minus six (the age at which schooling begins) and this has become widely used in empirical research on male earnings.

Using the subsample of the 1983 Israeli census described in Section II and regression equations similar to those described in Section III and Table 3, we examine experience- earnings profiles.

The equations were run separately for each education level (0–8, 9–11, 12, 13–16 and 17 + years of schooling), and for high-tech and low-tech employees separately. High school graduates were separated since, in studies uing U.S. data, they have been seen to exhibit different earnings patterns from workers with 9–11 years of education. This pattern should hold even more strongly in Israel where the financial cost of going to high school is very low, so that high school dropouts are likely to have vastly different productive capacties than do high school graduates.

Experience-earnings profiles derived from the separate earnings regressions are plotted in Figure 4. As seen, workers in high-tech oriented branches have higher earnings than similarly educated individuals in the low-tech branches. This relationship holds for all education levels and almost all experience levels. In addition, the gap increases as the education level rises. The experience-earnings profiles for both the high-tech and low-tech industries have the usual concave shapes found in cross-sectional studies, with the profiles being higher and steeper the higher the educational attainment. [8] The experience levels at which earnings peak, which are of particular interest here, decrease with schooling in both the low-tech and high-tech industries but the peaks in the high-tech industries decrease much faster, as shown in columns 4 and 5 of Table 5 and in Figure 4. In fact, while for the lowest education group low-tech workers' earnings peak 2.5 years earlier than they do for high-tech workers, for the highest education group low-tech workers' earnings peak 2.7 years later than they do for high-tech workers. In addition, as predicted, earnings converge at more advanced levels of experience.

As mentioned above earnings peak and then decrease as a result of depreciation of human capital. This depreciation can be broken down into two major types: internal depreciation and external depreciation. Internal depreciation, which is implicitly assumed in most studies, is the depreciation attributable to worker. This includes the loss of physical ability as well as any loss of mental capacity. External depreciation is that caused by external forces, i.e., it is the

lowering of the value of a worker in the market due to changes in the environment. In particular, one element of these external forces is the gradual obsolescence over time of the stock of knowledge obtained during the schooling process. This is due to so-called «vintage» effects (*see*, e.g., Becker, 1975; van Imhoff, 1988). Knowledge becomes outdated and irrelevant. Vintage effects are more significant for higher levels of education. We suggest that the drastic shape change and shift of the peak for high-tech workers has to do with different rates of human capital obsolescence. For high- tech industries obsolescence of schooling is relatively more important and therefore obsolescence effects are more significant, resulting in a more pronounced shift of the peak to the left.

Cross-national evidence would contribute significantly to the robustness of our suggested theory and empirical findings. We hypothesize that the richer in human capital and the more technologically oriented the country is, the larger will be the life-cycle differences between experience-earnings profiles of workers in «high-tech» versus «low-tech» industries. Thus, for example, such a distinction would be important for countries like Israel where natural resources are scarce and two of the resources contributing most significantly to production are human capital and technology.

In addition, studies of a single economy over time would provide useful tests, particularly if technological changes over the period were significant. Israel, again, may be a good example, since the massive Russian immigration currently under way is comprised largely of immigrants with high educational attainments (more than half of them are college graduates) concentrated mainly in technologically oriented professions. Thus, significant structural and technological changes can be expected in the near future.

Summary and Discussion

Human capital is Israel's main natural resource. It is therefore felt that an examination of the Israeli experience, where so much relative importance has been accorded to vocational schooling and to high-tech industries, should be of interest, both in its own right and by adding to the roster of case studies on these issues around the world.

Vocational schooling in Israel has proven more cost-effective than general academic training. In particular, vocational school attenders who later worked in occupations related to their course of study earned more. Their wages were up to 10 percent more per month than the wages of their peers who studied at academic secondary schools and those who attended vocational schools but found employment in occupations not related to the subjects they studied.

Another factor is the national consensus in Israel favoring education designed to equip young people for the social and cultural role of integrating the country's heterogenous, largely immigrant population. This consensus acts as a major constraint on the development of training alternatives such as the apprenticeship and factory-based vocational programs.

