Fiscal Survey and Selected Research Analyses

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This publication replaces the "Recent Economic Developments" series.
This publication will also be published semi-annually, and will include analyses by the
Research Department of relevant topics in Israel's economy, as well as a periodic fiscal survey.

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Analysis of fiscal developments in 2016, the fiscal situation for 2017, and trends expected over the remainder of the decade
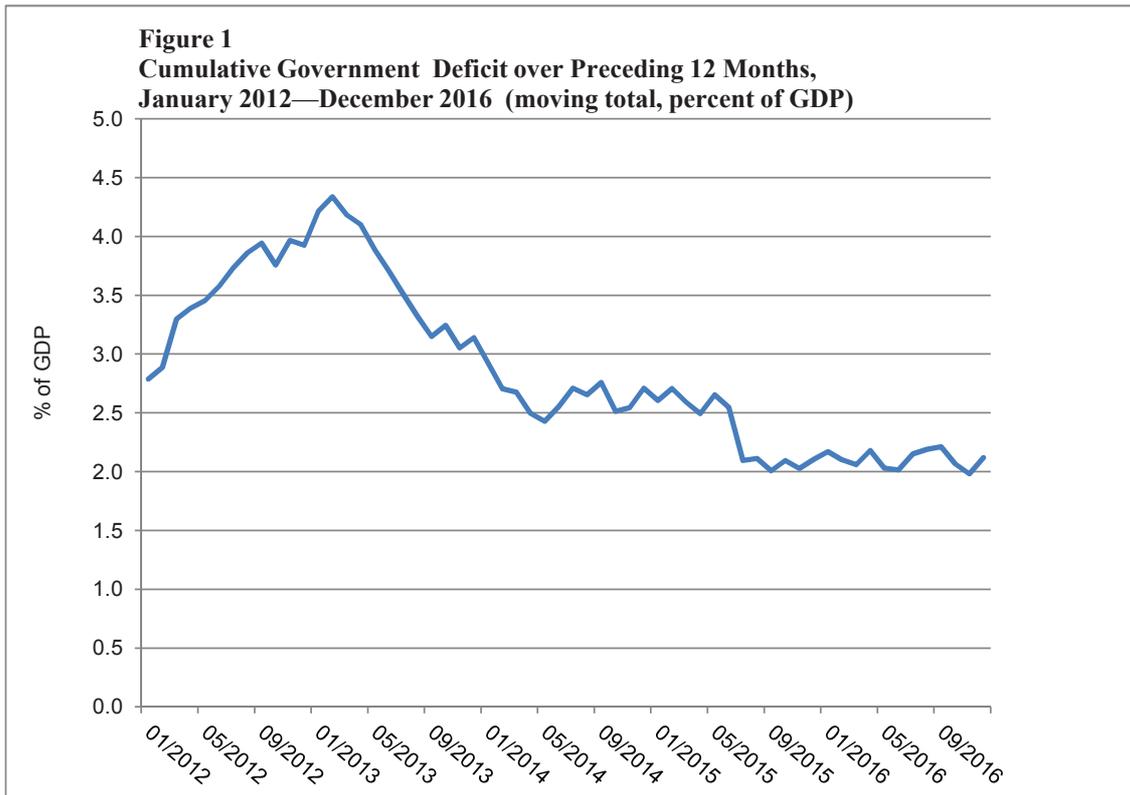
- The government finished 2016 with a deficit of 2.1 percent of GDP, similar to 2015 and significantly lower than the deficit ceiling set in the budget. The public debt to GDP ratio declined to about 62 percent.
- The below-target deficit reflected a) unexpectedly strong tax receipts, tracing to unexpectedly vigorous growth, improved terms of trade, and an exceptional increase in imports of motor vehicles—a highly taxed product; b) surpluses in National Insurance Institute activity that reflected overbudgeting of benefit payments; and c) expenditure that was somewhat lower than budgeted.
- The deficit ceiling for 2017 and 2018 was set at 2.9 percent of GDP, but the deficit in 2017 is likely to be lower, at about 2.5 percent of GDP, and the 2018 deficit is also expected to be slightly below the ceiling.
- The below-target deficit is supported by the economy's current near-full-employment environment and by the marked contribution of tax receipts from the volatile real estate and vehicle markets—which increased by 0.8 percent of GDP between 2012 and 2016.
- Primary civilian expenditure in Israel is almost the lowest in the OECD, making it difficult for the government to allocate resources to policy measures that will entrench long-term economic growth. In the last two budgets, however, the government significantly increased its primary civilian expenditure so that its share of GDP is expected to increase by about one percent of GDP. This expansion reflects the decision to relax the expenditure ceiling, both directly and indirectly, the only moderate increase in defense expenditure, and the decline in interest payments.
- According to the multiyear control mechanism over the budget aggregates (the "numerator"), the government must make sure that its decisions do not lead to a deviation from the expenditure and deficit ceilings even in the years following the current budget. At this stage, it appears that the mechanism has contributed to an improvement in budget discipline.
- Based on decisions made thus far, expected expenditure in 2019 approximates the ceiling but expenditure in 2020 is already expected to surpass the ceiling by at least NIS 2 billion. The expected deficit in those two years exceeds the ceiling set by law, even assuming that the high level of economic activity is sustained.
- Since the expected deficit in the medium term is higher than the ceiling set by law, government decisions on tax reductions or increased expenditure that will permanently raise the deficit must be accompanied by measures that will offset the increase in the deficit.
- The low deficits of the past two years supported the decline in the debt to GDP ratio, but most of that decline in recent years reflected a rapid increase of the GDP deflator relative to the Consumer Price Index, repayment of the public's debts to the government, and receipts from land sales. Over time, one cannot assume that these sources will continue making significant contributions to the process of lowering the debt to GDP ratio.

1. 2016 budget performance

The government ended 2016 with a budget deficit of 2.1 percent of GDP—approximating the 2015 deficit and far below the 2.9 percent deficit ceiling established in the budget. The below-target deficit was due to much stronger revenues than those envisaged in the original budget forecast and, to a lesser extent, lower-than-budgeted expenditure. The small deficit, the increase in the GDP deflator relative to the Consumer Price Index, and repayment of previously issued government housing loans allowed the government to lower the debt-to-GDP ratio to 62 percent. In several years' retrospect, the deficit has been stable at its current level since the middle of 2015 (Figure 1)[1] after having declined gradually since the middle of 2013 following tax increases in 2012 and 2013[2] and some restraint of growth in government spending in 2013 and, to a greater extent, in 2014.

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[1] Cumulative deficit in the twelve months ending each month.

[2] Brender and Politzer (2014) show that it takes two years for changes in tax rates to be fully manifested in tax receipts.

Figure 1
Cumulative Government Deficit over Preceding 12 Months,
January 2012—December 2016 (moving total, percent of GDP)

The unexpectedly strong revenues in 2016 mainly reflected tax receipts that exceeded the original forecast by NIS 6 billion (or by NIS 7.5 billion if an unplanned provision to the Property Tax compensation fund is taken into account). NIS 4.5 billion of the disparity between the forecast and actual collection is explained by unexpectedly strong nominal GDP growth (Table 1).[3] The other factors that affect tax collection can be examined through the Bank of Israel tax model (Brender and Navon, 2011), which includes several additional financial and nonfinancial variables that influence receipts. According to the model, the variable that contributed the most to the unexpected increase in tax receipts was imports of consumer goods—chiefly motor vehicles—which expanded by 11.3 percent in real terms compared with a forecast of 2.6 percent in December 2015. This component by itself contributed NIS 5 billion to the gap between the original revenue forecast and the amount actually collected.[4] An unexpectedly large increase in wages contributed another NIS 1 billion or so, whereas the other variables in the model made a negative contribution of around NIS 1 billion relative to the original forecast.[5] According to this analysis and following the model, macroeconomic developments in 2016 should have yielded NIS 2.0 billion more in tax receipts than actual receipts. At the present writing, it is premature to analyze the factors that caused collection to fall short of the level that the model predicted—assuming that such a shortfall existed at all, since some data on 2016 economic activity are still incomplete estimates.

Tax receipts increased in 2016 by NIS 13 billion—4.9 percent—over 2015.[6] This figure, however, disregards inter-year changes in tax rates and inter-year fluctuations in motor vehicle imports due to tax rate changes. The changes in tax rates—lowering

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[3] This assumes that the annual rate of increase in tax receipts resembles that of GDP, as has been found in the Bank of Israel tax model for years in which the growth rate is stable. Indeed, the relevant GDP variable (nominal GDP deflated by the CPI) rose at a similar 6 percent pace in 2015 and 2016.

[4] The import and wage variables in the model are calculated net of increases that originate in GDP growth.

[5] Compared with the corresponding analysis in our August 2016 survey, the increase in imports speeded up even more, wages grew at a similar pace, and new housing sales contracted and converged to the original forecast. However, since the contribution of imports and wages (both of which correlate positively with GDP) to revenues is calculated beyond the effect of GDP change, the nominal increase in GDP beyond the original forecast, caused largely by correction of the Central Bureau of Statistics estimates of growth in the first half of the year, offsets much of the additional upturn in imports and reduces the contribution of wage growth.

[6] This data point pertains to actual collection and not to budget data, which subtract government transfers to the compensation fund from receipts and make additional minor accounting adjustments.

Table 1
Tax revenues in 2016 - budget forecast vs. performance (NIS billion)

	Forecast	Actual	Difference	Difference (% of fore-cast)
Total tax revenues	277.3	283.2	5.9	2.1
Adjusted for provision to Property Tax compensation fund	277.3	284.8	7.5	2.7
Nominal GDP forecast (adjusted for change in GDP definitions)	1,202.0	1,222.4	20.4	1.7
Revenue forecast adjusted for actual growth rate and provision to Property Tax compensation fund	280.4	283.2	2.8	1.0

Value Added Tax in late 2015, reducing corporate tax at the beginning of 2016, and, conversely, curbing the tax benefit on employer contributions to pension funds—reduced revenues by NIS 4.4 billion in 2016. In contrast, inter-year rescheduling of motor vehicle imports boosted revenues by NIS 0.8 billion (Table 2). After adjustments for these changes are made, tax revenues increased by NIS 15 billion (5.6 percent)—a rate exceeding that of nominal GDP growth (5.1 percent). Here, too, analysis by means of the tax model traces the extra increase in revenues—NIS 3 billion—to rapid growth in imports of consumer goods (net of the effect of inter-year volatility in motor vehicle imports).

Table 2
Factors contributing to the increase in tax revenues - 2016 vs. 2015 (NIS billion)[a]

Total revenues in 2015	271.6
Undercollection in respect of bringing imports forward to 2014	1.0
Effect of legislative changes in 2016[b]	-4.4
2015 revenue adjusted for legislative changes	268.1
Effect of increase in nominal GDP (5.1 percent)[c]	13.6
Forecast adjusted to legislative changes - 2016	281.7
Actual revenues in 2016	284.9
Revenues net of bringing vehicle imports forward[d] from 2017	283.1

[a] Data on actual revenue collection, that are not affected by accounting transfers to the compensation fund.
[b] "Static" calculation that deos not refer to effect of legislative changes on GDP, imports, and composition of demand.
[c] Assuming that the elasticity of tax revenues to GDP is unitary.
[d] This component includes NIS 5 billion discussed above.

The appreciable effect of the increase in imports on tax receipts also stands out when tax receipts on motor vehicle imports, which include purchase tax and Value Added Tax, are examined directly. In 2016, these taxes accounted for NIS 17.3 billion in collection, compared with NIS 11.9 billion in 2015 and NIS 11.5 billion on average in 2012–2015. The increase in revenue relative to the average for these years is equivalent to 0.35 percent of GDP. The steep upturn in receipts generated by these taxes in 2016 originates in a large increase in the number of imported motor vehicles, whereas the average rate of purchase tax—50 percent of imported vehicle value—resembles that in previous years and the VAT rate declined by one percentage point. Some of the upturn in imports seems to come from advancing of purchases in anticipation of an increase in tax rates at the beginning of 2017, at an intensity that was exceptional relative to previous tax hikes. The large share of motor vehicle tax revenues in total tax receipts indicates that the current level of receipts is unlikely to persist if the level of imports reverts to that of previous years. It is true that in some earlier years, tax revenues from motor vehicle imports were only 0.2 percent of GDP below their current level (Figure 2) but the tax rates on imported vehicles were 16 percentage points higher in those years.

In addition to the abundant import tax revenues, the government has enjoyed a strong upturn in revenues on real estate taxes in recent years (Bank of Israel Annual Report for 2015, Chapter 6). These mainly include real estate purchase tax, land betterment tax, and Value Added Tax on new dwellings.[7] Real estate tax revenues leveled off in the reviewed year (as a percentage of GDP) at a plateau approximating that of 2015, which was considerably higher than in previous years: 0.3 percent of GDP more than the 2012–2015 average and 0.45 percent of GDP more than the 2009–2011 average (Figure 2). Thus, the combination of brisk revenue from motor vehicle imports and real estate—two volatile components—augmented tax receipts by 0.5–0.7 percent of GDP in recent years.

Figure 2
Total Revenue from Vehicle and Real Estate Taxes[a], 2009—16

a Purchase tax, betterment tax, and value added tax on new homes (estimate).
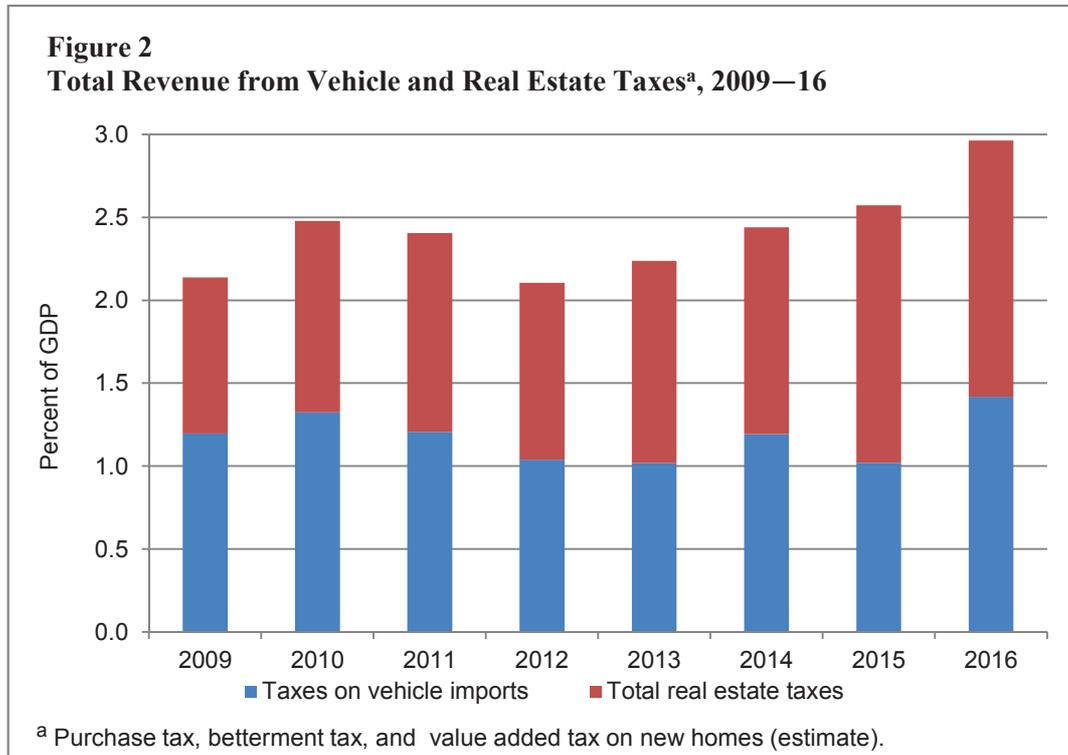
In addition to the strong tax receipts, revenues were boosted in 2016 by an unexpectedly large NIS 4.1 billion surplus from the National Insurance Institute (NII).[8] The unexpected surplus came from two sources:

An unexpectedly large NIS 2.6 billion operating surplus, most of it due to more than NIS 2 billion less in benefit payouts than the sum appearing in the draft budget (Main Provisions of the Budget 2015–2016, p. 156). There is no economic or institutional explanation for this discrepancy; it reflects an overestimate that already appeared when the budget was prepared. As a reflection of this overestimate, benefit payments in 2015 were NIS 2.5 billion smaller than the estimate in Main Provisions of the Budget, even though that publication came out only in late 2015;

An accounting measure in late 2016: The government transferred NIS 1.5 billion to NII as an advance on account of payments in coming years but immediately "clawed it back" as part of NII's operating surplus because NII was unable to spend the money in 2016. As a result, the expenditure side of the government budget was overstated by NIS 1.5 billion with a concurrent increase in revenue. This move had no effect whatsoever on the budget deficit in 2016.

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7 Data relating to VAT collection on dwellings are not reported directly. They are based on Bank of Israel calculations.

8 National Insurance revenue includes insurance premiums remitted by the public, transfers from the government, interest earnings on special government bonds in which NII invests surplus revenues, and redemptions of bonds. This revenue is used to pay out benefits and cover operating expenses. For a detailed explanation of the structure of accounts between the government and NII, see the Bank of Israel *Annual Report* for 2002, Box 3.3.

Total budget expenditure increased in 2016 by 6.4 percent over 2015 in real terms (deflated by the Consumer Price Index) or 5.9 percent net of the NIS 1.5 billion transfer to NII.[9] Excluding the transfer, expenditure (net, not including revenue-dependent expenditure items[10]) was NIS 2 billion below the ceiling established in the budget. Divided by expenditure items, spending by civilian ministries was in line with the original budget whereas the "Miscellaneous" and "Interest" items were underspent—as in most previous years. The unutilized balance in these items was invoked to give the defense budget a NIS 5 billion supplement, in accordance with the long-term outline for the defense budget that was drawn up in late 2015. Importantly, even after this increase, defense spending as a share of the budget and of GDP (including expenditure for the relocation of army bases to the Negev) declined in the reviewed year, as it has in most previous years, and was half a percent of GDP lower in 2016 than at the beginning of the decade. This decrease, coupled with the contraction of interest payments and the upturn in total spending, caused primary civilian public expenditure as a share of GDP to rise in 2016 after declining in 2015 (Table 3).

An examination of the growth rates of spending in the government budget—primary civilian expenditure in particular—in recent years (Figure 3) finds rapid acceleration (with the exception of 2014) far exceeding the growth rates of real GDP and public expenditure since the middle of the previous decade. Nevertheless, government expenditure as a share of GDP declined (with the exception of 2016). This outcome reflects the spread that opened up in these years between the CPI—by which budget expenditure is deflated in order to calculate the real rate of increase (this is the index by which the budget expenditure ceiling is calculated)—and the GDP deflator. While the two indices develop similarly in the long term, a 7.5 percentage-point spread has opened between them in recent years, causing spending in CPI terms to surge ahead even as spending relative to GDP erodes.[11]

Figure 3
Real Annual Rate of Change in Government Expenditure, 2007―16
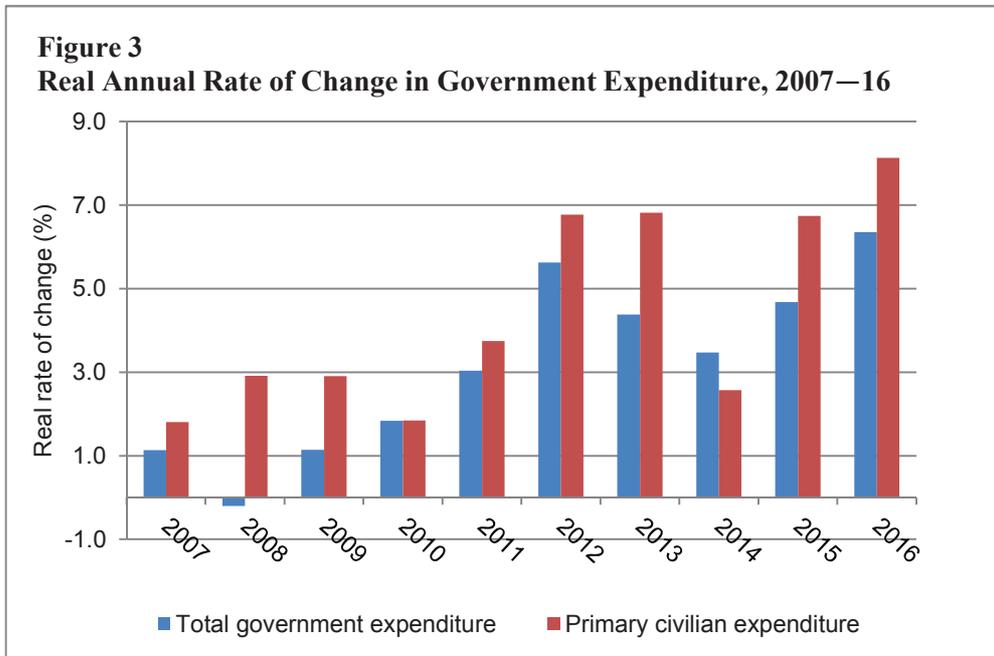
It is true that, according to the expenditure rule, spending should be cut back whenever the CPI rises more slowly than expected in order to maintain the real rate of increase that the rule establishes. The government, however, decided to refrain from making this adjustment and resolved to continue increasing its spending. It did this because much of the decline in the CPI originated in a downturn in import prices, which do not reflect the composition of public expenditure, and in the low level of spending. Even

[9] The rate of change is presented in accordance with accounting changes that were made in the transition from the 2015 budget to that of 2016, which increased reported expenditure by NIS 3.85 billion. (See the February 2016 *Fiscal Survey.*)

[10] Some budget expenditure items are performed only if revenue from specific sources is received. Detailed reportage on the performance of these items appears only in later reportage on budget performance. In recent years, such expenditure has fallen short of the amount allocated by NIS 2.5 billion per year.

