Selected Research and Policy Analysis Notes

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This publication replaces the “Recent Economic Developments” series.
This publication will also be published semiannually, and will include research analyses on various economic issues.

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THE ARAB POPULATION IN THE HIGH-TECH SECTOR[1]

- **In Arab society, employment in the high-tech sector is very low. In 2019, only 1 percent of all Arab employees worked in high tech, compared with 11 percent of all Jewish employees. The low representation of Arabs in high tech is mainly from disparities in human capital that accumulate over years, in various settings, from elementary school to university.**
- **Differences between Arabs and Jews are evident not only in the rate of their participation in the high-tech sector, but also in the quality of their employment, particularly the prestige of their jobs, the types of industries in which they are employed, and their salary. Some of these differences are explained by observed characteristics such as education, place of residence, and age, while others remain unexplained by these characteristics.**
- **Employees in high tech were adversely impacted by the COVID-19 crisis much less than employees in other sectors, and this differential impact was greater for Arab employees. Remote work opportunities that developed in response to the crisis may, in the future, increase access to high-quality employment in the high-tech sector for Arabs who live in the periphery.**

1. Background: Low integration in the high-tech sector

In recent decades, the high-tech sector has become a major component of Israel's economic growth,[2] accounting for approximately 13 percent of the GDP and 9 percent of total employment in 2019. Although the persistent shortage of skilled labor impedes the sector's continued economic expansion (see, for example, The Innovation Authority, 2021), Arab society's representation in this sector remains very low. The current analysis offers a brief summary of the data on Arab employees' integration into high-tech, and analyzes the features and patterns of participation of the few Arabs employed in this sector, offering an updated outlook on the barriers to employment in the high-tech sector encountered by members of Arab society.

As reflected in Figure 1, in 2019 only 1.2 percent of all Arab salaried workers were employed in high tech, compared with 10.7 percent of Jewish salaried workers.[3] By religion, the participation rate in the high-tech sector is lowest among Muslims (approximately 0.8 percent in 2018 and 2019), compared to 2.6 percent among Christian Arabs and 3.5 percent among Druze (Figure 2). Figure 3 looks at the relative share of

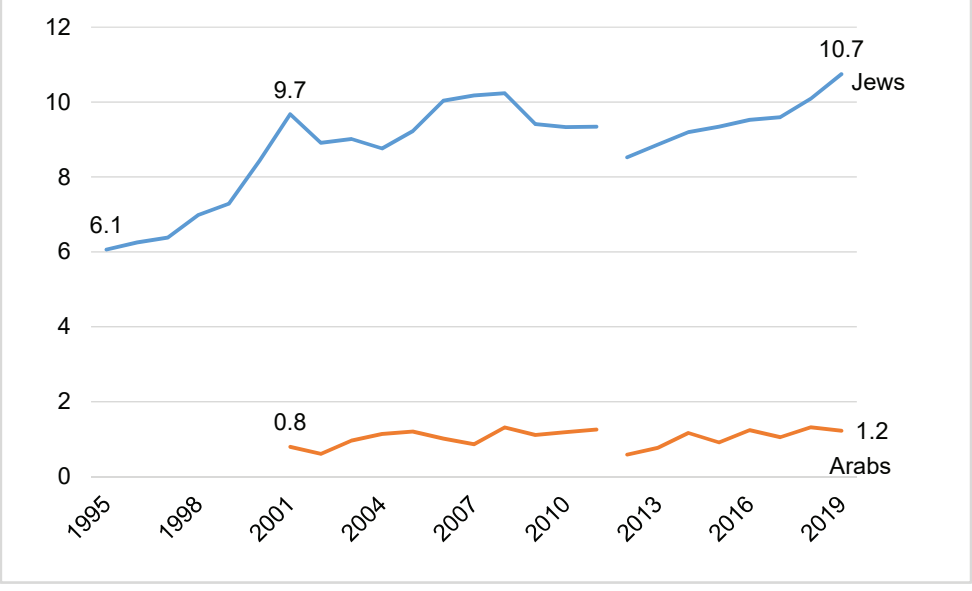
[1] Written by Elad DeMalach.

[2] The high-tech sector is defined as a group of the following industries, based on the Standard Industrial Classification of All Economic Activities of 2011: manufacture of pharmaceutical products, including homeopathic products (21), manufacturing of computer, electronic, and optical products (26), manufacture of other transport equipment (30), computer programming, consultancy, and related activities (62), information service activities (63), and scientific R&D (72). This definition is consistent with the definition of the Innovation Authority and the definition of Mazuz-Harpaz and Krill (2016), and is similar to the Central Bureau of Statistics' definition (2017) of the high-tech industry excluding the media industry. Figure 1 is the only figure that includes an analysis of the years 1995–2011, in which the high-tech industry was defined according to the 1993 classification of economic industries: the drug industry (245), manufacturing of machinery for office and accounting uses and computers (30), electronic components (32), electronic communications equipment (33), industrial equipment for control and supervision, and medical and scientific equipment (34), aircraft manufacturing (355), computing services (72), R&D (730). This definition is also similar to the definition of the Central Bureau of Statistics (2017) excluding the media industry.

[3] The category of Jews also includes individuals with no stated religion and non-Arab Christians (2.5 percent of the population, many of whom are former CIS citizens). The category of Arabs also includes Arabs living in East Jerusalem.

Arabs of the total employees in the high-tech sector (2 percent), which is very low compared to their percentage in Israel's population (21 percent). A relatively small share of these differences is driven by differences in employees' ages: Arabs account for approximately 1 percent of all high-tech employees aged 35 and over (and 16 percent of Israel's population), and 3 percent of all high-tech employees below age 35 (and 25 percent of the general population). That is, Arabs' representation in high tech increased among younger individuals, but only very moderately, and even in this group, the participation rate is significantly lower than their share in the population.

Figure 1
Share of total employees in each population group working in high-tech, by population group (Arab and Jewish salaried employees), (percent, 1995–2019)



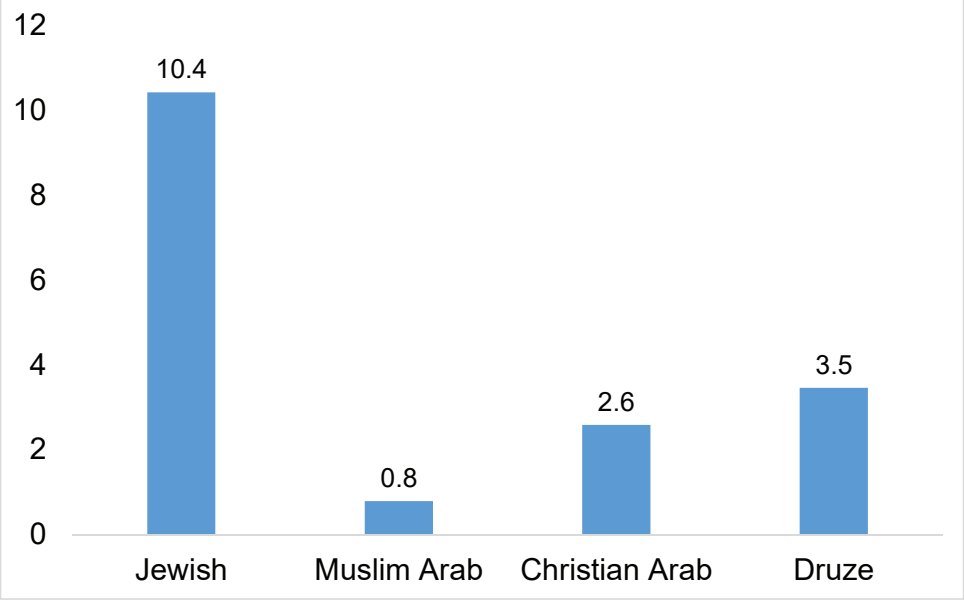
SOURCE: Based on Labor Force Surveys conducted by the Central Bureau of Statistics.

Despite the low rate of integration of Arab society in the high-tech sector, various indicators are signaling the beginning of an upward trend. First, in absolute terms, the number of Arab salaried employees in the high-tech sector increased almost threefold between 2012 and 2019, from 2,200 to 6,100. Statistics of the Council of Higher Education (CHE) show that the number of Arab students enrolled in high-tech-related fields doubled between 2012 and 2018, and their relative share of all students in these programs increased from 8 percent to 12 percent (CHE, 2019).[4] Furthermore, a recent study by the Directorate General of Labor found that while only 30 percent of all Arab graduates of high-tech-related fields were employed in the high-tech sector in 2012, by 2017 this rate had doubled, and reached 60 percent (Cohen-Kovatch and Kasir, 2020).[5] Still, this rate is lower than the rate of integration of all high-tech subject graduates in the general population, which was approximately 75 percent in 2018 (Central Bureau of Statistics, 2019).

[4] According to the definition of the Council of Higher Education, high-tech-related fields are: computer sciences, software engineering, electronic engineering, electrical engineering, communication systems engineering, information systems engineering, and data science. For additional information see Council of Higher Education (2018).

[5] In this study, the definition of high-tech-related fields is very similar to the definition used by the Council of Higher Education presented in footnote 4. For additional information, see Table A1 in Cohen-Kovatch and Kasir (2020).

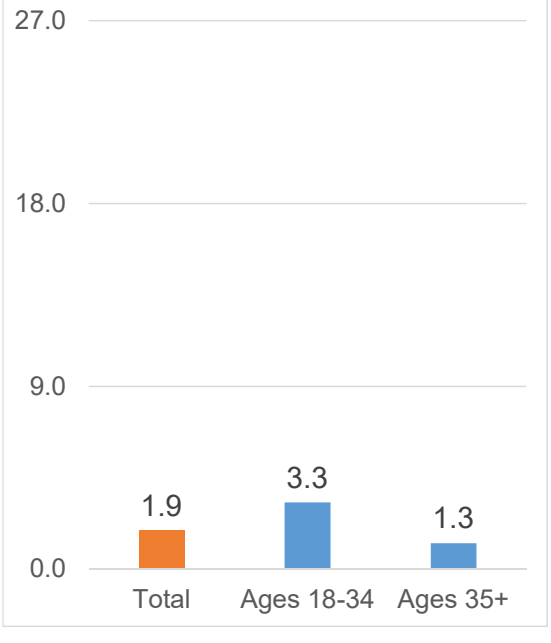
Figure 2
Percentage of employees in the high-tech industry, of total employees, by religion (percent, average 2018-19, salaried employees only)



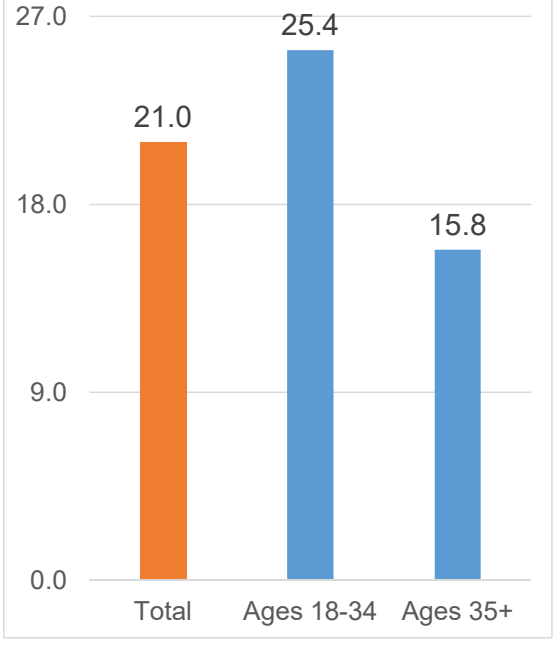
SOURCE: Based on Labor Force Surveys conducted by the Central Bureau of Statistics.
For additional information on the definition of the industries of the high-tech sector, see footnote 2.

Figure 3
Arabs' share in the high-tech industry and in the general population by age group (2019)

a. Share of Arabs of all salaried employees in high tech (percent)

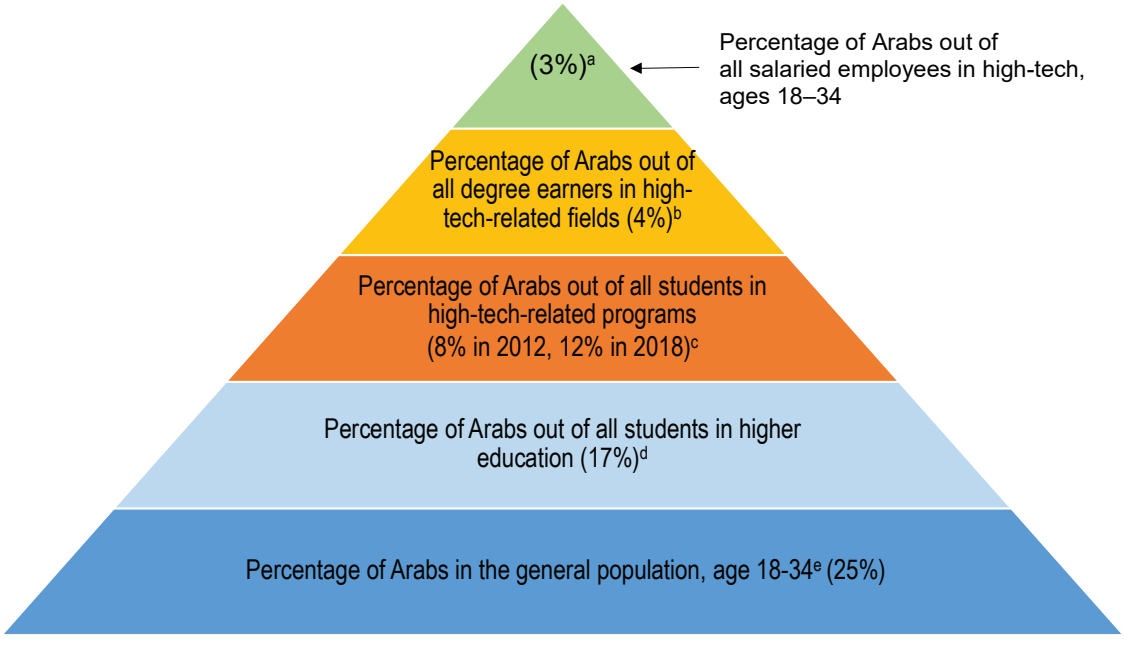


b. Share of Arabs in Israel's general population (percent)



SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics and the Statistical Abstract of Israel 2020.

Figure 4
The high-tech pyramid in the Arab population (2018 data)



SOURCES:
(a) Based on Labor Force Surveys conducted by the Central Bureau of Statistics.
(b) G. Cohen-Kovatch and N. Kasir (2020). "Trends in the integration of Arab society in Israel in the high-tech field." Ministry of Labor, Welfare, and Social Services.
(c) Council of Higher Education (2019). "The high-tech revolution in Arab society."
(d) Table 2.29.1 in "Students in institutions of higher education." Multi-annual publication of the Central Bureau of Statistics.
(e) Bank of Israel analysis of Table 2.3 of the Statistical Abstract of Israel.

Arabs' under-representation in employment in high tech may be due to several factors. Figure 4 presents a pyramid that describes the requisite stages toward gaining employment in high-skilled work in the high-tech sector. The lower portion of the pyramid shows that the relative share of Arabs among all students in 2018 (17 percent) was significantly lower than their share in the population that year (25 percent), Moreover, Arabs accounted for 12 percent of all higher education students enrolled in high-tech-related fields that year, after a considerable increase since 2012, when they accounted for a mere 8 percent of all students in such programs (CHE, 2019).

These figures underscore the significant difference between Jews and Arabs in the enrollment rates to institutions of higher education in general, and specifically to high-tech-related programs. Many of these differences are driven by differences in the skills of Arabs and Jews. These differences were documented in the Survey of Adult Skills in Israel (PIAAC), in which Arabs received an average score of 212 in mathematical skills, 225 in literacy, and 238 in problem solving in an online environment, compared to 264, 262, and 280, the scores achieved by Jews, respectively (Central Bureau of Statistics, 2016).

The achievement gaps between Jews and Arabs emerge early, at a young age. Taking the Meitzav standardized test scores for 2003 as an approximation of the childhood achievements of the young adults who are now in the labor market, we see very large gaps between the scores of Jews and Arabs in mathematics and English

in Grade 5, reaching 1.0 and 0.6 standard deviations, respectively, and in Grade 8 these gaps reached 0.8 and 0.9 standard deviations, respectively (Central Bureau of Statistics, 2010).[6] Achievement differences between Jews and Arabs have since diminished, but in general have not disappeared. For example, in 2017, Meitzav Grade 5 scores in mathematics (which are the most recent scores available) show that differences between Jews and Arabs diminished to approximately 0.3 standard deviations, and in English the differences were eliminated entirely. In 2017, based on Grade 8 scores, Meitzav achievement differences in mathematics and English were 0.38 standard deviations and 0.42 standard deviations, respectively (National Authority for Measurement and Assessment in Education, 2017).

Achievement differences are also reflected in differences in international test scores (TIMSS). In 2019, Arab students in Grade 8 achieved an average score of 476 in mathematics, compared with an average score of 536 achieved by Jewish students (National Authority for Measurement and Assessment in Education, 2020). On the PISA literacy test for 15-year-olds, Jewish students achieved a score of 506 (similar to the OECD average), while Arab students achieved a mean score of only 362. A significant difference between Arabs and Jews remains even after high school, when comparing average grades on psychometric exams. In 2019, the average score achieved by Jews was 579 compared with 495 achieved by Arabs. This is a difference of 85 points (approximately 0.85 standard deviations).[7]

It may be argued that the low representation of Arabs in high-tech-related fields is due not only to differences in human capital but also to individual preferences of high-skilled Arabs for other fields, specifically a preference for medicine. Indeed, there is evidence that supports Arabs' preferences for medicine over high-tech-related fields.[8] However, the number of Arab students who study medicine in Israel is small—only 390 individuals in 2018—and even under the extreme assumption that all these students had transferred to high-tech-related fields, they would increase the percentage of Arabs enrolled in high-tech-related fields that year by a single percentage point (from 12 percent to 13 percent).[9] Furthermore, in that year, the percentage of Arabs enrolled other fields that require high skills, such as engineering and medicine, was 11 percent and 12 percent, respectively, similar to their representation among the students enrolled in high-tech-related fields. Therefore it does not appear to be the case that differences in subject preferences of highly capable students explain a significant portion of Arabs' low representation in academic high-tech-related programs.

In addition, Arabs who earned a degree in high-tech-related fields in 2018 accounted for a mere 4 percent of all the graduates in these fields (Cohen-Kovatch & Kasir, 2020). This percentage is significantly lower

6 Standardized scores rather than grade points were used to create an objective assessment that is less sensitive to the scale of measurement. The range of scores on the Meitzav (as presented in the official reports by the National Authority of Measurement and Assessment in Education and the Ministry of Education) has changed completely over time.

7 Data from the report of the National Center for Testing and Evaluation for the year 2019 were analyzed by the Bank of Israel.

8 Arabs accounted for 18 percent of all medical students in 2018 and 15 percent in 2019 (Table 2.29.1 in the Multiannual Publication of Students in Institutions of Higher Education, Central Bureau of Statistics). In addition, the report of the National Center for Testing and Evaluation for the year 2019 indicates that 11 percent of Arabs who took the psychometric exam for the first time and responded to the preference questionnaires, selected computer sciences or computer engineering as their preferred field of study, compared to 15 percent of their Jewish counterparts. In contrast, if we focus on medical fields, this picture is reversed: 18 percent of Arabs selected medicine as their preferred field of study compared to 12 percent of Jews. This situation is also documented in in-depth interviews with young Arab adults in the study by Kenneth-Popper et al. (2015).

9 This figure is taken from Table 2.15 in the Multi-Annual Publication on Students in Institutions of Higher Education, Central Bureau of Statistics.

than the proportion of Arab students in these fields (12 percent). Part of this gap may be driven by the increase in recent years in the enrollment rates in high-tech-related fields of younger Arabs who have not yet graduated. But, additionally, the attrition rate of Arab students in high-tech-related fields is high. Mazuz-Harpaz and Krill (2017) found that of all individuals born between 1975 and 1985, only 51 percent of the Arab students who enrolled in high-tech-related fields earned a degree in those fields, compared with 68 percent of their Jewish counterparts. Amariya and Krill (2019) found that in Arab society, post-secondary dropout rates are higher especially among males than among Jewish males with comparable characteristics. These differences in attrition rates may also be due to the fact that Arab students encounter difficulties in studying in Hebrew, which is not their native language, and differs from their language of instruction in elementary and high school (Tahoco et al., 2019). These findings point to the need to provide support and follow-up programs for Arab students enrolled in high-tech-related fields. In summary, the findings above indicate that the gap between Arabs and Jews in employment in the high-tech sector is almost entirely due to differences in the acquisition of the human capital relevant for the high-tech sector. In fact, there is a gap of only one percentage point between the percentage of Arabs among graduates of high-tech-related fields (4 percent) and the percentage of Arabs among young adults up to age 34 employed in the high-tech sector (3 percent).

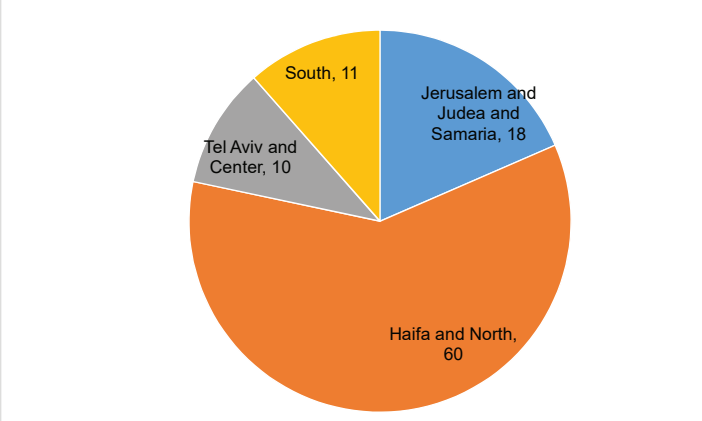
Public debates have also suggested additional explanations for Arabs' poor integration in the high-tech sector, but the contribution of these explanations is limited as the gap between Jews and Arabs in employment in the high-tech sector is very similar to the gap between Arab and Jewish degree earners in these fields. The first explanation is a mismatch between the location of business centers and Arabs' place of residence. In Israel, the vast majority of high-tech firms are located in central Israel, mainly in the Gush Dan (metropolitan Tel Aviv) region. In 2019, 62 percent of all high-tech employees in Israel worked in central Israel and the Tel Aviv area (Figure 5A). Only 12 percent of the Arab population resides in central Israel, compared with 50 percent of the Jewish population. Opportunities for remote work, which have expanded since the COVID-19 pandemic in 2020, may, in the future, increase access to high-quality employment in the high-tech sector in central Israel for Arabs who live in the country's periphery. The growing shortage of labor in the high-tech sector, which is reflected in recruitment efforts overseas and the employment of employees living overseas, may increase firms' willingness to relocate a portion of their operations in order to exploit the potential labor that is available in Israel's periphery.

A second factor proposed in public debates to explain the limited integration into the high-tech sector of Arab graduates of high-tech-related fields is related to Arabs generally lacking the social networks that Jews have, for example, networks based on joint military service in technology units (Tsofen, 2020). Various studies worldwide have indicated the impact of social networks and informal connections on employment opportunities (Calvo-Ammengol & Jackson, 2004; Dustmann et al., 2016): Many Arabs, however, have no prior acquaintance with the high-tech world. For example, according to a 2020 survey conducted by the NGO Presentense, 78 percent of Arab respondents stated that they have no acquaintances who are employed in high-tech, compared to 32 percent of Jewish respondents (Presentense, 2020). This lack of network ties is exacerbated by the fact that many high-tech firms use the informal "friend-brings-friend" referral method to recruit employees. In recent years, several organizations and projects have been

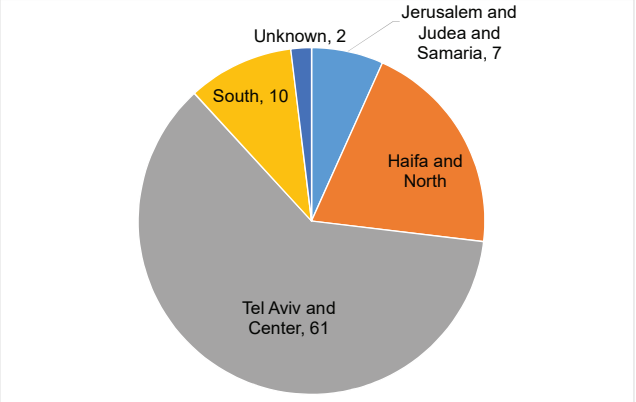
established to assist young Arabs in overcoming such barriers to integration.[10] Here, too, the labor shortage may, in the future, increase firms' willingness to diversify their recruitment methods and screening tests in order to expand their candidate pool.

Figure 5
Differences in the geographic distribution of workplaces in high-tech and Arabs' locations of residence in Israel

b. Distribution of Arabs' location of residence, by region, 2019 (percent)



a. Distribution of high-tech employees' workplaces, by region, 2019



2. Differences between Jewish and Arab high-tech employees

A. Employee characteristics

Despite the challenges and barriers they face, a small percentage of the Arab population managed to integrate into employment in high-tech. The current analysis identifies the characteristics of Arab high-tech employees and the differences between them and the characteristics of their Jewish counterparts. The analysis is based on aggregated data from the Labor Force Surveys conducted by the Central Bureau of Statistics between 2012 and 2017. Data were aggregated in order to include a sufficiently large number of observations, specifically observations of the Arab population whose representation in the high-tech sector is low. For technical reasons related to limited data availability, more recent years were not included in this analysis. Therefore, in view of the dynamic nature of the high-tech sector, caution should therefore be exercised in interpreting these data, which are merely a qualitative approximation of the current situation.[11]

The characteristics of high-tech employees differ significantly from the characteristics of the remainder of the population (Table 1). Specifically, high-tech employees are more highly education, and have a lower tendency to live in the periphery in the north and south of Israel. The patterns of these differences are not significantly different when comparing Jews and Arabs. In general, Arab employees are younger and less educated than Jewish employees, and have a higher tendency to live in the northern district. This is also

[10] For example, Tsofen cultivates a skilled labor force, integration of academic graduates, and the establishment of high-tech centers in Arab localities. Mentech is a project that encourages the integration of Arab engineers in the high-tech industry, Excellentteam is a course offered by Central Start-Up Nation (SNC) to integrate holders of undergraduate degrees in computer sciences in the high-tech industry.

[11] In addition, we conducted a separate analysis of the labor surveys for 2018 and 2019 and the descriptive findings there are similar and are presented in Table A1. It was not possible to conduct an in-depth analysis there because the number of observations of Arabs in the high-tech sector in that database is too small.

the case for Arabs who are employed in the high-tech sector. A notable finding is that young adults under age 40 account for a higher percentage of Arab employees in high tech than among Arab employees in all other fields (60 percent vs. 52 percent, respectively), while in the Jewish population, the reverse is found (34 percent vs. 42 percent, respectively). Furthermore, women account for 18 percent of all Arab high-tech employees, and for 34 percent of all Jewish high-tech employees. An additional analysis for the years 2018–19 based on more recent Labor Force Surveys, shows that the share of women among Arab high-tech employees increased to 31 percent (see Table A1 in the Appendix), although the number of observations in this analysis is small (approximately 440 observations), which makes it difficult to assess whether this increase reflects a genuine trend.

Table 1
Characteristics of high-tech vs. other employees, by population group (Jews and Arabs) (2012–17)

	Arabs		Jews	
	High-tech employees	**Other employees**	**High-tech employees**	**Other employees**
Years of schooling	14.74	12.56	15.73	14.17
Percentage of academic degree holders	48	23	62	33
Percentage of women	18	31	34	54
Percentage of youth (under age 35)	60	52	34	42
Number of children under age 14	1.23	1.55	1.12	0.95
District of residence: North and Haifa (%)	73	64	22	21
District of residence: Center and Gush Dan (%)	14	12	59	51
District of residence: Jerusalem (%)	10	17	8	13
District of residence: South (%)	3	7	11	15
No. of observations	881	117,394	63,358	770,038
Total no. of individuals in the population (weighted annual average)	4,042	414,301	250,222	2,473,215

SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics.
For information on the definitions of the high-tech industries, see footnote 2.

B. Gaps between Jews and Arabs in the quality of employment in high-tech

Figure 6 indicates that Jews and Arabs in high tech are employed in different occupations.[12] While 71 percent of Jews employed in this sector work in core high-tech occupations, only 59 percent of Arabs employed in the high-tech sector work in core-high-tech occupations and 28 percent work in production or non-professional occupations, which is almost three times the percentage of Jewish high-tech employees.

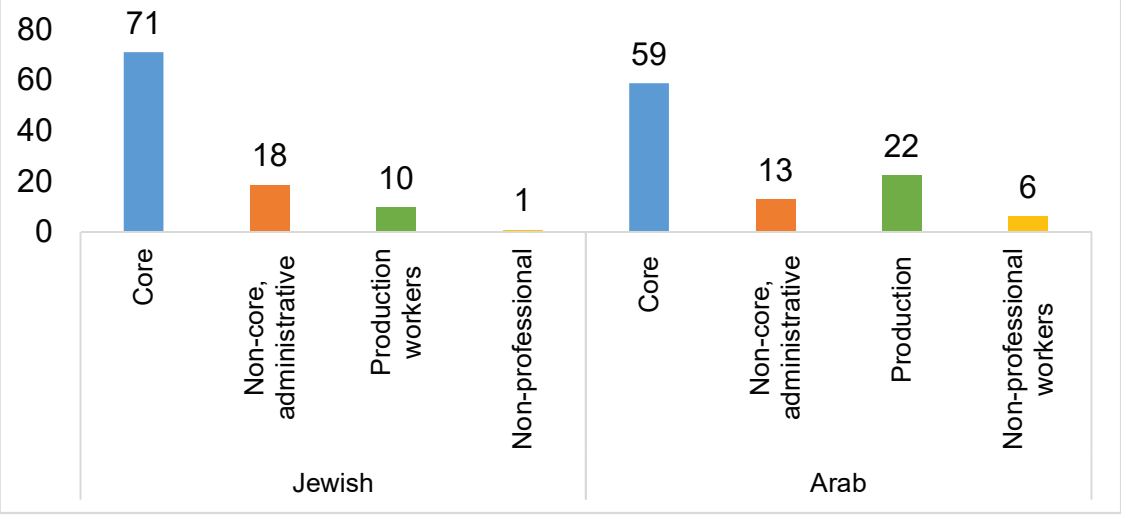
The sectoral composition of Arab and Jewish high-tech employees also differs. High-tech services (which include software and R&D sectors) are conventionally distinguished from high-tech manufacturing (which includes the manufacturing of goods such as computers and peripheral equipment, electronic devices, and drugs).[13] High tech, and especially its manufacturing sector, has a strong need for many non-core workers,

[12] Occupations in the high-tech sector are divided into four categories: (1) core employees (executives, ICT professionals, engineers, associate engineers, and practical engineers), (2) administrative support workers: occupations in business, administration, law, society, and culture; general clerks and officer workers; (3) production workers: craftspersons in manufacturing and in construction, and similar occupations; operators of equipment and machinery, product and equipment assemblers, and drivers; (4) in-professional workers.

