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Why Does the Start-Up Nation Still Have Low Productivity?

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Gilad Brand*

Abstract

Average labor productivity in Israel is relatively low and has remained so for many years, even though the country's high tech industry is considered a world leader. This study argues that this is due to the large gap between the performance of export-intensive industries and other industries that produce primarily for the domestic market. While all developed countries have this gap, it is exceptionally large in Israel. Furthermore, in other developed countries, the success of the export industries trickles down to other branches of the economy to some extent. While we might expect this to happen in Israel, too, it has not.

One possible explanation is the unique makeup of Israeli exports, which rely largely on high tech companies. These companies employ workers at the high end of the skills distribution, and thus there is a large difference between workers in export industries and other workers in the business sector. As a result, there is low substitution between workers in export industries and workers in industries geared toward the domestic market, and productivity growth in export industries does not lead to a change in the distribution of workers between industries or encourage wage pressures and efficiency in the rest of the labor market.

Given this situation, further government investment in high tech does not appear likely to lead to increased productivity in the rest of the economy, and thus, other directions for action must be found. These include expanding vocational training tracks to improve worker mobility between export industries and domestic industries; increasing infrastructure investment; and removing barriers to importing. The goal of these measures is to bring about wage pressures in domestic industries and thus to encourage increased efficiency and a reduced gap between workers in the various industries.

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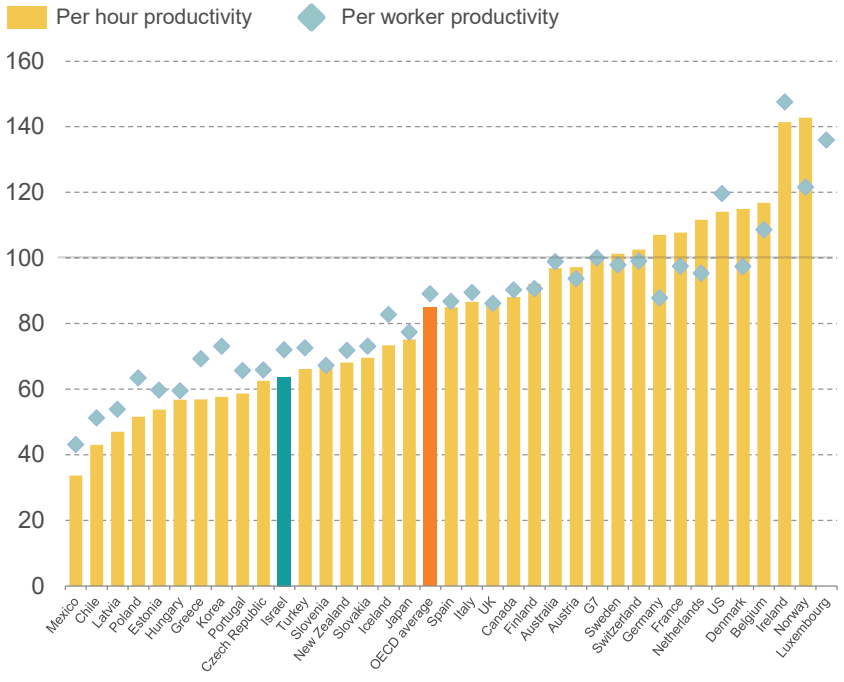
Introduction

The average Israeli does not work fewer hours than his OECD counterpart, and his share in the outcome of his work is no smaller. Nevertheless, his income from work is low relative to other developed countries, and the reason for this is low productivity. Labor productivity — the ratio of gross domestic product to total hours worked — measures the total value of goods and services produced in an average work hour and expresses the production capacity of the economy, accounting for total inputs at its disposal. In 2015, labor productivity in Israel was about 68 percent of the average in the G7 countries, and per worker productivity was about 77 percent (Figure 1).[1] These gaps have persisted for many years, and slow growth in productivity leads to slow growth in wages (Figure 2).

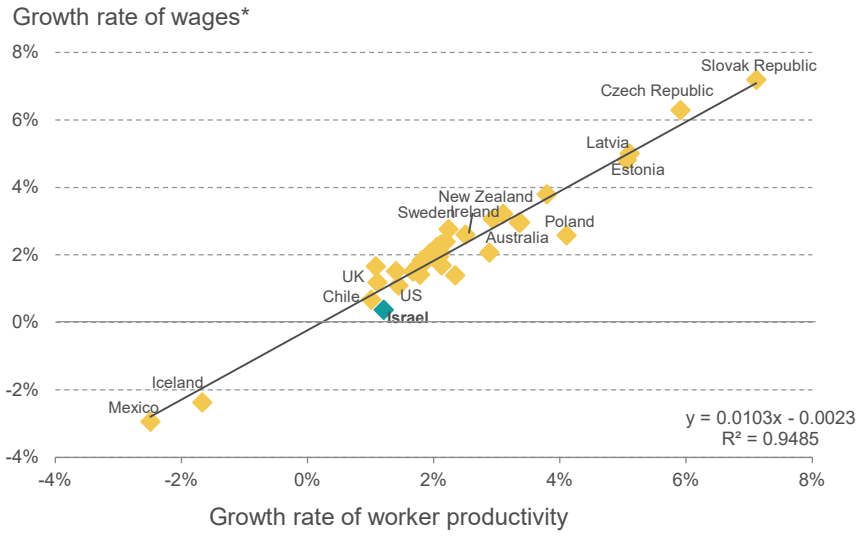
Figure 1. Labor productivity and worker productivity, 2015
Average of G7 countries = 100, in PPP dollars



Source: Gilad Brand, Taub Center | Data: OECD.Stat

1 The gap results from the fact that the average Israeli employee works many more hours than the average OECD worker.

Figure 2. Average growth rate of wages and productivity per worker, 1995-2015



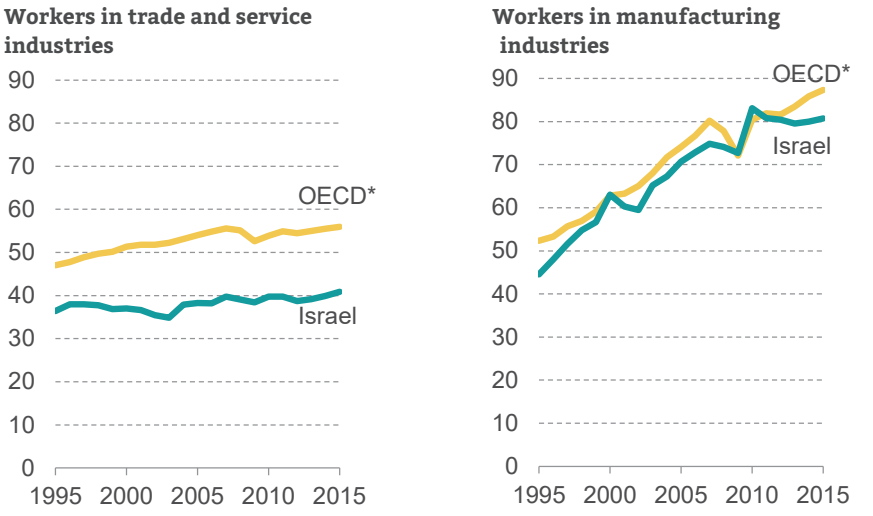
* Wages deflated by the GDP deflator.
Source: Gilad Brand, Taub Center | Data: OECD.Stat

At the same time, the differences in productivity between the Israeli economy and the rest of the world vary greatly from one branch of the economy to another (Figure 3). Productivity in Israel is especially low in industries that produce primarily for the domestic market and do not face competition from abroad (henceforth "non-tradable industries").[2] In contrast, the level of productivity and it's growth rate in the high tech and manufacturing industries that are engaged in the global market (henceforth "tradable industries") are fairly similar to the rest of the world (Bank of Israel, 2016a).[3]

2 Regev and Brand (2015) found that the categories of other business services, wholesale trade, and hospitality and food services industries have the greatest influence on the overall productivity gap. These industries provide services and products primarily for the domestic market and depend mainly on the local business environment.

3 The Bank of Israel (2014) found that there is a high correlation between the rate of export in the industry and the productivity gap between Israel and other developed countries.

Figure 3. Productivity per worker in Israel compared to the OECD, by industry group
Fixed PPP dollars, 1995-2015



Notes: 22 OECD countries with available data: Australia, Austria, Italy, Great Britain, Germany, Denmark, Netherlands, Hungary, Greece, Japan, Israel, Luxembourg, Latvia, Norway, Slovakia, Slovenia, Spain, Portugal, Finland, Czech Republic, France, and Sweden. Trade and service industries include wholesale and retail trade, transportation services, warehousing, postal and courier services, hospitality and food services.
Source: Gilad Brand, Taub Center | Data: OECD.Stat

It is not surprising that tradable industries in Israel have higher productivity than non-tradable industries because this is the case in most countries in the world. It is surprising, however, to see the size of the gap in Israel. Although standard economic theory and evidence in the literature have shown that productivity tends to be higher in tradable industries than in non-tradable industries, it also predicts that these gaps will be wider if the economy is more developed. Nevertheless, Israel's GDP per capita is low relative to the OECD average, while the productivity gap between tradable and non-tradable industries is relatively large (Figure 6 further on).

For many years, government policy has encouraged investment in exporting firms on the assumption that their success will have a positive impact on the rest of the job market. This can take place on two levels:

through typical, positive externalities or through the price system.[4] This study focuses on the price system. If this mechanism does, in fact, exist, the high productivity of the tradable industries can be expected to raise wages and increase the demand for workers in these industries and lead to wage pressures in non-tradable industries as well. The increased cost of labor can be expected to force non-tradable industries to invest in capital and technology and to streamline their work processes, thereby increasing work productivity and wages in these industries as well.

This study, however, seeks to show that the basic assumption behind this policy is inaccurate. The main problem with the assumption is the extreme disparity between workers in the export sector in Israel, which is composed largely of high tech companies, and workers in the rest of the economy. In general, tradable industries employ a more skilled work force and this study shows that the disparity in Israel is particularly great. As a result, there is low worker mobility between the two industry groups, and thus, growth in the tradable industries does not lead to a change in allocation of workers and does not result in wage pressure in other segments of the labor market. This study argues that in the current situation — with low worker mobility between sectors and tradable firms close to the supply constraint of high skilled workers — the marginal output of capital may be low. In this situation, economic incentives for tradable firms could lead to private investment being crowded out rather than to an increase in total investment. Therefore, it is possible that investing in non-tradable industries would actually yield a higher return. These industries account for at least 70-80 percent of employment in the business sector, and they are characterized by relatively low productivity and slow growth. As a result, reducing gaps between workers in the economy and improving the standard of living involves improving productivity in this sector. The main question this study will address is whether the way to improve average productivity in the economy is by increasing employment in the tradable industries or focusing on the non-tradable side of the economy.

This work is divided into several main parts. The first section is the theoretical basis of the study, and then, an examination of the effectiveness of economic incentives in the tradable industries as a means of confronting the challenge of low productivity in the economy. The third section discusses the possibility of focusing on strengthening non-tradable industries to improve productivity, and the fourth section proposes alternative approaches.

4 Externality is a by-product of a certain activity that affects factors not directly involved in it. Externality in this case could be spillover of knowledge, new technologies, and advanced management methods to the rest of the economy.

Data and Definitions

This study is based on the Central Bureau of Statistics (CBS) *Labor Force Surveys* and *Household Expenditure Surveys*, combined with the OECD's PIAAC (Program for the International Assessment of Adult Competencies), which was conducted in other developed countries as well.

- The division into industry sectors was done as follows:

  Tradable industries: A group that includes most of the manufacturing industries, high tech services, and water and air shipping.[5]

  Non-tradable industries: All other industries in the business sector. A division of this kind was suggested by the International Monetary Fund (2015).

