Growth in the Israeli Economy

Gilad Brand*

Abstract

Growth in GDP per capita in Israel has declined in recent years, and this chapter attempts to ascertain whether this slowdown reflects a change in the economy's long-term growth potential or is due to cyclical and temporary factors. To this end, the chapter analyzes the changes that have occurred in the supply factors that, to a large extent, determine the growth rate of the potential GDP. Sources of growth were identified via disaggregation into the production and productivity factors (growth accounting). The analysis reveals that per capita growth in recent years has rested mainly on expansion of the labor market and less on growth in human capital, and was accompanied by a decline in total factor productivity (TFP). The rise in employment rates stemmed largely from a rise in participation among population groups that tend not to participate in the labor market, and the sharp increase in the number of public service jobs helped to absorb the rise in the number of those employed in the economy. However, the higher the employment rate rises and the lower the share of those of primary working age (25-54), the more the future growth potential based on an increase in labor inputs shrinks. With regard to human capital, the expansion in the share of highly educated workers is nearing exhaustion, and estimates presented in this chapter show a decline in the contribution of human capital to growth over the past decade. Furthermore, the increase in human capital is expected to continue to slow in the wake of the demographic changes. The conclusion arising from these findings is that the economy will find it difficult to continue to grow at a rate similar to the past; and that without a recovery in the global economy or structural reforms that encourage growth, it is reasonable to expect slow growth in the coming years. In order to change this trend, the chapter points to possible steps to encourage sustainable growth: professional and technological training for low-skilled workers, improved competition in the local business environment and investments in infrastructure.

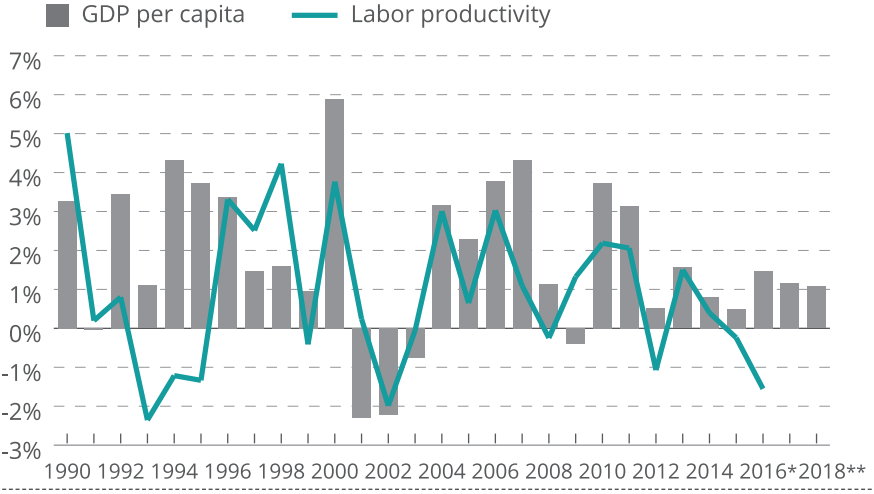
*Gilad Brand, Researcher, Taub Center; PhD candidate, Department of Economics, Bar-Ilan University. Thanks to Prof. Yaakov Rosenberg and Dr. Avichai Snir for their comments and clarifications. Additional thanks to Prof. Avi Weiss and Prof. Claude Berrebi for their helpful advice and assistance throughout the progress of this research.

1. Background

Growth

GDP per capita is the accepted measure for examining the standard of living in a country, both when monitoring progress over time and when comparing to other countries. Although this measure is rather general and simplistic, it reflects not only the economic activity of the economy, but also directly attests to changes in the socioeconomic condition of households. In 2016, GDP in Israel is expected to grow by 3.5 percent, a rate that reveals per capita growth of about 1.5 percent. Although this rate is a surprising improvement relative to the past two years, projections for 2017 and 2018 indicate continued slow annual growth of about 1.1 to 1.2 percent in per capita GDP.[1] A sharper decline in the growth of labor productivity was recorded and productivity levels have remained similar to those recorded at the beginning of the decade (Figure 1).

Figure 1. Annual growth rate of GDP per capita and labor productivity



* Labor productivity in 2016 relates to the first half of 2016 relative to the first half of 2015. ** The estimates for 2016 and the forecasts for 2017 and 2018 have been updated to those of the Bank of Israel from December 2016.

Source: Gilad Brand, Taub Center. Data: Bank of Israel website.

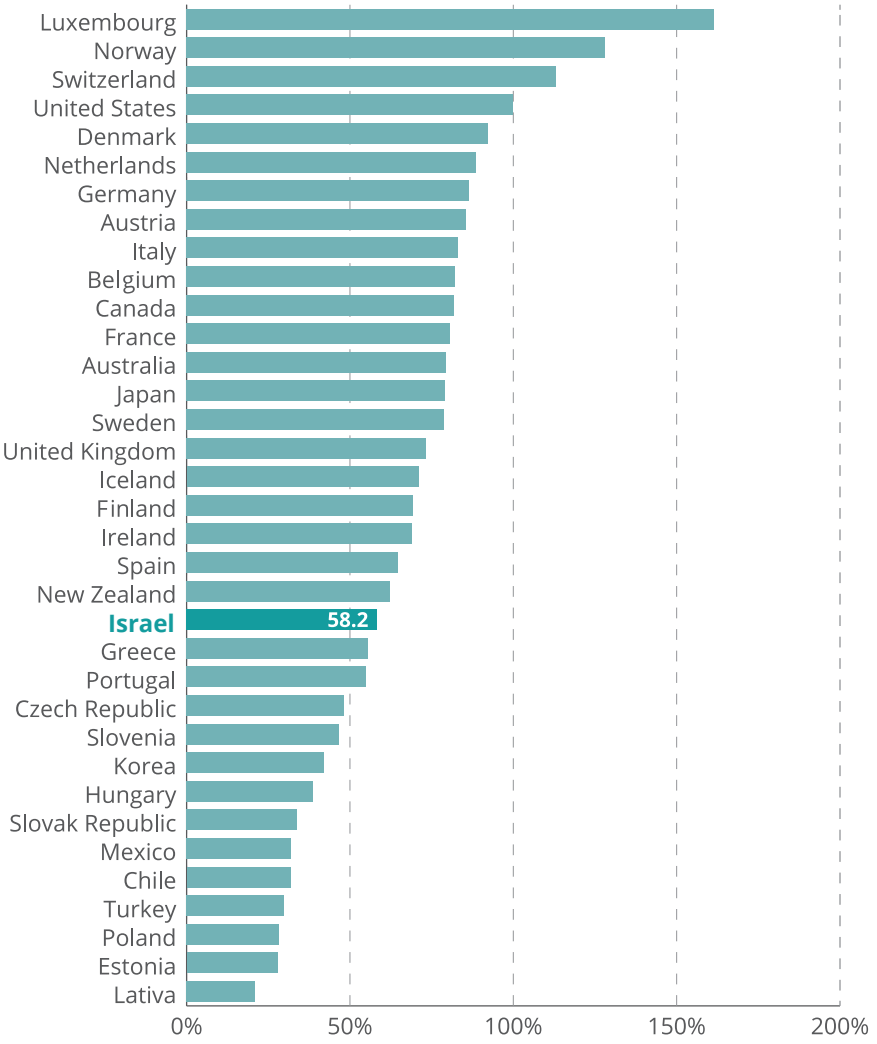
1 According to forecasts of the Bank of Israel from December 2016, growth rates of 3.1 and 3.2 percent in the GDP are expected in 2017 and 2018 respectively. These rates represent growth of 1.1 and 1.2 percent in GDP per capita.

Figures 2a and 2b show GDP per capita in Israel in comparison to the rest of the OECD countries for the years 1995 and 2015 with GDP in the United States serving as the basis for the comparison. In 2015, GDP per capita in Israel (in terms of purchasing power parity) stood at about 61 percent of GDP per capita in the United States, close to its share two decades ago. This puts Israel in 22nd place out of the 33 OECD countries. Although the ranking has remained relatively stable over the years, the gap between Israel and the countries ranked beneath it has narrowed significantly.

Figure 3 shows the average annual growth rate of GDP per capita in Israel between 2012 and 2016 relative to the rest of the OECD countries. GDP per capita in Israel grew at an annual average rate of 1.1 percent, slower than most OECD countries, in particular those now ranked beneath it. This slowdown raises concern that a permanent decline has occurred in the economy's long-term growth potential, and, as a result, GDP per capita and the standard of living in Israel may fall even further behind more developed countries. Despite the relatively low growth, the labor market in Israel continued to expand as participation rates continued to rise and unemployment rates declined. Although the expansion of the labor market reflects a positive trend, employment rates cannot rise indefinitely, and the higher they go, the less potential there is for continued growth based on an increase in labor inputs. Therefore, looking forward, it is also vital to examine the development of the other drivers of growth. A permanent decline in potential growth means a slowdown in the improvement in the standard of living, which would have serious consequences with regard to narrowing gaps between Israel and other developed countries.[2]

2 Geva and Drucker (2013) find a systemic break in economic growth in 1973 and 1991. The slowdown in growth of the past five years raises concerns of another such systemic break, that is, a change in the direction of economic growth.

