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Skills forecasting model

Methodology and results

Israel, December 2020

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Education 2030

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Executive summary

This report presents the occupational employment forecast for Israel in the period of 2020-2030 based on data from up to 2019. This forecast was based on demographic, industry employment, multisector macro-economic and aggregate economy models, in accordance with state-of-the-art methodologies.

The forecasts include labour force, production and output, employment by sector, by broad occupational groups and an analysis of employment forecast for three specific occupational groups. The sectors considered were agriculture, industry, electricity & water, construction, transportation & logistics, information & communication, financial services, local administration & government, education, healthcare, and arts & entertainment. The broad occupational groups considered were elementary occupations, plant and machine operators, tradesmen in manufacturing and construction, skilled agricultural, forestry and fishery, service and sales workers, clerks, technicians associate professionals, professionals, and managers. The three specific occupational groups analysed were: computer and engineering occupations, healthcare-related occupations, and office and administrative support occupations.

From the labour availability perspective, the forecast concludes an increase in working age population of almost 1.5 million people, but a reduction in participation rate from 63.5 per cent to 62.8 per cent. At the same time, GDP per employee is expected to increase at an annual rate of 1.5 per cent. Production growth is expected to be lower than the last decades, with an average of 3 per cent per annum. Information and communications is the sector with the highest expected production growth, of about 5 per cent per annum. Moreover, employment growth is expected to be higher in healthcare (3.7 per cent per annum) and arts & entertainment (4.8 per cent per annum).

By occupational group, service and sales workers, technicians associate professionals and professionals have the higher expansion needs. Particularly, for the group of computer and engineering occupations, software developers and applications programmers have the highest expected expansions. For healthcare, specialist medical practitioners and nursing professionals are expected to need more skilled people. Finally, for office and administrative support occupations, most of them are expected to have less people, such as administrative and executive secretaries and bank tellers and related clerks.

Employment projections were developed based on historical data and do not consider the effects of the COVID-19 pandemic. Because of that, the recommendations of this report include updating the forecasts considering the data from 2020 and 2021.

1. Introduction

1.1 Background

Demand for labour has been changing rapidly in recent years. Significant technological changes, globalization and aging populations are reshaping labour markets.

- Discussing the future of labour markets entails studying some of its determinants:
- The impact of new technologies (robots, autonomous cars, increasing automation in all areas of life).
- On the one hand, increasing worldwide economic integration (through international trade).
- On the other hand, the effects of increasing illiberalism, nationalism and authoritarianism, as well as populism.
- Impact of demographic changes (such as rapid population aging).

However, discussing the future of the labour market in Israel also requires considering the country's unique social and economic structure, characterized by the following elements:

- Israel has a high fertility rate and an unusually high rate of population growth.
- Israel is a society of immigrants, absorbing continuous waves of immigrations.
- Israel has a leading high-technology sector.
- High economic inequality.

To address these challenges, EU-funded YEM project has initiated the development of a labour market forecasting model to support the development of national capacities in undertaking labour market analysis.[1] The model is a quantitative tool for analysing the world of future professions and predicting the development of supply and demand for professions. The formulation of the model was led by an international expert team, who set a uniform methodology as a basis for developing the model in different countries.

The quantification of the expected patterns in the world of professions and skills will serve as a tool for planning education policy and professional training, will improve individual decision-making on investment in human capital and foster discussions relating to the younger generation's working world such as hours and conditions of work, possibilities for flexible work and more.

The model was built and compiled in December 2019 with the support of the Ministry of Labor and Social Services and the JDC-TEVET organization. It was presented to the Ministry of Social Affairs and Social Services ("National Partner") in December 2019. Following meetings with and a visit by Mr. Hiromichi Katayama (the coordinator of the YEM project for Israel), it was decided to:

- Extend the estimation period from 2016 to 2019.
- Revise the list of occupations by adding occupations from the four-digit classification and aggregate some of the existing occupations. The list of occupations was revised for two main reasons: (i) in order to provide policy makers with data on occupations of interest, (ii) in order to meet minimum sample-data requirements for each occupation.

1 The model was developed within the framework of the employment component under the Networks of Mediterranean Youth (NET-MED Youth) project. The project has been funded by the European Union.

1.2 International experience

The case for systematic assessment of future skills needs is now well established in many countries. The U.S. Bureau of Labour Statistics[2] was a pioneer in this area, and its work has since been emulated in many other parts of the world. In the European context, the case for regular quantitative anticipatory exercises in the area of the labour market and skills is set out in the European Comission's conclusions on "Anticipating and matching labour market needs,"[3] and has since been implemented by The European Centre for the Development of Vocational Training (Cedefop). It is now well accepted that comprehensive assessments of future skills requirements can make a key contribution to the identification of labour market trends and skills shortages, thus helping to better match labour market needs and skills supply.

1.3 Contents of the document

The following work was developed in accordance with the methodologies used in the field of skills forecasting. The model has been applied to data for Israel subject to the limitations of data availability, especially on sectors and on occupational employment structure.

The following document includes:

- A description of the model and its method (methodologies).
- Main results.

2 For examples for the U.S employment projections, see Appendix B.

3 See the references at to the European Commission's Staff Working Document at http://ec.europa.eu/social/main.jsp?langId=en&catId=89&newsId=431&furtherNews=yes

2. Methodologies

2.1 The model systems

The occupational forecasting model is based on a range of economic models, at the centre of which are the macro-economic model and the demographic model. Occupational employment projections are developed using a series of five interrelated steps, each based on a different procedure or model and different assumptions: population and labour force forecast, aggregate economy forecast, final demand by consuming sector and product, industry employment, and job openings by occupation.

The models system

Demographic model

Population and labour force: totals and by age, sex and population group.