The second case study compares experience-earnings profiles of workers in high-tech industries, where sophisticated human capital is essential, with those of workers in low-tech industries. The more sophisticated human capital is subject to obsolescence and vintage effects resulting in a different shape of the profiles. In particular, the peak of earnings falls faster in high- tech industries. This obsolescence phenomenon can be incorporated into the Mincerian wage equation.

Israel is now witnessing a dramatic change in its population. Over half a million immigrants from the former USSR have joined the five million Israelis, in the last four years. They differ from the immigrants of the 1950s. The majority of the adults have an academic education and are highly qualified in terms of human capital. A reexamination of the high school system and high-tech industries after these immigrants are fully absorbed into the schooling system and into the labor market will help to reevaluate the two case studies in this paper.

Notes

[1] In fact, individuals that had concluded other forms of vocational training for youth, notably the formal apprenticeship and industrial schools, were also included within the category of vocational school completers; also included were those that attended agricultural secondary schools. However, these groups constitute a small, and declining, proportion of vocationaly educated students.

[2] A revised version, based on Shoshana Neuman and Adrian Ziderman, 1989, «Vocational Secondary Schools Can be More Cost-Effective than Academic Schools: The Case of Israel,» *Comparative Education*, Vol. 25(2), pp. 151–163 and Shoshana Neuman and Adrian Ziderman, 1991, «Vocational Schooling, Occupational Matching and labor Market Earnings in Israel,» *The Journal of Human Resources*, Vol. 26(2), pp. 256–281. The reader is referred to the papers for a more formal and detailed discussion.

[3] The Ministry of Labor was left with residual responsibilty only for disadvantaged youth on the margin who, unable to be absorbed within existing secondary schools, were accomodated in non-formal training systems that carry low social status; these included formal apprenticeships and factory-based industrial schools.

[4] The actual percentage effect of the VOC.M dummy variable on earnings is somewhat higher than the dummy variable coefficient multiplied by 100 (*see* Halvorsen and Palmquist, 1980).

[5] The historical trend in real wage increases since the early 1970s has been higher, close to 3 percent.

[6] Under the 1968 reform of the Israeli educational system, secondary high schools offer a three-year program, compared with four years previously.

[7] Based on Shoshana Neuman and Avi Weiss, «On the Effects of Schooling Vintage on Experience – Earnings Profiles: Theory and Evidence,» *The European Economic Review*, forthcoming. The paper includes a theoretical model based on an extension of Mincer's (1974) human capital model.

[8] The drastic shape change for low-tech workers with post-graduate levels of schooling may be the result of the relatively small number of observations in that group.

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Education et revenus: considérations méthodologiques et deux études de cas israéliennes

Résumé

Les sciences de l'éducation et l'économique sont des disciplines qui se rencontrent fréquemment. On utilise des analyses et modèles économiques pour évaluer les systèmes de formation en général, mais aussi les résultats, sur le marché du travail, des investissements en capital humain. Les études de cas présentées ici se basent sur des données du recensement isarélien de 1983 et utilisent la technique de la régression pour évaluer deux aspects de la relation entre éducation et revenus: la distinction entre formation professionnelle et généraliste; les différences de profils âge-gains, par niveau d'éducation, pour les travailleurs dans les entreprises de «haute» ou de «basse» technologie.

1. En Israël, la formation professionnelle (fp) se révèle plus performante que la formation généraliste de type académique. Plus précisément, les personnes ayant suivi une fp et qui, par la suite, travaillent dans un domaine lié à leur formation gagnent davantage. Leurs salaires peuvent dépasser de 10 % ceux des personnes ayant suivi une formation généraliste ou celles ayant suivi une fp mais employées dans des professions sans rapport avec leur formation. Il faut toutefois tenir compte du concensus qui existe, en Israël, autour du rôle de l'école, en tant que facteur d'intégration sociale et culturelle des jeunes dans un pays à population hétérogène, largement composée d'immigrants. Ce consensus impose des limites au recours à d'autres systèmes de formation tels que les apprentissages ou la formation en entreprise.