[11] In 2012–2016, the GDP deflator rose by an annual average of 2 percent and the CPI rose by an annual average of 0.5 percent. In 1999–2016, in contrast, both indices advanced by an annual average of 2.1 percent.

though prices were not adjusted, the deficits remained small ex post because tax receipts grew in tandem with nominal GDP, since taxes are collected on the shekel value of economic activity. A similar development was observed in the business sector, where real wage per employee increased (in purchasing power terms) whereas wage expenses in terms of GDP prices did not grow. Therefore, a blow to profitability was avoided. However, if the price-ratio trend—which largely reflects global prices of imports and exports—turns around, one outcome may be a rapid increase in the deficit.

Table 3
Public expenditure 2012—16 (percent of GDP)[a]

	2012	2013	2014	2015	2016
Total expenditure (excluding credit)	**40.0**	**39.9**	**39.6**	**39.0**	**39.0**
Real change, percentage, (net of CPI)	7.1	4.7	3.1	4.4	5.6
Defense - gross	6.1	5.9	6.0	5.9	5.8
Interest (excluding interest payments to National Insurance Institute)	2.8	2.7	2.5	2.7	2.6
Primary civilian expenditure	31.1	31.3	31.1	30.4	30.6
Real change, percentage, (net of CPI)	7.9	5.8	3.2	3.5	6.5

[a] Adjusted for accounting changes in 2016.

Alongside the unexpectedly small deficit, the public debt to GDP ratio continued to decline—by 1.8 percent of GDP—to 62.1 percent, low by the standards of the advanced economies (Figure 4). About half of the decline in this ratio in 2016 is explained by the small deficit and the erosion of debt that existed at the end of 2015 relative to nominal GDP (Table 4). The rest of the decline originated in repayment of the public's debts to the government (mainly of previously issued housing loans) and a rapid increase in the GDP deflator relative to the CPI, to which about half of the public's debt is indexed. This phenomenon is not unique to 2016. An analysis of the precipitants of the decline in the debt to GDP ratio from the end of 2011 to the end of 2016 shows that the dynamic of the government budget deficit and GDP growth is responsible for only a small portion of the decline, with most of it coming from the aberrant change in the GDP deflator relative to the CPI, payback of housing loans to eligible recipients, and privatization receipts (Figure 5). Since the government's housing loan portfolio has contracted greatly and a large share of privatization revenue (foremost from land sales) is earmarked for extrabudgetary funding of government construction and housing activity, the government will find it difficult to continue lowering the debt to GDP ratio if the deficit rises to the levels that it has set as the ceiling in the next few years.
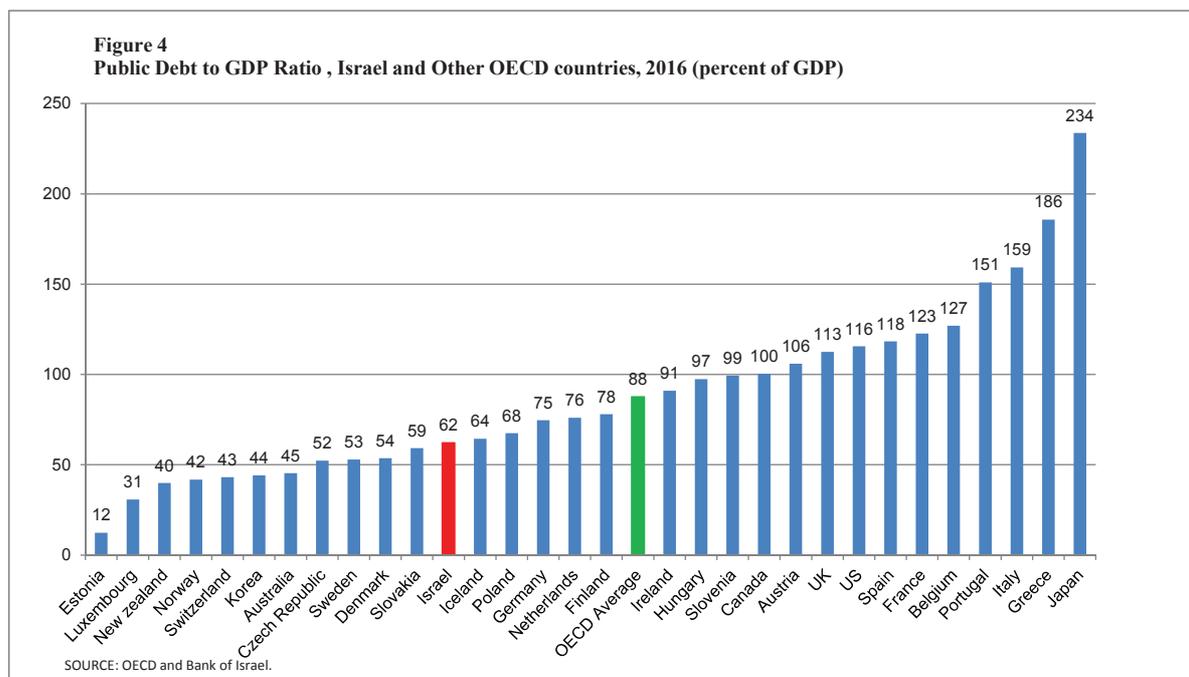
Figure 4
Public Debt to GDP Ratio , Israel and Other OECD countries, 2016 (percent of GDP)

SOURCE: OECD and Bank of Israel.

Table 4
Factors in the change of the public debt to GDP ratio, 2015 vs. 2016 (percent of GDP)

Debt to GDP ratio on December 31, 2015	**63.9**
Effect of deficit and real GDP growth	-0.4
Effect of change in GDP deflator on unindexed debt and foreign currency-denominated debt	-0.4
Revenues from privatization and public's debt repayment to the government	-0.4
Effect of change in GDP deflator and in CPI on CPI-indexed debt	-0.5
Increase in public non-government debt, excess funding, changes in exchange rates and changes in accrued interest	-0.1
Total change in debt to GDP ratio in 2016	-1.8
Debt to GDP ratio on December 31, 2016	**62.1**

Figure 5
Distribution of Factors in Reduction of Debt to GDP Ratio, 2011—16 (percent of total decline)
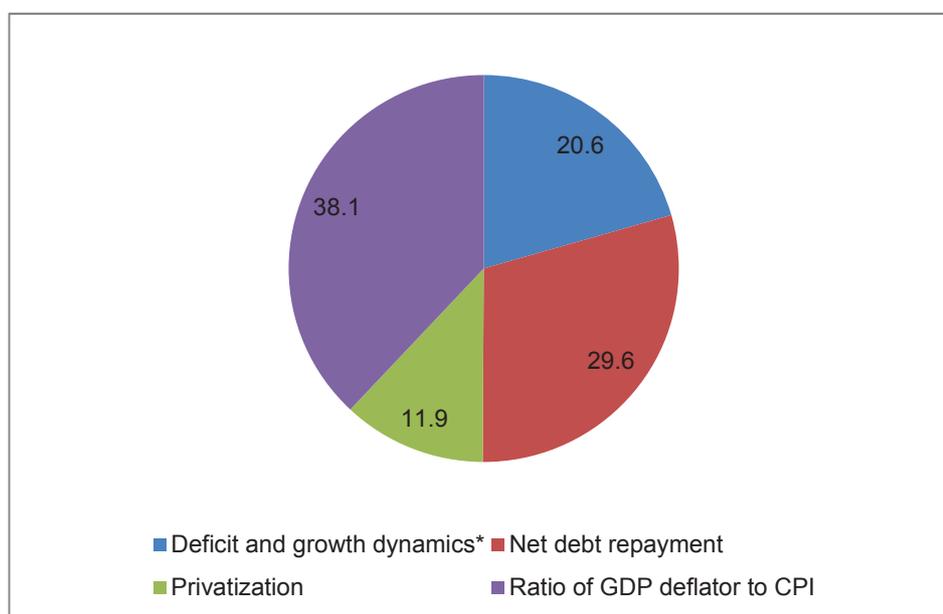
* Assuming that the CPI would have increased as the GDP deflator did, at 2 percent per year.

The aforementioned perceptible and ongoing contribution of repayment of the public's debt to the government to lowering gross public debt in the past decade is manifested in a rapid decline of gross public debt relative to net public debt (the total less the government's financial assets). This trend, a continuing one in Israel, is unusual among advanced economies. In most OECD member states (with the exceptions of Switzerland, the Czech Republic, and Poland), the gap between gross public debt and net public debt has widened in the past decade (i.e., the government has accumulated net assets as opposed to realizing them) by 9 percent of GDP on average. Thus, much of the spread that has opened in Israel's favor traces to this realization of assets.[12]

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[12] Since comparing levels of net public debt is complicated, the common practice is to base cross-country comparisons on gross debt. Despite the disclaimers, it appears that Israel's situation in terms of the size of its net debt is less auspicious than that of other countries— slightly less than 60 percent of GDP compared with 43 percent on average among OECD countries (excluding Norway, which has an aberrant assets surplus). The reason is that the average net share of portfolio assets in the OECD countries is 48 percent of GDP.

2. The 2017 and 2018 budget

The government's budget ceiling for 2017 and 2018 is 2.9 percent of GDP, far beyond the 2.1 percent deficit recorded in 2016. The increase reflects a sizable upturn in the spending limit—by 6 percent in 2017 and another 3.7 percent in 2018 (adjusted for accounting changes)—and a minuscule adjustment of tax rates in 2017[13] and moderate tax cuts in 2018. Furthermore, the planned real increase in total expenditure—including, in addition to the spending limit, revenue-dependent expenditure items[14]—is 7 percent in 2017 (relative to estimated performance in 2016) and another 2.5 percent in 2018 (Table 5). This vigorous rate of increase reflects the low level of public expenditure and the government's need to increase available resources in order to attain its goals. The upturn in revenue-dependent expenditure relies mainly on nonrecurring or provisional revenues that the government is trying to obtain from various state-owned enterprises and public institutions such as the Jewish National Fund, the Airports Authority, and the state lottery. The revenue-dependent component also includes budgets for relocating army bases to the Negev—NIS 2.8 billion in 2017 and NIS 2.1 billion in 2018—that can be performed only if receipts from land sales by the Israel Land Authority are received. Insofar as these earmarked revenues prove difficult to collect (some of them were already included in the 2015–2016 budget and not realized), the expenditure that depends on them—mainly for housing, school construction, infrastructure investment, and construction of army bases in the Negev—is likely to be delayed, impairing the attainment of important government objectives in these fields. While this method of recording expenditure makes it possible to except it from the spending limit, it is advisable that the government budget its investments—particularly in schools and infrastructure—directly, so these activities do not depend on the realization of revenues from these specific sources.

Table 5
Expenditure and revenue[a] in government budget for 2017—2018

	NIS billion		Real rate of change (%)	
	2017	2018	2016 to 2017	2017 to 2018
Net expenditure (expenditure ceiling, excluding credit)	359.4	376.4	6.2	3.7
Revenue contingent expenditure	44.9	42.0	...	-7.4
of which: civilian expenditure	23.0	23.0	15.0	-1.0
Total expenditure	404.3	418.4	7.0	2.5
of which: defense (including IDF move to the Negev)	82.8	82.4	6.2	-1.5
Total interest payments, including repayment of National Insurance Institute fund	49.1	50.4	0.5	1.6
Primary civilian expenditure	271.5	285.6	8.4	4.2
Total revenues	370.9	382.2	5.6	2.0
Taxes	298.8	309.9	4.6	2.7
Revenue from royalties, government companies, miscellaneous	5.0	6.5	50.8	28.7
Other	67.1	65.8	7.7	-2.9

[a] Data on revenue and its components are Bank of Israel estimates.

According to the Bank of Israel's adjusted forecast, which reflects amendments to the budget since the government passed it last summer and recent domestic and global economic developments, the deficit in 2017 is projected at 2.5 percent of GDP—below the ceiling that the government has set. This forecast does not take account of potential tax revenues from Intel's acquisition of Mobileye (which, insofar as they are received, may increase tax revenue in 2017 and/or 2018 by several billion shekels on a one-off basis). This assumes that the government will not adjust tax rates or levels of National Insurance benefits and will not

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[13] Total tax increases and decreases basically offset each other in 2017.

[14] Revenue-dependent expenditure is expenditure performed only if revenues from a specific source, earmarked in advance for this expenditure, are received.

perform revenue-dependent expenditure items unless their earmarked revenues arrive. The main precipitants of the below-target deficit are (a) favorable macroeconomic developments in the second half of 2016 and, particularly, rapid GDP growth coupled with the upward revision of data for early 2016, adding NIS 2.5 billion to the tax-revenue forecast, and (b) NII surpluses that are expected to surpass the budget by NIS 2 billion due to the aforementioned overestimation of benefits. As for 2018, expected tax revenues are similar to the budget forecast at the present writing but the NII surplus is poised to exceed the budget forecast by more than NIS 2 billion, probably leaving the deficit slightly under the ceiling. Importantly, at this early phase, one should treat the 2018 revenue outlooks very cautiously, especially since many tax-related legislative changes were approved along with the 2017–2018 budgets and developments in the real estate and motor vehicle markets have had powerful effects on revenues in the past two years.

To contend with the difficulty in predicting economic variables for 2018 in the summer of 2016, when the government approved the budget, and given the risk of new budget exigencies between the two dates, legislation established a control mechanism between the years of the two-year budget: the inclusion of a NIS 3.5 billion adjustment reserve in the budget.[15] According to the statute, in November 2017 the government must report to the Knesset Finance Committee on differences between the 2018 budget and expenditure forecasts and the budget as approved. If the foreseen differences exceed the adjustment reserve, the government will have to present the Knesset, in November 2017, with measures that will bridge the remaining gap. Otherwise, the budget for 2018 will be nullified, the year 2018 will begin with an interim budget (an allocation of one-twelfth of the 2017 budget each month), and the government will have to approve a new budget for 2018 within three months. Absent this, the Knesset will be dissolved. This mechanism responds to the forecasting problem effectively but minimizes the potential advantages of the biannual budget: a lengthier planning horizon for budget management than a one-year budget can provide.
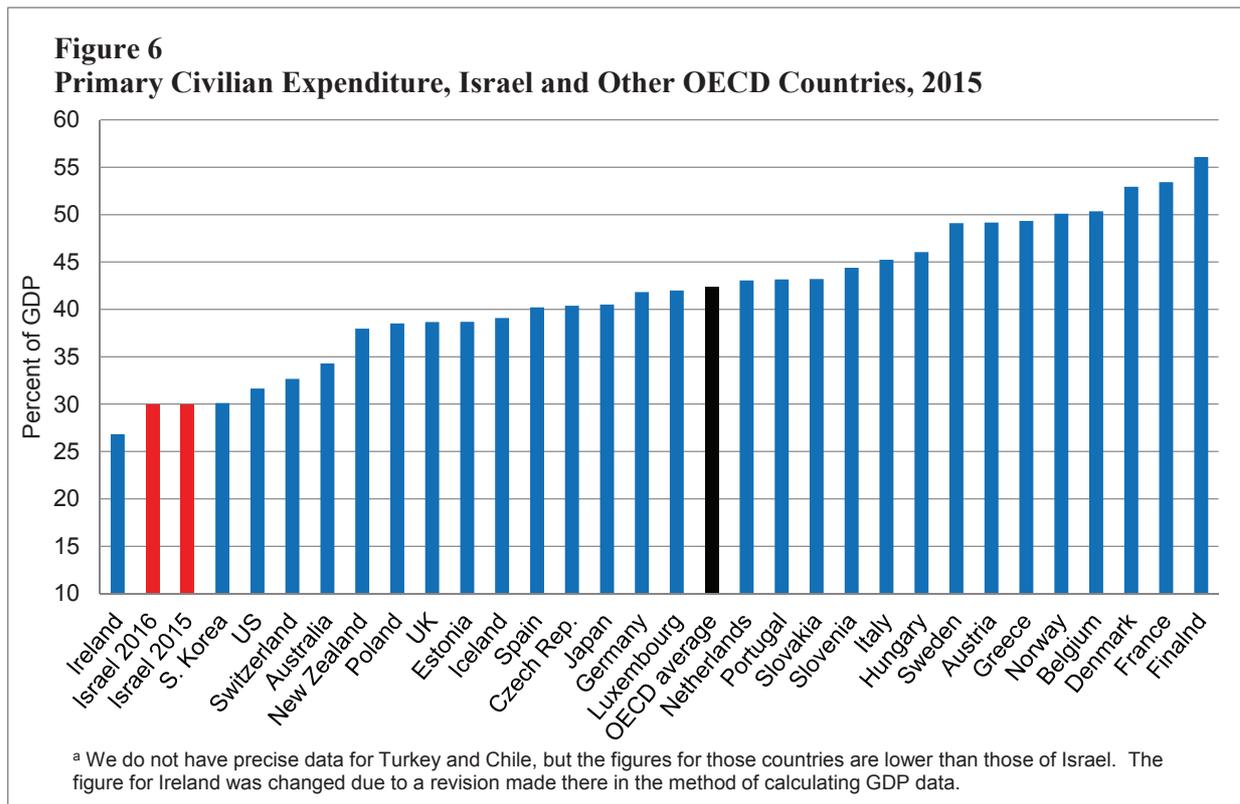
The rapid growth rate of expenditure in the current budget continues the trend of acceleration of expenditure that began after the social protests in the summer of 2011 (Figure 3). This evidently reflects the government's realization that it cannot attain its social, economic, and defense goals at the limited level of expenditure that the ceiling dictates. The rate of budget increase far exceeds that established by the expenditure ceiling—2.7 percent of GDP per annum. In the current budget, as in the 2015–2016 budget, the government resolved to revise the budget rules by not adjusting the expenditure ceiling to a CPI that rose at a slower pace than had been forecast. This was a reasonable decision in view of the weak relationship, in the short term, between the Consumer Price Index and budget outlays.[16]

For the same reason, the government also resolved to revise the price-adjustment formula on a permanent basis starting with the next budget, so as to require no immediate adjustment for deviations of the Consumer Price Index from the forecast. Additionally, in the current budget the government raised spending by a much higher rate than the increase set forth by the expenditure rule. Both measures are meant to cope with the spread that has built up between the cost of the government's spending programs for the next few years and the long-term spending limit that it had adopted. In previous years, the government contended with these differentials by taking one-off measures, making accounting adjustments, and deferring some spending to a later time. In view of the continued expansion of the spending programs, however, and of the differential between their cost and the spending ceiling, the government decided in 2016 to broaden the budget framework. Contributing to this decision was the mechanism that controls long-term spending commitments (the numerator) that the government has adopted, making it difficult to create long-term budget commitments for which no source of funding has been established.

In the current budget, the government raised not only the spending ceiling but the deficit ceiling as well. On top of this, it lowered tax rates from 2018 onward in view of propitious macroeconomic conditions that are helping to boost tax revenues. Just the same, as stated above, in the current budget—as in its predecessors—much expenditure is funded by provisional transfers from extrabudgetary entities or by recording the sale of assets (land) as budget revenue. Insofar as the government decides that spending should continue to accelerate—particularly given the very low level of primary civilian expenditure in Israel by OECD standards (Figure 6)— it will have to base implementation on more stable sources of revenue in order to avoid a permanent increase in the deficit and reversal of the downward trend of the debt-to-GDP ratio.