  The study focuses on the business sector and does not include public services.[6]

5 The food, beverages, and tobacco industry (code 10-12) and the paper and printing industry (code 17-18), in which the volume of exports and competing imports is relatively low, were defined as non-tradable industries. The other manufacturing industries were defined as exporters. High- tech services (code 62-63) and scientific research and development (code 72), along with shipping services (code 50-52), were defined as exporters. The communications services industry (code 61) is defined as high-tech, but its rates of exports and foreign competitive imports are low and therefore, it was defined as domestic (according to the input-output table from 2006, the proportion of exports from the total output in the industry in that year was only 3 percent and the rate of competing imports was 4 percent).

In agricultural industries (code 0-4), the division of economic branches into tradable and non-tradable is not clear-cut and varies from one country to another, and therefore, they were excluded from the comparisons in this study. Similarly, the financial industries (code 64-66) were excluded because in Israel, the volume of international trade in these industries is very low, while in some of the comparison countries, the volume of trade was relatively high. In addition, the analysis does not include the mining and quarrying industry (code 5-9).

6 The industries that were defined as public sector and excluded from the study were local administration and public services (codes 99, 84-85); education, welfare, and health (codes 85-88); and water and electricity (codes 35-39).

- The data on productivity that were used for international comparison are based on OECD.Stat, which has detailed information at a lower level (more industries are grouped together).[7] For this reason, the industries that were included in these comparisons were placed into two categories: manufacturing and trade and services as measurements for tradable and non-tradable industries.[8] This division includes about half of those employed in the business sector. It does not include the information and communications industries; financial services and insurance; professional, scientific, and technical services; and management services — for which the division is less clear and varies from country to country.

1. The theory of Conditional Convergence

The theoretical basis of this study is the theory of conditional convergence, which holds that productivity levels in countries with a similar ability to adopt technological innovation that have free movement of capital between them will converge over time. A central prediction of the theory is that over time, countries that start with low productivity will grow at a faster pace. Nevertheless, the evidence for the validity of the theory, at least its basic version, is not clear-cut, and the literature shows that convergence is conditional on a number of characteristics that are unique to each country, such as geographic location, quality of public institutions and government policy. Recently, Rodrik (2012) showed that while productivity per worker tends to converge depending on the characteristics of the country, productivity in manufacturing industries converges independently of these characteristics.

The slow growth in labor productivity in Israel thus contradicts the standard economic theory of conditional convergence. The data for the Israeli economy show that the growth rate of productivity in the past two decades was lower than expected, given the starting level of productivity in 1995. This is evidence that productivity per worker in the Israeli economy is not converging to the level of productivity in developed countries

7 The OECD's structural analysis database contains detailed time series on GDP and employment in the various industries in most OECD countries according to the 2011 classification, but it did not include statistics on Israel at the time this research was conducted. Given this situation, we conducted international comparisons at an industry group level (a more general level in which several industries are grouped together), for which there are data that can be compared starting in 1995.

8 Trade and services includes wholesale and retail trade; hospitality and food services; transportation, storage, postal, and courier services; art, entertainment, and leisure; and other services.

(Appendix Figure 1). Yet here, too, a comparison of productivity in the various branches of the economy shows a more complex picture. As Figure 3 shows, productivity in Israel's manufacturing industries is similar in both level and growth rate to the OECD average, but productivity in trade and services is lower than the average for developed countries and its growth rate is slower. This means that the situation in Israel confirms Rodrik's findings: the performance of the manufacturing industries is similar to those abroad, while productivity in trade and services industries lags behind.

According to Rodrik, the reason that productivity in manufacturing industries converges among countries around the world independently of a country's characteristics is that the companies in these industries produce tradable goods, that is, products that can be imported and exported. Therefore, they face strong competition in the global market. Due to the nature of their products, even when industrial companies produce only for the domestic market, they are under competitive threat from imports. In addition, tradable firms are less affected by regulatory obstacles and malfunctions in the domestic market.

In a later article (2016), Rodrik argues that there are developing countries that do not converge to higher levels of productivity levels because the economy has shifted prematurely from manufacturing to trade and services as a result of an erosion in the domestic industry's competitive advantage in the global market.

2. Incentives to encourage capital investment in tradable industries: Is this efficient?

Many years ago the economic literature documented two stable empirical patterns: tradable industries have a higher growth potential than non-tradable industries, and the gap between them increases with the country's level of development. The literature that developed in the wake of Melitz's article (2003) found that the productivity of exporting firms is higher than that of companies that do not export, even when both companies are in a similar field.[9] The mechanism proposed by Melitz focuses on the fact that companies that have higher productivity from the beginning will be those that choose to export — and will succeed in doing so. Other studies, however, have focused on the opposite direction for causation. Not only will companies that are more efficient initially choose to export, but companies that choose to export will improve their productivity. Greenaway and Kneller (2007)

9 A discussion on this topic can be found in Helpman, 2016.

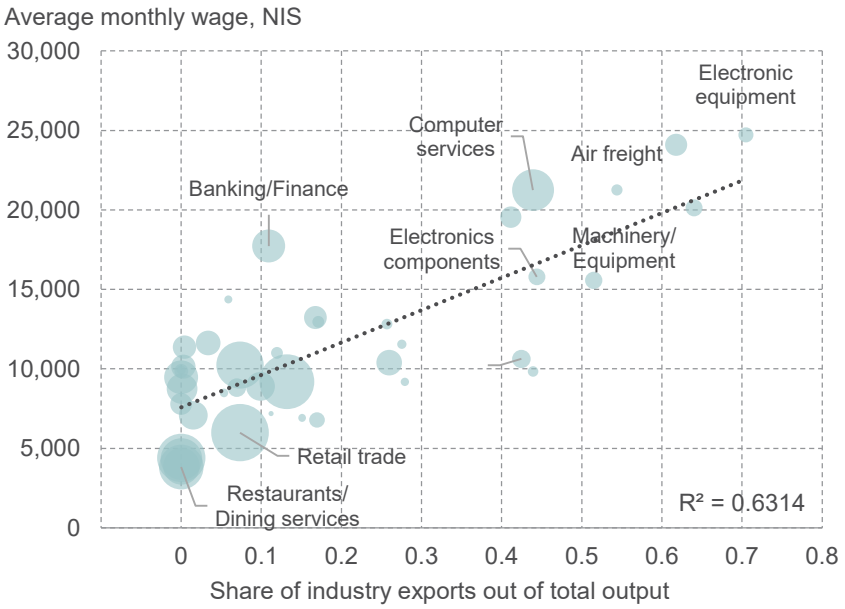
show that exporters are more exposed to the technological frontier and that they face strong competition in the global market and thus gain more experience as a result of exposure to new markets. For this reason, exporters are characterized by higher productivity. In a study of Israeli companies in the years after the lifting of trade barriers in the early 1990s, Gallo (2011) found that productivity of exporters was higher than that of non-exporting firms and that productivity of companies that started to export grew faster than that of companies not operating in the international market. Helpman, et al. (2010, 2017) showed that exporters tend to employ better skilled workers and to pay higher wages than companies that do not export, even to workers with the identical skill level.[10] Recently Macis and Schivardi (2016) showed that the high wages in exporting firms result from a combination of compensation for the workers' high level of skills and rent sharing.

The positive correlation between exports and employee wages is especially important for this study, and it is apparent in various branches of the economy. Figure 4 shows average wage levels in various industries versus the rate of exports in the industry (out of total output). The number of workers in each industry is represented by the size of the circle. It can be seen that non-exporting industries employ a large number of workers and that only a relatively small percentage of the economy is engaged in the international markets.

10 The authors show that this result is possibly due to labor market friction.

Figure 4. The relationship between exports and wage levels, 2010

The size of the circle represents the number of workers in the industry



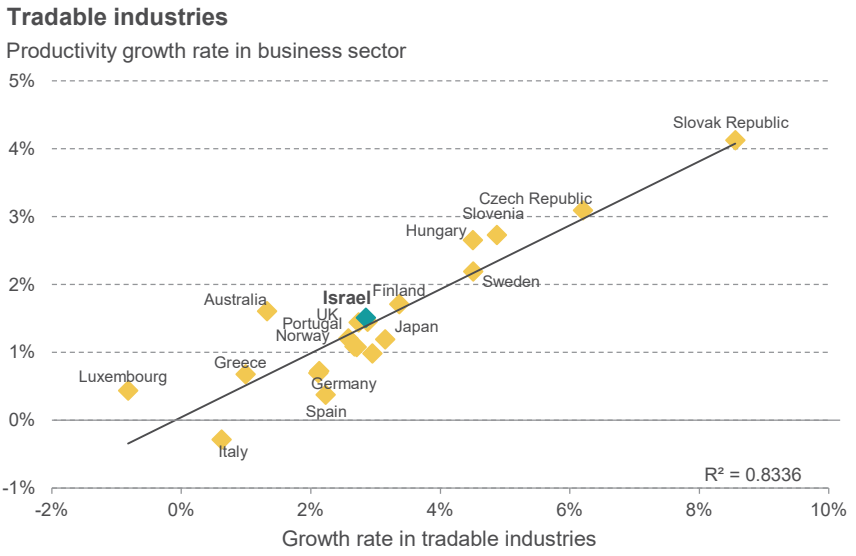
Source: Gilad Brand, Taub Center | Data: CBS, Supply and Use Tables; Survey of Industries; Survey of Trade, Services, Transport, Communications and Construction, 2010

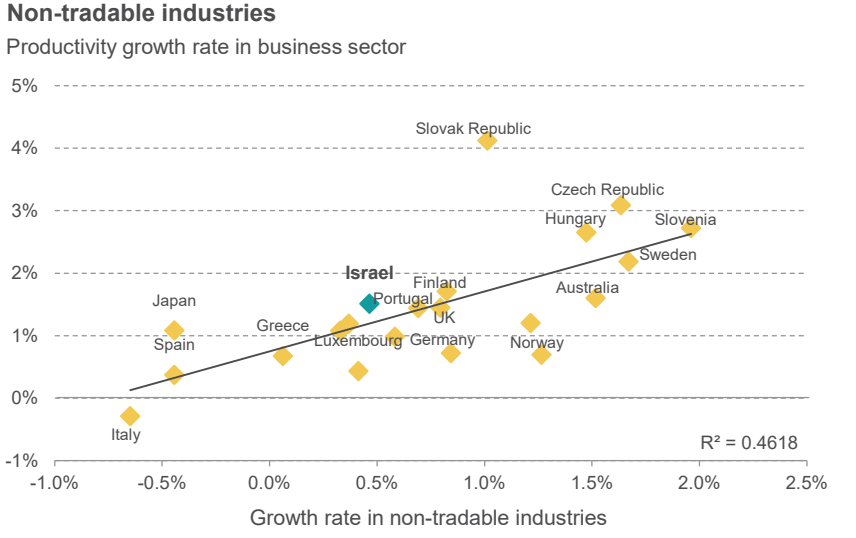
A prevalent assumption in the literature is that exporting industries are more affected by technological innovation, and therefore, their growth potential is greater. Figure 5 confirms this assumption. It presents the connection between the growth of productivity per worker in the entire economy and its growth in manufacturing industries (Figure 5a) and trade and services (Figure 5b) representing tradable and non-tradable industries, respectively. The figure shows that the average growth rate in manufacturing industries is more than twice that of trade and services industries, and thus, it is better correlated with growth in productivity in the business sector, despite the fact that share of trade and services' in the GDP is smaller.[11] This means that the growth of a modern economy depends on: (i) the proportion of the total economy associated with tradable industries; and (ii) productivity in that sector.

11 The annual growth rate in the economy is the weighted average of growth in all industries in that year, with the weights being the industries' share in GDP. Because of the weights, it is to be expected that there will be a higher correlation between aggregate growth and growth in the larger industries, and those with faster growth. In this case, growth in manufacturing industries is correlated with aggregate growth to a greater extent, because the rapid growth in these industries compensates for the fact that their share in GDP is lower than that of the trade and services industries.

Figure 5. The relationship between productivity growth in the business sector and productivity growth in tradable and non-tradable industries

Average growth rate from 1995-2015 in real terms





Notes: In this comparison, tradable industries are represented by manufacturing industries. Non-tradable industries are represented by: trade and services; wholesale and retail trade; hospitality and food services; warehousing, postal and courier services; culture and entertainment; and other services. Data were available for 22 OECD countries. Latvia's growth rate was unusually high and so was not included in this analysis.