2. La comparaison des profils expérience-gains, différenciée selon le niveau d'éducation atteint, des actifs dans les secteurs de «haute» et de «basse» technologie, montre qu'ils présentent tous la concavité habituelle. Toutefois, ils diffèrent de manière significative en ce qui concerne l'âge auquel les revenus atteignent leur maximum. Dans les deux groupes, le maximum se déplace vers la gauche pour les personnes mieux formées, mais cet effet est beaucoup plus marqué dans les secteurs de haute technologie. On peut y voir le résultat d'un processus d'obsolescence plus rapide dans ces secteurs. L'obsolescence peut être prise en compte au niveau théorique par une modification du modèle mincérien standard.

Bildung und Einkommen: Methodologische Betrachtungen und zwei israelische Fallstudien

Zusammenfassung

Die Wirtschafts- und Erziehungswissenschaften sind Disziplinen, die mehrere Berührungspunkte haben. Oft werden wirtschaftswissenschaftliche Modelle und Analysen angewandt, um Bildungssysteme im allgemeinen aber auch die Ergebnisse von Bildungsinvestitionen zu bewerten.

Die im vorliegenden Artikel behandelten Fallstudien stützen sich auf die Ergebnisse der israelischen Volkszählung von 1983 und benutzen die Humankapitaltheorie und die Regressionstechnik, um zwei Aspekte der Beziehung zwischen Bildung und Einkommen zu untersuchen: 1. Berufs- versus allgemeine Ausbildung; Erfahrung-Einkommen-Profile für Arbeiter in *high-tech* versus *low-tech* Tätigkeiten.

1. In Israel erweist sich die Berufsbildung als kosteffizienter als eine allgemeine Ausbildung. Berufsschulabsolventen, die später in jenen Bereichen tätig sind, die ihrer Bildung entsprechen, haben bis zu 10% höhere Einkommen als Hochschul- und Berufsschulabsolventen, die später eine ihrer Ausbildung nicht entsprechende Tätigkeit ausüben.

Es muss hier jedoch die besondere Rolle berücksichtigt werden, die der Schule in Israel zukommt als Instrument für die soziale und kulturelle Integration der Jugend in einem Land mit heterogen, sich zum grössten Teil aus Einwanderer zusammensetzenden Bevölkerung. Diese Tatsache schränkt die Wahl der Bildungsalternativen ein, wie zum Beispiel Lehren und Fachausbildung in Unternehmen.

2. Der Vergleich der Erfahrung-Einkommen-Profile, je nach Niveau der erreichten Ausbildung, in *low-tech* versus *high-tech* Industriebranchen, zeigt, dass alle Profile die gewohnte Konkavität aufweisen. Sie unterscheiden sich jedoch wesentlich, was das Alter der Erreichung des Höchsteinkommens betrifft. In beiden Gruppen verlagert sich der Höchstsatz nach links für die besser ausgebildeten Personen, aber dieser Effekt ist stärker in den *high-tech* Bereichen. Man kann hierin das Ergebnis eines schnelleren Alterungsprozesses in diesen Bereichen sehen, der in *high-tech* Bereichen eine wichtigere Rolle spielt. Der Alterungsprozess kann auf theoretischer Ebene durch eine Veränderung des Mincerischen Modells berücksichtigt werden.

Appendix

Table 1. General, vocational and agricultural secondary schooling in Israel: Comparative Statistics Selected years

Year	Number of schools			Number of students		
	General	Vocational	Agricultural	General	Vocational	Agricultural
1948/49	39	26	–	7,168	2,002	–
1959/60	113	60	30	32,894	10,167	5,016
1969/70	219	258	30	68,731	49,556	7,641
1979/80	231	310	27	61,581	70,681	4,108
1982/83	267	301	26	70,310	76.636	4,970
1984/85	292	305	26	73.213	84,633	4,648
1989/90	340	313	24	95,833	97,041	4,718
1991/92	372	306	23	112,885	105.270	6,232
1992/93	396	311	23	118,175	105,703	6,121

Source: Israel, Central Bureau of Statistics, Annual Statistical Abstract, various issues.

Table 2. Vocational School Completers Working in Matched Occupation Full-Time, Male, Salaried Workers General and Vocational School Attnders Israeli Census, 1983

		Percentage of Workers in Matched Occupation	
Area of Study	Number of Workers in Sample	Direct Matchings	Wider Matchings
Agriculture	1,002	6.09	14.47
Electricity	1,357	42.08	51.14
Electronics	691	49.06	60.35
Metal work	4,337	37.91	45.35
Mechanics	1,967	42.76	56.58
Bookkepping & clerical	331	51.06	58.31
Hotel management	93	40.86	40.86
Total	9,798	37.4	46.7

Table 3. Regeression of Monthly Earnings (ln)
Full-Time, Male, Salaried Workers
General and Vocational School Attnders
Israeli Census, 1983
n = 13,879

See below for variable definitions.

