Chapter 1

Investment of the Foreign Exchange Reserves[1]

The average level of the Bank of Israel's foreign exchange reserves portfolio was about $ 24 billion in 2003.[2] The reserves are managed in accordance with the Bank of Israel Law 5714–1954 and the legal interpretations which have been added over the years, together with a set of rules which are appropriate to the Bank's character and which reflect the functions that the reserves fulfill. Accordingly the reserves are invested in foreign-currency-denominated bonds issued by or fully guaranteed by foreign governments, and in foreign-currency deposits in foreign banks outside Israel.[3] As part of the management of the reserves, the Bank may perform transactions with banks and investment banks outside Israel, and may use derivative financial instruments such as futures provided their underlying asset is one which the Bank is authorized to hold. The bank may also carry out transactions with a limited number of domestic institutions, such as the government and the banking corporations.

In the past the main purpose of the reserves was to provide the liquidity required by the Bank of Israel to enable it to intervene in the foreign-currency market and to defend the exchange rate. That was the situation when the exchange rate was fixed or managed according to strict rules. Over time the role of the reserves changed, due to changes in macroeconomic and exchange-rate policy. Currently, the reserves have two types of function: (1) possible *uses* of the reserves, i.e., the option of transferring them to another entity in exchange for either cash NIS or a financial commitment, the most important use being the sale to the government of the foreign currency required to service its debts. (2) *Benefits* to the national economy

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[1] Appendix 1.1 contains a glossary of terms which appear in this chapter of the Report. Various aspects of the management of the reserves have been discussed in Chapter 1 of the Annual Reports of the Foreign Currency Department of previous years, available on the Bank of Israel's website: www.bankisrael.gov.il.

[2] The average level of the reserves in this Report is calculated from the figures of the daily balances of the reserves assessed at their full market value. All the holding-period rates of return in this Report are in terms of the numeraire, unless stated otherwise.

[3] In the context of the reserves, the Law also permits gold to be held, but this has not been done for several years for lack of economic justification.

stemming from the very fact that Israel has reserves of sufficient magnitude. The most important benefits are the lowering of the probability of a crisis in Israel's foreign-currency market and the improvement of Israel's standing in the international financial environment. The functions of the reserves provide a basis for determining their appropriate size as well as for defining the investment policy for the management of the reserves portfolio.

The holding-period rate of return on the foreign exchange reserves in 2003 in terms of the numeraire was 2.2 percent, down from 5.2 percent in 2002. This reflected the low level of yields to maturity throughout 2003 in the capital markets in which the reserves are invested. In NIS terms the holding-period rate of return in 2003 was negative, –1.3 percent, compared to 17.8 percent in 2002, reflecting the effect of the strengthening of the NIS against the dollar and its weakness against the other currencies in which the reserves are invested.

The yield on the reserves in 2003 was 21 basis points higher than that of the neutral benchmark—the hypothetical portfolio that serves as a criterion for the assessment of the investment performance of the reserves and as an anchor for the management of their financial risks. The yield spread between the reserves and the benchmark reflects the active management contribution. The yield on the reserves is greatly affected by the composition of the benchmark, due to the relatively low risk taken in managing the portfolio, risk that derives from deviations from the benchmark. Much effort has been invested in the last few years in the area of decisions on asset allocation, i.e., in a composition different from that of the benchmark, and decisions on the choice of assets not in the benchmark. On the other hand the scope of positions in the areas of duration and currency management has declined, in accordance with the policy of reducing exposure in these fields.

The contribution of asset-selection decisions to the yield spread between the portfolio and the benchmark was also 21 basis in 2003. This derived from investment in Treasury Inflation-Protected Securities (TIPS) (about 7 basis points), Eurobonds and GNMA mortgage-backed securities (about one basis point for each of these two), and securities-lending activities (about 2 basis points). Currency management contributed 4 basis points, while the duration management contribution was a negative 2 basis points.

The exposure of the reserves to the banking system is limited to 25 percent of the value of the portfolio. In 2003 this exposure averaged 18 percent, about half of which was used in securities-lending activities, which have a very short investment horizon. The exposure is managed under a system of quotas and rules which plays a central role in the credit-risk management of the portfolio.

The liquidity of the reserves, a measure of the proportion of the portfolio that can be realized quickly without reducing its value, is very high: about

88 percent of the reserves portfolio is invested in very liquid assets, and the rest in assets with lower liquidity. Bearing in mind the purposes for which the reserves are held, it seems that their level of liquidity is satisfactory. The high liquidity of the reserves is due on the one hand to the Bank of Israel Law and to the investment policy derived from the spirit of the Law, which require conservative management of financial risks, and on the other hand to considerations of profitability, which in the last few years have led to only partial use of the degrees of freedom to invest in assets with low liquidity.

1. THE RESERVES: THE PURPOSES OF HOLDING THEM, THEIR LEVEL AND THEIR NEW MANAGEMENT FRAMEWORK

The management of Israel's foreign exchange reserves is subject to the Bank of Israel Law, 5714–1954 and the relevant legal interpretations which have been added over the years. These define how the Bank may conduct its foreign-currency activities and set limitations on the types of asset it may purchase.

