Chapter 7: Balance of Payments Issue: Export Growth in the High-Tech Industries

- The accelerated growth in global demand for information technology services, in which Israel specializes, has contributed greatly to the growth of Israel's exports.
- The flourishing high-tech services industries have contributed to increases in the current account surplus, the real wage (in import terms), and GDP.
- The high-tech services industries employ an especially large number of workers with academic professions in the engineering and science fields.
- The R&D centers of multinational companies, which have been the growth drivers of R&D activity in Israel in recent years, have especially high levels of salaries and productivity.
- Israel's comparative advantage in high-tech services relies on a high percentage of college-educated employees, in international comparison, particularly in the engineering and natural sciences fields. However, there is a growing shortage of graduates in these fields of study, which restricts the potential growth of the economy.
- The high-tech services industries are concentrated in the central region and employ a small percentage of Arabs, older workers, and women.
- In contrast with the structural change in the 1990s, which was accompanied by a marked increase in wage differences by educational level (the return to schooling), the current structural change has not been accompanied by an increase in the return to schooling.
- The comparative advantage of the economy is based on human capital and education. This imposes a great responsibility on the government to improve the public education system, to promote students' achievements at all education levels, and to train academics in the engineering and science fields in order to realize the growth potential of the high-tech industries.
- The structural change involves a reduction in investment in physical capital in industries of the economy: the capital share of GDP is 20 percent of the product of the high-tech services industries in comparison with 40 percent of the product of the industrial sectors.

1. INTRODUCTION

The accelerated expansion in global demand for high-tech services has contributed to the growth of Israel's exports.

The importance to Israel's economy of services exports has increased since the beginning of the decade[1]; after two decades in which its share in overall exports remained virtually unchanged, it increased from 31 percent in 2011 to 42 percent in 2016. The growth in Israel's services exports was driven by growth in the export of business services in the information technology industries (ICT):[2] From 2011 to 2016, the share of these exports increased by ten percentage points to 29 percent of total exports (and 69 percent of total services exports). During the same period, international trade in services increased in the world as a whole, but the increase in Israel was of far greater significance. Thus, for example, services exports as a share of total exports of the OECD countries increased from 2011 to 2016 by only four percentage points (to 27 percent in 2016), and ICT services exports as a percentage of total exports increased by only 1.4 percentage points (to 8 percent in 2016).

Table 7.1
Share of total services exports and of services exports by information and communication technology (ICT) industries in total exports, Israel and OECD countries, 1995 and 2006–16

		1995	2006	2010	2012	2014	2016
Total services exports	Israel	29	30	31	34	36	42
	OECD countries above median[a]	21	24	25	25	27	29
	Leaders in ICT exports[b]	-	34	36	38	41	41
ICT services exports[c]	Israel	10	17	17	21	23	29
	OECD countries above median[a]	4	6	8	8	9	8
	Leaders in ICT exports[b]	-	12	15	16	18	18[d]

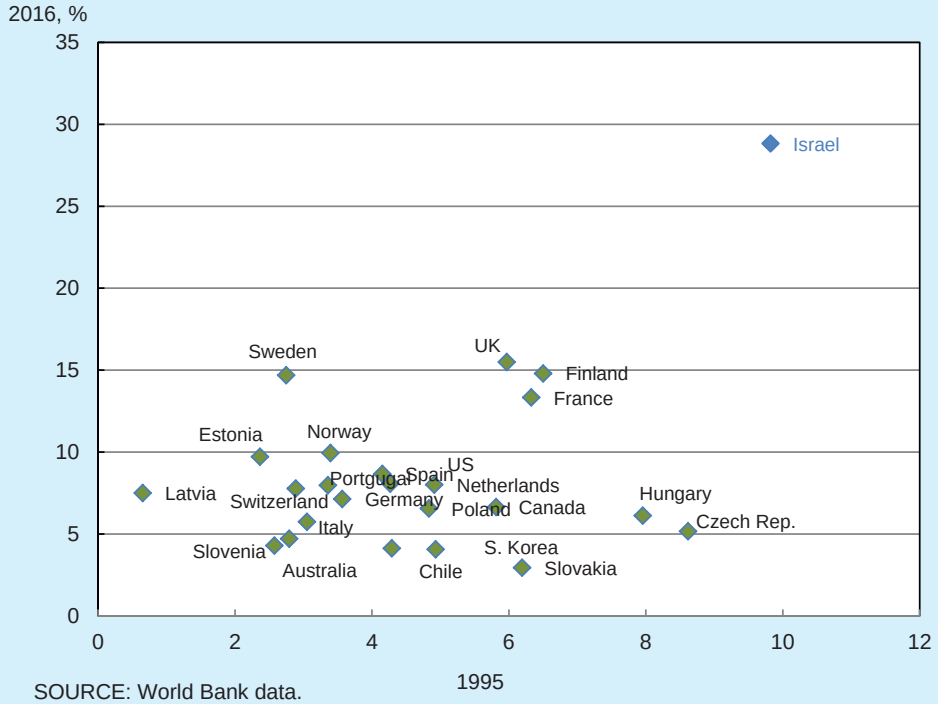
[a] OECD countries with a GDP per capita greater than the median of OECD countries.
[b] Leaders in ICT exports: Ireland, Sweden, and the UK - the leaders among OECD countries in ICT services exports (alongside Israel and Luxembourg).
[c] ICT - Information and Communication Technology industries.
[d] Data refers to 2015.
SOURCE: World Bank data.

[1] Services exports include the export of tourism and transportation services; insurance services and government services (whose weight in Israel's exports is negligible); and the export of business services, 60 percent of which are derived from the computer software sectors (the ICT sector) and research and development.
[2] The Information and Communications Technology (ICT) industries include service industries (the computer software sector, computer and other ancillary services consulting, the telecommunications industry, and three subsectors of software publication, data processing, and computer repair), the manufacturing industry (computer manufacture, consumer electronics products, and magnetic and optical media), and wholesale trade sectors in computers, communications equipment, and electronic components.

Israel's share of global trade in high-tech services is much larger than its share of global trade in goods.