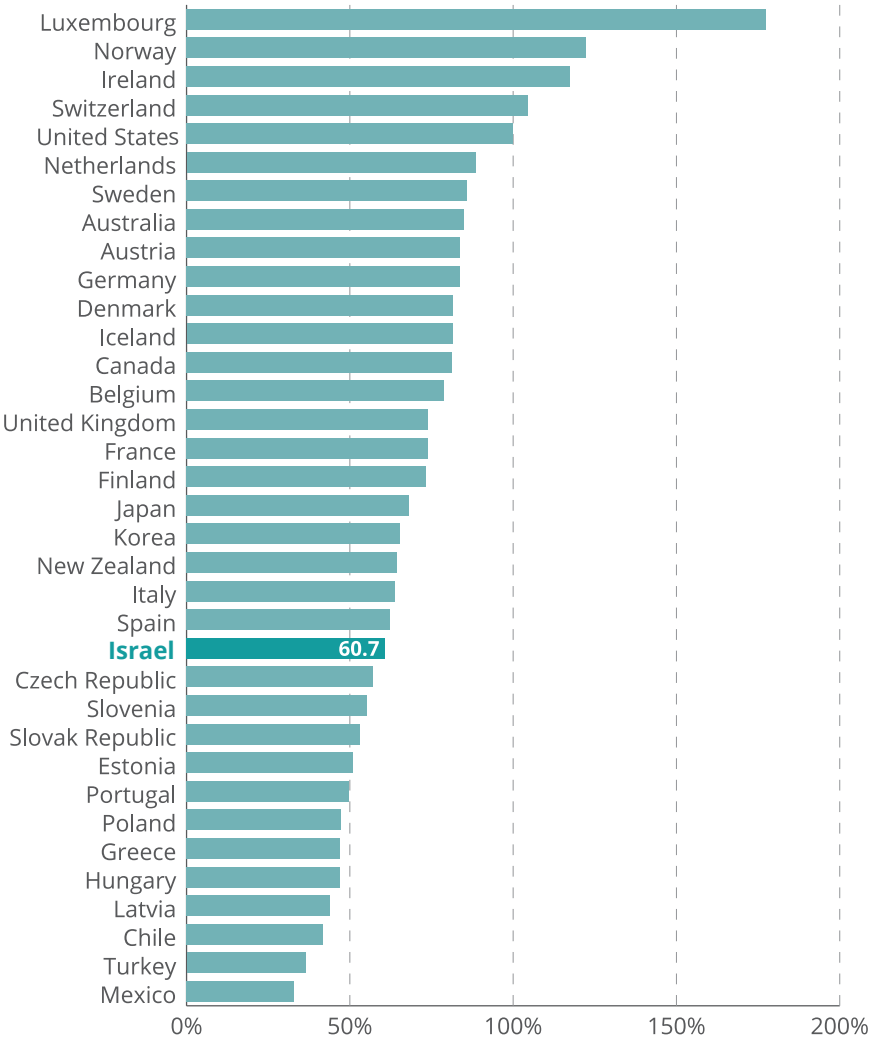
Figure 2a. GDP per capita in OECD countries as a percentage of GDP per capita in the US, 1995
In PPP terms



Source: Gilad Brand, Taub Center.
Data: IMF, World Economic Outlook Database.

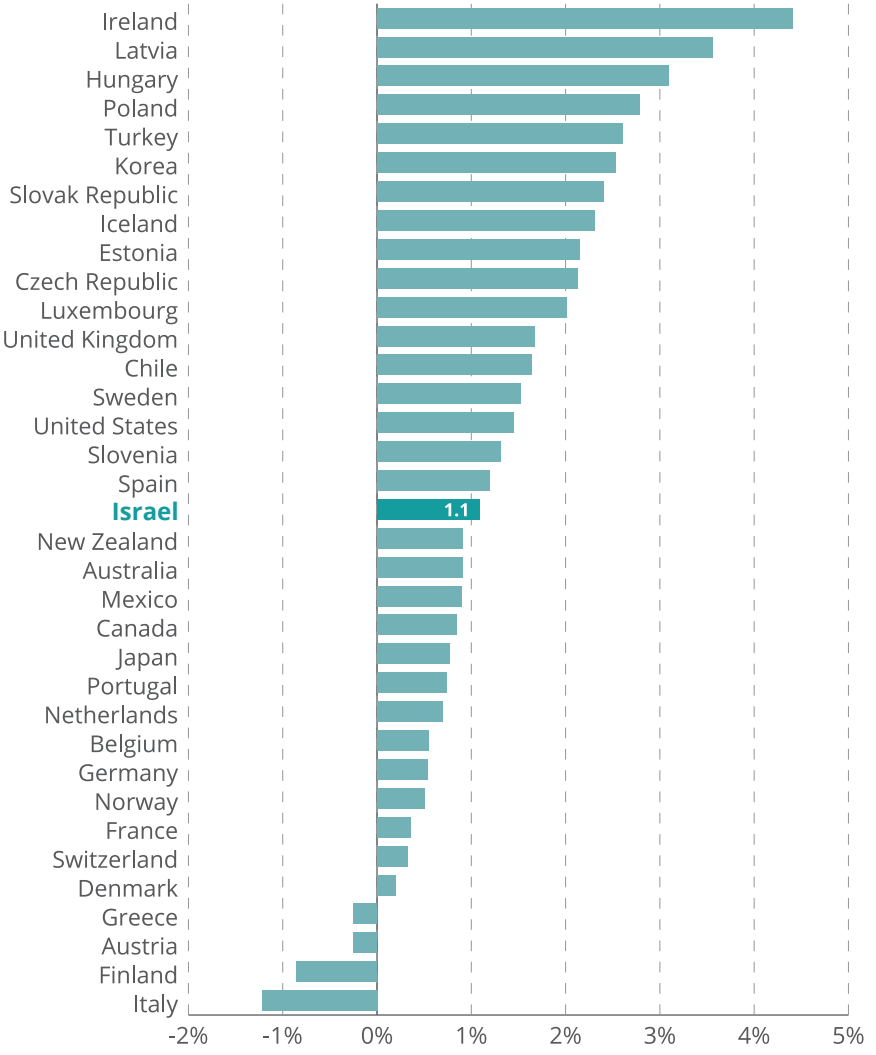
Figure 2b. GDP per capita in OECD countries as a percentage of GDP per capita in the US, 2015

In PPP terms



Source: Gilad Brand, Taub Center.
Data: IMF, World Economic Outlook Database.

Figure 3. Average annual growth rate of GDP per capita in OECD countries, 2012-2016



Early estimates for 2016.

Source: Gilad Brand, Taub Center.
Data: IMF, World Economic Outlook Database.

Growth accounting

The prevailing approach to examining the long-term potential for growth is based on disaggregating the growth components into production factors and productivity (growth accounting). This approach makes it possible to examine the long-term trends of each production factor and to extract an estimate of the total factor productivity (TFP).[3] The methodology rests on Solow's (1956) classic model, and it is a cornerstone of analyzing the sources of growth in more recent studies as well. Basic growth accounting includes among the production factors the simple sum of the total work hours in the economy based on the assumption that all workers are identical. In order to provide a more accurate estimate of changes in labor inputs, it is customary to combine them with estimates relating to human capital. One of the accepted ways of measuring the stock of human capital in the economy is to derive it from the average years of schooling rates, an approach that was recently presented in Argov (2016).

Another customary approach is to weight labor inputs by the potential wage derived from observed characteristics of workers, in combination with estimates of the returns on those characteristics. The advantage of this approach is the possibility of taking into account additional characteristics that influence the stock of human capital, such as years of experience. This approach rests on a relatively long-established methodology (Jorgenson and Griliches, 1967). An updated version was implemented in Zussman and Friedman (2008), who presented estimates of the quality of the labor force from 1987 to 2005. This chapter implements the methodology presented in Zussman and Friedman, updating the estimates presented in their research to 2015. This makes it possible to estimate the corrected labor inputs for quality of workers (a combination of experience, education and several other factors to be detailed), and to more accurately calculate the economy's sources of growth. Distinguishing between various trends of the production factors, as opposed to examining the growth trend in the economy as a whole, makes it possible to examine more closely the entirety of the changes undergone by the economy for the purpose of long-term planning.

3 According to one definition, potential GDP is the maximum output that can be achieved without inflationary pressures.

2. Methodology

In the standard framework of growth accounting, it is assumed the per capita GDP *y* in year *t* is produced with the use of labor inputs (hours) *l*, by means of the stock of physical capital *k* and stock of human capital *hc*. The function is defined as follows:

(1) $y_t = A_t \cdot k_t^{\alpha} \cdot (hc_t \cdot l_t)^{1-\alpha}$

where *A* is constant and α represents the part of capital in GDP (which is one-third, according to the accepted assumption). Basic growth accounting assumes that all workers are identical, and the labor component (*l*) represents the sum of all the work hours in the economy. The methodological framework presented here broadens the picture and includes an additional component that represents human capital (*hc*) as a multiplier of labor inputs, and thus makes it possible to give expression not only to the change in work hours, but also to changes in the quality of workers.[4]

In the next stage, each component's contribution to growth is calculated by a multiplication of the change in each variable by its coefficient. This framework allows us to extract the total factor productivity as the residual from the first equation, using the data on GDP per capita, stock of physical capital, human capital, and work hours:

(2) $\Delta ln(A_t) = \Delta ln(y_t) - \alpha \Delta ln(k_t) - (1-\alpha)[\Delta ln(hc_t) + \Delta ln(l_t)]$

Data regarding GDP, work hours and physical capital are published frequently as part of the national accounting[5] but when human capital is brought into the analysis an estimate of the quality of the labor force is required as well. The measurement method used in this study estimates changes in the human capital stock by weighting work hours using estimates of the expected hourly wages derived from workers observable characteristics as weights. The advantage of this approach lies in taking into consideration not only workers' formal education, but all of the workers'

4 This definition of production in the economy was applied in Hall and Jones (1999), the OECD used a similar version (Johansson et al., 2012), and it was used more recently by Argov (2016). On the other hand, some researchers have adopted the approach that was applied in Mankiw, Romer and Weil (1992), according to which the stock of human capital is brought in as a third input: $y_t = Ak^{\alpha} \cdot hc^{\alpha} \cdot l^{\alpha}$, where α equals one-third. This approach appeared recently in Aviram and Brezis (2016).

