Chapter 3
Inflation and Monetary Policy

- The Consumer Price Index increased by 5.3 percent in 2022—above the inflation target of 1–3 percent. This increase continued the acceleration in the pace of inflation that began in 2021. As a result, the Bank of Israel increased the interest rate markedly—from 0.1 percent to 3.25 percent—during the year. The interest rate increases continued into 2023.
- Inflation in 2022 encompassed many CPI components. As in 2021, inflation in 2022 was influenced by supply limitations, including disruptions in global supply chains with the exit from the COVID-19 crisis. These were joined at the beginning of the year by supply disruptions in the energy and food markets due to the unexpected and prolonged war between Russia and Ukraine.
- In addition to the supply factors, the increase in inflation was also influenced by strong domestic demand, in view of the recovery from the COVID-19 crisis and the accommodative monetary and fiscal policies adopted during the crisis. Domestic demand's contribution to inflation increased during the year.
- One-year inflation expectations increased at the beginning of 2022, but remained around the upper bound of the inflation target range throughout most of the year. Expectations for between the first and third years crossed the upper bound of the target range during the year, but toward the end of the year they returned to within the range. Longer-term expectations remained anchored within the target range.
- Despite the acceleration of inflation, its rate in Israel remained lower than in other OECD countries. Some of this gap is due to the fact that the Israeli economy was not exposed to increases in the price of natural gas, and its exposure to shortages of energy products as a result of the war in Ukraine was limited. The increase in food prices in Israel was also more moderate than in the other OECD countries.
- In view of the increase in inflation, central banks, including the Bank of Israel, raised their monetary interest rates significantly during the year. The rapid increase in interest rates was intended to accelerate monetary tightening in order to deal with the risk of inflation becoming entrenched. Furthermore, the Bank of Israel was among the first central banks to stop the use of special monetary accommodation tools that were employed in recent years.
- Following a number of years in which the real interest rates in Israel were negative, they increased during the year to positive levels throughout the yield curve.
- In 2022, the shekel depreciated by 4 percent in terms of the nominal effective exchange rate, following a trend of appreciation that lasted for about a decade. The depreciation was supported by foreign exchange purchases by institutional investors due to the decline in equity prices abroad, as well as by the expansion of the monetary interest rate gap with the United States.

MONETARY POLICY TARGETS

According to the Bank of Israel Law, 5770–2010, the Bank of Israel has three objectives: (1) to maintain price stability as its central goal. The government determined that price stability means an annual inflation rate in the range of 1–3 percent. It was further determined that when inflation deviates from the target range, the Bank must adopt a policy that it believes will return it to the range within a period that does not exceed two years; (2) to support other objectives of the Government's economic policy, especially growth, employment, and reducing social gaps, provided that this support shall not prejudice the attainment of Price Stability over the Course of Time; and (3) to support the stability and orderly activity of the financial system.

Since October 2011, monetary policy is set by the Bank of Israel Monetary Committee. The concept whereby the central bank has a number of objectives, chiefly maintaining price stability, is referred to in the literature as "flexible inflation targeting". In such a regime, when inflation deviates from the target range, policy makers act to return it gradually to within the range. This gradual nature allows policy makers to also work to achieve the Bank's other objectives, while maintaining price stability in the medium and long terms. The Bank has a variety of tools available to help it achieve its objectives, and is independent in employing them.

This chapter analyzes the changes that took place in the inflation environment this year, and the monetary policy adopted by the Bank of Israel in response to those changes.

1. INFLATION

Inflation in 2022 totaled 5.3 percent, crossing the upper bound of the 1–3 percent inflation target range for the first time since 2011.

Inflation in 2022 totaled 5.3 percent, crossing the upper bound of the 1–3 percent inflation target range for the first time since 2011 (Figure 3.1). The upward trend of inflation began in 2021 with the recovery from the COVID-19 crisis. During these two years, the increase was influenced by price increases abroad as well as by strong domestic demand. This Section reviews the causes of the increase in inflation and quantifies their contributions.

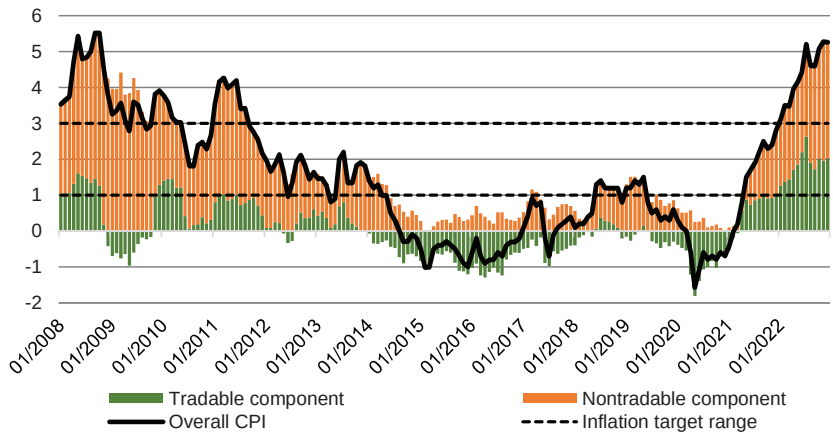
a. The causes of the increase in inflation

The increase in global inflation was due to supply-side contributions: supply chain disruptions that began during the COVID-19 crisis, and an increase in energy and food prices due to the Russia-Ukraine war.

(1) The global environment

The increase in global inflation, which began in 2021, continued in 2022. A significant part of this increase came from the supply side. At the beginning of the year, inflation was influenced by supply chain disruptions that began in 2021 with the recovery from the COVID-19 crisis. In addition, the global supply of several commodities was significantly impacted by the outbreak of war between Russia and Ukraine in February 2022. First, the export of agricultural commodities and food products from Ukraine and from Russia declined significantly, leading to price increases. Second, energy

Figure 3.1
Annual Inflation and Contribution of the Tradable and Nontradable Components, January 2008–December 2022
(cumulative change in the Consumer Price Index in the past 12 months, percent)



SOURCE: Based on Central Bureau of Statistics.

Table 3.1
Main indicators of inflation and monetary policy, 2018–2022

						2022			
	2018	2019	2020	2021	2022	Q1	Q2	Q3	Q4
A. Inflation (percent)									
1. Actual inflation[a]	0.8	0.6	-0.7	2.8	5.3	1.5	1.7	1.0	0.9
2. Seasonally adjusted quarterly inflation[b]						5.5	5.8	4.9	5.2
3. One-year inflation expectations derived from capital market[c]	1.0	1.1	0.0	1.9	3.1	2.8	3.4	3.4	2.8
4. Ten-year inflation expectations derived from capital market[c]	1.8	1.6	1.6	2.0	2.3	2.2	2.3	2.2	2.7
5. Forecasters' one-year inflation forecasts[c]	1.0	1.2	0.5	1.2	2.8	2.2	3.1	2.9	3.0
B. Yields (percent)[c]									
1. Bank of Israel declared interest rate	0.11	0.25	0.14	0.10	1.25	0.10	0.47	1.52	2.89
2. Real yield to maturity on one-year government bonds[d]	-0.8	-0.8	0.1	-1.9	-1.4	-2.5	-2.2	-1.3	0.5
3. Nominal yield to maturity on ten-year government bonds[e]	2.2	1.6	0.8	1.2	2.6	1.8	2.7	2.8	3.3
4. Real yield to maturity on ten-year government bonds[e]	0.5	0.0	-0.5	-0.8	0.1	-0.8	0.1	0.3	0.7
C. Change in the shekel exchange rate (percent)[f]									
1. Nominal effective	2.6	-8.0	-4.7	-7.9	4.0	1.3	3.4	-3.2	2.6
2. Vis-à-vis the dollar	7.1	-7.4	-6.6	-3.6	10.2	3.6	5.3	0.8	0.3
3. Vis-à-vis the euro	3.1	-9.6	2.3	-10.4	3.2	0.9	1.0	-5.2	6.8
D. Asset prices (percent)									
1. Overall yield on shares (general shares index, nominal)[f]	-3.9	17.8	-0.4	30.9	-15.5	1.6	-11.0	-0.5	-6.1
2. Rate of change in home prices	-0.8	4.2	4.0	13.1	14.6	4.3	5.2	4.0	0.5
E. The monetary aggregates (nominal rates of change)[f]									
1. M1 money supply	12.2	5.1	29.4	22.0	-10.3	5.5	0.2	-6.1	-9.6
2. M1 + SRO[g] + unindexed shekel deposits of up to one year	2.0	6.3	26.0	17.5	5.0	2.6	3.3	0.8	-1.8

[a] Change in CPI during the period.
[b] In annual terms, as calculated by the Central Bureau of Statistics.
[c] Period average.
[d] Based on the zero coupon yield curve. Period average.
[e] Gross yield, based on the zero coupon yield curve. Period average.
[f] Average of last month in period compared with average of last month in previous period. Minus sign refers to appreciation of the shekel.
[g] Self-Renewing Overnight Deposit (Current Credit Deposit) - a liquid daily deposit.
SOURCE: Bank of Israel, Ministry of Finance, and Central Bureau of Statistics.