The information technology services sector has been growing rapidly in the last few years and is contributing to the growth of the global economy overall, but the sector's contribution to the Israeli economy is particularly great. This contribution can be seen from World Bank data on the development of international trade in two main services—income from charges for the use of intangible assets (intellectual property)[3] and telecommunication, computerization, and information services. World trade in these two areas increased at a rapid pace (7.1 percent and 8.3 percent per year, respectively,) in the last decade, as did Israeli exports in the same areas. But whereas Israel's share of global income from charges on intangible assets from abroad (0.3 percent) is similar to Israel's share of world trade in goods, the share of Israeli exports in world trade in telecommunications, computerization, and information is about 10 times (3 percent) its share in world trade in goods. Consequently, the rapid increase in income from charges for the use of intangible assets contributed to an increase in Israel's GDP similar to its contribution to the growth in GDP of other countries in the world, whereas the increase in telecommunications, computerization, and information

Figure 7.1
Share of High-Tech Industries' Exports in Total Exports, 1995 and 2016



SOURCE: World Bank data.

[3] Charges for the use of intellectual property.

exports made an excess contribution to the growth in Israel's exports[4] of about $11 billion, which is 3.5% of GDP.[5]

The share of domestic value added in each export dollar of the Israeli high-tech sectors is 90 percent.

Exports of the two main technology service industries in the economy—computer software and scientific research and development—doubled from 2011–2017 (from $9 billion to $19 billion, excluding one-off transactions from sales of startups).[6] According to estimates of the World Trade Organization and the OECD for 2011, the percentage of Israeli added value in each export dollar of these industries is 90 percent. This indicates that the value added of the exports of both industries combined is currently 5 percent of the total value added in the economy (2016, excluding one-off export transactions), compared with only 3 percent in 2011. The value added of both these service industries in 2016 was one quarter of the total value added of exports, compared with only an eighth in 2011.

Table 7.2
Israel's exports and world trade in selected high technology services, 2006 and 2015

	Telecommunications, Computer, and Information Services		Charges for the use of intellectual property	
	2006	2015	2006	2015
Index of world trade	100	205	100	186
Index of Israel's exports	100	256	100	185
Share of Israel's exports in world trade, percent	2.7	3.2	0.3	0.3
Share of total exports from Israel[a], percent	9.4	15.9	1.0	1.2

[a] Excluding diamonds and exports to the Palestinian Authority.
SOURCE: World Bank data.

China is currently the leader in high-tech goods production.

Goods exports of Israeli high-tech industries slowed in parallel with the accelerated growth of high-tech services exports. The main factors for this are the slowdown of world trade in the high-tech goods industries and a decline in the share of advanced economies in it: in 1999–2006, world trade in these industries grew at a rapid annual rate of 7 percent, which has since slowed. From 2011 to 2014 it grew at an annual rate

[4] From 2006–16, Israel's revenue from the export of intellectual property increased by $0.7 billion, while its revenue from computerization, information, and communications services exports increased by $12 billion.
[5] According to World Bank data, Israel was the seventh largest exporter in 2016 of computerization, information, and communications services ($17.7 billion) behind India, which is the largest exporter in the sector, Ireland, the US, Germany, the UK, and China (which has increased its exports of computerization services fourfold in the last decade). All the 15 largest exporters in the sector, apart from India and China, are advanced economies, and majority of them—France, Sweden, Switzerland, the Netherlands, Belgium, Italy, Canada, and Singapore—have GDP per capita greater than Israel.
[6] High-tech services as defined by the Central Bureau of Statistics include the following sectors: computer programming and consultancy (62), R&D centers (720), engineering and natural sciences R&D (721), data processing, storage and ancillary services (631), and telecommunications services (61). Although the telecommunications services sector is included in high-tech services and in the science technology sector, it lacks the characteristics of the high-tech and innovation sectors, and so it is not included in this discussion with the high-tech industries.

of only 3.5 percent, and in 2015 it declined by 8 percent. Moreover, while the share of the advanced economies, particularly the US, in this trade fell steeply, China's share increased steeply. China is currently the dominant country in the high-tech goods manufacturing sector, while the United States' lead in the technology sector as expressed in the manufacturing of high-tech services (principally charges for the use of intellectual property).[7]

Pharmaceuticals exports, accounting for a third of the total exports of the high-tech industry, are expected to decrease in 2018.

Goods exports of the Israeli high-tech sector increased in 1999–2015 faster than those of countries with a high per capita GDP,[8] and similar to world trade in those industries. But pharmaceuticals company Teva's patent for the multiple sclerosis drug (Copaxone) that provided a large part of Israel's income from drug exports lapsed in 2017, and competition in the generic drugs sector increased in Teva's main export markets. Against this background, a serious crisis developed in the company, which is expected to lead to the dismissal of 1,700 employees and a considerable drop in pharmaceuticals exports, which constitute 36 percent of overall Israeli high-technology industry exports (in 2017). Other factors threatening to lead to a reduction in goods exports over the next few years are the strengthening of the shekel, a shortage in the number of professional workers in industry, and a reduction in the corporate tax rate in the US, which is aimed at bringing back the export activities of US companies to the United States.[9]

The domestic value added in each dollar of services exports is 25 percentage points higher than that of a manufacturing export dollar.

According to World Trade Organization and OECD estimates for Israel in 2011, the domestic value added in each export dollar of the manufacturing industry was 25 percentage points less than that of an export dollar in services industries; the difference in the percentage of the value added in the high-tech industries between manufacturing exports and service exports was 19 percentage points.[10] On the assumption that these estimates have remained fixed, then due to the increase in the share of business services exports in the total exports of the economy, the value added in each export dollar increased from 75 percent in 2011 to 77 percent in 2016. Thus, the cumulative increase in the value added of exports (excluding diamonds) from 2011–16, estimated at 12.2 percent, is greater than the cumulative increase in exports at fixed prices (excluding diamonds) for the same period (9.2 percent).[11]

The high-tech services sectors are concentrated in the center of the country and are characterized by a relatively homogenous composition of employees from the aspects of religion, gender, age, and education.

Increasing specialization of the economy in high-tech services has contributed in the last few years to an increase in its foreign currency income, a reduction in the economy's liabilities to abroad, an increase in the standard of living (purchasing power for imported products), and an increase in GDP. This specialization is the result of Israel's comparative advantage in human capital, and maintaining it requires constant

[7] The added value per dollar of China's exports in the electronics and optics sector in 2011 was 46 percent, far lower than that of the US (85 percent), the EU (66 percent) and Israel (74 percent).
[8] According to the World Bank's definition of countries with a high per capita GDP.
[9] Intel is an important US company operating in Israel. The company recently decided to make an additional large investment in Israel (estimated at $4.5 billion) in return for tax benefits and grants.
[10] The value added in business services exports in the computerization and telecommunications sectors is 93 percent, whereas the value added in goods exports in the electronics and optics sectors is 74 percent.
[11] Israel's GDP increased in the same period by 17.6 percent (an average annual rate of increase of 3.3 percent). The share of the value added of exports in GDP declined from 23.8 percent in 2011 to 21.5 percent in 2016.