In areas in which the Bank is not restricted by the wording of the law, it always tends to follow a conservative policy that derives from the spirit of the law. In order to manage the reserves in a manner appropriate to the changing macroeconomic and financial environment, a set of detailed rules has been developed over the years that reflects the Bank's special characteristics and imposes limits on the various financial risks to which the reserves portfolio may be exposed. The main risks are credit risk, controlled by a system of rules and quotas; interest-rate risk, controlled mainly by setting a target average duration for each currency portfolio; and currency risk, controlled by defining a neutral, currency-risk-free portfolio composition, called the numeraire, that acts as a yardstick for measuring the performance of the actual portfolio.

During the last few years, the Bank has been engaged in defining the purposes of holding foreign exchange reserves and in tightening the link between those purposes and the reserves-management framework. Towards the end of 2003 the Bank adopted a new definition of the function of the reserves, that led to a new method of determining the numeraire which will govern the currency composition of reserves from December 2003. The new management approach is described below, while the principles that guided the Bank of Israel in setting the numeraire until December 2003 are set out in Box 1.1.

a. The purposes of holding the reserves

In the course of the 1990s far-reaching changes took place in Israel's economic environment. Monetary policy moved from acting via the exchange rate as a nominal anchor to the use of a declared inflation target. This step paved the way for a number of

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positive changes in the foreign currency sphere: the exchange-rate regime gradually was made more flexible, until the width of the exchange-rate band reached above 50 percent; foreign-exchange controls were abolished, also via a gradual process; the Bank of Israel stopped intervening in the foreign-currency market, announced a policy of non-intervention while the exchange rate was within the band, and declared itself ready for the abolition of the exchange-rate band and its replacement by a completely free float regime; the private sector took the place of the Bank of Israel as market maker in the foreign-currency market, and it sustains an active and dynamic market. These developments in the economic environment prompted the management of the Bank of Israel to reassess the purposes of holding the foreign exchange reserves.

The purposes for which the Bank holds foreign exchange reserves can be divided into two categories: one consists of the uses that can be made of the reserves, i.e., their transfer to another entity in various circumstances, in exchange for NIS or a liability denominated in local or foreign currency. The other relates to economic benefits which derive from the fact that the country is holding foreign exchange reserves of sufficient magnitude. Both types of purpose will be described below.

1. *Uses of the reserves*

a) By the government

For many years it has been customary for the Bank of Israel to sell the government foreign currency on demand against local currency at the representative exchange rate. It is also accepted practice for the government to sell to the Bank—or in certain situations to deposit with the Bank—any sum of foreign currency it receives and does not use in the immediate future. The extent of changes in the reserves, related to government currency conversions and deposits, and even the direction of the change, can vary from year to year. Factors that affect the net change in the reserves include the government's ability to raise external (net) debt, its preferred currency composition of the public debt (i.e., local versus foreign currency), the extent of its foreign-currency income (grants, the proceeds of privatization, tax receipts in foreign currency, etc.), and the scope of its foreign-currency expenditures.

Government purchase of foreign currency from the Bank of Israel for the following two main reasons are liable to cause a marked fall in the foreign exchange reserves (unless there are receipts of foreign currency of a similar magnitude at about the same time):

• *To service the government's foreign-currency debts*. The sums required for this purpose are known in advance with a high degree of certainty. According to Ministry of Finance data, the cost of servicing the current level of foreign-currency debt for the next five years will amount to an average of about $ 3.5 billion a year.

• *To cover exceptional government expenditure on imports of goods and services at times of emergency*. This covers several possible scenarios, the probability of each of which is assessed as being extremely low. In these situations the government would coordinate the import of goods and services necessary to save life and to reconstruct

the economy under emergency conditions; to do so it would use NIS to purchase foreign currency from the Bank of Israel.

b)   Special uses by the central bank
i. Response to a financial crisis
In most countries, Israel among them, one of the roles of the central bank is to support the stability of the country's financial system and to ensure the proper functioning of the local foreign-currency market. International experience has shown that in the course of this activity a crisis may, on rare occasions, be encountered in which the use of part of the foreign exchange reserves may grant central bank policy makers the degrees of freedom essential to cope with the situation. Two examples are described below:

•   Danger to the financial stability of a banking corporation or the whole banking system as a result of difficulties in repaying customers' foreign-currency deposits. In such a situation the ability of the central bank to make foreign-currency credit available to banking institutions that have run into *temporary* foreign-currency liquidity problems can serve as an important and even vital instrument for the re-establishment of stability, to be used together with other measures leading to financial recovery.