	Direct Matchings		Wider Matchings	
Independent Variables	Coefficient	t-statistic	Coefficient	t-statistic
YRS. SCH	0.017	1.34	0.017	1.29
EXP	0.034	3.52	0.034	3.49
EXP2	–0.0008	7.32	–0.0008	7.31
EXP*YRS.SCH	0.001	1.79	0.001	1.82
WEEKS (ln)	0.312	16.58	0.312	16.57
HOURS (ln)	0.312	9.60	0.313	9.64
ETHNIC	–0.131	13.59	–0.129	13.43
Economic Sector:				
IND	0.072	2.40	0.069	2.30
ELECT	0.260	6.55	0.261	6.59
COMM	–0.028	0.86	–0.027	0.84
FIN	0.128	3.82	0.130	3.88
TRANS	0.073	2.29	0.074	2.32
PUB	–0.029	0.94	–0.026	0.83
PRIV	–0.072	1.99	0.017	1.96
CONST	0.004	0.13	0.003	0.08
Occupation:				
ACAD	0.283	3.70	0.279	3.65
TECH	0.360	7.99	0.361	8.01
MANAG	0.525	11.65	0.480	10.68
CLER	0.215	4.90	0.211	4.82
SALES	0.224	4.87	0.199	4.35
SERV	0.212	4.60	0.208	4.53
UNSKILL	0.134	2.60	0.134	2.61
SKILL	0.173	4.03	0.174	4.07
Certification:				
P.CERT	–0.001	0.07	–0.001	0.05
S.CERT	0.063	3.18	0.064	3.22
BAG	0.113	4.66	0.116	4.81
VOC.M	0.096	6.84	0.081	6.27
VOC.U	–0.003	0.27	0.013	1.05
Intercept	6.940	31.49	6.959	31.57
R2	0.173	—	0.173	—

Table 4. Incremental Net Present Value of Vocational Schooling over Academic Secondary Schooling (Israeli shekel, per student)

	Direct Matchings ($\nu = 0.096$)			
	Matched in Occupation (m)			
	27%	37%		
	3 year schooling	3 year schooling	3 year schooling (Army service)	4 year schooling
Discount rate (i): 8%				
Income growth rate (g):				
1%	15,180	49,087	20,872	21,648
2%	25,778	**63,611**	31,500	36,172
3%	38,404	80,913	44,002	33,474
Discount rate (i): 10%				
Income growth rate (g):				
1%	–2,974	23,725	–1,991	–3713
2%	4,265	32,991	5,020	5552
3%	12,770	45,299	13,174	17860

	Wider Matchings (ν = 0.081)			
	Matched in Occupation (m)			
	37%	47%		
	3 year schooling	3 year schooling	3 year schooling (Army service)	4 year schooling
Discount rate (i): 8%				
Income growth rate (g):				
1%	72,320	112,506	76,029	85,067
2%	89,533	**134,371**	86,028	106,932
3%	116,039	160,419	104,849	132,980
Discount rate (i): 10%				
Income growth rate (g):				
1%	42,018	73,661	34,945	46,222
2%	53,000	88,594	45,501	61,115
3%	67,587	10,6141	57,776	78,702

Table 5. Years of Experience at which Earnings Peak
Full-time, Male, Married, Salaried, 21–65 year old Workers
Israeli Census, 1983
n = 19,749

	All Workers				
Schooling	Mean	Standard Deviation	Low-tech	High-tech	t-statistic
0–8	34.4	0.756	33.2	35.7	3.31*
9–11	31.3	0.848	31.2	31.9	0.83
12	29.5	0.797	31.3	28.9	–3.01*
13–16	27.0	0.714	28.5	26.8	–2.38*
17+	24.0	1.346	26.1	23.4	–2.01*

Note: The column «t-statistic» tests whether the difference between the peaks for high-tech and low-tech is significant using the standard deviation of the peak derived from the variance- convariance matrix of the regression for all workers. An asterisk denotes statistical significance at the 5% level.