Table 7.3
Goods exports by high-tech industries (high tech goods: HTG) in selected countries and indices of world trade in them, selected years, percent

	1999	2004	2009	2014	2015
Share of HTG exports from Israel out of those of advanced economies	0.6	0.5	0.7	0.8	1.0
Share of HTG exports from Israel out of global HTG exports	0.5	0.4	0.5	0.5	0.6
Share of HTG exports from OECD countries out of global HTG exports	76	68	59	57	59
Share of HTG exports from advanced economies out of global HTG exports	85	77	69	62	63
Share of HTG exports from China out of global HTG exports	3	11	20	26	28
Share of HTG exports from the US out of global HTG exports	18	12	8	7	8
Index of world trade in HTG, current dollars, 100=2006	54	78	86	118	108
Index of HTG exports from advanced economies, current dollars, 100=2006	62	81	79	97	91

SOURCE: World Bank data.

improvement in the quality of schooling in Israel at all levels. This desirable process naturally has its side effects: the advanced services industries are concentrated in the center of the country and are characterized by a relatively homogenous composition of employees from the point of view of religion, gender, age, and education: the success of these industries attracts highly skilled people to them, and so it is at the expense of other export industries, which employ a higher percentage of manufacturing workers characterized by a more heterogeneous composition of labor force. Creating inclusive growth requires acting to increase equality of opportunity. For this purpose, policy tools must be implemented to ensure the participation of all the industries, and in particular the Muslim population, in the advanced services industries.

2. THE STRUCTURAL CHANGE AND SPECIALIZATION IN TECHNOLOGY SERVICES EXPORTS

The current structural change is a stage in a long-term specialization process.

During the 1990s, a structural change occurred in the manufacturing industry—a rapid growth in the output and export of the high-tech industries (electronics and pharmaceuticals) and a waning of the traditional industrial sectors, such as the textiles sector. The burgeoning industries were distinguished from the waning industries by the employment of a more educated and skilled work force, the existence of research and development activities alongside production activities, and the achievement of far greater output per employee. In recent years, the economy has deepened its specialization in research and development activities. First to increase were the

activities of Israeli startups—small, entrepreneurial and innovative R&D companies. Leading international companies later set up R&D centers in Israel, but the R&D activity was not accompanied by production activity. The current change is evidence of an additional stage in the long-term structural change the Israeli economy is undergoing.

The need of multinational companies for R&D activities is driving the growth of the Israeli high-tech sector.

A survey conducted by the Central Bureau of Statistics shows that the R&D centers of multinational companies are the growth driver of R&D activity in Israel. From 2005–15 the outlays in R&D of multinational companies with R&D centers in Israel grew at an average annual rate of 8.2 percent, whereas the outlays of R&D companies in Israeli ownership grew at an average annual rate of only 0.8 percent, and that of other foreign-owned companies (that do not have R&D centers) grew at an average annual rate of only 2.4 percent. There were 31,000 R&D positions in R&D centers in Israel, of which 87 percent were filled by academic graduates.[12] The survey also shows that the R&D centers of foreign multinational companies pay a salary 60% higher than that paid by the local startups. The annual labor cost of a full-time position in R&D in the R&D centers of foreign multinational companies was NIS 530,000 in 2015.

Multinational companies' choices to conduct only R&D activities in Israel reflect Israel's comparative advantage in this area.

The multinational companies, whose percentage of GDP is increasing, split up the manufacturing process among various countries according to the comparative advantage of each country. Israel's comparative advantage in the high-tech sector used to be reflected in the activities of R&D-intensive manufacturing companies, whereas it is now reflected more straightforwardly in the choice of multinationals to come to Israel and conduct only their R&D activities there. Many countries in the world aspire to develop a similar comparative advantage and are investing many resources to that end. This is in recognition of the fact that the sector provides its workers with a high salary, contributes to innovation and productivity in the other sectors of the economy, and paves the way for an increase in the standard of living.

The comparative advantage of the Israeli economy lies in its educated work force.

Israel's comparative advantage in the computerization and R&D sectors relies on the human capital of its work force. Israel is ranked second among the OECD countries in the percentage of tertiary education among the working-age population (49 percent in the 25–64 age group in 2014, after Canada with a rate of 54 percent); Israel is ranked fifth in the share of people with tertiary education in the 35–44 age group.[13] The OECD publishes data on the percentage of recipients of degrees in the science and engineering fields (from 1998–2012), which do not include Israel.[14] However, it can be gathered from data of the Higher Education Council in Israel that

[12] Startups had 13,000 R&D positions, 77 percent of which were for academics (in 2015). The overall number of positions in startups was 21,000.
[13] The rate in Israel is 53 percent. Israel is ranked after Canada (61 percent), South Korea and Luxembourg (56 percent), equal to Japan (53 percent), and ahead of Finland (50 percent) and Ireland and Norway (49 percent).
[14] The data related to 30 OECD countries (out of 35). The highest rate of degree recipients in the engineering, computer science, natural science, and mathematics fields is in South Korea (37 percent), followed by Luxembourg and Germany (31 percent), Finland (29%), Austria, Sweden, and France (28 percent).

Israel is placed around the middle of the OECD countries.[15] The product of the two indices (the percentage of academics aged 35–44 and the percentage of recipients of degrees in the science and engineering fields from 1998–2012) provides an indication of the percentage of academics in the science and engineering fields among the young population; according to this index, Israel is ranked in the first decile of countries—behind South Korea, Luxembourg, Finland, and Japan, which lead the index, and close to Sweden, Canada, Ireland, Switzerland, and the UK,[16] which are ranked immediately after it. It should be noted that Israel's ranking in the human capital index would be even higher if taking into account that the share of the 35-44 age group in the work force in Israel is relatively greater than for the other countries. In all the leading countries in that index, apart from Israel and South Korea, GDP per capita is greater than the median of the OECD countries, and all of them, apart from Canada, specialize in human capital-intensive industries.

All the countries with an educated work force specialize in the high-tech sectors, as does Israel.