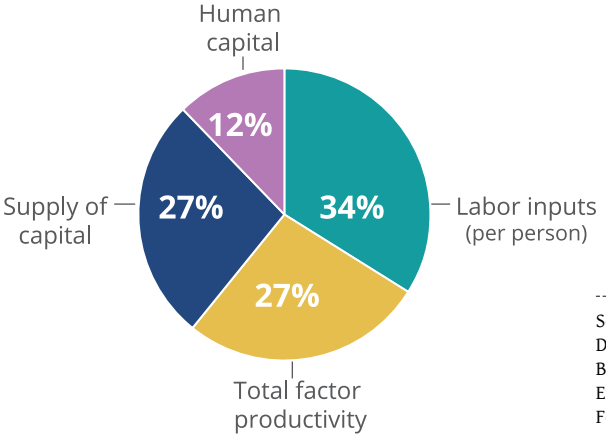
5 Data are available in the statistical appendix to the Bank of Israel's annual report.

observed characteristics combined with estimates for the return on those characteristics, relying on the assumption that workers are paid their marginal product. The methodology and the way it is implemented in the analysis are presented at length in the Appendix to this chapter.

3. Disaggregating the growth components

As noted, growth in GDP per capita can be decomposed into several components. Figure 4 shows the relative share of each component in the last decade. The calculation reveals that about 27 percent stems from an increase in the stock of capital per worker, 12 percent from an improvement in the quality of the labor force, 34 percent from the rise in the total work hours in the economy (labor inputs), and the rest, 27 percent, from the rise in TFP rates. Since the analysis refers to growth in per capita GDP, the labor component can be expected to contribute to growth only if the total work hours in the economy grew at a higher rate than the population; this can stem from a rise in the employment rate or an increase in the average work hours. Over the course of the period, the employment rate rose by 5 percentage points, and per capita work hours rose cumulatively by about 8 percent. The conclusion is that the rise in labor inputs was a primary engine of growth in the past decade.

Figure 4. Contribution of production factors to GDP per capita growth, 2006-2015



Source: Gilad Brand, Taub Center. Data: Bank of Israel; Central Bureau of Statistics, Income, Expenditure and Labor Force Survey.

Development of growth components over time

To provide a broader picture, in this section we examine how the growth components developed between 1996 and 2015. To determine this, we calculated the contribution of various components to total growth each year, for a period of four years (similar to a moving average).[6] The results are shown in Figure 5; the far left panel shows the growth rate of GDP per capita. The other panels show the growth rate of the growth components (from left to right, top to bottom): labor inputs, human capital, labor inputs adjusted for human capital, stock of physical capital, and TFP. The slowdown in growth is apparent in this figure, too; as noted previously, in the past four years per capita GDP grew at a rate of about 1.1 percent a year. Nonetheless, the direction of growth remained positive, largely due to a continuous increase in labor inputs (part- and full-time employment). In the past four years, this factor contributed about one-half of a percentage point a year to growth — about half of the total growth. The increase in the stock of physical capital constituted a significant source of growth in the late 1990s, but its contribution declined during the course of the 2000s, although in recent years a certain recovery trend is apparent. The contribution of human capital to growth is trending downward, as Argov (2016) also found.

6 Analyses of the growth accounting type are usually conducted over periods of about a decade (OECD, 2012). The reason for this is that an examination of short periods is accompanied by high volatility, making it difficult to draw any conclusions regarding trends. Since the changes that have occurred after 2012 are at the focus of interest in this chapter, a four-year period of comparison was chosen.

Figure 5. Contribution of production factors and productivity to GDP per capita growth

In percentage points, four-year moving average

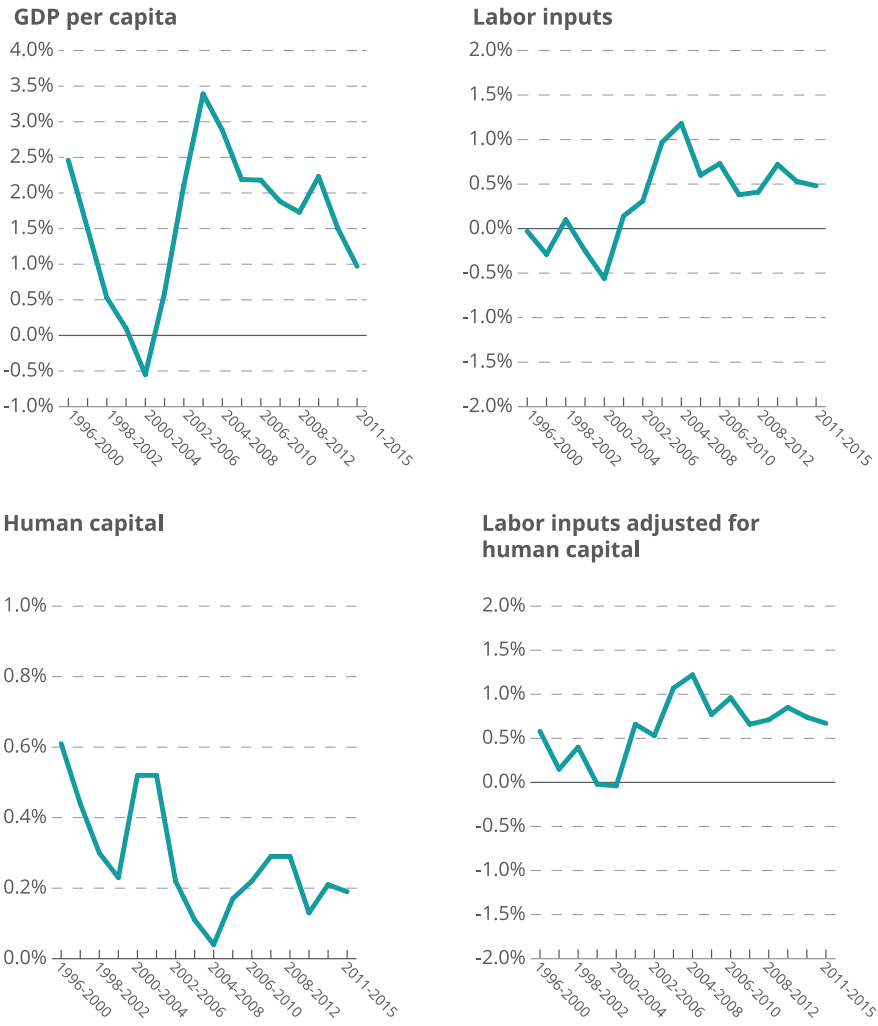
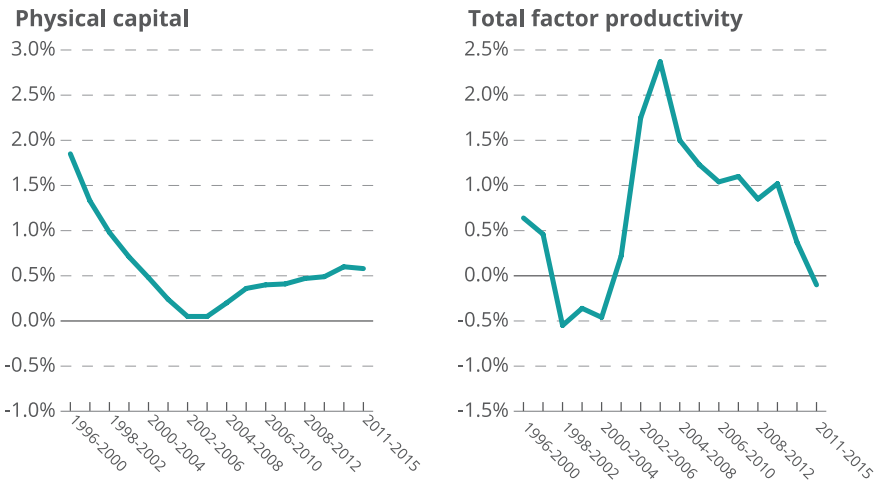


Figure 5. (continued) **Contribution of production factors and productivity to GDP per capita growth**
In percentage points, four-year moving average



Source: Gilad Brand, Taub Center.
Data: Bank of Israel and Central Bureau of Statistics, Income, Expenditure and Labor Force Surveys.

In recent years, the contribution of TFP has been at a negative rate, and the question arises as to the meaning of this finding. This may be related to the economy's location in the business cycle, which influences TFP in the short term because producers do not fully adjust production factors with demand, but change their rate of utilization (Bank of Israel, 2008). For example, a continuing decline was recorded in TFP during the severe recession years of the early 2000s, and a rapid rise in the boom during the recovery years. It is, therefore, reasonable to assume that the decline in productivity in recent years expresses mainly a dip in the business cycle, stemming from the recessionary global environment.[7] Likewise, TFP is negatively correlated with the employment rate; when demand for workers rises and less-skilled workers join the economy, production efficiency drops. Thus, the decline in

7 The Bank of Israel Report (2016) found evidence of this, which shows that companies in high technology sectors do not reduce the number of workers, but, rather, reduce the number of hours per job. According to the authors, the preference for decreasing hours stems from, among other things, a desire to preserve the human capital due to the costs entailed in recruiting it anew. Likewise, according to the Bank of Israel's yearly report for 2015, the production gap was at a negative rate in the years 2014 to 2016.

productivity in recent years may also stem from the expansion of the labor market.

We now move to analyzing the trends for each of the various production factors separately.