•   A crisis in the foreign-currency market. Financial markets in general and foreign-currency markets in particular are vulnerable to external shocks and the development of crisis conditions. A severe crisis in a country's foreign-currency market—leading to a collapse of the market mechanism—is likely to exact a high social and economic price, particularly in small open economies such as Israel's. In such a situation it may be appropriate for the central bank to intervene in the foreign-currency market, not with the intention of pegging the exchange rate, but rather of reestablishing the level of liquidity in the market required for normal activity. It must be emphasized that short-term intervention can only help to restore stability if the source of the crisis is a temporary exogenous shock that has disrupted the functioning of the market over the short term. In contrast, when a crisis results from pursuing an unsound macroeconomic policy, intervention in the foreign-currency market will not necessarily help restore stability, and in fact may well hinder the process.

ii. Regular monetary activity
In addition to their role in coping with financial crises, the foreign exchange reserves broaden the range of instruments available to central banks for the day-to-day conduct of monetary policy, for instance via currency swaps or exchange–rate options.

2.   *The benefit of holding reserves*

Experience from around the world, especially at times of financial crisis, indicates the following advantages arising from the very fact that a country holds foreign exchange reserves:
•   The reserves reduce the risk of a crisis erupting in the foreign-currency market. Research carried out in the last few years by the IMF and the World Bank show that the

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higher the level of a country's reserves, the lower the chances of a crisis in its foreign-currency market. This is because a high level of foreign-currency holdings calms foreign investors and residents on the one hand, and deters speculators on the other. It is nonetheless quite clear that holding foreign exchange reserves is no substitute for a responsible, credible macroeconomic policy.

• They raise a country's standing in the international financial arena. Important entities in the international capital markets, such as the main rating agencies, consider the size of a country's reserves to be an important indicator of its financial stability. This is because the reserves improve its ability to handle crises, and because the ability to hold reserves is indicative of economic robustness. Hence holding foreign exchange reserves gives a country access to international capital markets and reduces its cost of raising capital.

b. The actual and desired levels of the reserves

The average level of the reserves in 2003 was about $ 24 billion, similar to their level in 2001 and 2002.

At the end of 2003 Israel's foreign exchange reserves stood at $ 25,783 million, a rise of $ 2,113 million from their level at the end of 2002. Their average level in 2003 was about $ 24 billion, similar to their level in 2001 and 2002, and slightly higher than their level from 1998 to 2000. Their current level is far higher than it was at any time prior to 1998 (Figure 1.1). The steep rise in the reserves, mainly in 1995–97, also increased them relative to other economic aggregates which are usually used in assessing the level of the reserves: imports, the external debt, local-currency assets held by the public, and the money supply (Table 1.1).

Figure 1.1
Gross Foreign Exchange Reserves, 1994–2003

SOURCE: Bank of Israel.

Table 1.1
The Level of the Reserves Relative to Other Aggregates, 1991–2003

(percent)

| | Average level of reserves[a] ($ million) | Imports (months) | Gross external debt[b] | Short-term external debt | | Unindexed local-currency assets | Monetary base | Local-currency liabilities in Bank of Israel balance sheet[c] |
				excluding suppliers' credit	including suppliers' credit			
				Reserves as percent of aggregate				
1991	6,985	3.27	19	59	–	70	328	–
1992	6,279	2.73	17	55	–	58	283	–
1993	5,510	2.18	14	44	–	45	218	–
1994	6,151	2.17	13	43	28	35	208	–
1995	8,594	2.59	17	50	35	37	294	139
1996	9,665	2.71	18	49	39	35	288	107
1997	16,797	4.66	29	83	67	52	461	109
1998	21,392	6.03	35	107	79	61	517	110
1999	21,569	5.38	33	101	73	55	499	104
2000	21,843	4.58	32	–	71	46	441	97
2001	23,495	5.53	35	–	77	43	420	99
2002	23,948	5.85	34	–	74	48	429	116
2003	24,003	5.71	33	–	77	46	400	104

[a] Based on estimated daily valuations.
[b] From 1994 this includes suppliers' credit. In 1994 this inclusion reduced the ratio of the reserves to the gross external debt by 2 percentage points.
[c] These liabilities include the monetary base, interest-bearing deposits of the banks, and the Treasury bills deposit.
SOURCE: Bank of Israel, The Central Bureau of Statistics, and returns from the banks.

The desired level of the reserves is determined in accordance with the purposes for which they are held, and is derived from their uses and from the level needed to enable their inherent benefits to be achieved. Whereas the level of reserves required for the various uses is *cumulative* (as reserves which are used obviously cease to exist), benefits are derived from the *total* level, and are unaffected by the specific needs for which the reserves are held.

The level of the reserves derived from their uses
The level of the reserves appropriate for the government's uses is set according to the cost of servicing the foreign-currency debt (undiscounted principal and interest) for the next five years, with the addition of a sum—five percent of the value of annual imports—held as a fund for exceptional occurrences. At the beginning of 2004 the amounts required for these uses were $ 17.4 billion and $ 2.5 billion respectively. The desired level of the Bank of Israel special-uses fund held for times of crisis and for conducting monetary policy is set as a function of the extent of activity in the foreign-currency market and of the foreign-currency liabilities of Israel's banking system; at the beginning of 2004 this stood at $ 13.9 billion. Hence the level of reserves required to achieve the objectives outlined above came to about $ 34 billion, significantly higher than the reserves' current level.