Almost all the leading OECD countries in the share of academics in the young work force in the science and engineering sectors are also dominant in the share of value added in GDP by the high-tech sectors:[17] some of them specialize in high-tech intensive industry—South Korea, Japan, Ireland, and Sweden; some of them in advanced financial services—UK, Sweden, and Luxembourg; and some in computerization and R&D services—Ireland, Israel, and Sweden.[18] The specialization of all of these countries in the high-tech sectors is therefore a consequence of having an educated work force, and Israel is no exception.

One of the reasons for Israel's specialization in the information services and computerization industries is that its objective constraints and disadvantages affected the other high-tech industries more.

The R&D services industry, in which Israel specializes, is more educated labor intensive than the high-tech manufacturing and advanced financial services sectors.[19] Israel specializes in this sector, but the percentage of academics from the science and engineering fields in the industry is no greater than their percentages in the other leading OECD countries mentioned above. Possible explanations for this could be a younger average age of the work force in Israel, and the training provided when serving compulsory national service in the IDF computerization and intelligence units. Another possible explanation is actually in Israel's relative disadvantages: a complex geopolitical situation, a large distance from the target markets in the United States and Western Europe, a small domestic market, a lack of land and sea transportation

[15] The percentage of graduates with a bachelor's degree in the engineering and natural sciences fields in the Israeli higher education system (universities and colleges, excluding teachers' training colleges) in 2000, 2007 and 2008 was 25 percent. The rate of those with a master's degree is lower. Although the most recent data relates to 2011, it is reasonable to surmise that they have not changed much since.

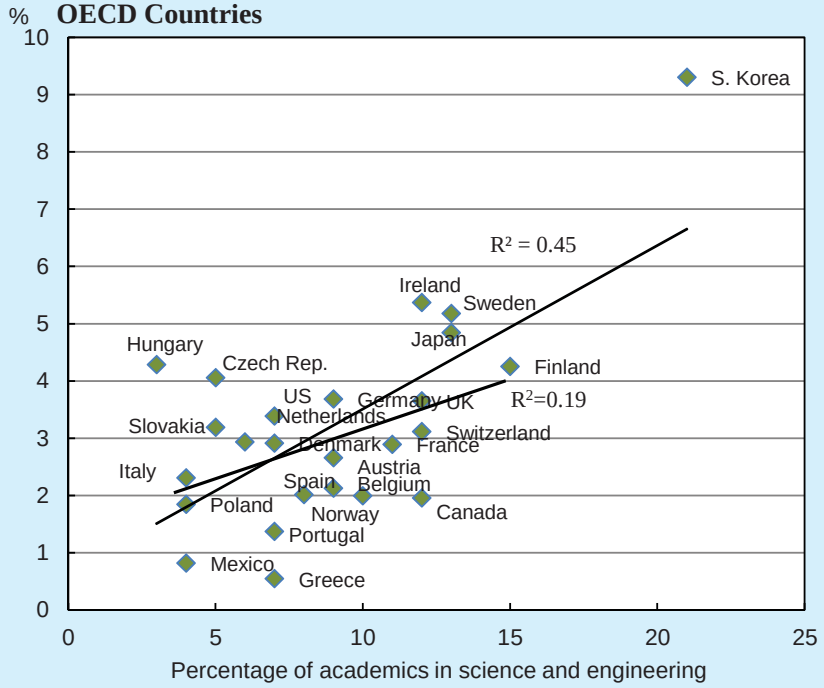
[16] Israel and Luxembourg are not included in the graph. The OECD data do not include Israel, but according to our estimate, the rate in Israel is around 13 percent.

[17] Apart from Canada, which is an exporter of natural resources. Hungary and the Czech Republic are the only two countries that are not leaders in the education index but are characterized by a high share of high-tech sectors in GDP.

[18] The percentage of exports of telecommunication services, computers, and information services is especially high in Ireland, Israel, and Sweden: 18 percent, 15 percent and 7 percent, respectively, in 2015. Sweden has relatively high revenues from royalties, which account for 4 percent of its exports.

[19] A 2015 Labor Force Survey shows that the education of those employed in high-tech services is far superior to that of those employed in high-tech industry—a difference of 23 percentage points in the percentage of academics and of 35 percentage points in the percentage of employees with an academic profession.

Figure 7.2
Share in GDP of High-Tech Industries' Value Added and Share of Academics in Science and Engineering Ages 35-44, OECD Countries



The long line is the regression line for all the countries listed.
The short line is a regression line excluding South Korea (the outlier observation in the top right corner).
SOURCE: Based on OECD data.

infrastructure, and in the distant past also the high cost of raising capital – all these have made it difficult for Israel to develop advanced manufacturing like South Korea and Japan, or to become a global financial center like Britain and Switzerland. Although the need for military capabilities led to the development of successful Israeli companies in the military sectors, not all those companies were equally successful in the civil sector.[20] However, the development of military capability in the area of information security led to the setting up of successful civilian companies (the best known of which is Check Point), and this activity has expanded into other fields.

Israel has become an attractive location for the development centers of the world's leading companies thanks to the success of local technological ventures:[21] from

[20] Thus, for example, the aircraft industry's success in the production of corporate aircraft has been less, until now, than its success in the military field. Another example in the civil field is the Israeli company Elscint, which was one of the world's leading companies in the development and manufacture of MRI equipment and which was finally purchased by Philips. The Israeli civil industry garnered success in the pharmaceutical sector in which knowledge is the main component in product value and the transportation and manufacturing element is low.

[21] Since 2014, at least 80 multinational corporations have opened R&D and innovation centers in Israel, 50 of which as the result of the purchase of local startups.

Companies prefer to locate new R&D centers in geographical proximity to existing R&D centers, a process that may gradually turn Israel into a global R&D center.

the point of view of multinational companies, the purchase of local technological ventures is a convenient way to purchase new knowledge and hire a quality team of workers that can adapt the knowledge it has developed to the special needs of the multinational. Multinationals that set up new development activities in Israel (and did not purchase local startups) also took advantage of special knowledge brought with them by workers who were exposed in their previous work place to new technologies. The flow of knowledge between firms also boosts the activities of local startups: Hassid (2016)[22] found that "local startups that recruited high-salaried workers from foreign-owned companies at the setting up stage grew at a faster pace than startups in the control groups", and concluded that "workers who left foreign companies took with them special knowledge and experience". The flow of knowledge through the transfer of workers between firms is one of the reasons for the tendency of firms in the same field to be concentrated in the same geographical area.[23] The desire of foreign companies and new ventures to benefit from the flow of knowledge attracts new activities to Israel in fields in which Israeli companies have garnered successes (cyber, autonomous vehicle technologies, etc.), and this activity allows Israeli workers to develop new and successful enterprises. Such a process is likely to be of important economic significance for the future of the economy, since there is a small number of large research and development centers in the world and each of them will benefit from the economies of scale supporting its continued prosperity.