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[15] Basic Law: State Budget for 2017 and 2018 (Special Provisions) (Ad Hoc Directive), *Sefer Hukim* (Israel lawbook), 2576, August 11, 2016, p. 1182.

[16] See detailed discussion in the previous fiscal survey: Bank of Israel, *Fiscal Survey and Selected Research Analyses* 141, October 2016.

Figure 6
Primary Civilian Expenditure, Israel and Other OECD Countries, 2015

ᵃ We do not have precise data for Turkey and Chile, but the figures for those countries are lower than those of Israel. The figure for Ireland was changed due to a revision made there in the method of calculating GDP data.

The expansion of public expenditure, coupled with the decrease in government interest payments (chiefly in 2017) and the mild upward slant of defense expenditure (most of which is in 2018), is manifested in a considerable increase in primary civilian expenditure, projected at more than 8 percent in 2017 and another 4 percent in 2018. Consequently, primary civilian expenditure is poised to increase considerably, by more than 1 percent of GDP, during the two years of the budget if the budget is fully performed. This will return civilian central government expenditure as a share of GDP to its level at the beginning of the previous decade, before the 2003 economic stabilization program. Even though some of the budgeted increase in expenditure will probably not be performed—particularly given the dependency of some expenditure items on realizing earmarked revenues from uncertain sources—this is a significant move that will give the government more maneuvering room to narrow economic gaps, invest in physical and human infrastructure, and improve its services.

However, several expenditure items that can be performed only if uncertain earmarked revenues arrive are of major importance, especially building schools and improving infrastructure and transport. The government would do well to prepare in advance for the possibility that the earmarked revenues will not materialize, for example by keeping sources from unused expenditure items in order to avert the possibility of nonperformance of such activities. It is worth emphasizing that even after the increase, Israel's civilian expenditure as a share of GDP remains almost the lowest among the OECD member states, making it difficult for the government to steer resources toward policy measures that would consolidate economic growth in the long run.

The defense budget for 2017–2018 is the first to be constructed on the basis of the new multiyear outline that the government approved. Alongside the complex and detailed agreements that the ministries of Defense and Finance concluded concerning the components of the plan, the budget anchors a multiyear IDF program that overlaps the term of the outline and was approved by the ministerial cabinet on diplomatic and security affairs. Government and defense establishment adherence to the outline will bolster both the effectiveness of the defense establishment's activity and the stability of the government's budget conduct.

In addition to adopting the multiyear outline and action plan, two changes were made in 2016 in the way defense spending is presented in the state budget, making the budget more transparent:

From this budget onward, all military aid will be reported as revenue-dependent expenditure, and will therefore not be subject to the expenditure ceiling.[17] Previously, $2.4 billion in assistance was included in the net budget—meaning that it was subject to the ceiling—and only the remaining $700 million was recorded as revenue-dependent expenditure. The importance of this change, which does not affect the size of the defense budget, is that it makes the expenditure ceiling less sensitive to the exchange rate and, in particular, obviates the need for unnecessary budget adjustments due to currency depreciation. The net spending limit of the budget was lowered commensurate with the recording change.

A section titled "Other Defense Expenditure" (Section 31) was added to the state budget. It aggregates several defense-spending items, some of which were presented in the past as part of the budget reserve. By linking this section with the defense expenditure that is included in the familiar budget items, it becomes possible to identify the total defense burden in the budget and, concurrently, the size of the effective reserve in the total budget (Section 47). Although the budget often includes "hidden reserves" in other items—such as "Miscellaneous"—that have been performed at a paltry rate for many years, the recent measure will help to make the budget more transparent.

Relative to the measures that are meant to improve the presentation of defense expenditure in the budget, the way spending related to relocating IDF facilities to the Negev is less transparent. In the 2016 budget, this expenditure (NIS 3.3 billion) was recorded under "Miscellaneous Development Expenses" in the Ministry of Finance budget, and in the 2017 and 2018 budgets they were moved to the "Government Housing" item, instead of appearing in the defense budget. Furthermore, most expenditure under this item is recorded as revenue-dependent, meaning that it is not subject to the expenditure ceiling. This, even though the "revenue" on which the construction of army facilities depends is the sale of land—that is to say, the realization of government assets that was recorded in the past, per the conventional practice, as a funding item. Thus, the government has excepted a national project—relocating army bases—from the public expenditure that has to be kept under the expenditure ceiling. Concurrently, it has lowered the reported deficit.

3. Fiscal targets for 2019 and 2020

According to the new statutory budgeting rules, the government must review the state of the budget not only for years in which a budget has already been approved (2017 and 2018 at the present writing) but also in regard to goals for years farther ahead. Thus, government resolutions that need a budget expenditure or a revenue cut for implementation require the examination of budget aggregates for years following the current budget as well. Insofar as such resolutions are expected to cause a breach in the expenditure or deficit ceiling, the government must concurrently make adjustments that will prevent the aberration. This rule was adopted in order to stop the process, which has repeatedly occurred since the beginning of the decade, of governments resolving to make various expenditures in years following the current budget without reconciling them with the multiyear budget targets. When it then came time to approve the budget, the government had to abrogate or postpone some of its resolutions and slash or revise the budget targets. The new budgeting rules are supposed to thwart this process, which impaired the efficacy of government activity and the public's trust—both in the government's promises to apply programs on which it had decided, and in the credibility of expenditure and deficit ceilings that changed again and again.

In the 2017–2018 budgets as approved, the government narrowed budgeting disparities for ensuing years considerably by raising the expenditure and deficit ceilings. Since the expenditure ceiling is set each year in terms of a rate of change relative to the previous year, the expansion of the current budget will allow the government to accommodate the inventory of surplus liabilities from the past and carry on henceforth under tougher auditing. Concurrently, by raising the deficit ceiling the government gave itself room to increase spending without raising tax rates, and may even lower them, as stated above, when tax receipts grow.

The expected spending path for 2019 and 2020 shows that the government has applied restraint in making new spending commitments since the budget was approved, and that the foreseen level of expenditure in 2019 is only slightly higher than this year's spending limit. Although the beginning of 2019 is still a year and nine months away at this writing, this is a major improvement in budget behavior in comparison with previous years because in the past a larger overrun became apparent at an early stage. Still any government decision to increase spending before the budget is approved (and, practically speaking, until the end of 2019) will have to be accompanied by a decision to reduce other expenditure items. It is important to stress that, according to the existing rules, an increase in revenue does not absolve the government from having to respect this limitation,

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[17] Value Added Tax on the transfers will still be recorded in the net budget.

since the spending limit remains in effect irrespective of the deficit ceiling. Although compliance with the spending limit for 2019 is a challenge that the government probably can meet, the fact that expenditure is already bumping against the ceiling today also shows how restrictive the spending limit is relative to needs—given the very low level of civilian expenditure in Israel. Furthermore, more than NIS 2 billion in spending beyond the ceiling is already expected in 2020, because the government set the rate of increase of expenditure that year especially low—2.2 percent—in order to offset some of the expansion in the current budget. Even though the budget at issue pertains to a relatively far-off year, the expected gap shows how stressed the budget is by the current expenditure limit. The rate of increase of expenditure closely resembles the supplement derived from demographic developments and benefit-adjustment mechanisms, National Health Insurance, and education services—alongside the cost of the multiyear investment plans and the defense budget outline.

The deficit ceiling enshrined in law for 2019 is 2.5 percent of GDP, down 0.4 percent of GDP from the limits in the current budget. According to the current forecast and assuming that the government indeed stays within the spending limit, the deficit for 2019 is expected to be quite similar to the target set forth, even given the uncertainty due to the time that remains until then. The discrepancy shows, however, that the government's decisions on permanent cutbacks in tax rates, even if not placing the deficit target at risk in the near term, will distance it from the possibility of staying within the deficit target in subsequent years—particularly given the tension between spending needs and the expenditure limit. A lower deficit—2.5 percent of GDP— is foreseen in 2020, but this is mainly due to the tough spending limit that was set for that year. Given this year's deficit target (2.25 percent of GDP) and the fact that expenditure set forth in existing government resolutions already breaches the ceiling, the government will have to make a total budget adjustment of more than NIS 6 billion to safeguard the deficit ceiling. As stated, it is rather premature to make accurate forecasts for 2019, let alone 2020. The current estimates, however, indicate that the government will, from this year on, have to be cautious in adopting measures, such as tax cuts, that will structurally widen the gaps between the expected deficit and the deficit ceiling. This is particularly the case in view of recent years' experience showing that the government finds it hard to stay under the expenditure ceiling at its current level, as well as the cyclical nature of several factors behind the high level of revenues. It is also noteworthy that the deficit targets for 2019 and 2020 are set at the level that is needed to hold the debt to GDP ratio where it is today, and a deviation from these levels may cause the downward trend of the ratio to reverse itself.

Part 2: Broader Review of Selected Issues

INFORMATION ON UNEXPECTED INFLATION AS REFLECTED IN CPI-INDEXED BOND PRICES

Summary

- At the beginning of every month, financial market players formulate their expectations about the changes that month in the Consumer Price Index (CPI), which is published on the 15th of the following month. The following analysis reviews how players adjust their assessments about changes in the CPI from the beginning of the month until after the publication date.
- Over the course of the approximately 45 days that elapse from the beginning of the month until the publication of the CPI (prior to its publication), financial market players learn a significant portion (42 percent) of the information about the inflation that was not expected at the beginning of the month. On the first trading day after publication, the market learns another 30 percent, and in the days following, players adjust bond prices to the remaining information.
- In the period between 2001 and 2009, players had a greater capacity to learn information about inflation as it developed than in the period between 2009 and 2015, probably because until 2009, the housing component of the CPI was very highly correlated with the shekel-dollar exchange rate, for which information is available on a continuous basis throughout the month.

Introduction

Financial market players continuously formulate their inflation expectations. Specifically, at the beginning of each month they compile their expectations about changes in the current month's CPI, which is published on the 15th of the following month. In what follows below, we use the term "unexpected inflation" to describe the difference between the change forecast at the beginning of the month and the actual change in the CPI, which is published on the 15th of the following month. The following analysis examines the timing at which investors learn information about unexpected inflation,[1] in order to identify and understand how much inflation information is learned during the month as inflation evolves, how much information is learned in the two weeks from the end of the month until the date the CPI is published by the Central Bureau of Statistics (CBS), and what part of the inflation do investors discover only after the publication date. Such understanding is important because investors' learned information is reflected in the prices of CPI-indexed bonds, which are used by the markets to calculate inflationary expectations from the real zero-coupon yield curve.

In Israel, the CPI is calculated by the CBS, which publishes it after the end of trading on the 15th of each month. It includes information on the changes in average prices in the preceding month.[2] The calculation is based on the prices that investors observe—at least partially— throughout the month, and therefore investors learn at least part of the information on the inflation rate as it develops.[3] On any given day, CPI-indexed bond prices reflect investors' information and their assessments about the inflation that developed from the bond issue date to that day. This inflation is made up of two elements: the inflation that developed and was published, and the inflation that developed and has not yet been published. Investors try to forecast the second element—they have a financial incentive to do because bond payments are indexed to the CPI—and they price the bonds according to their expectations. Theoretically it would be accurate to claim that in a market considered strong form efficient—that is, a market in which bond prices reflect all the (private and public) information that exists in the market at any time—indexed bond prices reflect the CPI of the current month already at the end of that month (approximately 15 days before the CPI is published) due to the corrections to the expectations that are made during that month. This is a claim that can be tested:

Written by David Ettun.

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[1] To measure the inflation expectation that investors develop at the beginning of the month, we used the average forecasts of several professional forecasters that are published at the beginning of each month.

[2] Information on the calculation method is available to the public on the CBS website. When the 15th of the month falls on a Saturday, the CBS publishes the CPI on the 14th of the month.

[3] Investors can see the prices of products and services over the course of the month, whether any changes have occurred and in what direction, and use this information when trading bonds whose payments are linked to the CPI. They are, however, unable to perform the calculations that the CBS performs because the procedure is complicated and requires resources that are not available to investors.

If it is correct, we would expect to see no change in CPI-indexed bond prices after the publication of the CPI. In contrast, the less information investors discover before the CPI publication date, the greater the change observed in CPI-indexed bond prices after the publication date.

The following two examples illustrate this idea:

- A bond that is traded on January 20 reflects assessments of the inflation that developed from the beginning of January until January 20. The price of this bond will change on a daily basis according to any additional inflation that develops to that day. If there is a change in the bond price on January 21, this change comprises three elements: the change in bond's real yield, the inflation that investors assess has developed between January 20 and January 21 (and was not published), and corrections to the predictions of the inflation that developed up to January 20 (and was not yet published). These corrections reduce the gap between investors' expectations and the actual CPI, and therefore reduce any changes in bond prices observed after publication of the CPI.
- A bond that is traded on February 15 also reflects the inflation that investors believe developed in January but was not yet published. On February 16, after publication of the January CPI, investors check to see whether the published CPI matches their own expectations. If it does, we will not see any change in bond prices after the publication of the January CPI, but if the published CPI is higher/lower than their expectations, the price will increase/decrease. This change is the result of the fact that the bond payments are indexed to the CPI.

To understand what part of the change in price occurs as a result of the new information that investors learn every day, we estimated the connection between the daily change in bond prices and the unexpected inflation in the same month. Our findings show that 42 percent of the unexpected inflation is learned gradually over the 45 days that elapse from the beginning of the month up to the CPI publication date (before the publication) on the 15th of the following month. On the day after the publication date, the market aggregates approximately 31 percent of the information on the inflation that was not predicted at the beginning of the month, and this information is also reflected in bond prices. In the five days following the CPI publication date, investors learn the remaining information (approximately 23 percent) on the inflation that was unexpected at the beginning of the month[4]— even though the CPI is already known at this time. In other words, the market responds with a lag to the publication of the CPI.

If we divide the period between 2001 and 2015 into two subperiods—April 2001 to June 2009 and July 2009 to November 2015—we see that very different results are obtained in each one period. In the early subperiod, publication of the CPI revealed 30 percent of the unexpected inflation to investors after investors learned a significant portion of the information about the inflation over the month, as the inflation developed. In contrast, in the second subperiod, investors learned very little information about the unexpected inflation as it developed, and publication of the CPI revealed 81 percent of the inflation that had not been anticipated at the beginning of the month.

Literature review

Huberman and Schwert (1985) examined how information on unexpected inflation was reflected in CPI-indexed government bonds in Israel, focusing on the period from 1970 to 1979.[5] They measured inflation expectations using a statistical model based on inflation in previous months. Their findings showed that approximately 85 percent of the information on unexpected inflation is reflected in bond prices even before the CPI is announced, and the remaining information is aggregated and reflected in bond prices after publication of the CPI. However, Chu, Pittman and Yu (2009) pointed to several concerns about that study. They claimed that since some of the information refers to partially indexed bonds, the data may be skewed. Moreover, during the period of their study the government intervened in the indexed bond market, which might have caused an additional bias in the data.

Chu (1991) studied how the market collects information on unexpected inflation from the prices of inflation futures contracts in the US. Chu also estimated expected inflation using a statistical model based on previous months' inflation. His study indicated that the market learns 71 percent of unexpected inflation over the month, and investors update bond prices with respect to the

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[4] We can see that the total effect of 1 percent unexpected inflation leads to an effect of 0.96 percent on bond prices, but this effect is not statistically significantly different from 1 percent.

[5] In these years, the rate of inflation was high and almost all trading was concentrated in CPI-indexed bonds.

remaining 29 percent of the information on the days after publication of the CPI, especially on the publication date and the two days following that date.

Chu, Pittman and Yu (2009) examined the effect of information on unexpected inflation on the US CPI-indexed bond market (TIPS), focusing on the years 2007–09. The breakeven inflation rate served as the measure of inflation expectations. The breakeven inflation rate is the difference between the yield on nominal government bonds and the yield on CPI-indexed government bonds. They found that most of the information on inflation was reflected in bond prices even before publication of the CPI, with a slight correction in prices after the announcement.

CPI-indexed government bonds in Israel

The CPI-indexed government bond market in Israel is relatively developed, compared to similar markets worldwide. In Israel, CPI-indexed bonds account for 21 percent of the market value of all government bonds, compared to the average of merely 5 percent for OECD countries.[6] In 2015, trading in CPI-indexed bonds accounted for 30 percent of the total trading volume in the government bond market, and 83 percent of these trades were conducted on the TASE, with the remainder traded over the counter. The daily trading volume in CPI-indexed bonds has increased gradually from NIS 136 million in 2001 to NIS 986 million in 2015, while trading volumes in unindexed government bonds rose from NIS 319 million to NIS 2,080 million in the same period.[7] As such, over the years, trading volume in CPI-indexed government bonds has retained its share of total trading in government bonds.

Several factors affect the prices of CPI-indexed bonds:

• The CPI – Bond payments are determined according to the CPI, and bond prices reflect the inflation that developed since the bond was issued until the current day. This inflation has two elements: the inflation that developed and was published (information that is reflected in the most recent published CPI), and the inflation that developed but was not yet published (the inflation component that developed from the beginning of the month following the one for which the CPI was published until the current day). Investors observe the prices in the market, the information that was made public, and other information that serves as cues for the CPI for a specific month, and investors use all this information to develop expectations about the changes that already occurred in the CPI but have not yet been published.

For example, on February 20, the price of a CPI-indexed bond reflects the change in the CPI from its issue date through the end of January (the January CPI was published on February 15) and the inflation that investors believe has developed from February 1 to February 20. See Figure 1.

Figure 1
Information about Inflation Incorporated in CPI-indexed Bond Prices

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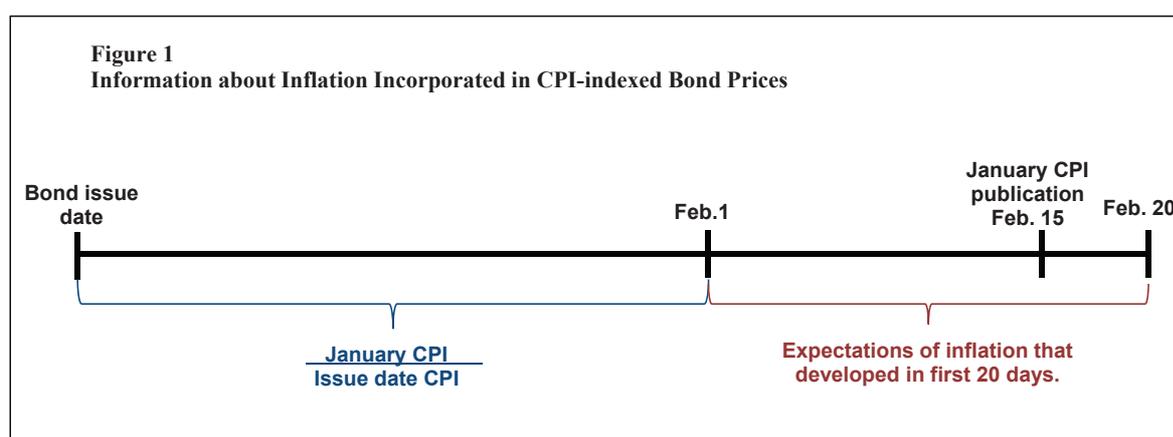
[6]   Source: OECD Central Government Debt Database.

[7]   Source: Ministry of Finance, Government Debt Management Unit.

- The real yield in the market - An increase (decrease) in real returns leads to a decrease (increase) in bond prices. Changes in real returns may have a more significant effect on the prices of bonds with more distant maturity dates than the prices of bonds with earlier maturity dates.
- Coupon (interest) payments - The price of the bond increases over the month as a result of the accrued interest, which reaches the coupon level on the ex date and is equal to the interest payment on the ex date. After the ex date, the bond price decreases by the amount of the coupon.
- Credit risk – When there is a risk that the bond issuer is unable to make payment on the bond, investors demand a credit risk premium, and the bond price consequently declines. In this analysis we used Israeli government bonds, whose credit rating changed little in the period of this study.

It is important to clarify that changes in expectations of future inflation (inflation that will develop beyond the current month) or policy changes that affect such expectations will not have a direct impact on the prices of CPI-indexed bonds because the payments of those bonds are determined by the inflation rate. Changes in expectations may affect their prices if they affect the real yields demanded by investors. In this way, CPI-indexed bonds differ from nominal bonds, which are directly affected by inflation expectations.