The desired level of the reserves is determined in accordance with the purposes for which they are held, and is derived from their uses and from the level needed to enable their inherent benefits to be achieved.

The level of reserves derived from their uses is about $ 34 billion, significantly higher than their current level.

The desired level to achieve the benefits of holding the reserves

The level of the reserves needed to achieve these benefits is not in addition to the amount derived from the uses, but rather overlaps with it. Hence the reserves should only be increased to the extent that the level needed to achieve the benefits exceeds the level derived from analysis of the uses. As the objective falls within the behavioral area, i.e. to affect the actions of potential or actual participants in Israel's foreign-currency market and in the international capital markets, there is no direct economic method of setting the sum required for this purpose, and indirect indicators must be employed. Three methods of obtaining these indicators are described below.

• *The Guidotti Rule*: according to this rule, a country's reserves must be greater than its gross foreign-currency short-term debt. The Bank of Israel has not adopted this rule, but in the last few years the rule has attained the status of a quasi-mandatory criterion within the international financial community, so that it cannot be ignored completely. The estimate of Israel's external debt servicing requirement for the next twelve months stood at $ 32.4 billion at the end of 2002, and at the end of September 2003 was $ 30.9 billion (Table 1.2). The size of the reserves proposed above thus satisfies the requirement of the Guidotti Rule.

• *Estimates from models* formulated in the Bank of Israel Foreign Exchange Department. According to the first model developed in the Bank, based on research published by the Inter-American Development Bank,[4] countries' levels of reserves are explained by the extent to which prices are affected by the exchange rate and the degree of the economy's exposure to external shocks that derives from a currency imbalance in private- and public-sector entities' balance sheets. According to the model Israel would be expected to hold reserves of $ 29 billion.

• The second model compares the size of reserves in countries at a similar level of economic development to Israel's. According to this approach, Israel's reserves should be between $ 19 billion and $ 33 billion, with the second figure the more credible. Hence the level of Israel's reserves derived from their uses is sufficient according to the estimates in both models. A detailed description of the two models appears in Chapter 1.4 of the 2002 Annual Report of the Foreign Exchange Department.

It may be inferred from the above that Israel's reserves ought to be increased. Given the government's foreign-currency cash flow, the foreign exchange reserves can increase in two ways: (1) It seems that in the future, as in the past, the Bank of Israel will accumulate profits from the existing reserves from interest, changes in the yield-to-maturity curves and changes in the exchange rate of the dollar against the other currencies in which the reserves are invested. (Changes in yield curves and exchange rates could of course also reduce the reserves.) (2) The Bank of Israel could purchase reserves by intervening in the domestic foreign-currency market. Thus the option of bringing the reserves closer to the desired level by net foreign-currency purchases may be considered, but only if and when such a step is consistent with the needs of a monetary

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[4] R. Hausmann, U. Panizza and E. Stein, "*Why Do Countries Float The Way They Float?*" IADB Research Department Working Paper 418, May 2000.

Table 1.2
The Gross Short-Term External Debt, by Sector, 1994–2003

($ million)

Year	The public sector (1)	The nonbanking private sector (2)	The banking system (3)	Total short-term external debt excluding interest (4) = (1) + (2) + (3)	Total short-term external debt including interest
1994	1,691	5,771	12,316	19,779	22,295
1995	1,961	6,350	13,770	22,081	24,574
1996	1,741	5,936	14,250	21,927	24,613
1997	2,018	5,610	14,755	22,383	25,114
1998	1,743	6,099	16,323	24,165	26,962
1999	1,704	6,252	18,073	26,029	29,486
2000	2,277	5,612	19,405	27,294	30,605
2001	2,164	5,640	20,233	28,036	30,511
2002	3,091	7,054	19,644	29,789	32,244
2003	2,846	6,926	19,348	29,121	31,301

SOURCE: Bank of Israel

policy committed to maintaining price stability. It is worth noting that the Bank of Israel has not intervened in the foreign-currency market since July 1997 (except for a few days at the end of that year).

c. The management of the reserves

In the areas where it is not limited by the Bank of Israel Law, the Bank acts within a framework of rules constructed over the years. The main directives governing the management of the exposure of the reserves portfolio to financial risks and the degrees of freedom of the Foreign Exchange Department's day-to-day activities (henceforth, investment policy) are set by the Foreign-Currency Committee headed by the Governor of the Bank. The Foreign Exchange Department suggests topics to be discussed by the committee, and reports to it on the performance of the portfolio and on investment decisions it has taken. The committee also reviews current developments in the international markets.

The investment policy of the reserves portfolio is set by the Foreign-Currency Committee headed by the Governor of the Bank.

The investment policy guiding the management of the foreign exchange reserves is founded on three principles:

• *Maintaining the value of the reserves in terms of their uses*, in other words, the ability of the Bank to supply foreign currency for the intended uses of the reserves, described above. This is expressed in the determination of the currency composition of the reserves, the limitations on their exposure to credit risk and to some extent the management of their interest-rate risk.