Table 3.2
Development of prices, by various components, 2018–2022

	Consumer Price Index	Fruit and Vegetables	Food	Housing	Dwellings Maintenance	Furniture and Household Equipment	Clothing and Footwear	Education, Culture and Entertainment	Health	Transport and Communication	Miscellaneous	Energy Index[a]	CPI excluding energy and food	CPI excluding energy, food, and fruit and vegetables	CPI excluding energy, fruit and vegetables, taxation, and regulation	Nontradable component minus electricity, water, communication, food, and fruit and vegetables	Nontradable component minus electricity, water, communication, and fruit and vegetables	Seasonally adjusted CPI[b]
Component's weight in 2022	100.0%	3.3%	#####	24.7%	9.2%	3.6%	2.9%	11.2%	6.0%	18.4%	6.0%	5.1%	80.3%	77.0%		47.0%	54.7%	
Annual rate of change (end of period, percent)																		
2018	0.8	12.4	1.3	1.9	0.8	-1.2	-2.9	0.2	-0.1	-0.5	0.1	-1.5	0.9	0.5	0.7	1.5	1.5	
2019	0.6	-2.8	1.1	2.1	1.8	-2.5	-5.5	1.3	0.0	-0.2	-0.5	2.5	0.4	0.5	0.7	1.8	1.7	
2020	-0.7	4.4	-0.6	-0.2	-0.6	-0.1	-5.7	0.2	-0.6	-2.1	-0.4	-8.2	-0.1	-0.4	-0.4	0.1	0.1	
2021	2.8	-2.0	3.5	3.4	2.7	8.3	-7.3	3.2	1.5	3.3	1.7	7.5	2.4	2.5	2.4	3.4	3.4	
2022	5.3	3.1	4.9	6.3	5.7	0.1	-4.6	3.3	3.6	9.2	2.5	9.4	5.0	5.0	4.9	5.3	5.3	
Monthly rate of change, 2022 (percent)																		
January	0.2	1.4	1.3	0.1	-0.3	0.7	-5.0	-0.3	0.3	0.4	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.1	0.4
February	0.7	4.3	0.6	0.2	1.1	0.1	-2.6	0.1	0.4	1.7	0.1	4.3	0.5	0.3	0.4	0.2	0.3	0.5
March	0.6	-2.1	0.0	0.7	0.2	0.2	4.6	1.2	0.0	1.4	0.2	2.8	0.5	0.7	0.5	0.7	0.6	0.4
April	0.8	2.8	0.6	0.0	0.3	-0.2	2.1	0.9	0.1	2.0	-0.3	1.2	0.8	0.7	0.7	0.4	0.4	0.5
May	0.6	4.5	0.9	0.2	0.4	0.3	2.2	0.6	0.2	0.5	0.6	-0.8	0.6	0.5	0.6	0.3	0.4	0.4
June	0.4	-8.5	0.4	0.7	0.3	-0.4	-3.4	0.5	0.6	2.3	0.2	5.0	0.1	0.5	0.5	0.7	0.6	0.5
July	1.1	1.5	0.5	1.2	0.5	0.0	-4.0	0.8	0.5	3.0	1.0	3.0	1.1	1.1	1.0	1.0	0.9	1.0
August	-0.3	0.0	-0.1	0.8	2.2	0.3	-1.6	0.4	0.2	-3.5	0.4	-7.6	0.2	0.3	0.2	0.6	0.5	-0.2
September	0.2	2.2	-0.4	0.6	0.1	0.6	0.3	-0.1	1.0	-0.5	0.1	-1.3	0.4	0.2	0.1	0.4	0.3	0.4
October	0.6	3.2	1.0	0.6	0.4	-0.5	4.0	-0.3	-0.3	0.5	0.1	-0.1	0.5	0.4	0.5	0.3	0.3	0.4
November	0.1	-3.0	0.2	0.6	0.3	-0.3	0.1	0.1	0.1	0.2	-0.1	1.0	0.0	0.2	0.2	0.4	0.4	0.5
December	0.3	-2.3	0.0	0.6	0.2	-0.7	-1.0	-0.6	0.5	1.0	0.3	2.4	0.2	0.2	0.2	0.3	0.3	0.4

[a] The energy component includes vehicle fuels and oils, and household electricity, natural gas and diesel.

[b] As calculated by the Central Bureau of Statistics.

SOURCE: Based on Central Bureau of Statistics.

prices increased due to an intentional reduction in natural gas exports by Russia, and because various other countries adopted measures to reduce their dependence on Russian gas and pivoted to alternatives such as coal and oil.[1] The shortage of energy products and the increase in their prices also led to reduced production of other goods in some countries.

In addition to supply factors, some countries experienced an increase in inflation due to strong domestic demand. In these countries, demand increased with the recovery from the COVID-19 crisis in view of expansionary fiscal policy and accommodative monetary policy during the crisis. The stronger demand contributed to a tightening of the labor market, wage increases, and a resulting increase in inflation.

There are two main mechanisms through which the increase in global inflation can affect inflation in Israel. The first operates directly on the domestic consumption basket through price increases of imported tradable goods, which are influenced by the prices of those goods in foreign currency. The second mechanism works through price increases of imported inputs, which motivate domestic firms to raise their prices.

With regard to the first mechanism, Figure 3.1 shows that the upward trend in inflation in Israel began with the increase in prices of tradable goods. This increase was at first due to the higher dollar prices on imported products (including oil), while during 2022, it was more influenced by the depreciation of the shekel against the US dollar. The increase in inflation of tradable goods prices led to higher prices relative to nontradable goods and services, following a long trend of decline in the relative prices of tradable goods (See Figure 1.10 in Chapter 1).

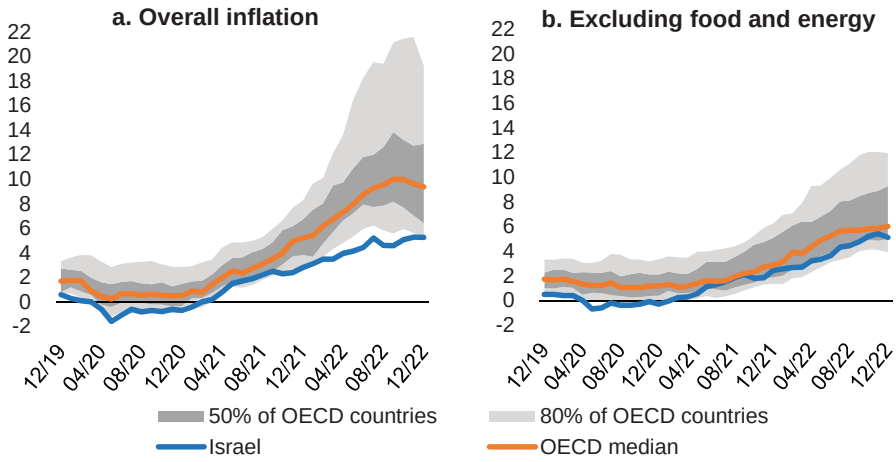
Energy prices in particular contributed to the increase in inflation abroad in the past year, but those prices increased more moderately in Israel for several reasons. First, the increase in global natural gas prices due to the war between Russia and Ukraine was not reflected in domestic prices, since those prices and supply quantities were set in long-term deals between electricity producers—primarily the Israel Electric Company—and the natural gas suppliers. Second, the Electricity Authority spread the increase in electricity prices derived from higher coal prices over several years, such that the price of electricity increased by a relatively moderate amount this year. Finally, the increase in global oil and coal prices was partly offset by a reduction in excise tax during the year. (For more information on the energy crisis's effects on the Israeli economy, see Chapter 1.) The increase in food prices in Israel was also relatively moderate. Thanks to the moderated increases in energy and food prices, the inflation rate in Israel was significantly lower than in other OECD countries (Figure 3.2a). Net of these components, inflation in Israel was closer to the OECD median (Figure 3.2b).

The increase in global energy prices had a relatively moderate effect on inflation in Israel, since the price of natural gas is fixed in long-term deals, and thanks to measures taken by the Electricity Authority and the government.

Food prices also increased relatively moderately in Israel. Thanks to the moderate increases in energy and food prices, the inflation rate in Israel was significantly lower than in other OECD countries.

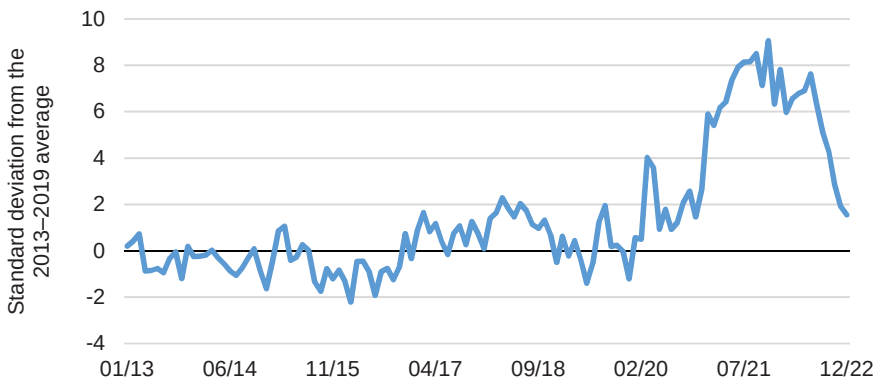
[1] For more information on the effect of the Russia-Ukraine war on energy and commodity prices, see: World Bank Group (2022), "Commodity Markets Outlook: Pandemic, War, Recession: Drivers of Aluminum and Copper Prices, October 2022", World Bank, Washington, DC.

Figure 3.2
Inflation in Israel and in OECD Countries, January 2019– December 2022 (percent)



SOURCE: Based on OECD data.

Figure 3.3
Supply Chain Pressure Index in Israel, January 2013–December 2022



SOURCE: Based on Bank Hapoalim Purchasing Managers Index and Bloomberg data.

The second mechanism for the effect of foreign inflation works through increases in the prices of imported inputs, which cause domestic firms to raise their prices. One of the causes of higher prices on imported inputs was, as stated, supply chain disruptions. Figure 3.3 shows the supply chain pressure index in Israel—the effect

of supply chain disruptions on the domestic economy.[2] The index shows that these disruptions increased significantly in 2021, but moderated during 2022. However, they were joined by an increase in global commodity prices, particularly energy prices, which contributed to higher prices on imported inputs over the course of the year.

(2) Strong domestic demand

In addition to supply factors, inflation in 2021–2022 was also influenced by the recovery of domestic demand with the exit from the COVID-19 crisis.

In addition to the global effects, inflation in 2021–2022 was also influenced by strong domestic demand. During those two years, the domestic economy recovered from the COVID-19 crisis, and domestic demand increased with support from the accommodative monetary policy and expansionary fiscal policy that were implemented during the crisis. In particular, domestic consumer demand recovered, as indicated by the high growth rate of private consumption during those years, even though its level relative to GDP remained lower than its precrisis level. (For more information, see Chapter 2.)

An increase in domestic demand can influence consumer prices in two ways. First, it enables producers to raise prices beyond production costs, which means an increase to their profits. Second, an increase in aggregate demand leads to an increase in the demand for labor, and thereby to an increase in workers' wages. Wage increases raise production costs for domestic producers, which leads to increased prices for consumers.

Below, this Chapter presents analyses that quantify the effect of domestic demand and show that it was a significant force for increasing inflation in Israel in the past two years. However, even though the increase in demand for domestic output also led to an increase in demand for workers, real wages increased only moderately, particularly in industries that produce for the domestic market. Thus, wage growth was not a dominant contributor to the increase in inflation. Chapter 2 shows that the GDP labor share declined in 2022—an indication of moderating inflationary pressures derived from wages and greater increasing profitability.

(3) The exchange rate

The shekel depreciated by 4 percent in terms of the nominal effective exchange rate, following a trend of appreciation in previous years.

In 2022, the shekel depreciated by 4 percent in terms of the nominal effective exchange rate (December 2022 average compared with the December 2021 average, see Table 3.1). The shekel depreciated by about 10 percent against the US dollar and by about 3 percent against the euro. The depreciation in 2022 took place following a trend of appreciation in previous years. (In the previous 5 years, 2017–2021, the shekel appreciated by an average of about 4.5 percent per year in terms of the nominal effective exchange rate.) Despite the depreciation during the year, the average level

[2] The supply chain pressure index is adjusted to the Israeli economy, and is based on a similar methodology to the one used by the Federal Reserve: Gianluca Benigno, Julian Di Giovanni, Jan Groen, and Adam Noble (2022), "A New Barometer of Global Supply Chain Pressures", Federal Reserve Bank of New York, January 4.

of the shekel in 2022 was stronger in terms of the nominal effective exchange rate than its 2021 average.

