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High-Tech Employment: Its Sources and Expansion Opportunities

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In the name of Aaron Dovrat z"l

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High-Tech Employment: Its Sources and Expansion Opportunities

This study examines changes in the economic environment which might increase the rate of workers employed in the Israeli high-tech sector, who currently constitute around 9% of employees in the business sector, and bring it up to 12 percent. Assuming the average output of high-tech workers continues to be twice as high as that of their counterparts in other industries, such an increase in the rate of high-tech employees will raise the gross business product by approximately 5%, and the GDP by around 3%, based on the assumption that the high-tech sector does indeed incorporate these workers. Hence, in order to explore mechanisms which might increase the volume of employment in the high-tech sector, this study focuses on the characteristics of workers in high-tech industries and in other economic sectors, across different age and population groups.

The analysis of the characteristics of high-tech employees and their comparison to employees in other sectors drew on a database compiled by the Israeli Central Bureau of Statistics, which includes demographic background variables along with data regarding training, education, employment, and income of Israelis born between 1978 and 1985. This data shows that 96% of high-tech employees hail from the non-Haredi (i.e., not ultra-Orthodox) Jewish population, which constitutes less than 75% of the general population. Among high-tech employees, the percentage of non-Haredi Jewish men is 63%, almost double than the rate of non-Haredi Jewish women which is 33%.

Our study finds that an increase of 40% over the next ten years in the rate of STEM[1] graduates among the younger generation, from 11 to 16 percent, would in itself raise the rate of high-tech employees by 1.9 percentage points, with the addition being derived mainly from the group of Jewish men. The forecast for such an increase is deemed conservative, considering the fact that the national objective of a 40% increase in the rate of STEM graduates is supposed to be achieved within just five years (2017-2022).

An increase of around 20% in the rate of high-school graduates taking expanded matriculation (5 study units) in mathematics would lead to a rise of 0.7 percentage points in the rate of high-tech employees in the business sector. This increase stems mainly from the Jewish population, with an almost equal distribution between men and women. According to our study,

[1] STEM: Science, Technology, Engineering and Mathematics. STEM-related academic fields include mathematics, statistics, computer science, engineering, and architecture, as well as physical and biological sciences.

increasing the wage gap between high-tech employees and their counterparts in other industries by NIS 1,000 per month (about 10% of the average wage gaps in our sample) has a limited effect on the rate of high-tech employees. However, due to data limitations, it is likely that these findings do not fully reflect the effects of earnings on the rate of high-school students who take expanded matriculation in scientific subjects and choose to major in STEM-related subjects. The findings of this study demonstrate that the policy which aims to increase the rate of students who take expanded matriculation in mathematics and major in STEM-related subjects is effective in increasing the rate of high-tech employees, and support its further implementation. In addition, the study identifies Jewish women, as well as the Haredi and Arab population groups, as potential sources for a further expansion of the high-tech workforce.

This paper was written before the outbreak of the COVID-19 crisis and does not include any reference to its possible effects on the high-tech sector.

1. Summary and conclusions

The aim of this study is to examine changes in the economic environment which might increase the rate of workers employed in the Israeli high-tech sector, who currently constitute around 9% of employees in the business sector, and bring it up to 12 percent. This aspiration stems from the fact that the average output of high-tech workers is twice as high as that of their counterparts in other industries. Insofar as the additional workers maintain this relative advantage, the gross business product is projected to rise by approximately 5%, and the GDP by around 3%. Our working assumption is that the expansion of high-tech employment is currently restricted by short supply of suitable workers and is not constrained on the demand side. Therefore, the analysis in this study focused on the characteristics of workers in high-tech industries and in other economic sectors, across different age and population groups, while considering various alternative scenarios of education and training, in an attempt to figure out where and how many additional high-tech employees may be found.

The analysis of the characteristics of high-tech employees and their comparison to employees in other sectors drew on a database compiled by the Israeli Central Bureau of Statistics, which includes demographic background variables along with data regarding training, education, employment, and income of Israelis born between 1978 and 1985. These people were aged 30-37 in 2015, the year when the data was gathered. The analysis differentiated between six population groups: Jewish non-Haredi men and women, Arab men and women, and Haredi men and women. This data shows that 96% of high-tech employees (among those who are included in the database) hail from the non-Haredi Jewish population, which constitutes less than 80% of the general population. Among high-tech employees, the percentage of non-Haredi Jewish men is 63%, almost double than the rate of non-Haredi Jewish women which is 33%.

The study focused on three primary areas of change: raising the rate of students who major in STEM-related subjects by about 40%,[2] raising the number of high-school students who take expanded matriculation in mathematics, and raising wages in the high-tech sector. While the former two measures depend largely on policy choices, changes in wages are determined by market forces. For the purposes of the analysis of the different scenarios, we applied the typical employment patterns of each of the six population groups, as observed in our sample. The projected impact of increasing the rate of students who major in STEM-related fields was examined in two ways: Chapter 3 presents a simulation based on an estimate of the effect of

[2] In line with the explicit intention stated in government plans, e.g., government decision no. 2292 from January 15, 2017.

an academic degree in a STEM-related field on the likelihood of employment in the high-tech industry. The basic simulation is predicated on the assumption that the behavior patterns of senior workers will remain unchanged ten years down the line, while the rate of STEM graduates among the younger generation rises from 11 to 16 percent. This change produces an increase of 1.9 percentage points in the rate of business sector employees in high-tech industries over the next ten years. That process is repeated in Chapter 4, using a more complex model which is predicated on the application of rational choice when selecting academic courses and STEM-related studies. This model is based on the existing patterns of behavior among non-Haredi Jewish as well as Arab population groups, in the age group born between 1978 and 1985. In this sample, the rate of high-tech employees in the business sector has already reached 12%. Given the relatively young population represented in this sample, it is not surprising that the outcomes of the analysis presented in Chapter 4 are very similar to those of Chapter 3. For instance, if we disregard the rational choice processes on which the model is based, and instead assume a 40% increase in the rate of STEM graduates among academic degree recipients in the 30-37 age group, the result is an increase of 1.1 percentage points in the rate of high-tech employees in the business sector. Once the influence of the higher income in high-tech industries on individual decisions to opt for academic studies is also taken into consideration, the increase in the rate of high-tech employees among workers aged 30-37 rises to 1.4 percentage points. This rise derives mostly from the Jewish population group and is composed of a much larger proportion of men than women.