Variable definitions

The full set of variables employed in the regressions are defined as follows:

Schooling variables:

YRS.SCH: Years of schooling (ranging from 8 to 12 years)

Two dummy variables: VOC.M representing matched vocational school attenders, and VOC.U for unmatched vocational school attenders. The categoy «general academic school attenders» is the reference group.

A series of dummy variables, P.CERT, S.CERT and BAG, relating to the highest level of school certification attained – completed primary or intermediate level, completed secondary schooling, and gained *Bagrut* (matriculation), respectively. The category «no certificate obtained» enters the constant term.

Personal background variable:

ETHNIC: a dummy indicating ethnic origin (Eastern = 1, Western = 0).

Work related variables:

EXP: years of work experience (defined as Age-YRS.SCH-6)

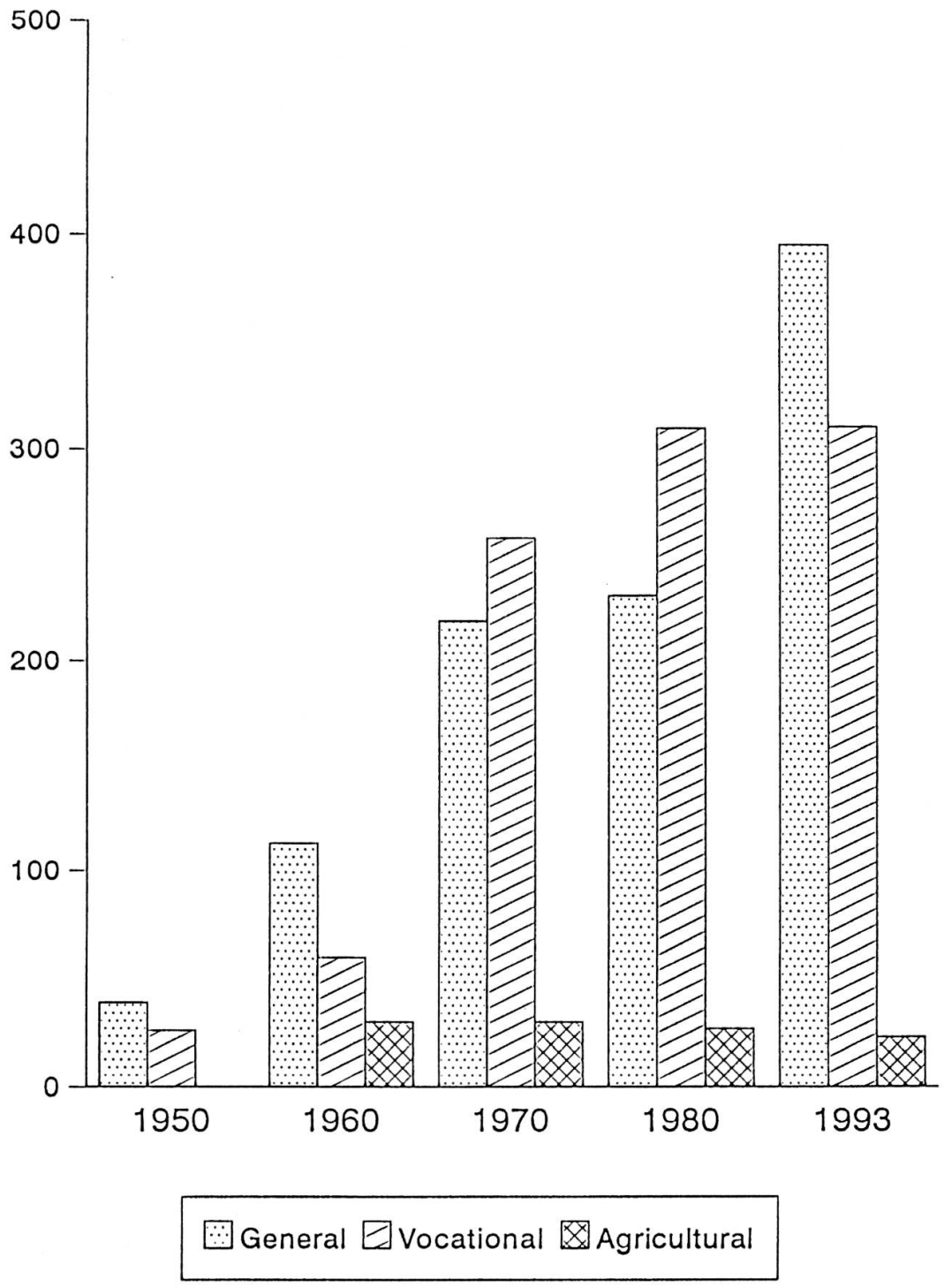
WEEKS: ln of number of weeks worked in the past year