Source CBS

Aggregate economy model

GDP total, TFP, capital stock, human capital projections

The multisector macro-economic model

Major demand categories. Sales to consumers, businesses, government and foreigners

Industry employment model

Labour productivity, number of employees

Occupational forecasting model

Job openings due to growth and replacement

2.2 The demographic model

Labour force projections are based on expectations of the future size and composition of the population, as well as on trends in labour force participation rates of different age, gender and population groups. Population forecasts are prepared by the Central Bureau of Statistics.[4] The projected participation rate for each age, gender and population group is multiplied by the corresponding projection of the population to obtain the labour force projection for that group. The labour force outlook plays a critical role in assessing long run macro-economic trends and is therefore among the most important exogenous data within the macro-economic projections.

2.3 The multisector macro-economic model (MSSM)

The multisector macro-economic model of the Israeli economy is a detailed sectorial model that calculates the expected composition of demand and supply in each industry. The model provides forecasts for the medium and long term and represents a major tool for forecasting sectorial development.

At the centre of the model is the demand for goods and services. This depends on consumer and government demand as well as external demand (export demand). A key component is a Leontief input–output table, which takes into account interlinkages between sectors. The input–output element drives demand for goods and services from producers, along with gross fixed capital formation.

4 Central Bureau of Statistics (2015), Population Projections 2015–2050.

Together, these then determine output of goods and services, which in turn drives employment and income. The latter is one of the main drivers of consumer expenditure. The current version of the model includes 13 sectors.

2.4 The employment by industry model

The next step is to forecast the industry employment necessary to produce the projected output. To do so, the projected output is divided by the output per employee (labour productivity) to estimate the number of employees by industry. Implied output per employee is calculated for each industry using the Autoregressive Integrated Moving Average Model (ARIMA) process.[5]

2.5 The occupational forecasting model

Occupations' demand forecasts are obtained through a model known as the Manpower Requirements Approach[6] (MRA). This approach is used by researchers and governmental institutions around the world.[7] According to the manpower approach, demand for occupations comes from two main components:

- Demand due to economic expansion (expansion demand): This is the number of job openings resulting from growth in the various industries or growth in occupations within those industries.
- Demand due to replacement (replacement demand): This is the number of openings created by people leaving the labour market on a temporary basis (such as maternity leave or sickness) and those retiring, dying or emigrating

According to this approach, the demand for new occupations is made up of the expansion demand (net expansion) and the replacement demand.

Occupations were disaggregated based on the International Standard Classification of Occupations (ISCO) using the four-digit classification: 138 occupations were chosen to be included in the model according to the following criteria:

- A minimum sample data limitation, requiring that for each occupation–industry profile contains enough data (employees).
- An occupation that is of interest to policymakers.

Expansion demand: Annual projected employment data is developed using a conceptual framework which divides industry employment between occupations based on expected structural changes in the demand for those occupations within a given industry. It thus makes it possible to derive the number of workers required in each occupation (occupation–industry matrix) in the forecast period. The forecasted share of each occupation in each industry is obtained through logistic function estimation of data based on a yearly occupation–industry matrix of the years 2012–19.[8] The logistic function estimates the pace of penetration in terms of each occupation's share in different industries.

To project these changes in occupational demand, we also review qualitative sources such as scholarly articles, expert interviews and news stories, as well as quantitative resources such as historical data and externally produced projections. These reviews identify structural changes in the economy that are expected to change an occupation's share in industry employment.

Replacement demand: In order to estimate replacement demand (demand for workers resulting from turnover of workers), we calculate the age structure in each occupation and then apply two coefficients: mortality and retirement. We roll each age cohort over the projection time span according to the retirement and mortality coefficient to get the number of workers who leave each occupation each year. We ignore workers who leave an occupation to enter a different occupation, due to data limitations. We also ignore immigration and emigration as well as cross-border mobility of workers for the same reason.

5 ARIMA are used to time series data to identify patterns and forecast future points.
6 The main steps of this approach were first presented by Youdi (1985).
7 For example: *Economics of Education, Research and Studies*, 1987 pp. 331–335. "Manpower Forecasting and Modelling Replacement Demand: an overview, Research Centre for Education and the Labour Market Maastricht."
8 We project the demand for in based on the development of the employment mix of occupation j in industry i over time. We then multiply the occupation share in each industry by the employment in each industry to get the number of employees in each occupation (j) in each industry (X).

The mortality and retirement coefficients are calculated as follows:

- Mortality rates for each age group are calculated from CBS tables (annual bulletin).
- **Retirement:** To estimate the number of workers who leave the labour force permanently, historical exits are estimated using data from the monthly Labour Force Survey (LFS). Monthly LFS data include respondents who are in the sample for 16 consecutive months, on an in-for-four, out-for-eight, in-for-four month pattern.

3. Main results

Effects of the COVID-19 pandemic on the 2020–2030 projections

The 2020–30 projections do not include impacts of the coronavirus disease (COVID-19) pandemic and response efforts. Employment projections were developed by using models based on historical data, which, in this set of projections, cover the period through 2019; therefore, all input data precedes the pandemic.

The model's employment and occupational projections are long-term projections intended to capture structural change in the economy, not cyclical fluctuations. As such, they are not intended to capture the impact of the recession that began in February 2020. We present employment data for 2019 as our base year and for 2030 as the mid-term forecast horizon. We assume that by 2030 unemployment will decrease again to 4.5 per cent (see macro forecast). However, besides the immediate recessionary impacts, the pandemic may cause new structural changes. These changes will be addressed in a special report.

3.1 Demography and labour force

The growth rate of the Israeli population[9] is expected to remain high in the next decade, at 1.8 per cent per year, and population aging will continue. According to the Central Bureau of Statistics forecast, the 65+ age group is expected to grow by 2.8 per cent per year, while the 25–64 age group is expected to grow by only 1.5 per cent. As a result, the share of the population aged 65+ is expected to rise to 13 per cent in 2030, compared to 11 per cent in 2015. The aging of the population presents significant challenges for the Israeli labour market and has fiscal implications for the intergenerational pension and financial burden.