Data and methodology

For the purpose of the analysis we collected daily data on 60 fixed-rate CPI-indexed government bonds that were traded between April 1, 2001 and November 30, 2015 (Table A.1). The maturities ranged from 180 days to 5 years, with an average maturity of 2.8 years. Coupon interest rates ranged from 1 percent to 6 percent, and the median coupon rate was 4 percent.
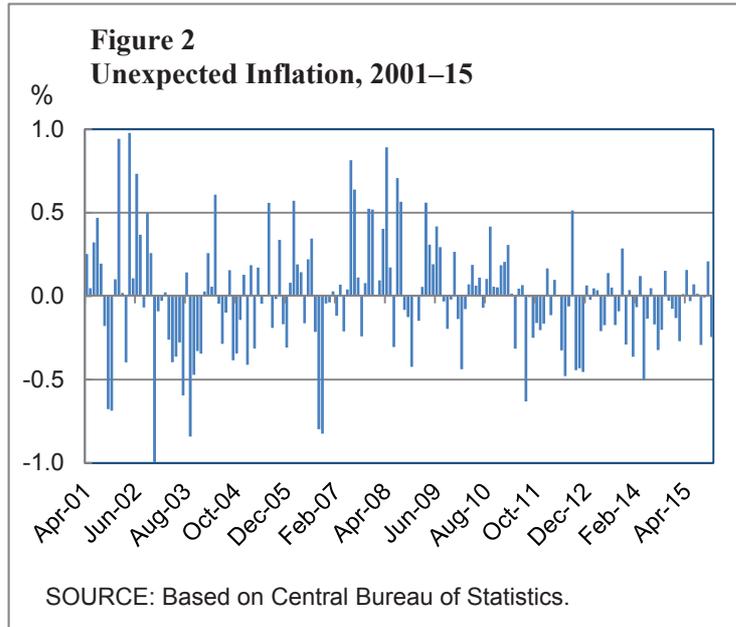
Data included the closing prices of every bond on each day it was traded during the study period, daily trading volumes, and the payment schedule for each bond. To prevent biases caused by a drop in price after coupon payment, we removed all the data on closing prices in coupon payment months. To prevent biases as a result of illiquidity, we used only prices that were determined after days on which the daily trading volume exceeded NIS 10,000. Furthermore, we used bond prices only for bonds whose maturity exceeded 180 days; later on, the bonds were stricken from the sample as they were not fully indexed: Close to maturity, the bond payments are not indexed.

To conduct the analysis that interests us, we must also separate the inflation into its two components: (1) expected inflation — that is, the inflation that investors anticipated at the beginning of the month, and (2) the unexpected inflation; this element is calculated ex post, and is equal to the difference between the inflation that actually developed (the change in the CPI) and the expected inflation.

$$\pi^{unexpected} = \pi^{actual} - \pi^{expected}$$

The estimate of expected inflation will be the average forecasted change in the CPI that forecasters announce at the beginning of each month.[8] The unexpected inflation in each month is presented in Figure 2. This figure indicates that the unexpected inflation shows significant fluctuations until 2009 (this is also reflected in Tables A.6 and A.7 in the Appendix), which stems mainly from the fact that until 2007, apartment leases were denominated in dollars. The transition to shekel-denominated leases began at that point in time, and was completed in 2009. Therefore, until 2009, the unexpected inflation also contained the unexpected changes in the shekel-dollar exchange rate, through their effect of the housing component of the CPI (between 20 percent and 25 percent of the CPI).

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[8] Since it is not possible to extract the expectations about the forthcoming CPI from bond prices, we used analysts' forecasts.

Figure 2
Unexpected Inflation, 2001–15

%

1.0

0.5

0.0

-0.5

-1.0

Apr-01 Jun-02 Aug-03 Oct-04 Dec-05 Feb-07 Apr-08 Jun-09 Aug-10 Oct-11 Dec-12 Feb-14 Apr-15

SOURCE: Based on Central Bureau of Statistics.

To examine how the information on unexpected inflation was included, we indexed the trading days during the period from the beginning of the month to five days after the CPI publication date (approximately 36 trading days[9]) relative to the publication date. The first trading day after the publication date is considered Day 0, the publication date is considered Day -1,[10] and the sixth day thereafter—Day 5 (see Figure 3).

Figure 3
Trading Days Relative to Publication of CPI

| -30 | -10 | 0 | 5 |

| 1/t | 15/t | 30/t | 16/t+1 | Sixth trading day |
| First trading day in month t | Publication date of CPI for month t-1 | Last trading day in month t | First trading day following publication of CPI for month t | following publication of CPI for month t |
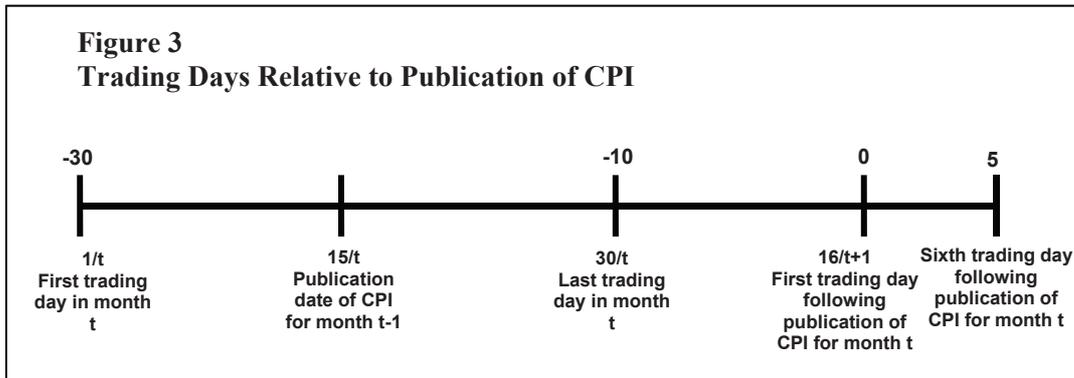
To calculate the portion of unexpected inflation that is contained in the CPI-indexed bond prices every day, we have to explain any changes in the bond prices. Such changes can derive from two factors: a change in real yields, and the expected and unexpected inflation. For example, if a 1 percent change occurs in the bond price, we want to break down this change into the change in real yields in the market, and the change in price levels. But breaking down the price change in this manner is problematic because we do not have data on either of the two factors. To deal with this problem, it is customary to assume the change that was caused by inflation (on the basis of analysts or other sources), and then extract the change that occurred as a result of the real yields. Since we want to identify the effect of inflation, we cannot assume this variable. However, we cannot assume the change that was caused by real returns because this variable can only be extracted as described above. As a result, our regression is unable to explain the entire change in bond prices. However, since the change in real yields is not correlated with

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[9]   36 trading days are approximately 50 calendar days.

[10]   If the CPI is published on Friday or a holiday, when no trading takes place, the day prior to publication is indexed as -1.

unexpected inflation, we omitted the daily change in real yields from the regression without causing any bias in the unexpected inflation measures.

For each of the 36 days, we ran a panel regression (on the data of the bonds that traded that month), where the dependent variable is the change in bond prices relative to the previous day's price,[11] and the independent variables are unexpected inflation and the intercept.

$$\Delta P^i_{t,k} = \alpha^i + \beta^i \pi^{unexpected}_t + \epsilon^i_{t,k}$$

The regression equation for day i relative to the CPI-publication date is

where

i - is the trading day index (relative to the CPI publication date)

t – the month index

k – the bond index (of n bonds traded in that month)

$\Delta P^i_{t,k}$ is the change in the price of bond k on trading day i, relative to the publication of CPI for month t.

$\pi^{unexpected}_t$ is the unexpected inflation. This variable is fixed for all the days of a given month.

We ran the panel regression on the 175 months between April 2001 and November 2015, for each indexed day. In the first half of this period, the number of CPI-indexed government bonds was greater than in the second half. Therefore, in the first half, we collected observations on an average of 15 bonds each month, and in the second half we collected observations on an average of 6 bonds each month. The number of observations in each regression was 2,369 — 66 percent from 2001–08 and the remainder from 2009–15.

After running the 36 panel regressions, one for each indexed day, we obtained estimates for each day. The estimates in which we are particularly interested are b-30–b5, that is—the coefficients of the unexpected inflation on every indexed day. Since the unexpected inflation variable is fixed on all the 36 months checked in any given month, the coefficient βi represents the portion of unexpected inflation that is added to the bond price on day i. In other words, βi represents the portion of new information about the inflation that investors learned on this day, of the total unexpected inflation that developed over the month. The sum of these coefficients represents the total effect of the unexpected inflation on bond prices.

Results

On average, analysts are accurate about predicting monthly changes in the CPI, and the average unexpected inflation—which is the analysts' error at the beginning of the month—is -0.005 percent. Since the standard deviation of the unexpected inflation is 0.335 percent and its average absolute value is 0.248 percent, we may conclude that in some of the months, actual inflation differed from the forecasts (Table A.1).

Table A.2 refers to the period from the beginning of the month to six days after the CPI publication date, and divides this period into periods of five trading days each, and in each column presents the average coefficients of the relevant five-day period. For example, in each of the first five trading days in the month, the market aggregated an average of 2.2 percent of the information

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[11] For example, the change on Tuesday divided by the change on Monday, less 1. We then multiplied by 100 to represent the result as a percentage.

on unexpected inflation, and the average standard deviation for these days was 3.6 percent. The coefficient of the publication date, which represents the extent of information on the CPI that the market did not anticipate before its publication, is presented separately.

The coefficients of the unexpected inflation are the anticipated changes (on the appropriate days, in percent) in bond prices as a result of a one percentage point change in the unexpected inflation. It can be seen that investors learned significant information about the unexpected inflation as it was developing. Subsequently, in the period after the end of the month, bond prices showed little change with respect to the unexpected inflation—see columns of the coefficients (-1)–(-10). Finally, after the CPI of the month in question was published, the bond prices changed in accordance with the portion of the unexpected inflation that investors had been unable to discover before publication. We see that 42 percent[12] of the unexpected inflation was reflected in bond prices even before the CPI was published, and the information was already contained in bond prices over the course of the month. On the day after the publication of the CPI, bond prices reflected an additional 30.7 percent of the information on the unexpected inflation. On the days following CPI publication, bond prices continued to rise relative to the unexpected inflation, even though all the information about the unexpected inflation was already known. In each of the five days after CPI publication, bond prices incorporated an additional 4.5 percent of the information on the unexpected inflation.

To see how much of the information was learned up to each indexed day, we studied the cumulative sum of the coefficients on the 36 trading days in the period from the beginning of the month to six days after the CPI publication date. Figure 4 indicates that the market aggregates the information on the unexpected inflation over the course of the month, as the inflation develops, and prices stop changing after the end of the month. This means that investors learn the information about the inflation that was not expected at the beginning of the month only during that same month, and learn no additional information in the period from the end of the month until the publication of the CPI.

Figure 4
The Cumulative Effect of Unexpected Inflation on the Price of CPI-Indexed Bonds

The figure presents the sum of coefficients of unexpected inflation. This amount reflects the portion of unexpected inflation that the market learned about until that day. The index of 0 is given to the first trading day after publication of the CPI. It can be seen that a lot of information about bond prices enters in on that day. Red lines represent the confidence interaval at the 5% significance level for the sum of the coefficients to that date.

The results point to an additional interesting conclusion: Apparently on the day after the CPI publication, the total cumulative effect of 1 percent unexpected inflation is 0.8 percent, although we would expected 1 percent unexpected inflation to lead to a 1 percent increase in bond prices since the bond prices are linked to the CPI. To check the hypothesis that the sum of coefficients on the day after publication differs from 1 percent, we calculated the confidence interval at a significance level of 5 percent,
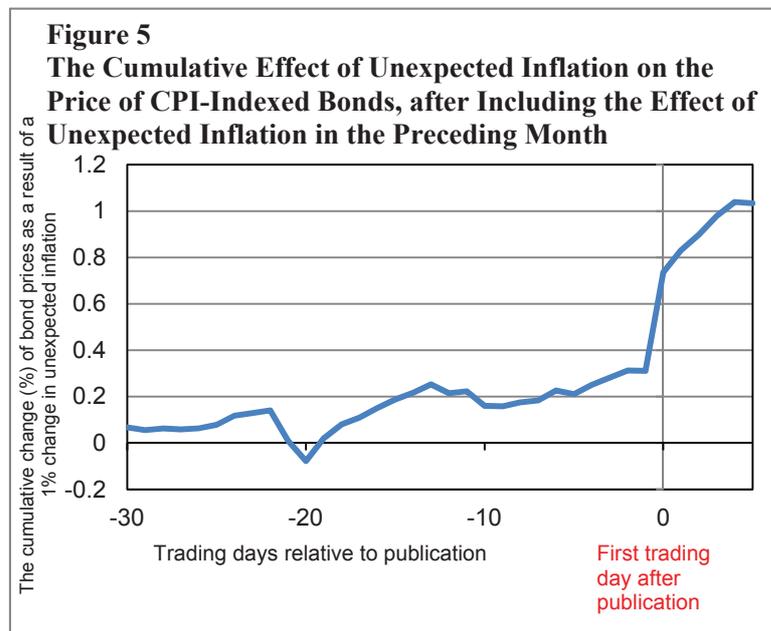
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[12] We obtained 42 percent after we multiplied by 5 each average unexpected inflation coefficient on the days to publication. These days are marked by indices (-1)–(-30).

using the bootstrap method, repeated 10,000 times. On the first day after publication, the upper bound of the interval is 1.02 percent and the lower bound is 0.476 percent. It therefore appears that we cannot reject the hypothesis that the sum of the coefficients on the day after publication is equal to 1 percent. The bounds of the confidence interval for each day are presented in Figure 4 and Table A.3.

The general regression also indicates that the extent of information that investors learn increases in the middle of the month. This increase can be explained by the fact that this is the period in which the CPI of the previous month is published. There is a positive serial correlation (0.25) between the unexpected inflation in any given month and the unexpected inflation in the preceding month. Therefore, if we include the unexpected inflation in the preceding month as a variable in the regression, we will be able to identify the change in prices caused by the new information about the unexpected inflation in the given month. For example, the January CPI is published in mid-February. Since the bonds are linked to the CPI, their price will change in line with any new information that is discovered as a result of the publication of the CPI. This information is correlated with February's unexpected inflation. To identify the effect of the new information that was learned after publication of the CPI and is related to the unexpected inflation in February, we add the unexpected inflation in January to the equation:

$$\Delta P_{t,k}^i = \alpha^i + \beta^i \pi_t^{unexpected} + \gamma^i \pi_{t-1}^{unexpected} + \epsilon_{t,k}^i$$

The results of this regression are presented in Table A.5 and Figure 5. We can see that publication of the CPI of the preceding month revealed significant information that helped investors improve their expectations about the current month's inflation. We can also see that the unexpected inflation in the preceding month has a positive effect at the beginning of the month; thereafter, its effect is negative, and on the day of publication the coefficient is negative and statistically significant (-0.229).

Figure 5
The Cumulative Effect of Unexpected Inflation on the Price of CPI-Indexed Bonds, after Including the Effect of Unexpected Inflation in the Preceding Month

Testing the subperiods

In addition to the analysis of the period from 2001 to 2015, we analyzed two subperiods: (a) 2001–June 2009[13] and (b) July 2009–2015. As Tables A.8 and A.9 illustrate, in subperiod (a) 29.5 percent of the information on the unexpected inflation was reflected in bond prices only after publication of the CPI, but in subperiod (b) 80.8 percent of the information was reflected in bond prices after the publication of the CPI.

As Figure 6 illustrates, the results of the first subperiod are similar to the results obtained for the entire period, because in this subperiod, the number of CPI-indexed bonds was significantly greater than the number of CPI-indexed bonds in the second subperiod; therefore most of the observations in the general regression were taken from this period. In contrast, the second subperiod (2009–15) shows entirely different results about investors' ability to reveal information about the unexpected inflation during a given month: In this subperiod, investors learned very little about the unexpected inflation over the course of a given month, and learned only 10 percent before publication of the CPI—this is a significantly smaller portion of the information on expected inflation compared with the first subperiod. Accordingly, in the second subperiod, 81 percent of the information was reflected in the bond prices only after publication of the CPI, compared to 30 percent in the first period. That is, in the second period, publication of the CPI revealed more information about the unexpected inflation, while in the first subperiod investors managed to reveal a greater portion of the information as the inflation developed.

Figure 6
The Cumulative Effect of Unexpected Inflation on the Price of CPI-Indexed Bonds, by Subperiods
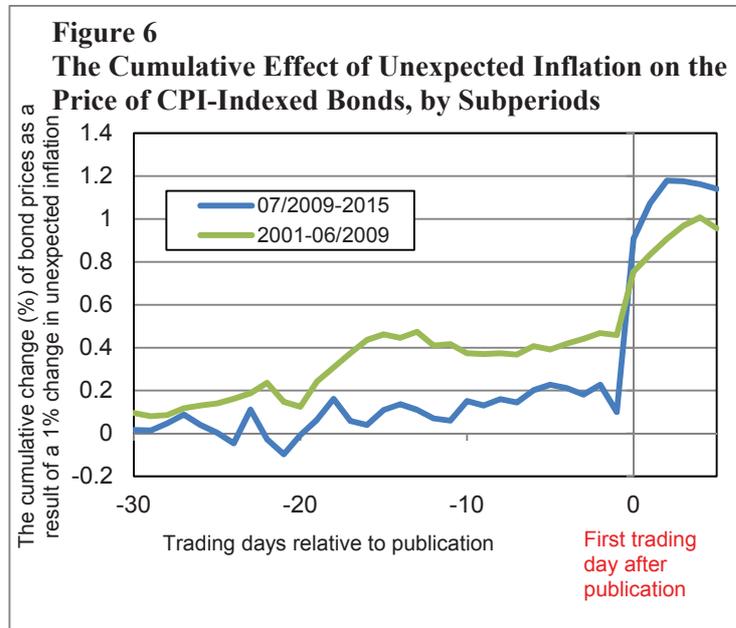
To understand the differences between the two subperiods, we compared the inflation environments in these two periods, and will try to explain how the differences between them affect the way investors learn information. As Tables A.6 and A.7 indicate, the average monthly inflation rate in the first subperiod was 0.189 percent (2.29 percent in annual terms) and the standard deviation was 0.524 percent. In contrast, the average monthly inflation rate in the second period was 0.102 percent (1.23 percent in annual terms) and the standard deviation was 0.363 percent. As a result of differences in the inflationary environment, the standard deviation of the unexpected inflation in the early subperiod was significantly higher than the standard deviation in the later subperiod (0.397 percent compared to 0.22 percent), as was the average absolute value (0.305 percent compared to 0.174 percent). In other words, the first subperiod was characterized by a high average rate of inflation, and analysts' errors at the beginning of the month were also greater on average.

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[13] We stopped at June 2009 after we performed the Chow test to identify the breakeven point in longitudinal series of unexpected inflation coefficients on the CPI publication date.

However, it is possible that this test does not accurately reflect the differences between the two subperiods. Specifically, this test focuses on the portion of unexpected inflation that investors learn after the CPI is published, and this portion diminishes if the publication of the CPI reveals a fixed amount of information while the unexpected inflation increases. Since the unexpected inflation rate changed significantly in these two subperiods, we would like to calculate the absolute size of the information learned as a result of the publication of the CPI, or in other words, independent of the unexpected inflation. To know how many percentage points of inflation were on average reflected in bond prices on the publication date in each of these two subperiods, we multiplied the unexpected inflation coefficient on the publication date by the standard deviation of the unexpected inflation. These data appear in Tables A.6–A.9. The result of this calculation shows the amount of inflation that the measure reveals to investors. This is a different calculation, as it does not refer to that part of the unexpected inflation that is discovered on the publication date, but instead presents its absolute size. In the first subperiod, an average of 0.117 percentage points was reflected in bond prices, and an average of 0.178 percentage points was reflected in bond prices in the second subperiod. We can perform the same calculation using the results obtained by Huberman and Schwert (1985)—15 percent of the unexpected inflation was reflected in bond prices only after the announcement (of the CPI). The standard deviation of the unexpected inflation between 1970 and 1979 is 0.74 percent, and the product of its multiplication by the coefficient shows that in this period, on average, 0.11 percentage points were reflected in bond prices after publication. In other words, although the two subperiods differ significantly when we observe the unexpected inflation rate that investors learn only after publication of the CPI, this difference is dramatically reduced when we look at the inflation in term of percentage points. Nonetheless, there still apparently remains a considerable difference between the subperiods in terms of the extent of information that publication of the CPI reveals to investors.