The second experiment conducted using the complex model examined an increase of slightly over 20% in the rate of high school graduates taking expanded math matriculation.[3] The impact of that change on the rate of high-tech employees among business sector employees would amount to an increase of 0.7 percentage points. In this case as well, the increase derives from the Jewish population group, yet here the gender distribution is nearly equal.

Finally, we examined the effect of a NIS 1,000 increase in the wage gap between high-tech industries and other economic sectors. According to our model, such an increase has a minor effect on the rate of high-tech employees. The effect may be augmented if that wage increase is already taken into consideration when students select which matriculation subjects they wish to expand, and if the effect of wages on the decision to undertake academic studies is separated from their effect on the selection of a specific study course.

[3] A sharp upward trend in the rate of students who expand their math matriculation and do 5 study units has been evident since 2012, particularly in the non-Haredi Jewish sector. See Appendix C.

As stated above, these scenarios are based on the behavior patterns of the different population groups. The Jewish population is characterized by a large gap between men and women in terms of high-tech employment rates, exhibiting a ratio of 2:1. According to the estimates in our model, there are no major differences between the genders in the marginal effect of the choice of matriculation electives on the probability of obtaining employment in high-tech industries, or on the probability of studying STEM-related fields. Gender differences are present mainly in the constants of the regression equations, both for the probability of high-tech employment and of studying STEM-related fields, where they also reflect a ratio approximating 2:1. The estimated model does not reveal the source of these gender gaps, but it is worth noting that similar gaps in both these areas have been also observed in data from other countries.[4]

According to the sample presented in Chapter 4 – that is, supposing that after an interim period of adaptation the characteristics of the 30-37 age group from our 2015 sample will come to apply to all ages within the workforce – in the absence of those gender gaps, the rate of Jewish women employed in high-tech industries would have been similar to that of their male counterparts, raising the rate of high-tech employees in the business sector by approximately 5 percentage points to reach 17% of the sampled group! In a less extreme scenario, which maintains the existing rates of STEM studies among non-Haredi Jewish women compared to non-Haredi Jewish men (8% vs. 17%), if the integration rate of women in high-tech industries had been equal to that of men – 47% integration rate among men compared to 30% among women – then the rate of high-tech employees among the women in our sample would have risen from 9.1 to 10.2 percent, denoting a rise of about 0.5 percentage points in the overall rate of high-tech employees.

Our model illustrates the tougher barriers which exist in Arab population groups. The regression equations in Chapter 4 regarding choice of STEM fields are pretty similar to those of the Jewish population. The matriculation attainment levels of the Arab groups in relation to the relevant fields are indeed lower compared to Jewish men, but they are not very different than those of Jewish women. Nevertheless, given their matriculation attainment levels, the likelihood of high-tech employment for Arab men, and even more so of Arab women, is far lower compared to their Jewish counterparts. Another notable aspect is the negative reaction of academic studies selection in response to the rise in the return on these

[4] See e.g., Goldin, C. (2014), "A Grand Gender Convergence: Its Last Chapter", *American Economic Review* 104(4), 1091-1119.

studies, indicated by the regression equation of the Arab population groups. These findings point to the existence of barriers and market failures which require further, in-depth research. In conclusion, the following points may be highlighted as policy recommendations arising from our research, with the aim of increasing the rates of high-tech employees:

1. Raise the rate of high school students who take expanded matriculation in mathematics.
2. Raise the rate of students who undertake academic studies in STEM-related fields.

Both these measures have already been discussed at length in other studies as well.[5] As shown above, even when they have a positive impact, it is limited.

Cultivating a profound change in the rate of high-tech employees requires dedicating some research attention and defining policy measures which would affect a change in the behavior patterns of Jewish women. Specifically, the high-tech sector should consider whether the following adjustments would increase the tendency of women to work in high-tech industries:

- Create positions which offer flexible work hours.
- Expand the availability of working from home.
- Find childcare solutions for young children near the workplace.[6]

As for Arab population groups, the causes of market failures should be investigated. In particular:

- Examine overt and covert forms of discrimination against Arab workers which exist in high-tech industries.
- Bring workplaces nearer to the areas inhabited by this population group.

Finally, the low attainment levels and employment rates among the Haredi (ultra-orthodox) society are not exclusive to the high-tech sector. It is vitally important to enhance the study of core subjects, to raise the rate of Haredi high school students who take matriculation exams, to integrate Haredi students in academic studies, and to find ways to adapt workplaces for the needs of this population group.

[5] See Zafar, B. (2013), "College Major Choice and the Gender Gap", *Journal of Human Resources* 48(3), 545-595.

[6] A report on human capital in high-tech industries (Start-up Nation Central and The Israel Innovation Authority, 2019) finds significant erosion in the employment of women in high-tech at the ages which correspond to the family-building period. For further reading (in Hebrew): https://innovationisrael.org.il/sites/default/files/High%20Tech%20Human%20Capital%20Report%202019%20-%20Hebrew%20Version_4.pdf.