Source: Gilad Brand, Taub Center | Data: OECD.Stat

That being the case, it appears that productivity in non-tradable industries tends to grow at a relatively slow pace. However, under certain conditions, it can be expected that growth in tradable industries will also have a positive effect on wages and productivity in non-tradable industries.

According to economic theory, a positive shock in productivity in a particular industry — in this case, tradable industries — increases demand for workers in the industry and as a result, initially, both wages and employment will grow. If workers in the export industry are perfect substitutes for workers in non-tradable industries (identical in every way), and if there is full mobility between industries, then employment in non-tradable industries will decrease (because the workers will move to tradable industries, where wages are higher), and wages will rise to the same extent as in tradable industries, where the increased number of workers will decrease marginal output. In such a case, domestic companies can be expected to raise prices, which would lead to a rise in prices of non-tradable goods and result in a real appreciation of the local currency. In contrast, the price of tradable goods is determined in the global market, and therefore, it can be expected to remain unchanged, so that the ratio of prices of non-tradable goods to tradable goods will increase. As a result, the domestic industry workers' standard of living can be expected to improve because their wages will rise, while the price of their consumption basket will rise less than the wage increase. This is because the basket includes non-tradable goods that have gone up in price and tradable goods that have not.

In the real labor market, however, the situation is different. Workers in various industries are not perfect substitutes for each other due to worker skill heterogeneity. Different companies employ workers with different skills, and thus there is no such thing as full mobility between industries — and accordingly, wages in the various sectors are not equal and this mechanism exists to a more limited extent. These processes were described for the first time by Balassa (1964) and Samuelson (1964) as an explanation for the development of the real exchange rate.[12]

12 The Balassa-Samuelson effect appears to provide a good explanation of the process of appreciation in countries that have undergone modernization (Japan, Korea, and other East Asian countries are obvious examples). However, it occurs to a lesser extent in countries whose level of development is close to the global technology front. While the evidence and conditions for the existence of the Balassa-Samuelson effect are not unambiguous, it is a cornerstone of modern macro-economic models.

The Balassa-Samuelson model shows that:

1. The growth of the economy will be accompanied by an increase in the ratio between the productivity of tradable industries and productivity in non-tradable industries ("relative productivity"), and therefore, wealthy countries can be expected to have higher relative productivity.

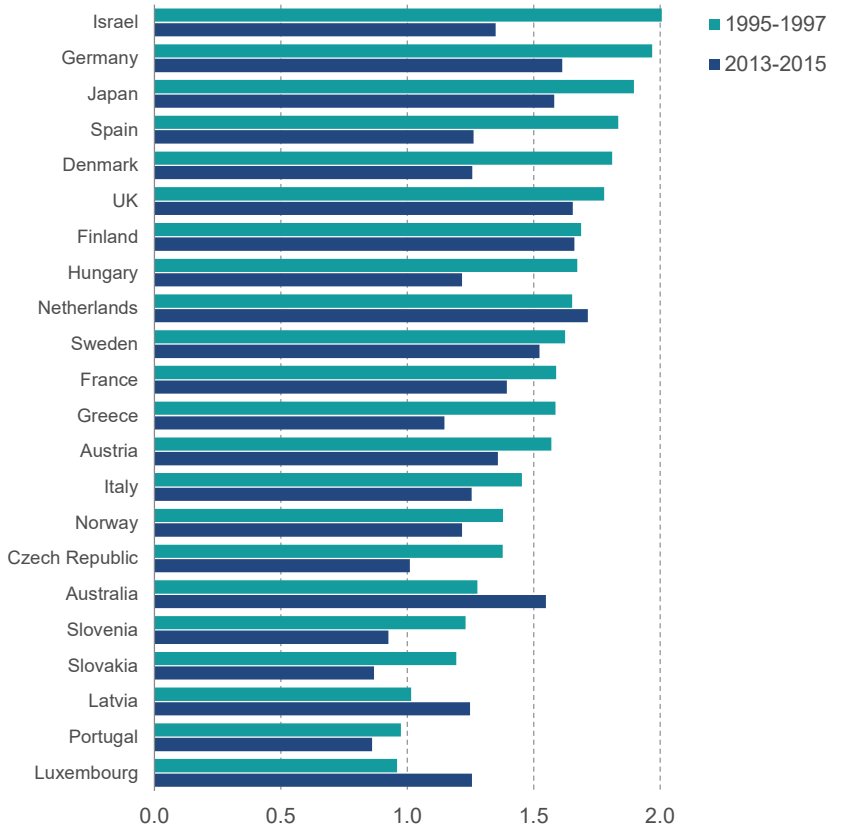
2. Increased productivity in tradable industries can be expected to lead to a nominal increase in productivity per worker in all branches of the economy (in terms of the purchasing power of a uniform currency — the value effect).

However, when mobility between industries is weak and increased productivity in tradable industries does not lead to a change in the distribution of workers between the industries, the results of the Balassa-Samuelson model are not valid, In such a case, wages in the two groups of industries will develop differently and independently.

Productivity in tradable industries: An international comparison of its effect on the whole economy

The series of figures below examine the validity of the hypotheses described above. Figure 6 presents relative productivity in OECD countries with available data. It shows that in Israel, the ratio between labor productivity in tradable industries and labor productivity in non-tradable industries is higher than the ratio in other countries and similar to the ratio in Germany and Japan, which are more developed than Israel. It also shows that relative productivity has expanded greatly over the past two decades.

Figure 6. Relative productivity: The relationship between productivity in manufacturing and trade and service industries
Average for 2013-2015 versus 1995-1997, in current PPP dollars



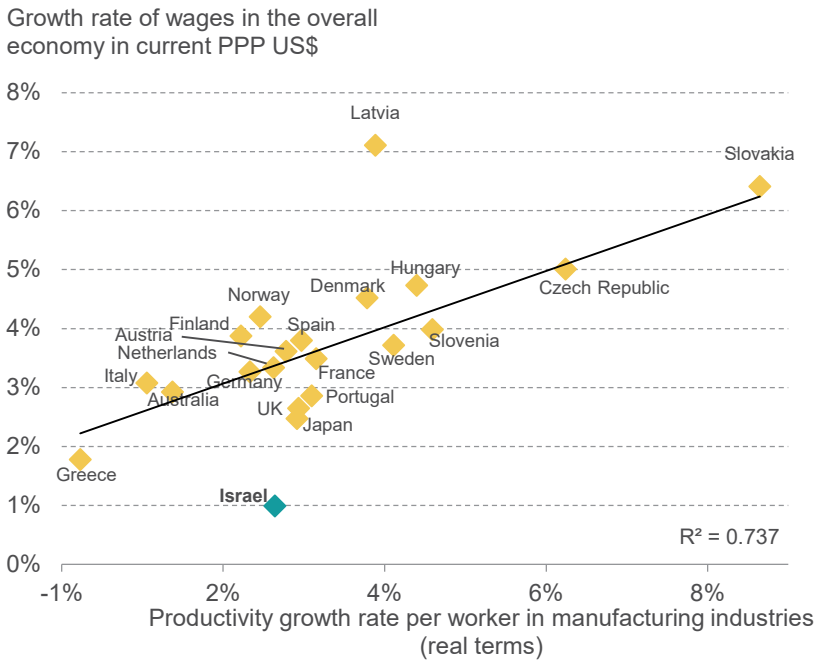
Notes: In this comparison, tradable industries are represented by manufacturing industries. Non-tradable industries are represented by trade and services which consists of wholesale and retail trade; hospitality and food services; warehousing, postal and courier services; culture and entertainment; and other services. Data were available for 22 OECD countries.
Source: Gilad Brand, Taub Center | Data: OECD.Stat

According to the Balassa-Samuelson explanation, when productivity in tradable industries rises, wages can be expected to rise in other industries as well, with a rise in prices and real appreciation as the expected result. In other words, it was to be expected that the increased productivity in tradable industries would lead to an increase in the cost of labor in the

economy relative to other countries. Figure 7, shows the relationship between the real change in productivity in manufacturing industries, representing the tradable side, and the change in nominal wages, in current dollars according to purchasing power parity. The comparison shows that in countries in which productivity improved, wages in the entire economy rose relative to other countries. However, the Israeli economy deviates from the relationship between the variables. Wages in Israel grew more slowly than expected, given the growth in productivity in manufacturing industries. Israel's economy is exceptional from this standpoint, even when the growth in manufacturing is compared to the nominal growth in productivity per worker in the entire economy (Figure 8).

Figure 7. Rate of growth in productivity in manufacturing industries and the rate of growth in wages in the overall economy

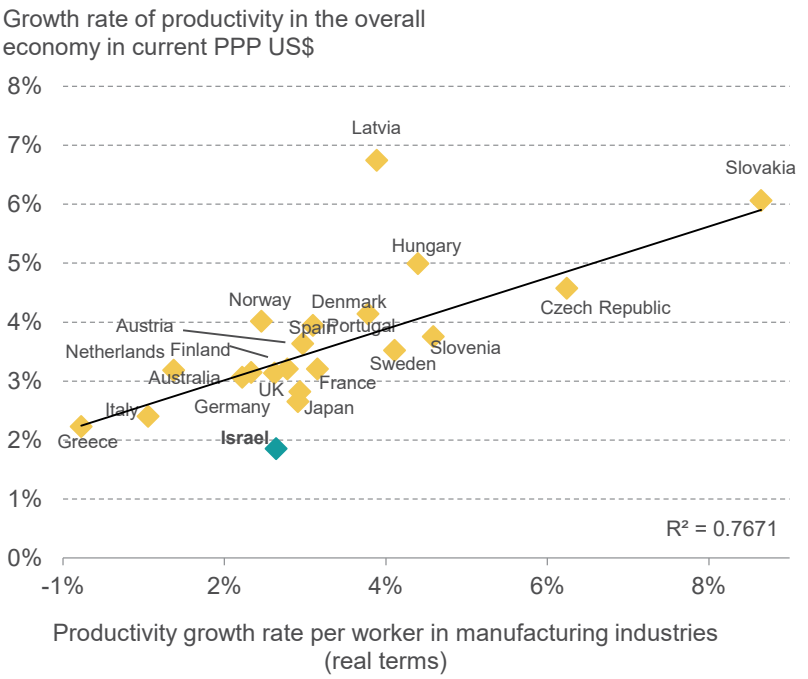
Annual average growth, 2000-2015



Notes: Data were available for 22 OECD countries. Israel and Latvia were exceptional relative to the other countries and so the R-square was calculated without them.
Source: Gilad Brand, Taub Center | Data: OECD.Stat

Figure 8. Growth rate in productivity in manufacturing industries and the overall economy

Average annual growth, 2000-2015



Notes: Data were available for 22 OECD countries. Israel and Latvia were exceptional relative to the other countries, and so the R-squared was calculated without them.
Source: Gilad Brand, Taub Center | Data: OECD.Stat

It was also found that the correlation shown in these figures exists only in manufacturing industries; in other industries in the business sector, the correlation is much weaker. This is true even when the comparison was conducted using industries larger than manufacturing in terms of employment and GDP. The results also remained the same when the correlation was calculated over different time periods.

If Israeli manufacturing industries share in total employment was lower than other countries in the comparison, this could have explained the fact that Israel's economy was found to be an outlier in this comparison. However, Israel does not deviate substantially in this respect from other developed countries, and thus it appears that another explanation is needed.

Heterogeneity in worker skills

The mechanism described here is based on the assumption that there is worker mobility between tradable industries and non-tradable ones and that wages in one sector can affect wages in the other. In Israel, however, this mobility appears to be especially low. In fact, in a statistical analysis that includes a more precise distinction between tradable industries and non-tradable industries, no evidence was found of a long-term connection between the sectors, and it appears that wages in the two groups diverge from each other (Appendix Table 1).