There is a worsening shortage of an educated and skilled labor force in the high-tech industries which is restricting the realization of the growth potential.

Israel's specialization in the advanced technology industries is consistent, as previously noted, with its being one of the leading countries in the educated labor force indices. However, Israel's accelerated specialization in these sectors in recent years has not been the result of an increase in the supply of educated workers: the flow of engineering and natural sciences graduates in universities and colleges increased in 2010–16 at an annual rate of 2.8 percent, similar to the rate of increase in the number of employees in the economy in 2012–16 (2.7 percent). For the sake of comparison: from 2012–16, the number of employees in the high-tech services (excluding the communications sector[24]) grew at an annual rate of 9.4 percent (from 111,000 to 160,000 employees), and the number of employees in the high-tech sectors (services and manufacturing) grew at an annual rate of 4.4 percent.[25] It follows that the structural

[22] E. Hassid, (2016). "The Influence of Multinational Companies on the Performance of Startups in Israel: The Flow of Knowledge through the Transfer of Workers", dissertation under the guidance of Prof. Saul Lach.

[23] Porter (1998) indicates other reasons for clusters of similar industries in neighboring geographical areas: universities training a quality work force, advanced research centers, a large variety of suppliers and marketers, etc.
M. Porter, "Clusters and the New Economics of Competition" Harvard Business Review, November-December 1998.

[24] High-tech services as defined by the Central Bureau of Statistics include the following sectors: computer programming and consultancy (62), R&D centers (720), engineering and natural sciences R&D (721), data processing, storage and ancillary services (631), as well as telecommunications services (61), which are not included in this discussion with the high-tech industries.

[25] The number of engineering and natural sciences graduates reached 50,000 in 2012–16, similar to the increase in the number of employees in the high-tech services (excluding the communications sector) during the same period.

change that occurred in the economy in recent years has led to an increasing shortage of an educated and skilled labor force in the sector.

The yield to the economy from additional investment in the training of computer sciences and engineering graduates is especially high.

Data from a 2015 Labor Force Survey support the hypothesis concerning a shortage of formally educated people in the high-tech sectors. A considerable percentage—19 percent—of those with academic professions in the software and R&D services sector have no formal academic education. (This phenomenon may also be an indication of the importance of non-professional training tracks to the sector, including in the IDF computerization and intelligence units.[26]) Another indication is obtained from a measurement of the percentage of graduates who are not employed in academic or management professions; only 7 percent of academics in the software and R&D sectors are not employed in those professions, compared with 23 percent in the computer and electronics sector and 28 percent in the economy as a whole. Moreover, clear evidence of the potential in training students in the science and engineering fields emerges from the research of Krill, Geva and Aloni (2016):[27] They found that the salaries of computer science and engineering graduates in Israel were 50–60 percent higher than the salaries of other graduates with similar abilities. This finding testifies to the high anticipated yield to the economy from investment in additional computer sciences and engineering graduates in the higher education system. This yield was present in the minds of a joint team led by Professor Kandel, which discussed the matter in 2012.

The implementation of the Kandel team's recommendations and the salary surge in the sector led to a substantial increase in the number of computer sciences and engineering students.

Due to the implementation of the Kandel team's recommendations for an increased budget in the training of university graduates in the software and hardware fields, there is expected to be a significant increase in the near future in the number of engineering and science graduates in the institutes of higher education. The number of first year students in universities in the fields of engineering and the fields of computer sciences, mathematics, and statistics has increased by 30 percent and 26 percent, respectively, within only three years (2015/2016 academic year compared with 2012/2013 academic year);[28] and during the same period, the number of students who began their studies in the other fields of study in universities declined by 8 percent. The implementation of the Kandel team's recommendations and the surge in salaries in the sector[29] led to a substantial increase in the number of applicants for places in these two fields of study in the universities by 30 percent and 24 percent, respectively. At the beginning of 2017, the government approved another essential plan to increase the skilled labor force in the industry, the main thrust of which was an increase in the number of university graduates in the high-tech professions by 40 percent within 6 years and budgeting for special, non-academic training for the sector.[30]

[26] In 2012, there were similar percentages of those with academic professions but without a formal education in both the high-tech services sector (20 percent) and the high-tech industrial sector (11 percent).
[27] Zeev Krill, Assaf Geva and Tslil Aloni (2016). "Not all Degrees Were Born Equal". Discussion Papers Series, the Chief Economist's Division in the Ministry of Finance.
[28] Central Bureau of Statistics data, schooling and education, higher education, Table 1.4 – candidates and first-year students in universities according to fields of study.
[29] Yoav Friedmann (2016), "The Information Technology Industries: Employees, Wages, and Dealing with Shocks", Israel Economic Review 14(1), pp.97–132, Bank of Israel.
[30] The plan includes granting permits for the import of high-tech 'experts' from abroad. This import has advantages and disadvantages, and the issue will only be resolved in the future.

Table 7.4
Indicators of excess schooling in the overall economy and in selected industries, percent

	High-tech services[a]	High-tech manufacturing[b]	Overall economy
Employed in academic profession (excluding teaching)	66	32	17
Of which: Do not have an academic degree	19	11	15
Hold an academic degree	70	47	30
Of which: Do not have an academic or managerial occupation	7	23	28

[a] These services include computer programming and consultancy and other related services (62) and scientific R&D (72).
[b] This includes the manufacture of computers, electronic and optical equipment (26) and the electric equipment manufacturing industry (27).
SOURCE: Based on 2015 Labor Force Survey.

The meager achievements of many students in Israel, expressed in international assessment tests, endanger its comparative advantage.

The government seems to be aware of the need to adopt a broad and comprehensive approach to the improvement of the human capital. An inter-ministerial committee on dealing with the labor force shortage in high-tech industry (2014), which discussed the labor shortage in the sector, put the emphasis on a substantial increase in the number of high-school graduates with a quality matriculation in science and technology, and the Ministry of Education is taking steps to double the number of graduates with 5 study units (the maximum possible) in mathematics. The meager accomplishments of most of Israel's students in international assessment tests is restricting the potential supply of a labor force to the high-tech sectors and endangering Israel's comparative advantage in the field. In view of these meager accomplishments and against the background of the aspirations of many countries to develop a comparative advantage in the high-tech sectors, Israel is faced with an especially daunting challenge to maintain the comparative advantage it has achieved, which is mainly to improve the quality of education and adapt it to the needs of the economy.