Physical capital

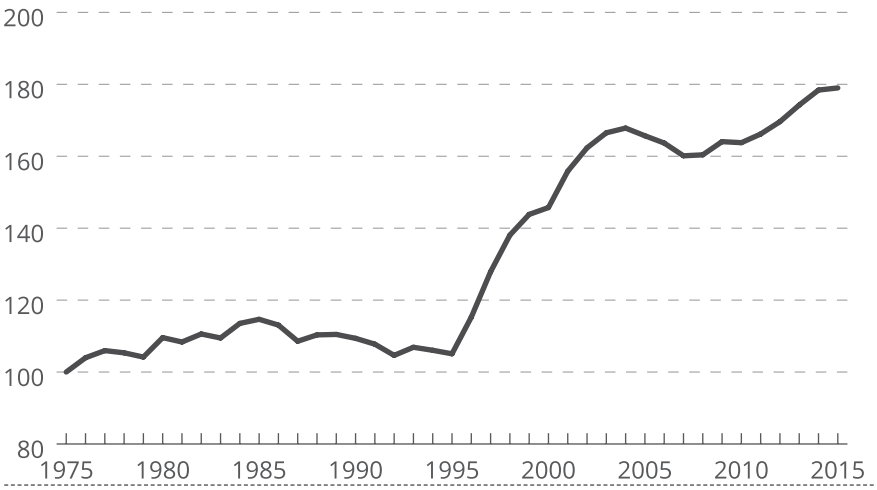
Figure 6 shows the developments with regard to the capital stock in the business sector in recent decades. For many years, the capital stock per work hour (derived by dividing the total physical capital stock by the number of work hours) remained almost unchanged, until there was an appreciable rise in the second half of the 1990s. During the 2000s, a decline ensued, and the rising trend was only renewed toward the end of the past decade. From 2014 to 2015, the capital stock per worker grew, but there is a noticeable slowdown in its growth rate.

Growth in investments in the economy's various sectors is vital for the Israeli economy to enjoy balanced growth, which is not based solely on a continual rise in the supply of low-paid and low-skilled workers. Nonetheless, these developments are dependent on each other, and given that labor is a substitute for capital,[8] there is reason to assume that the increase in the supply of low-paid workers lowers the incentive for employers to invest in capital and advanced technologies.[9]

8 The analysis presented in this study uses the Cobb-Douglas production function which relies on the assumption that labor and capital are complements and not substitutes. However, it is more likely that in some cases physical capital and technology are supplementary factors of production to the workers' skills.

9 While the stock of capital is endogenous in the short term, it is customary to assume that in an economy that is open to capital movements, the stock of capital per worker is constant in the long run and not dependent on the other components' levels.

Figure 6. Net capital stock per hour worked
In the business sector, Index year: 100=1975



Source: Gilad Brand, Taub Center.
Data: Statistical appendix of the Bank of Israel Annual Report 2015.

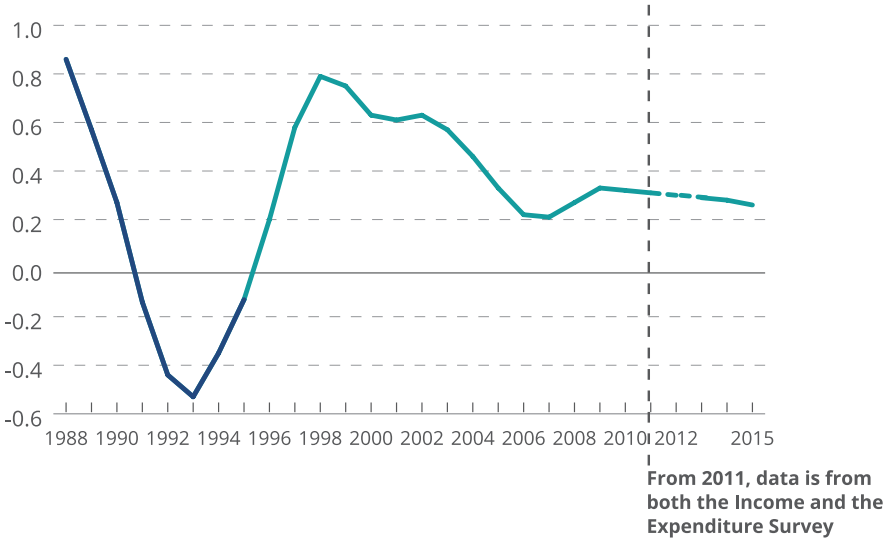
Human capital

Estimating the changes in the human capital stock was the main challenge in this analysis. The methodology implemented in this chapter is that used by Zussman and Friedman (2008), and it is presented in detail in the Appendix to this chapter.[10] The approach rests on a broad definition of human capital, according to which the quality of the labor force is estimated not only by the workers' formal education, but by weighting all of the observed characteristics such as potential experience and family status, in combination with estimates of the return on those characteristics. Figure 7 shows the annual rate of improvement in the quality of the labor force (trend data)

10 The changes made in the Income Survey starting in 2012 constituted a major challenge. The change in the survey sample in 2012 makes it impossible to derive an estimate for that year; furthermore, a break in the series was found also between the years 2012 and 2013. For 2013, the authors used data from the Labor Force Survey to overcome the break. Using the coefficients for the income data, the missing data were imputed from the observations in the Labor Force Survey. For the purpose of growth accounting, we assumed that the missing estimate for 2012 is approximately equal to the average of the trend data in the years 2010 to 2014. The trend data were calculated using an *hp* filter, where $\lambda=6.25$.

according to this method. The data show that the aggregate human capital saw a sharp decline during the years of immigration from countries of the former Soviet Union, but recovered quickly when the immigrants adapted their human capital to the economy.[11] In recent years the stock of human capital has been rising at an average rate of 0.3 percentage points per year.

Figure 7. Rate of growth of human capital in Israel
Trends, in percentage points



* Data for 1988 to 1995 (dark blue line) are based on estimates of Zussman and Friedman (2008). Due to changes made in the Central Bureau of Statistics' surveys in 2012, it is not possible to derive an estimate for that year. See this chapter's online appendix for more on the methodology of the calculations.

Source: Gilad Brand, Taub Center.
Data: Central Bureau of Statistics, Labor Force Survey, Income and Expenditure Surveys.

The quality of the labor force is negatively correlated with the business cycle; in boom times, the demand for workers rises and, consequently, less-skilled workers join the economy and bring down the average quality of the labor force. In the course of the early 2000s, for example, there was an improvement in the quality of the labor force, among other things because

11 Human capital's contribution to growth in the late 1990s is largely attributable to the development of knowledge-intensive industries in that period. For example, Friedman (2013) shows that the rise in productivity and pay in the information technology sectors in the second half of the 1990s improved the quality of the labor force in these sectors.

unskilled workers experienced higher rates of unemployment relative to skilled workers. Similarly, the slowdown in the rate of improvement in the quality of the labor force in recent years also stems from the expansion of the labor market.

The analysis reveals that the continuing improvement in the quality of the labor force from the mid-1990s until about 2009 stems primarily from a rise in education rates (Figure 8).[12,13] This rise improved the quality of the labor force without lowering the return on education (Figure 9).[14] Similarly, the moderation in the rate of improvement in the quality of the labor force stems mainly from a slowdown in the expansion of education. The rate of those enrolling in institutions of higher education stabilized about a decade ago at almost 50 percent, similar to the rate of matriculation eligibility (Bank of Israel, 2012). Therefore, looking forward, the expansion of education seems to have neared its limit. In addition, the increase in the relative share of Arab Israeli and Haredi (ultra-Orthodox) populations, whose education levels are relatively low, also casts a shadow over the potential for improvement in the quality of the labor force.[15] Argov (2016) finds that the expected increase in the relative weight of the Haredi population, together with their educational patterns, can be expected to decrease the aggregate human capital in the economy in the coming years. Nonetheless, in the long term, changes in the education patterns among these populations harbor potential for growth.

12 Bergman and Marom (2005) find that the rise in human capital between 1970 and 1999 contributed about 45 percent of GDP growth.

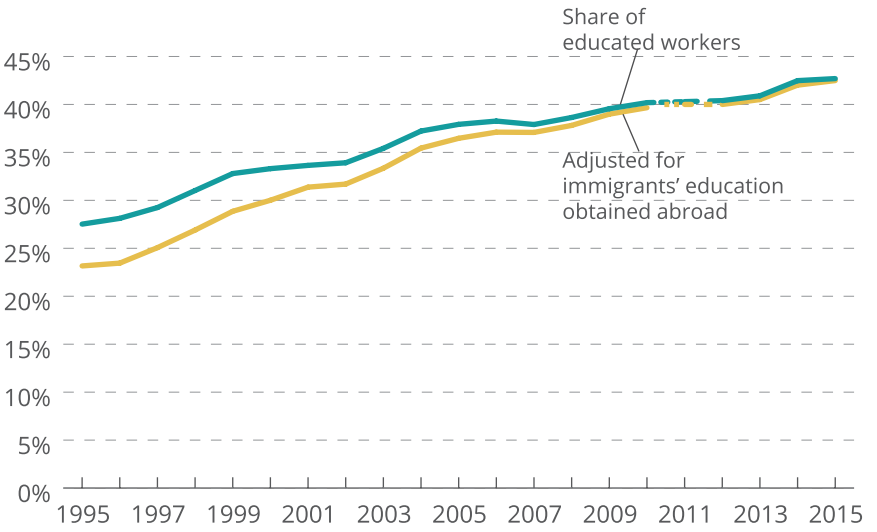
13 The rate of the highly educated was calculated using weights for work hours. A highly educated worker was defined as someone with 15 years of study who reported that his/ her last learning institution was an academic one. The calibration for immigrants was performed on the basis of the calculation presented in Argov (2016, p. 39), according to which the education of immigrants with more than 12 years of study in the year of migration was calculated as equal to the education of long-term residents with 3 fewer years of study, but over the first ten years in Israel the education calculation for immigrants was gradually adjusted to include all years of study.