A possible explanation is the disparity in the labor market: the worker skill set in tradable industries is very different that of workers in other industries in terms of their education and skills. As noted, such a situation weakens the Balassa-Samuelson effect, makes worker mobility less likely, and causes employee wages in every sector to develop differently and independently. This hypothesis was raised by Lavi and Friedman (2007).

In order to examine if this is the case in Israel, we will examine employee characteristics in both groups using the PIAAC survey, which looks at the skills of the adult population in several developed countries.[13] The survey includes detailed data that enable us to make a more accurate distinction between tradable industries and the non-tradable industries.

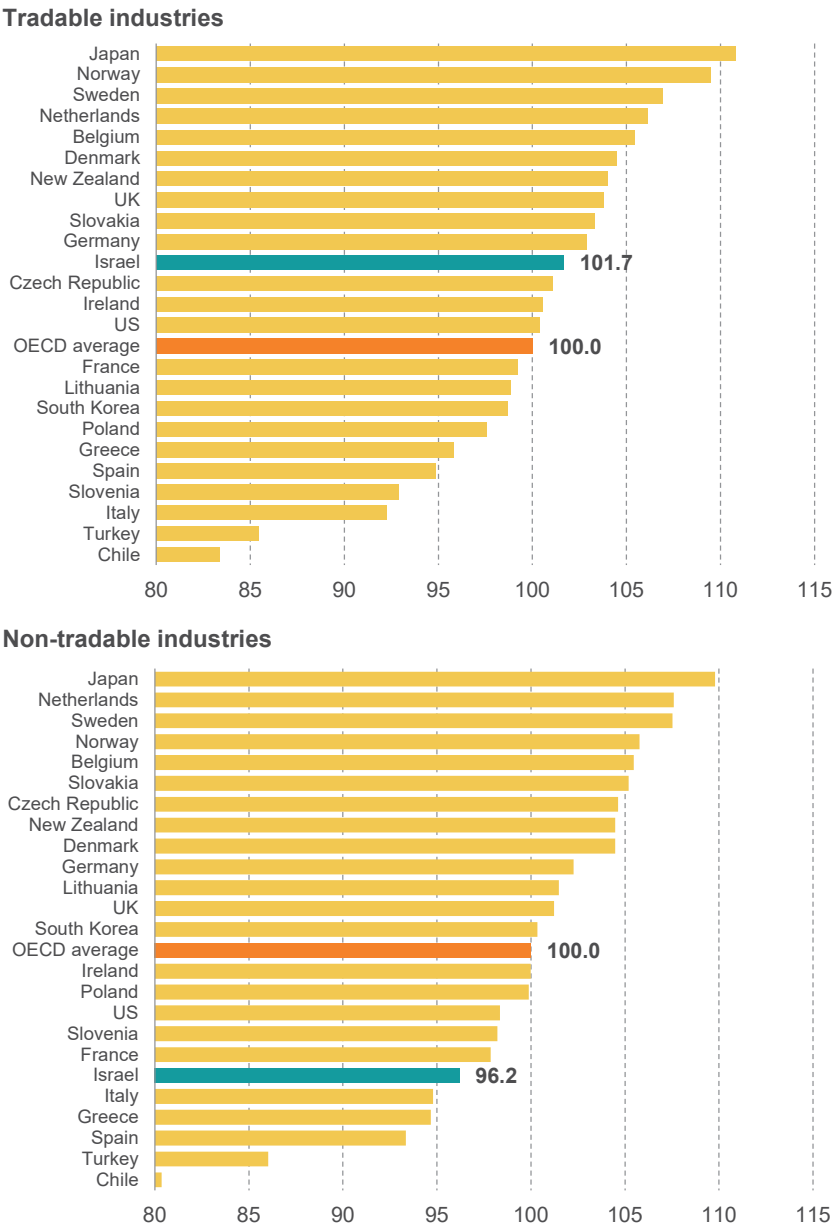
First, we present the achievements of workers in both groups. Figure 9 shows that the skill level of workers in non-tradable industries is low in an international comparison, while export-industry worker skills are on average high. Further, the gap between workers in the two groups in Israel is much higher than the average relative to other countries (Figure 10).[14]

13 The survey includes three areas of knowledge: literacy, numeracy, and problem solving in technology-rich environments. Some countries lack data on achievements in the last part, so it is not included in some of the comparisons.

14 The differences are especially large between educated workers, while the differences between workers with a high school education are relatively similar to other OECD countries.

Figure 9. Skill level of workers in the business sector

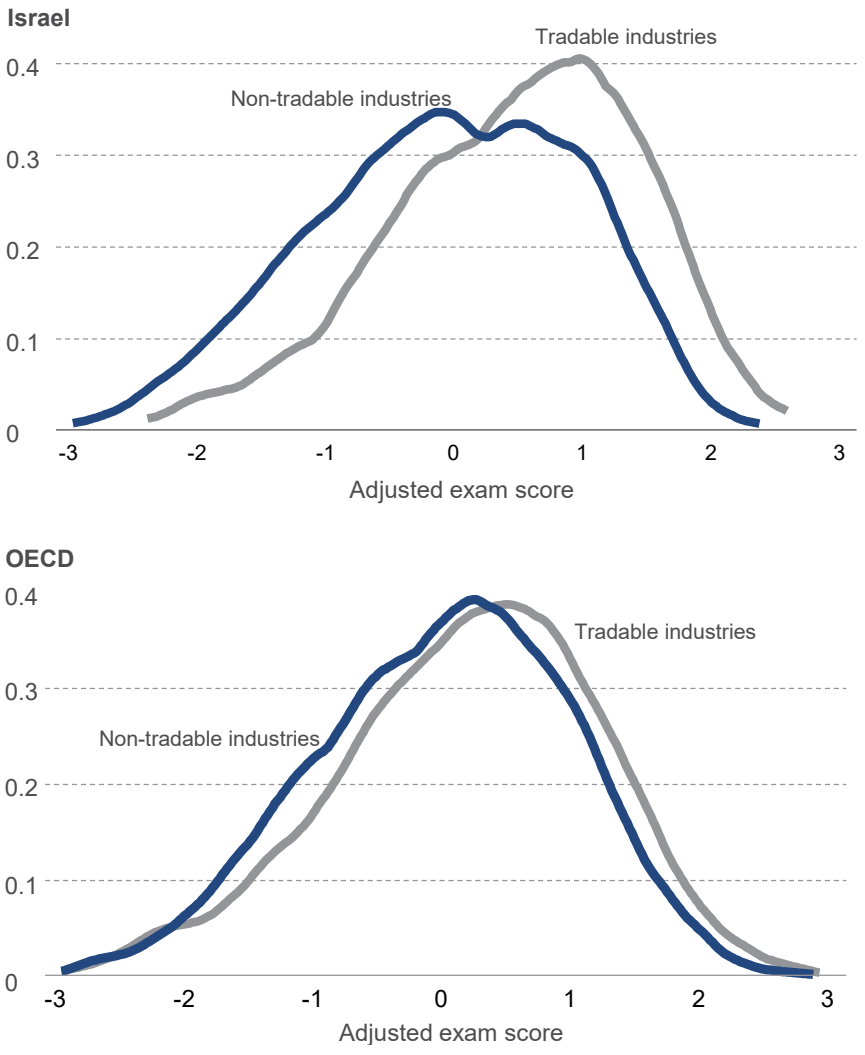
Achievement on the adult skills exam (PIAAC), average of 24 countries = 100



Notes: Weighted average of the exam sections, without problem solving in technology-rich environments. Tradable industries: high tech services excluding communications; scientific research and development; manufacturing (excluding paper and printing and beverages and tobacco); air and sea transport. The remaining industry branches were categorized as non-tradable (local) industries. The branches of agriculture, quarrying and mining, finance, water and electricity were not included in the comparison.
Source: Gilad Brand, Taub Center | Data: OECD Survey of Adult Skills (PIAAC)

Figure 10. Worker skills levels

Distribution of achievements on the adult skills exam (PIAAC)

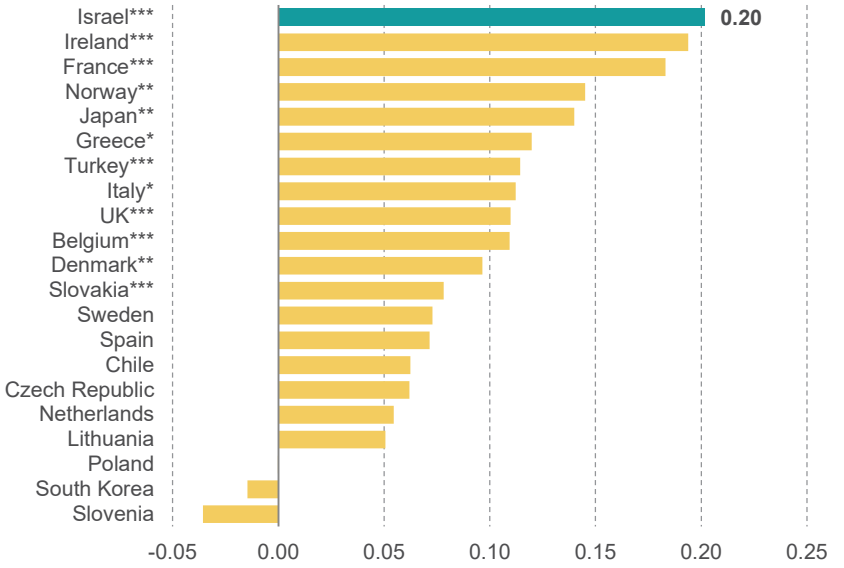


Notes: The score is a simple average of the exam sections compared separately for each country: Belgium, Chile, Czech Republic, Denmark, Germany, Greece, Ireland, Japan, Netherlands, New Zealand, Poland, Slovakia, Slovenia, South Korea, Sweden, Turkey, US, and UK. Tradable industries: high tech services excluding communications; scientific research and development; manufacturing (excluding paper and printing and beverages and tobacco); air and sea transport. The: remaining industry branches were categorized as non-tradable (local) industries. The branches of agriculture, quarrying and mining, finance, water and electricity were not included in the comparison.
Source: Gilad Brand, Taub Center | Data: OECD Survey of Adult Skills (PIAAC)

The gaps between the sectors in Israel remain relatively high in a statistical analysis that controls for differences in occupations and other observable worker characteristics. In this comparison, an average gap of some 0.2 standard deviations was found between the two industry groups, a higher rate than in all other comparison countries (Figure 11).

Figure 11. Disparities in worker skills levels: Workers in tradable vs non-tradable industries

In standard deviations, after controlling for occupation and observable worker differences

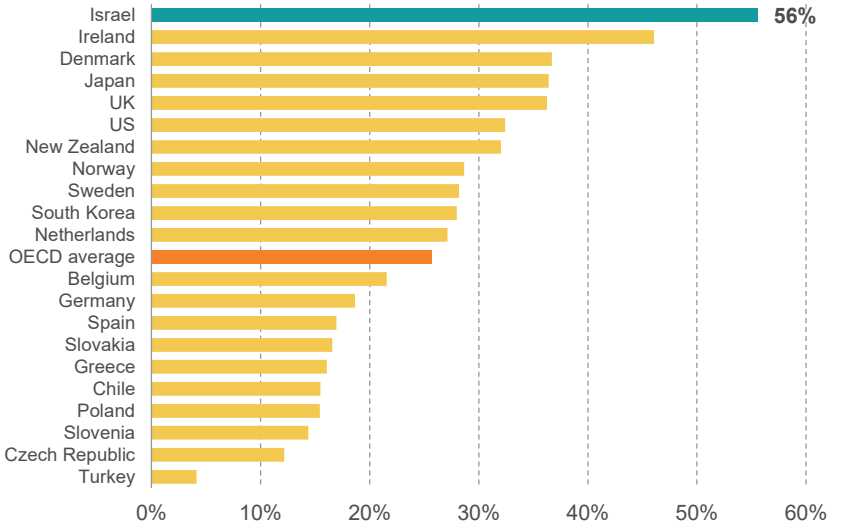


Notes: * p < 0.1; ** p < 0.05; *** p < 0.01.
The score is a simple average of the exam sections (without problem solving in technology-rich environments). The comparison included controls for occupation at the 2 digit classification level and observable worker characteristics (marital status, age, gender, mother tongue, and country of origin). Tradable industries: high tech services excluding communications; scientific research and development; manufacturing (excluding paper and printing and beverages and tobacco); air and sea transport. The remaining industry branches were categorized as non-tradable (local) industries. The branches of agriculture, quarrying and mining, finance, water and electricity were not included in the comparison.
Source: Gilad Brand, Taub Center | Data: OECD Survey of Adult Skills (PIAAC)

The disparity between the skill levels of workers in tradable industries and those in the rest of the economy exists to a certain extent in every country. However, it may be that the Israeli economy is distinguished by the makeup of the tradable industries, which are more heavily concentrated

in high tech than they are in other OECD countries (Figure 12). In an international comparison, the Bank of Israel (2012) shows that the human capital and technological intensity of Israeli exports is large, and unusual considering the relative low level of per capita GDP. Frisch (2015) shows that this trend has developed since the 1990s. The Ministry of Finance (2017), which examined the extent of concentration of Israeli exports by products, finds that it is nearly double the average of other OECD countries. These findings can also be seen in Figure 15, which shows that nearly 60 percent of workers in tradable industries are employed in high tech, a significantly higher percentage than in other developed countries.