[13] The high-tech manufacturing sector includes the following industries: drug manufacturing (21), manufacturing of computers, and electrical and optical devices (26), manufacture of vehicles (30). The high-tech services sector include: computer software, consulting, and ancillary services (62), information services (63), scientific R&D (72). The industries are classified according to the uniform classification of industrial sectors (2011) of the Central Bureau of Statistics.

and therefore in this sector only 59 percent of employees were occupied in core-high-tech professions in 2019. In contrast, the composition of occupations in the high-tech services sector is more homogenous, and 78 percent of all employees are employed in core high-tech occupations. Geographic distribution also differs by sector: In 2019, 76 percent of all salaried workers in the high-tech services sector, but only 48 percent of all salaried workers in the high-tech manufacturing sector, worked in Tel Aviv and the central district.

Figure 6
Distribution of high-tech employees by occupation and population group (Arabs and Jews), 2012–17 (percent)

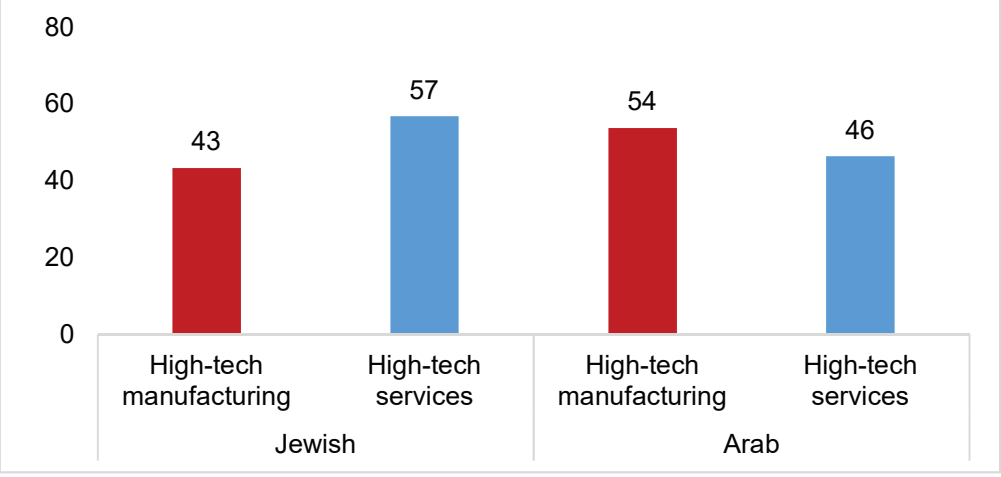


SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics.
(1) For a precise definition of core high-tech occupations, see footnote 12.

Figure 7 indicates that while 57 percent of Jews in high-tech work in the high-tech services sector and 43 percent in the manufacturing sector, 54 percent of Arab high-tech employees work in the manufacturing sector and 46 percent in the services sector. The sectoral distribution of Arab high-tech employees may further worsen their representation in this sector in the future, as the general trend in the past decade has been a stagnation in the growth of the manufacturing sector, and a decline in its relative share of the total product of the high-tech sector, and a rise in the share of the high-tech services sector (see Bank of Israel, 2018, "An Issue in the Balance of Payments," Chapter 7). In the past decade, the average annual growth rate of the high-tech manufacturing sector was -0.1 percent, compared to 7.8 percent in the high-tech services sector. In 2011, the manufacturing sector accounted for 53 percent of the total product of the high-tech sector, but for only 30 percent in 2020.[14]

[14] Special data of the Central Bureau of Statistics on the product of the high-tech sector were analyzed by the Bank of Israel.

Figure 7
Distribution of high-tech employees by industry types, 2012–17



SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics.
(1) For a definition of the classification of the services and manufacturing sectors of the high-tech industry, see footnote 13.

C. Analysis and decomposition of the quality gap in high-tech employment, by population group

To determine the extent to which the background variables of Arabs employed in high tech contribute to the differences in the quality of their occupations compared to Jewish high-tech employees, we ran a regression analysis and decomposition following the Blinder-Oaxaca method (Oaxaca, 1973; Oaxaca & Ransom, 1994), which is used to estimate and quantify the unique contribution of each independent variable to the between-groups difference. The difference in occupational quality between Arab and Jewish high-tech employees can be represented by eq. (1):

(1) $$\bar{Y}^{Jews} - \bar{Y}^{Arabs} = (\bar{X}^{Jews} - \bar{X}^{Arabs})\hat{\beta} + (\bar{X}^{Jews}[\hat{\beta} - \hat{\beta}^{Jewish}) + \bar{X}^{Arabs}[\hat{\beta}^{Arabs} - \hat{\beta}]$$

Explained Portion — Unexplained Portion

The explained portion of the difference (X) is made up of the following components: education, district of residence, gender, personal status, no. of children, and employment status of spouse. The explained variable represents quality of employment (employment in core vs. non-core high-tech occupations, or employment in high-tech services vs. manufacturing sector). represents the vector of the regression coefficients that describe the relationship between the explanatory variables and the outcome variable.

Table 2 and Figure 8 present the results of the analysis of employment rate gaps between Arab and Jewish employees in core high-tech occupations. The findings show that the distribution of districts of residence and low educational attainment partially contribute to the different employment rates in core high-tech professions. In contrast, Arab employees' younger age and small percentage of women employees has a

negative impact on this gap. That is, if Arab women and young adults were employed in high tech at an identical rate as Jewish women and young adults, the difference between the probability of employment of Jews and Arabs in core high-tech professions would be even larger. Still, most of the contribution to this gap is attributed to unobservables, such as differences in qualifications and skills, differences in school subjects, and other factors.

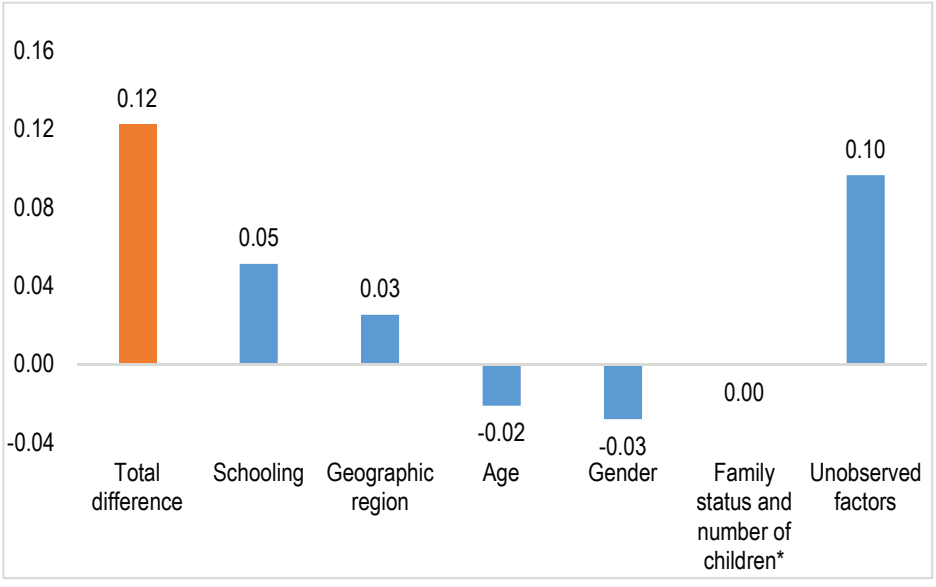
Table 3 and Figure 9 illustrate the differences between Arabs and Jews employed in the high-tech services sector compared to the high-tech manufacturing sector. These figures show that the difference in the by-industry composition of Jews' and Arabs' employment in high tech is explained by geographic differences more than by any other variable, and the difference between these two population groups becomes insignificant when controlling for differences in district of residence. This implies that increasing the periphery's geographic access to the center may contribute to increased integration of Arab employees in the high-tech services sector, which has been characterized by high productivity and grew markedly in recent years. An additional factor, albeit of much more limited significance, is the lower educational attainment of Arab employees. In contrast, the younger age of Arab high-tech employees is a factor that promotes their integration into the high-tech services sector because this sector is typically characterized by younger employees compared to the high-tech manufacturing sector. Differences in personal status and number of children make no contribution to the differences between the two population groups in occupational quality.

Table 2
Regression coefficients of the difference between Arabs and Jews in the probability of working in core high-tech occupations[a]
(all high-tech employees, 2012-2017)

	(1)	(2)	(3)	(4)	(5
Difference in probabilities[b]	-0.123***	-0.127***	-0.155***	-0.119***	-0.096***
(in percentage points)	(0.018)	(0.018)	(0.017)	(0.016)	(0.016)
Controlling for personal status and number of children		V	V	V	V
Controlling for age and gender			V	V	V
Controlling for schooling				V	V
Controlling for district of residence					V
R^2	0.001	0.011	0.058	0.156	0.169
No. of observations	64,239	64,239	64,239	64,239	64,239

SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics.
*** significant at the 1% level, ** significant at the 5% level.
(a) The dependent variable is a dummy variable representing high-tech employees' employment in core high-tech occupations, as defined in footnote 12 (1– core occupations, 0 – non-core occupations).
(b) The difference in probabilities is the regression coefficient of the dummy variable (1 – Arab, 0 – Jew) in the regression model.

Figure 8
Decomposition of the gaps between Jews and Arabs in the probability of employment in core high-tech occupations[a] (all high-tech employees, 2012–17)

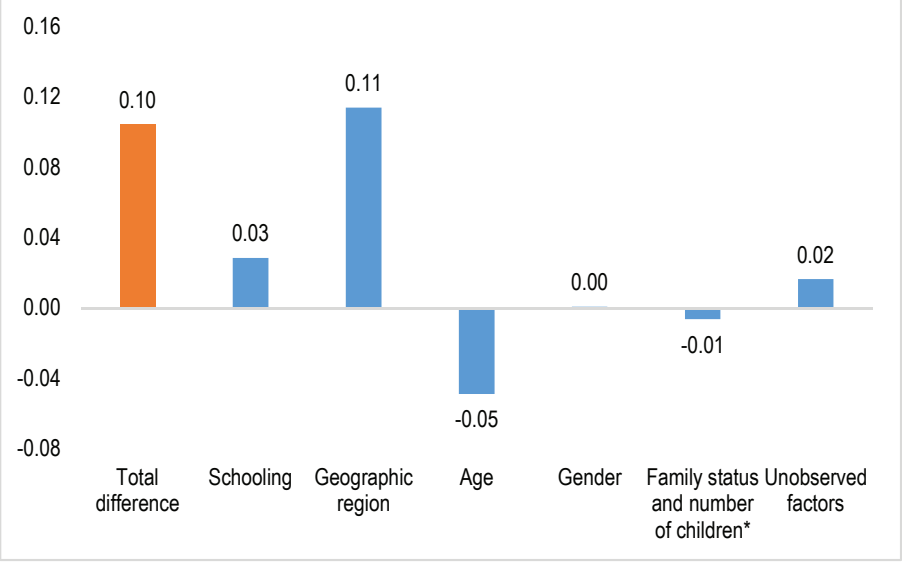


This figure represents the various variables' contributions to the gap in quality of high-tech employment between Arab and Jews employed in high-tech, measured according to the Blinder-Oaxaca decomposition method.
(a) For a precise definition of core high-tech occupations, see footnote 13.
SOURCE: Based on Labor Force Surveys by the Central Bureau of Statistics.

Table 3
Regression coefficients of the difference between Arabs and Jews in the probability of working in the high-tech services sector[a]
(all high-tech employees, 2012–2017)

	(1)	(2)	(3)	(4)	(5)
Difference in probabilities[b]	-0.104***	-0.119***	-0.149***	-0.126***	-0.016
(in percentage points)	(0.018)	(0.019)	(0.018)	(0.017)	(0.017)
Controlling for personal status and number of children		V	V	V	V
Controlling for age and gender			V	V	V
Controlling for schooling				V	V
Controlling for district of residence					V
R^2	0.001	0.018	0.048	0.08	0.145
Number of observations	64,239	64,239	64,239	64,239	64,239

Figure 9
Decomposition of the gaps between Jews and Arabs in the probability of employment in the high-tech services sector[a] (all high-tech employees, 2012–17)



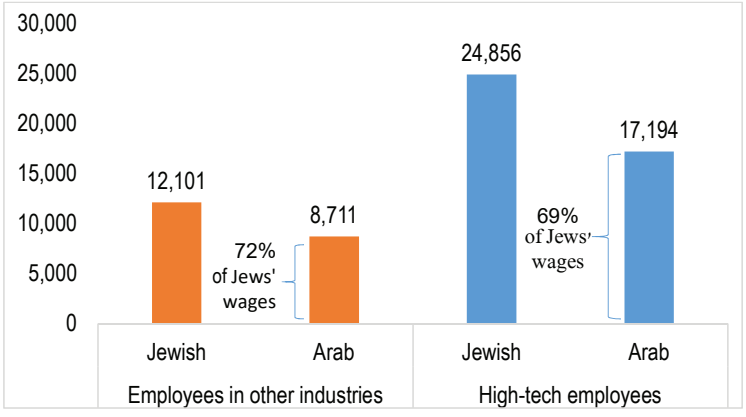
SOURCE: Based on Labor Force Surveys by the Central Bureau of Statistics.
This figure represents the varioous variables' contributions to the gap in quality of high-tech employment between Arab and Jews employed in high-tech, measured according to the Blinder-Oaxaca decomposition method.
(a) Compared to work in high tech manufacturing. For a precise definition of high tech services industries and high-tech manufacturing industries, see footnote 13.

D. Wage gaps between Jews and Arabs in high tech

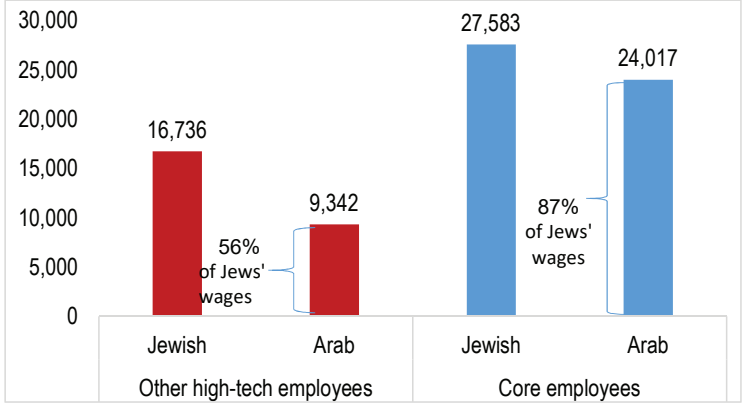
The differences between Jews and Arabs in high tech are also evident in wage gaps, which are reflected in the data on wages of salaried workers who participated in Labor Force Surveys in 2018 and 2019. Figure 10A indicates a considerable wage difference between Jews and Arabs in the high-tech sector (31 percent), which is slightly higher than the wage gap between Jews and Arabs in other industries. A more in-depth look indicates that a large share of this gap stems from the differences in the occupational composition of each group, as presented in Figure 6. Figure 10B presents a finer segmentation, which shows that the wage gap exists primarily in non-core occupations (44 percent) while the wage gap in core high-tech occupations is a mere 13 percent. Furthermore, Figure 7C shows that the wage difference is large in the high-tech manufacturing sector (47 percent) and much smaller in the high-tech services sector (15 percent). These wage differences may reflect differences in various factors such as human capital, types of job, type of company, work hours, bargaining differences, etc. An in-depth analysis of these factors is important but is beyond the scope of this study due to the limited availability of data.

Figure 10
Wage gaps between Jews and Arabs in high tech vs. other industries (average monthly wages, NIS, 2018–19)

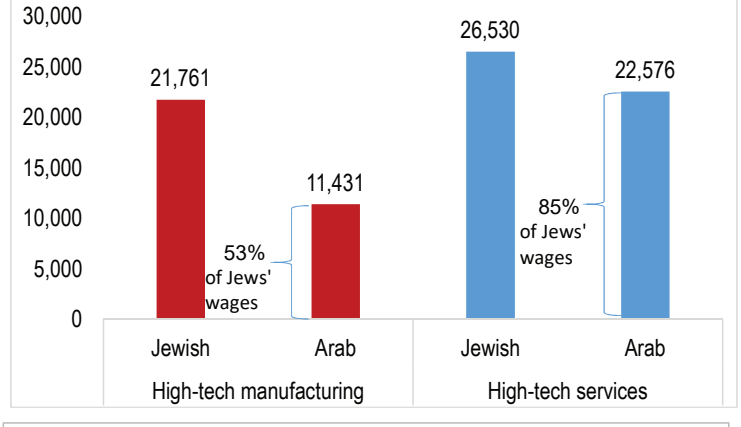
a. Employees in high tech vs. other industries



b. Employees in core vs. non-core high-tech occupations[a]



c. The high-tech services sector and the high-tech manufacturing sector[b]



SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics.
(a) For a precise definition of core high-tech occupations, see footnote 12.
(b) For a precise definition of the high-tech services and high-tech manufacturing industries, see footnote 13.

3. Arab employees of high tech sector during the COVID-19 crisis

The outbreak of COVID-19 in early 2020 triggered an unprecedented shock to the global economy, and Israel's economy contracted by 2.5 percent. However, in contrast to many other industries, the product of the Israeli high-tech sector grew by an annual rate of 5.8 percent in 2020, due to the rise in the global demand for technological services, triggered by the social distancing regulations imposed during the crisis. Furthermore, the negative impact on employment in the high-tech sector was limited to short-term effects, and by the end of that year employment returned to pre-crisis levels (Bank of Israel, 2021).

Table 4 indicates that while the number of Jewish salaried employees in the high-tech sector in 2020 was almost unchanged from the previous year (319,000), the number of Arab salaried employees in high tech declined by approximately 5 percent.[15] In contrast, in other industries, employment rates dropped between March and December 2020 by 13 percent for Jewish employees and 21 percent for Arab employees from the corresponding period in 2019. That is, high tech offered greater job security to both its Jewish and Arab employees, compared to other industries.

Table 4
Employment in high-tech vs. other industries, 2019–2020

	High tech		Other industries	
	Jews	Arabs	Jews	Arabs
March–December (average 2018-2019)	319,306	6,621	2,636,304	495,197
March–December 2020	319,272	6,290	2,297,920	390,690
Change (%)	0	5-	-13	21-

SOURCE: Based on Labor Force Surveys of the Central Bureau of Statistics.

Furthermore, the COVID-19 crisis may, in the future, increase the integration of Arab in the high-tech sector due to these firms' rapid adjustment to remote work arrangements, which created new work patterns. According to the Survey of the State of Businesses during the Spread of COVID-19 conducted by the Central Bureau of Statistics in January 2021, 80 percent of all high-tech employees worked in companies that declared their intention to expand options for working from home after the end of the COVID-19 crisis. While the geographic distance between Arab localities and workplaces in previous years might have been a barrier to employment, the transition to working from home and the new flexible work arrangements may accelerate the integration into the high-tech sector for Arabs who live in the periphery.

[15] This estimate should be treated with care in view of the small number of observations of Arabs in the high-tech industry in the labor survey (184 in 2019 and 153 in 2020).

4. Conclusion

The participation of workers from Arab society in high tech is very low, due to differences in human capital that accumulate over the years in various settings. Arabs account for a very low percentage of all degree earners in high-tech-related fields (4 percent), and their representation is very similar to their representation among all salaried high-tech employees (2 percent of all employees, 3 percent of all employees up to age 34). There are additional explanations for the differences in participation in the high-tech sector, such as lack of networks or geographic mismatch, but these explanations are apparently less significant because the pool of skilled Arab high-tech workers is very small. Furthermore, the difference between Arabs and Jews in the percentage of degree earners among all students enrolled in high-tech-related fields indicates that attrition from higher education is a significant problem for Arab students in these fields.

The analysis points to several important factors that exacerbate the gap between Jews and Arabs in occupational quality within the high-tech sector. The first factor is the educational gap, which primarily affects the probability of working in core high-tech occupations. The second factor is the mismatch between the geographic distribution of workplaces and the places of residence of Arab high-tech employees, who tend more to live and work in the northern district, compared to Jews, and consequently become more integrated into the high-tech manufacturing sector than in the high-tech services sector, which offers higher salaries and growth. However, the young age of Arabs increases their probability of working in core high-tech occupations and integrating into the high-tech services sector. In addition, it is important to note that a considerable portion of the differences in occupational quality is not explained by the data available in the current analysis. This gap appears to be due to differences in skills, quality and nature of education (rather than number of years of schooling), and other factors, which should be incorporated in appropriate databases and explored in follow-up studies in this field.

The difficulties Arabs encounter in integrating in the high-tech sector adversely affect the Arab population, which is unable to realize its full potential and abilities, and also negatively impacts high-tech sector itself, which suffers from a shortage of skilled labor. As noted above, a significant contributor to Arabs' low participation in the high-tech sector is the gap in human capital that emerge at younger ages, which underscores the importance of increasing investments to improve the quality of the Arab school system and to reduce gaps in the achievements of these two groups from pre-school to university. Detailed recommendations for such efforts appear in the Bank of Israel's Program on Accelerating Growth in Israel's Economy (Bank of Israel, 2021). These recommendations include expanding remedial efforts by increasing study time based on differentiated budgeting, development of tools to attract high-quality teachers in order to increase the efficiency in allocation of resources for the instruction of elementary subjects, and support to help students enrolled in computer studies programs, of which there is a shortage. Furthermore, efforts should be directed to resolve the issue of attrition of Arab post-secondary students in high-tech-related fields, and to operate follow-up programs that support these students and help them successfully complete their studies. The integration of Arabs in high-quality technological jobs in the high-tech sectors is an important process that should be promoted in order to accelerate their integration into Israeli economy and society, and in order to allow the Israeli high-tech sector to utilize the full potential of the local human capital.

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APPENDIX

Table A-1
Characteristics of high-tech vs. other employees, by population group (Jews and Arabs) (2012–2017)

	Arab		Jewish	
	High-tech employees	**Other employees**	**High-tech employees**	**Other employees**
Years of schooling	14.63	12.75	15.88	14.32
Percentage of academic degree holders	52	24	64	36
Percentage of women	31	34	34	54
Percentage of youth (under age 35)	54	49	34	39
Number of children under age 14	1.03	1.42	1.12	0.99
District of residence: North and Haifa (%)	80	65	21	21
District of residence: Center and Gush Dan (%)	11	11	60	50
District of residence: Jerusalem (%)	6	17	9	14
District of residence: South (%)	3	7	9	16
No. of observations	437	31,581	21,659	190,309
Total no. of individuals in the population (weighted annual average)	6,280	490,182	306,120	2,631,901

Source: Based on Labor Force Surveys conducted by the Central Bureau of Statistics.
For information on the definition of the sectors of the high-tech industry, see footnote 2.

EMPLOYMENT AROUND RETIREMENT AGE[1] DURING THE COVID-19 CRISIS THROUGH THE SECOND QUARTER OF 2021

- **Employment recovered quickly following the COVID-19 vaccination campaign of the first quarter of 2021. Among non-ultra-Orthodox Jews aged over 35, the employment rate practically returned to its pre-crisis level, including for most of the older age groups (those aged 55+), despite concerns about the long-term impact of the COVID-19 crisis on employment of older adults. This may reflect, inter alia, the contribution of the furlough arrangements, which retained employer-employee affinity.**
- **Among men aged over 62 and women aged over 67, the employment rate has yet to fully recover, as of the end of the second quarter of 2021, and this is most evident among those with lower education levels.**
- **During the COVID-19 crisis, employment rates (in percent) of these groups decreased more sharply compared to younger age groups, in particular for those with lower education levels and those employed in the proximity industries.[2]**
- **Given that in previous crises older people resumed employment more slowly than younger ones did, and older people also tend towards early retirement, there is uncertainty associated with further recovery of the employment rates among older age groups (women aged 67 and older and men aged 62 and older), which have yet to return to their pre-crisis level. That is so especially given the renewed COVID-19 morbidity outbreak following the reviewed period.**

Growing life expectancy and higher budgetary expenditure associated with it place the employment of age groups around the retirement age and thereafter at the focal point of employment policy in Israel and worldwide, due to their growing share of the population and the desire to ensure proper quality of life for the elderly after retirement. The COVID-19 (herewith COVID) crisis did affect employment rates across all age groups[3], but studies indicate a particular difficulty faced by the older population in resuming and entering the labor market following financial crises.[4] Hence it raises concerns about the capability of employees approaching retirement age, and those past retirement age, to return to work following the crisis. A most severe impact to employment rates was observed in those aged over 67 (men and women aged 67–71), who are subject to particularly high healthcare risk.[5] This study documents the change in employment rates for different age groups, focusing on the older age groups—a few years before and after the retirement age—where employment rates are still significant. This analysis is based on monthly Labor Force Surveys conducted by the Central Bureau of Statistics in periods prior to the crisis, during the crisis, and in March-June 2021 following the vaccination campaign.

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1 "Retirement age", as used below, refers to the age of eligibility for old age pension (contingent on an income test).

2 See the definition of this term in the Bank of Israel Annual Report for 2020, Chapter 2, Box 2.1.

3 For more information, please see: Bank of Israel (2021), Chapter 5.

4 For more information, please see Summary.

5 The risk of severe illness and complications due to COVID-19 increase with age and with certain health conditions more prevalent in older age, such as high blood pressure, diabetes, and cardiovascular disease (Israel Gerontological Data Center, Comprehensive information bulletin, volume 46, December 2020).

In late January 2020, restrictions were first imposed on those entering Israel, in order to prevent an outbreak of the COVID-19 virus. Concern about this virus resulted in stricter restrictions imposed on economic activity and on movement in the public space, going as far as to prohibit leaving the dwelling except in cases where it was absolutely required. Movement restrictions were strictest in late March 2020 ("first lockdown"), and from mid-April these restrictions were gradually lifted. In the summer of 2020, economic activity resumed, with restrictions imposed on social gatherings. These restrictions were once again made stricter in late September, for about one month ("second lockdown"), and for the third time very strict restrictions were imposed from early January to early February 2021 ("third lockdown"). The vaccination campaign in Israel, which started in late December 2020—first to the elderly and gradually to the rest of the population—dramatically reduced COVID morbidity in Israel and allowed the gradual lifting of restrictions from early March 2021 through to the full lifting of all restrictions in mid-June 2021 (which turned out to be temporary).[6] During the COVID crisis, several adjustments were made, designed to bolster the social safety net[7] and to reduce the impact on income of discontinued employment due to the crisis, while maintaining the affiliation with the place of work. These adjustments remained in effect through the reviewed period.[8] For the population in the working age, eligibility criteria for unemployment benefits were made more flexible, both for employees placed on furlough and for the unemployed, and benefit amounts were increased.[9] For the elderly, over the statutory retirement age, the social safety net was expanded during the crisis, through two policy changes: For women aged 62–67, the Government permitted "double benefits", allowing them to concurrently receive their old age pension and unemployment benefits[10], and those aged over 67—men and women who are not eligible for unemployment benefits due to their age—were eligible for an "adjustment bonus".[11] We have analyzed the employment patterns during COVID and during the subsequent recovery period, by five age groups, identical for men and for women: 35–44; 45–54; 55–61; 62–66; 67–71. The groups we have defined allow us to monitor different employment trends based on the eligibility age for old age pension contingent on income testing, which differs for men (67) and for women (62), while observing and comparing employment trends common to both men and women. The age groups on which our analysis focuses are those aged 55+. As for women, the 55–61 age group is the last one before reaching

6 Due to further increase in morbidity, restrictions were once again made stricter in July-August 2021, a period not covered in this document.

7 For more information please see: Bank of Israel (2021), Chapter 5.

8 Towards the end of the reviewed period, in mid-June 2021, the Government decided to revise the support model, with changes becoming effective in July: A gradual discontinuation of support by the end of 2021 was defined, first for the unemployed aged 45 and under, and then for those aged 45 and over and for pension recipients.

9 The increased flexibility was reflected in waiving the requirement for employees to first receive from employers payment in full for paid leave and other rights.

10 In general, an unemployed woman eligible for both unemployment benefits and an old age pension, would receive the higher of the two. The special arrangement during the COVID period stipulated that women aged 62–67 who receive an old age pension would be subject to the "double benefits" arrangement, allowing them to receive unemployment benefits concurrently with the old age pension, and for the income test to determine eligibility for the old age pension, these unemployment benefits would be regarded as work income.

11 Israeli residents aged 67 and over are not eligible for unemployment benefits. As part of adjusting the social safety net during COVID, as from March 2020 residents who had worked for at least 3 contiguous months in a salaried position prior to being placed on furlough or being terminated for the first time, and whose monthly pension income is up to NIS 5,000, are eligible for a bonus of up to NIS 4,000 (for those whose pension income is up to NIS 2,000), and at least NIS 1,000 for those whose pension income is from NIS 4,000 to 5,000. In June 2021, the Knesset approved a three-month extension of this arrangement, and revised the bonus amounts to gradually decrease, down to 70% of the previous amount by September.

the eligibility age for old age pension contingent on income testing[12] (62), while in the 62–66 age group they are entitled to this pension. Furthermore, during the COVID period and the subsequent recovery, the unemployed women in this age group benefited from the aforementioned special arrangement for payment of "double benefits". As for men, the 62–66 age group is the last one before reaching the eligibility age for old age pension contingent on income testing (67). In the 67–71 age group, both men and women are of the age when eligibility for old age pension is contingent on income testing (this period runs through age 70, after which their eligibility is no longer contingent on income testing), and during the COVID period, the unemployed in this age group were subject to the aforementioned "adjustment bonus" arrangement.