To investigate the source of this important difference, recall that a major change occurred between 2001 and 2015. In 2007, the Israeli market began to depart from the custom of denoting leases in dollars. Until 2007, leases were denoted in dollars, and since the housing component (based on residential leases) accounts for 25 percent of the CPI, the change in the index is strongly affected by rental prices. When rent is denoted in dollars, changes in rentals also reflect changes in exchange rates. This affected two main parameters: the measure's fluctuations and investors' ability to learn about inflation. With regard to the first parameter, the shekel-dollar exchange rate is highly volatile, and apparently this made a strong contribution to the fact that in the first subperiod, the information that was not observed at the beginning of the month was much more volatile. With regard to the second subperiod, since exchange rates are published continuously, investors observed it and could use it to learn a large portion of the information that was not observed in the beginning. In the first subperiod, the unexpected inflation at the beginning of the month was more volatile, but it was relatively easy to learn it by observing exchange rates over the month. In 2007, rentals gradually began to be denominated in shekels, and this process was concluded in mid-2009. Therefore in the more recent subperiod, the investors were unable to learn about housing prices from exchange rates, and that may have been the reason that investors found it more difficult to learn information on unexpected inflation before publication of the CPI.

Had we been able to include a new variable in the regression—the product of the share of dollar denominated contracts and the monthly change in the exchange rate—this would have allowed us to directly examine whether the change in question is what caused the differences between the subperiods. But this is not possible because the change in the exchange rate is correlated with the change in real yields, which was omitted from the regression. Therefore we used a different method to check this. We took the analysts' forecasts for each month's CPI and we calculated the difference between the inflation that was not forecast at the beginning of the month and the unexpected inflation on the CPI publication date (prior to publication). This difference reflects the extent of information on the unexpected inflation that was learned over the month. We then examined the correlation between this result and the product of the change in the exchange rate[14] and the share of dollar denominated contracts. In the first subperiod, this correlation is 32.82 percent and is statistically significant at 5 percent. In contrast, the correlation in the second subperiod is -18.16 percent, and is not statistically significant.

Another interesting difference between the two subperiods concerns the fact that in the later subperiod, the daily coefficients of the unexpected inflation add up to 1.14 (in other words, a 1 percent increase (decrease) in unexpected inflation leads to a 1.14 percent increase (decrease) in bond prices, on average), while in the earlier subperiod, the coefficients add up to 0.96. Although in both cases we cannot reject the hypothesis that the total effect differs from 1, but the results are nonetheless considerably different. It is possible that the sum of the coefficients increased in the second subperiod because investors learned a small

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[14] In effect, to perform this test, one must use the change in the exchange rate that was not anticipated at the beginning of the month, but since it is extremely difficult to forecast exchange rates, we can consider any change in the exchange rate during the month as an unexpected change.

portion of the unexpected inflation over the month, and therefore a surprise in any given month is significant for the inflation forecast for the following month. In other words, after a surprise occurred in a certain direction, investors corrected their inflationary forecast for the following month in that direction.

Discussion and conclusions

An analysis of the entire period shows how investors learn information about unexpected inflation in the period from the beginning of a given month to six days after publication of the CPI. As Figure 4 illustrates, investors learned 42 percent of the unexpected inflation as it developed. There is no new information about inflation between the end of the month and the publication of the CPI, and therefore bond prices showed no change that was correlated with the unexpected inflation. On the first trading day after publication of the CPI, bond prices reflected 31 percent of the unexpected inflation. In the following days, prices continued to change although the information about the CPI had already been published. In other words, there is an interval in which bond prices did not reflect all the information that was available on the market and responded slower than expected to the publication of the CPI. This may be the result of inefficiency reflected in investor's lagged response to the publication, but it also may be that prices continue to respond after publication of the CPI because investors have different assessments about the information that the publication of the CPI reveals about the unexpected inflation in the following month. Furthermore, in each period, bond prices fully reflect the total effect—an increase of 1 percent in the CPI leads to an increase of 1 percent in nominal bond payments and a 1 percent increase in bond prices.

It is possible that part of the information becomes reflected in bond prices only after publication of the CPI because it is difficult to replicate the procedure that the CBS uses and to precisely discover the CPI before it is published, and because the potential benefits of this information do not justify the high costs entailed in such efforts.

In conclusion, this analysis indicates that the publication of the CPI contains significant information that investors did not anticipate over the course of the month. When bond prices rose significantly and rentals were denominated in dollars, investors managed to learn a significant portion of the information on unexpected inflation over the course of the month, and publication of the CPI revealed 30 percent of the unexpected inflation on average each month. A considerable portion of the information that was learned over the course of the month was related to exchange rates, which affected rental prices. In contrast, when prices rose by a relatively low rate and rentals were denominated in shekels, investors found it difficult to learn significant information on the unexpected inflation, and 81 percent of the information was revealed only when the CPI was published. When we examine inflation by percentage points, the differences between these two periods diminish, yet remain.

Table A.1
Theoretical statistics of inflation and bonds data, April 2001–November 2015

Number of bonds	Average term to maturity	Median coupon rate
60	2.783	4%

	CPI	Forecasters' projections	Unexpected inflation
Mean	0.15%	0.16%	-0.005%
Standard deviation	0.46%	0.30%	0.34%
Average absolute value	0.37%	0.27%	0.25%

Table A.2

Results of regression $\Delta P_{t,k}^i = \alpha^i + \beta^i \pi_t^{unexpected} + \epsilon_{t,k}^i$ **2001–15**

	(-26) - (-30)	(-21) - (-25)	(-16) - (-20)	(-11) - (-15)	(-6) - (-10)	(-1) - (-5)	0	1 - 5
α	0.029	-0.11	0.003	0.018	0.034	0.013	-0.123	-0.004
	(0.010)	(0.014)	(0.015)	(0.010)	(0.009)	(0.009)	(0.027)	(0.019)
β	0.022	0.003	0.049	0.001	0.002	0.007	0.307	0.045
	(0.036)	(0.049)	(0.042)	(0.034)	(0.028)	(0.027)	(0.074)	(0.044)
	Statistically significant increase		Statistically significant increase				Statistically significant increase	Statistically significant increase

Every column presents the average estimation over the five relevant days, and the publication date is represented separately and noted with index 0. For example, the average coefficient of unexpected inflation over the first five days of the month is 0.022. This number represents the portion of unexpected inflation that is incorporated on average into bond prices in each one of the first five days of the month.
The first four columns on the left, covering an index of (-11) to (-30), represent the days between the beginning and the end of the month. The following two columns, with an index of (-1) to (-10), represent the days between the end of the month and the publication of the CPI. The last column, with an index of 1 to 5, represents the days after the publication of the CPI.
The last row of the table shows the results of the examination with regard to the statistical significance of the amount of the variables in the column. Thus, for example, in the first five days of the month the increase is statistically significant.
The average standard deviations for each 5 days are shown in parentheses, and were calculated using the Newey-West method.
The absolute value of R2 in the regression is 0.3923 percent.

Table A.3

The cumulative amount of coefficients and the bounds of confidence intervals

Days relative to publication	-26	-21	-16	-11	-6	-1	0	5
Cumulative sum	0.112	0.127	0.374	0.379	0.389	0.426	0.733	0.957
Lower bound	0.009	-0.029	0.187	0.177	0.162	0.188	0.476	0.683
Upper bound	0.216	0.289	0.582	0.614	0.645	0.694	1.02	1.253

The table represents, for each days, the total of cofficients through that day. Thus, for example, the amount that appears under the number (-21) represents the amount of the coefficients (-21) through (-30). These coefficients represent the total effect of unexpected inflation up to that day. The rows under the amount represent the lower and upper bounds, and serve as the confidence interval with a significance level of 5 percent. These data were calculated using a bootstrap method based on 10,000 repetitions.

Table A.4

Coefficients of unexpected inflation that were found to be significant at the 5 percent confidence level

2001–15	β^2	β^0	β^{-19}	β^{-30}	
2001–09	β^3	β^2	β^0	β^{-19}	β^{-30}
2009–15	β^1	β^0	β^{-10}	β^{-20}	

Table A.5
Results of regression $\Delta P_{t,k}^i = \alpha^i + \beta^i \pi_t^{unexpected} + \gamma^i \pi_{t-1}^{unexpected} + \epsilon_{t,k}^i$, after including unexpected inflation in the previous month, 2001–15

	(-30) - (-26)	(-25) - (-21)	(-20) - (-16)	(-15) - (-11)	(-10) - (-6)	(-5) - (-1)	0	1 - 5
α	0.029	-0.014	0.001	0.016	0.031	0.01	-0.129	-0.002
	(0.011)	(0.016)	(0.016)	(0.011)	(0.009)	(0.010)	(0.031)	(0.021)
β	0.013	-0.011	0.028	0.014	0.001	0.017	0.424	0.060
	(0.042)	(0.059)	(0.053)	(0.042)	(0.033)	(0.032)	(0.080)	(0.049)
γ	0.024	0.061	0.045	-0.049	-0.005	-0.031	-0.229	-0.060
	(0.034)	(0.046)	(0.051)	(0.043)	(0.033)	0.039	(0.079)	(0.099)

Table A.6
Theoretical statistics of inflation and bonds data, April 2001–July 2009

Median coupon rate	Average term to maturity	Number of bonds		Unexpected inflation	Forecasters' projections	CPI
0.04%	0.17%	0.19%	Mean	4%	3.473	54
0.40%	0.31%	0.52%	Standard deviation			
0.31%	0.27%	0.42%	Average absolute value			

Table A.7
Theoretical statistics of inflation and bonds data, July 2009–November 2015

Median coupon rate	Average term to maturity	Number of bonds		Unexpected inflation	Forecasters' projections	CPI
-0.058%	0.16%	0.10%	Mean	4%	2.453	17
0.22%	0.28%	0.36%	Standard deviation			
0.17%	0.26%	0.30%	Average absolute value			

Table A.8

Results of regression $\Delta P^i_{t,k} = \alpha^i + \beta^i \pi^{unexpected}_t + \epsilon^i_{t,k}$ **, April 2001–July 2009**

	(-30) - (-26)	(-25) - (-21)	(-20) - (-16)	(-15) - (-11)	(-10) - (-6)	(-5) - (-1)	0	1 - 5
α	0.033	-0.009	0.004	0.02	0.039	0.015	-0.107	-0.008
	(0.011)	(0.014)	(0.015)	(0.010)	(0.010)	(0.009)	(0.026)	(0.018)
β	0.026	0.003	0.058	-0.004	-0.002	0.01	0.295	0.04
	(0.032)	(0.044)	(0.038)	(0.031)	(0.027)	(0.025)	(0.064)	(0.039)

Table A.9

Results of regression $\Delta P^i_{t,k} = \alpha^i + \beta^i \pi^{unexpected}_t + \epsilon^i_{t,k}$ **, July 2009–November 2015**

	(-30) - (-26)	(-25) - (-21)	(-20) - (-16)	(-15) - (-11)	(-10) - (-6)	(-5) - (-1)	0	1 - 5
α	0.009	-0.030	-0.011	0.009	0.01	0.001	-0.135	0.01
	(0.007)	(0.021)	(0.010)	(0.007)	(0.006)	(0.012)	(0.045)	(0.009)
β	0.008	-0.027	0.027	0.004	0.028	-0.020	0.808	0.047
	(0.028)	(0.081)	(0.069)	(0.042)	(0.027)	(0.043)	(0.285)	(0.032)

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SIGNIFICANT REVISIONS IN ESTIMATING HOUSING STARTS

- Data on housing starts in Israel serve as an important ingredient in formulating policy regarding the housing field as well as in formulating monetary policy. This analysis shows that between 2004 and 2014, the initial quarterly estimate of housing starts was biased downward by an average of about 10 percent. The figure is revised upwards mainly during the first year after publication, and stabilizes after two years (8 quarterly publications).
- Policy makers in the housing field are exposed to the initial estimate, and the broad public has also been exposed to it through the broad media attention it has attracted in recent years. They may therefore develop a misleading concept regarding activity in the construction industry. Caution must therefore be exercised when using the initial estimate, and resources should be invested in improving it.
- Data collection depends on many authorities dealing with construction initiation, approval and actual start, and some of these authorities provide the Central Bureau of Statistics with only partial data. This complex process makes it difficult to publish quality data in real time.
- A statistical model for forecasting the revisions makes it possible to narrow the size of the average revision by at least one-third, and to formulate a forecast that is not biased in a particular direction—a forecast that is revised sometimes upward and sometimes downward. This model relies on data known in real time (ex ante), and can therefore be used to improve the estimate at the time of publication.

The Central Bureau of Statistics (CBS) publishes quarterly figures on the number of housing starts. An examination conducted by the Bank of Israel Research Department found that the initial published figure is consistently biased downward to a quantitatively significant extent. This figure is revised upward, mainly during the first year after publication, and stabilizes after two years (8 quarterly publications) at a significantly higher value. This underestimate also affects the rates of change, both between consecutive quarters and between parallel quarters, and it may distort the information concerning activity in the Israeli construction industry. This study is intended to direct the attention of housing starts data users to the problematic nature of the figures and to recommend that they be used cautiously and critically when making decisions. In addition, the study shows that models can be proposed to enable a correction to the initial estimate.

Housing starts: Sources and revisions of the data

Housing starts—the beginning of earthworks for the building foundations—are also the start of the final link in the production chain of a housing unit. A slowdown or acceleration in the number of starts does not depend only on the forces of supply and demand in the market, but also on the previous links (government or local) in the production chain, from the initiation of the project through its approval in the planning institutions, to the marketing and improvement of the land, and the building permit authorization process.

There are many authorities involved in the process, which makes it difficult to collect quality data regarding housing starts or to estimate the number of such starts. The Central Bureau of Statistics collects data from four sources: (a) The figures on starts initiated by the Ministry of Construction and Housing are obtained from the ministry in a monthly administrative file. Even though this is an administrative file, the ministry revises and cleanses it, as the CBS emphasized in the last housing starts quarterly publication.[1] (b) The estimates of the other types of construction (most of which are by private initiators, while some are public construction, whether government or local authorities) are obtained by the CBS from monthly reports on building permits provided by the local planning committees. The CBS conducts a monthly telephone survey among construction companies based on these data. (c) The figures on permits that were not surveyed in the telephone survey are attributed according to a statistical model by the CBS. (d) The figures on construction with no permit are obtained from an annual report on relevant judicial verdicts provided to the CBS by the Ministry of the Interior. As an example, we look at the December 2016 figure on housing starts in 2015. Most of the figure comes from the telephone survey (55.2 percent of starts), about two-fifths come from the Ministry of Construction file (22.5 percent) and data attribution (19.5 percent), and the rest comes from Ministry of the Interior data on illegal construction (2.6 percent) and from the attribution model (0.4 percent).[2]

Written by Adi Finkelstein.

[1] In the press release on December 15, 2016, the CBS clarified that in recent months, the Ministry of Construction and Housing scrubbed the data on the number of starts it initiated between 2014 and 2016. This had a particular effect on the figure for public construction starts, but since the breakdown by initiator is no longer published, it is hard to know the scale of the revisions resulting from the scrubbing.

[2] Central Bureau of Statistics presentation (2016), "Methods of estimating housing starts: Information sources and work process".

The Central Bureau of Statistics makes huge efforts to scrub the data it obtains, but there are still many limitations that make it difficult to significantly improve the initial estimate. The original data on construction by private initiators are exposed to retroactive revisions for a number of reasons: a lag in the building permit reporting provided by the local planning and building committees, a delay in reporting provided by the initiators on the building start and end dates, construction starts prior to the issue of the permit[3], and a delay in discovering double permits in the database.[4] In order to deal with the lag in reporting on permits, the CBS created a statistical model that attributes figures according to the permits issued in the given locality in previous periods and according to existing trends in similar localities. In order to deal with the lag in reporting on housing starts, the CBS focuses on initiators that obtained a permit during an earlier period, examines how much time elapsed until they began construction, and accordingly attributes the projected start date. These methods are intended to narrow possible deviations in the survey figures as much as possible. Later on, the CBS replaces the attributions with data obtained with a lag.[5] In this context, it should be noted that the attribution model does not include administrative figures obtained from the Ministry of Construction and Housing on housing starts by public initiation. The Ministry revised the figures for 2009–2014 upward by an average of about 28 percent, while the figures on private construction were revised upward by about 10 percent on average, showing that the figures obtained from the Ministry of Construction and Housing are of inferior quality.[6] However, public construction constituted 20 percent of total housing starts in the reviewed years, and revisions to those figures therefore have a smaller weighted effect on the overall revision.

The gaps between the initial publication and the revised publication

Figure 1 compares the initial estimate of the number of housing starts with the revised estimate[7], from the first quarter of 2004 to the third quarter of 2016. The Figure shows that the initial estimate was always lower than the revised one. When the gaps are expressed as a share of the initial estimate (the purple line), the Figure shows that the gaps increased since 2011. The average gap over the entire period is about 11 percent of housing starts. The figure also shows that in the past year, the revision rate has been low. But as we will see below, most of the revision was made in the year following the initial publication, so we can expect that the revision rates for 2015–2016 will continue to increase.

Figure 2a examines the rate of change in the number of housing starts compared to the same period in the previous year, and Figure 2b examines it compared to the previous quarter. It is clear that the data are constantly underestimated. There is even sometimes the impression that the number of housing starts declined, while in retrospect it turns out that it increased (for instance in the data on the second half of 2013 and the first quarter of 2014). The underestimate is greater when comparing the number of housing starts to the same quarter in the previous year, which is mainly the result of the fact that the figure for the same quarter has undergone four revisions from the time it was first published until the time it is used in the comparison. The figure for the same quarter in the previous year continues to be revised and to affect the rate of change, but to a lesser extent.

Table 1 summarizes the extent of the revisions in the data obtained over two years from the date of publication of new quarterly data.[8] The upper part of the table shows the study period as a whole, while the parts below it show two sub-periods: (1) 2004 to mid-2009, during which there was no significant change in housing start levels (see Figure 1); and (2) mid-2009 to mid-2014, during which there was an upward trend in the number of housing starts.[9] An initial examination of the differences between the periods shows that the average number of housing starts in the first period is lower than in the second. Moreover, in the first period, the gap between the initial estimate and the estimate after 8 revisions was an average of 700 units per quarter (about 10 percent), while in the second period, the gap increased to 1,250 units per quarter (about 13 percent). An argument can be made that the increase is a result of the fact that the Central Bureau of Statistics relies on prior years' data in order to attribute missing

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[3]   These starts constitute about 30 percent of starts by private construction.

[4]   Deleting the duplicates is expected to lead to a downward revision of the figure.

[5]   Central Bureau of Statistics, Press release from February 10, 2015, "Housing Starts and Housing Completions in 2014".

[6]   As reported by the Central Bureau of Statistics, construction section.

[7]   That is, the last publication in which the quarterly figure appears, or the December 2016 publication in the case of quarters that still appear in the CBS tables (2008–2016).

[8]   We are interested in examining the "final" figure, meaning the one after the revisions are complete. The initial examination revealed that changes more than 2 years after the initial publication are not significant, so we view the number published after 8 quarters as being the final figure.

[9]   We cut the study period in mid-2014 because there are still no "final" figures for the following quarters.
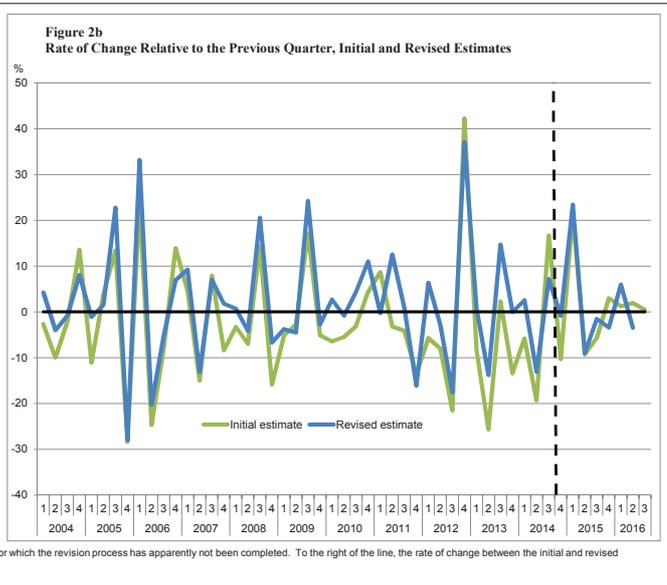
Figure 1
Building Starts (Housing Units): Initial and Revised Estimates and Rates of Change Between Them, 2004:Q1 to 2016:Q3[a]

Legend:
- Revised estimate
- Initial estimate
- Rate of change between the initial and revised estimates

[a] The dotted line distinguishes between the estimates that were already revised at least 8 times, which we consider as final data, and those where revisions have apparently not been completed (the former in blue and the latter in orange). To the right of the line, the rate of change is therefore expected to increase in coming revisions.
SOURCE: Based on quarterly notices published by the Central Bureau of Statistics on building starts.