A recent Bank of Israel analysis shows that depreciation of the shekel by 1 percent against the US dollar contributes 0.1–0.2 percentage points to inflation[3], similar to previous estimations. According to this analysis, the change in the shekel-dollar exchange rate contributed 1–2 percentage points to inflation in 2022, while the euro had a near-zero effect. The importance of the US dollar exchange rate to the development of inflation sharpens the need to understand the forces that affected it this year.

The shekel depreciated by about 10 percent against the US dollar, influenced by the widening of the interest rate gap vis-à-vis the US and foreign exchange purchases by institutional investors.

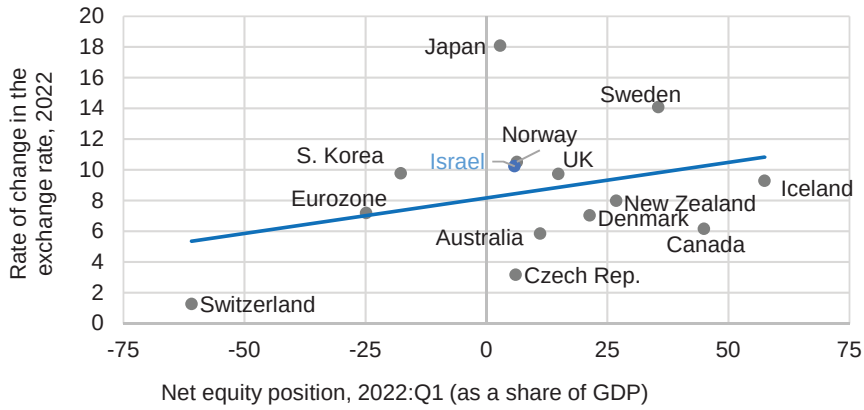
Many advanced economies experienced depreciation of their currencies against the US dollar in 2022, for two main reasons. First, the sharp increases in the monetary interest rate in the US expanded the interest rate gaps vis-à-vis a number of countries. In Israel, the gap widened by 1.1 percentage points during the year. Second, the decline in equity prices in the US (the S&P500 index declined by about 20 percent during the year) led institutional investors to adjust their asset portfolios and their hedging positions, which worked to depreciate domestic currencies.[4] Figure 3.4 shows that among the advanced OECD economies, those with higher net positions of portfolio investment in equities at the start of 2022 experienced a more significant depreciation during the year.[5] In Israel as well, institutional investors purchased foreign exchange this year, thereby contributing to the depreciation of the shekel against the US dollar (Figure 3.5).

[3] The pass-through from the exchange rate to prices is estimated using a regression of monthly inflation on the rate of change of the NIS/$ or NIS/€ exchange rate and common control variables (the change in import prices and the change in the dollar prices of oil).

[4] When foreign assets yield lower returns than domestic assets, institutional investors' exposure to foreign assets declines. In order to rebalance their portfolio, institutional investors buy dollars, use them to purchase foreign assets, and thereby increase their exposure to such assets. (For more information, see H. Hau and H. Rey (2004), "Can Portfolio Rebalancing Explain the Dynamics of Equity Returns, Equity Flows, and Exchange Rates?" *American Economic Review*, 94(2): 126–133.) In addition, declines in the values of foreign assets lead institutional investors to make swap transactions to purchase dollars in order to adjust the hedging in their investment portfolios. These transactions add to the depreciation pressure on the domestic currency in the spot market. Ben-Ze'ev and Nathan (2022) find evidence of this channel in Israel (Nadav Ben-Ze'ev and Daniel Nathan (2022). "Shorting the Dollar When Global Stock Markets Roar: The Equity Hedging Channel of Exchange Rate Determination". https://mpra.ub.uni-muenchen.de/115194).

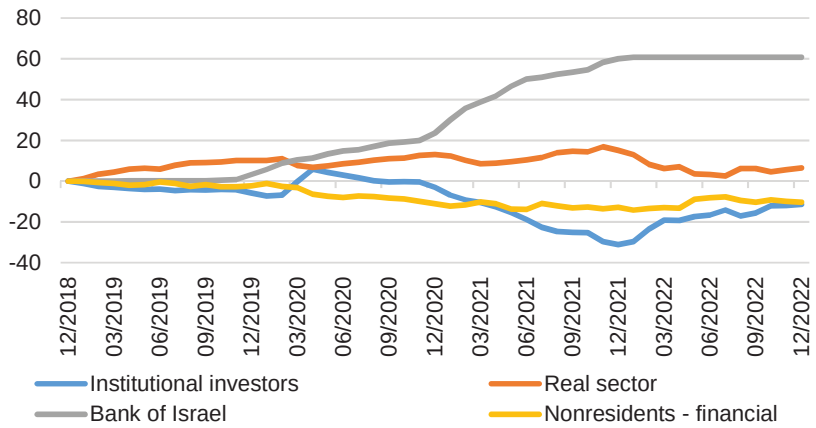
[5] The net position of financial investments in equities is the total of foreign equities held in the domestic market minus the total of domestic equities held by nonresidents. For the purpose of the analysis, central bank and government assets and liabilities were deducted from this balance, and the remainder was normalized by nominal GDP of each country. A study by the Federal Reserve found a link between the Net International Investment Position (NIIP) in the economy, which includes net equity holdings, and changes in the exchange rate during periods of significant volatility (G. Liao and T. Zhang (2020). "The Hedging Channel of Exchange Rate Determination", International Finance Discussion Paper 1283).

Figure 3.4
Equity Assets and Shekel Depreciation Against the Dollar, 2022



The sample includes the OECD countries defined as advanced by the IMF.
SOURCE: Based on IMF and Bloomberg data.

Figure 3.5
Cumulative Foreign Exchange Purchases (+) of the Main Segments, December 2018–December 2022
($ billion)



SOURCE: Bank of Israel.

In order to assess the effects of these two channels, we used a panel of countries. We estimated the change in the exchange rate that is explained by the change in the interest rate gap between them and the US, by the change in the S&P500 stock index,

and by the economy's net equity position as a share of GDP (Table 3.3).[6] According to this estimation, a one percentage point increase in the US interest rate beyond the domestic rate contributes an average of 1.0–1.7 percentage points to depreciation during that quarter (depending on the estimated model). A decline in the S&P500 index also contributes to depreciation of the domestic currency, and the effect is more prominent the greater the economy's exposure to foreign equities is.

For Israel, this means that out of a roughly 10 percent depreciation of the shekel against the US dollar, 1.1–1.7 percentage points are explained by the change in the interest rate gap vis-à-vis the US, and about 6–9 percentage points are explained by exposure to foreign equities, the changes in the S&P500 index, and the fixed effects in the regression.[7] However, the effect of changes in the S&P500 index this year may have been greater than what is captured in the regression, since during a significant part of the sample, the Bank of Israel purchased foreign exchange against sales by the institutional investors, thereby offsetting the effect of those sales on the exchange rate, whereas the Bank of Israel did not operate in the foreign exchange market in 2022 (Figure 3.5).[8]

(4) Housing prices

The housing component of the CPI, which measures the costs of housing services, accounts for about one-quarter of the Consumer Price Index. This component increased by 6.3 percent in 2022—more than in 2021 when it increased by 3.4 percent (Table 3.2). The owner-occupied housing services component accounts for about 70 percent of the housing component, and imputes the rent that home owners would have received on the rental market based on new and renewing rental contracts. In 2022, this component increased by 6.3 percent. The rents component, which measures rents for those renting their dwelling and accounts for about 25 percent of the housing

[6] The estimated model is: $\Delta S_{i,t} = \beta_0 + \beta_1 \Delta(r_{i,t} - r_{US,t}) + \beta_2 \Delta SP_t + \beta_3 Pos_{i,t} \Delta SP_t + \beta_4 Pos_{i,t} + \varepsilon_{i,t}$

Where $S_{i,t}$ is a log of the exchange rate of the domestic currency vis-à-vis the US dollar (where an increase indicates depreciation of the domestic currency), $r_{i,t}$ is the domestic monetary interest rate, $r_{US,t}$ is the monetary interest rate in the US, SP_t is a log of the S&P500 index, and $Pos_{i,t}$ is the net position of portfolio investment in equities by private investors relative to GDP. The model was estimated on data from 14 OECD countries that the International Monetary Fund defines as advanced, at a quarterly frequency between 2013 and 2022. While changes in the S&P500 index are correlated with changes in the US interest rate, the regression controls for this through the change in the interest rate gap. In addition, an estimation of a model with the US interest rate as a separate explanatory variable from the domestic interest rate generates a similar estimator for the S&P500's effect on the exchange rate.

[7] By way of comparison, the Bank of Israel Annual Report for 2020 contains findings that a 1 percent decline in the S&P500 index contributes about 0.2 percentage points to a depreciation of the shekel vis-à-vis the US dollar. According to this estimation, the decline in the index in 2022 contributed about 4 percentage points to the depreciation.

[8] Hercowitz and Friedman (2022) present evidence that the Bank of Israel's foreign exchange purchases between 2010 and 2021 offset the effects of foreign and institutional investors' flows on the shekel-dollar exchange rate. (Z. Hercowitz and A. Friedman (2022). "The Effect of Foreign Exchange Market Activity by Various Sectors and the Bank of Israel on the Exchange Rate", in Amir Yaron and Michel Strawczynski (eds.) *Monetary Policy In a Period of Price Stability*, Bank of Israel.)

Table 3.3
Effect of the interest rate gap and US equity prices on the US dollar exchange rate in a panel of countries

	Explanatory variable: Change in the US dollar exchange rate during the quarter (percent change, positive change marks depreication of the domestic currency)		
	(1)	**(2)**	**(3)**
Change in the interest rate gap vis-à-vis the US	-1.08*	-1.03**	-1.65**
	(0.59)	(0.51)	(0.67)
Change in the S&P 500 index	-0.24***	-0.24***	
	(0.02)	(0.02)	
Net equity position (balance, previous quarter) X change in S&P500	-0.002**	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)
Net equity position (balance, previous quarter)	0.01	-0.03	0.01**
	(0.01)	(0.02)	(0.004)
Constant	1.22***		
	(0.19)		
Currency fixed effect		V	
Quarter fixed effect			V
Number of observations	531	531	531
R^2	0.14	0.14	0.03

The sample includes the 14 OECD economies that are defined as advanced by the IMF.
* p<0.1; ** p<0.05; *** p<0.01. Standard deviations clustered by currency appear in parentheses.
SOURCE: Based on IMF and Bloomberg data.

index, increased by a lower rate of 4.6 percent. In both 2022 and 2021, the "other housing expenses" component, which is included in the housing component, increased significantly (by an average of about 18 percent). The increase in this component was influenced by higher purchase tax payments (both due to the increase in the tax rate for investors at the end of 2021 and due to the increase in home prices), and by increases in the costs of agency and contract preparation, which are indexed to home prices. Even though the weight of this component in the housing component is just 4 percent, its significant increase contributed 0.8 percentage points to the increase in the housing component, and about 0.2 percentage points to overall inflation in each of 2021 and 2022.