14 Bar-Haim, Blank and Shavit (2013) found evidence of a decline in returns on education during the 2000s. Zussman, Furman, Caplan, and Romanov (2009) found that the returns on education among college graduates is low in comparison to university graduates, and, therefore, the expansion of education in the course of the 1990s may not have led to as high a rise in the quality of the human capital as in the past.

15 Melzer (2013) finds that the returns on education among Arab Israeli men is low compared to Jewish men. Gera (2005) shows that the chances of educated Arab Israelis being employed in an occupation commensurate with their education are low relative to Jews.

In conclusion, the human capital component was a significant driver of growth in the past, but in recent years its contribution has declined. It is apparent that the expansion of education is nearing its limits, and so there seems little prospect for a rise in the contribution of education to growth.

Figure 8. Share of educated workers in the labor force



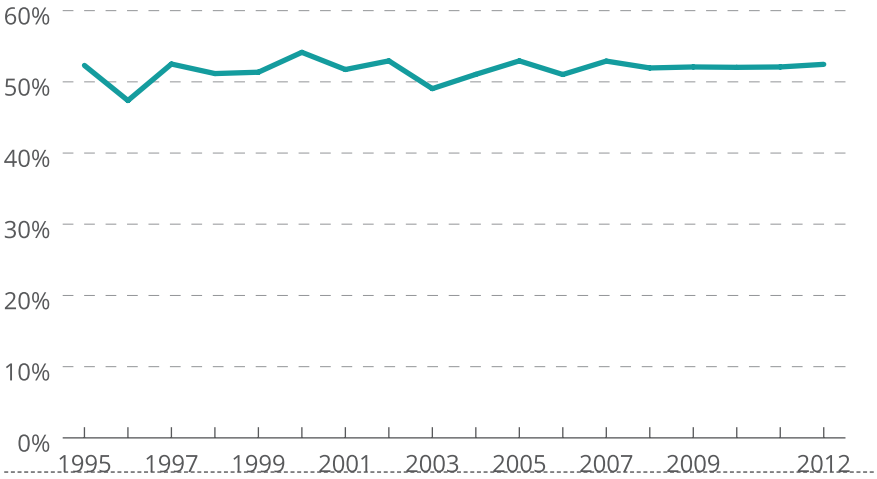
Following Argov (2016), immigrants' education level was adjusted downward at their arrival in Israel and gradually raised after acclimation in the local labor market. The calibration makes it possible to give expression to the process of adaption of the immigrants' human capital to the local market.

Due to changes made in the Labor Force Survey, there is a break in the series in 2012. The data are adjusted to the levels after the break.

Source: Gilad Brand, Taub Center.
Data: Central Bureau of Statistics, Labor Force Surveys.

Figure 9. Returns on education

Wage gap between college graduates and high school graduates



The wage gap per hour controlled for the individual's observed characteristics.[16]

Source: Gilad Brand, Taub Center. Data: Central Bureau of Statistics, Income and Expenditure Surveys.

Labor inputs

The labor market exhibits surprising strength in view of the slowdown in the economy's growth. In recent years, the employment rate has risen appreciably, and the unemployment rate is relatively low. As noted previously, the labor market is tightly linked to the state of the economy: in times of expansion, the demand for workers rises, seen in an increase in the number of job vacancies and a decline in the unemployment rate; in contractionary times, the number of job vacancies decreases and the unemployment rate rises. It is customary to examine the state of the labor market in the business cycle by using the Beveridge curve, which shows the unemployment rate versus the job vacancy rate (Figure 10).[17] The observations in the figure mark

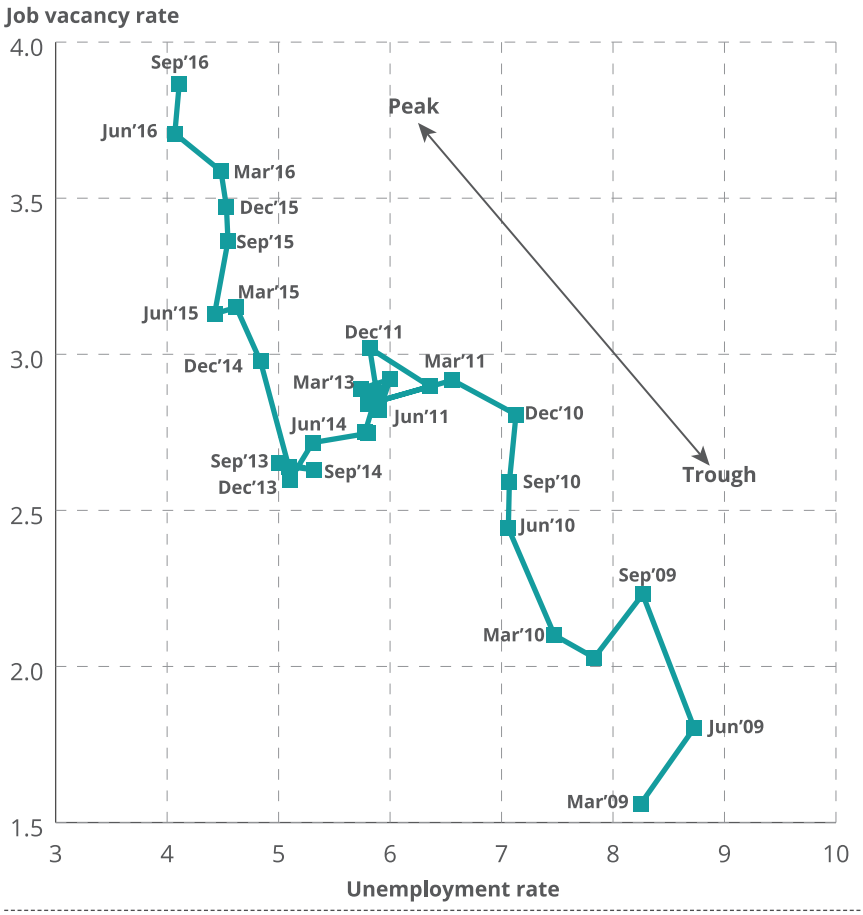
16 The premium was calculated by means of a standard Mincer equation, in which the log wage per hour is explained by means of the variables gender, family status, a squared polynomial of the years of tenure, a dummy variable for immigrants, and an interaction term between the dummy variable for immigrants and years of tenure. The premium shown is the coefficient of a dummy variable for the highly educated. The regression is calculated for each year separately. Changes made in the survey in the years after 2011 resulted in several breaks and inconsistency in the estimation results, therefore, the results are shown only until 2012.

17 The Beveridge curve also serves to examine the frictions in the labor market (Bank of Israel, 2012, p. 197).

points in time, and movement of the curve in the direction of the figure's upper left corner reflects a peak in the business cycle (a low unemployment rate and a high job vacancy rate). In contrast, movement toward the lower right is an indication of a downturn (a high unemployment rate and low job vacancy rate). The movement of the Beveridge curve in recent years points to a peak in the labor market.

Figure 10. Unemployment rate and job vacancy rate

Beveridge curve: unemployment rate among ages 64-25 and job vacancy rate, seasonally adjusted quarterly data

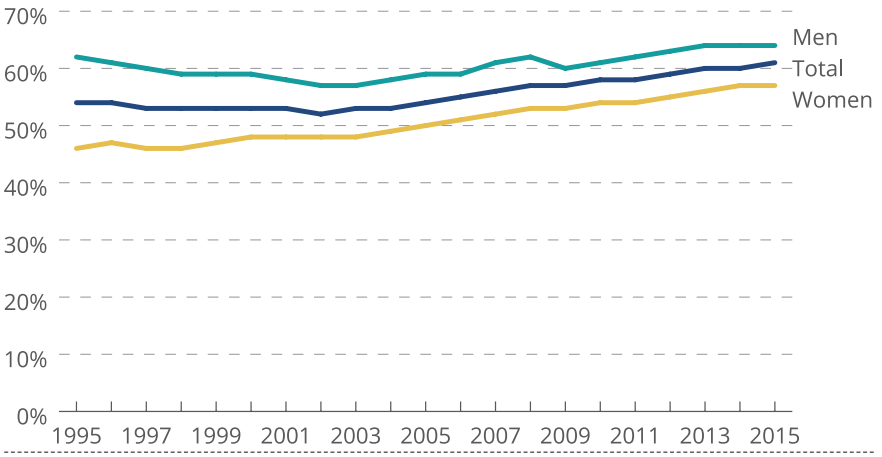


Source: Gilad Brand, Taub Center. Data: Bank of Israel website (latest data: September, 2016).

As discussed previously, the rise in employment was the main growth driver in the past decade, contributing about half of the growth in per capita GDP in the last four years. In order to more fully understand the source of the upsurge in the labor market, we will examine the trends in the labor market according to several variables: workers' gender and sector, number of work hours, distribution of workers between the various industry and population sectors (public versus private), and the share of the working age population in the general population.

Figure 11 presents employment rate by gender, showing that a rise in employment was recorded among both men and women.