It was recently decided to reduce corporate tax on high-tech companies that transfer intellectual property to Israel to 12 percent for all companies and 6 percent for global giants; and the tax on dividends was reduced to 4 percent for all high-tech companies, a step that is aimed at attracting more foreign companies to Israel. However, against the background of the shortage of a skilled labor force in the sector, discrimination in the tax rates imposes a burden on the other companies; a supplementary step to the tax benefits is therefore needed, and that is an additional investment in training workers for the sector.

3. THE CONTRIBUTION OF THE HIGH-TECH INDUSTRIES TO AN INCREASE IN THE STANDARD OF LIVING IN THE ECONOMY

Due to the success of the high-tech industries, GDP per employee in industry as a whole has increased rapidly in the last ten years.

The success of the high-tech industries is leading to greater efficiency in the entire tradable sector of the economy (the exportable/importable product manufacturing or services industries) because the export industries are competing not only with similar industries abroad but also among themselves. An improvement in the productivity of one export industry relative to its competitors abroad will increase the foreign currency supply in the economy and thus cause an appreciation in the real exchange rate of the shekel. This appreciation will adversely impact the profitability of the other export industries and will force them to become more efficient or downsize. The high-tech industries in Israel are extremely efficient, as evidenced by GDP per employee and salaries paid in those industries being at least 50 percent higher than the average in the economy.[31] Their success is a gradual contribution to the efficiency and productivity of the entire tradable sector, and the GDP per employee in manufacturing (a tradable industry) increased in the last decade at a far greater rate than that of the economy as a whole, and this relative increase is also remarkable in comparison with the OECD countries.[32]

Increased productivity in the tradable sector increases the standard of living in the economy, even when it means higher prices for domestically produced products and services.

The productivity increase in the tradable sector makes it possible to increase imports, and consequently to raise the standard of living in the economy. Moreover, the productivity increase generally reduces the percentage of employees in the tradable sector;[33] those dropping out from it are taken up by other sectors, create necessary products and services that are not negotiable in international trade (education and health services, etc.), and thus contribute to an increase in the standard of living in the economy. However, this process is to the detriment of the salaries and employment conditions of those dropping out of the tradable sectors since the special knowledge accumulated (specific human capital) has lost its value. Furthermore, those dropping out of the tradable sectors (mainly non-academic males) increase the labor supply which leads to relatively lower wages of all the workers with similar characteristics.

The range of tradable services in international trade is expanding and this forces the sectors producing them to become more efficient or to downsize.

The contribution of those taken on by the non-tradable sector depends on the productivity of the non-tradable sectors: If productivity in those sectors is low, the economy will not derive the full potential in the improvement of the productivity of the tradable sectors.[34] However, the technological development makes an additional

[31] The annual salary of an employee in high-tech manufacturing is 50 percent higher than the manufacturing average (in 2004). The product per employee in the ICT sectors is 60 percent higher than the average in the business sector.

[32] From 1996 to 2005 the GDP per employee in the manufacturing industry was similar to that in the economy as a whole, whereas in 2015 and 2016 it was 14 percent higher than in the economy as a whole. Furthermore, the growth rate of GDP per employee in manufacturing relative to that of the economy overall in Israel was higher than in OECD countries by 8 percent.

[33] Evidence for this is the downward trend in the percentage of employees in the tradable sectors in the great majority of the countries. Between 2011 and 2016 the percentage of employees in manufacturing in Israel declined by 1.6 percentage points (to 10 percent).

[34] Box 2.1 in the Bank of Israel 2013 Annual Report.

contribution in this respect: due to technology, the range of tradable services in international trade is growing: services such as banking, insurance, advertising, and brokerage are becoming an important part of international trade. Tradability increases competitive pressure in the domestic market and forces these industries to come into line with the high productivity of the other tradable industries. If these industries do not become efficient enough they will lose workers for the benefit of more efficient tradable ones (almost certainly the high-tech industries); these will increase their output and will supply the foreign currency to finance the increase of the services imports.

The global increase in demand for high-tech services, in which Israel specializes, may also be beneficial for less skilled and educated workers in the economy.

The increase in global demand for high-tech services, in which Israel specializes, acts first and foremost to increase the real salaries of the skilled and educated workers in the economy, who are qualitied to be taken on by the sector. However, the increase in these incomes acts indirectly to increase the real salaries of most of the workers in the economy, because an increase in the purchasing power of employees in the high-tech sectors leads to an increase in the demand for some of the products and services that are not importable from abroad (non-tradable products) and in their prices. This increase in prices does not harm the other workers and is even beneficial to them, since the payment flows into the pockets of the workers (and the owners of local capital[35]) that manufacture them. The purchasing power of workers in the economy in terms of the local product is not small, and their purchasing power in terms of imported products is increasing.[36]

The prosperity of the high-tech industries is one of the most important factors in the improvement of Israel's relative position in recent years.

The contribution of the high-tech industries to the economy therefore exceeds the increase in their own product. A clue to the contribution of these sectors to an improvement in the condition of the economy can be found in Israel's rise in the rankings of GDP per capita in terms of purchasing power parity published by the World Bank (in current prices[37]) from 43rd and 44th places in 2006–09 to 36th place in 2013–16; Israel's GDP per capita, which was 56 percent of that of the United States from 2005–07, is now (in 2016) 66 percent of it; some of the improvement is the result of an increase in purchasing power in terms of imported products. (As evidence – the rise in Israel's relative position in the GDP per capita index at fixed prices, which measures only the increase in GDP, was more moderate.) The improvement in Israel's relative position in recent years was affected by many factors, the prosperity of the high-tech industries being one of the most important of them.

[35] The accepted hypothesis is that some of the labor in GDP is fixed—an increase in demand contributes both to an increase in the income of business owners and an increase in the salaries paid to their employees.

[36] In effect, a necessary condition (generally met) for the increase in employees' salaries in the high-tech sector to increase the purchasing power of the other workers in the economy is that the price of the products and services produced in the economy will become more expensive. Thus the salaries of workers in the other sectors (the non-high-tech sectors) will increase, which will allow them to purchase more imported products and services.

[37] PPP, current international $. (The comparison does not include Bermuda, Libya, and Puerto Rico.)