Compared to the increase in the CPI excluding housing (meaning in real terms), the housing component increased by 1.3 percent in 2022, and the owner-occupied housing services component increased by a similar rate. These are moderate real increases compared to the period before the COVID-19 crisis. In 2016–2019, the housing index increased by an average of about 2 percent in real terms, and the owner-occupied housing services component increased by about 2.5 percent.

b. The contributions of domestic and global supply and demand to the increase in inflation

Inflation originating on the demand side is characterized by an increase in activity, while inflation originating on the supply side is characterized by a decline in activity. Therefore, central banks' response to inflation derived from supply factors is more moderate.

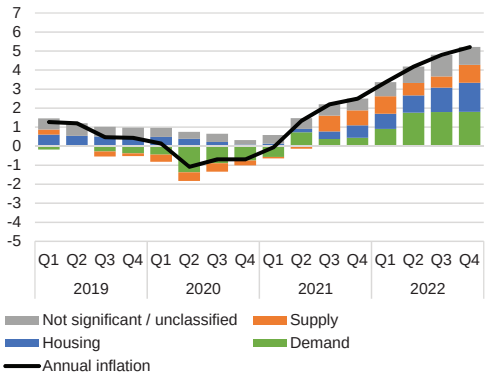
The increase in inflation in the past two years is, as stated, due to both global developments, which were largely on the supply side, and strong domestic demand. Identifying the sources for inflation increases and the distinction between supply-side and demand factors is essential for determining the suitable monetary policy response. Inflation that originates on the demand side is characterized by increased activity. As such, monetary tightening contributes to both stabilizing inflation and stabilizing activity. In contrast, inflation that originates on the supply side is characterized by a moderation of activity. As such, in dealing with it, central banks must balance restraint of prices with deepening the moderation of activity. Therefore, we examine below how much of the increase in inflation in the past two years can be attributed to supply factors, how much of it to demand factors, and what part of the supply factors originated abroad, and what part is domestic.

We identify the sources of inflation using two methods. The first analyzes prices and quantities at the level of CPI components (Box 3.1). The second is based on a structural macroeconomic model—the DSGE model developed by the Bank of Israel Research Department (Box 3.2). Both methods offer identifications of unexpected developments in the economy (shocks) by their effect on prices and quantities. As a rule, both methods identify a positive supply shock as a change that raises prices and lowers quantities, and a positive demand shock as a change that raises both prices and quantities. However, the first method is based on microeconomic data and imposes a few identification restrictions, while the second method is based on macroeconomic variables and a general equilibrium structural model with many identification restrictions.

Figure 3.6a shows a breakdown of annual inflation according to a CPI component-level analysis. According to this analysis, the increase in inflation over the past two years was due to both an increase in demand and supply factors, similar to the findings in other countries where analyses were conducted using similar methods.[9] However, in 2022, the contribution of demand increased. It should be noted that this method does not differentiate between domestic supply shocks and those originating abroad. (In this method, global price changes will be captured as supply shocks even if they originate in changes in demand abroad, because the Israeli economy is a small open economy that is influenced by foreign prices but does not influence them.)

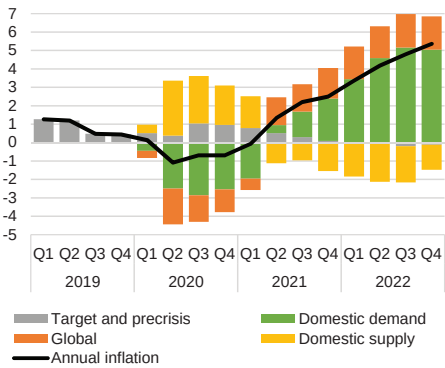
[9] See OECD (2022), "Box 1.1. Supply- and Demand-Driven Inflation in OECD Economies", *OECD Economic Outlook*, Volume 2022, Issue 2, No. 112.

Figure 3.6a
Breakdown of Inflation at the CPI Component Level, 2019–2022 (quarterly frequency, percent)



SOURCE: Based on Central Bureau of Statistics, StoreNext, and SHVA data.

Figure 3.6b
Breakdown of Inflation Using the DSGE Model, 2019–2022 (quarterly frequency, percent)



SOURCE: Bank of Israel calculations using the Research Department's DSGE model (Argov at al, 2012)..

Figure 3.6b shows annual inflation and the shocks that contributed to its development since the outbreak of the COVID-19 crisis, according to the DSGE model. This analysis makes it possible to distinguish between the effects of domestic supply and those originating in price changes abroad. First, the global factors contributed significantly to the increase in inflation in 2021. Second, the model shows that strong domestic demand began to contribute to the increase in inflation already in 2021, in view of the recovery from the COVID-19 crisis and the accommodative monetary policy and expansionary fiscal policy adopted during that period. (For more information, see the Bank of Israel *Annual Report* for 2021.) The model identifies an increase in domestic demand pressures during 2022, due to accelerated growth of domestic uses, particularly private consumption, which was accompanied by high growth of imports. (For more information see Chapter 2.) At the end of 2022, domestic demand became the predominant factor influencing inflation.

Two different analyses show that the increase in inflation in the past two years was influenced by supply factors originating abroad, but also from the recovery of domestic demand, the influence of which increased during 2022.

As stated, global factors and domestic demand contributed to increased inflation in recent years. Yet according to the model, the increase in inflation was less than would have been derived from these factors. The model attributes this to the slow adaptation of domestic prices and of wages to the inflation environment—an adaptation that is included in the group of domestic supply shocks. One of the most dominant such shocks is a shock that moderates workers' wages, which the model identifies according to the deterioration of real wages (see Chapter 2). A gradual adaptation of wages to inflation enables firms to partially and gradually absorb the higher costs of imported inputs, while rolling some of them over to workers' wages. These factors, which are reflected in the group of domestic supply factors, actually made a moderating contribution to inflation in the past two years. However, their restraining effect lessened at the end of 2022, such that inflation began responding more powerfully to the increase in domestic demand and to global inflation.

In conclusion, despite methodological differences between the methods, both show that the increase in inflation in 2021 was influenced by supply shocks (originating abroad) and by the recovery of domestic demand. In 2022, the effect of domestic demand increased, and according to the DSGE model, it even became the dominant factor in contributing to inflation.

BOX 3.1: BREAKING DOWN THE SUPPLY AND DEMAND EFFECTS AT THE CPI COMPONENT LEVEL

This box presents an estimation of the contribution of supply and demand factors to inflation, based on the work of Shapiro (2022a, b), a method that was implemented by the OECD regarding a number of countries (OECD, 2022). The method proposes an identification of unexpected changes (shocks) to prices and quantities of product groups. Shocks are classified as demand or supply based on the distinction of whether the changes in product prices were in line with an increase or decrease in the consumed quantity of those products. The identification is at the CPI subcomponent level, and is based on an estimation of supply and demand equations in a vector autoregression (VAR) model. The shocks in the model were classified as supply or demand shocks according to the direction of their effect on prices and quantities, but only if the effect was statistically significant. (The rest of the shocks were classified as insignificant.) For details on the estimated model, see Shapiro (2022a, b).

The database included price changes at the CPI subcomponent level, calculated by the Central Bureau of Statistics. These data were merged with changes in total expenditures on matching product groups according to credit card expenditure data from SHVA and data from StoreNext. The changes in consumed quantities were derived by deducting the change in the component price from the change in total expenditure on it.

The model was estimated on price and quantity data of 72 subcomponents in the CPI, the combined weight of which exceeds 90 percent of the CPI excluding housing. The housing component and a number of other subcomponents were not included in the analysis because we could not build a quantitative index for them using this method. A number of additional subcomponents were omitted because their prices are not set under market conditions by supply and demand factors (for instance, municipal tax and other payments, or products under price control). In total, the database covered the vast majority of the consumption basket excluding housing, and included information on price and quantity changes at the monthly level from January 2016 to December 2022.

Figure 3.6a shows the breakdown of inflation using this method, with the contributions converted to quarterly frequency in order to compare them with the breakdown of inflation from the DSGE model.

References:

Shapiro, A. (2022a), "A Simple Framework to Monitor Inflation", Federal Reserve Bank of San Francisco Working Paper, 2020-29.

Shapiro, A. (2022b), "How Much do Supply and Demand Drive Inflation?", *FRBSF Economic Letters* 2022-15 (June 2022).

OECD (2022), "Box 1.1. Supply- and Demand-Driven Inflation in OECD Economies", *OECD Economic Outlook*, Volume 2022 Issue 2, No. 112.

BOX 3.2: BREAKDOWN OF THE SUPPLY AND DEMAND EFFECTS USING A DSGE MODEL

The Bank of Israel Research Department's Dynamic Stochastic General Equilibrium (DSGE) model (Argov et al. 2012) is a macroeconomic structural model of the Israeli economy. The model enables an identification of the shocks that contribute to the development of inflation (historical decomposition), based on the common movements of many macroeconomic variables. The model chooses the combination of shocks that are most likely to have created the common movement of the observed variables, given the model's structure and the parameters estimated for it.

The model includes many shocks, but for the purpose of this analysis, they were classified into three categories. First, the shocks that affect global variables in the model were put into one group. Then, domestic shocks were put into supply or demand groups based on the response of domestic inflation and GDP to those shocks (the immediate effect according to the impulse response function). In particular, a shock that affects domestic inflation and GDP in the same direction was classified as a demand shock, while a shock that affects the two variables in opposite directions was classified as a supply shock. Figure 3.6b shows the total contribution of the shocks in each group to the development of inflation since 2020.