Figure 11. Employment rate among men, women and total

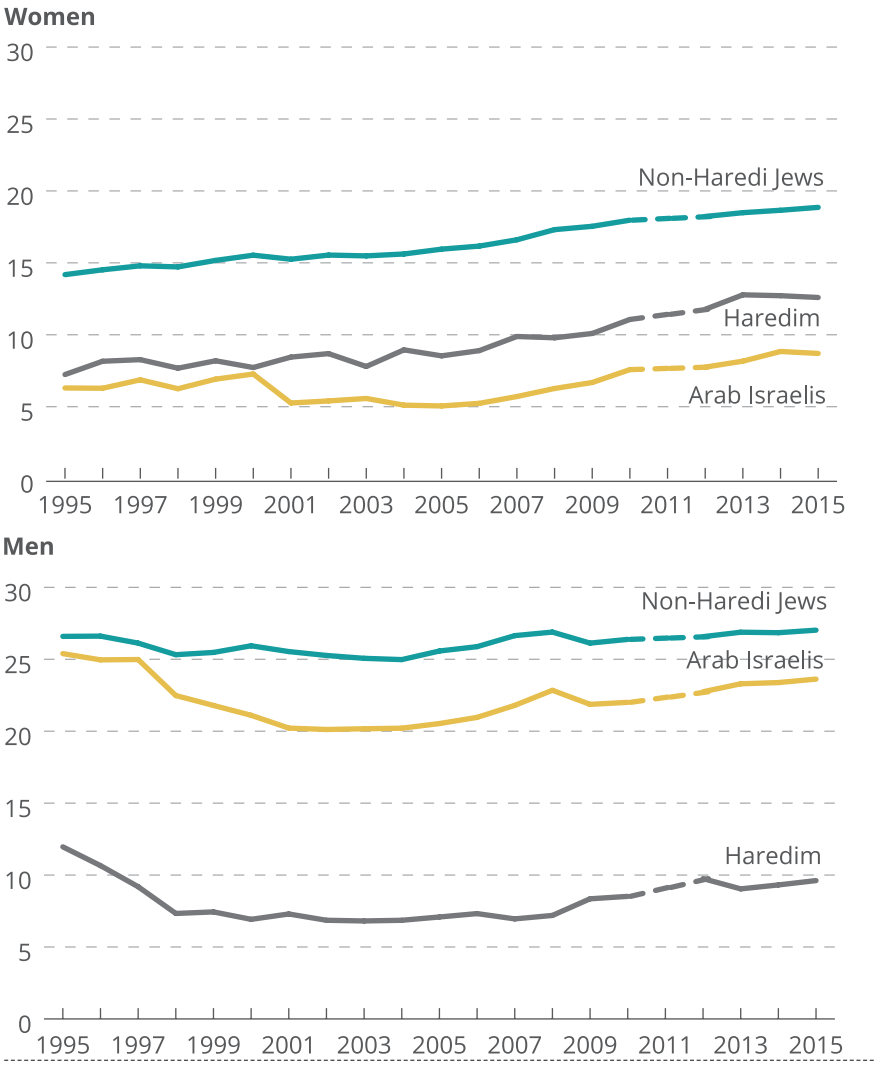


Source: Gilad Brand, Taub Center.
Data: Bank of Israel website.

The expansion of employment covered all segments of the population. Figure 12 shows the average per capita number of work hours (total hours worked in the economy divided by the number of working age individuals) in various population groups. The figure indicates a rise in the number of work hours among all population groups.

Figure 12. Average weekly work hours for working age population (15+)

Total weekly work hours divided by the number of working age individuals



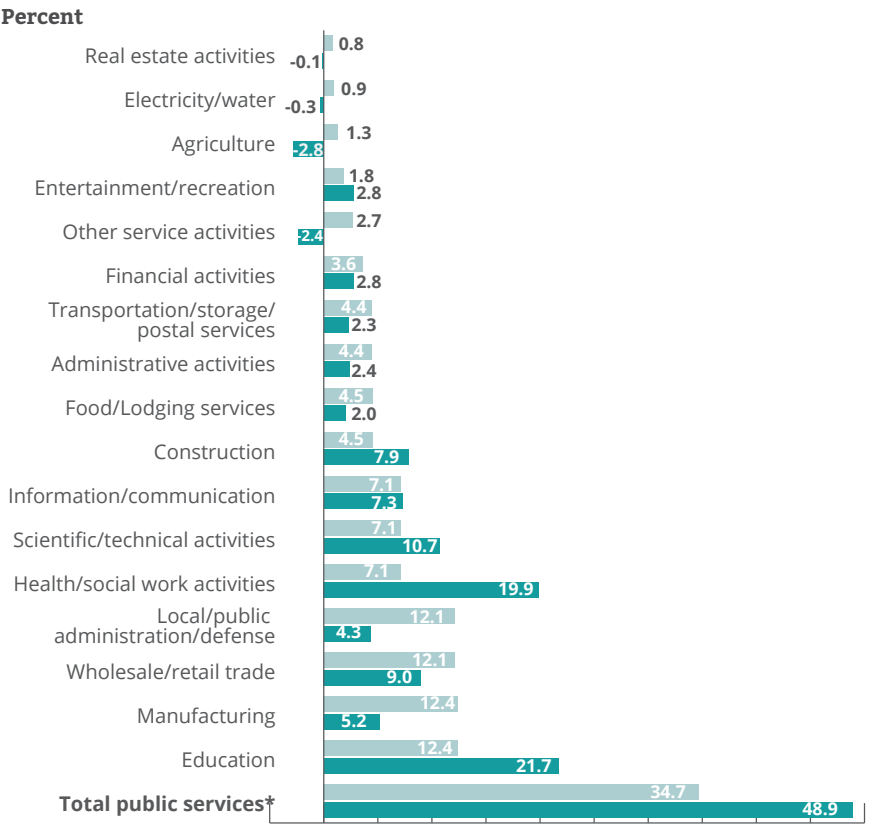
Due to changes made in the Labor Force Survey, there is a break in the series in 2012. The data are adjusted to the levels after the break.
Source: Gilad Brand, Taub Center.
Data: Central Bureau of Statistics, Labor Force Surveys.

A simulation was conducted to calculate the effect of changes in the population's composition on employment in the economy. Since employment rates in the Arab Israeli population are low relative to the overall population, the increase in this group's share of the population was liable to lead to a decline in the employment rate. However, the results indicate that the rise in the extent of employment in the Arab Israeli population in recent years not only cancels out the effect of this population's increasing weight on labor input in the economy, but even surpasses it (for details, see the Appendix to this chapter).

Given the rise in participation rates alongside a decline in unemployment rates, it is interesting to examine which of the economy's sectors increased their demand for workers. The answer appears in Figure 13, which shows the distribution of employment among the economy's sectors for 2013 and the distribution of the increase in employment for the years 2013 to 2015.[18] The comparison reveals that the sectors of education, healthcare and welfare absorbed about 42 percent of the rise in employment, although their share of employment stood at only 19 percent. Altogether, during the years 2012 to 2015, the public sector absorbed about half of the increase in employment, while its share of employment was slightly above one-third. This implies that the increase in demand for workers in public services largely helped to absorb the growth in supply.

18 The transition to the new classification of the economy's sectors makes any comparison to earlier years difficult.

Figure 13. Distribution of employees and increase in number of employed persons in various economic sectors

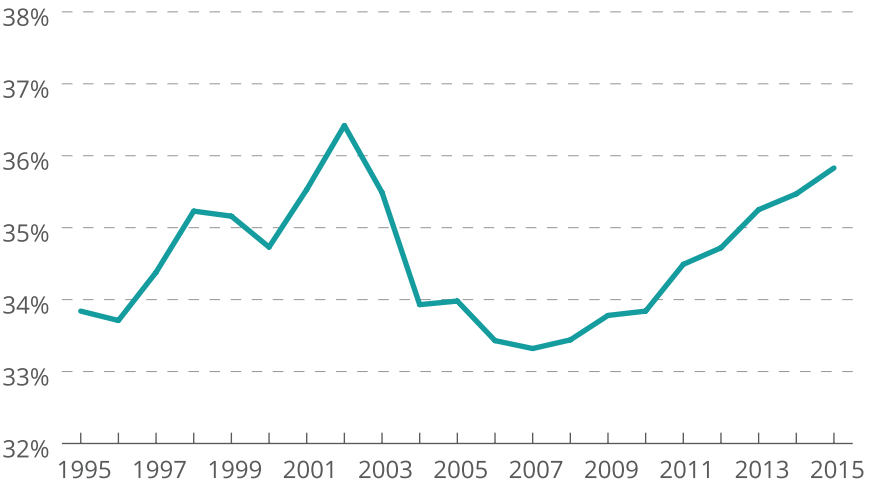


*Data for public services are for 2012-2015.

Source: Gilad Brand, Taub Center. Data: Bank of Israel website.

In light of these findings, the question arises as to whether growth based on an increase in labor inputs is nearing its limits. Regarding demand for workers in recent years, the growth in public sector employment largely supported the growth in supply. Since the share of workers in public services is currently high relative to the past, it is reasonable to assume that other sources will be required to absorb individuals new to the labor market (Figure 13). Regading supply, the low employment rates in the Arab Israeli population (women) and the Haredi population (men) harbor most of the potential for continued rise in employment, but due to the relatively low aggregate human capital in these populations, their potential contribution to growth is limited.

Figure 14. Share of the public sector in overall employment



Source: Gilad Brand, Taub Center.
Data: Bank of Israel website.

Furthermore, the anticipated change in the age composition in Israel is expected to have a negative impact on the extent of employment in the economy. Starting in 2010, there has been a decline in the share of the primary working-age (25-64) population, and this trend is expected to intensify in the coming years (Figure 15). The estimates indicate that the decline in the share of the primary working age population in the past five years cumulatively reduced the potential for growth of per capita GDP by about 2 percentage points.[19] This trend is expected to intensify and reduce potential growth through the end of the decade by an average of about 0.6 percentage points in each year.