4. THE STRUCTURAL CHANGE AND WAGES

There is a question of whether the accelerated growth of the high-tech industries in the last decade has led to an erosion of wages of the less educated workers in the periphery.

The accelerated growth of the high-tech industries has mainly benefited the educated workers in the economy and employees in the center of the country; this is because the sector employs a particularly high proportion of educated workers and is concentrated in the central region (Table 7.5). Following is an examination of whether the accelerated growth of the high-tech industries was accompanied by a significant change in wage differentials between educated and non-educated workers and between employees in the center and those in the periphery. This examination will make it possible to obtain a preliminary sense of the power of the influence of the structural change on wage differentials in the economy. A precise quantification of the structural change on wage differentials in the economy requires meticulous research that controls for the development of wages over time. For example, the quality of human capital of the employees needs to be controlled for, since in recent years both the percentage of graduates from colleges and the percentage of engineering and computer science graduates have increased among degree graduates.

Table 7.5
Composition of employees in high-technology industries and in the overall economy, 2015

	High-tech services[a]	High-tech manufacturing[b]	Overall economy
Highest certification—Bagrut high-school matriculation or lower	17	31	55
Work district: North and South	9	39	20
Tel Aviv and Central	71	34	39
Religion: Muslim	1	2	10
Gender: Female	36	32	44
Age cohort: 45 and older	24	42	35
Born in advanced economy	25	38	19
Born in developing economy	2	4	6
Born in Israel, mother born in Asia or Africa	16	15	19

[a] These services include computer programming and consultancy and other related services (62) and scientific R&D (72).
[b] This includes the manufacture of computers, electronic and optical equipment (26) and the electric equipment manufacturing industry (27).
SOURCE: Based on 2015 Labor Force Survey.

The accelerated growth of the high-tech industries may be deleterious to the relative salaries of the less educated workers in the periphery, since many of them are employed in the tradable, low technology industries which are waning as the success of the high-tech industries is on the ascendancy. However, a comparison among a homogenous group of high school graduates (male, Jewish, non-ultra-Orthodox, aged

The salaries of high school graduates in the periphery have not been eroded relative to the average salary.

25–64 in salaried employment) from 2007–16 shows that the salaries of high school graduates, with or without a matriculation certificate, employed in the periphery (in the northern or southern districts) have not decreased relative to the salaries of all (male, Jewish, non-ultra-Orthodox aged 25–64 in salaried employment) employees in the country.[38] On further examination, in relation to all the geographical areas, the salaries of less educated workers in Israel were found to have remained stable relative to the salaries of bachelor's degree graduates and holders of post high school, non-academic certificates, but have been eroded relative to those of master's degree graduates. It was also found that the relative salaries of employees in the periphery (at all educational levels) have not been eroded, and have even increased slightly relative to the (male, Jewish, non-ultra-Orthodox aged 25–64 in salaried employment) average salary in the country as a whole. The comparison shows that the acceleration in activities in the high-tech services sector has not been accompanied by any real erosion of the relative salaries of the less educated workers in the peripheral areas, in which the low-technology export industries operate. It should be clarified that in order to control for the effect of the growth stage in the business cycle on the relative salaries of less educated workers, a comparison must be made between the years 2007–08 and 2015–16, all of which were peak years.

Table 7.6
Wages of employees in the periphery and in the center, relative to all employees country-wide, by selected levels of schooling, 2007–16

	Relative wage—Periphery			Relative wage—Center of country		
	All	High school graduate	Academic degree	All	High school graduate	Academic degree
2007–2008	0.81	0.91	0.77	1.08	1.09	1.06
2010–2011	0.86	0.95	0.85	1.09	1.06	1.06
2012–2013	0.84	0.9	0.84	1.1	1.06	1.09
2015–2016	0.84	0.93	0.83	1.1	1.07	1.07

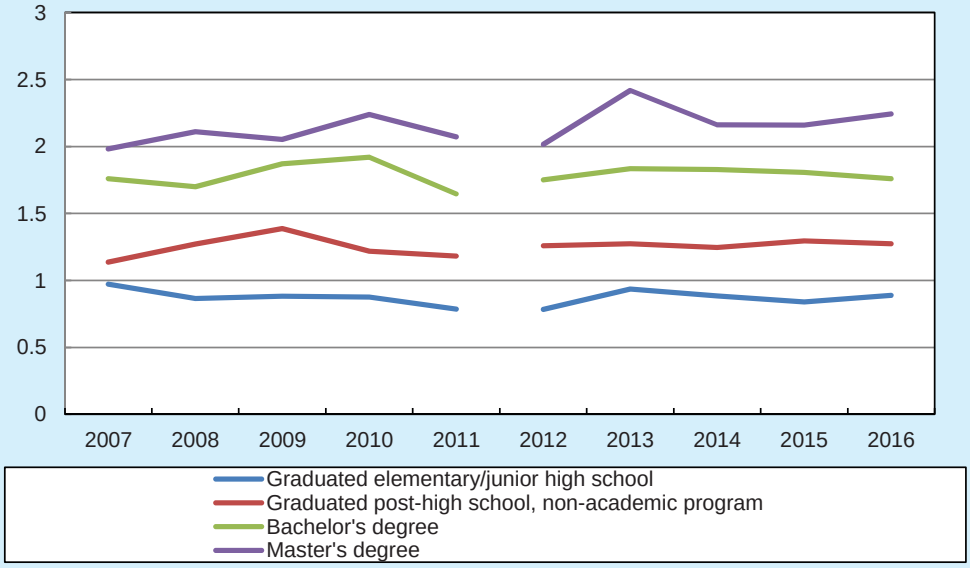
Periphery: North and South districts. Center: Tel Aviv and Central districts.
High school graduates: Those whose highest level certification is a high school Bagrut matriculation diploma or certificate of completing high school.
Academic degree: Holders of Bachelor's or Master's degree from colleges or universities.
The comparison relates to a homogeneous group of employees - non-ultra-Orthodox Jewish males aged 25-64.
SOURCE: Based on Central Bureau of Statistics Income Surveys.

[38] The salaries of the less educated workers in the periphery are lower than the salaries of those with a similar education in the center of the country. The increase in the minimum salary apparently contributed to an increase in their relative salaries.