Employment prior to the COVID-19 crisis, during the crisis, and after the vaccination campaign: Analysis by age, education level and gender

Employment prior to the crisis

Differences in employment rates by age are readily visible in data prior to the crisis (Figure 1). The higher the age group, the lower the employment rate: the gap in employment rates of men and women is most visible between ages before and after eligibility for old age pension: Employment rates of men aged 67+ and women aged 62+ are significantly lower than those of younger people. These findings match those from analysis of employment rates by age and gender in the Arab and Ultra-Orthodox Jewish populations (Figure 1 in the appendix). Due to difference between employment patterns of ultra-Orthodox Jewish men and of Arab women, and those of the rest of the population, and due to the small number of observations among these populations for some age groups, the analysis below is focused on the non-Ultra-Orthodox Jewish population.

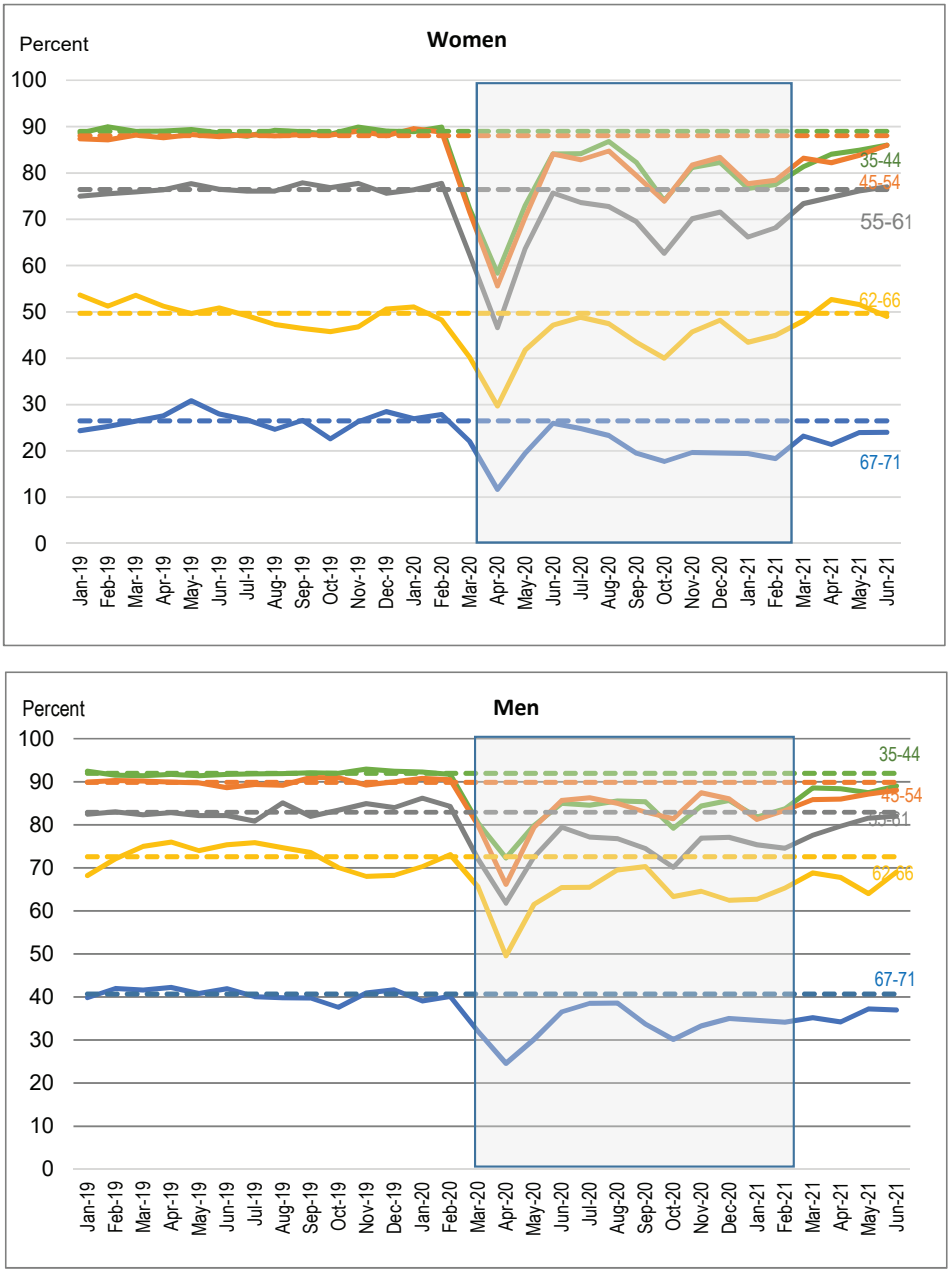
In addition to differences in employment rate between different age groups, we also see differences in their employment patterns (Table 1). The differences between employees from different age groups in occupations and economic sectors' distribution reflect two effects: The **cohort effect**—differences in educational attainment, in entering the labor market and in choice of occupation at a young age, resulting from the fact that people were born and entered the labor market in different periods; and the **age effect**—differences within the older population and between the older and the younger population, due to employment experience and, in contrast, healthcare restrictions and erosion of skills and productivity.

The COVID crisis had a particular impact on economic activity and employment for a group of sectors with high infection potential, because they require proximity to customers or prolonged stay in closed spaces (hereinafter: "proximity industries").[13] Occupations where employees were impacted to a lesser degree are white collar occupations, where working remotely is more prevalent. Another group especially impacted by the COVID crisis is the self-employed, in particular the small business owners. Prior to the crisis, the percentage of women employed in proximity industries, out of all women employed in the different age groups, were quite similar, but for men, the percentage of those employed in these sectors increased with

12 The eligibility age for old age pension contingent on income testing (62 for women, 67 for men) is also the eligibility age for pension payouts from legacy pension funds.

13 Proximity services are: Transportation, storage, mail and courier services (category H); hospitality and food services (category I); administration and support services (category N); education (category P); art, entertainment and leisure (category R); and other services (category S). See: Bank of Israel (2021), Box 2.1.

Figure 1
Employment Rate of Non-Ultra-Orthodox Jews, by Gender and Age, January 2019 to June 2021



Source: Based on CBS Labor Force Survey.

Notes to Figures: Employment rate: Percentage of those employed (salaried position or self-employed) out of the total population in the age group. "Employed" excludes those absent for COVID-related reasons. The solid lines represent monthly data. The dashed lines represent the average for 2019. The rectangle denotes the "COVID-19 crisis period" of March 2020 to February 2021.

age (Table 1). As for occupation and employment format—the percentage of those employed in white collar occupations out of all those employed, for both men and women, decreased with age, while the percentage of the self-employed increased. Among women (compared to men), a higher percentage of those employed in white collar occupations were employed in the public sector, reaching the highest share in the 55–61 age group (whereas for men, the highest share was in the 62–66 age group).

Table 1: Employment characteristics (of Non-Ultra-Orthodox Jews) prior to the COVID crisis (2019), by gender and age

Age group	35-44	45-54	55-61	62-66	67-71
Women					
Employed in proximity industries (percentage of those employed)	28	33	34	32	30
Employed in white collar occupations (percentage of those employed)	67	62	54	51	45
Employed in public sector as percentage of those employed in white collar occupations (%)	34	40	45	42	29
Self-employed (percentage of those employed)	11	12	11	14	17
Average weekly working hours	36	36	35	29	23
Men					
Employed in proximity industries (percentage of those employed)	20	23	24	26	32
Employed in white collar occupations (percentage of those employed)	65	57	52	49	48
Employed in public sector as percentage of those employed in white collar occupations (%)	18	18	22	25	15
Self-employed (percentage of those employed)	15	20	21	22	31
Average weekly working hours	43	43	42	40	34

Source: Based on CBS Labor Force Surveys.
Notes to table: Employment in proximity industries and employment in white-collar occupations do not add up to 100 percent of those employed, since the former refers to the economic sector where the individual is employed, while the latter refers to their occupation. Employment "in the public sector" is based on "sector definition" in the CBS labor survey. This definition can be found here: https://www.cbs.gov.il/he/mediarelease/DocLib/2021/287/20_21_287b.pdf.

Employment during the crisis

The dynamics of change in employment during the COVID crisis period, presented in Figure 1, is similar for men and women, as well as for different age groups: The three lockdown periods saw a sharp decrease in employment rates—in particular in March–April 2020, and to a lesser degree during the other lockdown periods: in September 2020 and finally in February 2021. Between lockdown periods, and in particular in the summer months (July–August 2020), employment recovered across all age groups: It came close to the 2019 average, but only slightly lower.

Table 2: Change in employment rates of non-ultra-Orthodox Jews crisis period (March 2020 to February 2021) compared to the pre-crisis period (January 2019 to February 2020)

Age group	35-44	45-54	55-61	62-66	67-71	35-71
Women						
Employment rate (1.9–2.20)	89	88	77	50	27	75
Employment rate (3.20–2.21)	78	77	67	43	20	65
Change in employment rate, in percent (3.20–2.21 vs. 1.9–2.20)						
Women, all	-13	-13	-13	-13	-24	-13
Women, under 12 years of schooling	-19	-17	-15	-12	-26	-17
Women, over 12 years of schooling	-11	-11	-11	-13	-22	-11
Change in employment rate, in percentage points (3.20–2.21 vs. 1.9–2.20)						
Women, all	-11	-11	-10	-6	-6	-10
Women, under 12 years of schooling	-16	-14	-11	-6	-6	-11
Women, over 12 years of schooling	-10	-10	-9	-7	-6	-9
Men						
Employment rate (1.9–2.20)	92	90	83	72	41	82
Employment rate (3.20–2.21)	82	82	74	64	33	73
Change in employment rate, in percent (3.20–2.21 vs. 1.9–2.20)						
Men, all	-10	-9	-11	-12	-17	-11
Men, under 12 years of schooling	-14	-12	-14	-15	-17	-14
Men, over 12 years of schooling	-9	-7	-9	-11	-18	-9
Change in employment rate, in percentage points (3.20–2.21 vs. 1.9–2.20)						
Men, all	-10	-8	-9	-9	-7	-9
Men, under 12 years of schooling	-13	-10	-11	-10	-6	-11
Men, over 12 years of schooling	-8	-7	-8	-8	-8	-7

Source: Based on Central Bureau of Statistics Labor Force Survey.

Notes to table: Employment rate is defined as those employed (salaried or self-employed) as percentage of total population in age group. "Employed" excludes those absent for COVID-related reasons.

The average employment rates during the crisis period (March 2020 through February 2021), compared to the period from January 2019 through February 2020, by gender, education and age, are presented in Table 2. During the crisis period, employment rates for women aged 35–71 decreased slightly more (in percentage and in percentage points) than for men of the same age. For both genders, the decrease in percentage was fairly similar across all age groups, except for those aged 67+, where a sharper decrease in percentage was observed.[14] For most groups, the decrease in employment by percentage was led by a sharp decrease in employment rates of those with lower education levels (up to 12 years of schooling).

Table 3 shows the degree of impact to employment in various age groups based on their employment patterns. During the crisis, for all age groups and for men and women alike, the percentage of those employed in white collar occupations in the population decreased[15], but the decrease in proximity industries was much higher. Among women aged 55–61, the decrease (in percent) in employment rate in proximity industries was over 4 times higher than among women in white collar occupations (23 percent vs. 5 percent); the decrease in employment among those in such occupations and sectors was especially high for those aged +67. For the self-employed, we see a relatively gradual decrease in employment rates for older men (aged 55+).

Employment after the third lockdown and the vaccination campaign

Vaccination of the population in Israel started in late December 2020, in a rapid and extensive campaign. The queue for vaccination was primarily managed by age: First to be vaccinated were those aged 60+, with the vaccination campaign gradually progressing to younger age groups. Concurrently with the rapid progress made on the vaccination campaign, COVID morbidity in Israel decreased sharply. At the end of the third lockdown, in early March 2021, the Government gradually lifted restrictions on economic activity, except for certain sectors–such as incoming tourism. In mid-June 2021, the Government almost completely lifted restrictions on activity. The social safety net offered at the outset of the COVID crisis remained in effect through the reviewed period.[16] With the gradual resumption of activities, many of those absent due to COVID resumed their employment, and consequently the employment rates increased.

Data for May and June 2021 (Chart 1) show significant recovery in employment rates across most age groups for both men and women, although in some groups, the gaps compared to the average employment rates in 2019 have yet to close fully. Significant gaps remain for women aged 67+ and for men aged 62+.

14 The analysis below shows the changes in employment rates, in both percent and percentage points. Analysis of the change in employment rates, in percentage points, highlights the contribution of the change in employment for each population group to the change in employment for the entire population, whereas the change in employment rates by percentages highlights the differences between groups in changes in employment rates.

15 White collar occupations refers to occupations in categories 1-3: Managers, academic occupations, practical engineers, technicians, agents and related occupations. Prior to the COVID crisis, in the 35–71 age group, some 40 percent of women in white collar occupations and some 20 percent of men in such occupations were employed in the public sector.

16 The social safety net offered by the Government at the outset of the COVID crisis was extended in July 2020 through June 2021, and was later extended through the end of 2021. Pursuant to this outline, the furlough arrangement for the unemployed aged 45 and under was terminated at the end of June 2021. For the unemployed aged 45 and over, some benefits remained through the end of 2021: They are eligible for half of the unemployment days they were eligible for from March 2020 through the end of the year, the arrangement for payment of "double benefits" would continue, allowing women eligible for old age pension in the 62–67 age group to also receive unemployment benefits during the COVID period. For all of the unemployed, the arrangement allowing them to receive full unemployment benefits while undergoing professional training would continue through the end of 2021, and the qualification period for receiving unemployment benefits would be gradually extended, but would remain shorter than normal times. Employees with low wages who resume part-time employment may continue to benefit from the "flexible furlough" arrangement through October 2021.

Table 3: Employment rates among non-ultra-Orthodox Jews in white collar occupations in proximity industries and self-employed, by age group, crisis period compared to pre-crisis period

Age group	35-44	45-54	55-61	62-66	67-71	35-71
Women						
Employed as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	89	88	77	50	27	75
March 2020–Feb. 2021	78	77	67	43	20	65
Change in %	-13	-13	-13	-13	-24	-13
Employed in white collar occupations as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	60	55	41	25	12	45
March 2020–Feb. 2021	54	50	39	23	10	41
Change in %	-9	-9	-5	-8	-20	-9
Employed in proximity industries as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	25	29	26	16	8	23
March 2020–Feb. 2021	21	23	20	12	5	18
Change in %	-18	-23	-23	-23	-38	-22
Self-employed as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	10	11	8	7	5	9
March 2020–Feb. 2021	7	8	6	5	4	7
Change in %	-25	-22	-24	-36	-20	-25
Men						
Employed as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	92	90	83	72	41	82
March 2020–Feb. 2021	82	82	74	64	33	73
Change in %	-10	-9	-11	-12	-17	-11
Employed in white collar occupations as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	59	52	43	36	19	47
March 2020–Feb. 2021	55	50	40	32	17	44
Change in %	-8	-4	-8	-9	-11	-7
Employed in proximity industries as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	19	21	20	19	13	19
March 2020–Feb. 2021	15	17	16	14	9	15
Change in %	-22	-19	-23	-24	-29	-22
Self-employed as percentage of total population in age group (%)						
Jan. 2019–Feb. 2020	14	18	18	16	13	16
March 2020–Feb. 2021	11	15	15	14	11	13
Change in %	-18	-17	-15	-12	-11	-16

Source: Based on Central Bureau of Statistics Labor Force Survey.
Notes to table: White collar occupations refers to occupations in categories 1–3: Managers, academic occupations, practical engineers, technicians, agents and related occupations. Proximity industries are defined as sectors in categories H,I,N,P,R,S – see Bank of Israel (2021), Box 2.

Table 4 shows the employment gap remaining in May and June 2021, compared to the same months in 2019, highlighting the remaining gaps by gender, age and education–in particular for those with lower education, men and women aged 67–71, as well as men aged 62–66.[17] The reasons for the slow conversion may be impacted to a different extent by supply factors such as differences in the social safety net for different age groups, and by demand factors such as differences in employment sector, education and occupation. Termination of some of the special arrangements to support employment due to loss of employment, as set in place during COVID, may serve as a catalyst for higher supply of employment. This is particularly true for the unemployed and for those absent due to COVID aged 45 and under, since as from July 2021 many of them are no longer eligible for unemployment benefits.

Table 4: Change in employment rate of non-ultra-Orthodox Jews by gender, age and education, May–June 2021 compared to May–June 2019

Age group	**35-44**	**45-54**	**55-61**	**62-66**	**67-71**	**35-71**
			Women			
Employment rate (May-June 2019)	**89**	**88**	**77**	**50**	**29**	**75**
Employment rate (May-June 2021)	**85**	**85**	**77**	**50**	**24**	**72**
Change in employment rate, in percent (May–June 2021 vs. May–June 2019)						
Women, all	-4	-4	-1	0	-18	-3
Women, under 12 years of schooling	-4	-3	-1	-6	-24	-6
Women, over 12 years of schooling	-4	-3	0	5	-12	-3
Change in employment rate, in percentage points (May–June 2021 vs. May–June 2019)						
Women, all	-4	-3	0	0	-5	-3
Women, under 12 years of schooling	-3	-3	-1	-3	-7	-4
Women, over 12 years of schooling	-4	-3	0	3	-4	-2
			Men			
Employment rate (May–June 2019)	92	89	82	75	41	82
Employment rate (May–June 2021)	88	88	82	67	37	79
Change in employment rate, in percent (May–June 2021 vs. May–June 2019)						
Men, all	-4	-2	0	-11	-10	-4
Men, under 12 years of schooling	-3	-1	-3	-18	-11	-6
Men, over 12 years of schooling	-4	-2	1	-6	-8	-2
Change in employment rate, in percentage points (May–June 2021 vs. May–June 2019)						
Men, all	-3	-2	0	-8	-4	-3
Men, under 12 years of schooling	-3	-1	-3	-13	-5	-4
Men, over 12 years of schooling	-3	-2	1	-5	-4	-2

Source: Based on Central Bureau of Statistics Labor Force Survey.

Notes to table: Employment rate is defined as those employed (salaried or self-employed) as percentage of total population in age group. "Employed" excludes those absent for COVID-related reasons.

17 Looking at two months allows us to smooth sharp fluctuations in the monthly data.

Summary

The recovery of employment in the current crisis is rapid compared to previous ones. It appears that as the population was vaccinated, and with most of the distancing restrictions lifted, and given that the background to this crisis was not economic (but rather health-related), demand for employees increased and many of those unemployed during COVID resumed their employment. Government support, and adjustments in the business and public sectors that allowed for extensive employment while working from home, moderated the impact to individuals' income and supported the rapid resumption of activity in market sectors. The relatively rapid recovery in employment and extensive return of the unemployed across all age groups, including the older ones, to employment is also due to the furlough arrangement, which retained employee affinity with their former employers. This spared employees, in particular older ones, the challenge of looking for a new job.

At the macroeconomic level, recovery is evident in employment rates across most age groups, but the gap compared to the pre-crisis period has yet to be fully closed, in particular for the older population. And indeed, following the rates of return to employment of individuals aged 35–66 who were unemployed in January and February 2021, using longitudinal data from the Central Bureau of Statistics Labor Force Survey, shows that for women the return to employment rates by May 2021 in the younger and older age groups is similar, but for men the rates among those aged 55+ are slightly lower than among younger men.[18]

It is still too early to characterize the demographics of those whose employment would struggle to recover over the long term, as the health crisis is yet to be over. The prolonged crisis may increase the likelihood of a long-term effect on employment prospects of the older population and the income of those whose employment was affected during the crisis, similar to what has been observed in previous crises.

During economic crises or periods of economic recession, the employment rates of older age groups are not necessarily affected to a larger extent by comparison to younger age groups, but older people apparently struggle more than younger people in resuming employment after periods of unemployment, in particular during an economic recession. In such case, episodes of unemployment may result in involuntary full or partial retirement. Neumark & Button (2014) demonstrate a longer unemployment period for the unemployed aged 55+ compared to those aged 25–54, showing that this gap increased in the years following the financial crisis in the US. Coile & Levine (2007) show that during periods of recession in the US, retirement rates increased—especially among those who are able to withdraw their retirement savings. Coile et al. (2014) found that exposure to an economic crisis after age 50, beyond the impact to employment, may prolong the period of unemployment and may affect employment-related rights, such as medical insurance—and consequently may impact the state of health and life expectancy—especially when the quality of medical insurance is employment-dependent.[19]

[18] The rates of women who were unemployed (including those absent for COVID-related reasons) during the third lockdown (January and February 2021) who returned to being employed three months later were as follows: 43% in the 35-44 age group, 34% in the 45-54 age group and 44% in the 55-66 age group. The corresponding rates for men in the same age groups were 43%, 36% and 19%, respectively. Due to the low number of observations, the sample only included those unemployed / absent due to COVID aged up to 66.

[19] This is true for the US, where the type of medical insurance often depends on the place of work.

Several economic reasons may explain the relative difficulty older unemployed persons face in resuming employment, especially during a recession when demand for labor is low: (1) Low (potential) productivity of the unemployed around the retirement age, due to erosion of their skills; (2) Shorter employment horizon, which increases the cost of recruitment and training of such employees relative to their future value; (3) Age-based discrimination. Concurrently, internalizing the low demand for labor may dissuade older unemployed persons from looking for a job in the first place, and may impact their job supply. The assessment by older employees of the relative difficulty in finding a new job is reflected in responses to the 2019 social survey: According to this survey, the higher the age, the higher the share of those employed who believe they would struggle to resume employment should they lose their job. This likelihood for men and women aged 50–64 is 1.5 times and 2 times higher than for men and women aged 35–49, respectively.[20]

In addition to the impact on employment due to periods of recession, the income of older age groups may also be permanently affected during such times for other reasons. Coile and Levine (2011) point to the long-term effect on income of the older cohorts, which may result from loss of employment during a crisis: High unemployment during the financial crisis in the US increased the likelihood of older people retiring, and encouraged retirement and early withdrawal of retirement funds. This reduced their income for the remainder of their life, with the impact on those with lower education being more pronounced than on other older persons. Similar findings were reported by Munnell and Rutledge (2013). Conversely, in certain situations, during an economic recession those approaching the retirement age would make more of an effort to retain their job and may delay their retirement compared to periods of economic prosperity, e.g., to compensate for loss of income or impact to capital caused by a downturn in the capital markets (Goda, et al. 2011 and Helppie-McFall, 2011).[21]

The aforementioned risk factors have not materialized in Israel among the majority of the older population. The impact on employment in the period following the third lockdown is limited, to a large extent, to the population older than the retirement age and to men approaching this age, especially for those with lower education and for those employed in proximity sectors. However, this paper, which refers to employment rates, does not make reference to other important dimensions, such as the number of work hours and the quality of employment—as the data for these did not allow for real-time analysis; these merit further investigation by future studies. Moreover, given that in addition to higher income, employment at an older age has many other benefits, such as the contribution to social interaction and to maintaining good physical and mental health, it is important to bolster the policy designed to assist older persons who lost their jobs and want to be employed again. Some of the desirable policy measures include increasing the professional training appropriate for older populations and assistance in the job search and assignment processes.

20 Based on data from the Central Bureau of Statistics 2019 Social Survey, the replies for the question: "Should you lose your job, what is the likelihood that you would find another job earning at least the same income as you currently earn?" We refer to the percentage of those employed who answered: "Low likelihood" or "No likelihood".

21 This last factor is probably not as relevant for the current crisis, where values of financial assets actually rose sharply, after a short-term decline at the outset of the crisis.

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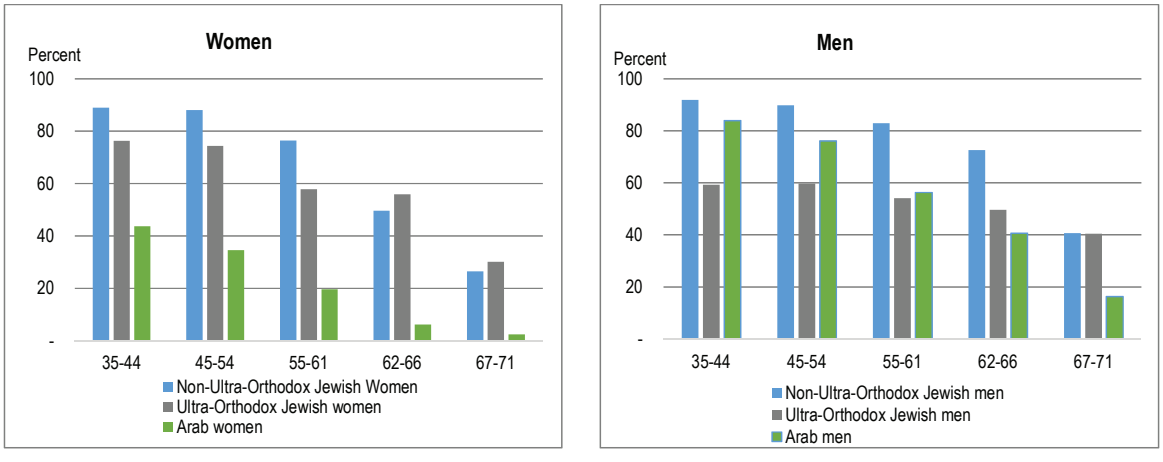
Appendix:

Figure A.1
Employment Rate by Gender, Age and Population Group, 2019



Source: Based on Central Bureau of Statistics Labor Force Survey.

REDUCING THE CLIMATE FOOTPRINT OF THE TRANSPORTATION SECTOR IN ISRAEL[1]

- **The transportation industry is the source of about one quarter of greenhouse gas emissions in Israel, and its share of total emissions is increasing as those from electricity generation are decreasing.**
- **Emissions can be reduced by switching to emission-free vehicles, by switching from using private vehicles to public ones, or a combination of both—particularly by switching to electricity-powered public transportation.**
- **An examination of different scenarios shows that under the current composition of electricity generation, transition of one percent of all private vehicles to zero-emission vehicles would reduce total greenhouse gas emissions in Israel by 0.05 percentage points. Diversion of one percent of private vehicle users to public transportation would reduce total greenhouse gas emissions by 0.06 percentage points. A combination of these two measures—transition to and electrification of public transportation—would reduce total greenhouse gas emissions by 0.1 percentage points. Transition to public transportation would also contribute to reduced congestion on the roads.**
- **By 2030, zero-emission vehicles should account for 7 percent of total vehicles worldwide, and similar developments should be expected in Israel—including expanded options for charging these vehicles and setting variable electricity tariffs by time of day. It is also necessary to formulate soon a legal framework for recycling electric car batteries and to determine whether such recycling would take place in Israel.**

This paper deals with the climate footprint of the transportation industry in Israel – greenhouse gas emissions. This paper describes the international constraints that require Israel to address this issue, presents possible courses of action and reviews the resulting conclusions for Israel's economy.[2]

Currently, the transportation industry is a major source of greenhouse gas emissions in Israel, second in volume only to electricity generation.[3] In 2019, vehicle greenhouse gas emissions reached 18.6 million tons, or one quarter of total greenhouse gas emissions in Israel.[4] Over the past decade, emissions due to this sector have grown at an annualized 2 percent. In order to reach carbon neutrality by 2050 and to comply with environmental conditions that the world is striving to achieve, Israel is required, like all other advanced economies, to reduce greenhouse gas emissions nationwide by 80 percent. In Israel, as in the rest of the world, total energy generation is the source of 80 percent of all emissions, and of

1 Written by Lior Gallo and Yossi Margoninsky. We wish to thank Amir Zaltsberg for significant comments on previous versions of this paper, and to thank Ofira Ayalon, Lior Elbaz, David Bedal, Shachar Dolev, Galit Paltzur, Gideon Friedman, Ariel Kaplan and Ido Schwab, as well as Eyal Argov, Adi Brender and Avshalom Baranovich for their constructive comments. Special thanks to Tomer Weiss, who helped tremendously in finding, analyzing, and presenting data.

2 Pursuant to Government resolution 542, approved at the 2015 Climate Conference, Israel is committed to significantly reducing emissions, including through reduced traffic mileage.
https://www.gov.il/he/departments/policies/pmo_542

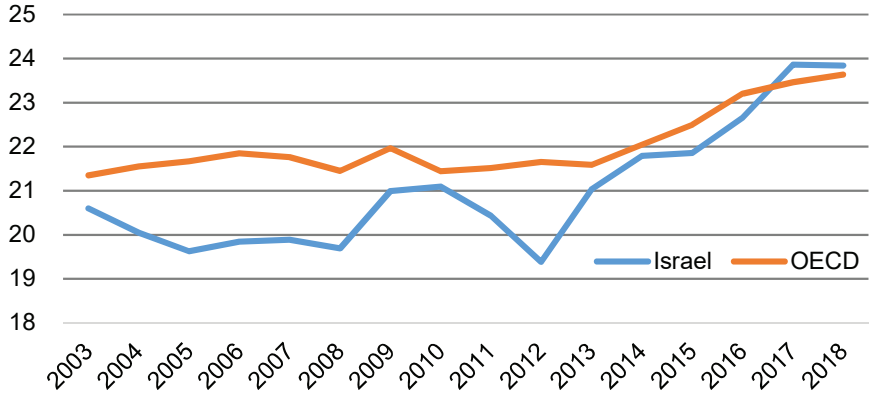
3 For analysis of the electricity market and its impact on emissions, see:
https://www.boi.org.il/he/NewsAndPublications/PressReleases/Pages/10-6-2020.aspx

4 https://www.cbs.gov.il/he/publications/doclib/2021/22.shnatonenvironment/st22_07.xls

these, the transportation sector accounts for one quarter. These data indicate that addressing greenhouse gas emissions from energy generation as a whole, and in particular from the transportation sector, is a necessary and sufficient requirement for Israel to comply with international commitments with regard to reduction of greenhouse gas emissions, which are expected to become more demanding as the global effort on this front intensifies.[5,6] And indeed, the Government recently adopted Government resolution 171, with regard to transition to a low-carbon economy which refers, inter alia, to the transportation sector.[7]

Since the diversion of most electricity generation in Israel from burning coal to burning natural gas (with lower carbon emissions per energy unit generated), and a concurrent increase in the share of electricity generation using renewable energy sources, the share of electricity generation out of total emissions has decreased, and the share of other components has increased, in particular that of transportation (Figure 1). Although this paper is not about the impact of emissions on Israeli residents, it should be noted that vehicles burning fuel also emit other toxins, with limited impact on the climate—but extremely harmful for the health of residents. Health damage caused by emissions from the transportation sector is especially severe, as toxins are emitted at ground level within population concentrations. International comparison of toxin levels in the air indicates that the exposure to pollutants in Israel is high compared to advanced economies, and this level is similar to that of countries with an economy based on coal, copper, and aluminum industries (Figure 2).