19 The production function can also be represented as follows:
$\frac{y}{pop} = A \cdot (\frac{k}{pop})^{\alpha} \cdot (\frac{hc \cdot l}{pop^{25-64}} \cdot \frac{pop^{25-64}}{pop})^{1-\alpha}$
where pop represents the total population and pop^{25-64} represents the primary working ages population. By representing the production function in this way, it is possible to see how the contribution of changes in the share of the primary working ages population to per capita GDP growth can be derived independently of the other variables, by multiplying $\Delta ln \frac{pop^{25-64}}{pop}$ with the coefficient $(1-\alpha)$.

Figure 15a. Share of the working age population (25-64) and their contribution to changes in GDP per capita growth

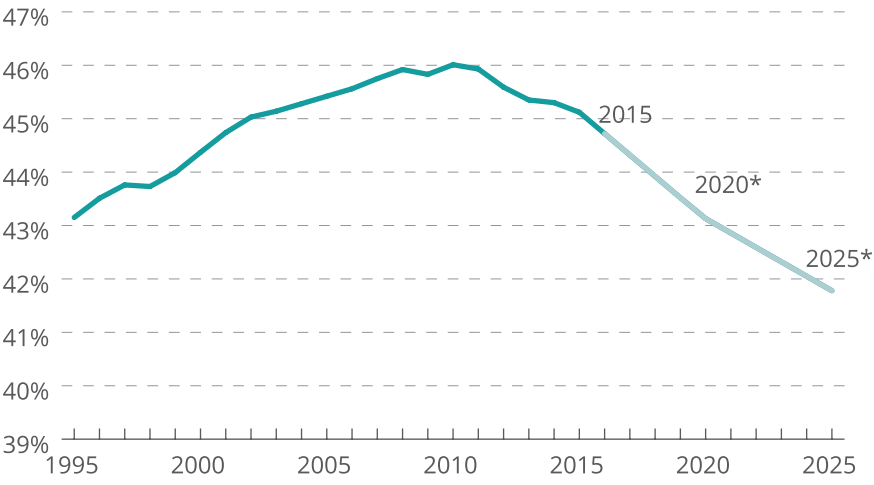
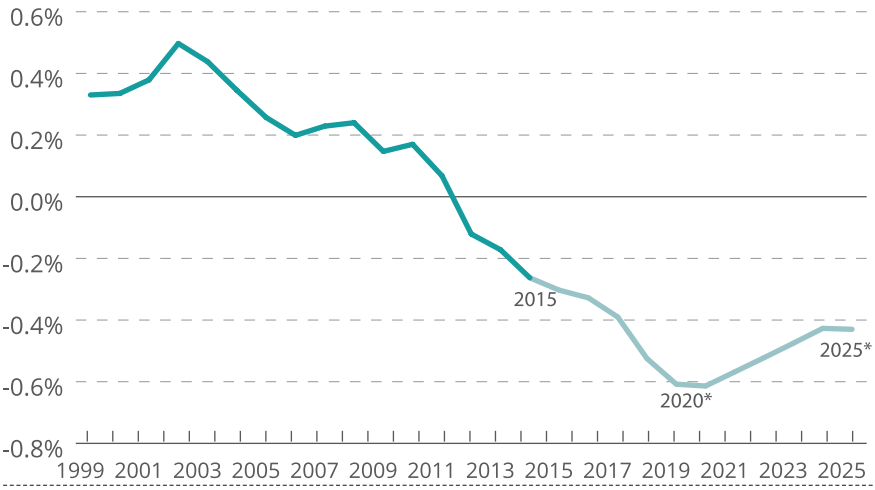


Figure 15b. Yearly contribution to per capita GDP growth
Four-year average



Source: Gilad Brand, Taub Center.
Data: Central Bureau of Statistics, Table 2.10, population forecasts for Israel for 20202035- (published September 1, 2016).

In parallel with the increase in participation rates in the labor market, there has been a continuous decline in the natural unemployment rate (the minimal unemployment rate reconcilable with fixed inflation), but this decline is also nearing its limit (Bank of Israel, 2016), and this trend, too, is expected to make it difficult for employment rates to continue to rise.

In summary, in recent years growth largely rested upon a sharp increase in the extent of employment, but the higher the employment rate rises and the lower the share of the working age population drops, the less potential there is for growth based on rising labor inputs. Other sources will therefore be required to support the economy's growth.

Conclusion

In recent years, a slowdown in growth is apparent. In previous decades, GDP per capita grew on average by 2.0 to 2.5 percent yearly, while in the past five years, the average yearly growth rate slowed to about 1 percent. The concern that arises is that the slowdown expresses a decline in the long-term potential for growth of the economy. To shed light on the sources of the slowdown, this chapter has presented an analysis based on a growth accounting approach, which makes it possible to examine the long-term trends regarding each production factor and to use them to calculate the total factor productivity (TFP). The analysis reveals that GDP per capita growth in recent years has rested mainly upon the rise in employment rates and less on an increase in the stock of human capital, alongside some rise in TFP.

Among the growth components, the share of the rise in employment was the largest in recent years — about half of the total growth. The increase stemmed largely from a rise in the participation rate among populations that tended in the past not to participate in the labor market. In addition, the sharp increase in the number of public service jobs helped to absorb the rise in the number of those employed in the economy. However, the higher the employment rate rises, the more the growth potential based on an increase in labor inputs shrinks. The low employment rates in the Arab Israeli population (women) and the Haredi population (men) harbor most of the potential for a continued rise in employment, but due to the relatively low cumulative human capital in these populations, their potential contribution to growth is limited. Moreover, the share of the primary working-age (25-64) population is trending down, which slows the potential growth stemming

from those employed. This process is expected to intensify in the coming years, and to reduce the potential growth each year by an average of 0.6 percentage points until the end of the present decade.

The expansion of education was a primary growth component in the past, but the estimates indicate that the contribution of human capital to growth is decreasing alongside the gradual moderation in the rise in education rates. The rate of those enrolling in institutions of higher education stabilized a decade ago at almost 50 percent, similar to the rate of matriculation qualification. Therefore, unless there is an appreciable change in education patterns among the underperforming populations, the process of expansion of education is nearing exhaustion. The rising weight of populations that do not usually acquire higher education that are relevant to the labor market is also expected to detract from continued improvement in the quality of the labor force. Nonetheless, in the long term, change in the education patterns among these populations harbors potential for growth.

The physical capital per work hour exhibited a rising trend in recent years, yet there was a decline in its rate of growth from 2014 to 2015. An increase in investments is vital for the Israeli economy to be able to sustain balanced growth, which is not based solely on new workers joining the labor market. Nonetheless, these developments are dependent on each other and the increase in the supply of low-paid workers makes investing in capital and advanced technologies less worthwhile. On the other hand, the slowdown in the rise in employment may eventually increase the incentive to invest in capital and advanced production technologies, and augmenting the skills and earning capacity of those new to the labor market will help.

A decline in TFP was recorded in recent years. The decline expresses low exploitation of the production factors, which apparently stems from a slowdown in demand, but its source may also be low-skilled and low-paid workers joining the labor force.

In the short term, the growth of the economy is dependent on the global environment. Slow global growth and the moderation in world trade in recent years are a drag on demand in the economy and impede local growth. The expansion of the labor market supported the economy's growth until now, but indications are that this channel is nearing exhaustion, and without a change in the underlying conditions, the likelihood of an additional slowdown in growth increases. Long-term growth is also possible in these conditions, but it is dependent on a proactive policy and the implementation of reforms that will support such growth. Improving competition in the

local business environment, removing unnecessary regulatory obstacles,[20] investing in infrastructure[21] and encouraging research and development, including in traditional industries[22] can all help to raise TFP in the long term and contend with the challenges facing the economy. A policy for augmenting the earning capacity of workers in the lowest wage category, both by means of academic education and professional and technological training is also required in order to engender competitive advantages based on technology rather than on the low cost of labor.

20 There is an abundance of empirical findings showing that the removal of regulatory obstacles and improvement of the business environment have a positive effect on the economy's growth. This connection was demonstrated in, among others, a study conducted recently by the International Monetary Fund (Lanau and Topalova, 2016). IMF (2016) and OECD (2016) also recently presented a survey along these lines.

21 There is evidence in the literature showing that investment in infrastructure may help in the process of convergence (i.e., reducing gaps in GDP per capita between countries). Bom and Ligthart (2014) and Romp and De Haan (2007) present surveys of empirical findings on the topic. See, also, Duval and Furceri (2016).

22 According to Rodrik (2016), a rapid contraction of manufacturing — in particular manufacturing sectors that are not rich in human capital but based on workers with a wide range of abilities — slows the process of convergence.

References

English

Bank of Israel (2008), *Bank of Israel Annual Report 2007*.

Bank of Israel (2012), *Bank of Israel Annual Report 2011*.

Bank of Israel (2016), *Bank of Israel Annual Report 2015*.

Bar-Haim, Eyal, Carmel Blank and Yossi Shavit (2013), "Educational Opportunity, Employment and Income: 1995-2008," in Dan Ben-David (ed.), *State of the Nation Report: Society, Economy and Policy in Israel 2013*, Taub Center for Social Policy Studies in Israel, pp. 233-252.

Bom, Pedro R. D. and Jenny E. Ligthart (2014), "What Have We Learned From Three Decades of Research on the Productivity of Public Capital? *Journal of Economic Surveys*, 28, No. 5, pp. 889-916.

Duval, Romain and Davide Furceri (2016), *IMF Survey 2016: Structural Reforms in Advanced Economies: Pressing Ahead and Doing Them Right*, IMF Research Department.