Figure 12. Share of workers in high tech out of all workers in tradable industries



Notes: Tradable industries: high tech services excluding communications; scientific research and development; manufacturing (excluding paper and printing and beverages and tobacco); air and sea transport.
Source: Gilad Brand, Taub Center | Data: OECD Survey of Adult Skills (PIAAC)

An over-reliance on a limited number of areas of activity based on the most capable workers excludes the rest of the workers in the economy from employment in the tradable sector. Thus, while the percentage of workers employed in tradable industries in Israel is similar to the percentage in other developed countries, the diversity of employment in tradable industries other than high tech is relatively low.

The sharp differences in worker skills could explain the weak connection between the sectors, but the differences in the return on skills also appear contribute. The economic literature shows that higher productivity in tradable industries allows employers to compensate their workers with higher wages even when their skill level is identical to that of workers in non-tradable industries. Figure 13a shows that while this situation exists in other countries, in Israel, the gap on the return for skill between the two industry groups is the largest out of the comparison countries (Figure 13b).

Figure 13a. Return on skills among workers

The rise in per hour wage with an increase of one standard deviation in worker skill level

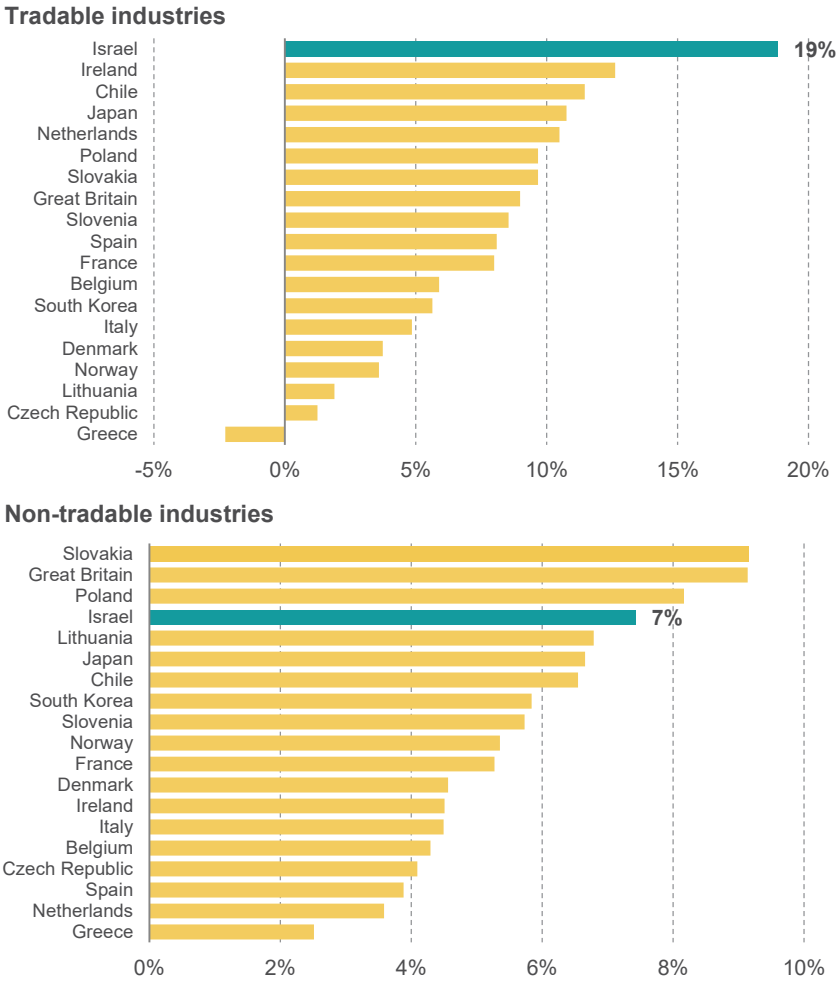
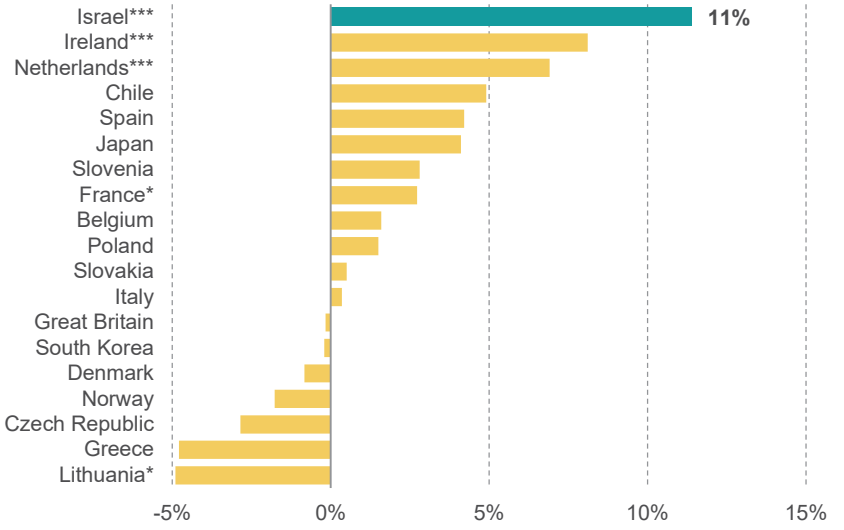


Figure 13b. Difference in return on skills: Tradable industries compared to non-tradable industries (percentage points)



Notes for all three figures: * p < 0.1; ** p < 0.05; *** p < 0.01.
Returns are calculated using the typical Mincer equation that includes controlling for occupation at the 2 digit classification level and observable worker characteristics (marital status, age, gender, mother tongue, and country of origin). The skill level is a simple average of the exam sections (without problem solving in technology-rich environments; PIAAC).
Tradable industries: high tech services excluding communications; scientific research and development; manufacturing (excluding paper and printing and beverages and tobacco); air and sea transport. The remaining industry branches were categorized as non-tradable (local) industries. The branches of agriculture, quarrying and mining, finance, water and electricity were not included in the comparison.
Source for all three figures: Gilad Brand, Taub Center | Data for all three figures: OECD Survey of Adult Skills (PIAAC)

A possible explanation for the level of concentration in Israeli high tech exports is that Israel has a clear comparative advantage in this field. Nevertheless, this appears to be insufficient as an explanation for the high concentration of Israeli exports relative to other countries; the government incentives provided over the years to encourage investments in this area have apparently also contributed to this situation.

In summary, the conclusion from the comparisons is that tradable industries employ the most capable workers and compensate them with higher wages.[15] It is reasonable to assume that the level of substitution

15 Brand and Regev (2015) found evidence of a decline in worker mobility between sectors.

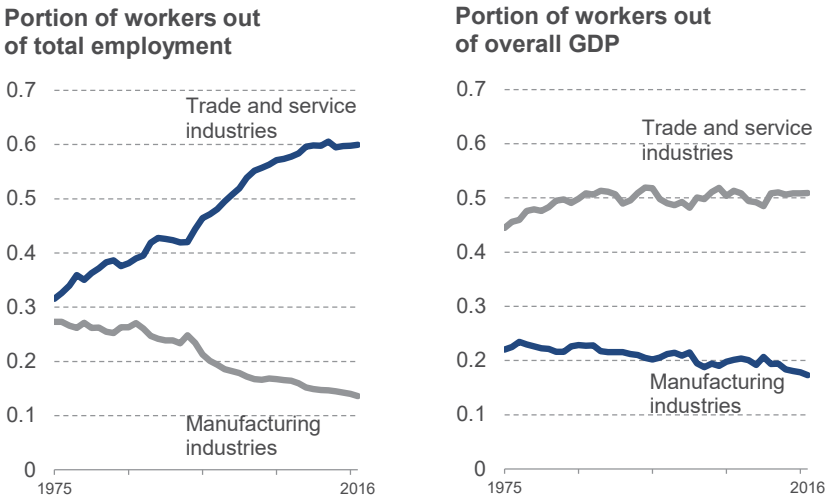
between workers in the tradable and other industries is low. This situation has apparently intensified over the years, and, the connection between wages in the two sectors has weakened over time. Given the extreme disparities observed, which in effect create two separate labor markets, the effectiveness of incentives to encourage capital investment in tradable industries as a means of improving productivity in non-tradable industries is questionable.

3. An alternate approach: Focusing on non-tradable industries

Economic theory and historical experience show that the road to realizing the aggregate potential of the economy passes through the area in which Israel has a comparative advantage: tradable industries. However, given the circumstances of the Israeli economy and the existing makeup of the labor force, and taking into account distributive considerations, it may be appropriate to consider an alternative route: a focus on non-tradable industries. The question, however, is whether such an investment is likely to lead to increased productivity.

The inherent disadvantage of non-tradable industries is their limited growth potential. They are less affected by technological innovation and depend solely on domestic demand, which by its nature is limited and depends on the income level of the domestic economy (see Rodrik, 2015). This is clearly shown in Figure 14, which presents the share of trade and services in GDP and employment over four decades. Despite the sharp increase in the percentage of workers in the trade and services industries, their share in GDP has remained almost unchanged for four decades. As a result, an increasing number of workers is dividing a share of the GDP pie that has not grown larger.

Figure 14. The portion of tradable and non-tradable industries out of total employment and its share in GDP, the business sector



Notes: Industry categorization in the earlier years did not allow division into tradable and non-tradable industries. The manufacturing branches in this figure represent tradable industry and the trade and services branches represent non-tradable industries.
Source: Gilad Brand, Taub Center | Data: Statistical Appendix to the Bank of Israel Annual Report 2016

The PIAAC Survey of Adult Skills finds that human capital in the non-tradable industries is relatively low yet the proportion of workers with formal higher education in these industries is relatively high. This contrast casts doubts on the effectiveness of higher education as a mean to increase workers' skill sets and improve productivity. The Bank of Israel (2014) shows that industries with low export rates have a high proportion of college graduates compared to other countries, and a low proportion of positions that require academic education.[16] This is consistent with Figure 16, which shows the relative abundance of college-educated workers relative to demand. In this context, it is worth noting that recent evidence in the literature shows that an increase in the proportion of educated individuals in the population

16 The Bank of Israel (2016b) found a negative correlation between disparities in productivity relative to other countries and disparities in the formal education of workers, and a positive correlation between the productivity gap and the skills gap measured in the PIAAC test.

is not necessarily translated into an increase in labor force skills,[17] and thus it appears that a further increase in access to formal education will not help much in improving the quality of employment in non-tradable industries.