HOURS: ln of hours work in the past week

A series of dummy variables relating to sector in which employed:
IND (Industry), ELECT (Electricity), COMM (Commerce), FIN (Finance), TRANS (Transport), PUB (Public services), PRIV (Private services), CONST (Construction), with Agriculture in the constant term.

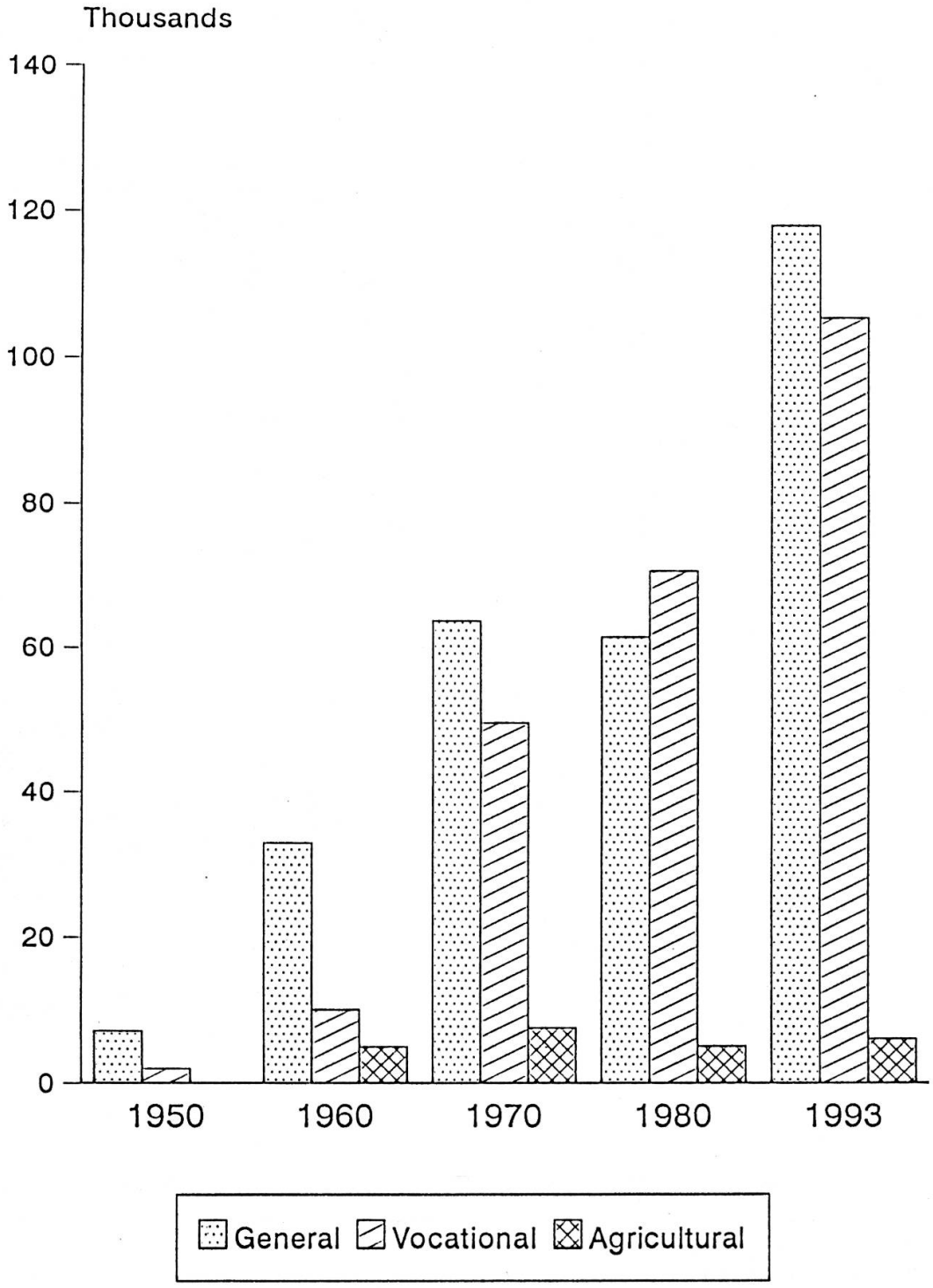
A series of dummy variables relating to occupation in which employed:
ACAD (Scientific and academic), TECH (Other professional and technical), MANAG (Administrators and managers), CLER (Cerical), SALES (Sales), SERV (Services), SKILL (Skilled) and UNSKILL (Unskilled), with agricultural workers entering the constant term.