References:

Argov, Eyal, Emanuel Barnea, Alon Binyamini, Eliezer Borenstein, David Elkayam, and Irit Rozenshtrom (2012). "MOISE: A DSGE Model for the Israeli Economy", Bank of Israel Research Department Discussion Papers Series 2012.06.

c. The risk of persistence of high inflation

The increase in inflation began, as stated, with an increase in the tradable goods component due to global developments, and then spread to the nontradable components (Figure 3.1). Basically, inflation gradually became broader and encompassed a growing number of CPI components. As an indication of the broadness of inflation, Figure 3.7 shows a breakdown of the variance of inflation into two components: the variance of the CPI components, and their covariance.[10] The breakdown shows that the increase in inflation over the past two years was broad, and was due to price

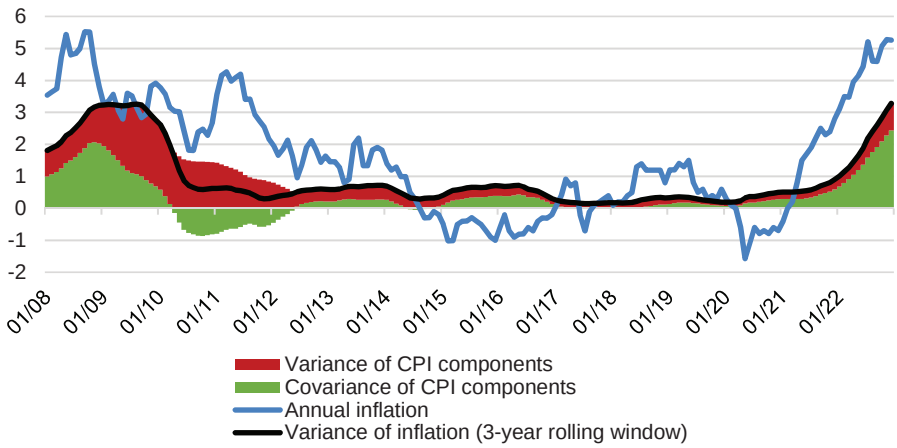
The increase in inflation in the past two years was broad, and encompassed many components.

[10] The variance of inflation was calculated on a three-year rolling sample, and broken down according to the following equation: $Var(\pi_t) = \sum_i Var(w_{i,t}\pi_{i,t}) + \sum_{i \neq j} cov(w_{i,t}\pi_{i,t}, w_{j,t}\pi_{j,t})$

where $\pi_{i,t}$ is inflation in component i in the three years ending in month t, and $w_{i,t}$ is that component's weight. The first part of the breakdown captures the variance of CPI components, and the second part captures their covariance. The analysis is based on the breakdown presented in a BIS report that also shows an increase in the covariance of inflation components in various countries. See Bank for International Settlements (2022), "Inflation: A Look Under the Hood", *Annual Economic Report*, Chapter 2, June 2022 (pp. 41–73).

increases in many components, as seen by the increase in the covariance of the CPI components.

Figure 3.7
Breakdown of the Variance of Inflation, January 2008–December 2022
(percent)



SOURCE: Based on Central Bureau of Statistics data.

An increase in inflation that encompasses many components may change the inflation dynamics and make it more persistent. Such a change could take place if, for instance, wages are indexed to inflation.

As inflation increases and becomes broader, there is greater risk that the high inflation will become more persistent, such that the cost of mitigating it (in terms of the impact on economic activity) will be higher. More significant price increases, encompassing more goods and services, may make businesses and households more aware of inflation. Businesses will be more likely to include inflation in the pricing of their goods and services, workers will include it in their wage demands, and landlords will include it in the rent that they demand. Thus, price increases that have already taken place will feed additional price increases, and inflation will become more persistent. (For more details, see Box 1.2 in Chapter 1.) Moreover, if individuals believe that inflation will remain high in the future, they may demand compensation for it in the present in order to minimize its future impact, thereby contributing to an acceleration of inflation.[11]

One of the main mechanisms through which the dynamic of inflation may change is, as stated, the response of labor wages. Price increases due to global factors, such as what happened in the past two years, erode households' purchasing power. To moderate that erosion, workers may increase their wage demands. From the standpoint of domestic firms, this means an additional increase in production costs, beyond the direct increase of imported input prices, such that the firms must further increase the

[11] Chapter 2 of the International Monetary Fund Report from October 2022 discusses the impact of the nature of inflation expectations (adaptive or rational) on the link between wages and inflation: See International Monetary Fund (2022), "Wage Dynamics Post-COVID-19 and Wage-Price Spiral Risks", *World Economic Outlook*, Chapter 2, October (pp.51–69).

prices of the goods and services they provide in order to maintain their profitability. Wage increases therefore feed increases in inflation, which then leads to further wage increases.

The risk in this feedback between wages and inflation is called the "wage-inflation spiral", and discussion of it has recently been renewed at several central banks and international institutions.[12] Wages may be indexed to inflation officially as part of wage contracts with indexation clauses, or unofficially by raising workers' wage demands. Either way, it affects the dynamic of inflation.

Wages did not contribute to the acceleration of inflation this year.

So far, it seems that in Israel, the risk of a wage-inflation spiral has not come to pass. Wages per employee post did increase in nominal terms, but the increase did not match the rise in consumer prices. Thus, on average, salaried employees were not compensated for the full increase in the price of the consumption basket. However, as explained in Chapter 5, the increase in the average wage varied between the private and public sectors. While wages in the public sector eroded significantly in real terms, the increase in private sector wages was similar to the increase in the Consumer Price Index, mainly due to wage increases in the export industries. The wage increases in these industries do not directly affect the costs of production for the domestic economy—and therefore have no direct impact on inflation. Moreover, from the standpoint of domestic producers, real wages increased less than labor productivity, such that the GDP labor share declined (see Chapter 2).[13] Wages are therefore not among the causes of accelerated inflation.

Inflation expectations from all sources and for all ranges increased this year, but for the most part they did not significantly exceed the upper bound of the inflation target.

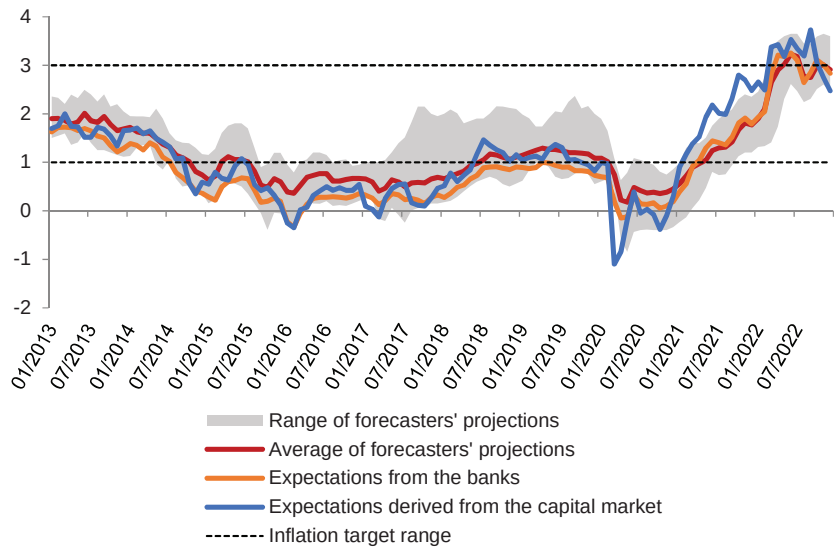
The development of inflation expectations provides strong evidence that high inflation has so far not taken root significantly. While one-year inflation expectations increased in the first half of 2022 to about 3–3.5 percent, they moderated to 2.5–3 percent later in the year, even though actual inflation increased to above 5 percent during that period (Figure 3.8).[14] Thus, despite the increase in the inflation environment, market participants maintained the assessment throughout the year that inflation would moderate and would return to around the upper bound of the target range (3 percent) within a year. Expectations for ranges between the first and second years, and between the second and third years, were also within the target range for most of the year, which also shows that the public did not perceive the increased inflation beyond the target range as persistent (Figure 3.9). Moreover, expectations for longer ranges remained anchored within the target range. The fact that expectations for all ranges are within the target range shows, among other things, that the public believed that the Bank of Israel would act to restrain inflation and maintain it within the target range.

[12] Bank for International Settlements (2022), "Inflation: A Look Under the Hood", *Annual Economic Report*, Chapter 2, June 2022 (pp. 41–73); International Monetary Fund (2022), "Wage Dynamics Post-COVID-19 and Wage-Price Spiral Risks", *World Economic Outlook*, Chapter 2, October (pp.51–69).

[13] However, in an open economy such as Israel's, the GDP labor share is only partly connected to the Consumer Price Index. While it includes the GDP labor share of the export industries, which does not directly affect the CPI, it is not directly connected to changes in import prices, which are included in the CPI.

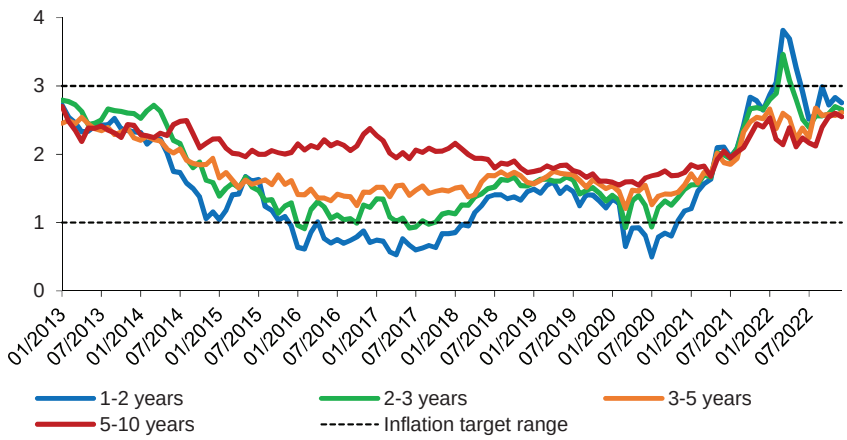
[14] For more details on estimations of inflation expectations, see Bank of Israel (2022), *Statistical Bulletin.*

Figure 3.8
One-Year Inflation Expectations from Various Sources, January 2013–December 2022 (monthly average, percent)



SOURCE: Bank of Israel calculations.

Figure 3.9
Medium- and Long-Term Inflation Expectations, January 2013–December 2022 (monthly average, percent)



SOURCE: Bank of Israel calculations.

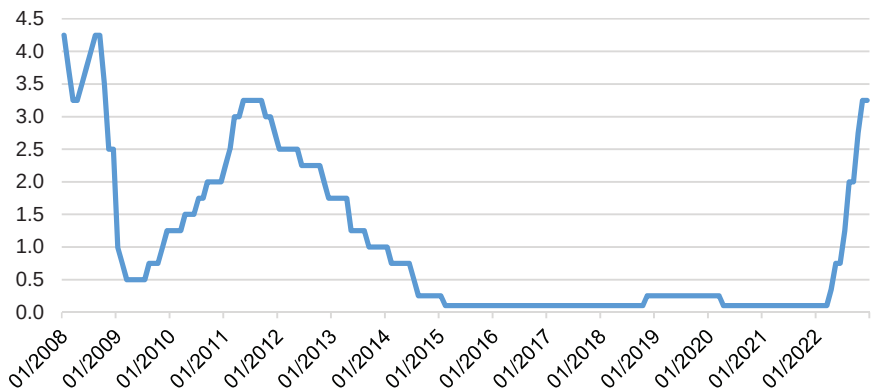
2. MONETARY POLICY

a. Policy measures

In 2022, the Monetary Committee raised the Bank of Israel interest rate significantly—from 0.1 percent at the beginning of the year to 3.25 percent at year-end.