Due to high fertility rates of the Ultra-Orthodox population and, to a lesser degree, of the Arab population, the share of these two groups is expected to rise.

The table below presents the expected demographic changes up to 2030.

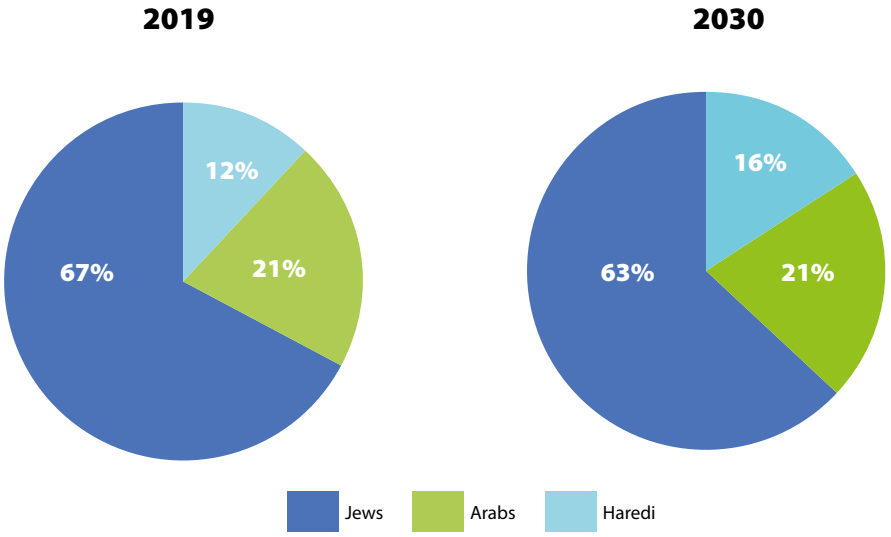
Table 1. Population forecast

	2019		2030		2020-2030	
Total	**Thousands**	**% of total**	**Thousands**	**% of total**	**Percentage change**	**Addition Thousands**
	9 054	100%	11 048	100%	1.8%	1 994
Age 0–14	2 574	28%	3 115	28%	1.7%	541
Ages 15-24	1 364	15%	1 704	15%	2.0%	340
Ages 25-64	4 036	45%	4 763	43%	1.5%	727
Ages 65 and over	1 080	12%	1 466	13%	2.8%	386

Source: CBS, Projections of Israel's Population to 2065.

9 Population forecasts are based on CBS projections. Labour force participation rates and forecasts are based on our calculations.

The chart below presents the expected demographic changes up to 2030.



Labour force forecast

The aging of the population alongside the rise in the share of Ultra-Orthodox and Arab populations, both characterized by low labour force participation rates, are expected to moderate the growth rates of the major working age population and cause the overall participation rate to decline. The results obtained under this scenario show the overall participation rate declining to 62.8 per cent by 2030, compared with 63.5 per cent in 2019. Therefore, the growth rate of the labour force is expected to stand at only 1.8 per cent. This phenomenon is in sharp contrast to the previous decade, during which the participation rate increased from 59 per cent to 64 per cent and presents a major challenge for labour market policy makers.

Table 2. Demographic forecast

	2019	2030	2020-2030	
	Thousands	Thousands	Annual percent change	Addition thousands
Population	9 054	11 048	1.8%	1 994
Working age population	6 494	7 952	1.9%	1 458
Labour force, thousands	4 124	4 994	1.8%	870
Participation rate, per cent	63.5%	62.8%	-0.1%	-0.7%
Employment, thousands	2 529	3 289	2.4%	760
Employment ratio*	43.8%	43.2%	-0.1%	-0.6%
Unemployment rate	3.8%	4.5%	1.5%	0.7%

* Employment–population ratio, measures the civilian labour force currently employed against the total population

Source: Macro-economic forecasts

3.2 Production and output

The macro forecast is based on the aggregate economy model presented in chapter 1. According to the forecast, the GDP average growth rate in the period from 2020 to 2030 is expected to be 3.2 per cent per year — 3.4 per cent in business-sector production and 2.1 per cent in public sector production, respectively. On the supply side, the increase in GDP is attributed to an increase of 2.4 per cent per annum in effective employment (taking into consideration the continued growth in human capital) and the continued increase in capital input, of 2.8 per cent per annum. Total factor productivity is expected to grow by 0.9 per cent, in line with the previous decade. In terms of GDP per employee, this will increase by 1.5 per cent annually, while capital per employee will grow by 0.8 per cent over the same timeframe. The increased labour productivity stems from this growth in capital per worker and the rise in total factor productivity.