Figure 1
The Transportation Industry's Share of Total Greenhouse Gas Emisssions
(Israel and the OECD Average, percent)



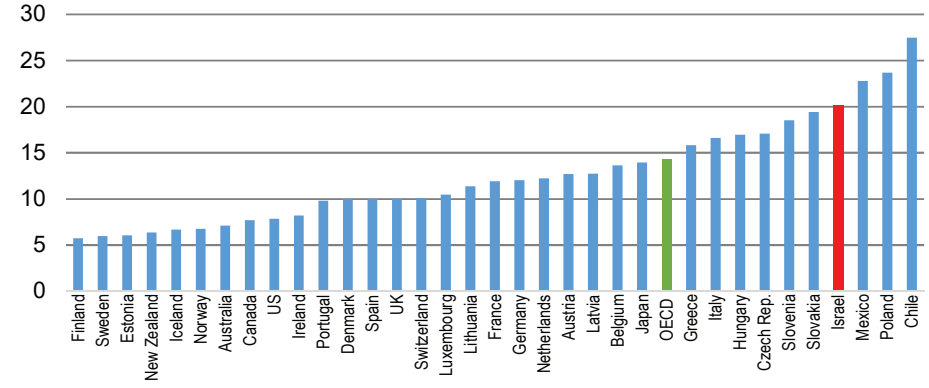
SOURCE: OECD.Stat and Central Bureau of Statistics.

5 For calculation, see: https://www.boi.org.il/he/NewsAndPublications/PressReleases/Pages/10-6-2020.aspx

6 See: https://www.europarl.europa.eu/news/en/headlines/society/20190926STO62270/what-is-carbon-neutrality-and-how-can-it-be-achieved-by-2050

7 See section 2.A and 2.F https://www.gov.il/he/departments/policies/dec171_2021.

Figure 2
Average Exposure of the Population to Pollutants
(2.5 pm* in micrograms per cubic meter), **2019**



PM - particulate matter - is the accepted term for measuring air pollution that negatively impacts health in the short term, in contrast to greenhouse gasses that harm over the long term. The reference is to particulate matter with a diameter less than 2.5 micrometers.

SOURCE: OECD - Going Green database.

To deal with this issue, the OECD recommended addressing congestion on roads.[8] This recommendation highlights the importance of addressing air pollution caused by the transportation sector. Possible solutions for such pollution are transition to public transportation, with lower pollution per passenger than private transportation, or transition to zero-emission vehicles (ZEV). This paper is focused on these solutions.[9]

A. Transition to zero-emission vehicles

Breaking down greenhouse gas emissions of the transportation sector by vehicle type (Figure 3) shows that private cars and trucks account for most of these emissions, whereas public transportation accounts for a smaller share. For many years, trucks were the source of most emissions—and then their share declined as the share of private vehicles increased. Some countries, including China, Japan, Chile and California, have decided to address transportation sector emissions by promoting, among other measures, the transition to zero-emission trucks. However, we can estimate that as of now, relying on transition to such technology is premature, as global experience with it is still meager. In 2020, there were only 31,000 zero-emission trucks on roads worldwide, and use of current technologies to expand the use of zero-emission trucks poses complex challenges, due to the range traveled by such trucks and the resulting weight of batteries. Therefore, adoption of zero-emission truck technology is still in its initial stages. Moreover, truck traffic is the backbone of the economy; dramatic changes to the cost structure of this basic manufacturing component may have far-reaching implications, and therefore must be gradually and carefully introduced. By comparison, the number of zero-emission buses—another heavy vehicle—on world roads is 20 times

8 OECD (2020), OECD Economic Surveys: Israel 2020, OECD Publishing, Paris, https://doi.org/10.1787/d6a7d907-en.

9 Promoting work from home and urban planning supportive of pedestrians and cyclists, as well as use of micro vehicles such as eBikes and eScooters, may reduce the mileage driven, thereby reducing greenhouse gas and toxin emissions into the air. The same goes for improved urban and transportation planning, improved urban walkability, urban mixed uses and car- and ride-sharing – all these are outside the scope of this paper.

higher, at over half a million (although this figure, too, pales by comparison to the total number of buses).

Given that the relevant technologies for trucks, airplanes, ships, etc. has yet to mature, our paper focuses on the potential for reducing emissions from private vehicles and public transportation. The total potential reduction of emissions over the medium term is 50 percent of vehicle emissions; as these emissions account for one quarter of all emissions—this would be a 12 percent reduction in total emissions.

According to a report by the International Energy Agency, approximately 5 percent of new vehicle sales worldwide are zero-emission vehicles, mostly in China and in European countries.[10] In 2020, zero-emission vehicles accounted for 1 percent of all vehicles, and IEA experts believe that with the impact of policies promoting transition to zero-emission vehicles, they could reach 7 percent of all vehicles by 2030. Looking at the share of zero-emission vehicles in various countries indicates that it is particularly high in Scandinavian countries—primarily in Norway. In most other countries, the share of zero-emission vehicles is less than 1 percent.

A major question faced by policy makers in this regard is that of the timing of technology adoption. Late adoption of technology may expose Israel to international sanctions regarding emission reduction. However, in contrast, a sedate pace in adoption of new technologies, relying on accumulated experience globally and on technological improvements, reduces the cost of transition to such technologies—all the more so in Israel, being a small economy affected by dominant global trends. Thus, in the past, Israel's trailing behind the curve in implementing targets for generating electricity from renewable sources ended up saving billions of dollars, as the cost of electricity generation from such sources declined by 90 percent.[11] Another, yet opposite, example of the importance of timing the adoption of technology is the installation of scrubbers on chimneys of coal-burning power stations (which was later than common in Europe). The installation cost was NIS 8.5 billion, and the scrubbers were designed to operate for decades; However, recently a decision was made to shut down the coal-based power stations, and thus a significant portion of the investment in scrubbers was lost. The dilemma of whether to introduce now hydrogen-powered cars, which have their advantages—but the required technology is still in the formative stage—is a current example of the optimal timing dilemma. These examples demonstrate that timing the adoption of technology has significant macroeconomic implications.

The State plays an important role in promoting zero-emission vehicles, namely in resolving the market failure known as the "chicken and egg paradox" which is typical of these vehicles coming into use: As long as there is no infrastructure in place for zero-emission vehicles—consumers would not find it worthwhile to buy such vehicles. However, as long as there is no demand for charging or for hydrogen fueling—there is no economic incentive to install such infrastructure. Government intervention in this area can resolve this market failure. This paradox was reflected in a survey conducted by the Ministry of Energy, to identify bottlenecks in the transition to electric vehicles. According to the survey, the major obstacle reported by drivers is the lack of charging stations at home and at work.[12] Another study, prepared by the Ministry of Construction and Housing, found that consumers in various countries who transitioned to electric vehicles

10 IEA (2021).

11 For more information see: https://www.boi.org.il/he/NewsAndPublications/PressReleases/Pages/27-9-17.aspx

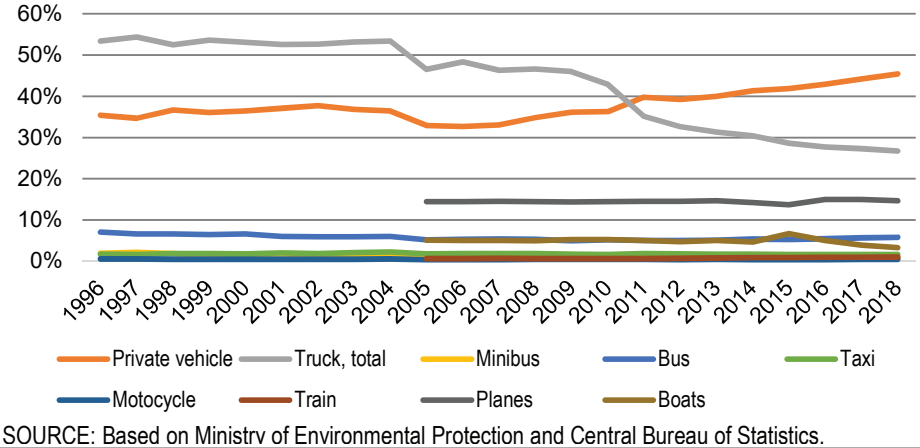
12 https://www.gov.il/he/Departments/news/spokesperson_electric_vehicle

also installed a charging station at home.[13] In order to address the market failure, and because maintaining the current state of affairs has negative implications, governments around the world started, in recent years, to act in order to kick-start the process of developing infrastructure for zero-emission vehicles. The Israeli Government has also started making progress on the processes required to install electric charging stations, as well as a pilot installation of the first hydrogen fueling station for heavy vehicles.[14]

Currently, there are two energy storage technologies that allow zero-emission vehicles to be used: Electricity storage in a battery[15] and storage in hydrogen.[16] Note that these storage technologies, in and of themselves, do not make the need to reduce emissions from energy generation redundant: Greenhouse gas emissions of zero-emission vehicles do not occur when driving or charging, but rather when generating the energy being stored. Therefore, a polluting fuel mix in generating energy for zero-emission vehicles would only divert the emissions issue from one place to another.[17] Thus, in case of electric vehicles, pollution depends on the fuel mix used in electricity generation, and for hydrogen cars—in how hydrogen is produced. Indeed, the transition from burning fuels in population centers to burning natural gas in power stations would reduce toxin emissions into the air, but its effect on greenhouse gas emissions may be limited. Only if the electricity or energy would be generated in a non-polluting way would the vehicles using this energy be truly "green".

Hydrogen cars only became commercially available in 2014, and estimates vary as to their adoption rate over the ensuing decades.[18] Currently, there are only 38,000 hydrogen cars around the world, mostly in China, the US, and South Korea. The Korean government has decided to be a leader in this field, including

Figure 3
Distribution of Greenhouse Gas Emissions, by Vehicle Type
(Percent of total transportation emissions in Israel)



SOURCE: Based on Ministry of Environmental Protection and Central Bureau of Statistics.

13 https://www.gov.il/he/Departments/news/spokesman-12032020

14 https://www.gov.il/he/departments/general/electric_vehicle_ac_dc

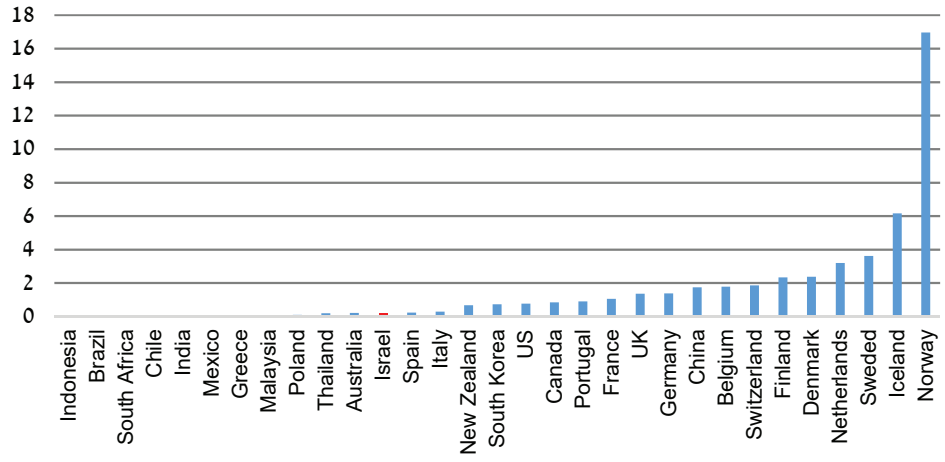
15 Ibid.

16 IEA (2019), The Future of Hydrogen, IEA, Paris https://www.iea.org/reports/the-future-of-hydrogen

17 From a healthcare perspective (though not from a greenhouse gas perspective), such diversion is rather important, as emissions are moved away from ground level in city centers, and because it is easier to address polluting emissions from chimneys – which are far less numerous than cars. Moreover, the energy utilization in generating electricity is higher than in internal combustion engines. These matters are outside the scope of this paper.

18 IEA (2019), Grossman, G. & Shapira, N. (April 2021).

Figure 4
The Share of Zero-Emission Cars out of Total Cars, by Country
(2020, percent**)**



SOURCE: IEA and Ministry of Environmental Protection.

conversion of some public transportation, primarily buses and garbage trucks, to this technology. Hydrogen cars have the advantage over electric cars from several aspects. First, using hydrogen does not overload the power grid. Second, filling up with hydrogen takes 3 to 5 minutes, whereas charging an electric car may take several hours or, in case of rapid charging, 20 minutes.[19] Moreover, the electric batteries required for heavy vehicles such as trucks are especially sizable and heavy. This is why hydrogen technology is especially attractive for heavy vehicles, and it would appear that the transition to hydrogen energy may start in this segment. The process of producing hydrogen by burning natural gas produces greenhouse gas, but less of it per energy unit compared to generating electricity by burning natural gas.

Currently, the most developed technology for zero-emission vehicles is electric cars with energy storage in lithium batteries; this technology is becoming more and more viable as battery prices drop. Currently, these account for 1 percent of all cars worldwide—with the great majority being in China—but the number of models is growing by the year, as does the range of travel using the vehicle without recharging.[20] The advantage of this technology lies in its availability. Based on data from the Central Bureau of Statistics, in 2019 there were 3,500 electric cars in Israel, out of a total of just over 3.5 million cars[21]. Based on data from car importers, this figure increased in 2020 by 1,500 cars and in the first half of 2021—by a further 4,600.

Estimating total CO_2 emissions from electric cars (over their entire lifespan) is not straightforward, and depends primarily on the fuel mix used to generate electricity, as aforesaid. For example: A gasoline-powered car emits more CO_2 than a similar-size car powered by electricity as currently generated in Israel—but this would not be the case if electricity were generated by burning coal. There are further pertinent engineering issues, such as CO_2 emissions in manufacturing batteries compared to manufacturing of current engines,

19 Rapid charging is materially different to standard charging, because with current technology it significantly shortens the battery life, and therefore makes using an electric car more costly.

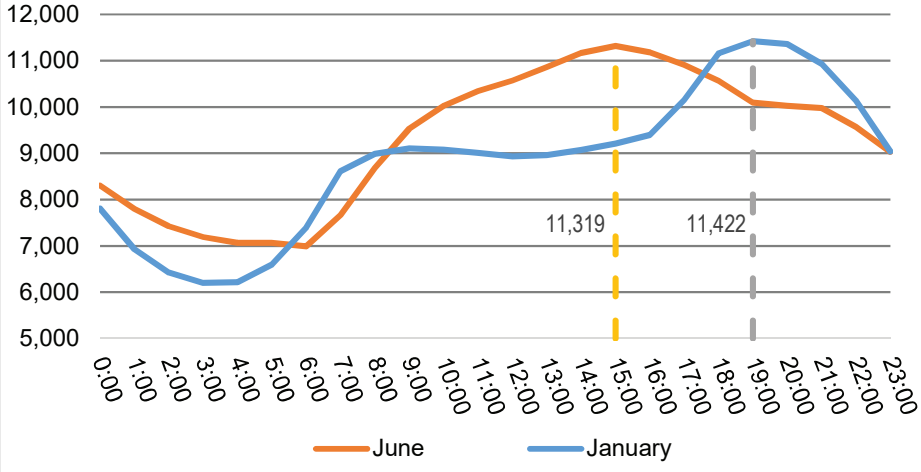
20 IEA (2021)

21 https://www.cbs.gov.il/he/publications/Pages/2020/%D7%9B%D7%9C%D7%99-%D7%A8%D7%9B%D7%91-%D7%9E%D7%A0%D7%95%D7%A2%D7%99%D7%99%D7%9D-2019.aspx

efficiency of using electric motors in various climates and so forth. This is why estimates differ with regard to comparing CO_2 emissions of electric cars and of internal-combustion ones.[22]

The use of cars powered by lithium batteries raises some other issues. First is the load on the power grid. Forecasts by the Ministry of Energy expect gradual growth in electricity consumption as the transition to electric cars progresses, and it would appear that the power grid in Israel will be sufficient—as long as electric cars remain below 10 percent of all cars. However, significant growth beyond this 10 percent share

Figure 5
Average Monthly Production in Selected Months
(January and June, 2019, MWH)



SOURCE: Israel Electric Corporation data.

would require significant investment in upgrading power transmission lines.

Such upgrading of power transmission lines would also be required if the growth in demand is primarily focused in hours of peak demand.[23] Figure 5 shows the composition of electricity consumption in Israel in 2019, on average, for a business day, in winter and in summer. The figure shows that peak hours differ from summer to winter: In summer, peak average consumption is around 3pm, and in winter—around 8pm. It is reasonable to assume the electric cars would be charged after arriving at work or after returning from work. If, indeed, charging would take place at home during the evening, in winter this may add a significant load – right around peak hours for electricity consumption. However, growth in electricity generated by photo-voltaic technology should generate excess supply around mid-day, when the sun is at its brightest. Informed planning for the charging issue would require these matters to be taken into consideration, as in absence of satisfactory solutions, the high demand may require electricity to be generated using polluting technology at power stations that would only operate during peak demand periods. One solution for this issue is diverting excess supply from noon-time to the evening by means of storage, should the technology advance and make this feasible. Another way is to divert excess demand from evening to noon-time hours,

22 Ager-Wick Ellingsen, L., Singh, B., & Hammer Stromman, A. (May 2016).

23 https://www.gov.il/he/Departments/publications/reports/electric_vehicle_040221

by variable time-based pricing for electricity. In order to realize this solution, the electricity market would have to be transitioned to using meters with time-based pricing[24] and installation of charging stations in work places, in public parking spaces or even on sidewalks would have to be promoted.

Another issue is that of taxation of electric cars, which are currently more expensive (before tax) than conventional ones. Today, the tax rate on electric cars in Israel is very low (10 percent compared to an average 60 percent for conventional cars).[25]

Another issue, of growing importance as the number of electric cars continues to rise, and in particular the number of electric cars being scrapped, is the handling of batteries at end of life. In principle, it would be possible to impose the cost of battery recycling on the public at large (by direct Government handling of no longer used batteries), or on the manufacturers (and so, indirectly, on consumers), by requiring them to take back the no longer used batteries and to be responsible for recycling them. The UK government, for example, requires local manufacturers of electric cars and importers of electric cars, to collect their electric cars or batteries after they are no longer in use, free of charge, and to convey the batteries to a designated recycling facility. [26] The European Union is forming a new regulatory framework to address recycling of batteries in general, and car batteries in particular. This framework would expand the framework stipulated in 2012, in order to require all battery manufacturers to also handle battery recycling.[27] In Israel, by comparison, the Environmental Handling of Electric and Electronic Equipment and Batteries Law, enacted in 2014, excludes electric car batteries from its scope. Thus it would appear that this issue requires the relevant government ministries to address this issue as soon as practicable.[28] The question of whether recycling would take place in Israel or whether used batteries would be sent overseas for recycling should also be addressed soon, because preferring the former alternative would mean it would need to start implementation in the coming years.[29]

Another issue is selection of the charging technology. This analysis has been provided in a study by the Ministry of Construction and Housing.[30] There are two types of charging stations: The first is cheaper but requires batteries to be charged for 1–8 hours depending on battery type, and is appropriate for charging at home or at work; the second is faster (charging times of 20-40 minutes) and is therefore appropriate for charging on road-side fueling stations. However, chargers for the faster technology are more expensive, require a power supply with higher power, meaning it requires adaptation of and investment in the power grid, and it causes much higher battery degradation and therefore, over the long term, exacerbates the problem of battery recycling. A dominant technology has yet to emerge in this regard, but it would appear

24 For example, development of supply markets to optimally manage demand. Development of supply markets was referred to in the IEC reform, and may be able to also provide a solution for timing car charging beyond the differentiation in billing for electricity.

25 https://www.gov.il/he/Departments/General/rules_for_electric_vehicles https://www.boi.org.il/he/NewsAndPublications/PressReleases/Pages/11-03-2014-GreenTax.aspx

26 https://www.gov.uk/guidance/waste-batteries-producer-responsibility

27 https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689337/EPRS_BRI(2021)689337_EN.pdf

28 https://www.nevo.co.il/law_html/law01/500_735.htm#Seif30 https://www.adamteva.org.il/wp-content/uploads/2019/07/%D7%A4%D7%A1%D7%95%D7%9C%D7%AA-%D7%90%D7%9C%D7%A7%D7%98%D7%A8%D7%95%D7%A0%D7%99%D7%AA-%D7%91%D7%99%D7%A9%D7%A8%D7%90%D7%9C-2017.pdf

29 We can estimate that recycling would not take place in Israel, as it would appear that it would only take place in very few countries, with all other countries exporting their batteries for recycling.

30 https://www.gov.il/BlobFolder/reports/tashtiyot_rechev_chashmali/he/documents_tashtiyot_rechev_chashmali.pdf

that most of the charging would use the slower technology due to the shortcomings of rapid charging. As for expected prices of electric cars – their price is expected to further decrease in the coming years due to technological improvements and economies of scale, given the significant growth in manufacturing volumes.

In summary of this section: The process of transition from cars with internal-combustion engines to zero emission electric cars is underway in many countries, and consequently in Israel as well. This process should intensify over the coming years, but the pace of change is hard to predict. In any case, making progress on this process requires policy makers to provide a response to several issues soon, as set forth above. One area yet to be addressed, in this regard, is regulation for handling no longer used batteries. Beyond that, it would appear that rapid technology changes in this field would require, over the coming years, constant adaptation of policy in this regard.

B. Transition to public transportation

Another way to address the emissions issue is transition from private transportation to public transportation, including to mass transit systems – where total emissions are spread across more users. In order to consider this alternative in quantitative terms, one should compare the climate cost (i.e., CO_2 grams per mile driven) for driving in a private vehicle to that for mass transit systems.

For example, greenhouse gas emissions per mile driven by a bus are 7 times higher than by a private vehicle, but the average number of passengers per bus is more than 7 times higher than for private transportation. This means that emissions per passenger miles in public transportation are lower than in private transportation.

To illustrate this, Figure 6 shows the load factors (average number of passengers per mile driven) for private vehicles and for buses. The figure shows that per mile driven, the number of passengers in public transportation is 20 times higher than in private transportation[31]. However, due to the higher number of passengers per mile driven, each gram of emissions per mile driven by public transportation is divided across more passengers, therefore the quantity of emissions per passenger per mile driven are lower. It is also evident that the number of passengers per mile driven in private vehicles has been decreasing in recent years, which is not the case for public transportation. This means that emissions per passenger in private transportation are growing, since the number of passengers per trip is declining.

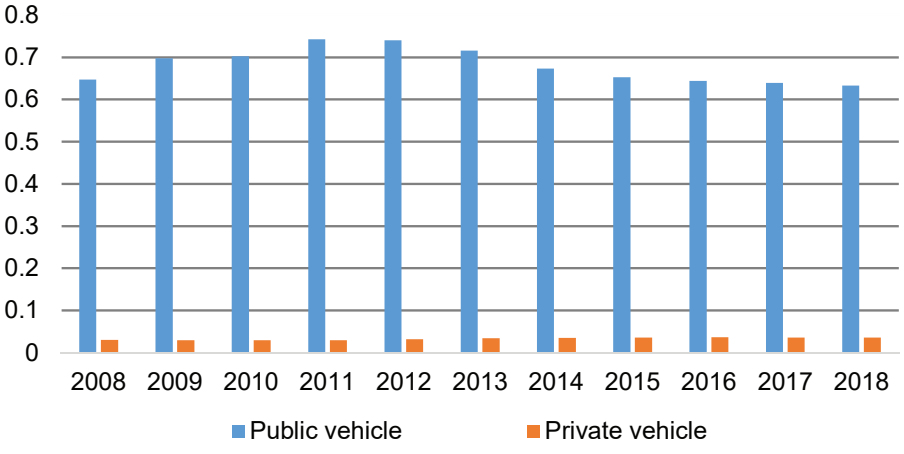
One benchmark for the decrease in emissions due to transition from private to public transportation is emission elasticity by means of transportation[32]—the percentage decrease in total greenhouse gas emissions in Israel due to diverting 1 percent of mileage driven from private to public transportation.

To calculate the emission elasticity vis-à-vis transportation, one should account for both emission coefficients

31 The conventional way to address this issue is through load factors for various vehicles. We have no load factors available for Israel. Data from Europe suggests that over there, the load factor for public transportation is 26 times higher than for private transportation. For more information see: https://www.eea.europa.eu/data-and-maps/indicators/occupancy-rates-of-passenger-vehicles/occupancy-rates-of-passenger-vehicles (data shown in percent. To obtain the data, multiply the occupancy rate on buses by the average number of seats per bus.)

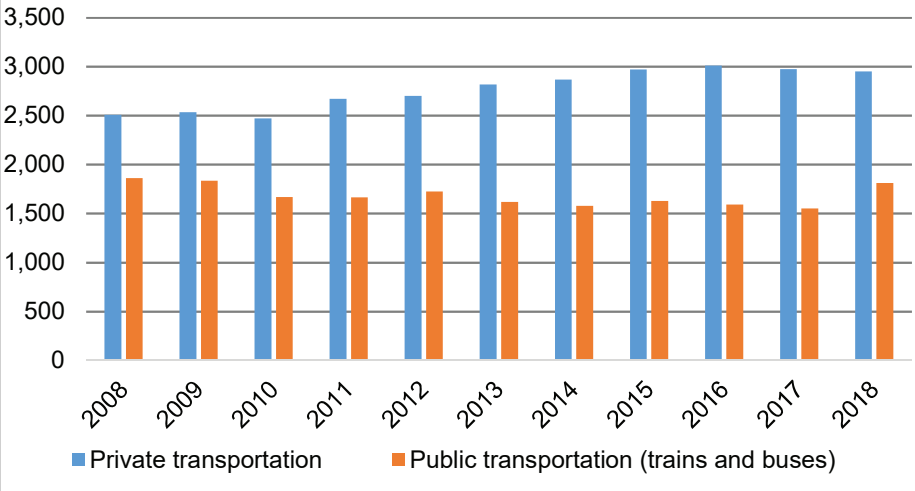
32 Here, too, we should emphasize the significant variance in passenger trips – such as trips within the city, between cities, at different hours of the day and so forth. A more accurate estimate should account for this variance, but such calculation is beyond the limits of this paper.

Figure 6
Congestion Coefficients
(Number of riders per kilometer traveled)



SOURCE: The Knesset and Central Bureau of Statistics.

Figure 7
Pollution per Rider (grams of CO2 per rider)



SOURCE: Based on Ministry of Environmental Protection and Central Bureau of Statistics.

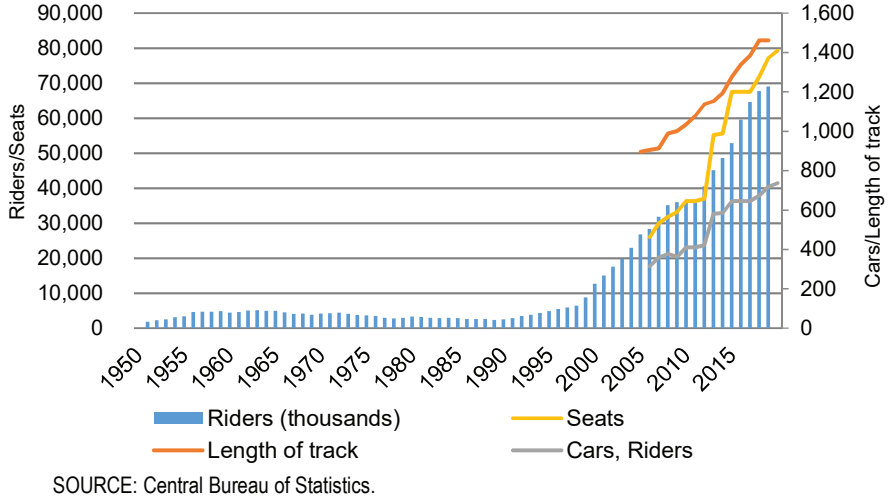
of each means of transportation (public/private) and their load factors. To this end, Figure 7 shows the emission indices per passenger in private transportation vs. public transportation. These indices take into account the emissions per mile for each type of vehicle, as well as the average number of passengers per mile for each type of vehicle—thus providing a more complete reflection of the climate cost per trip in either mode. The figure shows that the climate cost per trip in public transportation is lower than in private transportation.[33] As the emission coefficient per passenger in public transportation is 40 percent that per

[33] This calculation does not account for emissions from trucks. Therefore, the factor for private vehicles should be revised upwards.

passenger in private transportation, every passenger diverted from private to public transportation would reduce emissions per passenger by 60 percent. The figure also shows that in recent years, the difference in pollution per passenger between private and public transportation has increased. That is because the number of passengers per mile in a private vehicle has decreased, as shown in Figure 6, while the number of passengers in a public vehicle has remained essentially unchanged.

The consensus among policy makers is that there is very high potential demand for public transportation, which does not materialize due to quality of service; thus, if the service would be improved and enhanced, it should be possible to divert mileage from private to public transportation. This is reflected in recommendations made by the Trajtenberg Commission, which included a special chapter dedicated to public transportation[34], in the strategic plan of the Ministry of Transportation and Ministry of Finance[35], in the 2017 report by the Bank of Israel[36], in the 2018 report by the IMF, in the 2018 report by the OECD[37], as well as in the special report by the Office of the State Comptroller on public transportation.[38] Another reflection of excess demand for public transportation is evident in the sharp increase in number of train passengers as the number of available train routes increased between 2000 and 2010 and from 2012 to date, in particular the increase in the number of train cars and seats (Figure 8). Moreover, a study conducted by the Bank of Israel found a high degree of willingness to use the train, when available, across all socioeconomic groups.[39]

Figure 8
Trains: Riders, Seats, Cars, and Length of Tracks (thousands of riders and seats; number of cars; kilometers of track)



SOURCE: Central Bureau of Statistics.