During 2022, monetary policy dealt with an increase of inflation beyond the target range, in view of strong economic activity. In order to restrain inflation, the Monetary Committee raised the interest rate rapidly during the year. Until March 2022, the Bank of Israel interest rate remained 0.1 percent. At the beginning of April, it was raised to 0.35 percent. Since then, the rate was raised at each decision by 40–75 basis points, reaching 3.25 percent at the end of the year. (The interest rate increases continued into 2023.)[15] These interest rate increases came after about seven years in which the rate remained near zero, and brought the rate to its highest point since 2010 (Figure 3.10).

Figure 3.10
Bank of Israel Interest Rate, January 2008–December 2022 (percent)



SOURCE: Bank of Israel.

The interest rate increases in the first half of 2022 came after the Bank of Israel stopped using special monetary accommodation tools in 2021.

The interest rate increases in the first half of 2022 were further to the measures that the Bank of Israel adopted in 2021 to reduce monetary accommodation. During the COVID-19 crisis, the Bank of Israel operated special programs to support economic and financial activity. These were stopped gradually beginning in 2021, with the recovery of the Israeli economy from the crisis. The Bank of Israel was among the first in the world to stop using special monetary accommodation tools. Repo transactions with institutional investors were stopped at the beginning of 2021. Later in the year, the loan program to banks[16] was stopped, as were government and corporate bonds

[15] In parallel with the interest rate decision in July, the Bank of Israel widened the band around the Bank of Israel interest rate in the credit window and in the deposits window for commercial banks from ±10 basis points to ±50 basis points.

[16] In 2022, loans issued during the programs were not repaid, and the banks continued to provide collateral for them.

purchases later on.[17] Foreign exchange purchases continued throughout 2021, totaling about US$ 35 billion, and were stopped in 2022.

The measures taken to move away from accommodative policy, which began in 2021, were in response to rising inflation, which reached 2.8 percent at the end of 2021. The upward trend of inflation continued in 2022, but at the beginning of the year, the Monetary Committee decided to leave the interest rate at 0.1 percent, even when inflation reached the upper bound of the target range.[18]

At the beginning of the year, the Monetary Committee chose to conduct the monetary tightening process gradually, believing that the supply-side causes of increased inflation were temporary, and out of concern regarding the continued economic recovery from the COVID-19 crisis.

There were a number of reasons for the decision to leave the interest rate at its low level at the beginning of the year. First, even though the recovery from the COVID-19 crisis began in 2021, the Monetary Committee's assessment at the beginning of 2022 was that the economy had not yet recovered completely from the crisis. This assessment was supported by the outbreak of the "Omicron" variant of the disease in January, and indications of economic contraction in the first quarter of the year. Second, the assessment in Israel and abroad was that most of the increase in inflation was due to disruptions in the global supply chains and an increase in commodity prices—phenomena that were expected to moderate within a short time, which would reduce the inflationary pressures. Third, at the beginning of the year, the shekel was historically appreciated in terms of the nominal effective exchange rate, which created difficulties for the tradable sector. Increasing the interest rate before the major central banks (chiefly the Federal Reserve) did so would lead to a further appreciation of the shekel, and perhaps to a negative impact on economic activity. In view of doubts regarding the continued economic recovery, and in view of the perception that the increase in inflation was, until then, mainly due to temporary supply shocks, the Committee decided at the beginning of the year to be extra cautious and to implement monetary tightening gradually.

The assessment of the situation in the real economy changed during the year, as National Accounts data showed stronger activity than previously assessed. (See Chapter 2.) But the most significant change was in the nominal picture, with the outbreak of the war between Russia and Ukraine at the end of February. (Box 3.3 analyzes the changes in the inflation environment in 2022 relative to previous forecasts.) The war worsened supply disruptions, and particularly led to higher food

[17] During 2022, there were repayments of only small amounts on bonds purchased in previous years, since the program focused on relatively long-term bonds. As such, the repayments did not contribute significantly to monetary tapering.

[18] At the interest rate decision in February 2022 (the last one where the rate was set at 0.1 percent) the Monetary Committee was aware of the annual inflation figure for January (3.1 percent). One-year inflation expectations from the various sources ranged from 2.0 to 2.7 percent. Prior to the decision, the fourth-quarter growth figure for 2021 was received. It was higher than the previous assessment. In view of these developments, the Monetary Committee's stated assessment was that in the coming months, conditions would allow for the start of a gradual process of raising the interest rate. The first increase in the interest rate took place in April, when the Monetary Committee had the inflation figure for February, which was 3.5 percent annualized, and one-year inflation expectations were in the range of 3.0–3.5 percent. (See the press releases on the interest rate decisions of February 21 and April 11, 2022, and the accompanying economic data.)

and energy prices. As the war continued, there was growing concern among many central banks that continued supply disruptions would lead to a general change in inflation dynamics, particularly if a wage-inflation spiral developed. The concern was that there would be a transition to a dynamic of high and persistent inflation, in which changes in relative prices (such as an increase in commodity prices) would filter down to other prices, and inflation would remain high even after the basic force affecting the relative price would abate. (For more information, see Box 1.2 in Chapter 1.) This concern was particularly significant in economies that had experienced surplus demand, such as the US economy.

The outbreak of war between Russia and Ukraine at the end of February, and its continuation, made it clear to policy makers around the world that the supply factors were expected to influence inflation for a longer time. Therefore, an accelerated process of interest rate increases began in Israel and around the world in order to rein in inflation.

To nip these processes in the bud, many central banks began significant tapering and sending hawkish messages regarding their determination to return inflation to the target.[19] However, at this stage, inflation in many countries, led by the US, had already significantly exceeded the central bank targets. Many of them therefore chose to increase the interest rate rapidly—a process that became known as "front-loading". In Israel as well, the process of raising the interest rate that began in April was accelerated, even though inflation in Israel was lower than in other countries (Figure 3.2). The interest rate increases in Israel were at significant rates, mostly beyond market expectations, and were intended to quickly bring the interest rate to the level necessary to restrain inflation, according to assessments at that time.[20]

A rapid increase of the interest rate serves a number of purposes. First, it lowers inflation more rapidly than a gradual interest rate increase does. For instance, an analysis using the Bank of Israel Research Department's DSGE model shows that the rapid interest rate increase in 2022 is expected to restrain inflation by an aggregate of about 1.5 percentage points in 2022 and 2023, relative to a scenario in which the interest rate would be raised gradually to 3.25 percent by the end of 2023.[21] Thus, the accelerated increase of the interest rate contributes to anchoring inflation expectations and reducing the risk of an inflationary spiral developing. Second, a BIS study found that historically, rapid interest rate increases led to a "soft landing" of activity more than gradual and prolonged increases.[22] In contrast, a policy of raising interest rates rapidly also involves risks. Since there is a lag until the increase affects economic activity and inflation, the central bank may raise the rate to a level that would later turn out to be too high, leading to an economic slowdown beyond what was necessary to

[19] See, for instance, speeches by the Federal Reserve Chairman and the President of the European Central Bank: Jerome Powell (2022). "Monetary Policy and Price Stability", speech at the "Reassessing Constraints on the Economy and Policy" symposium, Jackson Hole, Wyoming, August 26, 2022; Christine Lagarde (2022). "Monetary Policy in the Euro Area", Karl otto Pohl Lecture, Frankfurt, September 20, 2022.

[20] See the Bank of Israel's *Monetary Policy Report* for the second half of 2022.

[21] The effect on inflation was estimated by comparing two scenarios. In the first scenario, the interest rate was raised in accordance with the actual pace of increase and left at 3.25 percent until the end of 2023. In the second scenario, the interest rate was increased more gradually from April 2022, reaching 3.25 percent only at the end of 2023.

[22] F. Boissay, F. De Fiore, and E. Kharroubi (2022). "Hard of Soft Landing?" Bank for International Settlements Bulletin (No. 59).

return inflation to the target. In addition, sharp changes in the interest rate contribute to volatility in the prices of financial assets and make it difficult for households and businesses to adjust their credit and asset portfolios.[23] In Israel, the acceleration of the interest rate increases was made possible, despite the macroeconomic developments abroad and the volatility in asset prices, due to the strong state of the economy and of the financial system.

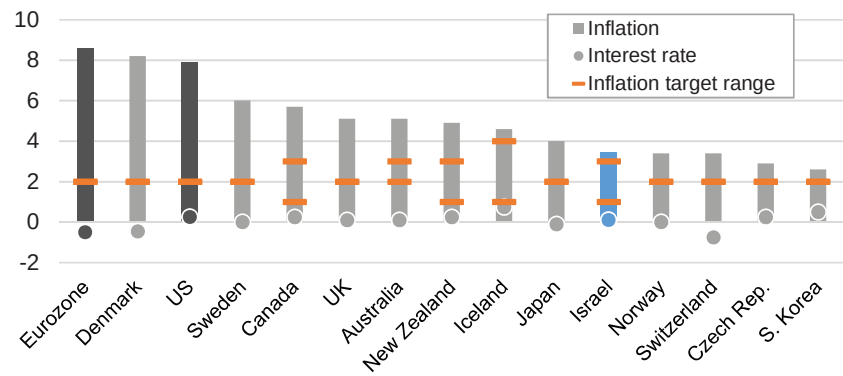
b. Monetary policy compared to other countries

In Israel, the interest rate was first increased in April, when inflation only slightly exceeded the target range, while interest rate increases around the world began when inflation significantly exceeded the central bank targets.

As stated, inflation increased in the past two years in many countries, which motivated the central banks to reduce the extent of monetary accommodation. Most central banks began raising their interest rates when inflation significantly exceeded the targets (Figure 3.11). Specifically, in the US and in Europe interest rate raises began when inflation was at about 8 percent. In contrast, the Bank of Israel started raising its interest rate when inflation exceeded the target slightly, at 3.5 percent.

Once the process of raising the interest rate began around the world, it was executed rapidly. The increases were led by the United States, which experienced a significant increase in inflation and strong domestic demand, reflected in a tight labor market. These factors led the Federal Reserve to accelerate the interest rate increases during the year, aiming to restrain surplus demand in the economy, and inflation together with it. In contrast, the state of economic activity in Europe was more fragile, due to the war between Russia and Ukraine that began early in the year and the sanctions imposed on Russia as a result. These led to a significant increase in inflation, mainly from the supply side.