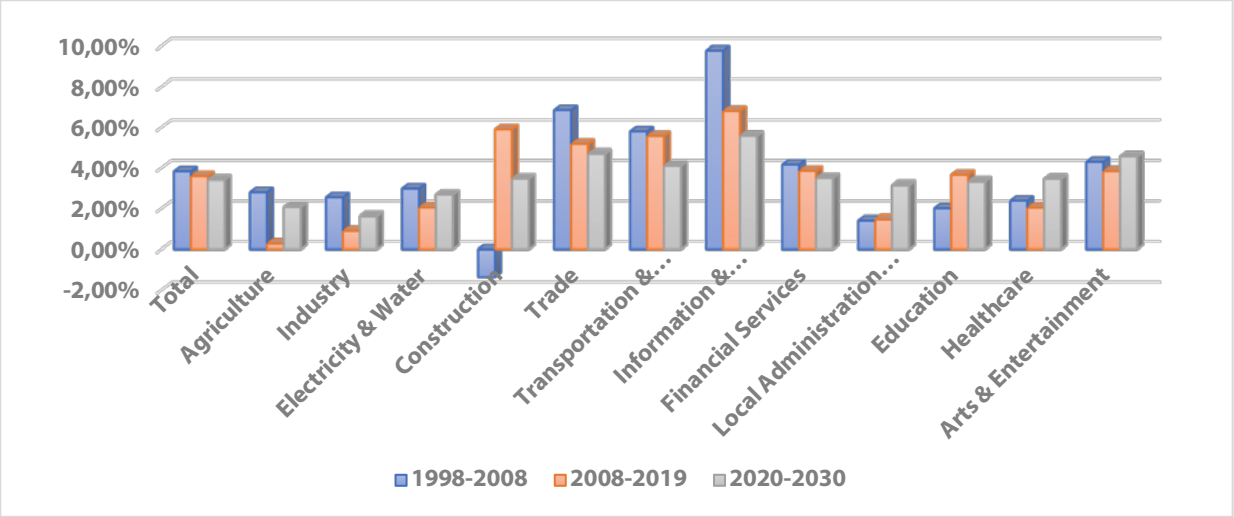
Table 3. Macro forecast – main results

	2019 Thousands	2030 Thousands	Annual per cent change 2020–2030
Population, thousands	9 054	11 041	1.8%
GDP, millions NIS	1 344	1 929	3.3%
GDP per capita, thousands NIS	148	175	1.5%
Employee, thousands	3 967	4 957	2.0%
GDP per employee	339	389	1.3%

Source: Macro-economic forecasts

On the supply side, most sectors are expected to see a slowdown in growth, remaining below the historical rates witnessed over 1998–2019. The information and communication sector, which saw the strongest growth in production (6.8 per cent per annum) over 1998–2019, is expected to experience slower growth over the forecast period, while remaining Israel economic growth engine. Regarding the financial services industry, which also grew strongly over 1998–2019 (3.9 per cent per annum), growth is expected to slightly slow down over the whole forecast period (3.5 per cent per annum). Growth of the distribution and transport sector is expected to remain robust, at 4.1 per cent per annum over 2020–2030, as new technologies improve logistics and transportation systems. The construction industry is expected to grow over the forecast period due to lack of housing units. Israel's manufacturing sector is expected to grow by 2 per cent each year, benefiting from strong demand for electronic components, electronic boards, communication equipment, machinery and defence equipment, chemicals and pharmaceuticals, while on the other hand suffering from global competition. The healthcare sector is expected to grow by 3.5 per cent annually (compared to 2.1 per cent over the past decade). Factors expected to contribute to this significant increase include greater demand to care for the aging population, longer life expectancies, and continued growth in the number of patients with chronic conditions. The arts, entertainment and recreation industry, expected to grow by 4.6 epr cent per annum (compared to 3.8 per cent over the past decade), is one of the three fastest growing sectors in the economy.

Figure 1. Production growth by broad sector of economic activity, 1998–2030 – average rate of change by industry

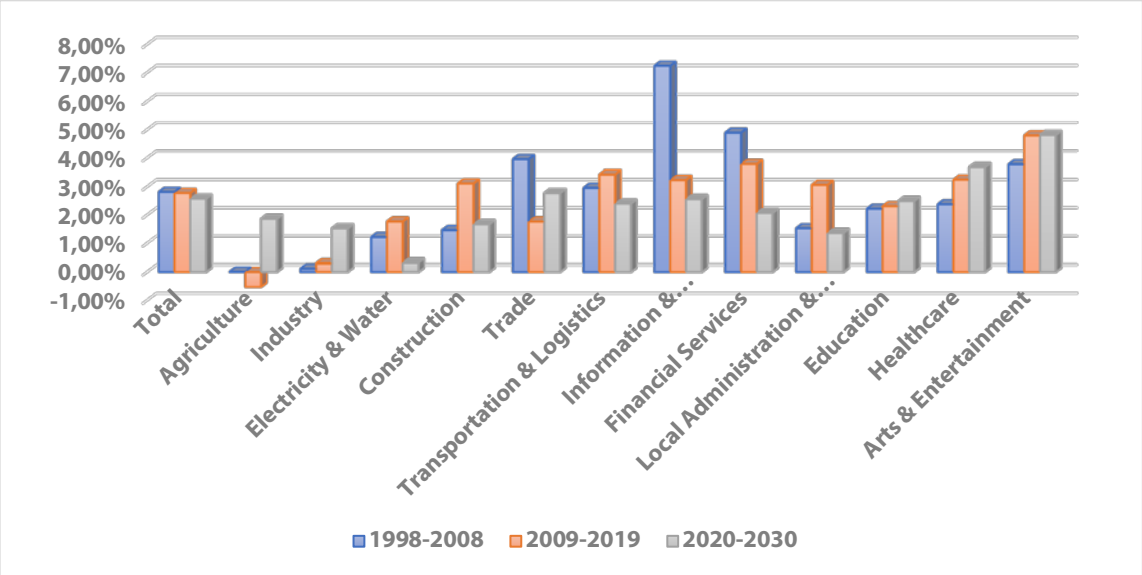


3.3 Employment by sector

To estimate the number of employees working in each industry, we divide the projected output of each sector by the projected output per employee (labour productivity).

Figure 2 compares annual employment growth by sector for three periods of time between 1998 and 2030. In most sectors, except for health services and agriculture, employment is expected to grow at lower rates than between 2009 and 2019. Employment in the health sector, in art and entertainment and in information and communication is expected to see the strongest growth in the longer run (2019–2030), growing at 3.7, 4.8 and 3.0 per cent per annum. respectively. The electricity and water sector is alone in being expected to remain stable in the period 2019 to 2030 after having increased by 1.8 per cent per annum over 2009 to 2019. However, it is worth noting that employment growth in construction is expected to slow down, from 3.1 per cent per annum over 2009–2018 to 1.4 per cent per annum over 2020–2030. According to the forecast, most employment growth will occur in the service industries (health, education, art and entertainment, which enjoy highly elastic income demand). Because of their large share in employment today, they are expected to generate most of the new employment. The information and communication (high tech) sector is expected to create a mere 68,000 jobs, despite its high growth rate of 3.0 per cent per annum, higher than that of other industries. This low number is easily explained by its current low share of the sector in total employment. Employment in the financial sector is predicted to grow by 2 per cent annually, while employment in the agricultural sector is expected to decline.