Hall, Robert E. and Charles I. Jones (1999), "Why Do Some Countries Produce so Much More Output per Worker than Others," *The Quarterly Journal of Economics*, 114, No. 1, pp. 83-116.

Jorgenson, D.W. and Zvi Griliches (1967), "The Explanation of Productivity Change," *Review of Economic Studies*, 34, No. 3, pp. 249-283.

Johansson, Åsa, Yvan Guillemette, Fabrice Murtin, David Turner, Giuseppe Nicoletti, Christine de la Maisonneuve, Phillip Bagnoli, Guillaume Bousquet, and Francesca Spinelli (2012), *Long-Term Growth Scenarios*, OECD Economics Department Working Papers, No. 1000.

Lanau, Sergi and Petia Topalova (2016), *The Impact of Product Market Reforms on Firm Productivity in Italy*, International Monetary Fund.

Mankiw, Gregory, David Romer and David N. Weil (1992), "A Contribution to the Empirics of Economic Growth," *The Quarterly Journal of Economics*, 107, No. 2, pp. 407-437.

OECD (2012), *Looking to 2060: Long-Term Global Growth Prospects*.

OECD (2016), *Economic Policy Reforms 2016: Going for Growth Report*, http://www.oecd.org/eco/growth/goingforgrowth.htm.

Rodrik, Dani (2016), "Premature Deindustrialization," *Journal of Economic Growth*, 21, No. 1, pp. 1-33.

Romp, Ward and Jakob De Haan (2007), "Public Capital and Economic Growth: A Critical Survey," *Perspektiven der Wirtschaftspolitik*, 8, No. S1, pp. 6-52.

Hebrew

Argov, Eyal (2016), *Development of Israeli Education and Its Contribution to Growth*, Bank of Israel (publication forthcoming).

Aviram, Nitzan and Elise Brezis (2016), *The Impact of French Aliyah on the Economy of Israel*, The Aharon Meir Center for Banking, Department of Economics, Bar-Ilan University.

Bregman, Arie and Arie Marom (2005), *The Contribution of Human Capital to Growth and Productivity in Israel's Business Sector, 1970 to 1999*, Research Department, Bank of Israel.

Friedman, Yoav (2013), *The Information Technology Industries: Employees, Wages and Dealing with Shocks*, Discussion Paper No. 2013.07, Bank of Israel.

Gera, Ramsis (2005), "Labor Inequality Between Educated Arabs and Jews in the Labor Market in Israel," in Aziz Haidar (ed.), *Arab Society in Israel: Populations, Society and Economy*, Van Leer Jerusalem Institute.

Geva, Assaf and Lev Drucker (2013), "Economic Growth in Israel: From Developing Economy to Modern Economy," *Economic Quarterly*, pp. 207-231.

Melzer, Yael (2013), *Education Returns: Inequality Between Different Populations in Israel*, doctoral thesis, Ben-Gurion University of the Negev.

Zussman, Noam and Amit Friedman (2008), *Labor Quality in Israel*, Discussion Paper 2008.01, Bank of Israel.

Zussman, Noam, Orly Furman, Tom Caplan, Dmitri Romanov (2009), *Differences in the Quality of Education Between Universities and Colleges: Looking at It Through Returns in the Labor Market*, Working Paper No. 42, Central Bureau of Statistics.

Appendix

Estimate of changes in the quality of the labor force in Israel

There are several approaches to estimating human capital in the economy. According to the most prominent among them — recently presented in Argov (2016) and common also in periodical assessments by international bodies — the cumulative human capital in the economy is measured by weighting the number of years of study of individuals, while making certain assumptions regarding the economy's yield from workers' education. This chapter uses a different and older approach, an updated version of which was implemented in Zussman and Friedman (2008). Under this measurement method, the labor inputs standardized for quality are calculated by weighting the aggregate work hours. The workers' imputed wages serve as the weights, and the change in the quality of the labor inputs is defined as the difference between the change in labor inputs standardized for quality and the change in aggregate work hours. The advantage of this approach lies in that it does not rest on a broad definition of human capital according to which the quality of the labor force is estimated not only by workers' formal education, but also by weighting all the observed characteristics, such as years of potential experience and family status, in combination with estimates of the returns to those characteristics.

The analysis was conducted for the entire economy, without differentiating between the different sectors, for the period 1995 to 2015 for the full population of employees.[23] The methodology's principles are as follows.

In the first stage, each worker's contribution to the total aggregate work hours is calculated:

1. $\tilde{n}_{i,t} = n_{i,t} \cdot h_{i,t} / \sum n_{i,t} \cdot h_{i,t}$

where n represents the weighting coefficient of the worker in the Income Survey, and h represents his/her work hours.

23 Zussman and Friedman (2008) present estimates using imputed wages of self-employed workers. Since for a portion of the years there is no data about the number of work hours for the self-employed in the income survey, the analysis was conducted for the employed population only. The differences between the estimate presented in their work for the employed population and the estimate based on the total population are relatively minimal, and since there have been no significant changes in the share of the self-employed or composition, it can be assumed that use of the data for the employed population only reliably represents the changes in the overall labor force.

In the next stage, the workers' expected wage is calculated by using a standard Mincer wage equation where the log of hourly wage *W* is explained by a dummy variable for four categories of education level, according to years of schooling[24] (0-11, 13-14, 15-16, 17+), a squared polynomial of potential experience,[25] dummy variables for Arab Israeli, new immigrants, gender, family status, the interaction between new immigrant status and potential experience, and an additional interaction between various schooling categories and dummy variables for immigrants and Arab Israelis. The equation is calculated for each year between 1995 and 2015 on the basis of data from the Income and Expenditures Surveys.[26]

In the third stage, the change in the quality of the labor force is calculated between each pair of consecutive years, first using the wage equation for the earlier year:

$$2.\ dq_t^{t-1} = \sum \tilde{n}_{i,t} \cdot \hat{W}_{i,t-1} / \sum \tilde{n}_{i,t-1} \cdot \hat{W}_{i,t-1}$$

and then according to the wage equation for the later year:

$$3.\ dq_t^{t} = \sum \tilde{n}_{i,t} \cdot \hat{W}_{i,t} / \sum \tilde{n}_{i,t-1} \cdot \hat{W}_{i,t}$$

Finally, the measure of change in quality is calculated as the geometric average of the changes by the Laspeyres method and by the Paasche method:

$$4.\ dq_t^{g} = (dq_t^{t-1} + dq_t^{t})^{1/2}$$

24 The calculation is based on data regarding years of schooling and not on the highest degree obtained, since the latter is not available in the Income Surveys for the entire study period. In order for the education groups to cover formal education as closely as possible, a worker is classified as belonging to the 1516- years of schooling group if the last educational institution was reported to be an academic one. If not, the worker was placed in the group of 1314- years of schooling. These education categories are slightly different than those used by Zussman and Friedman (2008). The difference in educational categories was not found to change the estimates for the early years in the sample, but the estimates are slightly different in the later years. Another addition to this study is an interaction term between education categories and a dummy variable for Arab Israeli sector. The education of workers enrolled in the Haredi school system was limited to 10 years according to the correction made by Argov (2016).

25 Potential experience is defined as age minus expected years of military service, minus years of schooling, minus 6, with corrections for new immigrant status (according to Zussman and Friedman, 2008, p. 74).

26 Beginning in 2012, the Income Survey was stopped and the data from the expanded Household Expenditure Survey was utilized.

The changes made in the Income Surveys starting in 2012 were a major challenge in the analysis. The change in the survey sample in 2012 makes it impossible to derive an estimate for that year, and furthermore, there was a break in the series between 2012 and 2013. In order to overcome the break, for 2013, the author used data from the Labor Force Survey. Using the coefficients for the income data, the missing data were imputed from the observations in the Labor Force Survey.[27] For the purpose of growth accounting, it was assumed that the missing estimate for 2012 is approximately equal to the average of the trend data between 2010 and 2014. The trend data were calculated using an hp filter, where $\lambda = 6.25$.

27 The calculation was conducted by aggregating the data into synthetic panels by categories of education and potential experience; this method has been found to be the more reliable than imputing wage for single observations in the labor force survey. The lack of consistency in the Expenditure Survey in the years after 2012 is reflected also in the regression coefficients, thus the estimates for quality of labor force for 2012 to 2015 were calculated using a geometric mean of the estimates from the selection of each year between 2012 and 2015 as the base line year.

Appendix Table 1. Labor force quality for employees, rate of annual change

	Trend data*	Zussman and Friedman's estimates	Estimate in this study
1988	0.86	0.82	
1989	0.57	-0.02	
1990	0.27	2.24	
1991	-0.14	-0.84	
1992	-0.44	-0.72	
1993	-0.53	-2.30	
1994	-0.35	1.52	
1995	-0.13	-0.97	
1996	0.20	-0.71	-0.79
1997	0.58	1.68	1.42
1998	0.79	2.36	2.36**
1999	0.75	1.04	0.93
2000	0.63	-0.43	-1.06
2001	0.61	0.53	0.43
2002	0.63	1.64	1.46
2003	0.57	0.62	0.56
2004	0.46	0.91	0.65
2005	0.33	0.41	0.36
2006	0.22		-0.27
2007	0.21		-0.13
2008	0.27		0.29
2009	0.33		1.09
2010	0.32		0.05
2011	0.31		0.28
2012	—		—
2013	0.29		0.13
2014	0.28		0.51
2015	0.26		0.17

* Until 1996, trend data are calculated using the estimates of Zussman and Friedman; from 1996, the data relates to estimates from the current study.

** In this year, there is a substantial difference in the estimate from the current study and that of Zussman and Friedman. As a result, their estimate was used.