• *Managing the reserves with a high degree of liquidity,* in other words, investing most of the reserves in assets which can be sold in large volume and at short notice without lowering the sale price. This is expressed mainly in the restrictions on the types of asset in which the reserves may be invested. Most of these restrictions are specified in the Bank of Israel Law and the relevant legal interpretations of it, and

The reserves investment policy is founded on three principles: maintaining their value in terms of their uses; maintaining a high degree of liquidity; and achieving a reasonable yield (subject to the first two principles).

some of them are determined by internal Bank of Israel decisions that are consistent with the spirit of the law.

• *Achieving a reasonable yield on the reserves portfolio subject to the above two principles*. This is expressed in decisions on the duration of the portfolio, the permitted level of exposure to credit risk and the use of active portfolio management.

The investment policy is described in greater detail in the Annual Reports of the Foreign Currency Department for 2000, 2001 and 2002.

In the light of the redefinition of the purposes of holding the reserves described above, a review was carried out of the consistency of the current investment policy with the new definitions. In line with the conclusions drawn in the review, the Foreign-Currency Committee decided that from December 2003 the currency numeraire will be determined according to the currency composition of the uses for which the reserves are intended. With regard to the reserves intended for government uses, the relevant factors are the currency composition of the debt-servicing requirements for the next five years and the geographical distribution of Israel's imports. The question of the reserves intended for Bank of Israel uses requires further clarification; at present a temporary composition has been assigned based on various economic considerations. It was also decided that from the beginning of 2004 the numeraire will be defined on the basis of constant quantities of currencies, and not constant percentages of the total as was the case hitherto (see Box 1.1).

A further conclusion drawn from the above review was to leave unchanged the current principles regarding the exposure of the reserves to interest-rate risk. This was because bringing the duration of part of the reserves into line with that of the government's five-year debt-servicing requirement would likely result in a marked rise in the reserves' volatility, which would probably hinder the achievement of their intended benefits as described above. It is true that in some countries the management of public-sector foreign-currency debt and management of the foreign exchange reserves are coordinated (assets held against liabilities). However, among those countries which similarly to Israel are active as borrowers in the international markets, operate a free-floating exchange rate (or floating within a broad band) and pursue a monetary policy based on declared inflation targets, the number of those that coordinate their foreign exchange reserves and debt is very small.[5] Those countries have the following characteristics in common, among others:

• A very high credit rating, between AA+ and AAA;

• A national long-term policy of holding foreign exchange reserves that exceed or at least equal the country's foreign-currency liabilities;

• Complete or partial central bank responsibility for determining the structure of the external liabilities of the public sector, in addition to its responsibility for the management of the foreign exchange reserves.

It appears that these are not chance findings, but essential conditions for the coordinated management of the debt and the reserves.

[5] There are a few other countries whose governments have stopped borrowing foreign currency but that still have foreign-currency liabilities carried forward from the past.

Since December 2003 the currency numeraire has been determined according to the currency composition of the reserves' intended uses.

Box 1.1

The Numeraire in 2003

Until the beginning of December 2003 the currency composition of the reserves was managed along the same principles that guided the Bank in previous years (henceforth, the previous numeraire). The previous numeraire consisted of fixed weights (percentages) of several currencies. The weights were originally set according to the geographical distribution of Israel's goods and services imports,[1] and later also according to the currency composition of the external-debt-servicing cost for one year. The purpose of basing the currency composition on these two factors was to preserve the purchasing power of the reserves in terms of the foreign-currency component of the economy's final uses. This system was appropriate to a situation in which the Bank of Israel absorbed the economy's surplus supply of and demand for foreign currency. Under the macroeconomic conditions currently prevailing it is less suited to the intended uses of the reserves.

Experience has shown that the geographical distribution of imports remains fairly constant over a long period. It seems that this occurs because changes in the exchange rate, and hence in import prices, eventually lead to the diversion of trade from one country to another. As this distribution constituted the major factor in determining the previous numeraire, it was decided, when the numeraire started being used as the risk-free currency composition of the reserves, to construct it with constant weights of currencies. On the other hand, the currency composition of the cost of servicing the government debt, which is the main item in setting the new numeraire, is unaffected by changes in the exchange rate, and remains stable in terms of currency units. It was therefore decided that from the beginning of 2004 the numeraire would be defined on the basis of constant currency amounts, and not on the basis of relative weights (percentages) as in the previous numeraire.

[1] Based on research carried out by Avi Ben Bassat in 1979, "Management of Foreign Exchange Reserves: Israel's Experience," Research Department, Bank of Israel (Hebrew), an abridged English version of which was published in the *Bank of Israel Economic Review*, May, 1981.