Figure 2. Employment growth by broad sector of economic activity, 1998–2030 – average rate of change by industry



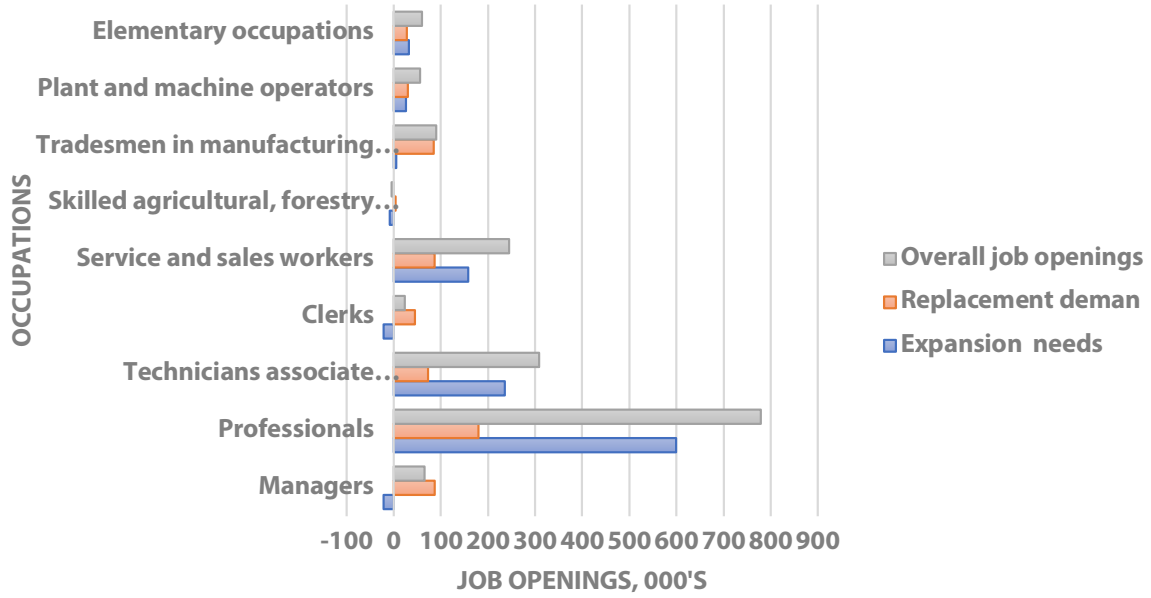
3.4 Employment by broad occupational group

The occupational forecast estimates the total job openings by occupational group as the sum of net employment change and replacement needs. Net employment change refers to new jobs created due to the expansion of employment in a given sector or occupation. Replacement needs arise as workers leave an occupation due to retirement.[10] Replacement needs, generally speaking, provide more job opportunities than new jobs, meaning that significant job opportunities arise even in occupations declining in size (i.e., agricultural workers are a typical example, as aging workers employed in the sector will need to be replaced). In Israel, expansion needs will provide 1,005,000 jobs, 61 per cent of total openings, whereas replacement needs will provide only 650,000. This is due to Israel's high labour force growth rate (2 per cent) compared to less than 1 per cent in other developed countries, as well as the younger age structure of the Israeli labour force compared to other developed countries.

Figure 3 shows total job openings by broad occupational group over 2020–2030. All occupational groups except skilled agricultural work are expected to recruit driven by high expansion needs. The highest number of overall job openings is expected for professionals (779,100) through job creation (599,300) and replacement demand (179,800). A high number of job openings is also expected for practical engineers, technicians, agents and associate professionals (308,000) and for service and sales workers (245,000). Net employment change is expected to be lower for clerks, tradesmen in manufacturing and construction and workers in elementary occupations. Net employment change is expected to be negative for skilled agricultural and fishery workers, meaning a contraction of employment in these occupations.

10 Replacement due to career changes has not been estimated due to limited data.

Figure 3. Job openings by broad occupational group, 2019–2030 – average rate of change by occupation



3.5 Occupational employment by three major groups

In this section we analyse the occupational forecasting according to three main groups: computer and engineering occupations, healthcare-related occupations and office and administrative support occupations. This disaggregation is based on the U.S major occupational groups (SOC) and differ from the ISCO-08 classification we used in the previous section.

Occupational groups in which employment is projected to grow markedly faster than the average include computer and engineering occupations, healthcare support occupations and community and social service occupations.

Computer occupations are projected to grow fast, with strong demand being expected for IT security and software development and as new products associated with the Internet of Things (IoT) are developed. These occupations include software developers as well as information security analysts. Considering the digitization and automation trend, we expect high growth in software developers and applications programmers.