34 https://www.gov.il/he/departments/policies/2011_des3756

35 https://www.gov.il/BlobFolder/reports/development_of_public_transport-strategic_plan_december_2012/he/development_of_public_transport-strategic_plan_december_2012.pdf

36 https://www.boi.org.il/he/NewsAndPublications/PressReleases/Documents/%D7%AA%D7%97%D7%91%D7%95%D7%A8%D7%94%20%D7%A6%D7%99%D7%91%D7%95%D7%A8%D7%99%D7%AA%20%D7%91%D7%99%D7%A9%D7%A8%D7%90%D7%9C%20%D7%95%D7%91%D7%90%D7%99%D7%A8%D7%95%D7%A4%D7%94.docx

37 Israel: Staff Concluding Statement of the 2018 Article for IV Mission. https://www.imf.org/en/News/Articles/2018/03/14/mcs031418-israel-staff-concluding-statement-of-the-2018-article-iv-mission

38 https://www.mevaker.gov.il/he/publication/Articles/Pages/2019-Transport.aspx?AspxAutoDetectCookieSupport=1

39 See: Suhoy and Soffer (2020).

Other than the direct impact on climate of diverting mileage driven from private to public transportation, further impact may be created by reducing emissions by public transportation. This would be done by development of new "green" bus routes—or routes based on storage technology. Indeed, today the share of public transportation out of total emissions is not high, but it is expected to increase as more passengers are diverted from private to public transportation, especially if a mass transit system (metro) would be created in the central region of Israel. As this sector is managed in a rather centralized manner, converting it to zero emission vehicles may be less complicated. Development of zero emission public transportation could address further growth in demand for transportation by supply with low greenhouse gas emissions. In order to initiate the development of zero emission vehicles, multiple governments—of the Netherlands, Norway, California, Massachusetts, New Jersey, India, Canada, New Zealand, Chile and Colombia—have invested in development of carbon-free public transportation systems.[40] As for Israel—according to a government resolution dated July 2021, as from 2026 only zero emission city buses may be purchased.[41]

The calculations below quantify the effectiveness of combining diversion of travel from private to public transportation and increasing the supply of public transportation along with improving its quality, so as to reduce the climate footprint of the transportation sector in Israel. This is also the reason for importance of policy measures designed to act towards this goal.

Table 1: Key parameters for the transportation sector used to calculate simulations

	Private transportation		Public transportation	
	Private vehicle	Motorcycle	Bus	Train
	Emission factor (gram per km.)			
Internal combustion engine vehicle	177	60	1,525	13,063****
Zero emission vehicle				
Based on fuel mix for 2019	99		640	11,267
Based on expected fuel mix for 2030	50		325	6,622
	Transportation volume per year (millions)			
Mileage driven (km.)	47,754	999	1,212	14.14
Estimated number of trips	2,174*			
Estimated number of passengers	1,812**	96***	767	68

The difference between number of trips and number of passengers in private vehicles is due to the average load factor, which is currently estimated at 1.2 persons per vehicle; for public transportation, we only refer to the number of passengers.
* Calculation of trips per year: Total mileage driven per year, divided by mileage per trip. Mileage per trip was calculated as the average mileage per vehicle divided by 365 divided by 2 (assuming that a private vehicle is driven 365 days per year, twice per day on average). (Approximately the number of vehicles on the road multiplied by 365 and multiplied by 2).
** Number of passengers per year is the number of trips per year, divided by the load factor (currently estimated at 1.2).
*** Calculated based on the number of motorcycles on the road multiplied by 365 and multiplied by 2 (assuming that a motorcycle is driven 365 days per year, twice per day on average).
**** Calculated based on annual diesel consumption, divided by annual mileage driven, multiplied by emissions per liter of diesel. The emission factor by fuel mix for trains is calculated as emissions for diesel per energy unit, divided by emissions for the fuel mix per energy unit, multiplied by the current emissions factor.
Source: Central Bureau of Statistics and Ministry of Environmental Protection.

40 IEA (2021).

41 https://www.gov.il/he/departments/policies/dec171_2021

C. Transition to zero emission vehicles and transition to public transportation—scenario review

The previous sections described two major policy paths to reduce emissions in the transportation sector: Zero emission vehicles and transition to public transportation.[42] In this section, we present scenarios based on simulations we have run, which demonstrate the greenhouse gas emission elasticity of each of these policy paths. The scenarios quantify the potential impact of each path on total greenhouse gas emissions in Israel. We emphasize that these are not detailed forecasts for the transportation sector, nor for greenhouse gas emissions, but rather basic back-of-the-envelope calculations. These scenarios answer the question: What would the overall decrease in greenhouse gas emissions be should this or the other policy be implemented? Specifically: What would be the decrease in greenhouse gas emissions upon transition of part of private transportation from internal combustion engines to electric motors? And what would be the decrease in greenhouse gas emissions upon diversion of part of private mileage driven to public transportation—according to energy sources used in driving such public transportation?

The scenarios rely on parameters, some of which have been presented and described above, summarized in Table 1. As noted above, emission factors are emissions (in grams of CO_2) by a vehicle when driven for one kilometer. Note that the parameters presented here are on average, and vary for vehicles of different type, size, and even by weather conditions. More accurate calculation of the potential for reducing emissions would need to account for such variance. The table shows that the average emission factor per conventional private vehicle is 177 grams per kilometer. The emission factor per conventional motorcycle is lower, as it uses less energy to drive one kilometer. CO_2 emissions of a conventional bus are 8.5 times higher than a private vehicle driven over the same distance, and for a train—8.5 times higher than for a bus. Note, in this regard, that train emissions are due, *inter alia*, to being driven using diesel. Israel Railways is currently in the process of converting all trains to using electricity; this would take several years[43], after which train emissions would be significantly lower.

Transition to zero emission vehicles reduces emissions per kilometer driven depending on the fuel mix used to generate electricity. In particular, emissions of an electric private vehicle are 28 percent to 56 percent of emissions of a conventional vehicle—depending on the fuel mix used to generate electricity. Transition from conventional to electric bus reduces 60–80 percent of emissions per kilometer, and for trains—15 percent to 50 percent. These figures are testimony to the important impact of the fuel mix and the importance of train electrification. The table also lists the number of passengers for means of transportation—official data exists for some of these, and in absence of such data for others, the calculation is based on assumptions set forth in Table 1. We should emphasize that we have no data on number of passengers in private vehicles, and this calculation is based on simplification assumptions.

The first scenario, reviewed and presented in Figure 9, involves electrification of private transportation. That is, transition from private vehicles with internal combustion engine to electric vehicles. As noted above, the reduction of emissions due to such electrification depends on the fuel mix used to generate electricity stored in batteries of electric cars. Therefore, we considered two scenarios (Figure 9): The first is for the fuel mix in 2019 and the second is for the expected fuel mix in 2030, with zero coal burn and 30

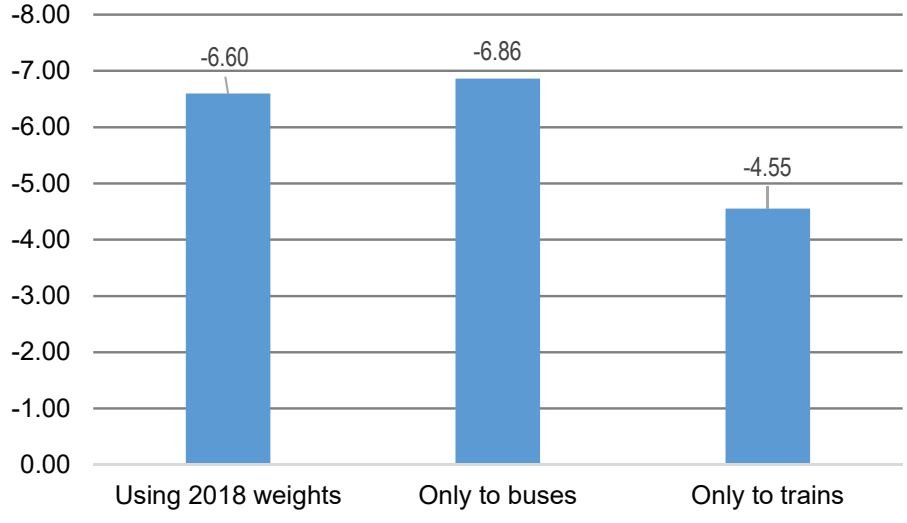
42 As noted, the discussion of trucks, airplanes, ships and other means of transportation is outside the scope of this paper.

43 The electrification process should be concluded between 2025-2029: https://www.mevaker.gov.il/(X(1)S(zpxwuj2fz3nhfil5mvs1cw2a))/sites/DigitalLibrary/Pages/Reports/3831-16.aspx?AspxAutoDetectCookieSupport=1

percent renewable energy. The table shows that compared to total emissions nationwide (from all sources) in 2018, had private vehicles been converted to zero emission vehicles, total emissions would have been lower by 4.7 percent. This means that electrification of 1 percent of private transportation would reduce total emissions nationwide by 0.04 percent. The more environmentally-friendly fuel mix expected in 2030 results in higher reduction of emissions—electrification of 1 percent of private transportation would reduce total emissions nationwide by up to nearly 0.08 percent.

Another scenario, presented in Figure 10, involves diverting passengers from private transportation to public transportation. In this scenario, we considered diversion to buses, to trains or to both—i.e., public transportation in general—with the passenger mix between trains and buses maintained constant based on 2018 weighting.[44] Diverting passengers from private to public transportation, with the bus-train mix remaining as it was in 2018, should reduce emissions by over 6 percent compared to the current state of affairs: A 10 percent decrease in private transportation emissions, with a 4 percent offset for additional emissions in public transportation. The impact of diverting 1 percent of mileage driven from private transportation to public transportation would decrease total emissions by 0.066 percent. As noted, this estimated impact is skewed lower due to the low share of electric trains, which would increase over the coming years.

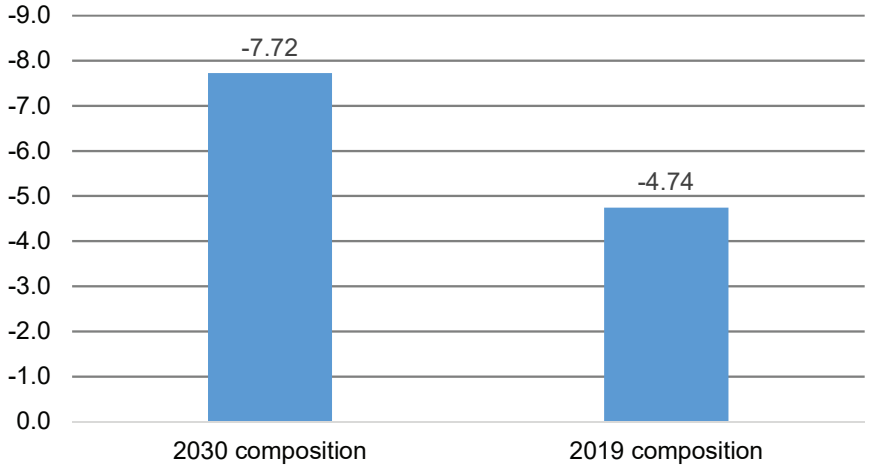
Figure 10
Switch from All Private Vehicles to Public Transportation (change in total emissions, percent)



SOURCE: Based on Ministry of Environmental Protection and Central Bureau of Statistics.

44 The scenario of diverting 100% of transportation is designed to illustrate the potential limit of such change, rather than to present a realistic scenario.

Figure 9
Switch from Vehicles with Internal Combustion Engine to Zero-Emission Vehicles (change in total emissions, percent)



SOURCE: Based on Ministry of Environmental Protection and Central Bureau of Statistics.

Table 2: Expected decrease in greenhouse gas emissions by combination of simulations and under various scenarios

(Percentage of total emissions)

Transition of 100 percent of public transportation to zero emission vehicles		
Fuel mix in 2030	Fuel mix in 2019	
		Transition of 100 percent of private vehicles to public transportation
-11.7	-10.2	Based on 2018 weighting
-11.9	-10.5	To buses only
-9.5	-6.7	To trains only

Source: Central Bureau of Statistics and Ministry of Environmental Protection.

For other scenarios, which combine passenger diversion and electrification of transportation, see Table 2. Each column in this table shows the result based on a different mix of power generation. In particular, the 2019 mix still includes use of coal burning power stations, and renewable energy only accounts for a few percent, whereas the 2030 mix includes no coal burning power stations at all and 30 percent of renewable energy. Rows in this table each describe a scenario of diverting passengers from private transportation to public transportation. Thus, each scenario combines assumptions on electrification of transportation with diversion of mileage driven from private to public transportation. These show that a combination of policy measures would increase the effect up to 12 percent at most. This table also demonstrates the varying impact of policy measures for different fuel mixes. In particular, a more "green" fuel mix in electricity generation makes the policy measures with regard to emissions from transportation more effective.

D. Summary and conclusions

Currently, Israel is in compliance with reduction targets it has set for itself in the Paris Accord, and would appear to be in compliance with these in 2030 as well. However, stricter global criteria would require further measures to be applied, the impact of which would only be evident in many years' time.[45] Therefore, the Government of Israel resolved, in July 2021, to transition to a low-carbon economy and to pricing greenhouse gas emissions by way of carbon tax.[46] The share of the transportation sector out of total greenhouse gas emissions in Israel is large and constantly growing. Therefore, in order to continue compliance with global criteria, policy is required in order to reduce emissions from vehicles.

This paper analyzes two policy paths to reducing greenhouse gas emissions by the transportation sector—transition to zero emission vehicles and transition to using public transportation. Development of each of these would bring benefits in terms of the climate, estimated by simulations presented in this paper. These would indicate that converting 1 percent of mileage driven using private transportation from internal combustion engine vehicles to zero emission vehicles, would reduce total greenhouse gas emissions by 0.05 percent to 0.08 percent; converting 1 percent of mileage driven using private transportation to using public transportation (assuming current electrification level), would reduce such emissions by just over 0.06 percent. Such conversion coupled with electrification of public transportation would reduce emissions by 0.1 percent.

In order to make progress on solutions for reducing emissions by transportation, it is key to address upfront the potential load issue that may be created in the power grid from the charging of electric vehicles, by diverting such charging from evening to noon-time hours, development of storage technologies, demand management and so forth. Given the potential demand for public transportation in Israel, and the public investment already required in this area, it is important for such investment to be directed towards zero emission vehicles. In this regard, consideration should also be given to introducing heavy vehicles based on hydrogen technology, as it becomes available.

An investment program in green public transportation would intensify the impact of diverting mileage from private to public transportation on reduction of greenhouse gas emissions, by also reducing emissions by public transportation. Such a program could help in addressing the "chicken and egg" conundrum, as the range of services required for electric vehicles, to be installed as part of such program for electric public transportation, could also spread over to the private vehicle sector. Development of green public transportation in Israel would signal Israel's commitment to promoting a greener climate environment, in line with the commitments of many countries that have been adopted in forecasts by the International Energy Agency. According to such forecasts, the most significant increase in number of electric vehicles expected in the coming years would be in the number of buses.[47]

45 In this regard, consideration should also be given to the long duration it takes to promote new standards and investments in Israel. Porat (2009) found that in 90 percent of transportation projects in Israel, the actual duration is longer than planned with an average delay of 60 percent of the duration.

46 https://www.gov.il/he/departments/policies/dec171_2021
https://www.gov.il/he/departments/policies/dec286_2021

47 https://www.iea.org/articles/global-ev-policy-explorer

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EMPLOYEE UNIONIZATION IN ISRAEL, 2014–18[1]

- **Following a sharp decline in unionization rates in previous decades, the share of employees paying membership fees to labor unions (hereinafter, "unionized employees") increased slightly between 2012 and 2018, as part of the wave of unionizations in the economy. In 2018, about one-quarter of employees in Israel aged 25–64 paid membership fees to unions, totaling more than NIS 1 billion. In contrast, the unionization rates in most OECD countries declined moderately during that period.**
- **The share of unionized employees in the public sector (65 percent) is higher than among companies and non-profit organizations providing public services, such as education and health, (11 percent) and in the business sector industries (about 15 percent). Thus, in choosing to provide public services through nonprofit organizations/companies rather than through government units, the government reduces the share of public services provided through unionized employees.**
- **Unionized employees in the public sector and in companies and nonprofit organizations providing public services generally enjoy higher wages than their nonunionized colleagues, and this is particularly notable among women employees. These wage gaps may reflect different professions, vocations, and various other workplace characteristics.**
- **In the business sector industries—taking a view of the sector as a whole—wage gaps between unionized and nonunionized employees are smaller than the corresponding wage gaps in the public sector and among companies and nonprofit organizations providing public services. However, while the wages of unionized employees aged 50–60 in these sectors is high and stable, the wages of nonunionized employees decrease with age.**

1. Foreword

This study maps the unionization trends, characteristics of unionized employees, and the relationship between unionization and wages between 2014 and 2018 using a new statistical source: employer reports to the Israel Tax Authority on the deduction of union fees from wages. The payment of fees provides an indication of union activity, since membership fees are paid by employees who have decided to join labor unions, while the coverage fees are paid by employees who are not union members but are covered by a collective or sectoral labor agreement at their place of work.[2] Thus, using a large administrative database (about 280,000 observations a year), the study sheds light on labor unions. In the past two decades, these unions have been studied sporadically using surveys covering several thousand employees (the Social Surveys of 2012 and 2016, and Ministry of Labor surveys in 2000 and 2006). This descriptive study presents statistical correlations, rather than causal connections, between unionization and the characteristics and wages of employees who pay membership fees, thereby filling a lacuna in labor market statistics.

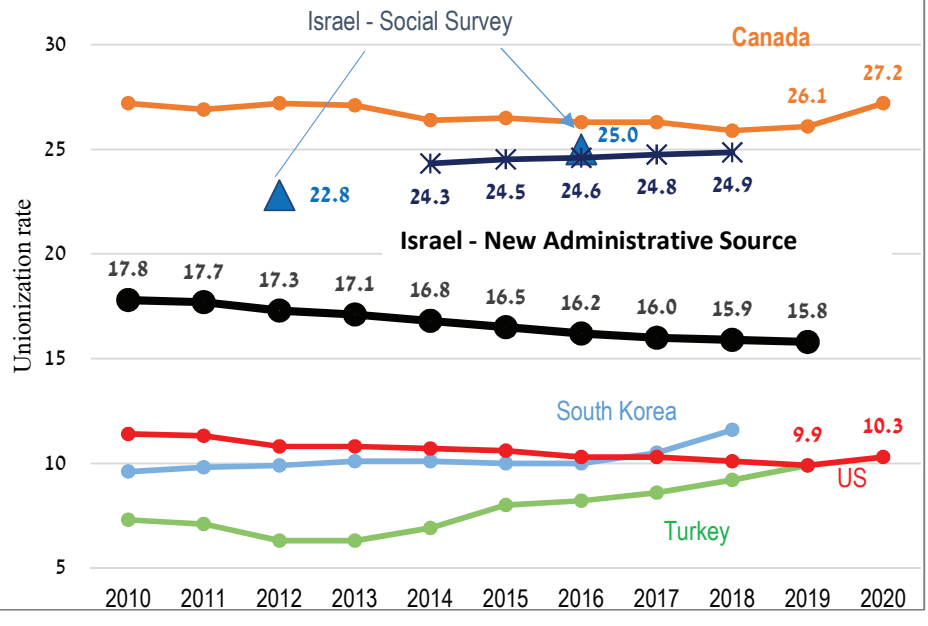
[1] Written by Haggay Etkes and Guy Almog.

[2] Employees pay coverage fees when their employer is signed on a local labor agreement that applies to the employees (excluding employees with an individual contract) or where the employer belongs to an employers' organization that is signed on a sector-based agreement. Employees who are covered by a sector-based extension order but their employers are not members of the employers' organization signed on the extended sector do not pay coverage fees.

Unions in Israel experienced a drop in membership numbers beginning in the 1980s, particularly after the disconnection between union membership and health insurance following the legislation of the Public Health Law in 1995. However, in the past decade, unions' recruitment activity has expanded. The establishment of the *Koach LaOvdim* (Power to the Workers) organization in 2007, and the establishment of an employee unionization department by the Histadrut (General Federation of Labor in Israel) in 2009, reflected intensive union activity to unionize employees at nonunionized workplaces, including in cellular communications, finance, public transit, colleges, and even in the high tech sector.

Employee unionization was also encouraged by legislative changes (2013), and the Pelephone judicial ruling (2012) even prevented employers from opposing unionization efforts by their employees. These processes encouraged employees to form unions in new workplaces, halting the downward trend in union membership from 45 percent in 2000 to 34 percent in 2006 and 23 percent in 2012 (Kristal, et al. 2015) and union membership even rose slightly to 25 percent in 2016 (the blue triangles in Figure 1). Similar to these findings, the present study also points to a slight increase in the share of unionized employees in the economy in 2014–18[3] (the stars and blue line in Figure 1).

Figure 1
Unionization Rate in the OECD and Selected Countries, 2010–20



Note: The unionization rate in OECD data reflects the share of employees that are members of workers' organizations, while the administrative source present the share of employees that pay membership/coverage fees to workers' organizations by deductions from their paycheck.
SOURCE: OECD and based on Bank of Israel processing of the employees' file.

[3] The term unionized employees generally refers to union membership, and in this study we use this term, for convenience, to mean employees who pay membership/coverage fees.

Although moderate, the increase in the unionization rate in Israel is in marked contrast to the slight decline in union membership rates in the OECD. Among OECD countries, the unionization rate increased between 2010 and 2019 only in Turkey, South Korea, and Iceland (Figure 1). In the other countries, unionization rates remained stable or declined. In 2020, when COVID-19 broke out, the share of unionized employees measured in several countries increased due to the fact that unionized employees were less severely impacted by the pandemic than other employees. So far, the data do not make it possible to determine whether this result reflects differences in the industry composition of unionized and nonunionized employees or is the outcome of being unionized per se. In the US, the unionization rate could increase in coming years due to the publication of a White House Executive Order in 2021, which seeks to encourage the unionization of employees in the US economy.[4]

The study also documents the gaps in unionization rates between economic sectors: About 65 percent in the public sector (the vast majority of nonunionized workers in the public sector belong to the defense establishment, including the police and the Prisons Service, and to other organizations in which the employees are not unionized), compared with about 11 percent in the other public services (health, education, and so forth) that are not in the public sector, and about 15 percent in the business sector industries. In the business sector industries, the unionization rate increased during the reviewed period (2014–18) by about one percentage point, partly due to an increase of 5 percentage points in the unionization rate in the communications, transportation, and finance industries with the wave of unionizations in the cellular communication, insurance, and public transit companies. The study also shows that in the public sector and public services, wages of unionized employees are higher than those of nonunionized employees, whereas in the business sectors, wage levels for unionized and nonunionized employees are similar. Nonetheless, in the business sector industries, unionized employees enjoy higher wages than nonunionized employees in their 50s and 60s as well as higher employer contributions that will increase their post-retirement pension income.

Statistical research on employee unionization in Israel in the 21st century is limited, partly due to the paucity of statistical sources available until now. Several studies reviewed the scope and characteristics of unionization using the Ministry of Labor surveys (Cohen, et al. 2003; Mundlak, et al. 2010) and the Central Bureau of Statistics (CBS) Social Survey (Etkes 2013, Kristal, et al. 2015). However, the constraints of these surveys and particularly the small number of observations made it difficult to conduct detailed studies based on these datasets. Feder et al. (2016) published a critical policy paper that includes various recommendations made by the Kohelet Policy Forum aimed at restricting the power of the unions, whereas Vazana (2017), Stauber (2018) and Bar-On (2021) published popular books supporting employee unionization, in which they primarily examined a number of industries or case studies.

Margalit (2019) and Kristal (2020) use Israel Tax Authority data to analyze the characteristics of unionized and nonunionized employees. Their studies used employee unionization identification in the CBS Social Survey (2012) as a way of identifying unionized employees in the Israel Tax Authority file. Margalit (2019) argued that the labor market is characterized by castes of unionized and nonunionized employees, and that the wage gaps between the castes are particularly large among employees without higher education. In contrast, Kristal (2020) argued that unionization reduces income gaps between unionized employees,

[4] The White House, "Executive Order on Worker Organizing and Empowerment", Presidential Actions (April 26, 2021); BLS (January 22, 2021 "Union Members – 2020"

including between men and women. The present study uses administrative identification of employees affected by collective labor agreements, and unlike Margalit (2019) and Kristal (2020), it is not dependent in the estimation period on the likelihood that an employee who appears in the administrative data will be unionized on the basis of the Social Survey (2012).

Compared with other quantitative studies about unionization in Israel in the past decade, the present study is unique in its ability to identify unionized employees on the basis of administrative data, unlike other studies that identified these employees based on reports made by the surveyed individuals. In this study, the identification is based on employer reports to the Israel Tax Authority on the deduction of union membership or coverage fees from wages. As a rule, employers deduct membership fees from the wages of members of the representative union with which they have signed a collective labor agreement, and in the Civil Service at least, also from the wages of members of other unions.[5] Employers who signed on a local collective labor agreement, or indirectly through membership of an employers' organization that has signed a sector-based labor agreement, are supposed to deduct the coverage fees from the wages of the employees covered by the agreement. It can reasonably be assumed that the actual deduction from employees covered by a sector-based agreement is partial, given that the union does not necessarily have direct contact with the employer.[6] Reporting on membership/coverage fees to the Israel Tax Authority began in 2013 in the wake of an agreement between the Histadrut (General Federation of Labor in Israel) and the Finance Ministry with respect to recognizing these expenses as a tax-deductible expense. The period reviewed in our study begins in 2014 since we assume that the employer reports to the Israel Tax Authority on membership/coverage fees in the first year of recognition of this deduction, 2013[7], was partial.

The constraints of administrative identification in the present study must be emphasized. First, this statistical identification does not include a small number of employees who are union members and pay their membership fees directly to those unions, such as some high-school teachers, doctors and social workers.[8] The share of those paying membership/coverage fees according to the CBS Social Survey, which includes employees paying membership directly as well those who pay through a deduction from their wages, is therefore higher than the share of those paying by means of an employer reported wage deduction. Moreover, unlike the Social Survey, the administrative database makes it impossible to differentiate between union members and employees covered by a collective labor agreement but are not union members.[9]

Appendix A presents a comparison of the characteristics of employees who, in the Social Survey reported that they paid membership/coverage fees in 2012 and 2016 to the administrative report in the Israel Tax

5 Excluding members of early-stage unionization in new workplaces that have not yet signed collective labor agreements.

6 The most noticeable exception is Palestinian workers where the regulator collected from their employers the coverage fees for sector-based industries together with the other taxes and social-benefit contributions. In the period covered in the study, coverage fees were deducted from the wages of about 70 percent of the Palestinian workers listed in the Tax Authority file. These deductions were withheld in 2020 following an administrative petition by *Kav LaOved* and the employers organization *Maan*. Source: Population and Immigration Authority (May 27, 2020), "Update concerning suspension of the collection of deducted professional-union coverage fees from the wages of Palestinian workers".

7 The proportion of employees whose employers reported the deduction of union membership/coverage fees in 2013 to the Israel Tax Authority was 2 percentage points less than the rate in 2014, whereas the change in from 2014 to 2018 were less than one percentage point.

8 According to Histadrut data approximately 100,000 members, out of 800,000 members, pay their membership directly, of which an unknown number are employees.

9 The Income Tax Regulations in 2014-2018 (2013) recognized as a tax-deductible expense some 90 percent (50 percent) of the membership fees or coverage fees that union members would have paid were they not members. The scope of the tax benefit is therefore the same for members and for those covered who are not members, and they cannot be distinguished from one another in the Israel Tax Authority file.

Authority file for 2013 and 2016 (respectively) and it points to the similarity in the characteristics of those who paid according to both statistical sources. The analysis shows that employees whose employers reported the deduction of membership/coverage fees from their wages, and in the relevant tax year had only one employer, have similar characteristics to employees who in the Social Survey reported that they paid membership/coverage fees in the corresponding year. Additionally, the Social Survey shows that the unionized employees are slightly older and their income is slightly higher than that of their counterparts in the administrative file. This might reflect inaccurate responses to the Survey, as we will discuss below.

The administrative database has a number of important advantages over the Social Surveys: first, this study analyzes Form 126 for approximately 10 percent of Israeli employees, with approximately 1.4 million employee observations emerging from the sample (280,000 observations per year). Second, the administrative database analyzed here also provides information about the employment of the spouses of the employees in the sample. In comparison, the CBS Social Survey contains about 7,000 individuals, of which only half are employees, and it does not provide any information about the spouse's occupation. The surveys conducted by the Ministry of Labor (2000 and 2006) are even more limited in scope. Furthermore, whereas the administrative database refers to reliable data for employer deductions, the Social Surveys are based on employees' reports about the payment of membership/coverage fees, some of whom may not be aware of these deductions from their wages. Notwithstanding these concerns, in the final outcome, the estimated share of employees who pay membership/coverage fees in both sources is similar, as can be seen in Figure 2.

The rest of the study is as follows: Section 2 presents unionization rates and the characteristics of unionized and nonunionized employees throughout the economy; Section 3 examines unionization rates and wages in the public and business sectors; and Section 4 focuses on unionization and its characteristics in the business sector industries. Appendix A (in Hebrew only) compares the characteristics of employees who pay coverage fees according to the Israel Tax Authority file and the characteristics of employees who reported their union membership in the Social Survey. Thus, it validates of the use of the administrative data as an indication of unionization.

2. Unionization rates and characteristics of unionized employees

In the second decade of the 21st century, union activity intensified, partly as a result of legislative and judicial changes that facilitated the unionization of new workplaces, and encouraged by the social protests of 2011.[10] Between 2012 and 2020 in particular, the Histadrut formed unions in more than 160 new workplaces, including in the cellular communication, financial services, and transportation industries, as well as in communication and local government sectors (municipalities and municipal corporations). This unionization wave came after several failed attempts to unionize new workplaces in the previous decade. *Koach LaOvdim* (Power to the Workers) was established in 2007 and formed unions in 60 new workplaces, while the National Labor Federation (Histadrut HaOvdim Haleumit—HOL) was also successful in forming unions in dozens of new workplaces.

[10] Vazana (2017) argues that many of the unionization activists had also been involved in the wave of social protests in 2011. Quoting Avi Nissenkorn, former Histadrut chairman: "One of the main outcomes of the social protest was employee unionizations […] the atmosphere of protest spurred people to bring about change, they realized that collective organization gives people the power to bring about change" (ibid p. 208).