2. YIELD AND RISK IN MANAGING THE RESERVES

a. The return on the reserves portfolio

In 2003 the holding-period rate of return on the foreign exchange reserves in terms of the numeraire was 2.2 percent, down from 5.2 percent in 2002 and a 5.0 percent average in the years from 1994 to 2003 (Table 1.3 and Figure 1.2). The holding-period rate of

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Table 1.3
The Performance of the Actual Portfolio vis-à-vis the Neutral Benchmark Portfolio, 1994–2003

(percent, in annual terms)

	Portfolio performance		Incremental yield							
			Currency management		Asset and duration management					
					Decision to invest in GNMA		Duration management	Asset and dispersion management		
	Actual portfolio	Neutral benchmark	Total	ment	Total	GNMA	ment	Total	Asset management	Dispersion management
1994										
Yield	2.68	2.81	–0.13	–0.01	–0.12	0.27	0.19	–0.57	–	–
Standard deviation	0.75	0.62	0.32	0.07	0.33	–	–	–	–	–
1995										
Yield	8.31	7.94	0.35	0.35	0.00	–0.10	0.26	–0.16	–	–
Standard deviation	0.56	0.56	0.24	0.10	0.21	0.05	0.19	0.10	–	–
1996										
Yield	4.87	4.86	0.01	–0.01	0.02	0.03	–0.11	0.11	0.20	–0.09
Standard deviation	0.70	0.59	0.23	0.10	0.17	0.05	0.16	0.06	0.08	0.03
1997										
Yield	4.99	5.24	–0.24	–0.26	0.02	0.03	–0.17	0.17	0.18	–0.01
Standard deviation	0.44	0.49	0.16	0.08	0.12	0.02	0.09	0.06	0.07	0.02
1998										
Yield	6.00	5.99	0.01	0.00	0.01	–0.03	0.01	0.04	0.10	–0.07
Standard deviation	0.63	0.69	0.08	0.03	0.08	0.06	0.02	0.05	0.05	0.02
1999										
Yield	3.26	3.17	0.08	0.02	0.06	0.03	–0.06	0.10	0.05	0.05
Standard deviation	0.66	0.60	0.13	0.02	0.13	0.05	0.08	0.07	–	–
2000										
Yield	6.79	6.78	0.01	–0.15	0.16	–0.04	0.00	0.20	0.19	0.01
Standard deviation	0.89	0.86	0.11	0.06	0.10	0.03	0.02	0.10	–	–
2001										
Yield	6.35	6.13	0.22	0.00	0.22[a]	–0.05	–0.01	0.22	0.23	–0.01
Standard deviation	1.44	1.36	0.20	0.03	0.10	0.04	0.04	0.08	0.09	0.00
2002										
Yield	5.18	4.98	0.20	0.03	0.17	0.00	–0.02	0.19	0.20	–0.01
Standard deviation	1.32	1.41	0.17	0.04	0.16	–	0.05	0.09	–	–
2003										
Yield	2.15	1.94	0.21	0.04	0.16	–0.01	–0.02	0.20	0.21	0.00
Standard deviation	0.81	0.79	0.09	0.03	0.10	–	0.07	0.15	–	–
1994–2003										
Yield	5.04	4.97	0.07	0.00	0.05	0.01	0.01	0.05	–	–

[a] 5.5 basis points of total incremental yield not attributed to any listed component in this year.
SOURCE: Bank of Israel.

return on the foreign exchange reserves is generally assessed by the Bank of Israel in terms of a neutral currency composition, the numeraire. Until November 2003 this

Figure 1.2
Yield and the Total Management Contribution, 1994–2003

SOURCE: Bank of Israel.
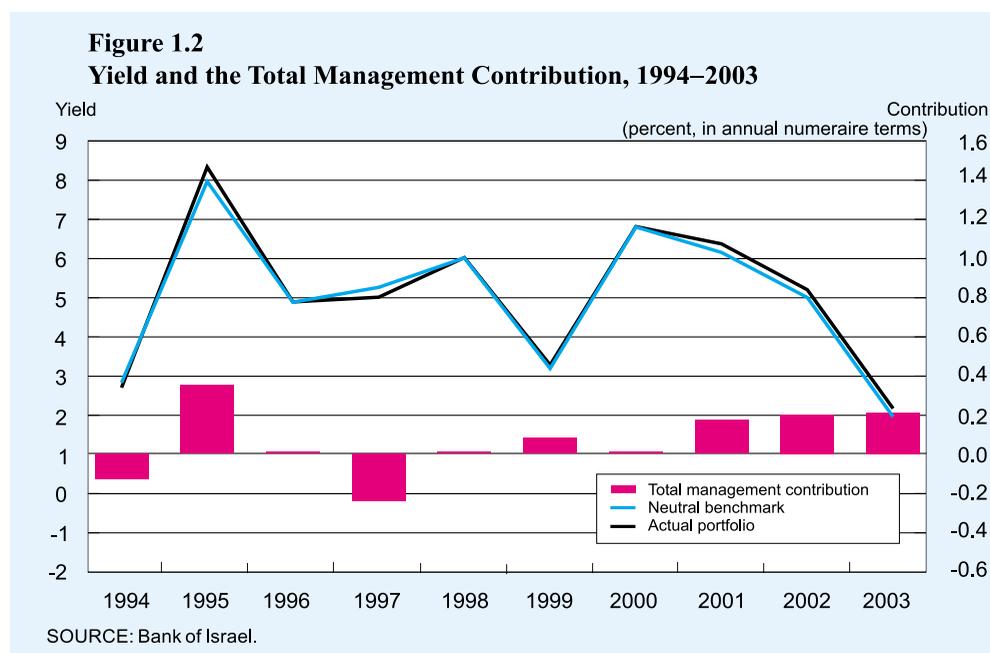
currency basket was calculated according to the composition of imports and debt repayments (see Box 1.1). Since December 2003 it is calculated according to the intended uses of the reserves.