Table 4. Net job openings in computer and engineering occupations

	Employment, thousands		Net job openings thousands		
	2019	2030	Expansion	Replacement	Total
Software developers	60.05	101.38	41.33	4.73	46.06
Applications programmers	46.88	79.64	32.76	3.38	36.14
Mechanical engineers	18.02	41.89	23.87	4.48	28.35
Electronics engineers	18.95	39.12	20.17	3.06	23.23
Electrical engineers, telecommunications engineers	12.52	21.97	9.45	2.46	11.91
Systems analysts	19.06	27.71	8.65	2.81	11.46

Population aging, along with technological changes, will drive the projected employment growth for healthcare and healthcare-related occupations. As a result of this growing demand for healthcare, we expect high demand for specialist medical practitioners, nursing professionals and other related health professionals

Table 5. Net job openings in healthcare-related occupations

	Employment, thousands		Net job openings thousands		
	2019	2030	Expansion	Replacement	Total
Specialist medical practitioners	51.42	100.15	48.73	9.34	58.07
Nursing professionals	92.68	118.08	25.40	32.69	58.09
Additional related health professionals *	14.25	32.26	18.01	3.03	21.04
medical imaging and therapeutic equipment technicians	24.06	35.70	11.64	9.22	20.86
Dental assistants and therapists, Medical records and health information technicians,	37.22	44.49	7.27	6.41	13.68
Medical secretaries	20.54	22.24	1.70	4.02	5.72

** Dentists, Pharmacists, Physiotherapists, Dieticians and nutritionists, Occupational therapists*

Technological changes facilitating automation and e-commerce are expected to result in declining employment for office and administrative support occupations, shop sales assistants, other service and sales workers and sales occupations.

Table 6. Net job openings in office and administrative support occupations

	Employment, thousands		Net job openings,thousands		
	2019	2030	Expansion	Replacement	Total
Administrative and executive secretaries	13.64	7.15	-6.49	2.17	-4.32
Bank tellers and related clerks	14.04	9.02	-5.02	3.54	-1.48
Others clerks occupations*	35.29	31.20	-4.09	3.91	-0.18
Commercial sales representatives	31.26	27.22	-4.04	5.30	1.26
Customs and border inspectors, government tax and excise officials	14.42	11.46	-2.96	2.66	-0.30
Credit and loans officers	10.44	8.81	-1.63	1.32	-0.31

**Contact centre information clerks, Hotel receptionists, Enquiry clerks, Receptionists (general), Survey and market research interviewers, Client information workers n.e.c.*

4. Demand for skills

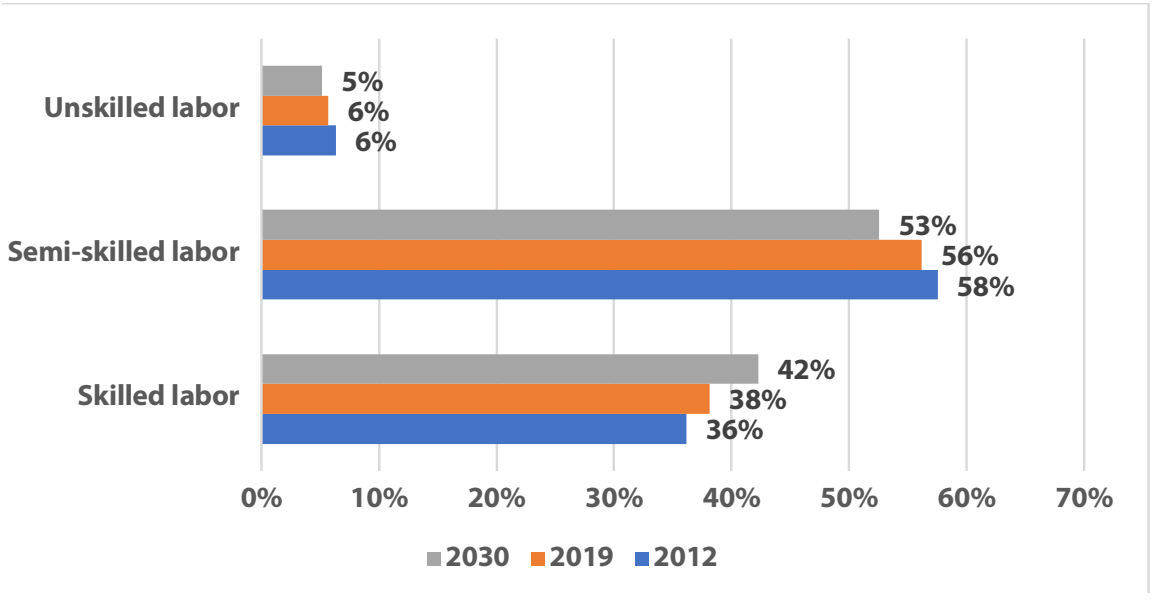
Within the skills forecast, skills are classified by the highest level of qualification held by individuals in employment: high level, medium level, and low level, which correspond to the official ISCED classification.[11] The occupational group also offers an indication of the skill level required, as some occupations (e.g., professionals) typically require high-level skills, while some others (e.g. elementary) typically require only basic ones. Thus, occupational groups are also linked to a skill level.

Skill levels (ISCED)	ISCO-08 major labour groups
1. Skilled labour	Managers
	Professionals
	Technicians and associated professors
2. Semi-skilled labour	Clerical support workers
	Service and sales workers
	Craft and related trades workers
	Skilled agricultural
	Plant and machinery operators
3. Unskilled labour	Elementary occupations

Source: ILO, 2012

Figure 4 shows that 42 per cent of the total job openings that are expected to be created in Israel over 2019-2030 will require high qualifications (skilled labour). Around 53 per cent of total job openings are expected to require medium qualifications (semi-skilled), while 5 per cent are expected to require low qualifications (unskilled).

Figure 4. Shares of total job openings by level of qualification



11 International Standard Classification of Occupations, International Labour Organization, Geneva.

Appendix A: The multisector macro-economic model

The multisector macro-economic model of the Israeli economy is a detailed sectorial model that addresses questions related to the expected composition of demand and the source of supply: import or local production. The model provides forecasts for the medium term and the long term (30 years) and operates as a major tool for forecasting sectorial development. The model was developed based on 13 industries and it was built and maintained in R and Stata.