Unionization activity has also continued in new workplaces in the past two years, with unions formed by Pazgaz employees (Histadrut, 2020), Dor Alon (HOL, 2020), 10bis (Histadrut, 2020) and Maccabi Healthcare Services (HOL, 2021), while the Labor Court prohibited the management of Tower Semiconductor from interfering in the Histadrut's unionization activity within the company (June 2021). Nonetheless, some of these unionization efforts failed because the unions' action committees failed to achieve the support of one-third of the employees as required for workplace unionization (e.g., Amdocs in 2017) or where negotiations failed to culminate in the signing of a collective labor agreement (e.g., McDonalds, 2014).[11]

Union activity is also manifested in competition between unions, in unionization of nonunionized workplaces, as well as in changing the union representation in unionized workplaces. This competition even reached courts, which established rules for competition between labor unions: for example, the Sonol ruling (2010) prohibited replacing the representative labor union in the year following the signing of a collective labor agreement, while the El Batouf ruling (2013) set out 13 rules for regulating competition between unions. Besides the ideological enthusiasm to unionize employees, the labor unions are incentivized to unionize new workplaces or persuade employees to move to a different union due to the collection of membership/coverage fees. Between 2014 and 2018, there was an 18 percent increase in membership/coverage fees paid by Israeli employees that were reported to the Tax Authority (from NIS 828 million to NIS 978 million).[12] We estimate that the total amount collected by the labor unions in 2018, including amounts that were not reported as a tax deductible expense[13] and membership fees paid to unions directly was more than one billion shekels.[14]

Unionization activity is reflected in the Social Survey data, which point to a moderate increase in unionization rates between 2012 and 2016: The share of members, the share of employees who reported that there is a workers committee in their place of work, and the share of those paying membership/coverage fees, all rose during this period. (Compare the purple diamonds, the green circles and the blue diamond shapes in Figure 2.)[15] A review of the administrative data for 2014-2018 shows that the increase in the share of employees who paid membership / coverage fees according to employers' reports to the Tax Authority was

[11] In contrast Tacharut (The Movement for Freedom of Employment), which works to curb union power in the workplace was successful in isolated cases, such as Afcon, Automatzia and Palram, which reverted to non-collective labor agreements in 2018. Tali Heruti-Sover (December 30, 2018), TheMarker. In parallel, the number of state employees who are members of religious labor unions (Hapoel Hamizrachi, Histadrut Poalei Agudat Israel and Histadrut Agudat Israel) has declined in the past decade to a combined total of about 100 employees in all three organizations (data provided by the Ministry of Finance).

[12] These estimates include 10 percent of the coverage fees that are not recognized for tax purposes. Additionally, membership/coverage fees amounting to more than NIS 40 million were reported for non-Israeli employees in 2018.

[13] The difference between membership fees and coverage fees which for the Histadrut and the National Labor Federation is 0.15 percent of the wage up to the limit, is not a tax deductible expense.

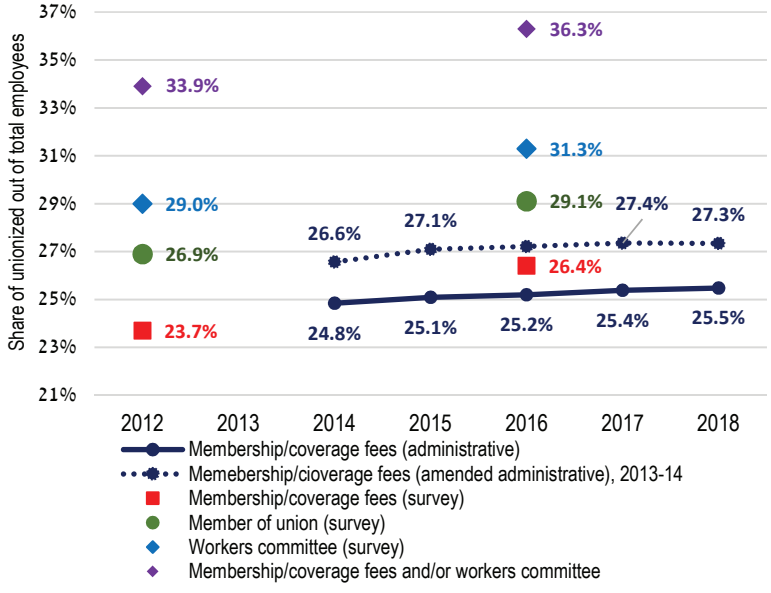
[14] For the sake of comparison, in 2018 the General Histadrut budget was more than NIS 658 million.

[15] The share of covered salaried employees also increased in 2012–16 (from 33.9 percent to 36.3 percent) according to an extended identification for cover in collective labor agreements: employees noted that they paid coverage/membership fees and/or that there was a workers committee in their workplace in 2012 and 2016. Kristal et al. (2015) used a broad identification for employee cover in analyzing the Social Survey (2012): they identified covered as surveyed subjects who replied in the affirmative to at least one of the following questions: payment of coverage/membership fees, workers committee activity in the workplace, the wage set in the collective labor agreement. This method of identification has several drawbacks: first, any reporting error for one of the questions increases the cover rate, but only an error in reporting several questions might skew the estimate downward among employees with comprehensive labor relations, including the payment of membership/coverage fees and where a committee operates in their workplace. In particular, employees with personal contracts or contract workers who noted that there is a workers committee in their place of work, are included in the extended identification as covered even though legally they are not covered by a collective labor agreement.
Furthermore, Kristal et al. (2015) omitted from their sample 780 subjects (out of 3,800) who replied that they do not have an employment contract. Omitting these observations from the sample raises the proportion of employees aged 25–64 whose salary was fixed in a collective labor agreement by seven percentage points.

even more moderate than the increase in this rate according to the Survey (the blue line in Figure 2).[16]

Figure 2 also includes a revised estimate of the share of unionized employees, which includes unionized teachers, only some of whom pay membership fees by way of an employer deduction (blue dotted line). This correction is partial, given that an unknown number of doctors, social workers and other salaried employees pay membership directly and not by means of an employer deduction. Nonetheless, a simple calculation based on the difference between the share of those reporting who paid membership/coverage fees in the Social Survey and those who paid according to the administrative data shows that in 2016, 34,000 salaried employees paid membership/coverage fees directly to the unions.[17] This rough estimate is less than the number who paid the unions directly in 2020, which included approximately 100,000 paying the Histadrut, 25,000 college teachers, and thousands of doctors, social workers, etc.[18]

Figure 2
Share of employees who pay membership/coverage fees to a union, by source, ages 25–64, 2012–18



Notes: The shares in this figure, referring to those aged 25–64, are higher than the shares in Figure 1, which refers to the population ages 20+.
Social Survey data refer to employees who worked in the week before the interview, and Israel Tax Authority file data refer to employees who paid membership/coverage fees out of total employees who worked in a given month. This means that the share of every observation in the Social Survey is the number of weeks in the year that the respondent worked, while in the employee file it is the number of weeks worked in the tax year.
SOURCE: Processed data from the Social Survey and the employee file, Israel Tax Authority.

[16] It is reasonable to assume that a substantial part of the increase in the share of those paying membership/coverage fees in 2013–14 according to the administrative database can be explained by the expansion of the reporting to the Israel Tax Authority in the first two years of adopting the reporting on this subject.

[17] The calculation is based on the difference between the share of those paying according to the Social Survey (26.4 percent) and the share paying by means of an employer salary deduction (20.9 percent), multiplied by the number of employees in the sample. This simple calculation does not take into account the differences between the time units of both sources (a work week and work month, respectively) and reporting errors

[18] The number of those paying the Histadrut directly is estimated at 100,000 by the Histradrut's Economic Division, although we have no information about the distribution of this figure between Israeli employees, who are included in the study, and other Histadrut and union members who are not included in it, for example because they did not report on Form 126 (such as employees in informal pre-school child care) or with respect to foreign workers or pensioners.

In both statistical sources, women account for a higher share of unionized employees than men—30 percent and 21 percent, respectively, and the moderate increase in the unionization rate is mainly due to an increase in the share of female unionized employees, whereas the share of male unionized employees rose extremely slowly. The gender gap in the rate of unionized employees, therefore, expanded further. The increase in the share of unionized women according to both statistical sources compared with the proportion of unionized men provides further confirmation of the reliability of the sources (Figure A.1).

A comparison of unionized and nonunionized employees shows that unionized employees are generally older, less likely to be single, and they have more children. Unionized employees also have longer employment tenure, and their rate of switching primary employer is about half that of nonunionized employees. Both categories of employee live in similar areas on the CBS socioeconomic ranking. About 57 percent of the unionized employees worked in places identified on the database as associated with the public sector[19], in contrast with just 12 percent who are nonunionized (Table 1).

Another interesting finding is that the annual labor income of unionized employees in 2018 was about NIS 22,000 (or 16 percent) higher than that of nonunionized employees. This was due to employment stability, which was reflected in an additional 0.8 work months per year, and due to a monthly wage gap of about NIS 2,000. The monthly wage gap is partly explained by the share of workers with higher education (most have an academic qualification), which is much higher among unionized workers. In addition, employer deductions to pension and advanced training funds for unionized employees are about NIS 4,800 higher per year than employer deductions for nonunionized employees (Table 1).

Furthermore, the spouses of unionized employees tend themselves to be more unionized than the spouses of nonunionized employees and their wages are also higher. The labor income of households of unionized employees is therefore higher than that of other households and they also enjoy larger deductions to savings. Obviously, these comparisons do not highlight the effect of unionization on the variables examined; it is possible that the relationship is not causal or perhaps there is reverse causality at play.

[19] Employers were identified as a public-sector employer based on the wage cuts that formed part of the 2003 wage package. This identification does not include public sector organizations established after 2003.

Table 1
Characteristics of Unionized and Nonunionized Employees, 2018

	Unionized (paying membership/coverage fees)	Nonunionized (not paying membership/coverage fees)	Difference
Age	43.7	40.9	2.7***
Women	60%	47%	13%***
Jewish	86%	84%	1%***
Singles	17%	27%	-10%***
Number of children	2.4	2.1	0.2***
Bagrut matriculation certificate[1]	85%	74%	11%***
Bachelor's degree[1]	58%	37%	21%***
Home ownership[1]	80%	67%	13%
Socioeconomic cluster	10.4	10.3	0.0
Public sector[2]	57%	12%	45%***
Changed employer in the past year	12%	24%	-13%***
Tenure with current employer (years)	11.8	5.9	5.9***
Monthly wage (NIS thousand)	13.3	11.6	1.6***
Number of work months per year	11.3	10.5	0.8***
Annual income (NIS thousand)	159.1	136.7	22.5***
Employer deductions (NIS thousand)	14.9	10.1	4.8***
Spouses - unionized (percent)	14.5%	9.0%	53.5%***
Spouses - annual income (NIS thousand)	161.1	145.1	16.0***
Spouses - employer deductions	14.1	12.4	1.7***
Number of employees (thousands)	709	2,096	
Share of salaried employees	25.3%	74.7%	

*** - Statistically significant to 1 percent, ** to 5 percent, * to 10%.

[1] Based on the 2016 Social Survey.

[2] The public sector includes employers who reduced the wages of their employees in 2004 as part of the package deal in the economy, and does not include public employers that were established after that year.

SOURCE: Bank of Israel calculations based on the Salaried Employees File (2018) and the Social Survey (2016).

3. Unionization and wages by sector

Like other advanced economies, the scope of unionization is closely related to the characteristics of the economic sectors, and the rate of unionization in the public sector is higher than in the rest of the economy. To examine unionization rates in the economic sectors, we divided employees in the prime work ages (25–65) into the following sectors:

A. About 650,000 employees in 2018 in the public sector, which was identified by workplace participation in the economic package deal of 2003–04.[20] The share of unionized employees in this sector was estimated at 65 percent (see explanation below).

B. About 390,000 employees in the other public services—education, health and in the culture and entertainment industries, that are not part of the public sector although a substantial part of their funding comes from the public purse. Approximately 11 percent of employees in these services are unionized.

[20] This sector includes 160,000 employees in business sector industries (electricity, transportation, financial services, etc.).

C. 1.8 million employees in the business sector industries (agriculture, industry, support and management services, etc.), excluding employees in workplaces classified as belonging to the public sector given that they were included in the 2003–04 package deal. Based on employer deductions of membership fees, about 15 percent of employees in these sectors are unionized.

The distinction between the public sector and other public services is important as many economic analyses address public services as a whole, namely both groups together, even though the scope and quality of unionization in the two groups is completely different: even when the employees of public service providers are unionized, such unionization is less effective with respect to the employees' bargaining power since the government has the ability to terminate the agreement with the service provider.[21] Furthermore, by purchasing services from business entities or nonprofit organizations, the government reduces the share of the public services provided by the unionized employees.

The share of unionized employees in the public sector in 2018 is estimated at 65 percent (noted in Figure 3 with a red, dotted line).[22] This estimate consists of about 62 percent of employees whose membership fees were deducted from their wages and about 19,000 teachers who belong to the Teachers Union and are employed by schools run by the local authorities and Ministry of Education. In fact, the share of unionized employees rose in the reviewed period (2014–18) by about one and a half percentage points. In contrast, the share of unionized employees in the other public services (marked in green in Figure 3) was 11 percent. This rate too is skewed slightly downward due to the direct payment of membership fees by teachers, doctors, social workers, etc.[23]

The Histadrut and *Koach LaOvdim* both work to unionize employees in business sector and nonprofit workplaces that provide services to the public sector in the public services industries. However, competition between the service providers in those sectors and the fact that the providers are replaced every few years reduces the impact of such unionization activity on the share of unionized employees in business sector public services and on the unions' ability to improve workers' conditions. The Histadrut tries to limit the effect of the competition between the service-providers to the State on the work conditions of their employees by means of industry-wide agreements. For instance, the sector-based agreement and the Extension Order for Social Workers Employed on the Basis of State Contracts (2017) established wage scales and other conditions for social workers, whose employment is funded by the State.

In the period 2014–18, the share of unionized employees in the business sector industries (excluding public sector employees) increased by less than one percentage point, to 15.3 percent in 2018. In these industries, men and women account for the same share of unionized employees, whereas in the public sector, the share of unionized women employees is 8 percentage points higher than the share of unionized men. The slight increase in the share of unionized employees contrasts sharply with the image portrayed in the media

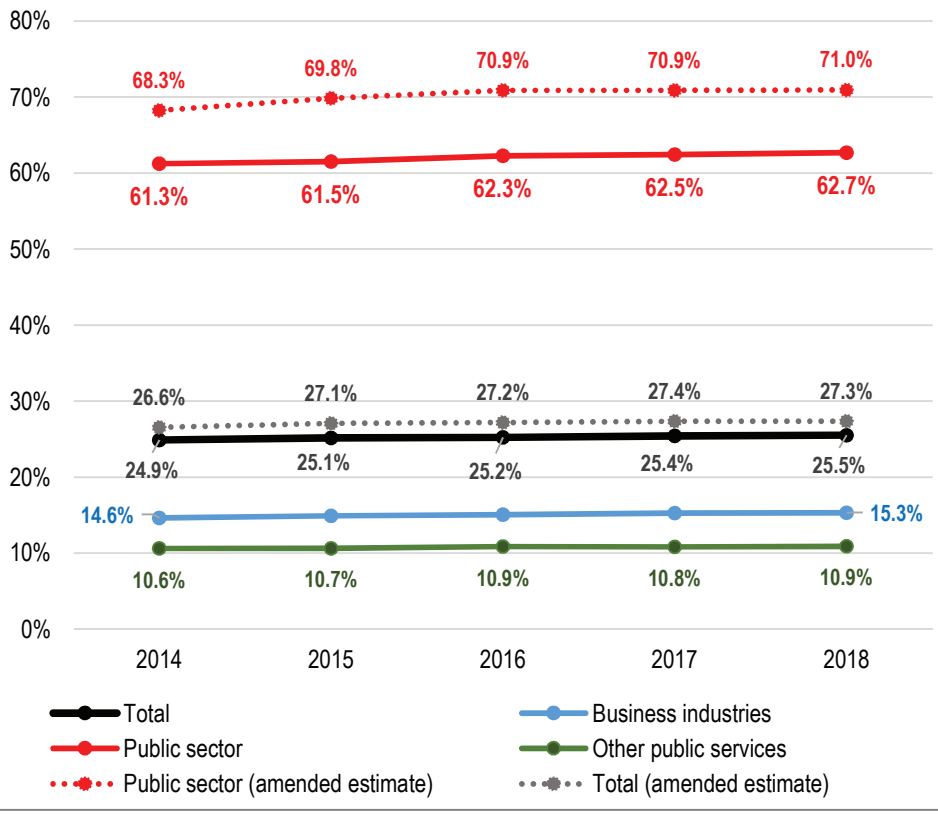
[21] For example, the government replaces the providers of welfare services such as the operators of daycare centers for the disabled and high-risk populations.

[22] In addition to the defense forces and organizations in which there are no unionized employees, some salaried employees in the public sector are employed in special contracts, personal contracts, contracts for economists, experts, etc. who are not unionized. Some of those employed with personal contracts do not earn high salaries.

[23] According to Central Bureau of Statistics data, about 5,000 teachers who are members of the Teachers Union teach at high schools associated with education networks and nonprofit organizations. If we add them to those paying employer deducted membership/coverage fees, the share of unionized employees in the other public services increases to 11.8 percent in 2018.

regarding a broad wave of unionization in the business sector. The following section details unionization rates and characteristics in the business sector industries.

Figure 3
Share of unionized employees by sector, ages 25–64 in 2014–18

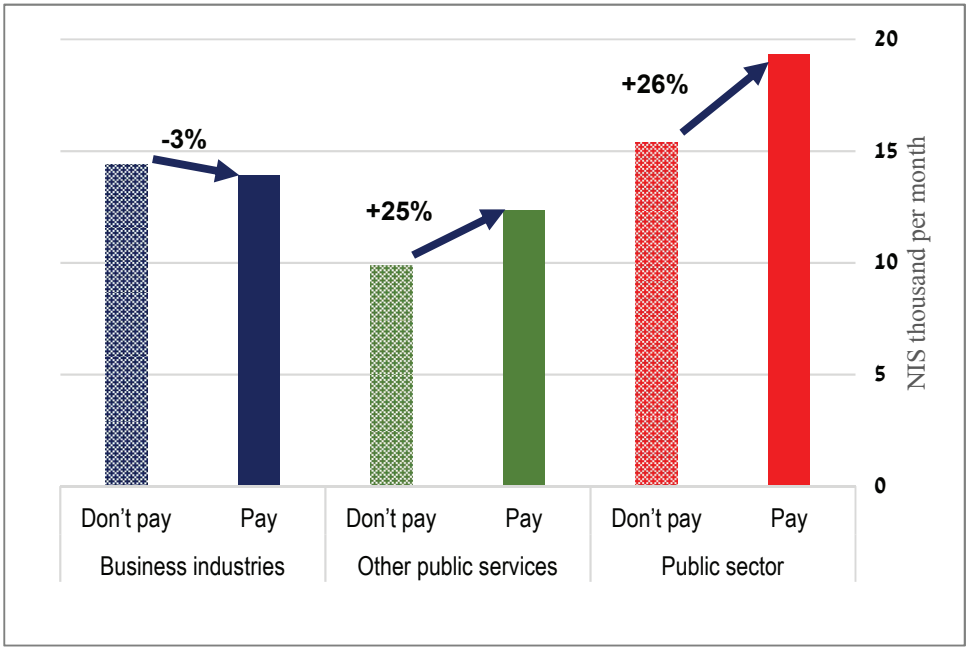


Notes:
1. The public sector includes employers who reduced their employees' wages in the 2003–04 package deal.
2. Employees in the business industries (A – Agriculture through N – Management and support services) excluding employees in public sector corporations whose wages were reduced in the 2003–04 package deal.
SOURCE: Processed data from the Social Survey and the employee file, Israel Tax Authority.

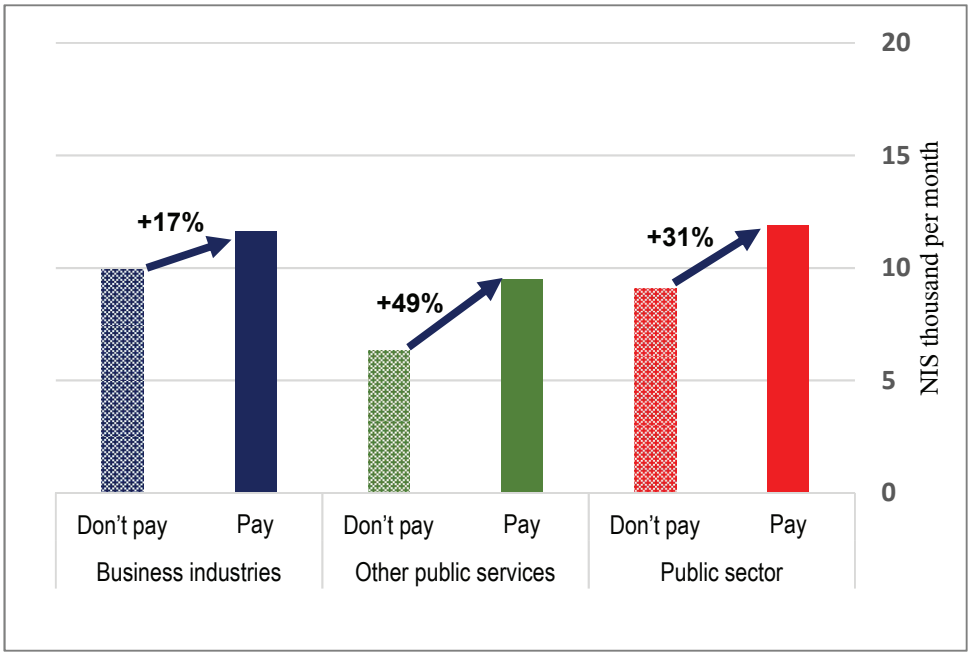
A comparison of the average monthly wage of unionized employees to that of nonunionized employees by gender and sector (Figure 4) shows two main patterns. First, the wage difference between unionized and nonunionized employees in the public sector and other public services is greater than in the business sector industries. In particular, the wages of unionized men in the business sector industries are slightly lower than that of their nonunionized counterparts, while among women, the wage gaps between unionized and nonunionized employees in the business sector industries are about half of the wage gaps of their counterparts in the public sector and other public services. Second, the wage gaps between unionized and nonunionized women are greater than the wage gaps between unionized and nonunionized men in all sectors.

Figure 4
Average monthly wage of unionized and nonunionized employees, by gender and sector, employees ages 25–64 in 2018

a. Men



b. Women

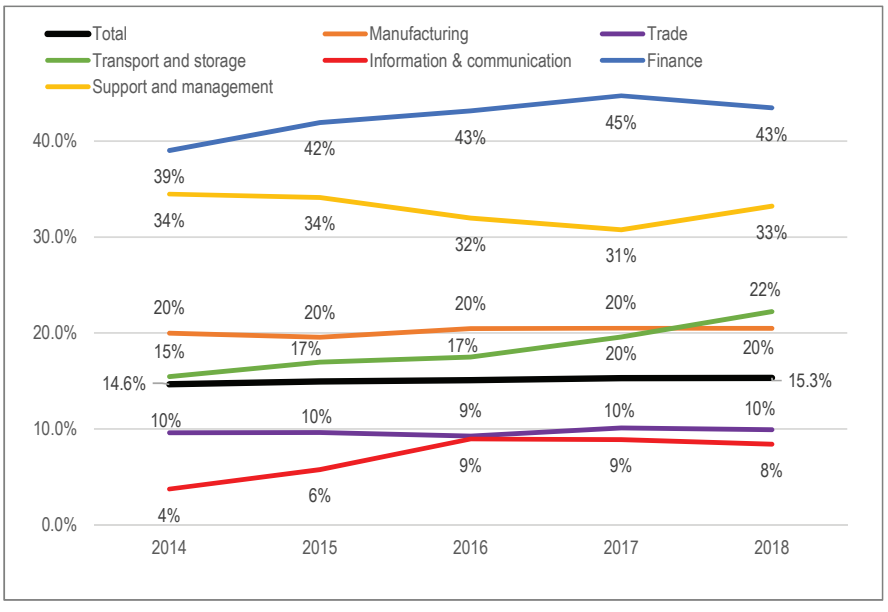


SOURCE: Based on Employees File.

4. Employee unionization in the business sector industries

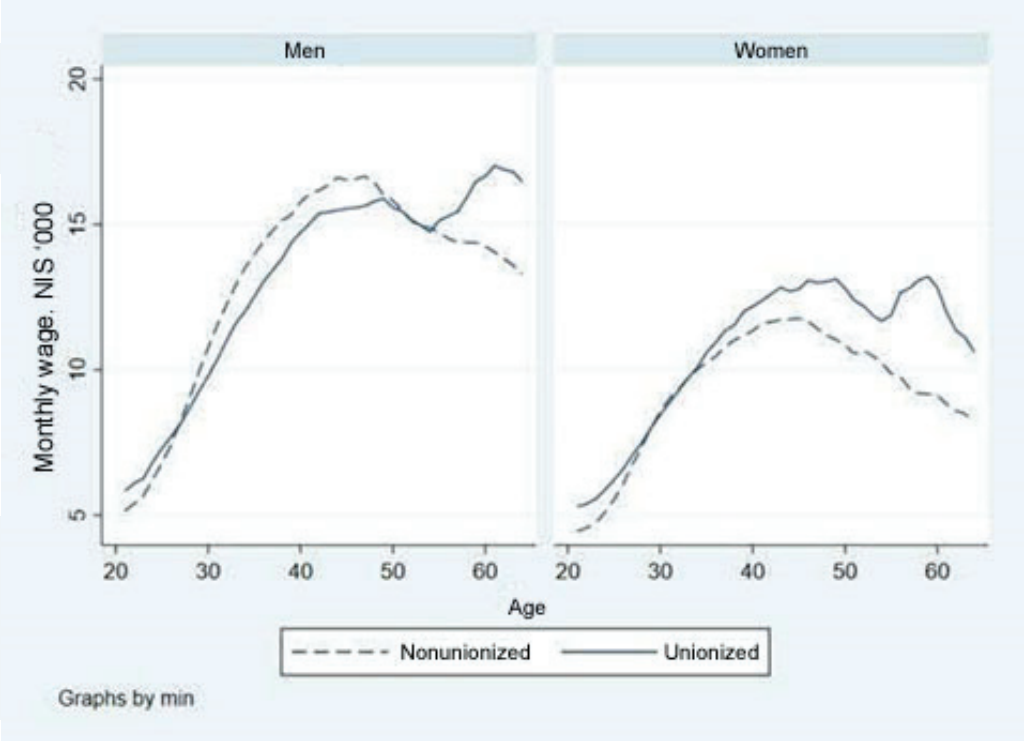
The moderate increase of 0.8 percentage points in the rate of unionization in the business sector industries reflects inter-industry heterogeneity. The increase here is mostly attributable to a rise of 5 percentage points in the rate of unionized employees in the information and communication industries—the outcome of unionization in the cellular communications sector, in the transportation sector with the unionization of public transit workers, and in the finance sector with the unionization of insurance company and credit card company employees (Figure 5). Competition in these industries is between a limited number of private companies offering services to the domestic market; these industries are highly regulated and there is no competition from imports. Unionization in the cellular communications industry began following the reforms of 2011, which intensified competition between the cellular companies and raised concern of deterioration in employment conditions in the industry. Employees in the public transit sector, bus drivers in particular, underwent a similar process of unionization as public transport routes were reassigned from the old transportation companies to new companies. The public transit sector has become a battleground between three unions: the Histadrut, the National Labor Federation (Hahistadrut Haleumit) and *Koach LaOvdim*. Like the service providers in the public services sectors, the unions' ability to improve employment conditions is limited due to the limited period in which they operate the bus routes and the tenders issued to replace the concessionaires. Unionization in the finance industry consisted mainly of insurance companies that used to be unionized in the past, and the credit card companies that were separated from the banks.

Figure 5
Share of employees paying membership/coverage fees out of total employees in the business industries, prime working ages (25–64), 2014–18



Notes:
This figure includes employees in the business industries (A – Agriculture through N – Management and support services) excluding employees in public sector corporations whose wages were reduced in the 2003–04 package deal.
Identification of the industry attribution of workplaces is based on the attribution by the Israel Tax Authority, and not the attribution of the Central Bureau of Statistics, even though both use the same industry classification.
SOURCE: Processed data from the Social Survey and the employee file, Israel Tax Authority.

Figure 6
Average wage of unionized and nonunionized employees in business sector industries by age and gender, 2018, NIS thousand per month



Notes: The wage is calculated as a 5-year moving average of the employee's age (2 years before the age presented, the age presented, and 2 years afterward.

The labor organizations also unionized companies in other business sector industries such as the food industry (Sunfrost, Tivall, Tempo, Carlsberg and parts of the Strauss conglomerate) and the wave of unionizations also reached several high-tech companies (Magal Industries, and more recently Tower Semiconductor). In view of the foregoing, the share of employees paying membership fees in the industrial sector as a whole remained unchanged in 2014–18, at 19 percent.[24]

Employee unionization in the business sector industries is also connected with the size of the employer: in small workplaces with fewer than 10 employees, the share of unionized employees is extremely low (3.6 percent), whereas in workplaces with 200 employees it can reach 30 percent. This rate increases further as the number of employees increases, but to a lesser degree (Figure A-2).

A comparison of unionized and nonunionized employees in the business sector industries shows that they resemble each other more closely than their counterparts in the rest of the economy (Tables 1 and 2). In particular, the rates for women and Jews and the number of children that employees have are similar in the business sector industries. Employer turnover and employment tenure rates in the past year show that unionized employees in the business sector industries are more mobile than unionized employees in the

[24] According to the Social Survey, between 2012 and 2016, the share of employees paying membership fees in the industrial sector rose from 19.7 percent to 20.7 percent.

Table 2
Characteristics of Unionized and Nonunionized Employees in the Business Sector, 2018

	Unionized (paying membership/coverage fees)	Nonunionized (not paying membership/coverage fees)	Difference
Age	42.7	40.7	2.0***
Women	40%	39%	0%
Jewish	87%	84%	3%***
Singles	23%	29%	-5%***
Number of children	2	2	0
Socioeconomic cluster	10.1	10.5	-0.3***
Changed employer in the past year	18%	25%	-7%***
Duration with current employer (years)	9.2	5.6	3.7***
Monthly wage (NIS thousand)	12.6	12.6	-0.1
Number of work months per year	11	10.5	0.5***
Annual income (NIS thousand)	151.5	148.7	2.8
Employer deductions	12.7	10.4	2.3***
Spouse - unionized (percent)	12.1	8.5	-3.5%***
Spouse – annual income (NIS thousand)	130.1	141.8	-11.8***
Spouse – employer deductions	11.4	12.1	-0.6
Number of employees (thousand)	263	1,496	
Percentage of employees	15	85	

*** - Statistically significant to 1 percent, ** to 5 percent, * to 10%.

[1] Based on the 2016 Social Survey.