The holding-period rate of return in NIS terms in 2003 was negative, –1.3 percent, compared with a return of 17.8 percent in 2002 and 14.9 percent in 2001. The negative return in 2003 reflects the strengthening of the NIS against the dollar, following its weakening in 2001 and 2002, and was partially offset by the weakening of the NIS against the other currencies in which the reserves are invested. Over the last ten years the holding-period rate of return came to 9.5 percent a year in NIS terms, or to 3.8 percent a year after deducting domestic price increases in that period.

b. Factors affecting the holding-period rate of return

Three main factors affect the holding-period rate of return on the foreign exchange reserves: (i) developments in the financial markets; (ii) long-term investment decisions relating to the currency composition, duration, asset composition and dispersion along the yield curve of the investment—these decisions are expressed in the composition of the neutral benchmark of the portfolio; and (iii) day-to-day portfolio management, including active management (decisions on deviations from the neutral benchmark).

Global and market developments
Economic growth in the US, Japan and the UK was higher in 2003 than in 2002, while in the eurozone it was slightly lower. In the US and Europe growth was not uniform

The holding-period rate of return in NIS terms in 2003 was negative, –1.3 percent, compared with a return of 17.8 percent in 2002 and 14.9 percent in 2001 reflecting the strengthening of the NIS against the dollar and its weakening against the other currencies in which the reserves are invested.

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Economic growth in the major economies was affected by several causes, including expansionary monetary and fiscal policies, the reduction in geopolitical risk, the contraction of yield spreads and the rise in share price indices and in prices of real estate and housing.

during the year, but accelerated in the second half of the year. The growth may be ascribed to several causes, including:

1. Expansionary monetary policy. Of particular note is the decision of the US Federal Reserve to set the short-term interest rate at a low level (1.25 percent in the first half of the year and 1.0 percent in the second), and to announce that it was expected to remain there "for a considerable period." In the background was concern regarding a deflationary cycle such as that prevailing in Japan in the last few years.

2. Expansionary fiscal policy, expressed *inter alia* as the largest ever federal deficit in US history—$ 375 billion, compared with the previous peak of $ 290 billion in 1992[6]—and the decision of the Ministers of Finance of the eurozone countries (ECOFIN) not to impose fines on Germany and France for breaching the terms of Maastricht Treaty.

3. The reduction in geopolitical risk in the wake of military and political developments in the Middle East.

4. A reduction in the cost of capital for businesses, expressed by the contraction of the yield spread on corporate bonds, in particular those with relatively low ratings (Figure 1.3) and by the rises in the main share price indices (Figure 1.4). These developments together with the rises in the prices of residential real estate in the US and the UK also affected households' propensity to consume, via the wealth effect.

5. The recovery of advanced economies from the side effects (psychological and otherwise) of the bursting of the bubble in the high-tech industries in 2000–01.

Against the background described above, the dollar continued to weaken against the other major currencies in 2003, continuing the trend that had started at the beginning of 2002. Over the whole of 2003 the dollar fell by 17 percent against the euro, 10 percent against the yen, and 10 percent against the pound sterling, similar to its rates of decline in 2003 (Figure 1.5).
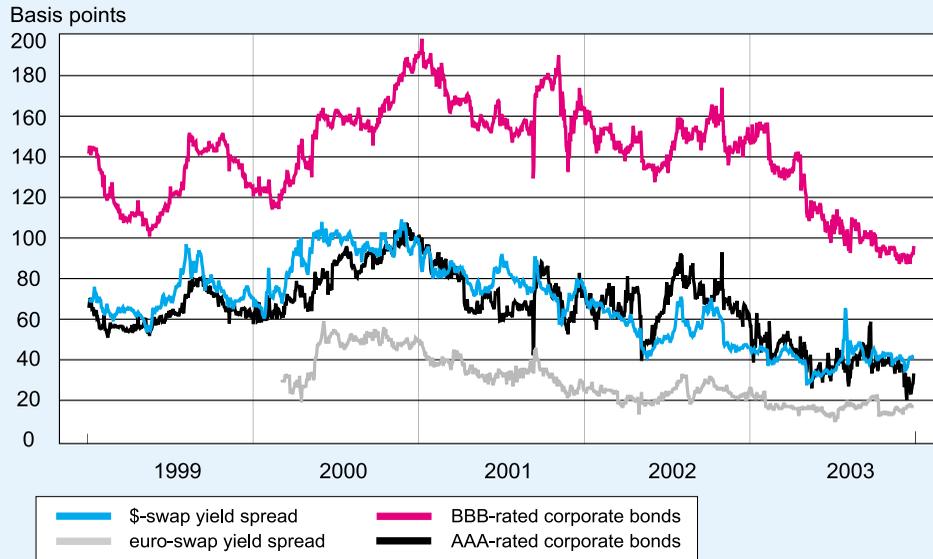
Yields to maturity fell in the US and Europe in the first half of 2003, and rose in the second half. Hence the contribution of these changes to the holding-period rate of return was positive in the first half of the year and negative in the second.