Figure 2a
Rate of Change Relative to the Same Quarter in the Previous Year, Initial and Revised Estimates

- Initial estimate
- Revised estimate

Figure 2b
Rate of Change Relative to the Previous Quarter, Initial and Revised Estimates

- Initial estimate
- Revised estimate

The dotted line distinguishes between the estimates that have already been revised at least 8 times, whcih we consider as final data, and those for which the revision process has apparently not been completed. To the right of the line, the rate of change between the initial and revised estimates is therefore expected to increase with future pubclications.
SOURCE: Based on quarterly press releases on housing starts published by the Central Bureau of Statistics.

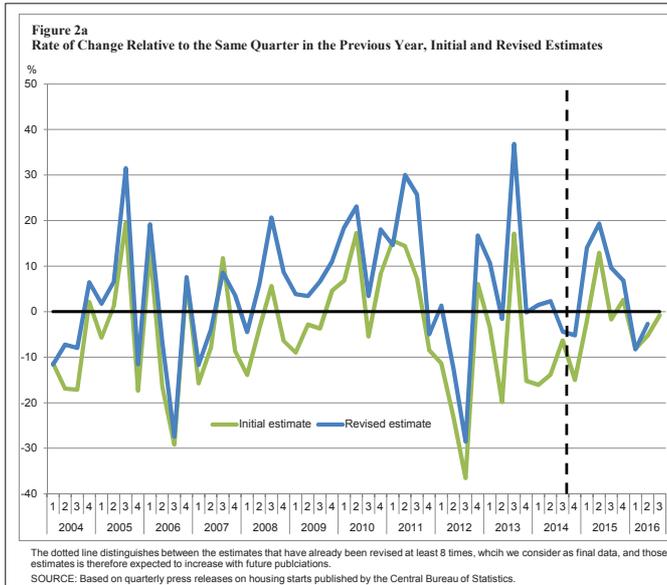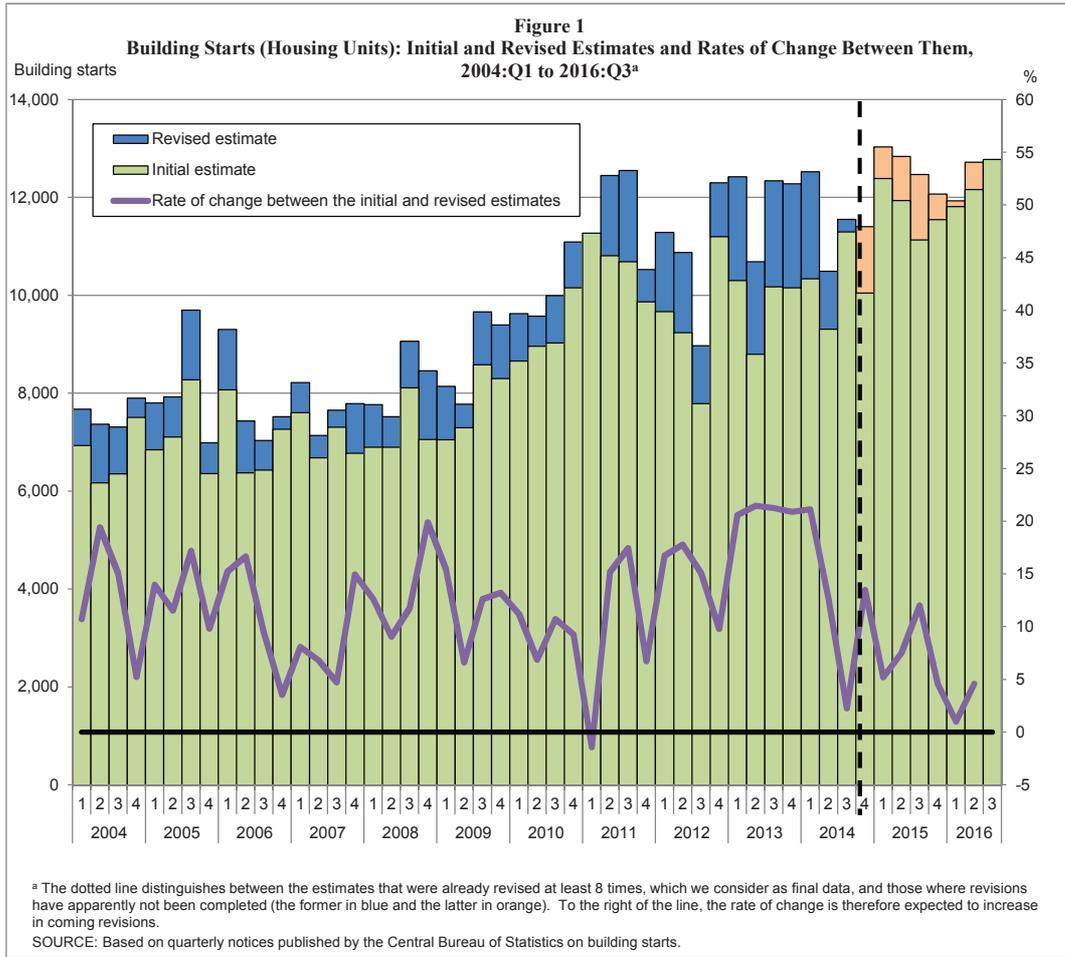| Publi-cation number	Number of housing starts in the quarter	Cumula-tive rate of revision in the quarterly figure	Rate of change relative to the previous quarter	Cumulative revision (in percentage points) of the rate of change relative to the previous quarter	Rate of change relative to the same quarter in the previous year	Cumulative revision (in percentage points) of the rate of change relative to the same quarter in the previous year
Table 1 **The average revisions made to the data during the two years following the publication of the initial quarterly estimate, 2004–14**						
				2004–2014:Q3		
1	8,371		-2.5		-4.4	
2	8,778	4.7	-0.1	2.4	-0.3	4.0
3	8,951	6.8	0.2	2.6	1.3	5.7
4	9,103	8.6	0.6	3.1	2.5	6.9
5	9,221	10.0	1.4	3.8	3.4	7.7
6	9,266	10.5	1.5	4.0	3.4	7.7
7	9,295	10.9	1.6	4.1	3.5	7.8
8	9,316	11.1	1.6	4.1	3.7	8.0
9	9,341	11.4	1.3	3.8	3.9	8.3
				Period A: 2004–2009:Q2		
1	7,063		-2.2		-5.5	
2	7,301	3.4	-1.0	1.2	-2.5	3.0
3	7,443	5.4	-0.5	1.7	-0.9	4.6
4	7,571	7.2	0.2	2.4	0.1	5.6
5	7,637	8.2	0.6	2.8	0.4	5.9
6	7,673	8.7	0.8	3.0	0.2	5.8
7	7,688	8.9	0.6	2.9	0.3	5.8
8	7,725	9.4	0.6	2.9	0.6	6.1
9	7,762	9.9	0.6	2.9	0.9	6.5
				Period B: 2009:Q3–2014:Q3		
1	9,742		-2.7		-3.1	
2	10,325	6.1	0.9	3.6	1.9	5.1
3	10,532	8.3	0.9	3.6	3.6	6.7
4	10,707	10.1	1.1	3.8	5.1	8.2
5	10,880	11.9	2.2	4.9	6.5	9.6
6	10,935	12.4	2.3	5.0	6.7	9.8
7	10,978	12.9	2.6	5.3	6.8	10.0
8	10,983	12.9	2.6	5.3	6.9	10.0
9	10,994	13.0	2.1	4.8	7.0	10.2

data, and the fact that in the second period, the number of housing starts was in an upward trend. However, since there were significant retroactive revisions in the first period as well, and since the number of housing starts during the first period increased slowly on average, it seems that the upward trend in the second period is not the only factor responsible for the current deviation.

We can also see that in the two sub-periods, the initial data published showed negative average rates of change relative to the previous quarter, while in following publications, those rates become positive (Column 4). The data were revised upward retroactively by 2.9 percentage points in the first sub-period and by 4.8 percentage points in the second sub-period. A similar phenomenon takes place in the figure on the rate of change relative to the same quarter in the previous year, but in this case, the revisions are more significant, reaching 6.5 percentage points in the first sub-period and 10.2 percentage points in the second. In the period as a whole, the average rate of change of the quarterly figure after 8 revisions is about 11.4 percent, and the average addition to the rate of change between parallel quarters is 8.3 percentage points. Finally, in the first year (publications 2 through 5), the average marginal contribution of the revisions is larger than in the second year.

Figure 3
Rate of Change in the Initial Quarterly Estimate of Housing Starts, by District, 2011:Q1 to 2016:Q1
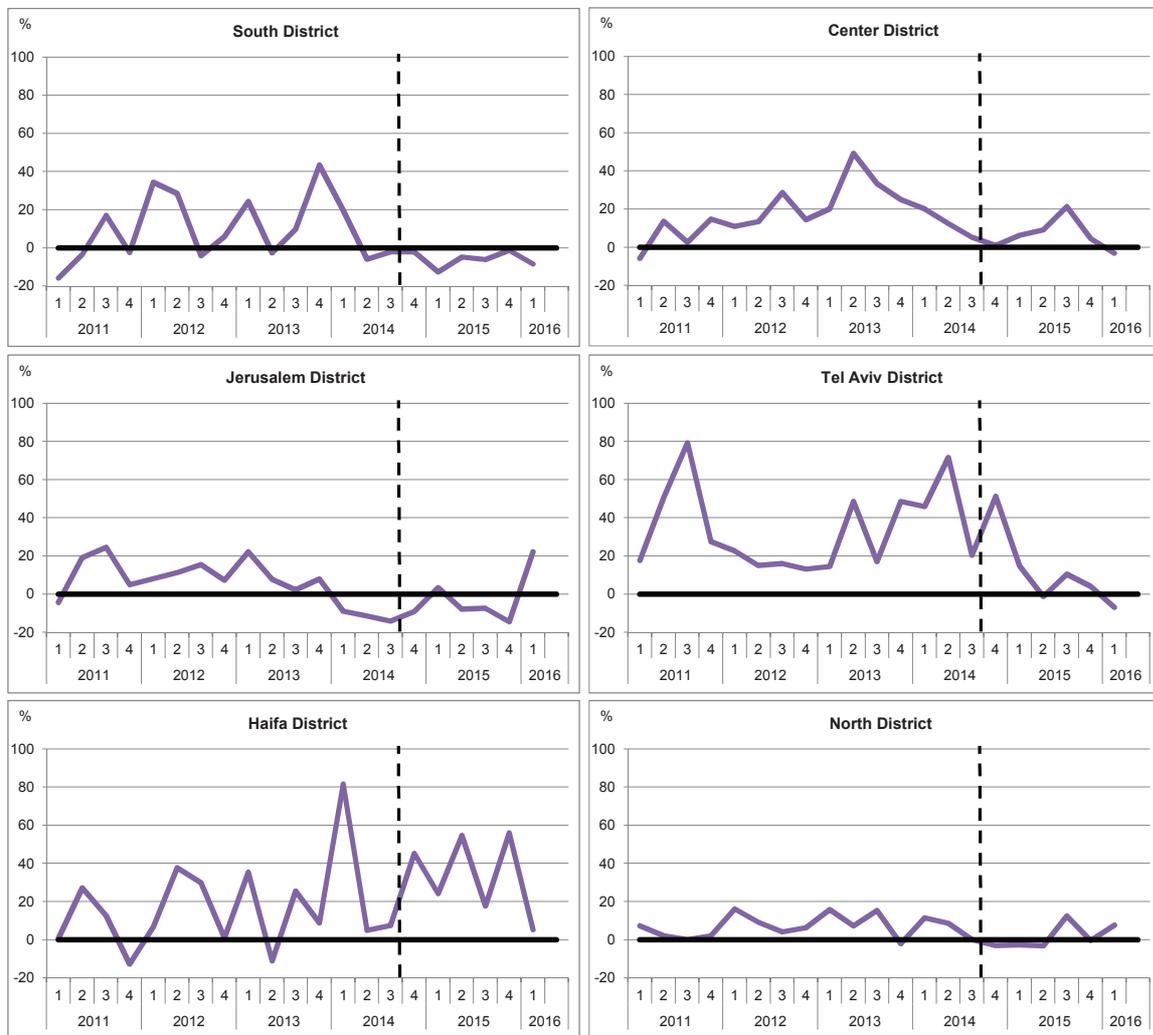
The dotted line distinguishes between the estimates that have already been revised at least 8 times, where we consider as final data, and those for which the revision process has apparently not been completed. To the right of the line, the rate of change between the initial and revised estimates is therefore expected to increase with future publciations.
SOURCE: Based on Central Bureau of Statistics figures on housing start.

Other than the figures that were revised at least eight times, we also examined the initial figures that were revised at least four times—that is, the initial estimates between the fourth quarter of 2014 and the third quarter of 2015. The initial estimates for these quarters reported an average decline of 1.4 percent relative to the same quarter in the previous year, while after four revisions the revised data report an average increase of 4 percent—a gap of 5.4 percentage points. This is a quantitatively significant gap, particularly if it changes the perception regarding the trends in activity of the construction industry in the past year. The estimates published since the fourth quarter of 2015 reported, on average, that the end data declined by 2.9 percent relative to the same quarters in the previous year, raising the question of whether the reports on the final figures in two years can be forecasted.

An argument can be made that the error is smaller when periods longer than a quarter are compared, such as the first half of a year compared with the first half of the previous year, the first nine months of a year compared with the same nine months in the previous year, or year over year. We therefore examined the rate of increase between such periods. Not only do such divisions not enable us to identify processes in the end data, there are retroactive upward revisions in such divisions as well. The problem is also not solved if we sum the data from the past four quarters with the objective of examining activity during an entire year, because for the most part, the newer data are biased downward and bias the overall figure. These examinations clarify that the problem is not in how the data are presented, but rather in their measurements.

In order to examine whether the revisions reflect a local problem in a given district, we also examined the number of housing starts by district (Figure 3). The numbers on housing starts in the Tel Aviv and Haifa districts, which together constitute about 27 percent of total housing starts in the period to which the Figure relates, have a greater tendency to be revised relative to the initial estimate. However, there are also significant revisions in other districts.

The figure's effects on policymakers and public opinion

The figure on the number of housing starts serves various government entities—the Ministry of Construction and Housing, the Ministry of Finance, the Housing Cabinet, and the Planning Administration—in assessing the number of new dwellings that will be added to the economy in the coming years. Through these assessments, they estimate the expected supply in the housing market and formulate policy regarding the need for government intervention in the construction industry. The figure also serves the Bank of Israel, since the Bank bases its monetary policy on economic activity. If the figure contains a systematic underestimation, it could create the impression that activity in the construction industry is slowing down, while the number of new homes is actually in a moderate upward trend over time.

The revisions in the housing start data also have an effect on National Accounts estimates, since the quarterly data on housing starts and completions serve in the calculation of fixed capital formation estimates. In this field as well, there are significant revisions, previously found to be around 3.5 percentage points higher than the initial quarterly growth rate figure.[10] A recent examination showed that the average underestimate between 2009 and 2016 was about 2.75 percentage points. The information available to us does not enable a quantification of how much the housing starts figure affects the fixed capital formation estimate, but since investment in residential construction constitutes about 30 percent of this component and about 6 percent of GDP, it is possible to estimate that the revisions in housing starts data have a direct effect on the investment in residential construction data, and that they may also have some effect on the revisions in the GDP estimates.

The biased figure on the number of housing starts also finds its way to the general public, through the media. By way of illustration, on May 31, 2009, the "Globes" newspaper published the headline, "For homebuyers: the number of housing starts declined by 9 percent in the first quarter". However, the last revision of the figure for that quarter (the first quarter of 2009) showed a 3.8 percent increase in the number of housing starts. A more recent example concerns the figure published by the CBS at the end of 2015, which drew the headline: "The gap continues to grow, only 47,000 new homes were started in 2015—not enough for young couples" (Globes, March 28, 2016). Today, after just three revisions, the figure increased from 47,700 starts to 52,700—an increase of 10.5 percent. The last example we will cite concerns the figure published in mid-December 2016 regarding housing starts in the third quarter of that year—about 38,700 in the first three quarters of 2016. In annual terms, this translates to about 51,600 housing starts. This figure was the basis for the headline: "CBS data expose: The government target of 60,000 housing starts grows only more distant" (Calcalist, December 15, 2016). However, the naïve examination of the average

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[10] Bank of Israel (2013), "Revisions to Quarterly National Accounts Data", Recent Economic Developments, 135, pp. 20–27.

of revisions thus far (Table 1) serves as a basis for expectations that the figure in annual terms will be revised to 57,200 housing starts—a results quite close to the government target. While this is just a rough estimate, as we will see below, it is in line with the revisions made in recent years.

There are two risks in underestimating housing starts. First, the figure may lose credibility and policymakers may stop using it.[11] The second risk concerns the creation of expectations among the public. If there are quarterly reports that the number of housing starts declined significantly, the public may begin to expect that supply will decline in the coming years and that prices will increase.

Can the revisions be forecasted?

a. Forecasting the revisions in macroeconomic data

The Mincer-Zarnowitz (1969) test of forecasting efficiency examines whether the retroactive changes in a figure can be forecasted based on the existing information when it is first published. The use of this test is based on the assumption that the initial publications of the housing starts data include errors relative to the final figure:

(1) $$S_t^{t+1} = S_t^f + \varepsilon_t$$

where represents the number of housing starts; S_t^{t+1} represents the number of starts in quarter t as known at the time of the initial publication—at time t+1; S_t^f represents the final figure (upon completion of the revisions) of the number of housing starts in quarter t; and represents the zero mean random term, that is an error that cannot be foreseen at the time of publication. In this context, Mankiew and Shapiro (1986) distinguish between two factors that affect the retroactive revision of the macroeconomic data—random "noise" and "news". The "noise" approach claims that in making the first estimate, there is noise that is not correlated with the final figure, and it is corrected during the revision of the data. The "news" approach holds that the initial figure reflects a rational forecast of the final figure, given the information available at the time of the initial publication, and that the revisions are the result of new information, correlated with the final figure, that cannot be foreseen. It seems that the CBS adopts the "news" approach, since it is aware of the expected revisions in the data and warns of them in its press releases—that is, there is the impression that it is impossible to foresee the revisions due to lack of information.

Aruoba (2006) emphasizes that when the expected mean of revisions is not zero, the basic Mincer-Zarnowitz regression may omit other explanatory variables. Therefore, he suggests examining whether at the time of the initial publication there were other known variables that could have assisted in forecasting the revisions—including revisions of previous quarterly data and of other macroeconomic data. As we have seen, the expected mean of revisions of the housing starts data is not zero. We will therefore relate below to the "news" hypothesis (the hypothesis that the revisions are zero mean and random), and examine whether that is the best hypothesis in the case of housing starts data. According to Aruoba's approach, we also use additional explanatory variables with the aim of examining whether they can add information to the model in real time. For this purpose, we will only use the explanatory variables available at the time the initial figure was published. Variables that are discovered only at the time of later publications cannot serve in projecting the future revisions, because they were not known at the time the estimation was made.

According to this approach, we distinguish between four approaches for forecasting revisions in the housing starts figure:

M0 – The "News"/zero hypothesis holds that there is no model and that the revisions are random and have zero mean, meaning the initial figure is the most effective estimate in forecasting the final figure.

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[11] See "Response of the Construction Ministry: The "real" pace of housing starts—47,000 units" (Ma'ariv NRG, March 10, 2015).