[2] The public sector includes employers who reduced the wages of their employees in 2004 as part of the package deal in the economy,

SOURCE: Bank of Israel calculations based on the Salaried Employees File (2018) and the Social Survey (2016).

rest of the economy, and in this too they are similar to the nonunionized employees in these sectors. In the business sector industries, the monthly wages of unionized and nonunionized employees are similar, but the annual wage of unionized employees is about NIS 3,000 higher due to their higher employment stability. The main difference between unionized and nonunionized employees with respect to labor income in the business sector industries is in employer contributions to pension and other saving, which are about NIS 2,300 higher per year for unionized employees. Here too, unionized employees in the business sector industries bear a greater similarity to their nonunionized counterparts than to unionized employees in other sectors.

However, if we examine the wage profile by age, we find a significant difference between unionized and nonunionized employees in their 50s and 60s in the business sector industries: whereas wages of nonunionized employees, particularly nonunionized women, among the 40+ age group are lower as age increases, wages of the unionized employees remain high or decrease only slightly at these ages. It is possible that older unionized employees are able to maintain high wage levels thanks to wage agreements that make it difficult to dismiss tenured employees or reduce their salaries. Additionally, employer contributions for saving, that are higher for unionized employees (Table 2), and beneficial pension fund agreements arranged by the workers' committees for union members as an organized group, suggest that unionized employees will also receive higher pension payments in retirement. As noted, this study is descriptive rather than a discussion of causality, since these differences may reflect different structural characteristics of the unionized sectors and businesses that correlate with unionization as well as with higher wages and a different employment structure.

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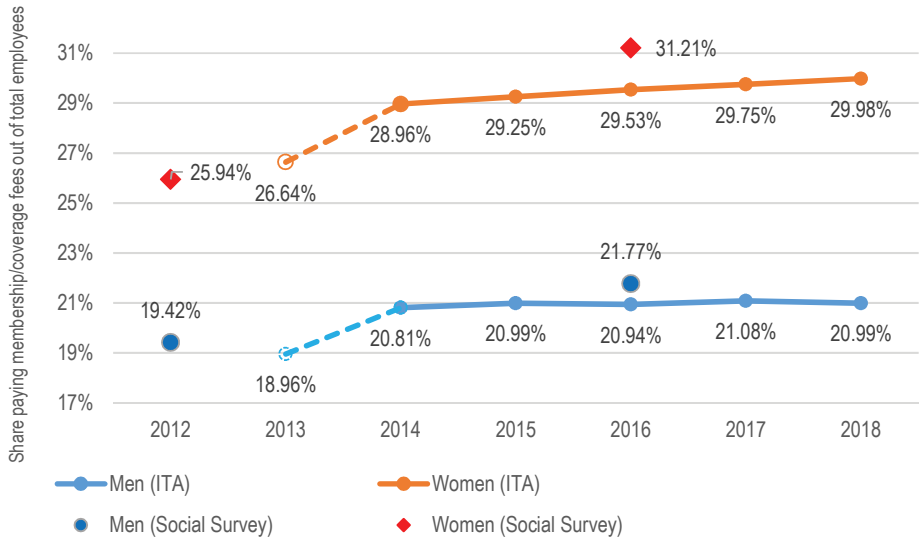
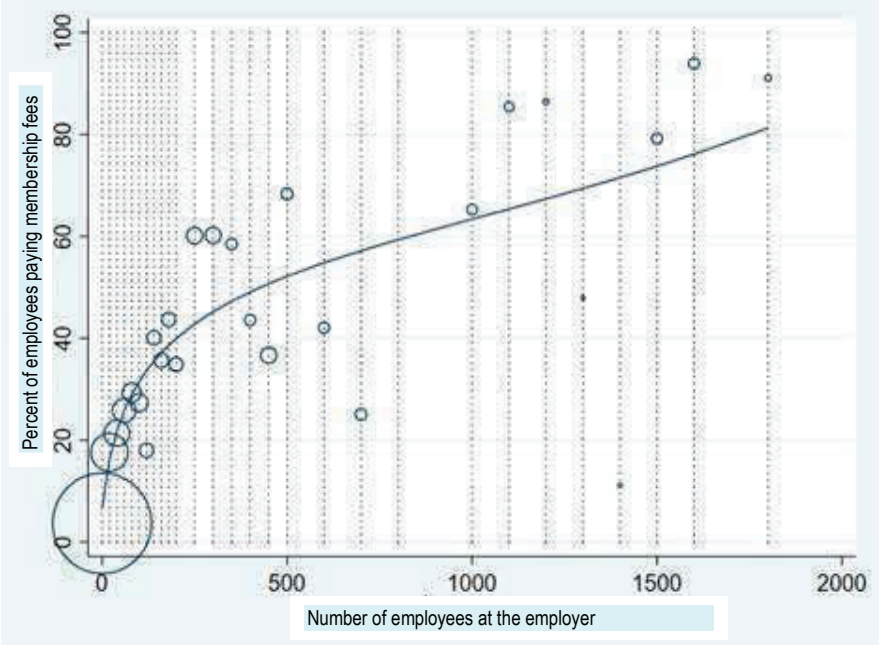
Figure A.1: Share of employees paying membership/coverage fees, by gender and statistical source, prime working ages (25–64), 2012–18



SOURCE: Processed data from the Employees File, the Israel Tax Authority, and the Social Survey.

Figure A.2
The share of unionized workers, by number of employees at the employer, 2018



SOURCE: Processing of Employees File.

THE OPEN SKIES REFORM AND ITS IMPACT ON THE TOURISM INDUSTRY AND THE ISRAELI CONSUMER[1]

- **The Open Skies reform, which was implemented during the period 2013–18, increased competition among the airlines.**
- **We examine the effect of the reform on the tourism industry and on the Israeli consumer. This is accomplished by analyzing the changes in the main tourism indices and by running regressions to determine the effect of the reform on the number of departures abroad of Israelis and the number of tourist arrivals to Israel as an indicator of activity in the tourism industry.**
- **During the period of the reform, there was a gradual increase in the number of flights between Europe and Israel, while the price of travel abroad declined relative to a vacation in Israel.**
- **The reform contributed to an exceptionally large increase—relative to other countries—in outbound tourism from Israel in all of the income quintiles.**
- **The reform improved the situation of consumers while the situation of the tourism industry was not negatively impacted. Thus, the level of activity and employment in the tourism industry continued to grow at a similar rate to that in other advanced economies and the Israeli airlines, which were directly affected by the reform, continued to increase their number of flights and passengers during the reform.**

1. The reform

Prior to the reform, the government of Israel maintained a conservative policy toward air travel. It was characterized by bilateral flight agreements that included: (a) limits on the number of companies permitted to operate regular flights on agreed routes ("designated carriers"), such that in a large majority of cases there was only one designated carrier for each country; (b) restrictions on capacity in the form of a limit on flight frequency or on number of seats on the agreed routes and/or a requirement for preapproval of a seasonal flight schedule; and (c) restrictions on the destinations of approved routes.

In response to a request by the EU in 2006 to formulate a uniform global agreement with the EU countries, the government decided to change its policy and initiate a gradual process to open Israel's skies to competition. As a result, an open skies agreement was signed with the EU and additional countries in Europe.[2] The agreement went into effect gradually starting from April 2013, and was fully implemented by March 2018. It included the immediate lifting of restrictions on the number of carriers that could operate regular flights between Israel and the EU countries and restrictions imposed as part of the bilateral agreements between Israel and EU countries. The agreement also allowed any company in the EU to offer regular flights between any point in the EU and Israel, subject to a quota on frequency for each route. This

[1] The authors, Dr. Ran Shahrabani and Dr. Ella Shachar, wish to thank Ms. Yafit Alfendari and Ms. Elena Shamashin at the CBS for the dataset; Nir Goidin, Hadar Zazun Deutsch and Itai Einat for the data processing; and Yossi Yakhin, Itamar Caspi and Yigal Menashe for reading previous drafts of the paper.

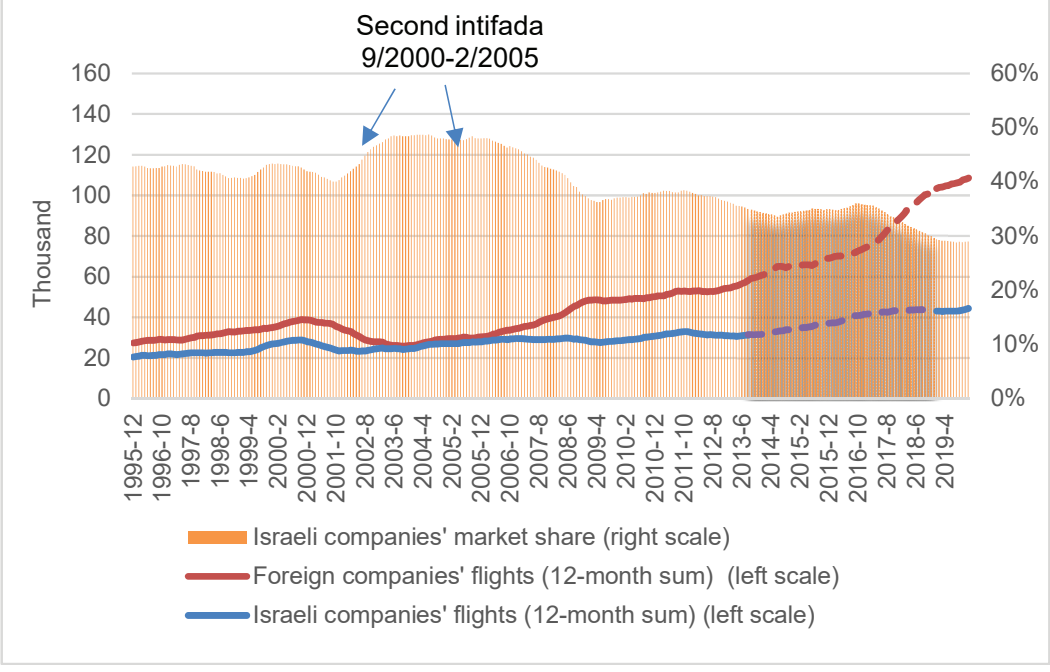
[2] The EU countries, as well as the UK (which was then a member of the EU), Sweden, Norway, Iceland and Lichtenstein. The rest of the European countries are not part of the agreement.

flexibility encouraged the entry of low-cost companies into the market. The agreement was implemented in a four-stage process to increase frequency quotas on each route between 2014 and 2017, and finally, in 2018, the restrictions were lifted entirely.

The new policy reduced regulation and increased the level of competition. It applied primarily to direct flights to Europe and "connection" flights to Europe and from there to more distant destinations. Together with the reform, there was a process of liberalization in bilateral agreements, and agreements were signed with additional countries.[3]

As a result of the reform, the number of flights to and from Israel grew. The number of flights—an indicator that reflects the growth in the supply of flights—shows a gradual increase in line with the stages of the reform (Figure 1). This was true for both Israeli and foreign companies. However, the rate of growth in the number of flights of foreign companies was greater, and as a result the Israeli companies' share of the market declined from 35 percent prior to the reform to somewhat less than 30 percent following it (Figure 1; right scale). The market share of Israeli companies also declined during prior periods of expansion in the supply of flights.[4]

Figure 1: Number of flights*



* A flight is defined as a landing or takeoff. The data series for flights starts from 2011. The previous data series of landings of international flights was concatenated with it.

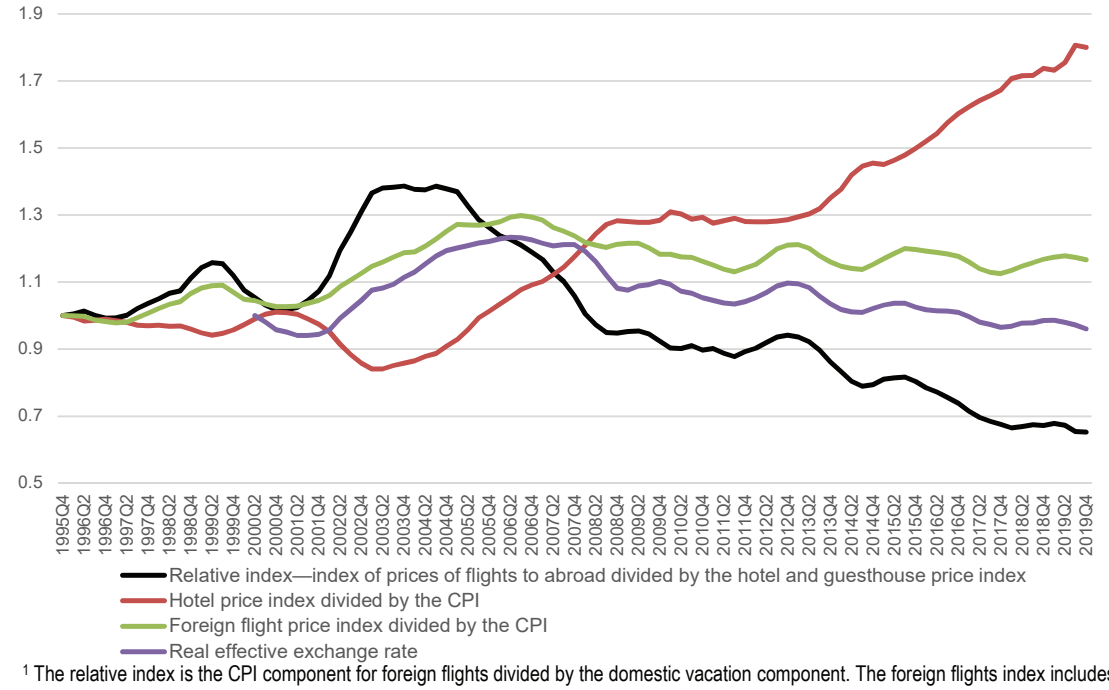
Source: Central Bureau of Statistics.

3 Civil Aviation Authority Report, 2019. [Hebrew]

4 Since the beginning of the 2000s, the market share of Israeli companies contracted during periods of rapid expansion in the supply of flights and grew during periods when it was shrinking. Thus, for example, during the Second Intifada, during which the number of flights flown by Israeli and foreign companies combined contracted, the market share of Israeli companies grew from 42.9 percent in September 2000 to about 48 percent in 2005. However, in contrast, when the number of flights was increasing, starting from 2005, the market share of Israeli companies fell to about 35 percent just prior to the reform.

The rapid increase in the supply of flights to and from Israel that began in 2005 was accompanied by a moderate decline in the prices of flights (as measured by the CPI component that includes the price of accommodation abroad and flights) relative to the overall CPI (Figure 2). This index was on a downward trend starting from 2007, in parallel with the appreciation of the real effective exchange rate. Starting from the end of 2008, its movements were impacted primarily by the exchange rate, without a clear trend. In contrast, an index of the price of a vacation in Israel (which is measured by the price index for hotels and guesthouses), net of the CPI, rose sharply, particularly after mid-2013. Thus, the price of flights to abroad relative to the cost of a vacation in Israel declined during the period of the reform (the relative index, Figure 2).

Figure 2: Index of prices of flights to abroad, index of hotel and guesthouse prices in Israel, and the ratio between them[1,2] (4-quarter moving average)



[1] The relative index is the CPI component for foreign flights divided by the domestic vacation component. The foreign flights index includes three types of expense: a. foreign airline or cruise ticket (its weight in the CPI in 2019 was 19.46 points within 1000), organized tours abroad (7.48 points) and accommodation abroad (21.03 points).

[2] The base for all of the indices is 1. The data on the real effective exchange rate starts from 2000.

Source: Central Bureau of Statistics.

For Israelis, the increase in the relative price of a vacation in Israel made a vacation abroad more attractive. In contrast, for inbound tourists, although airline tickets to and from Israel apparently became less expensive while, however, the price of domestic services in Israel apparently rose (on the assumption that the change in the recreation and excursions component of the CPI is correlated with the development of prices of goods and services consumed by foreign tourists in Israel, such as accommodation, transportation, restaurants, etc., alongside the appreciation).

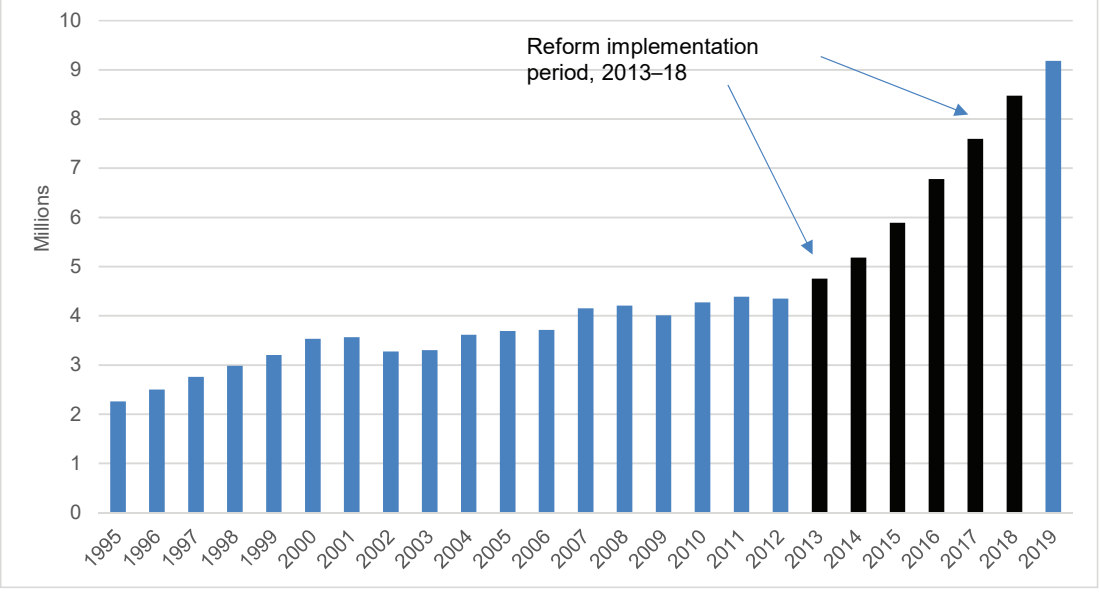
In the next section, we will examine the effect of increased competition in flights as a result of the reform on the consumption of tourist services in Israel by the Israeli consumer, and the level of activity and employment in the tourism industry.

2. The economic effect of the reform

a. The effect of the reform on the Israeli consumer

In view of the relative decline in prices of a vacation abroad and the increased supply of flights, outbound tourism from Israel has increased in recent years, particularly during the Open Skies reform from 2013–18 (Figure 3).

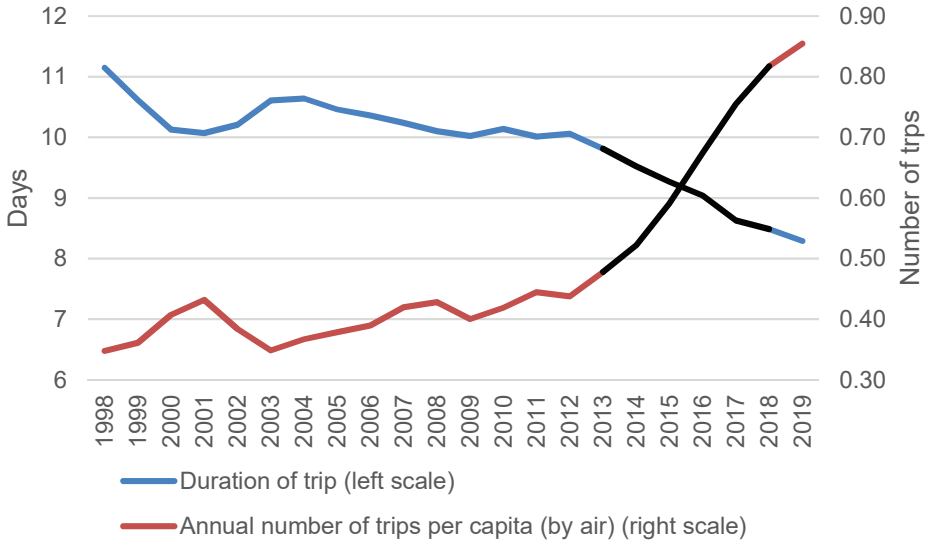
Figure 3: Departures abroad of Israelis, 1995–2019



Source: Central Bureau of Statistics.

A per capita calculation also shows an acceleration in the number of outgoing flights from Israel during the reform, in parallel to a decline in the average duration of a trip abroad, which is an indirect indicator of a decline in the prices of airline tickets (Figure 4). During the period of the reform, the proportion of travelers taking short trips (one to four days duration) increased from 25.2 percent of trips at the end of 2012 to 31.6 percent at the end of 2018; the proportion of intermediate-duration trips (of five to nine days) increased moderately from 40.2 percent to 42.4 percent; while the share of longer-duration trips fell.

Figure 4: Annual number of trips per capita and average duration of a trip [1,2]



[1] Period of the reform, 2013–18 – in black.
[2] Annual number of flights and average duration in days were calculated using the data for air travel of up to 60 days.

Source: Central Bureau of Statistics.

Table 1: The share of monthly expenditure by Israelis on trips abroad and vacations in Israel within total consumption, by income quintile* (percent)

Trips abroad	All of the quintiles	1	2	3	4	5
2012–13	3.6	1.2	1.4	3.0	3.5	6.0
2017–18	5.0	2.0	3.0	4.0	5.7	7.5
Vacations in Israel						
2012–13	1.0	0.5	0.7	1.0	1.1	1.2
2017–18	0.9	0.5	0.8	1.0	1.0	0.9

* The share of expenditure in a specific year was calculated as the total average expenditure on that component in each income quintile divided by the total average household consumption expenditure in the quintile. Each year was given an equal weight.
Source: Central Bureau of Statistics, Household Expenditure Survey for the years 2012, 2013, 2017 and 2018.

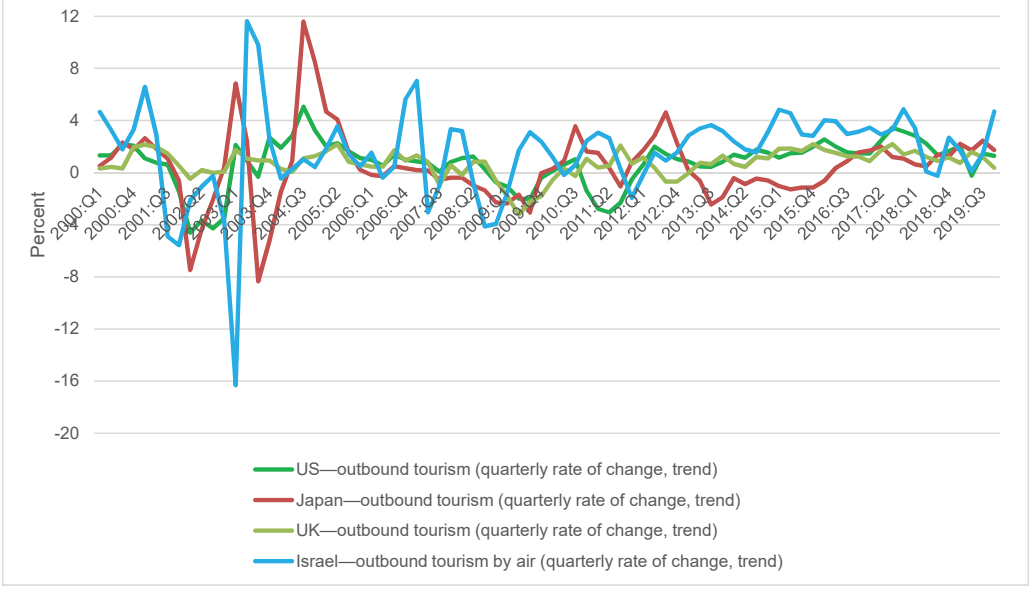
Flights abroad by Israelis increased for all income quintiles, including populations that prior to the reform seldom travelled abroad (Table 1). The table presents the share of expenditure by Israelis on trips abroad and on vacations in Israel within total consumption expenditure during the periods 2012–13 and 2017–18.

Table 2: The annual rate of change in number of outbound tourism before and during the Open Skies reform (percent)		
Countries	**Outbound tourism**	
	Before the reform 2005–12	During the reform 2003–18
Israel	2.4	12.2
EU	1.3	4.3
High income countries	3.0	3.6
OECD countries	1.3	3.2
Upper-middle income countries	3.3	3.3
Source: The World Bank.		

All of the quintiles markedly increased the share of their expenditure on travel abroad. In contrast, the per capita share of the expenditure on vacations in Israel within total income declined somewhat, primarily due to the decline in the top quintile's proportion of expenditure.

Table 2 presents the annual rate of change in outbound tourism from Israel and from various reference groups, such as European countries and the advanced economies. While the rate of increase in trips abroad by Israelis prior to the implementation of the reform was similar to that in the reference groups, during the reform it was higher against all reference groups.[5]

Figure 5: Trips abroad by residents of selected countries, quarterly rate of change* (percent)



* In the US and Israel, trips by air; in the UK and Japan, trips of any kind.

Sources: In the US, the US Department of Commerce, International Trade Administration, National Travel and Tourism Office (NTTO)
In Japan: Japan tourism statistics https://statistics.jnto.go.jp/en/
In the UK: Office for National Statistics https://www.ons.gov.uk

5 Even when the rate of increase in travel abroad is normalized by the rate of population increase, the picture remains virtually unchanged.

A similar picture is obtained from the data for trips abroad by Israelis and by residents of the US, UK, and Japan, which is an additional reference group representing the global trend in air travel by residents of the advanced economies, particularly countries in which travel abroad is primarily by air (Figure 5). It is found that starting from 2013 there is an increase in the rate of change in trips by Israelis relative to the reference groups.

The trends show a decline in global tourism as a result of the terrorist attacks in 2001, the SARS crisis at the beginning of 2003, and the global recession in 2008–09. While the representation of the global trend using a number of large countries may be subject to the internal effects of those countries, the three-country data has advantages over the aggregate World Bank data appearing in Table 2. First, the data are quarterly while the World Bank data are annual. This is an important advantage since a sharp change in trend can occur within the space of a year, as occurred for example with the September 11 and SARS events. Second, the World Bank data on the advanced economies are not complete for the period prior to 2005.

b. The effect of the reform on the tourism industry in Israel

The reform may have had contrasting effects on the tourism industry in Israel, which includes the consumption of tourist services by both foreign and domestic tourists.[6] This may include the following: 1) its contribution to increasing inbound tourism (consumption by inbound tourists totaled about NIS 25 billion in 2018[7]); and 2) the shift of part of the demand by Israelis from expenditure on a vacation in Israel (about NIS 13.5 billion in 2018)[8] to travel abroad, as a result of the increase in the relative price of a vacation in Israel; nonetheless, some of the decline in domestic tourism is offset by an increase in consumption: Outbound Israelis purchase services in Israel prior to their departure and the increase in travel abroad increased this consumption.[9]

Figure 6 presents an international comparison of the rate of increase in the consumption of tourism services. The data show that the rate of increase in Israel was close to the average for the OECD countries.

Similarly, the number of employees in tourism industries also grew at a rate close to the international average (Figure 7), and there was no major acceleration or slowdown in the rate of increase in number of employees during the years of the reform's implementation (Figure 8).

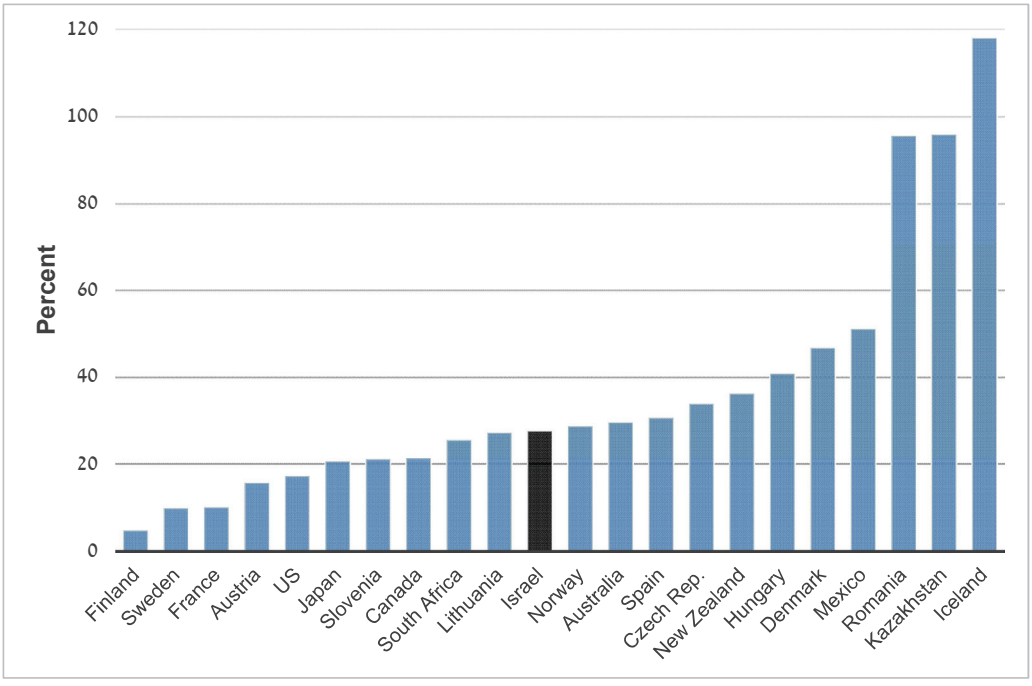
6 Total tourism activity is measured by summing the activity related to tourism within the various branches of the economy (transportation, accommodation, food services, etc.). The effect of the reform on tourism activity can be examined by way of total expenditure on tourism by both foreign and domestic tourists. The consumption by domestic tourists includes the expenditure on both a vacation in Israel and the acquisition of services from an Israeli provider for the purpose of travelling abroad.

7 Tourism 2019, Table 79, Tourism Consumption, according to type (1a) and industry (2), CBS.

8 Data processing by the Central Bureau of Statistics of Table 79 (see footnote 7), which breaks down the consumption of tourism by Israelis in Israel (which totaled about NIS 27 billion in 2018) as follows: a. expenditure on a vacation in Israel (NIS 13.5 billion) and b. The acquisition of travel services from an Israeli provider (NIS 13.5 billion). The processing was carried out for 2017 and was modified by the authors for 2018.