As opposed to the structural change in the 1990s, which was accompanied by a marked increase in salary differentials according to the educational level (the return to schooling), the present structural change has not been accompanied by an increase in the return to schooling. One possible explanation for this difference is that today a greater percentage of workers with lower education is employed in non-tradable industries, which benefit from increased demand for their products as long as the high-tech sectors continue to build on their success, whereas in the 1990s a considerable proportion of the less educated workers were employed in the low-technology tradable industries, which waned as the high-tech sectors became more successful: in 1995, the manufacturing sector employed more than one quarter (27 percent) of all the less educated salaried workers (high school graduates or less) living in the periphery, and this percentage declined to just 15 percent in 2015; the percentage of high school graduates (or less) in the economy employed in manufacturing declined from 23 percent in 1995 to 12 percent in 2015.

Most workers with little education are currently employed in industries that benefit from the success of the high-tech industries; only a small proportion of them are employed in low technology industries, which are waning as the high-tech industries build on their success.

Figure 7.3
Development of Wages by Schooling Level among Homogenous Group of Employees with Various Levels of Education Relative to Salary of High-School Graduates, 2007-16
(Comparison relates only to non-ultra-Orthodox Jewish males ages 25-64)



SOURCE: Based on Income Surveys by the Central Bureau of Statistics.

The relative salaries of Arab males with a master's degree declined between 2007 and 2016 relative to the salaries of Jewish males with a master's degree. One possible reason for this is the low share of Arabs in the high-tech sector: whereas the percentage of Muslims among all those employed in the economy is 10 percent, their percentage in the high-tech services sectors is no more than one percent. In research by Mazuz-

The percentage of Muslims among those employed in the economy is 10 percent, whereas their share among employees in the high-tech services industries is only one percent.

Harpaz and Krill[39] (2017), it was found that "Arabs who have studied in the relevant fields in academia are integrated into the high-tech industry in lower percentages than Jews who studied in the same fields". However, most of the difference occurs at the earlier stages: thus, for example, the percentage of Muslims among those studying in colleges for a bachelor's degree in computer sciences, mathematics, and statistics (2.5 percent) and in engineering (5.6 percent) is much less than their share in all fields of study (9.2 percent); the percentage of Muslims among those studying in universities for a bachelor's degree in engineering (5.1 percent) is also less than their weight in all fields of study (9.1 percent). An analysis by the Central Bureau of Statistics among those who excelled in the quantitative part of the psychometric test indicates a certain disparity, not particularly great, between Arabs and Jews who chose to study engineering or science.[40] The disparity in higher education is therefore created at the earlier educational stages (high school, elementary, and even earlier), a situation that emphasizes the need for increased government investment in those stages. Action must also be taken to increase the opportunities for Arabs with a suitable academic education to be integrated into the high-tech sector, which will increase Arab students' motivation to excel in the real professions in high school and to choose an academic track in the engineering and computer sciences fields.

5. OTHER ASPECTS OF THE STRUCTURAL CHANGE

An unanticipated slowdown in world demand for high-tech services could adversely impact the market value of the foreign and Israeli technology companies and could also adversely impact the Israeli economy, which is exposed to the sector.

Risk—The main risk to the economy is from a sharp slowdown in the growth rate of world trade in high-tech services. Sooner or later, the accelerated growth of demand for high-tech services will flatten out, competition in the sector will intensify, and then the competitive edge of countries with lower labor costs, including India, which is the world's largest exporter of computerization, science, and communications services, is likely to increase. (India's share of world trade was 17.5 percent in 2015 after increasing by 2.5 percentage points in the last decade).[41] Competition with India and Eastern European countries in a saturated market is liable to slow the rate of growth of Israeli exports of high-tech services, and there is some probability that it will also lead to a reduction of salaries in the sector. An even worse scenario can be contemplated, similar to the one that occurred in the sector in 2000 – a sharp decline in demand for the products of the high-tech sectors. The current market value of high-tech companies

[39] Yael Mazuz-Harpaz and Zeev Krill (2017). "The Springboard to High-Tech", Discussion Paper Series, the Chief Economist's Division, Ministry of Finance.

[40] A high proportion of male Arab outstanding students chooses the medical professions, and a small proportion chooses the humanities and social sciences (in comparison with their Jewish counterparts). The proportion of female Arab outstanding students choosing the sciences and the proportion of male Arab outstanding students choosing engineering are similar to those of Jews, but the proportion of female Arab outstanding students choosing engineering and the proportion of male Arab outstanding students choosing the sciences is lower by 4 percent and 9 percent, respectively, than among Jews. This is among those completing high school in 2006/2007.

[41] There are 600,000 academics in India in the ICT fields, five times more than in the United States.

is extremely high and reflects an optimistic growth projection; a downturn in demand for the sectors' products would therefore be a surprise to the markets, would adversely impact the market value of the high-tech companies, and could lead to a reduction in their operations.

Concentration in services exports is lower than in goods exports.

Concentration—A large part of Israel's industrial exports are concentrated in the hands of a small number of companies. In contrast, there are a large number of small and medium-sized export companies in high technology services. An analysis of Israeli companies' reports to the Bank of Israel shows that the share of the ten leading goods exporters in total goods exports is double the share of the ten leading exporters of services in total services exports.[42] From this aspect, it would seem that the risk to the economy lessens with an increase in the share of high technology services exports. However, the situation is different from the point of view of geographical dispersion: 70 percent of high-tech services exports is destined for the United States and the EU , compared with 60 percent of goods exports, and the exposure of the high-tech services sectors to the United States is especially great (42 percent).[43]

The structural change involves a decrease of investment by the business sector in physical capital and requires broad public investment to improve the human capital of the entire population.

Investments—An increase in the share of the technology services industries, which are human capital intensive, and a decrease in the share of the high-tech industrial sectors involve an increase in investment in human capital and a reduction of investment in physical capital. This is reflected in differences in the division of product between the return on labor (salary) and the return on capital: 80 percent of the product of the high-tech services sectors is return on labor and 20 percent is return on capital; in contrast, 60 percent of the product of the industrial sectors is return on labor and 40 percent is return on capital—a difference that reflects industry being more capital-intensive. Consequently, the structural change involves a decrease in physical capital. It also involves a reduction in the import and transport of manufacturing inputs, and so there is less urgency to develop infrastructures for the transportation of freight (seaports and freight trains). In contrast, there are greater yields from public investments in mass transportation to the development centers located in the center of the country, from investments in Internet and cellular infrastructures, and most important from investments in human capital at all educational levels.

[42] The analysis was conducted by the Information and Statistics Department and the Market Operations Department in the Bank of Israel.
[43] However, the final destination of the services and goods may be different, and so there is no precise way to examine the geographical risk.