Another possibility for improving productivity in non-tradable industries is to encourage capital investment. According to the Bank of Israel (2013), the rate of investment in manufacturing industries is high because they are exposed to external competition, which makes it necessary for companies to adopt advanced technologies, while investment in other branches of the economy is low. Thus, providing incentives to encourage capital investments in non-tradable industries may help to improve productivity in this sector. Nevertheless, such an investment carries a risk. The conventional argument is that in industries whose labor force is especially cheap, there is little incentive to improve technology, and it is reasonable to assume that the availability of cheap labor in non-tradable industries is what has prevented investments in machinery and advanced equipment over the years.[18] However, if it is the availability of unskilled workers that is preventing the adoption of new technology, then these workers act as a substitute for technology.[19] Encouraging the use of more advanced technologies in non-tradable industries, therefore, cannot be expected to improve the wages of workers in these industries: if more advanced technologies were introduced, unskilled workers would be pushed into industries in which productivity is even lower, or into unemployment. It would appear, therefore, that this is not a viable solution to low productivity in this segment.

To summarize, a focus on incentives for investment in non-tradable industries as a means of improving low productivity in this sector does not appear to be the optimal solution. These industries, by their nature, are less affected by technological innovation and therefore, their growth potential is relatively low. In addition, demand for these industries is solely domestic, which depends on income constraints in the economy. Furthermore, non-tradable industries are characterized by a relative abundance of low-skilled workers. Providing incentives to purchase advanced technologies could help productivity to a certain extent, but is likely to lead to unskilled workers' being pushed into industries in which productivity is even lower, or into

17 See the discussion in Hanushek (2017).

18 The Bank of Israel (2016b) found that the inferiority of the non-tradable industries in relation to other countries is correlated with a low worker skill level.

19 One way to define the substitutability of factors of production is this: Factor of production A is a substitute for factor of production B if a decrease in the price of factor A will cause a decrease in demand for factor B. Therefore, the claim that the availability and low cost of unskilled workers reduces demand for advanced technologies in non-tradable industries assumes that these workers are substitutes for advanced technology.

unemployment. On the other hand, tradable industries have the possibility of expanding in almost unlimited ways as long as there is economic justification for continuing production at the price set in the world market.

4. Other approaches to improving labor productivity

A change in trade policy and the current system of incentives

Diverting employment in non-tradable industries toward tradable industries, as proposed in the previous section, would, of course, require suitable worker training. However, even diversification of exports, which would make it possible to expand employment opportunities in this sector, could lead to more Israeli workers employed in tradable industries. This argument is reinforced by the fact that the concentration of Israeli exports in high tech products is apparently due not only to Israel's comparative advantages in this area, but also to government incentives that were a part of the regulations to encourage capital investment and as part of other policy measures on international trade. This section focuses on the contribution made by various policy measures to the concentration of Israeli exports in the high tech industry.

The Ministry of Finance shows that most of the cost of the benefits was concentrated in four large companies, and that 10 percent of the beneficiary companies received some 90 percent of the total cost of the benefits (Ministry of Finance, 2015, p. 223). These benefits contribute directly to the high level of concentration of Israeli exports. The cost of these incentives is reflected not only in the potential tax revenues foregone, but also in a distortion of resource allocation in the economy through their influence on the exchange rate. The non-uniform tax rates encourage activity by several large exporters at the expense of others. Since the activity of the large exporters leads to a significant flow of foreign currency into the economy, it causes a strengthening of the shekel. As a result, it decreases competitiveness of other exporters, which places an especially heavy burden on tradable firms that are not in high tech, which have lower profit margins. For such companies, relatively small changes in the exchange rate can be the difference between successful export activity and an inability to export.

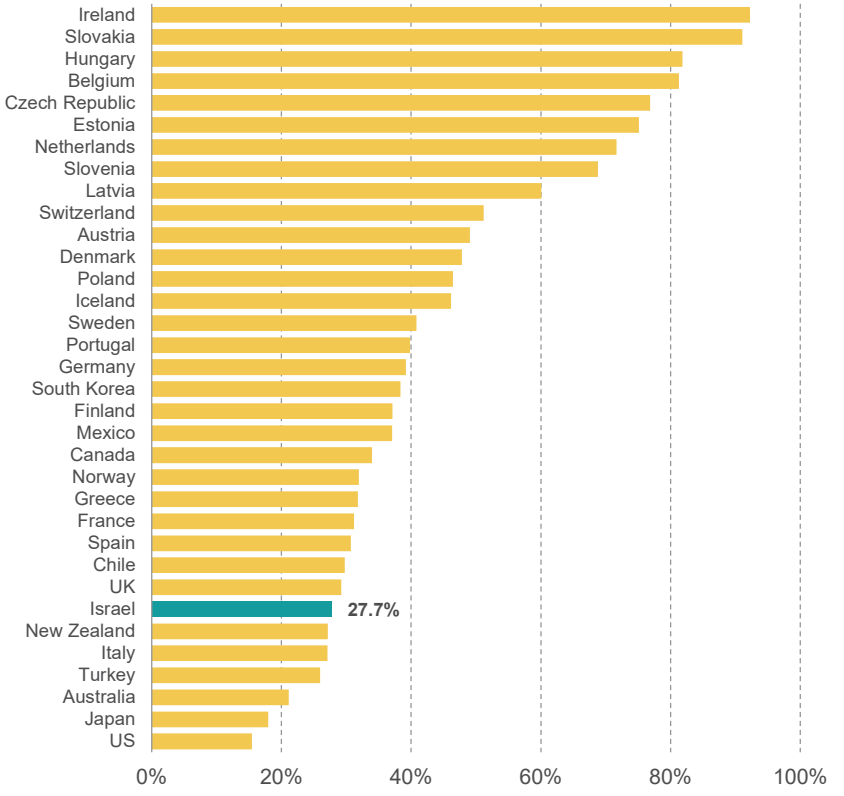
While an aggressive policy to encourage tradable firms was successfully implemented in Ireland, it should be noted that the Irish model is not relevant to Israel and it is difficult to learn from it, since Ireland is a member of the

Eurozone and thus can manage a surplus in the balance of payments without an effective influence on its currency. In other words, large exporters in Ireland do not make exporting difficult for smaller companies in industries with relatively low profit margins.

In addition to the direct distortion in resource allocation caused by the lack of uniformity in tax rates, the benefits given to the giant exporters are one of the causes of the low diversity of Israeli exports. It would appear, therefore, that it is better to set uniform tax rates in order to prevent a distortion in resource allocation.

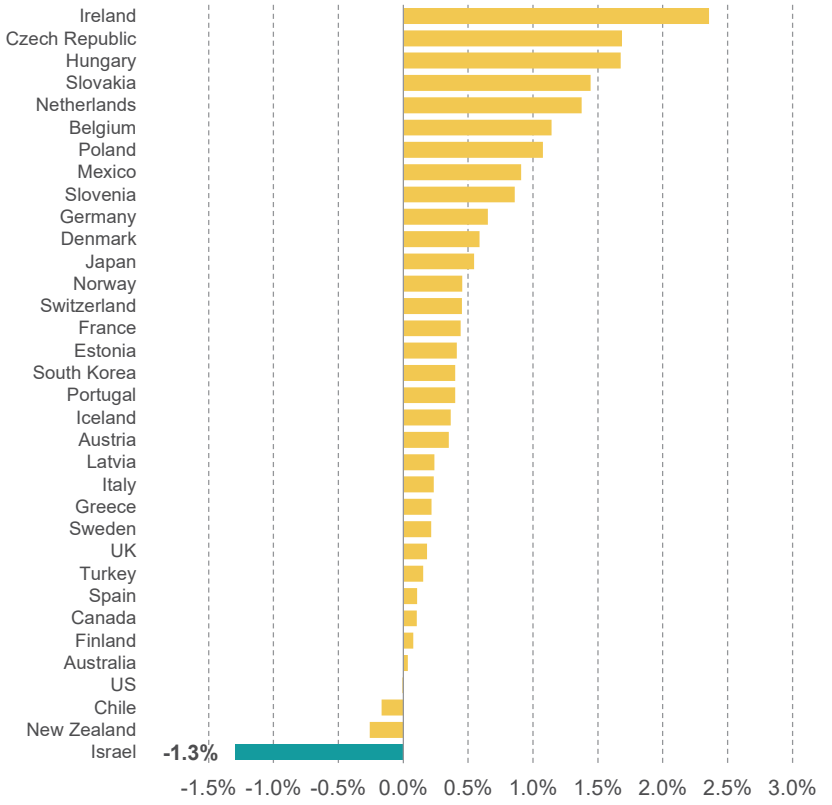
Another significant factor that burdens exporters is various barriers to import. Israel is ranked low in the OECD's Trade and Services Restrictiveness Index and in the various sections of the World Bank's Doing Business Index, which examine the ease of international trade. The Lang Committee Report (2014), which discussed the subject, points to the high level of concentration in the import sector and shows that the Israeli economy has many non-tariff barriers to trade, such as extensive regulation by government authorities, unique standards for the Israeli market, and arrangements that are burdensome for parallel importing. These factors create barriers to market entry for new players and reduce competition. As a result, the volume of imports to Israel is smaller than in most OECD countries (as a percentage of GDP), even though small economies tend to be more open to international trade (Figure 15). Moreover, Israel's is the only economy in the OECD in which there has been a decline in the volume of imports in the past decade (Figure 16).

Figure 15. Share of imports out of GDP in the OECD countries, 2015



Source: Gilad Brand, Taub Center | Data: World Bank

Figure 16. Average annual change in the share of imports out of GDP, 2006-2015

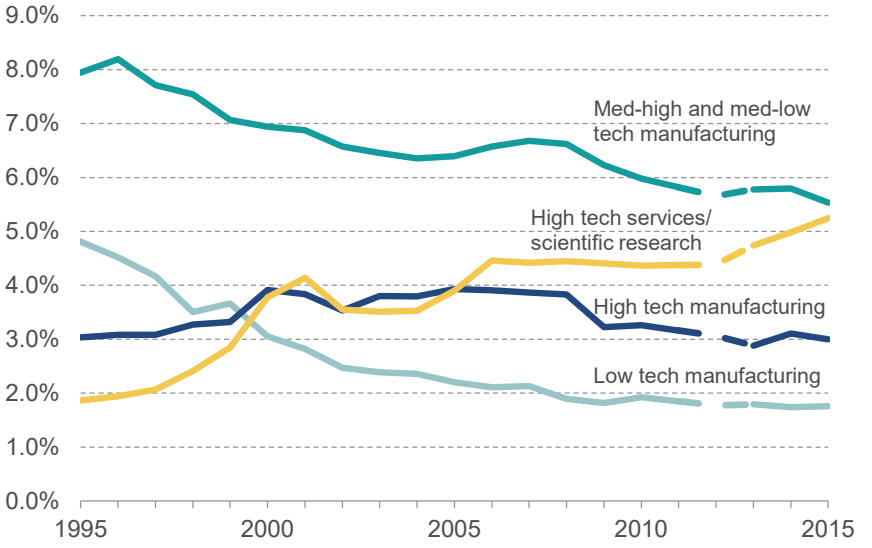


Source: Gilad Brand, Taub Center | Data: World Bank

Since the volume of imports largely determines the volume of exports, through the exchange-rate mechanism, the volume of exports in Israel is also low in an international comparison and getting lower. For this reason, the rate of employment in most sectors in the tradable industries is also declining (Figure 17). The decline in the volume of trade is a relatively new phenomenon. In fact, until the middle of the previous decade, the volume of trade was growing at a rate similar to the OECD average (Figure 18). The reduction in trade prevents the economy from exploiting its comparative advantages and therefore, is not a positive sign in the long term.

Current trade policy reduces the volume of imports in the economy while allocating resources to encourage activity by tradable firms. The justification for the policy is not clear, since exports tend to equalize over time through the exchange-rate mechanism. For example, restricting imports leads to appreciation of the shekel and thus reduces the profitability of tradable firms in the economy, while a few large exporters are given economic incentives at the expense of other exporters. All of these measures support the ongoing surplus in the balance of payments, and lead to an appreciation of the exchange rate. This factor is especially burdensome for tradable firms that are not in high tech, which have lower profit margins, and contributes to a high level of concentration of Israeli exports in high tech industries.[20] In order to solve this problem, we should consider making import policy more flexible and applying uniform tax rates.