Figure 1
Total Number of Secondary Schools



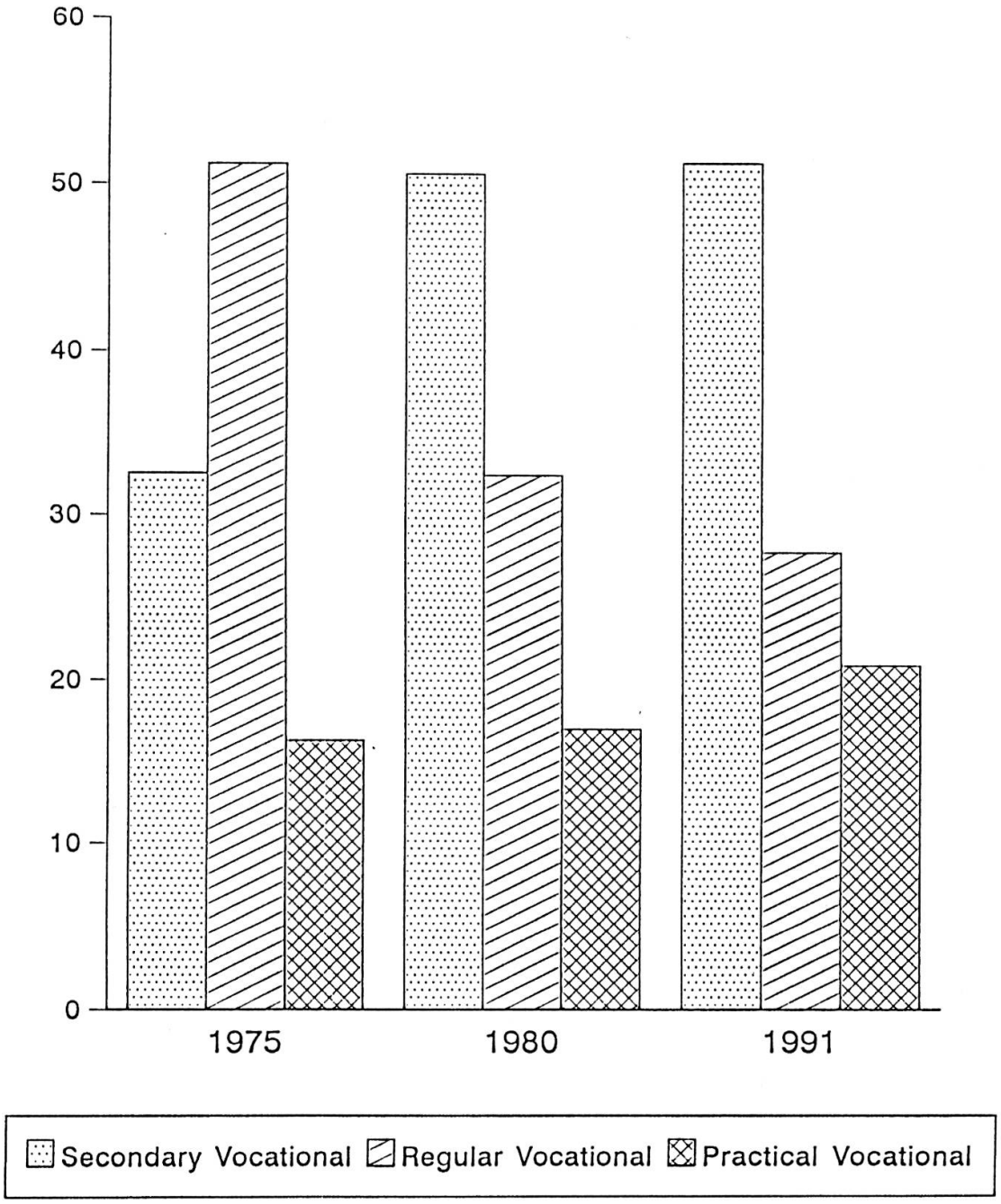
Source: Israel, Central Bureau of Statistics,
Annual Statistical Abstract, Various Issues