At the centre of the model is the demand for goods and services. This depends on consumer and government demand as well as external demand (export demand). A key component is a Leontief input-output table, which takes into account interlinkages between sectors. The input–output element drives demand for goods and services from producers, along with gross fixed capital formation. Together these then determine output of goods and services which in turn drives employment and income. The latter is one of the main drivers of consumer expenditure.

Figure 5. A multisectorial macro-economic model

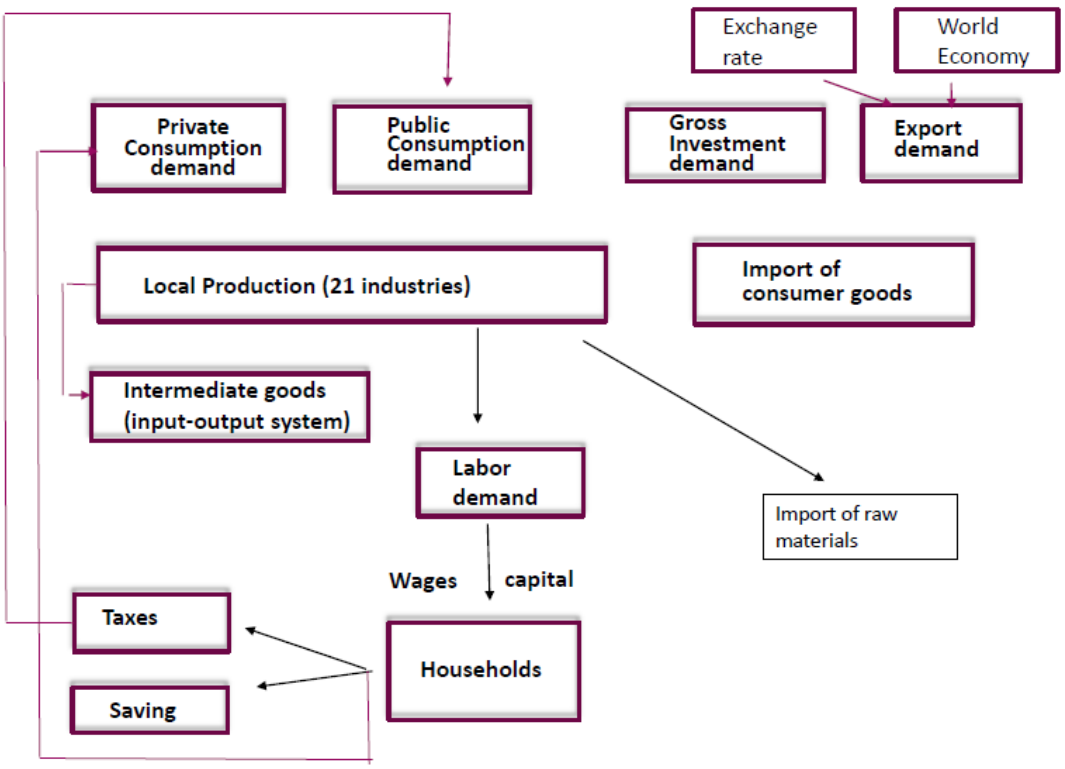


Figure 5 emphasizes the various links between the various economic agents. The various indicators are linked by technical accounting, and behavioral relationships, as indicated by the arrows. Each of the economic agents is disaggregated into many categories (industries, product groups, etc.). The boxes include exogenous variables, such as what is happening outside the area concerned (levels of world economic activity, real exchange rate, consumption demand elasticities, demography, government policies, tax rate, etc.).

Model calibration

To calibrate the model to Israel's base year, we constructed a social accounting matrix (SAM) for the year 2018. The SAM documents the financial transactions between agents in the economy with rows reporting for income (receipts) and columns expenditures (payments). This is a "double entry" system, and therefore total revenues (the sum of each row) equal total expenses (the sum of each column). The SAM is used to describe the flows between the different industries in the economy and final demand levels.

In order to separate the aggregates (production, import, export, consumption, etc.) into product groups and industries (which we will need for the occupation models), we obtained from the Central Bureau of Statistics disaggregation data for 205 industries and developed a SAM based on national accounts data from 2018. The input-output coefficients within the SAM (which describe the share of intermediate inputs in production) are based on the latest available IO data from 2006.

Our main SAM therefore has:

- 13 industries ("industries").
- 13 product groups ("products").
- 2 factors agents: labour and capital.
- Households: provide the factors, pay income tax, save and account for private consumption.
- Tax: collects taxes (direct and indirect).
- Government agent, which collects the tax and accounts for public consumption.
- Investment agent, which purchases investment products based on the savings of both households and government.
- External Trade: export and import of products.

All values are in 2018 NIS prices.

Model setup

The demand for each product *i* is defined by:

$$D_i = C_i + G_i + I_i + Ex_i + \sum_{j=1}^{21} N_{i,j}$$

Where

C_i is the demand for private consumption of product *i*

G_i is the demand for public consumption of product *i*

I_i is the demand for investment products of product *i*

EX_i is the demand of the international market of product *i* (export)

$N_{i,j}$ is the demand for product *i* as an intermediate product (raw materials) by industry *j*

Households and government

Households obtain revenue from wages and capital return (interest on loans, dividend) paid by firms. National income, , is the sum of payments made by industries to the factors of production (labour and capital).

F_j: $Y = \sum_{j=1}^{21} F_j$

The national income is used by households for tax payments (*HT)*, savings (*HS)*, and consumption of goods and services:

$$C = \sum_{i=1}^{21} C_i$$

Expenditure elasticity was estimated for each product and, based on net income growth and income elasticity, a forecast for the 13 groups of consumer products was made.

Household identity must hold $Y=HT+HS+C$

The savings rate is exogenous and assumed to be constant in time.

Expenditure elasticities are presented in Table 1 in the Annex 2.