Figure 3.11
Inflation and Interest Rate Levels the Month Before the First Interest Rate Increase (percent)



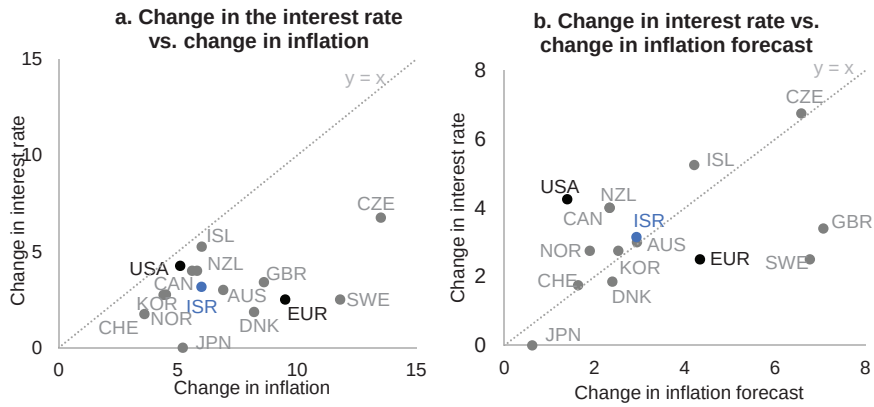
The interest rate in Japan was not raised until the end of 2022. The interest rate and inflation shown for Japan are for December 2022.
SOURCE: Based on data from the central banks.

[23] For a discussion of the advantages and disadvantages of front loading, see P. Cavallion, G. Cornelli, P. Hordahl, and E. Zakrajsek 92022), "'Front-Loading' Monetary Tightening: Pros and Cons", *Bank for International Settlements Bulletin*, (No. 63).

The central bank's reaction to the increase in inflation was more moderate in Israel than in the US, but stronger than in Europe.

Figure 3.12a shows the change in central bank interest rates in the advanced OECD countries in 2021 and 2022, compared to the change in inflation during the same period. Despite the significant interest rate increases in many countries, they did not catch up to the rise in inflation. However, monetary policy is forward-looking, and therefore reacts to changes in inflation expectations. According to the "Taylor Principle", central banks tend to raise the interest rate more than the change in expected inflation, in order to raise real interest rates and restrain inflation.[24] Figure 3.12b shows that in many of the comparison countries, the interest rate increases in the past two years were in accordance with this principle. The policy reaction in the US during the reviewed period was particularly strong relative to the change in expectations, because of the strength of demand in the US economy. On the other hand, the European Central Bank responded more moderately to the increase in inflation expectations, since in Europe, inflation increased mainly due to supply factors. In Israel, the policy reaction was moderate relative to the American reaction, but stronger than the European one, partly because the inflation level in Israel was lower than in the comparison countries throughout the entire year (Figure 3.2).

Figure 3.12
Change in the Central Bank Interest Rate Against the Change in Inflation and the Forecast for 2023, December 2020–December 2022 (percentage points)



The sample includes the OECD countries defined as advanced economies by the International Monetary Fund. Figure b shows the change in the IMF's inflation forecast for 2023 between October 2020 and October 2022.
SOURCE: Based on data from the OECD, the IMF, and the central banks.

c. The extent of monetary accommodation or tightening

As described above, the Monetary Committee raised the Bank of Israel interest rate significantly in 2022, from 0.1 percent at the beginning of the year to 3.25 percent at the end of the year. This was in addition to ending the special programs during 2021. In order to examine the extent of monetary accommodation or tightening derived from

[24] The Taylor Principle relates to the public's inflation expectations, but the Figure shows the International Monetary Fund's inflation forecasts, due to the availability of data on a broad sample of countries.

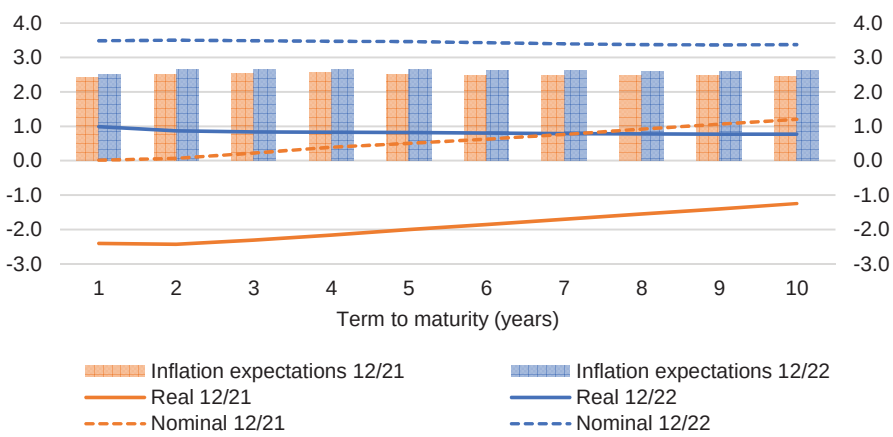
policy measures, it is common to look at the development of inflation expectations and yields in the short and medium terms, which are relevant to the public's consumption and investment decisions.

The real interest rate at the end of 2022 was positive throughout the yield curve, after it was negative throughout the curve in 2021.

Figure 3.13 shows that inflation expectations at the end of 2022 were similar to expectations at the end of 2021, at about 2.5 percent in the range of 1–10 years. However, at the end of 2022, the nominal and real yield curves were significantly higher than they were at the end of 2021.[25] In particular, the real interest rate at the end of 2022 was positive along the entire curve, after being negative along the entire curve in 2021. This means that the interest rate environment at the end of 2022 was tighter than in the previous year. In addition, the interest rate curves flattened. Since the nominal and real interest rates generally include a positive term premium, the flattening of the curves is a hint that, net of these premia, there is an expectation of future moderation of the interest rate. Such a moderation is consistent with a forecast of an economic slowdown, which will require a lowering of the interest rate later on.

Figure 3.14 shows that over time, the real five-year yield began to increase at the beginning of 2022, in parallel with the upward trend of yields in the US, which reflects the process of reducing the accommodative stance of monetary policy. However, the yield reached positive territory only in the fourth quarter of the year. The reduction in the accommodative stance began showing its effect mainly in the second half of 2022, in a slowdown in the growth of household and business credit (as described in Chapter 4) and in moderating surplus demand in the labor market (as described in Chapter 2).

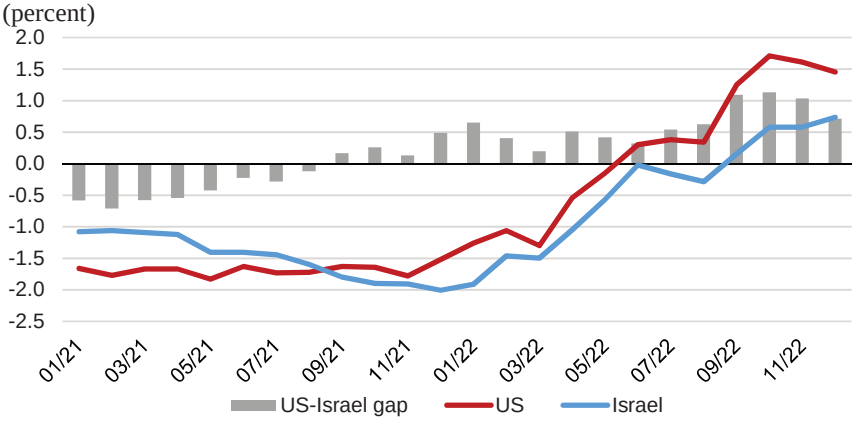
Figure 3.13
Spot Nominal and Real Yield Curves and Inflation Expectations
(percent)



SOURCE: Bank of Israel.

[25] The Bank of Israel's method of calculating the yield curves is detailed in Ana Brodesky and Nadav Steinberg (2011), "Improving the Yield Curve Estimation Model Implemented at the Bank of Israel", Periodic Papers 2011.01, Bank of Israel Research Division.

Figure 3.14
Real Five-Year Constant Maturity Yields, January 2021–December 2022
(percent)



SOURCE: Bank of Israel and FRED.

3. THE MONETARY BASE AND MONETARY AGGREGATES

Interest is the price of money—the alternative cost of holding liquidity. As such, changes to it, in addition to changes in economic activity, have an impact on the demand for liquidity. When the nominal interest rate serves as a policy tool, the central bank sets a completely flexible money supply at its declared interest rate, and the monetary base—the total of banknotes and coins in circulation plus the commercial banks' demand deposits with the Bank of Israel[26]—is determined by the demand for liquidity at the central bank's declared interest rate.

a. The monetary base

The Bank of Israel increased the pace of Makam issuances this year, thereby contributing to the improved pass-through from the monetary interest rate to alternatives available to the saving public.

The monetary base is affected by both flows that are not under the Bank of Israel's control, such as government accounts, and flows that are under its control, such as foreign exchange and bond purchases and *Makam* issues. The Bank of Israel absorbs or injects liquidity in order to meet the demand for the monetary base in accordance with the Bank of Israel interest rate. It adjusts the monetary base to the interest rate, taking into account the total of other flows, through interest-bearing deposits that it offers the banks by tender, which are not included in the monetary base, and by issuing *Makam.*

During 2022, the monetary base grew by about NIS 6 billion (Table 3.4)—growth of 3 percent relative to December 2021 (Table 3.5). While this growth was lower than it was in the past two years (growth of about 26 percent in 2020 and about 13 percent in 2021), it was similar to growth in the years prior to the COVID-19 crisis.

Government activity injected about NIS 24 billion in 2022, and against that the Bank of Israel absorbed about NIS 18 billion. As part of that absorption, the bank of

[26] The banks are obligated to deposit money in demand deposits at the Bank of Israel as part of their liquidity requirements.

Israel increased the pace of *Makam* issuances in the fourth quarter of the year. The volume of issuances was derived from demand for *Makam* in view of the interest rate increases, and it contributed to an increase in the pass-through from the Bank of Israel interest rate to the interest rate available to the public and for all tradable financial assets and alternatives available to the saving public.[27]

b. The monetary aggregates

In view of the increase in the Bank of Israel interest rate, the public reduced its demand deposits, while interest-bearing deposits were significantly expanded.

The M1 monetary aggregate—the amount of money—includes cash held by the public and the public's demand deposits at the banks. The M1 aggregate declined by about 10 percent in 2022, after consistent increases in previous years (Table 3.5). The decline in M1 is a result of the decline in the public's demand deposits, while cash continued to increase at a pace similar to the precrisis rate. (In 2020 and 2021, the volume of cash in the hands of the public increased exceptionally due to the COVID-19 crisis. For more details, see the Bank of Israel Annual Reports for those years.) In parallel with the decline in demand deposits, there was a significant expansion of 85 percent in interest-bearing deposits of up to one year in view of the increase in the Bank of Israel interest rate. In the near-zero interest rate environment that had typified the economy in previous years, it is reasonable that some of the public's savings would be kept in demand deposits. The increase in the monetary interest rate in 2022 led to an increase in the interest on deposits (a development that is analyzed in Box 4.2 in Chapter 4), making them a more attractive savings option than in the past, and particularly more attractive than demand deposits. Despite the change composition between demand deposits and interest-bearing deposits, the aggregate that includes M1 and unindexed deposits of up to one year increased at a similar pace to the precrisis years.