Models M1–M3 are as follows:

(M1)
$$R_t^{t+1+n} = \alpha_0 + \varepsilon_t$$

(M2)
$$R_t^{t+1+n} = \alpha_0 + \alpha_1 S_t^{t+1} + \varepsilon_t$$

(M3)
$$R_t^{t+1+n} = \alpha_0 + \alpha_1 S_t^{t+1} + \sum_{i=1}^{3} \beta_i R_{t-i}^{t+1} + t + \varepsilon_t$$

where R_t^{t+1+n} represents the cumulative revision of the figure for quarter t after n revisions, that is, the difference between the figure published for quarter t after n revisions (S_t^{t+1+n}) and the figure initially published for that quarter (S_t^{t+1}) ; S_t^{t+1} represents the rate of change between housing starts in quarter t and starts in the same quarter in the previous year (t-4); R_{t-i}^{t+1} represents the cumulative revision of the figure for quarter t-i known at the time of the initial publication of the figure for quarter t; and t represents a linear time trend that increases by one unit each quarter from the beginning of the study period.

Model M1 holds that the size of the revisions is not dependent on additional variables, and in order to forecast the final figure, we can add a fixed rate—the unconditional mean of the revisions—to the initial figure. The simple use of the figures from Table 1 is simply the application of Model M1, since we assume that we can correct the figures based on the currently known average of the revisions. Model M2 examines whether, in addition to the unconditional mean, the size of the initial figure also affects the revisions of that figure, that is, if a particularly small initial estimate is revised to a greater extent, or vice-versa. Model M3 examines whether, in addition to all the variables mentioned above, the time trend and the revisions published for previous quarters also have the ability to explain the revisions in the initial estimate of quarter t.

It is important to emphasize that this is a simple exercise that does not explain the real factors in the revisions, because it uses only one explanatory variable—the number of housing starts. In other words, models M1–M3 use only the information accumulated thus far on the revisions in order to indicate a continuing phenomenon that is expected to continue into the future. A real model requires a broader data set, including data on the true factors in the increase or decline in housing starts. Information on the volume of data attribution and on the statistical corrections already made to the raw data can also help in making the required correction and reducing the size of the error. However, the best way for solving the problem does not include statistical estimations, but rather improvement of data collection. By way of illustration, the CBS expects that the use of the data it will receive through the "Rishuy Zamin" ("available license" in Hebrew), the new online system for permits, will make it possible to accelerate and streamline how the information on building permits is provided to the CBS from the local planning committees, and this is expected to help improve the survey. If all of those who are involved in the process take the necessary measures to improve the transfer of information between the various entities, they will have a significant impact on the extent of the revisions and help bring better data to the data users in real time.

b. Retroactive (ex-post) examination of the "news" hypothesis

In order to examine whether it is possible to suggest a model that more efficiently forecasts the revisions, we compare the precision of models M1–M3 to that of the "news" hypothesis (M0). We examine the Adjusted R2 and the Residual Standard Error (RSE) of each model relative to that of the zero hypothesis.

Table 2 presents the results of the estimation of Models M1–M3 regarding the revisions in the rates of change between parallel quarters a year apart, since this rate of change suffers from larger errors and since it adjusts for some of the seasonal factors affecting the number of housing starts. The figures are taken from the tables published by the Central Bureau of Statistics in its quarterly press releases between 2004 and 2016 (original data).

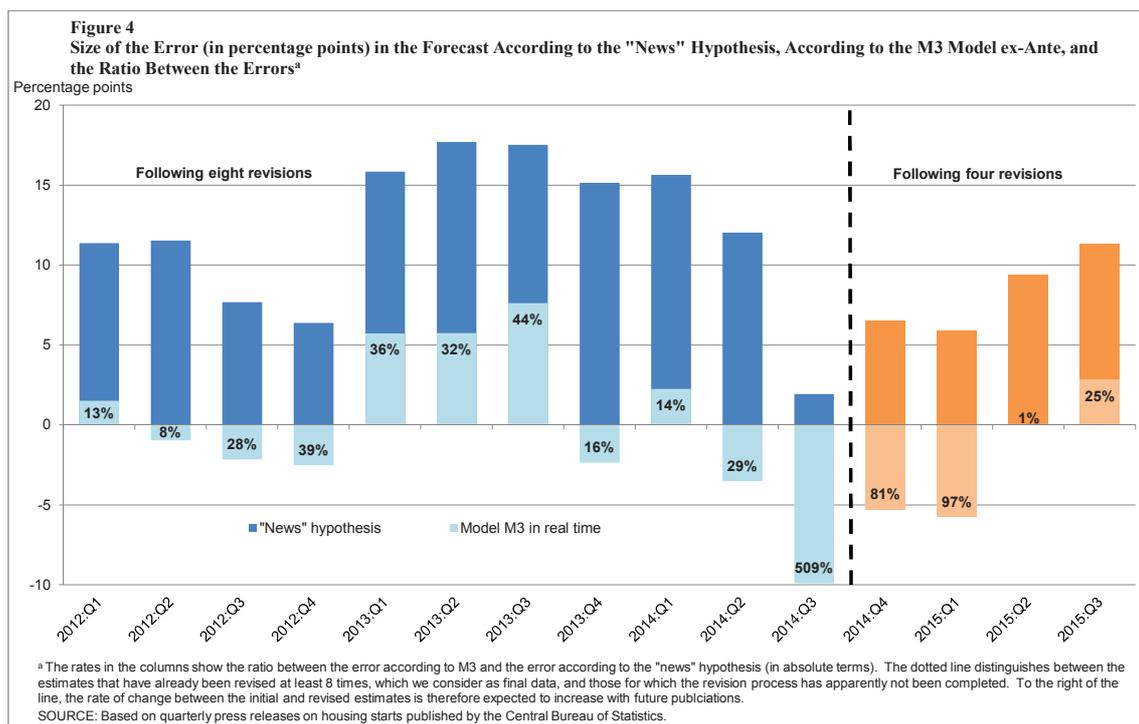|	M1	M2	M3	M1	M2	M3	M1	M2	M3
Table 2 **Cumulative revisions (in percentage points) in the figure on the rate of change in housing starts relative to the same quarter in the previous year, 2004:Q1–2016:Q3**									
		After one revision			After four revisions			After eight revisions	
Intercept	***3.81 (0.69)	***3.92 (0.70)	***2.16 (0.79)	***8.10 (0.94)	***8.01 (0.90)	**3.26 (1.27)	***8.56 (1.13)	***8.40 (1.12)	***3.02 (1.06)
First estimate		0.03 (0.03)	0.07 (0.05)		-0.03 (0.04)	0.03 (0.05)		-0.05 (0.04)	0.01 (0.06)
First revision of quarter t-1			***0.39 (0.12)			**0.41 (0.16)			***0.41 (0.15)
Cumulative revision of quarter t-2			*-0.19 (0.1)			-0.25 (0.15)			*-0.23 (0.17)
Cumulative revision of quarter t-3			***0.23 (0.09)			**0.25 (0.12)			*0.27 (0.14)
Dummy variable for the time trend			*-0.01 (0.04)			*0.12 (0.07)			*0.14 (0.08)
Number of observations	47	47	47	44	44	44	40	40	40
R^2	0	0.01	0.19	0	0.005	0.27	0	0.01	0.33
Adjusted R^2	0	-0.01	0.09	0	-0.02	0.18	0	-0.01	0.23
Residual Std. Error	3.82 (df = 46)	3.84 (df =45)	3.64 (df = 41)	5.03 (df =43)	5.08 (df = 2)	4.56 (df = 8)	5.27 (df = 9)	5.30 (df = 8)	4.62 (df = 4)
Statistical F		0.52 (df = 1; 45)	1.95 (df = 5; 41)		0.20 (df = 1; 42)	**2.86 (df = 5; 38)		0.56 (df = 1; 38)	**3.32 (df = 5; 34)
RSEi/RSE0	71%	72%	68%	53%	54%	48%	53%	53%	46%
*p<0.1,**p<0.05,***p<0.01 The value in parentheses denotes the standard deviation standardized to heteroskedasdicity and to the serial correlation according to Newey-West.									

The results in Table 2 show that the initial estimate of the rate of change in housing starts is systematically biased downward, with an estimated bias of about 8.6 percent. This bias is revealed as the figure stabilizes following 8 revisions, and represents the unconditional mean of revisions. This result means that the zero hypothesis is rejected, that is, the revisions are not only the result of unforeseeable news. Moreover, the coefficient of the initial estimate is not significantly different from zero, meaning the size of the initial figure has no effect on the size of the expected revisions. A comparison of the errors in Models M1–M3 to the error in the zero model shows the former are smaller. This is particularly true regarding model M3 which, on average, makes the closest prediction to the actual figure and reduces the error by 54 percent. In addition, the increase in Adjusted R2 shows that the variables added to the model improve its predictive capability by increasing the share of explained variance.

We conducted several sensitivity tests on the results of the estimation. First, we examined whether the difference between the forecast of one revision and the forecast of four and eight revisions is not the result of the "fresher" quarters that have still not been revised eight times (starting from the fourth quarter of 2014). For this purpose, we took the same 40 observations that were already revised a sufficiently large number of times and used only them in estimating the first and fourth revisions. We found that the results are not significantly different.

Second, we added the cumulative revisions of earlier quarters to the explanatory variables, and found that for the most part, they do not provide added value in forecasting the revisions. Finally, we added a dummy variable for the quarter in order to examine if the revisions have seasonal characteristics, and found that the type of quarter does not have an effect on the size of the revision.

c. Real-time (ex-ante) examination of the forecasting model

In Part B, we used the current information to retroactively estimate the biases, but it is interesting to also look at whether the information available at the time of the initial publication is sufficient in order to predict the revisions. For that purpose, we ran the various models on the sub-groups of the database to represent the information available in real time. This approach makes it possible to simulate the information available in a certain quarter and to use it to predict the expected cumulative revision after two years. As time progresses, we correct the model only through the new information that became available each quarter (including data on new quarters and revised data on previous quarters). Figure 4 compares the error caused when using the zero hypothesis and the error caused when using model M3.

Figure 4
Size of the Error (in percentage points) in the Forecast According to the "News" Hypothesis, According to the M3 Model ex-Ante, and the Ratio Between the Errors[a]

[a] The rates in the columns show the ratio between the error according to M3 and the error according to the "news" hypothesis (in absolute terms). The dotted line distinguishes between the estimates that have already been revised at least 8 times, which we consider as final data, and those for which the revision process has apparently not been completed. To the right of the line, the rate of change between the initial and revised estimates is therefore expected to increase with future publciations.
SOURCE: Based on quarterly press releases on housing starts published by the Central Bureau of Statistics.

Until the third quarter of 2014, the error of model M3 is equal to the difference between the size of the revision after eight quarters and the size of the revision predicted by the model. The error of the "news" hypothesis is equal to the size of the revision after eight quarters, since when using the figure from the original publication as is, we assume that the expected revisions are zero on average. Since, starting in the fourth quarter of 2014, it is not possible to know the actual revision after two years, we examine the difference between the model's expected revision after four quarters and the actual revision after four quarters. As the Figure shows, there are errors in our simple model as well, but they are not biased in a certain direction (where the error is negative, it means that the model overestimated the revision). In addition, the errors in model M3 are significantly smaller than the errors in M0. Our model corrects an average of about 34 percent of the size of the error derived from the "news" hypothesis, and corrects about 67 percent of it if we omit the outlier observation in the third quarter of 2014.

The sensitivity tests we conducted maintained a fixed number of observations. Each time an observation was added to the sample, the earliest existing one was removed. We did not find significant differences in the forecasts or in the predictive ability of this method. However, the first method is, in any case, more appropriate since it simulates how the existing information expands over time.

Conclusion

The data on housing starts are an important component of the Israeli economic outlook, particularly when housing is at the core of the economic policy discourse. If there is an underestimation in the real-time data, it influences policymakers and the public in a way which could, in turn, affect the housing market.

Examining the accumulating revisions in the housing starts series between 2004 and 2015 leads to the conclusion that there is a systematic underestimation of the initial data. This study found that the initial estimates can be corrected through models that examine the revisions in previous quarters' data. These results invite a more in-depth examination of the existing estimates and of additional statistical models for correcting the bias. Until then, and as the Central Bureau of Statistics notes in its quarterly press releases on housing starts, it is recommended that data users be cautious when relying on the initial publications of this figure.

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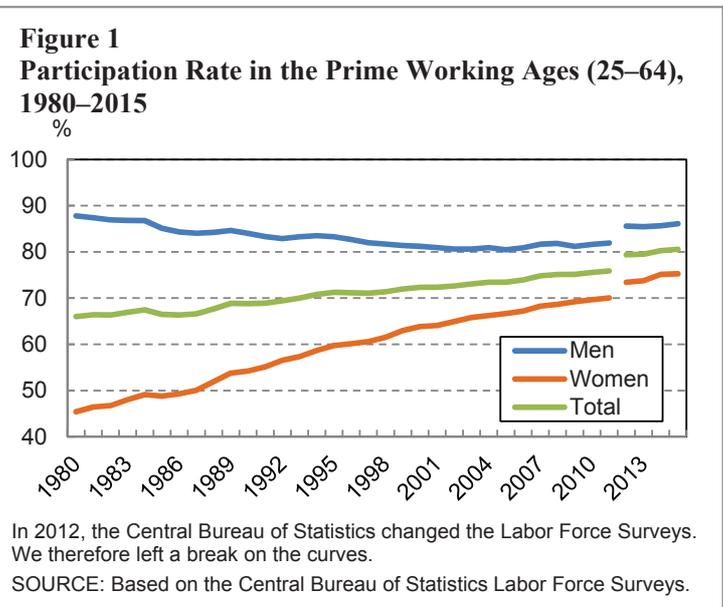
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THE COMPOSITION OF THOSE JOINING THE LABOR MARKET IN THE FIRST DECADES OF THE CENTURY

- The labor force participation rate among those aged 25–64 (the prime working ages) increased by about 4.5 percentage points since 2003, reaching 80.7 percent in 2015—higher than the OECD average.
- The most significant increase in the past decade took place among the older ages, because the retirement age increased gradually since 2004. The increase is prominent among Jewish men aged 60–69, among non-Jewish men aged 55–59, and among women aged 55–64.
- Since participation rates decline with age, they have declined as a result of the aging of the working-age population. However, older adults have increased their participation rates to a larger extent, so the over-all participation rate has actually increased.
- Until the beginning of this century, the participation rate among men declined over a number of decades. The increase in the past decade is mainly a result of the increase among older adults. The participation rate among women has increased constantly, in accordance with the global trend, but since 2003, a large part of the increase is a result of the increase in participation rate among older women.
- The analysis shows that the participation rate among older adults increased in the past decade, largely a result of the fact that the retirement age was increased gradually since 2004, since this encourages older population groups to participate in the labor market. Increasing the retirement age therefore contributed to the income of the elderly population and to their pensions. It has apparently also made a considerable contribution to economic growth in the past decade.

In the first decades of the 2000s, the Israeli economy has continued to benefit from the rapid increase in employment and labor force participation rates.[1] Between 2003 and 2015, the participation rate among those in the prime working ages (aged 25–64) increased by about 4.5 percentage points[2], to 80.7 percent—higher than the average rate in the OECD. This increase is further to the continued increase in the participation rate in previous decades.

The overall participation rate in the economy is comprised of the participation rates of various groups, since the population can be divided by age, gender, religion, schooling, and so forth. This analysis will examine the increase in the overall participation rate, separating between the effects of the population composition and the effects of the changes that developed in the participation rates among the groups. The discussion will emphasize signs of the increasing effects of policy changes that took place in the first decades of the 2000s, particularly the effect of the increase in the retirement age.

Figure 1
Participation Rate in the Prime Working Ages (25–64), 1980–2015

In 2012, the Central Bureau of Statistics changed the Labor Force Surveys. We therefore left a break on the curves.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

Written by Aviad Schwartz.

[1] The labor force participation rate is equal to the rate of workers and those looking for work, among working age people (aged 15 and above). However, this box focuses on the prime working ages (25–64).

[2] In 2012, the Central Bureau of Statistics changed the Labor Force Surveys, moving from a quarterly survey to a monthly survey, and expanding the areas to which the term "Labor Force" applies. The term no longer relates only to the civilian labor force, but to the general labor force, including soldiers in compulsory service. Therefore, when we calculated the change in participation rates, we did not take into account the actual change between 2011 and 2012, but replaced it with the average rate of change during the period. The changes made to the Labor Force Survey are detailed on the Central Bureau of Statistics website at http://www.cbs.gov.il/publications12/saka0712m/pdf/intro_e_e.pdf

An examination of the change in the participation rates in the past 30 years shows that it increases almost throughout the period (other than during the crisis in the mid-1980s), and that its increase moderated slightly over time.[3] As Figure 1 shows, until 2005 the participation rate increased thanks to an increase in the rate among women, since among men it declined until 2005, with the trend changing only thereafter. The increase among women reflects a continuing trend, which runs parallel to the worldwide trend of reducing the gaps between men's and women's participation rates.

The participation rate among women

The phenomenon of increasing participation rates among women is common to all population groups in Israel and, as stated, is also part of a worldwide phenomenon. There are many explanations for the global increase[4], and there are additional explanations in Israel concerning domestic developments such as policy changes in areas such as education and transfer payments, and the contribution made to the economy by immigrants since the 1990s. Figure 2 shows the growth in the participation rate of women in Israel by age group, and shows that in all groups, it increases with the year of birth. As the participation cycle over the years shows, participation rates decline in each cohort at older ages.

A breakdown by population group shows that among non-Ultra-Orthodox Jewish women, the participation rate is currently about 84 percent, and that it has increased by about 7 percentage points since 2003. Among the Ultra-Orthodox-women, it increased significantly over the same period—by close to 20 percent—and is currently close to the rate among the non-Ultra-Orthodox women. But we must remember that the scope of the position among the Ultra-Orthodox women is lower than average. Arab women increased their participation rate at a similar rate to the non-Ultra-Orthodox Jewish women—about 8 percentage points.

Figure 2
Participation Rates of Women Through Life By Year of Birth

Since there was a break in the labor force surveys in 2012, a broken line represents the data taken from the survey for 2015.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

In the first decade of the 2000s, a number of reforms were made in the labor market. One of the most significant had to do with increasing the retirement age: Between 2004 and 2009, the retirement age increased gradually[5], from 60 to 62 for woman and from 65 to 67 for men.[6] Figure 3 shows that the participation rate among older women increased more rapidly than among younger women. Particularly prominent is the fact that the participation rate among those aged 60–64 increased most sharply starting in 2004.

There are two factors that may explain the sharp increase in those years: (1) cohorts that reached retirement age during those years typically had a higher participation rate—even at younger ages—than those that preceded them (the "cohort effect"); and (2) the effect of policy—particularly the increase in the retirement age. Figure 2 shows that in some cases, the cohort effect holds: There is a large gap in the participation rate between those born in 1941–1945 and those born in 1936–1940,

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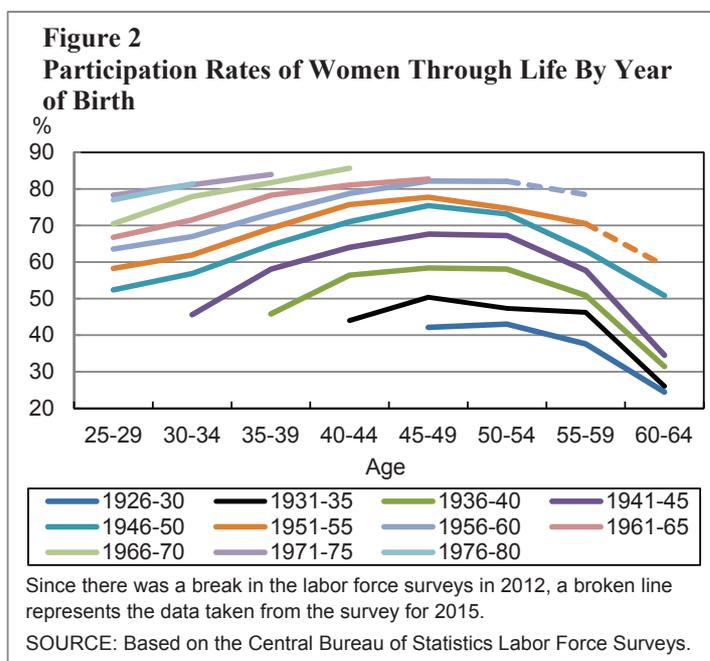
[3] The average annual rate of change between 1980 and 1995 was about 0.5 percent, while it was about 0.4 percent between 1995 and 2015.

[4] For instance, a decline in fertility rats and later marriage (Angrist and Evans, 1998); A change in social norms pertaining to women (Fernandez et al., 2004); increasing demand in the market for workers with higher education, which has led to a narrowing of the gender wage gap and will incentivize women to participate in the labor market (Katz and Murphy, 1992); and technological development and the entry of electrical appliances to the homes, which shortened the time women devote to household work and enabled them to work outside the home (Greenwood et al., 2005). It is obviously possible that some of these processes did not cause an expansion of women's employment, but resulted from it.