Public sector

Government expenditure (G_i) is exogenous and is assumed to grow by 2.7%, which is the limit set by the expenditure ceiling law. The budget deficit is assumed to slightly decline to 1% of GDP, according to the declining budget deficit path established in law. Tax rates are calculated to be consistent with assumed budget deficits according to the government's expenditure path.

The public sector equation is defined by:

$$\sum_{i=1}^{21} G_i + GS = HT + IT + CT$$

Where *GS* is the government's gross savings (outlays). HT+IT+CT are the taxes which set the public sector income.

Supply

The supply S_i for each product *i* is defined by:

$$S_i = P_i + Im_i + CT_i$$

Where P_i is local production of product *i, Im* is import of product *i* and CT_i is sales taxes on product i (VAT, duties).

The local production function of each industry is determined by total factor productivity, employment and net capital stock. In equilibrium, each industry satisfies income-expenditure identity, where $S_i=D_i$ (supply equals demand) in money terms.

Total factor productivity is exogenous. Table 2 in Appendix B presents total factor productivity coefficients by industries (based on historical performance). Total potential employment in the economy is determined by the demographic model. The natural rate of unemployment is assumed constant for the entire forecast horizon.

In equilibrium, total supply from local production and import in the economy must equal total demand. If total demand exceeds total supply, import grows to equilibrate the product markets.

In equilibrium, all markets are cleared and constraints on the balance of payments and the budget deficit must be satisfied

The investment-savings equation is:

$$\sum_{i=1}^{21} I_i = \left(\sum_{i=1}^{21} Ex_i - \sum_{i=1}^{21} Im_i \right) + GS + HS$$

Where investment is equal to net export (current account surplus), government savings and private savings. The current account surplus is assumed to decline to zero (in 2017, the current account surplus reached 3.8% of GDP).

The solution

Let's define the matrix *A*, so that $A_{i,j} = \frac{N_{i,j}}{P_i}$

The final products $Q_i = C_i + G_i + I_i + Ex_i$

In matrix algebra we can write that:

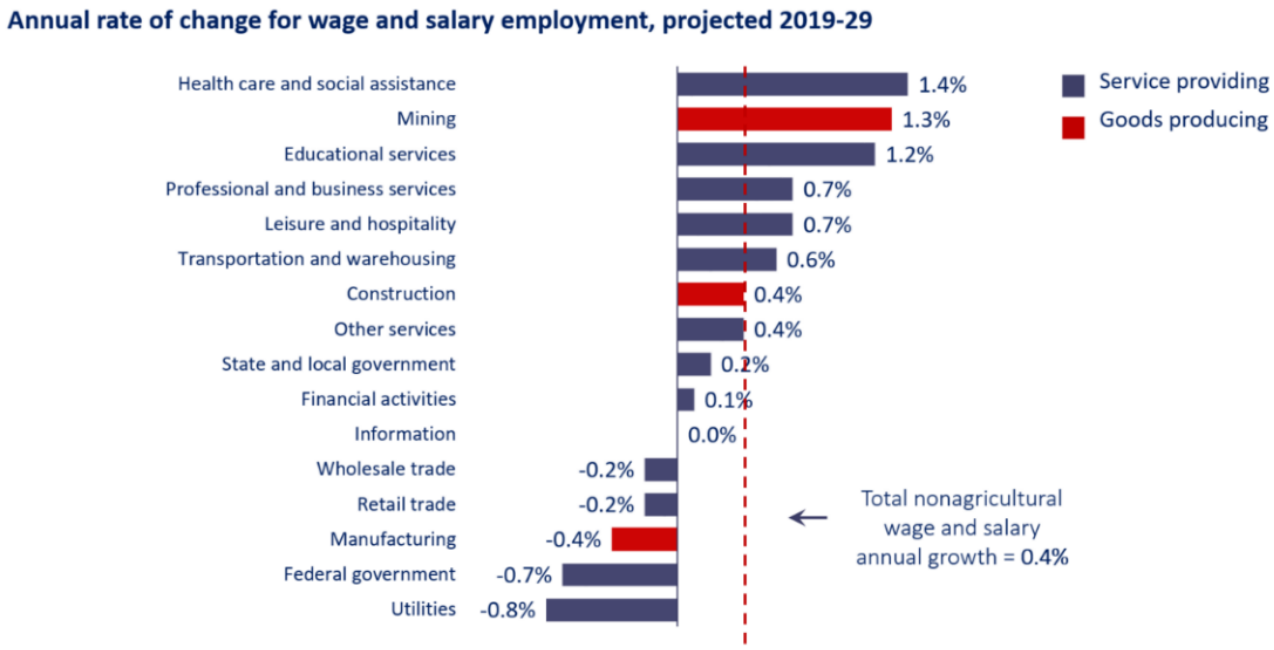
$$\underset{21\times21}{A} \cdot \underset{21\times1}{P} + \underset{21\times1}{Q} = \underset{21\times21}{\beta} \cdot \underset{21\times1}{P}$$

The production vector is $P = (\beta - A)^{-1} Q$

Using the above identities, all the values in the SAM are solved.

Appendix B: Employment projections, U.S. Bureau of labour statistics

Projected annual rate of change in industry employment, 2019-2029



Six of the 10 fastest growing occupations are related to healthcare

	Percent change, projected 2019-29	Employment change, projected 2019-29 (in thousands)	Median annual wages, May 2019
Wind turbine service technicians	60.7%	4.3	$52,910
Nurse practitioners	52.4%	110.7	$109,820
Solar photovoltaic installers	50.5%	6.1	$44,890
Occupational therapy assistants	34.6%	16.3	$61,510
Statisticians	34.6%	14.8	$91,160
Home health and personal care aides	33.7%	1,159.5	$25,280
Physical therapist assistants	32.6%	32.2	$58,790
Medical and health services managers	31.5%	133.2	$100,980
Physician assistants	31.3%	39.3	$112,260
Information security analysts	31.2%	40.9	$99,730

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