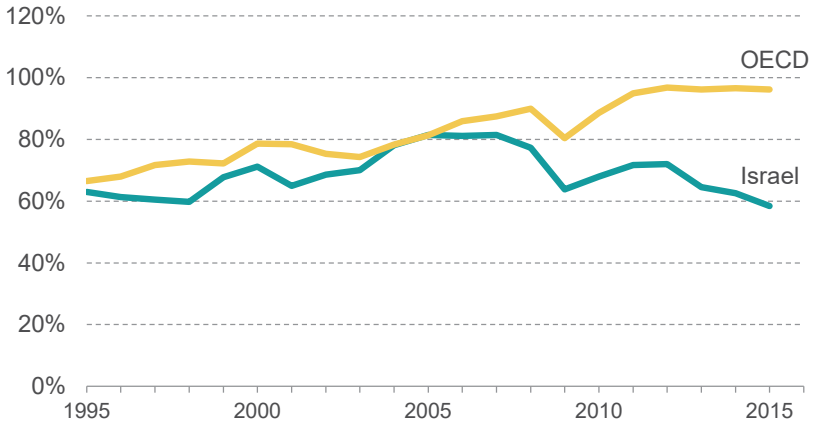
Figure 17. Share of workers in tradable industries as a percent of all employees, selected industries



Notes: Paper, printing, food, beverages and tobacco, which have very low levels of export were excluded from the calculations. As the result of changes in the categorization of industry branches in the CBS Labor Force Survey there is a break in the series in 2012. The data are chained to the level after the break.
Source: Gilad Brand, Taub Center | Data: CBS, *Labor Force Survey*

20 The Bank of Israel (2017) finds evidence that the strengthening of the currency in recent years had a negative impact on activity in export industries. A stronger effect was found in less technologically intensive industries.

Figure 18. Trade levels: Share of imports and exports out of GDP



Source: Gilad Brand, Taub Center | Data: World Bank

Improving mobility between sectors

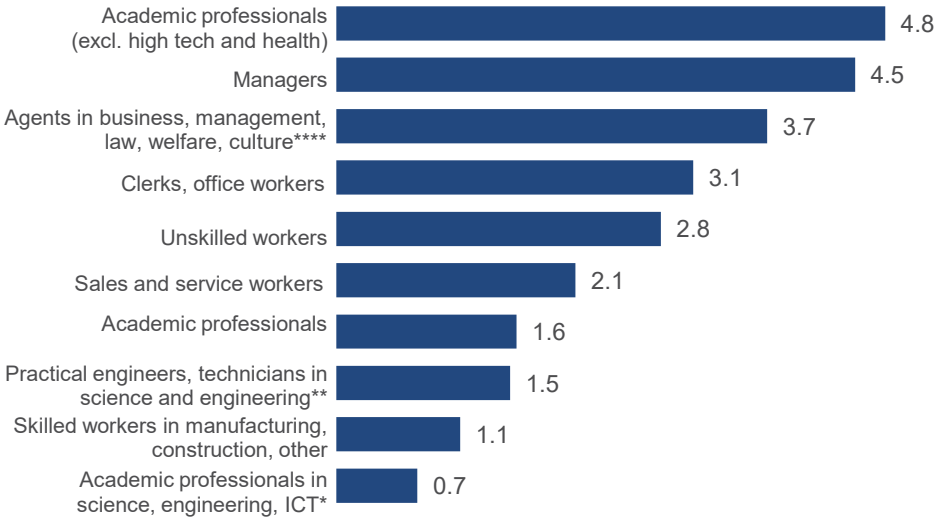
Demand and supply surveys by the Central Bureau of Statistics show a relative abundance of workers in professions characteristic of non-tradable industries, and a degree of difficulty recruiting workers for tradable industries. This is evident in the ratio of employment seekers to job vacancies in the various occupations (a ratio lower than 1 indicates a shortage of workers).[21] For example, among clerks and office workers there are 3.1 employment seekers for every available job, as opposed to 1.5 workers for every available job for practical engineers and technicians in science and engineering (Figure 19). It thus appears that companies in this field face a supply constraint of workers. It is reasonable to expect that further government incentives in high tech industries will be reflected more in additional wage increases, and less in increases in the number of workers.

It might be expected that the higher wages in occupations in tradable industries and the stronger competition for each available position in non-tradable industries would lead workers to move between professions. However, as noted, it seems to be difficult for workers to acquire the appropriate skills, and many of them go into fields in which wages are low and competition for every job is higher.

21 A shortage of workers is also possible when the ratio is higher than 1, inter alia as a result of friction in the labor market.

Figure 19. Labor market tightness, 2016

The relation between job seekers and job vacancies, annual average



Notes: Data for occupations at the 1-digit classification level. Depending on relevance and data availability, the following occupations are at the 2-digit level: * occupations 21 and 25; ** occupations 31 and 35; *** occupation 22; **** occupations 33 and 34 (according to classification in 2011).
Source: Gilad Brand, Taub Center | Data: CBS, Surveys of supply and demand, 2016

Another possible direction for changing the situation is to establish vocational training tracks to increase employment mobility and expand access to employment in tradable industries. This mobility would make it possible to reduce employment in non-tradable industries and increase it in tradable industries, where productivity and wages are higher. It is likely that workers who need vocational training will find it difficult to pay for it, and for business firms, it is less beneficial to bear the costs of vocational training when the training is also relevant to other employers (Becker, 1962). Therefore, government aid to finance training should be considered.

Removing regulatory barriers

Israel has a low ranking in the World Bank's Doing Business Index. Since companies that manufacture primarily for the domestic market are more sensitive than tradable firms to bureaucratic and regulatory barriers, improving regulation can be expected to encourage investment, increase efficiency, and create more domestic competition.[22] Section 1 in the Appendix

22 There is an abundance of empirical findings showing that removing regulatory barriers and improving the business environment has a positive impact on investment and economic growth. See, for example, Lanau and Topalova (2016).

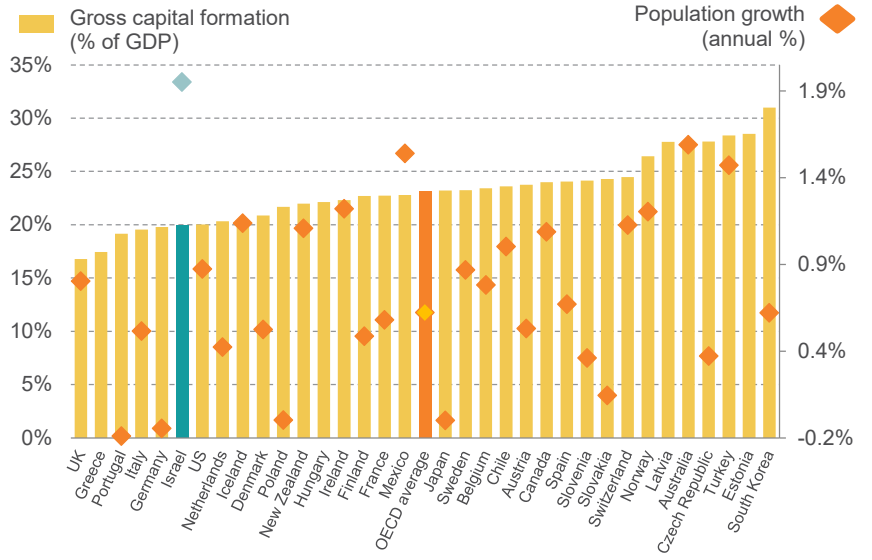
shows that low capital stock could explain some 40 percent of the aggregate productivity gap relative to the G7 countries, and improving regulation and increasing domestic competition would likely help to reduce the gap.

Encouraging capital investments

The large surplus in the balance of payments also reflects a situation in which national savings are higher than the volume of investments in the economy. 23An international comparison shows that the volume of investments in the economy (as a percentage of GDP) is lower than in most developed countries, even though the rapid growth in Israel's population requires higher rates of investment (Figure 20). Expanding public investment will increase the viability of private-sector investments, help reduce the balance of payments surplus, and increase export competition. In addition, infrastructure capital has a positive impact on the economy's productivity.[24]

Figure 20. Share of local investment in GDP and population growth

Average for 2006-2015



Source: Gilad Brand, Taub Center | Data: World Bank

23 The current account is the difference between gross national savings and gross capital formation. See the discussion in Bank of Israel (2017) on the volume of investments in Israel.

24 See the discussion in Sharabany (2008).

Conclusion

Israel's low level of productivity is not consistent with its image as the "startup nation." This study examines the connection between high productivity and performance in tradable industries — which are predominantly in the high tech sector — and the lower productivity in other industries.

Conventional economic theory predicts that productivity in similar countries will converge to a similar level over time. In practice, this convergence is only partial, in part because it is dependent on the unique characteristics of every country. Nevertheless, recent evidence in the literature shows that productivity in tradable industries tends to converge in a way that is not connected to the country's characteristics. In fact, productivity per worker and growth rate in tradable industries in Israel are similar to the OECD average, in contrast to productivity in the overall economy, which has remained low and is not converging.

We might assume that the tradable industries' success would trickle down to some extent to the other branches of the economy, but research shows that while this occurs in many developed countries, it is not valid for the Israeli economy. A possible explanation is the unique makeup of Israeli exports, which are largely high tech companies. These companies employ the most capable workers and as a result, the characteristics of workers in tradable industries are very different from those of other workers in the business sector. In such a situation, productivity growth in tradable industries does not lead to a change in the distribution of workers among the sectors and does not encourage wage pressures and increase efficiency in the rest of the labor market. The extreme disparity in worker skills in the Israeli economy and the return on these skills is exceptional by international standards, and it apparently explains why the success of the tradable industries does not affect other branches of the Israeli economy.

The study also shows that Israel's total exports (as a percentage of GDP) have been declining for the past decade, a situation unique to Israel. Accordingly, the percentage of those employed in tradable industries is also continually decreasing, except in high tech services. This decline may be partly due to the structure of incentives given over the years to encourage capital investments in tradable industries coupled with various import barriers. These two factors support a large and continuing surplus in the balance of payments, and thus work to strengthen the shekel. This is especially burdensome for tradable firms that are not in high tech, which have lower profit margins. Furthermore, given the extreme disparity between the tradable industries and the non-tradable industries, which in

effect creates two separate labor markets, the effectiveness of providing incentives to encourage capital investments in tradable industries as a means of improving the productivity of non-tradable industries is questionable, as long as there is no improvement in worker mobility between sectors.

The study discusses the expected effectiveness of investing in improving technologies. It is reasonable to assume that over the years, the availability of cheap labor in non-tradable industries has prevented companies from adopting technologies. It may be that giving employers incentives to purchase advanced technologies would increase productivity. However, the introduction of technology could push unskilled workers into industries where productivity is even lower or into unemployment, and thus this solution does not seem satisfactory.

Another possible solution for improving productivity in non-tradable industries would be to increase mobility between industries, making it possible to reduce employment in industries where productivity is low. The data in this study indicate that there is a relative abundance of workers in occupations typical of non-tradable industries, where wages are low and growth potential limited, along with a certain shortage of workers in tradable industries, where wages are high. Worker skills in non-tradable industries could be improved by diversifying the makeup of exports and investing in and improving vocational training tracks. This could increase employment mobility between the various industries and lead to wage pressures in the entire economy, which would encourage greater efficiency and lead to improved productivity in all branches of the economy.

Other possible directions for improving productivity are expanding investment in infrastructures, expanding public investments, and removing import barriers. Steps in this direction would contribute to diversifying the makeup of Israeli exports and reducing the disparities in the entire labor market.