Figure 2
Total Number of Students



Source: Israel, Central Bureau of Statistics,
Annual Statistical Abstract, Various Issues

Figure 3
Vocational Secondary Students by Type of Program

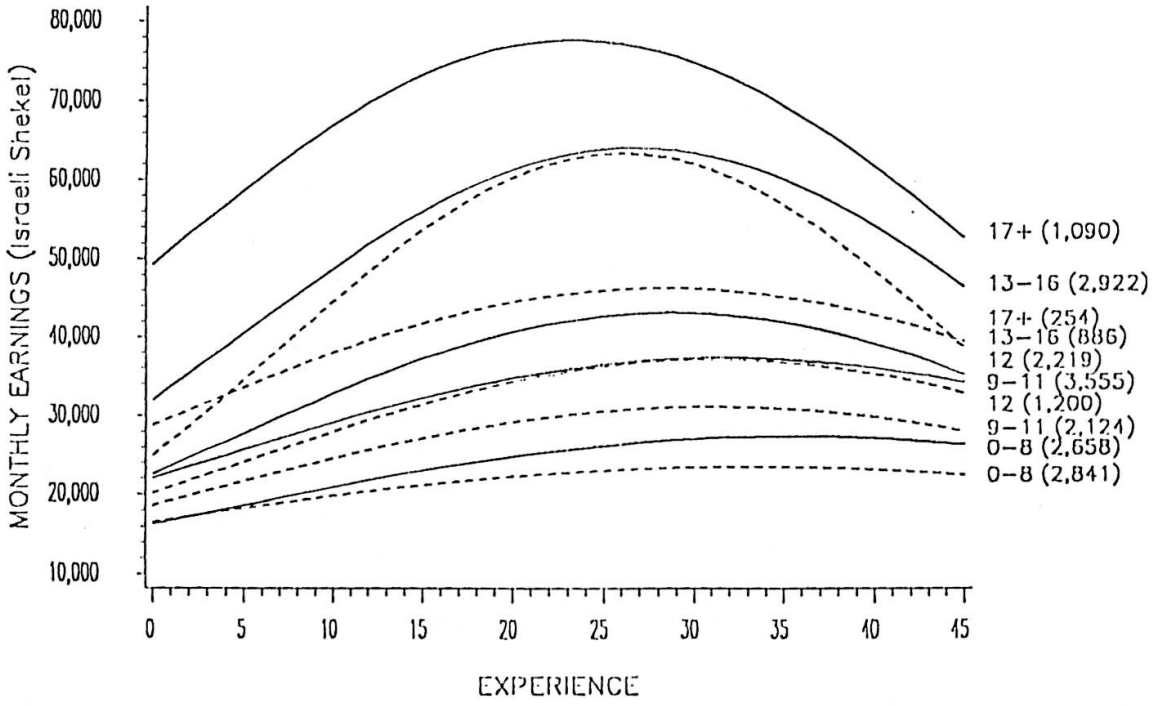


Source: Israel, Ministry of Education,
Education: Facts and Figures, Table 8b p.24, 1992.

Figure 4

Experience–Earnings Profiles By Education Level
Hightech and Lowtech Industries

Male, Jewish, Married, Full Time, 21–65 Year Old, Salaried Workers
Israeli Census, 1983



LEGEND: _____ High–Tech ---------- Low–Tech

Source: Tapes of the 1983 Israeli Census of Population and Housing.
Note: Number of observations in parentheses.