[5] The retirement age regarding old age pensions is conditional on the level of income provided by the National Insurance Institute.

[6] A discussion on the increase in the participation rate among women as a result of the increase in the retirement age appears in the Bank of Israel *Annual Report* for 2010, Chapter 8, and in the report of the Public Committee Examining the Retirement Age for Women, 2016.

and at the beginning of the 2000s it was reflected in an increase in the participation rate among women aged 55–59. (The gap between those cohorts narrowed in the following years.) However, among women aged 60–64, the situation is different. Until 2004, they were able to retire without a negative impact to their old age pensions, and the significant increase seen in Figure 3 began after the retirement age for women began to rise. Figure 2 shows this in the comparison between women born in 1946–1950 and those born before then: In the transition from the 55–59 age group to the 60–64 age group, the downward trend among the former is more moderate, which is consistent with the findings of microeconomic studies on how the increase in the retirement age affected the labor supply among older adults.[7]

The increase in the participation rate among those aged 60–64 had a significant effect on the overall participation rate in the economy. Table 1 shows the contribution from the changes in the participation rates of each age

Figure 3
Participation Rate of Women by Age, 1995–2015

In 2012, the Central Bureau of Statistics changed the Labor Force Surveys. We therefore left a break on the curves.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

group to the overall participation rate of the gender. The Table shows that the increase in the participation rate among women aged 60–64 contributed 1.2 percentage points to the total increase in the participation rate of women between 2003 and 2011. This accounts for one-quarter of the contribution made by all age groups to the increase in the participation rate—a high rate considering the fact that this group constitutes less than 10 percent of working-age women.[8] The Table also shows how the aging of the population affects the participation rate. As stated above, at older ages the participation rate declines in all cohorts, so an increase in the weight of older population groups will lead to a decline in the overall participation rate. This negative contribution amounted to more than one percentage point between 2003 and 2011, while it was negligible between 1995 and 2003.

The increase in the participation rate of older adults may be in coordination with changes in the characteristics that lead to such an increase, such as the geographic distribution of the population or its level of education. (The Bank of Israel Annual Report for 2012 included a finding that the increase in the level of schooling of the working-age population made a significant contribution to the increase in the participation rate.) It may also reflect unobserved changes that have contributed over the years to an increase in the participation rate of the cohort, such as cultural or institutional changes relating to women's participation in the labor market. In order to adjust for the other effects, we ran a regression for each year between 1995 and 2015, where the explanatory variables are the various characteristics and the dependent variable is the likelihood of working. Figure 4 shows the change in the coefficients[9] of the various age groups over the years. As it shows, the coefficients of the older age groups increased, and the likelihood of participation increased by about 20 percent among women aged 60–64 and by about 10 percent among women aged 55–59.[10] This increase is noticeable only among Jewish women. The low participation rate among older Arab women did not increase significantly over the years. The Figure also shows that prior to 2003, there was no change in the age coefficient of the younger groups, and there is therefore no evidence of the cohort effect being a significant factor in the results considering the other characteristics of those women.[11]

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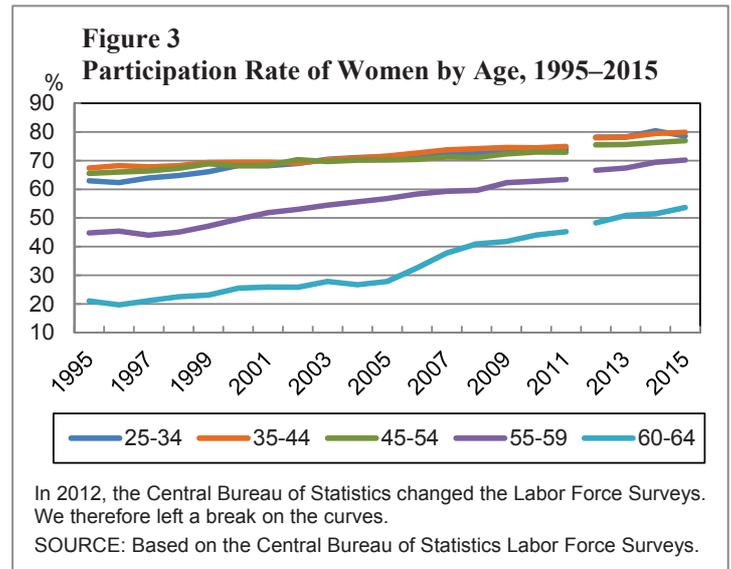
[7] See the Bank of Israel *Annual Report* for 2015, Chapter 5, and the Bank of Israel *Annual Report* for 2010, Box 5.1.

[8] Raising the retirement age also affected individuals close to the previous retirement age, causing some of them to remain in the labor market. The figures presented here do not take into account the effect of raising the retirement age on women aged 55–59 who remained in the labor market.

[9] We show the coefficients within the OLS regression because they are easy to understand, but they are in line with the results of the logit regression.

[10] Similar to the findings in the studies mentioned in Note 4.

[11] It is difficult to separate the possible cultural effects from the observed qualities of the women, such as family composition and education, because they have a mutual effect on each other. It is reasonable to assume, for instance, that women who want to participate in the labor market will choose to obtain more schooling, and the increase in the level of education will therefore reflect the cultural change and not stand on its own. Similarly, the desire to advance in the labor market may have an effect on the number of children a woman chooses to have and on the timing of her births.

Table 1
The contribution made by the various age groups to the change in the participation rates by gender, 1995–2011[a]
**(in percentage points)**

	2003—11				1995—2003			
	Men		Women		Men		Women	
Total change in participation rate	1.0		3.8		-2.9		5.8	
of which: Effect of the age distribution	-0.6		-1.1		-0.1		-0.1	
Effect of the increase in the participation rate of the age groups	1.6		5.0		-2.8		5.8	
of which[b]: Ages 25–34	-0.6	(34%)	1.1	(33%)	-0.7	(32%)	2.3	(31%)
Ages 35–44	0.6	(26%)	1.2	(26%)	-0.7	(30%)	0.9	(30%)
Ages 45–54	0.2	(24%)	0.8	(25%)	-0.8	(22%)	0.9	(22%)
Ages 55–64	1.3	(16%)	1.9	(16%)	-0.5	(15%)	1.6	(17%)
of which: 60–64	0.9	(6%)	1.2	(7%)	-0.4	(7%)	0.5	(8%)

[a] The analysis stops in 2011, since the formula of the labor force surveys was changed in 2012 for the surveys from then onward.
[b] Age group as a share of the total gender group at the beginning of the period appears in parentheses.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

Figure 4
Age Group Coefficients[a] Among Jewish and Non-Jewish Women, 1995–2015
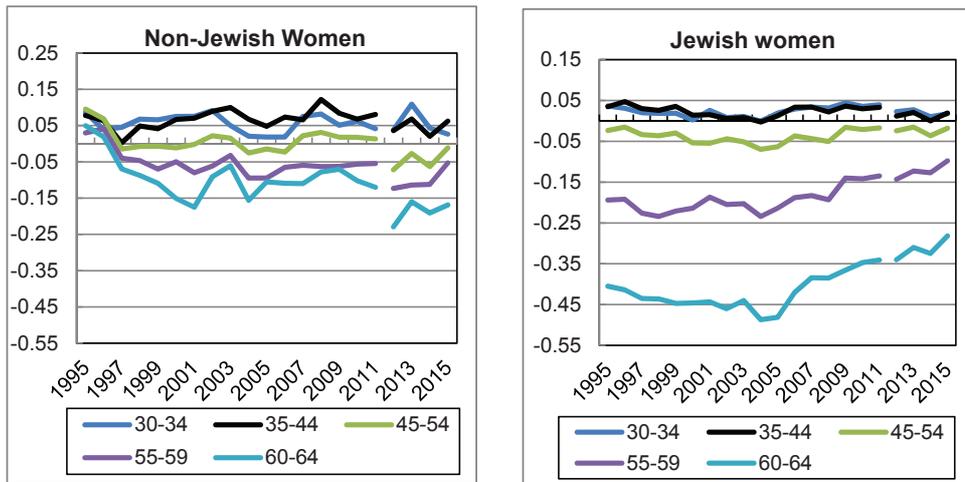

[a] The coefficients of the regressions that were run for the effect of belonging to a particular age group on labor force participation. In the OLS estimation, the explanatory variables are: age group, years of schoolng, family status, residential district, number of children, mother of a child under 4, new immigrant, and ultra-Orthodox. Women aged 25–29 were omitted from the estimation. In 2012, there was a change in the Labor Force Surveys. We therefore left breaks on the curves.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

The participation rate among men

The participation rate among men declined until the middle of the last decade, similar to the situation in most of the advanced economies (Figure 5). The decline in Israel is common to all population groups, although at varying levels of intensity between the groups.[12] Various studies—including Brender, Peled-Levi and Kassir (2002)—showed that this phenomenon is a result of the combination of a number of factors, including benefits policy, demographic changes, an increase in the number of students, and the import of foreign workers. We will focus mainly on the change in trend that took place in the middle of the last decade.

The increase in the proportions of ultra-Orthodox and Arab men in the population—a development that, according to Dahan (2005) had an effect on the decline in the participation rates—continued in the last decade as well, and as Table 2 shows, its contribution to the decline in the participation rates has even increased. However, the change in the participation rates of the various groups has overcome the negative effect.

Figure 5
Participation Rates of Men in Israel, the EU and the OECD, 1990–2015
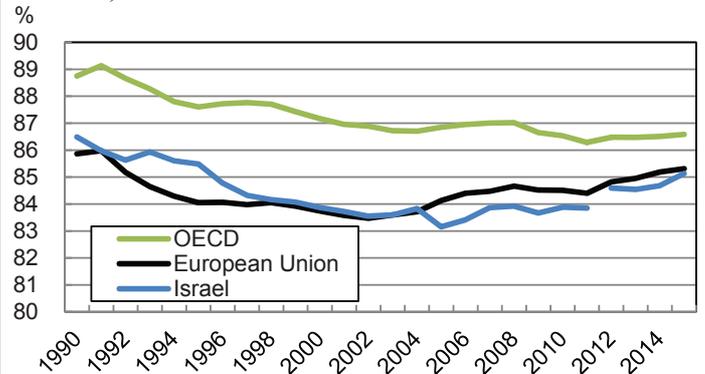
In 2012 there was a change in the definition of the labor force in Israel, and we therefore left a gap in the curve representing Israel. The country averages are weighted by size of the population in each group. The European Union includes the 28 current member countries.
SOURCE: OECD.

Table 2
The contribution made by the various population groups to the change in the participation rates by gender, 1995–2011[a] (in percentage points)

	2003—11		1995—2003	
	Men	Women	Men	Women
Total change in participation rate	1.0	3.8	-2.9	5.8
of which: Contribution of the change in the proportion of Arabs and ultra-Orthodox Jews in the population	-0.7	-1.0	-0.3	-0.9
Contribution of the increase in the participation rate of the population groups	1.8	5.1	-2.5	6.4
of which[b]: Non-ultra-Orthodox Jews	1.1 (78.1%)	3.6 (79.8%)	-1.2 (80.5%)	5.3 (81.7%)
Ultra-Orthodox Jews	0.3 (4.8%)	0.5 (4.0%)	-0.4 (4.1%)	0.2 (3.7%)
Arabs	0.4 (17.1%)	1.0 (16.3%)	-1.0 (15.4%)	0.9 (14.6%)

[a] The analysis stops in 2011, since the formula of the labor force surveys was changed in 2012 for the surveys from then onward.
[b] The figures in parentheses are the population group's share in the gender group at the beginning of the period.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

As we have noted, once of the main policy changes during the period of the study concerns the increase in the retirement age. An examination of the participation rates of men by age (Figure 6) shows that the trend changes significantly mainly among those aged 55–64. While those men account for a relatively small proportion of the population, they still make a decisive contribution to the increase in the participation rate of men during the reviewed period (1.3 out of 1.6 percentage points, as shown in Table 1). There is also a strong effect on Jewish men aged 65–69 (meaning beyond the prime working ages), a group that was partly included in the increase in the retirement age.

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[12] Between 1995 and 2005, the participation rates declined by 1.4 percentage points among non-ultra-Orthodox Jewish men, by 6.4 percentage points among ultra-Orthodox men, and by 7.6 percentage points among Arabs.

Figure 6
Participation Rates of Men by Age and Population Group, 1995–2015
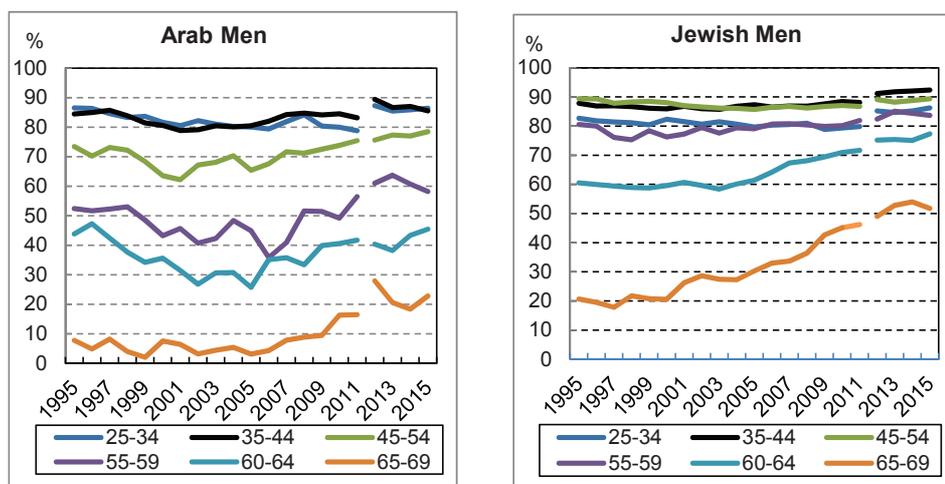
In 2012, the Central Bureau of Statistics changed the Labor Force Surveys. We therefore left a break on the curves.
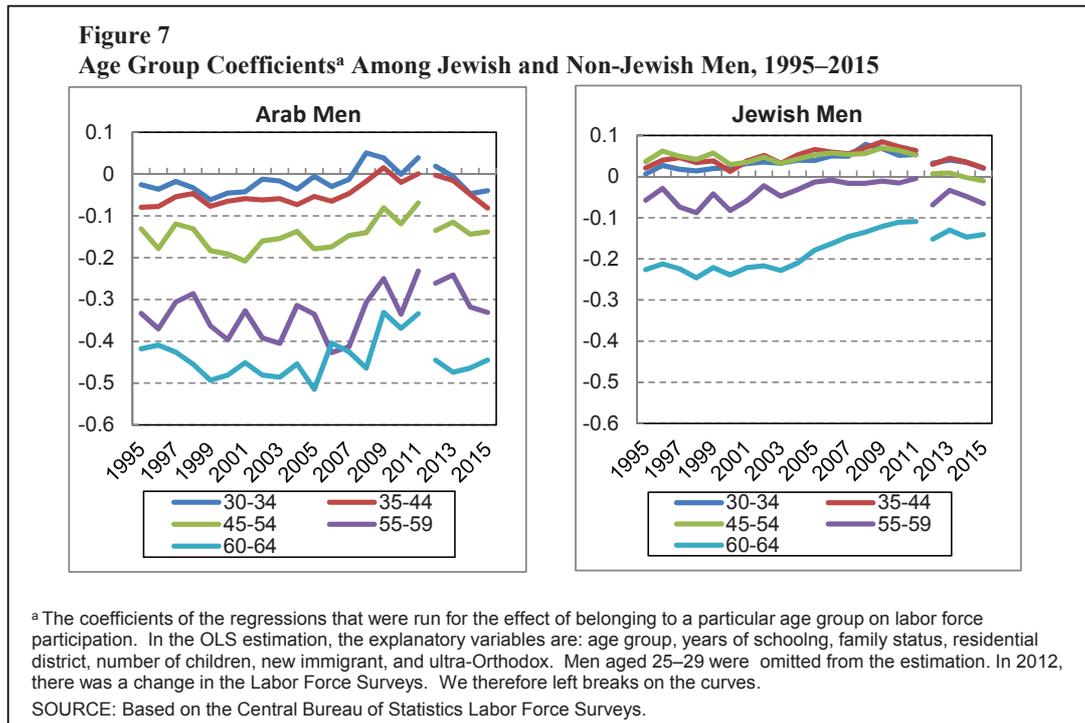SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

Among the Jewish population, the main change takes place among those aged 60–64, while among the Arabs it takes place in the 55–59 age group. The difference can be explained by the difference in participation patterns throughout the life cycle. Older Arab adults lower their participation rates at a younger age (the main decline begins at age 50, and sometimes even before then, while among Jews it begins after age 55), and the decline deepened from the mid-1990s onward.[13] Since Arab men retire many years before the official retirement age—meaning since it seems that their behavior is not coordinated with the retirement age—one can apparently think that increasing the retirement age will not affect them. However, increasing the retirement age increased the gap between the official retirement age and the common retirement age among Arab men, and extended the period during which the individual does not benefit from old age benefits. It also pressed them to remain in the labor market much longer (meaning the gap remained constant). It is possible that the supply of labor among Arab men was also affected by the cutback in child benefits and by more stringent criteria for receiving income support. In particular, these changes lowered the disposable income of many Arab families, since many of them are poor and rely on these transfer payments. Since the Arabs frequently live in a broad family framework and the retired adults rely on the younger family members, the lower disposable income may have caused older adults to continue working in order to increase the broader household's income.[14]

In order to reinforce the findings we derived from the theoretical statistics, we also estimated the likelihood of participation in the labor market here as well. Figure 7 shows the coefficients[15] obtained for the various age groups in the two population groups. It seems that there really was a significant increase in the likelihood of older men participating in the labor market (more than 10 percent among Jews and close to 20 percent among non-Jews). Among Jews, the change took place mainly among those aged 60–64, and among the non-Jews it also took place in the 55–59 age group. The difference between Arab and Jewish men is in line with the finding that the participation rate among Arab men starts to decline at a relatively early age.

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[13] See Yashiv and Kasir (2010). These researchers showed that according to the Social Survey, many Arab men leave the labor market due to physical or health limitations, and it is very possible that this is connected with the fact that many of them are less educated and work at jobs involving physical labor.

[14] Based on findings from the Social Survey, from Yashiv and Kasir (2010).

[15] Here too, we present the coefficients from the OLS regression because it is easy to understand their meaning, but they are consistent with the findings of the logit regression.

Figure 7
Age Group Coefficients[a] Among Jewish and Non-Jewish Men, 1995–2015

[a] The coefficients of the regressions that were run for the effect of belonging to a particular age group on labor force participation. In the OLS estimation, the explanatory variables are: age group, years of schoolng, family status, residential district, number of children, new immigrant, and ultra-Orthodox. Men aged 25–29 were omitted from the estimation. In 2012, there was a change in the Labor Force Surveys. We therefore left breaks on the curves.
SOURCE: Based on the Central Bureau of Statistics Labor Force Surveys.

Conclusion

The labor force participation rate increased by 2.9 percentage points between 2003 and 2011, while it increased by 1.6 percentage points between 1995 and 2003.[16] This acceleration was to a large extent a result of the fact that the downward trend in the participation rate of men was reversed, since the increase in the participation rate among women actually increased during both periods. This analysis shows that the change in trend among men made a significant contribution—beyond the cohort effect—to the increase in the participation rate of men aged 60–64 (which currently constitute about 10 percent of working-age men). It also shows that the acceleration in the increase of the participation rate of women aged 60–64 made a large contribution to the moderation of the slowdown in the increase in the participation rate among women. We found that this contribution is not a result of a change in the effect of age group characteristics such as education, family status, geographic area or nationality, and it is therefore reasonable to assume that it reflects the effect of the increased retirement age. The increase in the retirement age also had a significant impact on men aged 65–69. The ratio between the number of labor market participants at these ages and the number of participants among the prime working ages multiplied by 1.5 between 2003 and 2011, and this increase is the equivalent of an additional one percentage point to the participation rate of those aged 25–64. These findings show that not only did the increase contribute to the income and pensions of older adults, it also made a notable contribution to economic growth in the past decade.

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[16] The increase in the later period took place for the most part in the years when the increase in the retirement age was reflected (2006–2009), and it therefore deviates from the trend of moderation in the participation rate that was mentioned at the outset.

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