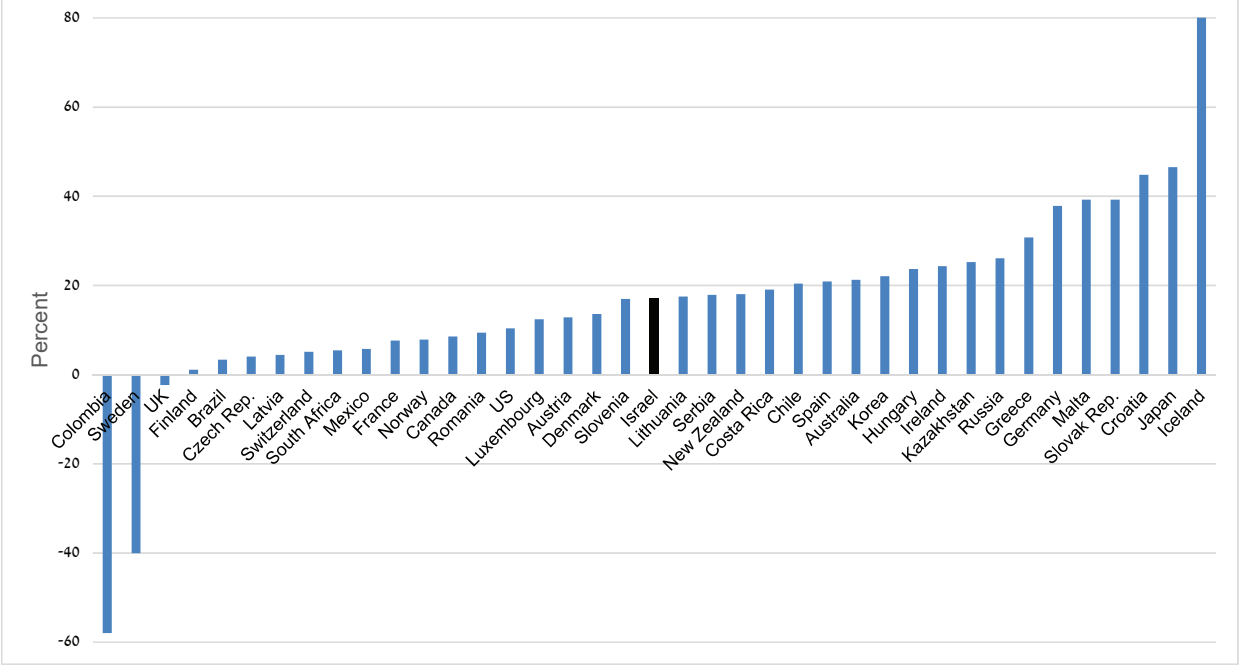
9 See footnote 8.

Figure 6: Rate of increase in tourism consumption, 2012–17*



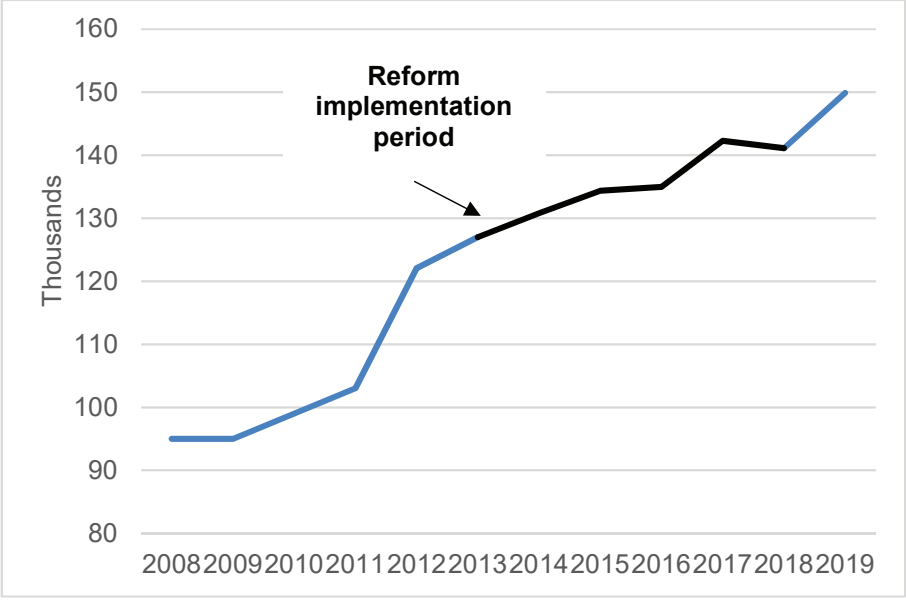
* Consumption of domestic and inbound tourism. The comparison includes all of the countries for which there is data.
Source: OECD tourism statistics.

Figure 7: Rate of change in number of employees in tourism industries, 2012–17*



* The comparison includes all of the countries for which there is data.
Source: OECD tourism statistics.

Figure 8: Employees in tourism industries in Israel*

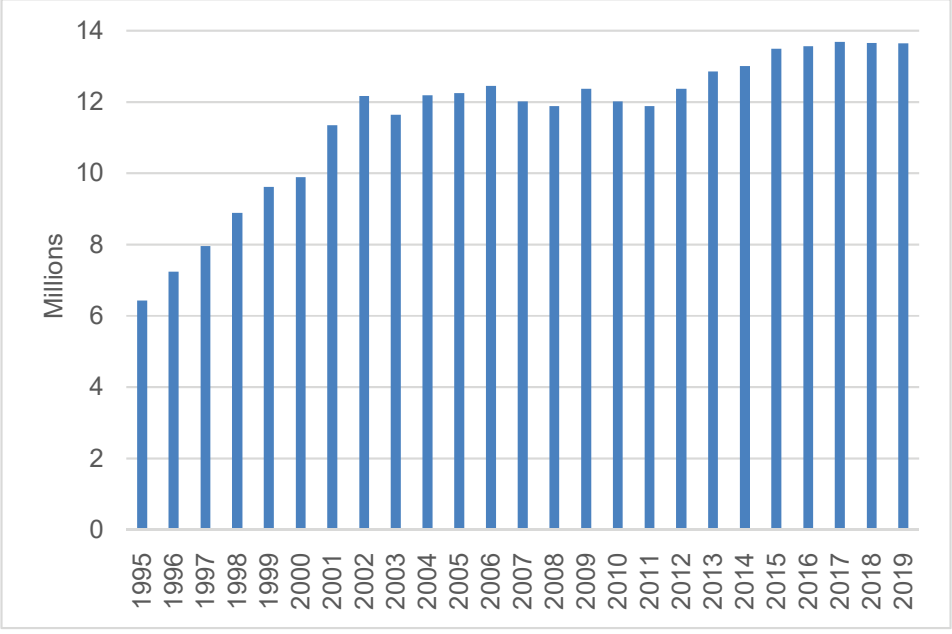


* Employees in tourism industries in terms of fulltime positions. Includes those employed in inbound tourism and domestic tourism for a vacation in Israel and for travel abroad.
In 2019, of 150,000 employees in tourism industries, about 46,500 were employed in accommodation services, 16,000 in food and beverage services, 15,000 in passenger flights and airport and seaport services, about 11,100 in public land transportation services and vehicle leasing, about 20,000 in travel agencies and tour organizers, 16,000 in recreational, holiday and entertainment activities, and the rest—about 25,000—in other tourism-related services.
Source: OECD.

Another measure of activity in the tourism industry is the number of person-nights by Israelis in hotels in Israel, which increased during the initial years of the reform and then stabilized during 2015–19 (Figure 9). The increase in the number of person-nights in hotels during the period of the reform (2012–18) was about 10 percent (in contrast, person-nights by Israelis in guesthouses declined during this period by 20 percent). In contrast, and in view of the change in the price of a vacation in Israel relative to a vacation abroad, the total number of days spent abroad by Israelis during this period increased by almost 80 percent, even though the average duration of each trip abroad declined, as mentioned above.

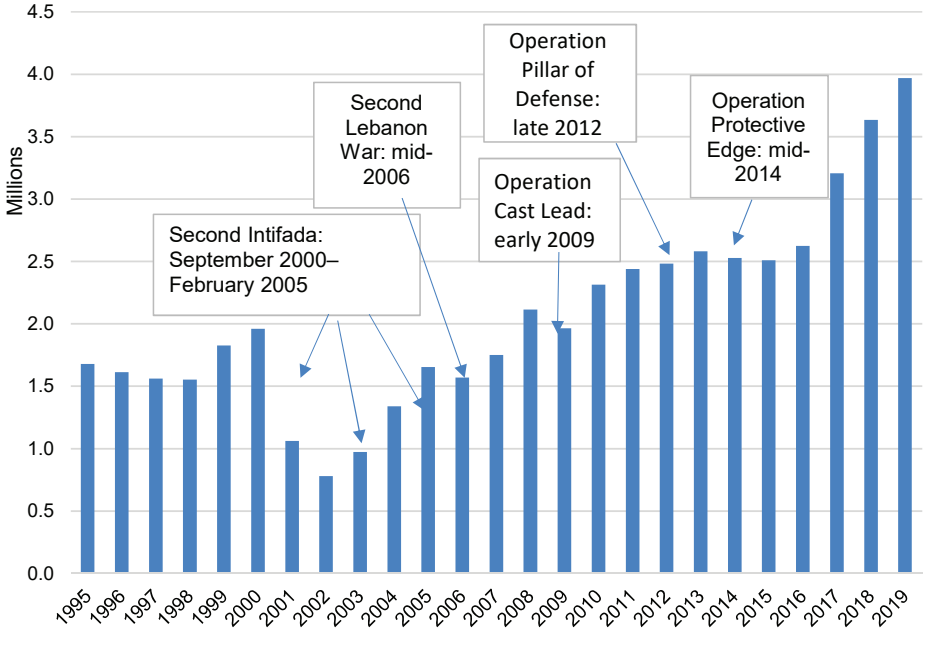
The activity in the tourism industry is correlated with the number of tourist arrivals, which is in turn determined primarily by the security situation in Israel and by economic growth in the countries of origin. In the initial years of the reform (2013–16), the number of tourist arrivals by air remained almost unchanged; however, from 2017 onward it rose significantly (Figure 10). The difference in timing between the increase in inbound tourism and the implementation of the reform raises questions as to the reason for the sharp increase. Thus, the question arises as to whether the increase during the years 2017 to 2019 reflects a surge in international tourism or whether it is a phenomenon unique to Israel as a result of the reform which affected foreign tourists with a lag of three years, or whether it was due to an improvement in the security situation.

Figure 9: Person-nights by Israelis in hotels in Israel (millions)



Source: Central Bureau of Statistics.

Figure 10: Inbound tourism by air



Source: Central Bureau of Statistics.

An international comparison of number of tourist arrivals shows that prior to the reform, the rate of change in number of tourist arrivals was higher than among the reference groups, while during the reform it was similar (Table 3). However, the number of tourists entering Israel is significantly affected by the security situation in Israel, and thus the improvement in the situation on the conclusion of the Second Intifada in 2005 led to an increase in inbound tourism during the period prior to the reform.

The data reveal moderate growth in employment and the level of tourism activity and a moderate increase in overnight stays by Israelis in hotels in Israel in recent years[10], as well as moderate growth in the entry of foreign tourists (an average annual growth rate of 4.4 percent during the period 2013–18; Table 3). It therefore appears that the Open Skies reform did not have a significant impact on inbound tourism. The tourism industries in Israel and in other countries appear to have grown by a similar rate. Thus, when flights abroad became more accessible to Israeli consumers due to the reform, neither the domestic tourism industry nor the Israeli airlines were negatively impacted. In the next section, we will examine the hypotheses by estimating a model for inbound and outbound tourism as a function of the implementation of the Open Skies reform and other factors.

Table 3: Average annual rates of change in number of tourists[a] entering Israel and various groups of countries, prior to the Open Skies reform and during it (percent)

Countries	Inbound tourism	
	Before the reform 2005–12	During the reform 2013–18
Israel	9.1	4.4
EU	1.6	3.7
High-income countries	3.3	3.3
OECD countries	2.5	3.3
Upper middle income countries	2.4	4.2

[a] The data includes travel of all types (primarily air and land). There are only a few countries that reported prior to 2005.
Source: The World Bank.

3. The model, the variables for estimation and the results

a. The model and the variables for estimation

This section empirically examines the two main questions regarding the reform's impact: 1) Did the reform contribute to the increase in outbound Israeli tourism? and 2) Did it contribute to the increase in inbound tourism? The empirical tests were carried out by estimating the demand for tourism. Each of the estimation equations includes the dependent variable on the left side while on the right side are the standard explanatory variables appearing in the literature. The explanatory and dependent variables are expressed as

[10] The growth in overnight stays by Israeli tourists in Israel as part of a short-term lease of an apartment and on the other side the drop in overnight stays by Israelis in guesthouses do not change the overall picture of increased travel abroad by Israelis relative to a vacation in Israel.

rates of change and therefore the model is estimated in logs.[11] The data in the estimation are quarterly; they range from 1999:Q3 until the end of 2019. The relevant variables are seasonally adjusted.

1) Number of Israelis travelling abroad by air (Isr air out tour per cap) is described by the following equation:

$$(1a) \quad log(Isr\ tour\ air\ per\ cap)_t = c + \beta_1 log(gdp\ per\ cap\ fp)_t + \beta_2 log(rer)_t + \beta_3 log(Us\ air\ out\ tour\ per\ cap)_t + \gamma_1 quarter \cdot reform + CRSIS08 + \gamma_2 SARS$$

The dependent variable is the per capita number of trips abroad by Israelis while the explanatory variables are: Israel's GDP per capita in fixed prices (*gdp_per_cap_fp*) and number of trips abroad per capita in the US (*US air out tour per cap*) as an indicator of the trend in global tourism in advanced economies. The model includes the real effective exchange rate (*rer*), where a low exchange rate lowers the cost of a vacation abroad for Israelis. Since the model is in logs, the coefficients β_i have the interpretation of elasticities.[12]

The economic assumption is that during the reform (2013:Q3–2018:Q4), **the quarterly rate of change** in trips abroad by Israelis grew temporarily, it remained high during the period of the reform, and following its full implementation at the end of 2018 it returned to its level prior to the reform (where the number of trips per capita is of course higher than it was prior to the reform).[13] The coefficient for the implementation of the reform (*quarter•reform*)[14] estimates the addition to the rate of change in trips abroad by Israelis beyond the rate of change explained by the basic variables and therefore can be attributed to the effect of the reform.

The regression equation also includes dummy variables for the period of the SARS epidemic and the financial crisis in 2008, on the assumption that the reaction of the Israeli tourist may have been different from that of the global trend, which is represented by the trips abroad by Americans.[15]

[11] The model assumes that the connection between the dependent variable and the explanatory variables is manifested in rates of change. For example, when testing the effect of GDP per capita on trips abroad by Israelis per capita it is assumed that the rate change in GDP per capita in quarter *t* affects the rate of change in trips abroad per capita during that same quarter. The accepted way to test the connection between rates of change is by a log transformation of the original variables. Therefore, we calculated the log of the original variables, both the dependent variables and the explanatory ones. Since in a log transformation, the estimated coefficients (the s) have the interpretation of elasticity, namely the coefficient represents the effect of a 1-percent change in an explanatory variable on the rate of change in the dependent variable.

[12] Pursuant to footnote 11, the estimated coefficient for , for example, answers the question of how much a one-percent increase in GDP per capita affects the rate of change in trips by Israelis abroad by air per capita.

[13] The increase in the rate of change in trips abroad by Israelis can be seen in Figure 5.

[14] This variable is constructed so that its value is zero prior to the reform, i.e., the difference between *t* and *t-1* during these quarters is zero. During the reform, its value increases by a fixed difference of 1 between *t* and *t-1*, (from 1 in the first quarter of the reform (2103:Q3) to 22 in the last quarter of the reform (2018:Q4)). After the reform, it remains at the same level (22). In other words, the difference between *t* and *t-1* returns to being zero. In the estimation where the dependent variable is expressed in logs, i.e. in terms of rates of change, when the difference in the explanatory variables between *t* and *t-1* is zero, it does not contribute to the rate of change in the dependent variable and when the difference is fixed it contributes a fixed contribution in terms of rate of change. For example, if the estimated coefficient of the reform variable is 0.015, then the reform contributes a value of 1*0.015 each quarter, i.e., an additional 1.5 percent is added to the rate of change resulting from the long-term variables (on the assumption that the effect of the lagged dependent variable is negligible).

[15] An alternative variable for capturing the trend abroad was calculated as follows: 70 percent – foreign travel by Americans (in other words, the current variable), 20 percent – foreign travel by British, and 10 percent – foreign travel by Japanese. The results of this regression were very similar.

2) The demand by tourists for flights to Israel (*Tour entry air*) is described by the following equation:[16]

$$(1b)\ log(Tour\ entry\ air)_t = c + \beta_1 log(gdp\ oecd\ fp)_t + \beta_2 log(rer)_t + \beta_3 log(Us\ air\ out\ tour)_t + \gamma_1 quarter \cdot reform + \gamma_2 Lebanon\ war + \gamma_3 log(terror)_t$$

The explanatory variables are GDP of the OECD countries (*gdp_oecd_fp*), the real effective exchange rate (*rer*), the global trend in outbound tourism and the security situation in Israel. The variables that capture the security situation are a dummy for the Second Lebanon War (*Lebanon war*) and the number of Israelis killed in terrorist attacks in the previous four quarters (*terror*).[17]

Estimation method: The estimation approach used here is cointegration. The accepted estimation method for tourism demand in cointegration is the autoregressive distributed lag model (ADLM) which makes it possible to include both short-term and long-term variables.[18,19] In this approach, the explanatory variables, apart from *quarter•reform* and the dummy variables, can be interpreted as long-term elasticities. The long-term specification has economic significance and therefore it provides validity to the estimated effect of the reform (the short-term variable) which is obtained from the estimation of long-term equilibrium. For further details on the estimation method, see Appendix 1.

b. Results

1) Outbound tourism from Israel by air

The estimation results for Israelis' demand for flights to other countries is presented in Appendix 2. The long-term elasticities were calculated on the basis of the estimated coefficients. They are in the conventional range appearing in the literature and are statistically significant (Table 4).

The "reform" variable was found to be statistically significant with a calculated value of 1.9 percent per quarter for each of the 22 quarters of the reform. The total impact of the reform was an increase of 51.2 percent in per capita departures abroad of Israelis beyond the growth explained by the traditional long-term variables.

16 Estimation of tourists' demand for flights in Israel is not in per capita terms.

17 The use of the variable *terror*, which is the number of Israelis killed in terrorist attacks only in the last quarter, produced similar results.

18 According to the survey articles on estimating tourism demand (Song, Haiyan and Gang Li, 2008 and more recently Song Qiu and Park, 2019), ADLM is the accepted method of estimation. It was developed in response to problems that arise when using the traditional methods, including spurious regression in the case of OLS.

19 The first to model tourism demand using the ADLM method was Narayan (2004). He examined the demand for vacations in Fiji.

Table 4: Long-term elasticities of outbound tourism from Israel per capita and the reform variable

Elasticity of outbound tourism from Israel per capita with respect to:	Elasticity
GDP per capita	0.75***
The real exchange rate (depreciation = a rise in the exchange rate)	-0.3***
The global trend in tourism (on the basis of outbound tourism from the US)	0.25*
Quarterly rate of change attributed to the Open Skies reform	0.01896***
* p<0.05 ** p<0.01 *** p<0.001	

2) Tourism to Israel by air

Tourism to Israel was estimated using two long-term models: Model 1, which includes the real effective exchange rate (log(rer)) and Model 2 which does not. The results of the estimation are presented in Appendix 2. The long-term elasticities were calculated on the basis of the estimated coefficients and are within the conventional range of values, although log(rer) is not statistically significant (Table 5).

Table 5: Long-term elasticities for inbound tourism by air and the reform variable

Elasticity of inbound tourism with respect to:	**Elasticity**	
	Model 1	**Model 2**
GDP of the OECD	1.63***	1.46***
Real exchange rate	0.55	
Number of fatalities in terrorist attacks	-0.23***	-0.23***
The global trend in tourism (on the basis of outbound tourism from the US*)	0.50	0.75*
Quarterly rate of change attributed to the Open Skies reform	0.002929	-0.004126
* The use of an alternative variable, i.e., outbound tourism from the US, UK, and Japan, did not significantly change the elasticities.		

The elasticity with respect to the real exchange rate is not statistically significant although it is in the right direction—a decline in price increases inbound tourism. The elasticity with respect to the number of fatalities in terrorist attacks is, as expected, negative (-0.23). This variable has a large effect since doubling the number of Israeli fatalities during the last four quarters reduces the number of tourists arriving in Israel by air by 23 percent. Similar results were obtained in the model without log(rer). The reform variable is not statistically significant in either specification, i.e., with or without log(rer). In other words, there is no empirical evidence that the reform had an effect on inbound tourism. There could be several reasons for this result: First, it may that the effect of shocks to Israel's security situation is dominant and demand is less sensitive to the other variables. This dominance can also explain why there was no long-term connection found between inbound tourism and the real effective exchange rate, a conventional price variable in the literature on tourism demand.

4. Conclusion

In response to a request from the EU in 2006 to formulate a uniform global aviation agreement with the EU countries, the government of Israel decided to initiate a process of gradual liberalization in order to open Israel's skies to competition. The Open Skies reform, which began to be implemented in 2013, increased competition in flights to and from Israel by removing restrictions on the companies operating flights from the EU countries to Israel. As a result, the supply of flights to Israel increased significantly. As a result of the reform, there was an exceptionally large increase in the number of trips abroad by Israelis per capita in comparison to other countries. The econometric analysis shows that as a result of the reform, the number of Israelis travelling abroad per capita grew by about 50 percent beyond that explained by the influence of fundamental factors such as GDP per capita, the effective real exchange rate and the global trend. The growth in the number of Israeli tourists travelling abroad encompassed all of the income quintiles.

Alongside the increase in outbound tourism, it appears that the reform did not adversely impact the activity of the local tourism industry. Despite the massive entry of international airline companies into the Israeli market, the number of flights and passengers of Israeli companies continued to rise, even though at a slower rate than in the case of the foreign airline companies. Total inbound tourism has risen significantly in recent years, but the estimation results indicate that the reform did not have a statistically significant effect on the number of tourist arrivals to Israel and that the rapid increase in inbound tourism can be attributed to other factors, such as growth in the GDP of the OECD countries and the improvement in Israel's security situation. Overall, the increased level of competition in the airline industry, including its effect on increasing outbound tourism from Israel, did not harm the activity of the tourism industry. Thus, activity and employment in the tourism industry during the period of the reform grew at a rate similar to the average of the OECD countries. At the same time, the prices of a vacation in Israel rose much more than the CPI.

APPENDIX 1

The estimation was carried out on levels and includes a cointegration estimation. In the cointegration approach, there are groups of nonstationary variables with joint random trends (a long-term relationship). The standard approach to cointegration in estimating tourism demand—in the case of both outbound tourism (Equation 1a) and inbound tourism (Equation 1b)—is the autoregressive distributed lag model (ADLM). The assumption in ADLM estimation is that there is a single long-term equation (Nkoro & Uko, 2016). This is similar to the approach of Engle & Granger (1987).[20] The ADLM is a dynamic model and therefore it can be interpreted as an error correction model.[21] In order to estimate cointegration using the ADLM method, the variables must be on the I(1) or I(0) integration level—not I(2).[22] The bound test is then used to determine if there is a single long-term connection between the variables. If we fail to show a single long-term connection, then the estimation result will be almost meaningless and therefore we must

[20] If there is more than one cointegration equation, then the Johansen Cointegration Test should be used.

[21] To complete the cointegration description, when there is a deviation from long-term equilibrium, some of the variables will react. A system that internalizes long-term error correction by means of short-term adjustments is called a vector error correction model.

[22] In contrast, the condition for cointegration in the Engle & Granger (1987) approach is that the variables must be on the same level of integration, i.e., I(1).

consider only the short term. In other words, we must estimate a differences equation.

In order to capture the short- and long-term dynamics in the demand function of Israelis for foreign travel, we write Equation (1a) in the following form:

$$\text{(2a) } \Delta log(Isr\ tour\ air\ per\ cap)_t = c + \sum_{j=1}^{p} \alpha_j\, \Delta log(Isr\ tour\ air\ per\ cap)_{t-j} +$$
$$\sum_{j=0}^{p} \delta_j\, \Delta log(gdp\ per\ cap\ fp)_{t-j} + \sum_{j=0}^{p} \theta_j\, \Delta log(rer)_{t-j} +$$
$$\beta_0 log(Isr\ tour\ air\ per\ cap)_{t-1} + \beta_1 log(gdp\ per\ cap\ fp)_{t-1} + \beta_2 log(rer)_{t-1} +$$
$$\beta_3 log(us\ air\ out\ tour\ per\ cap)_t + \gamma_1 quarter \cdot reform + \gamma_2 SARS + \varepsilon_t$$

where p is the optimal number of lags, as determined by the Akaike Information Criterion (AIC). The maximum lag that we allowed for the dependent variable was 4 quarters and for the explanatory variables it was two quarters. However, we did not allow for any lag in the variable $log(us\ air\ out\ tour\ per\ cap)_t$ since it captures the global trend.

The Pesaran, Shin and Smith (2001) bound test is used to check whether a long-term relationship exists. The null hypothesis of the bound test is that there is no long-term relationship, i.e., $\sum_{i=0}^{n} \beta_i = 0$.

Another indication in a bound test for a long-term relationship is obtained from the t-test of the lagged dependent variable.

In a similar manner, Equation can be written in a way that reflects the short- and long-term dynamics of the demand function of tourists for travelling to Israel.

APPENDIX 2

Results

Before we examine the integrative long-term relationship, we carry out a unit root test. The Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test found, as expected, that there are no variables on integration level I(2). See Appendix Table 2.1

Table 2.1 Unit Root Tests

	ADF Statistic*		P-P Statistic	
	Level	First difference	Level	First difference
log(Isr tour air per cap)	0.077	-11.434**	0.884	-12.116**
log(Tour air entry)	0.637	-9.125**	0.677	-9.126**
log(gdp per capita fp)	-0.871	-10.726**	-0.788	-10.827**
log(rer)	-0.726	-7.454**	-1.002	-7.459**
log(Us air out tour)	1.473	-4.028**	1.707	-10.922**
log(Us air out tour per cap)	1.101	-4.133**	1.233	-11.082**
log(terror)	-0.921	-7.686**	-1.089	-7.766**

* In the ADF test, the optimal number of lags is determined by the AIC.

a. Outbound tourism from Israel by air, per capita

In the model of outbound tourism from Israel by air per capita (Equation 2a), the ADLM bound test found that the F-statistic and the t-statistic are significant, such that the variables converge in the long term (Table 2.2). With respect to the diagnostic tests: the LM test shows that there may be a problem of serial correlation. The RESET test indicates a problem of specification while the white test does not indicate heteroscedasticity. The Jarque-Bera test may point to a non-normal distribution of the deviations; however, that may be because the sample is too small.

Table 2.2: The log of outbound Israeli tourism by air per capita (ADLM) 1999:Q3–2019:Q4

Variable	*Coefficient*	*t-Statistic*
$log(Isr\ tour\ air\ per\ cap)_{t-1}$	-0.01226	-0.09281
$log(gdp\ per\ cap\ fp)_t$	0.987216	1.439401
$log(gdp\ per\ cap\ fp)_{t-1}$	-2.33724**	-2.72887
$log(gdp\ per\ cap\ fp)_{t-2}$	2.112504***	4.654658
$log(rer)_t$	-0.57655**	-3.30002
$log(rer)_{t-1}$	0.2725	1.532642
$log(Us\ air\ out\ tour\ per\ cap)_t$	0.256205**	2.703044
$quarter \cdot reform$	0.019194***	4.899191
$SARS$	-0.17363***	-6.95257
$CRSIS08$	-0.09566***	-5.11531
C	-4.21909***	-8.23472
Bound Test		
$F-Statistic$	35.689***	
$t-Statitic$	11.916***	
R^2	0.986	
$\bar{R}^2$	0.984	
AIC	-3.893	
SBC	-3.893	
$D.W.$	1.549	
$F-Statistic$	489.939	
Diagnostic tests		
$JB-stat$	1.122	
$LM-test$	3.118+	
White test	0.331	
RESET	10.901***	

+ p<0.10 * p<0.05 ** p<0.01 *** p<0.001

The white test was carried without cross terms for the heteroscedasticity test.

RESET: Ramsey Regression Equation Specification Error Test with one augmentation term.

c. Inbound tourism to Israel by air

Two long-term models were estimated for inbound tourism to Israel: Model (1) which includes the effective real exchange rate (log(rer)) and Model (2) which does not.

Table 2.3: Log of inbound tourism by air (ADLM) 1999:Q3–2019:Q4

	Model 1		Model 2	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
$\log(\text{Tour entry air})_{t-1}$	0.241193*	2.364095	0.266366*	2.564576
$\log(\text{Tour entry air})_{t-2}$	0.061393	0.602461	0.084157	1.039219
$\log(\text{Tour entry air})_{t-3}$	0.092465	1.130821		
$\log(\text{gdp oecd fp})_t$	0.985125***	3.867975	0.949914***	4.126784
$\log(\text{terror})_t$	-0.2158***	-6.81622	-0.22807***	-7.18254
$\log(\text{terror})_{t-1}$	0.079134*	2.165665	0.081875*	2.307296
$\log(\text{rer})_t$	-0.41707	-0.96576		
$\log(\text{rer})_{t-1}$	0.747652^{+}	1.69345		
$\log(\text{Us air out tour})_t$	0.300751	1.206722	0.484886*	2.380387
LEBANONN WAR	-0.41452***	-6.36245	-0.38283***	-5.83718
quarter · reform	0.001772	0.302165	-0.00268	-0.6977
CRSIS08	0.135178*	2.494101	0.125677*	2.286959
SARS	-0.139^{+}	-1.99115	-0.13913*	-2.00399
SEP 11	-0.09969	-1.50155	-0.12193^{+}	-1.80758
C	-6.87479*	-2.00887	-7.83024*	-2.59005
Bound Test				
$F-$ Statistic	11.649***		13.702***	
$t-$ Statitic	-6.353***		-7.129***	
R^2	0.974		0.970	
$\overline{R}^2$	0.968		0.965	
AIC	-2.050		-2.016	
SBC	-1.600		-1.658	
D.W	1.528		1.503	
$F-$ Statistic	169.219		200.837	
Diagnostic tests				
JB −stat	0.411		0.443	
LM−stat	3.218*		6.236**	
White test	1.066		1.3016	
RESET	5.572*		7.643**	

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