[27] In view of the increased issuances of *Makam* in the fourth quarter, the gap between the interest rate on the 1-year *Makam* and the interbank (Telbor) rate narrowed from 72 basis points in September 2022 to 20 basis points in December.

Table 3.4
Sources of change in the monetary base, 2018–22
(NIS billion)

	2018	2019	2020	2021	2022	2022 Q1	2022 Q2	2022 Q3	2022 Q4
1. Injections from the government and the Jewish Agenc	1.81	7.17	21.39	-6.54	24.16	-33.90	-3.53	28.71	32.87
of which : the government	1.81	7.17	21.39	-6.54	24.16	-33.90	-3.53	28.71	32.87
2. Foreign exchange conversions[a]	11.69	13.67	72.13	112.14	1.10	1.11	0.00	0.00	0.00
of which: Bank of Israel	11.67	13.68	72.14	112.14	1.11	1.11	0.00	0.00	0.00
3. Total (1+2)	13.49	20.84	93.53	105.59	25.26	-32.80	-3.53	28.71	32.87
4. Bank of Israel injections	-8.69	-16.33	-66.14	-78.22	-17.62	32.25	3.90	-16.02	-37.75
of which : Monetary loan	0.00	0.00	19.56	20.44	0.00	0.00	0.00	0.00	0.00
Makam	-15.77	-11.63	33.08	-27.97	-94.10	-10.93	-8.64	-10.20	-64.33
Swap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bank term deposits	6.00	-6.00	-171.00	-109.00	71.00	43.00	12.00	-7.50	23.50
Interest[b]	0.21	0.44	0.36	0.41	5.04	0.11	0.46	1.55	2.93
Bond purchases	0.00	0.00	49.53	38.51	-0.32	-0.06	-0.11	-0.07	-0.08
Repo	0.00	0.00	1.50	-1.40	-0.10	-0.10	0.00	0.00	0.00
5. Total change in the monetary base	4.93	4.78	26.92	27.36	5.71	-0.48	0.39	10.55	-4.75

[a] This item includes, among other things, receipts (payments) in foreign exchange that the Bank of Israel and the government receive from (transfer to) the private sector, for instance income tax. These payments do not change the monetary base. They appear in the section on government injections, and in this section with the opposite sign.
[b] Excluding *Makam.*
SOURCE: Bank of Israel.

Table 3.5
Rate of change in the monetary aggregates, 2018–22 (percent)

	0	1	2	1+2=3	4	5	6	3+4+5+6=7
	Monetary base[a]	**Cash held by the public**	**Demand deposits**	**M1[b]**	**Term deposits up to 3 months**	**Term deposits of 3 months to 1 year**	**SRO[c]**	**Total[d]**
	(Average in December compared to average the previous December)							
2018	6.0	6.6	13.6	12.2	-15.6	-4.3	1.1	2.0
2019	2.9	1.8	5.8	5.1	-4.0	33.2	7.0	6.3
2020	25.8	23.3	30.7	29.4	24.7	12.2	25.9	26.0
2021	12.6	6.9	25.2	22.0	-3.6	12.6	23.8	17.5
2022	3.0	6.0	-13.2	-10.3	35.1	85.0	-7.2	5.0
	(Quarterly average compared with the average of the previous quarter							
2022								
Q1	2.1	0.2	5.9	5.0	-0.8	5.9	4.1	4.1
Q2	2.2	2.0	3.1	2.9	8.3	5.3	-0.5	3.0
Q3	0.2	1.7	-5.1	-4.1	6.3	34.6	-0.8	1.7
Q4	-0.6	0.8	-9.7	-8.1	14.6	18.6	-3.9	-0.7

[a] Total banknotes and coins in circulation and current deposits by the commercial banks with the Bank of Israel.
[b] M1 = cash and demand deposits.
[c] Self-renewing overnight deposit - a liquid daily deposit.
[d] M1+SRO+unindexed deposits of up to one year.
SOURCE: Bank of Israel and Central Bureau of Statistics data.

BOX 3.3: ANALYSIS OF THE INCREASE IN THE INFLATION ENVIRONMENT USING THE "INFLATION AT RISK" MODEL

Introduction

This box examines the development of the inflation environment in the past two years, as reflected in changes in actual inflation and one-year forecasts. In particular, it examines the development of the forecast obtained from the Inflation at Risk (IaR) model, which provides forecasts for a variety of inflation scenarios, and not just one main scenario as most forecast models do. The model thus allows for a more comprehensive assessment of changes in the inflation environment and in the risks to its development.

Forecasts for 2022 prepared using the model on the basis of data from 2021 showed upward movement in the inflation forecast distribution, with the higher tail widening. This means that the model identified an increase in the inflation environment and in the risks of high inflation. Actual inflation in 2022 came out in the higher tail of the model's forecast distribution. This means that the increase in inflation in 2022 was a realization of an unexpected event that was relatively anomalous in its intensity. The increase in

the likelihood of higher inflation, which the model reflected, and the realization of high actual inflation, were in line with similar assessment from other sources that formed a background for policy decisions, as discussed in this Chapter.

The forecast of inflation scenarios using the Inflation at Risk model

Most models provide a forecast of one main scenario for the development of inflation—either the most likely scenario or the average scenario. However, in practice, inflation may develop differently due to unexpected economic changes. The assessment of various inflation scenarios and the probability of their realization enables a broader view of the inflation environment and of the various risks to its development.

Therefore, the Bank of Israel Research Department developed an "Inflation at Risk" (IaR) model that provides forecasts of various possible inflation scenarios. Formally, the model provides a forecast in the form of the distribution of expected inflation in one year.

An earlier version of the model was presented by Gurkov and Zohar (2022b), who used a standard Phillips Curve model to forecast the distribution of future inflation using quantile regressions, similar to common models for other countries (Banerjee et al. (2020); López-Salido and Loria (2020)).[1] This box uses a similar method, but the explanatory variables were chosen to improve the quality of the model's forecast according to tests presented by Gurkov and Zohar (2022a, b). The current model estimates the distribution of one-year inflation forecasts, given three explanatory variables: actual inflation, the nominal effective exchange rate, and imported inflation (which weights inflation in the US and in Europe and the change in the prices of oil and of commodities excluding energy).

The IaR model's forecast and actual inflation

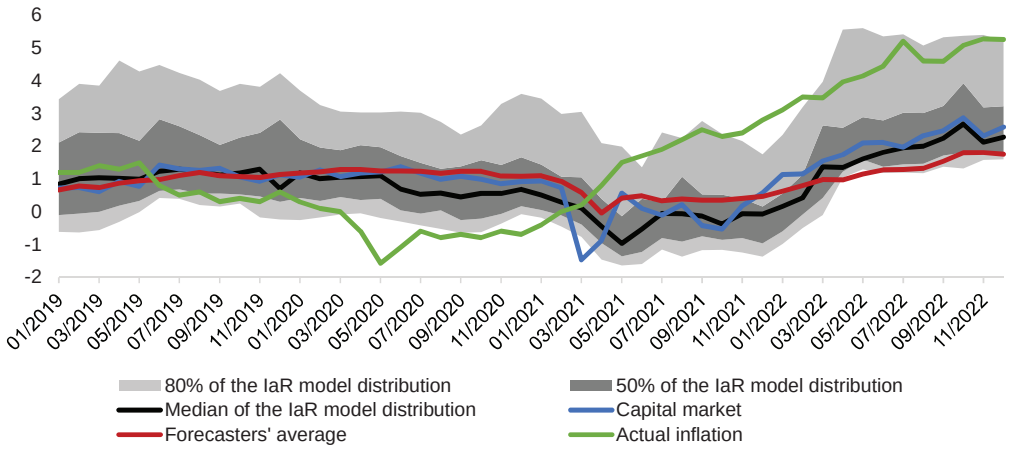
Figure 1 shows the median forecast of the IaR model, and shaded areas that capture 50 and 80 percent of the forecast's distribution.[2] By way of comparison, the Figure also shows forecasts from two additional sources: the capital market (forecasts derived from the Bank of Israel yield curve), and the average projections of professional forecasters. The forecast horizon of all the forecasts is one year ahead, and they are shifted one year back to be comparable with actual inflation.

The Figure shows that in the forecasts for 2022, which were prepared during 2021, the median of the IaR model increased, together with the increase in the distribution of the entire forecast. For instance, at the end of 2020, the model predicted an 80 percent probability that inflation in one year would be between -1.4 and 1.8 percent. At the end of 2021, the model attributed the same probability to a scenario in which inflation in one year would be between 1.6 and 5.2 percent. This means that the probability of high inflation scenarios increased. At the same time, the extent of uncertainty increased, reflecting an increase in the probability of high inflation scenarios, as seen in the widening of the upper shaded areas in the 2022 forecast. The changes in the forecast distribution from the IaR model during this period were mainly due to the increase of inflation abroad.

[1] A similar model that estimates the distribution of the GDP growth forecast given macrofinancial variables is brought in Gurkov and Zohar (2022a).

[2] Out-of-sample forecasts in an expanding window in which the model is estimated on a sample beginning in 2007 and ending in period t, which provides a forecast of inflation between period t and period t+12.

Figure 1
Annual Inflation Compared to 12-Month Forecasts Beforehand, January 2019–December 2022 (percent)



SOURCE: Based on Gurkov and Zohar (2022b).

Despite the changes in the forecast distribution, the main scenario from the model (the median of the distribution) indicated inflation of about 2 percent. This means that the model identified an increase in the inflation environment, but its assessment was that inflation would most likely be around the midpoint of the target range. Forecasts from other sources also increased but remained close to the midpoint of the target range during that period, since the inflation increase at that time was mainly attributed to supply pressures that were expected to subside within a short time. At the end of 2021, these assessments formed the background for the decisions to taper monetary accommodation by stopping the use of the special tools, but not to increase the interest rate at that stage.

However, the assessments of moderating inflation were proven wrong, and as Figure 1 illustrates, inflation in 2022 was higher than expected by all sources. This was partly due to the worsening supply disruptions due to the Russia-Ukraine war that broke out early in the year, which was obviously not expected when the forecasts were prepared. According to the IaR model, the unexpected developments in 2022 were anomalous and led to inflation at the extreme end of the forecast distribution (around the 90th percentile). In view of this, the Monetary Committee accelerated interest rate increases, as described in the Chapter.

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