Appendix

Breakdown of the productivity gap into factors of production and productivity

This section examines whether Israel's productivity per worker is low relative to other developed countries as a result of differences in factors of production — work hours per worker, physical and human capital — or other factors affecting utilization that are commonly associated with total factor productivity. The methodological framework is based on development accounting. This, in turn, is based on Solow's basic growth model (1957), in which we assume that production in the economy can be represented through the Cobb-Douglas function, in which the total domestic product *Y* in country *i* is determined by the number of work hours *L*, the supply of physical capital *K*, and the supply of human capital *H*. *A* represents the total factor productivity. The function is defined as follows:

$$(1)\quad Y_i = A_i \cdot K_i^{\alpha} \cdot (H_i \cdot L_i)^{1-\alpha}$$

Assuming equilibrium, is the elasticity of production of capital (which is one-third, according to the conventional assumption). We will perform a number of simple actions in order to express the production function in terms of productivity per worker, $y = Y/L$, which depends on the average number of employee work hours, $L/l=w$. In addition, we will present capital stock as a function of the ratio of capital to GDP, K/Y.

$$(2)\quad y_i = A_i^{\frac{1}{1-\alpha}} \cdot \left(\frac{K_i}{Y_i}\right)^{\frac{\alpha}{1-\alpha}} \cdot w_i \cdot H_i$$

In this way, productivity *y* depends on the ratio of capital to GDP *K*/*Y*, the average number of work hours per employee *w*, the human capital in the economy *H*, and total productivity *A*. A logarithmic formulation of equation (2) allows us to extract the contribution of the differences in inputs to the gaps in productivity per worker and to receive total productivity as the remainder. The comparison was conducted against the average of the G7 countries because the high rates of productivity in these countries are a kind of upper bound to the potential productivity of the Israeli economy. The calculation was also done for the average of 26 OECD countries for which data are available.

It is customary to measure human capital on the basis of the number of years of schooling, without considering the level and type of schooling. However, for the purposes of this calculation, we used data from the PIAAC Survey of Adult Skills, which was found to be better correlated with the level of productivity (Bank of Israel, 2016). The results of the calculation are presented in Appendix Figure 1, and details on factors of production and productivity in an international comparison are presented in Appendix Figure 2. The calculation was done for 2014, the year in which the PIAAC survey was conducted.

The findings show that the gap in productivity compared to the G7 countries and OECD countries in the sample amounts to some $30,000 and $24,000 respectively in annual terms. Most of the gap, $16,000 to $24,000, results from the component of total productivity. Some $3,500 to $4,000 of the total gap in productivity per worker can be attributed to the low level of human capital in the economy. However, it is reasonable to assume that the impact of human capital is also reflected in the low total productivity, and therefore, the overall effect is greater. The greater the physical capital, the more that can be produced with the help of each worker, but the ratio of capital to GDP in Israel is significantly lower than in the other countries—and we can attribute some $11,000 to $12,000 more to this component. The many work hours in the Israeli economy (some 15 percent more than the average in G7 countries) have contributed to reducing the gap in productivity per worker.

The conclusion from this study is that the low productivity in Israel is first and foremost a result of low utilization of the factors of production, and to a lesser extent, of a shortage of inputs. Therefore, the question why Israel's utilization is so low is critical to the growth of the economy in the future.

Appendix Table 1. Development accounting

The contribution of production and productivity factors for the gap in per worker productivity, 2014

	Capital: GDP K/Y		Human capital H		Work hours w		Total factor productivity A		Total gap in worker productivity Y/l
Productivity gap out of OECD countries*	$10,586	+	$3,447	+	-$6,642	+	$16,473	=	$23,865
	44.36%	+	14.45%	+	-27.83%	+	69.03%	=	100%
Productivity gap out of G7 countries	$12,300	+	$4,086	+	-$10,870	+	$24,687	=	$30,203
	40.72%	+	13.53%	+	-35.99%	+	81.74%	=	100%

* 26 OECD countries: Australia, Austria, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Slovakia, Slovenia, South Korea, Spain, Sweden, US, UK, and Turkey.
Source: Gilad Brand, Taub Center | Data: World Bank

Appendix Table 2. Long-term relationship between salaries in tradable industries and non-tradable industries

Per hour wage per employee

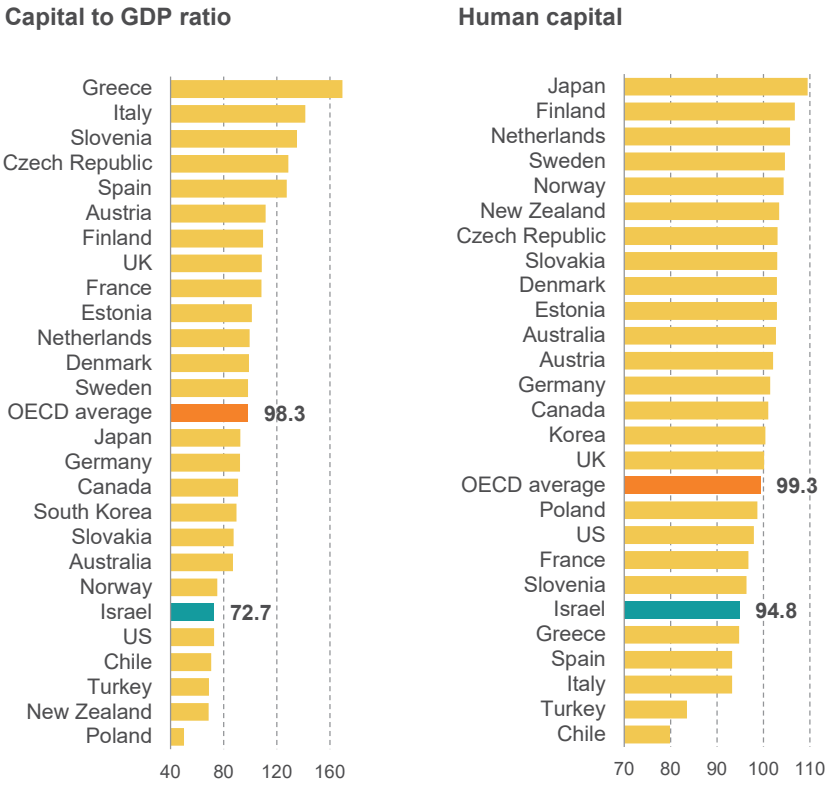
$$\ln(wagenontradable) = \beta_0 + \beta_1 \cdot \ln(wagetradable) + u$$

Time period	Cointegration test (KPSS test)	Cointegration test (DF-GLS test)	Elasticity β_1	Pearson correlation
1995-2007	Indeterminate	Indeterminate	0.51	97%
1996-2008	Indeterminate	Indeterminate	0.46	95%
1997-2009	Not cointegrated*	Indeterminate	0.42	78%
1998-2010	Not cointegrated**	Indeterminate	0.36	59%
Overall sample: 1995-2010	Not cointegrated**	Indeterminate	0.47	91%

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.
Source: Gilad Brand, Taub Center | Data: CBS, Survey of Trade, Services, Transport, Communications and Construction, 2010; *Labor Force Survey*

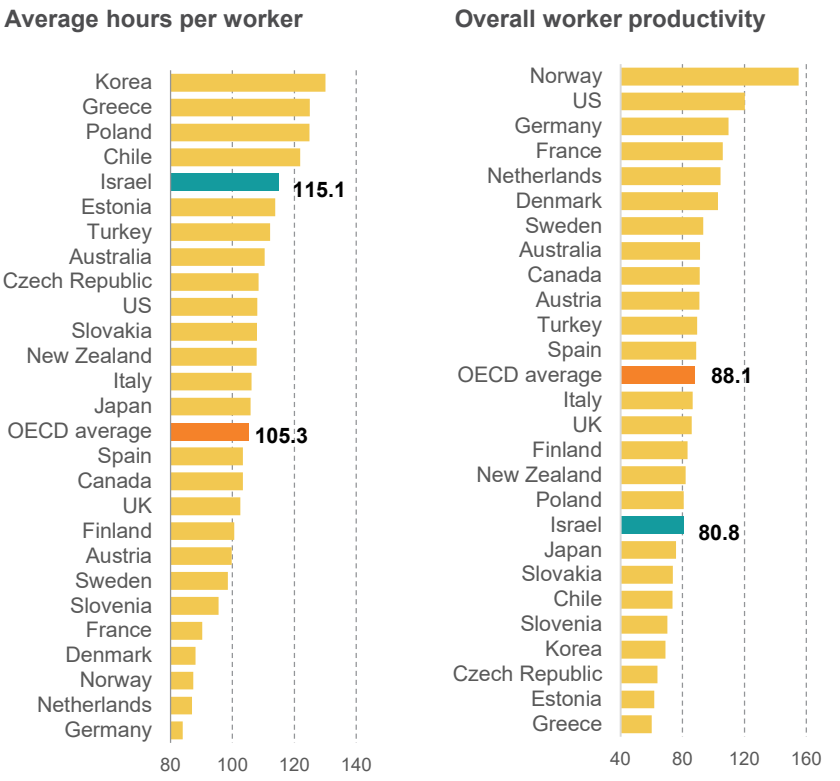
Appendix Figure 1. Production and productivity factors relative to the G7 countries, 2014

Average of G7 countries = 100



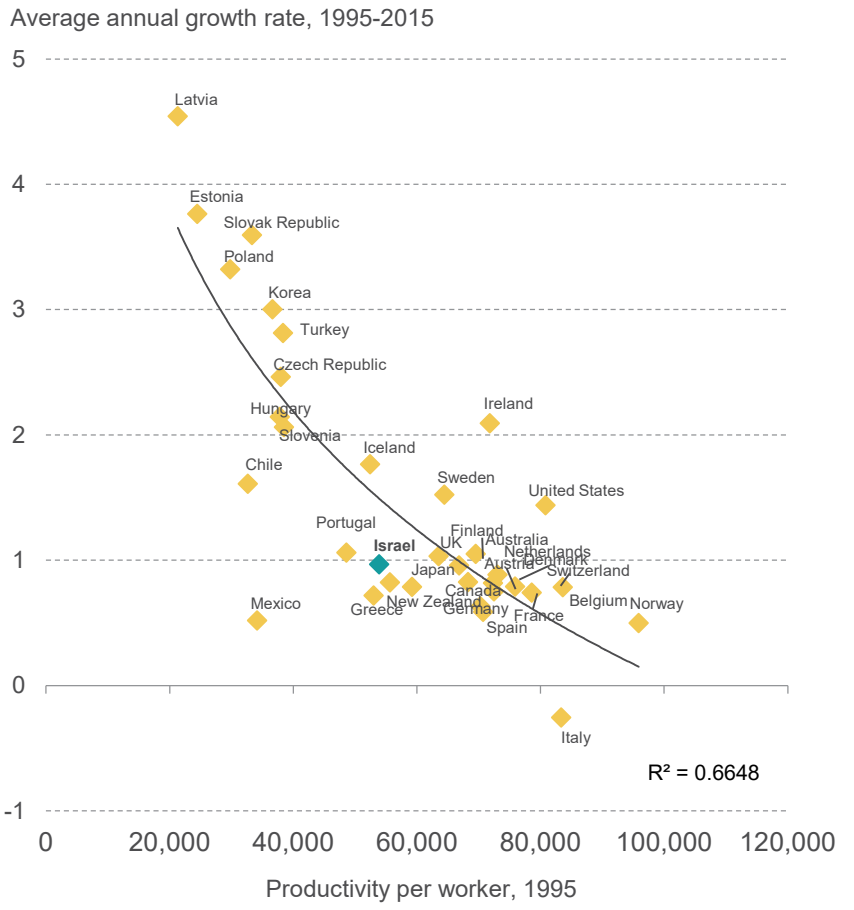
Appendix Figure 1. (continued) Production and productivity factors relative to the G7 countries, 2014

Average of G7 countries = 100



Notes: Average of 26 OECD countries.
Source: Gilad Brand, Taub Center | Data: OECD.Stat

Appendix Figure 2. Conditional convergence: Productivity per worker versus growth in productivity



Source: Gilad Brand, Taub Center | Data: OECD.Stat

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