Yields to maturity fell in the US and Europe in the first half of 2003 (till mid-June), following their decline in 2002. The trend reversed in the second half of the year and yields to maturity rose. Yields changed by similar amounts, both when they rose and when they fell, all along the yield curves, except for the short end of the curves (less than two years), so that the steepness of the curves did not change greatly. In Japan too yields rose in the second half of the year, but that was accompanied by a significant steepening of the curve, which had been close to zero along its whole length.

Yields to maturity in the US reached very low levels even before the beginning of 2003. These reduced the current income (the carry) included in the holding-period rate of return, and thus lowered the yield.

A drop in yields to maturity on a bond is reflected by a rise in its price, and vice versa. Thus the contribution of yield changes to the holding-period rate of return in 2003 was positive in the first half year and negative in the second.

The holding-period rate of return is affected not only by a change in yields to maturity but also by the level of the yields. The expansionary monetary policy adopted by the US from 2001 to the end of 2003 reduced yields to maturity in the US market to very

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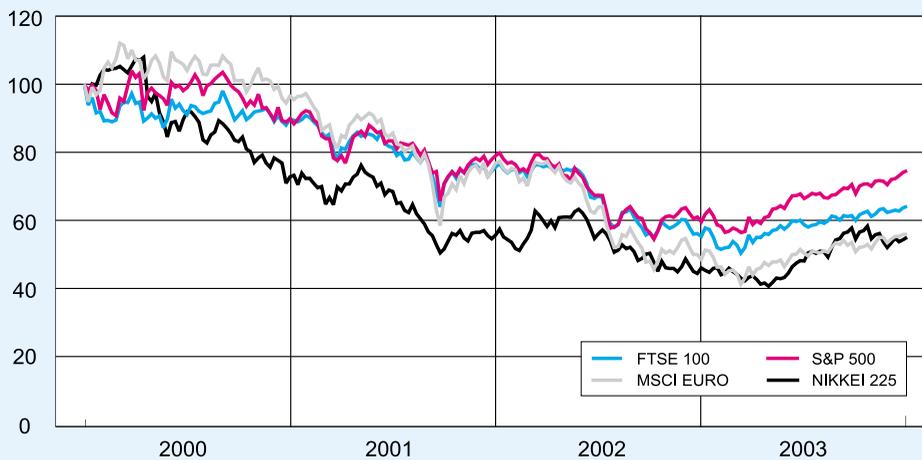[6] These data relate to the US government fiscal year, which starts on 1 October.

low levels by the beginning of 2003. Low yields to maturity reduce the current income (the carry) included in the holding-period rate of return, and thus lower the yield (Figures 1.6 and 1.7).

Figure 1.3
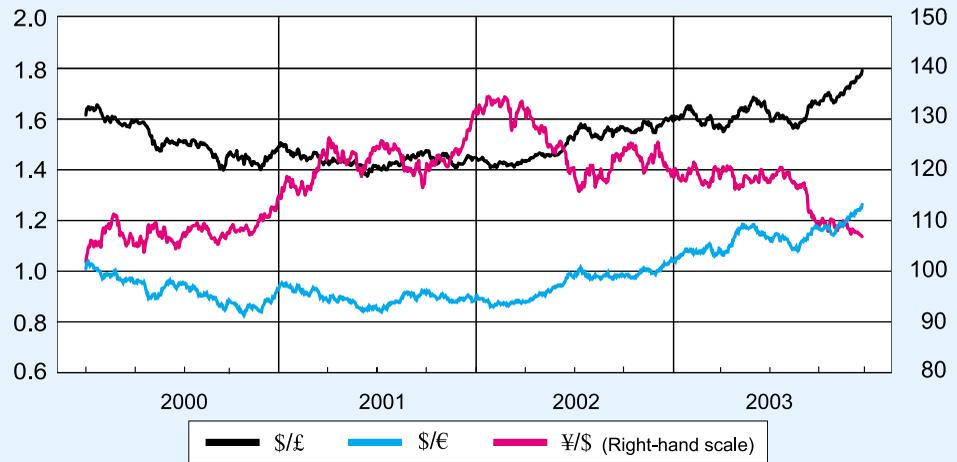**Yield Spreads vis-à-vis 5-Year Treasuries, 1999−2003**

Basis points

Legend:
- $-swap yield spread
- euro-swap yield spread
- BBB-rated corporate bonds
- AAA-rated corporate bonds

SOURCE: Bank of Israel.

Figure 1.4
Share-Price Indices, 2000−03

Legend:
- FTSE 100
- MSCI EURO
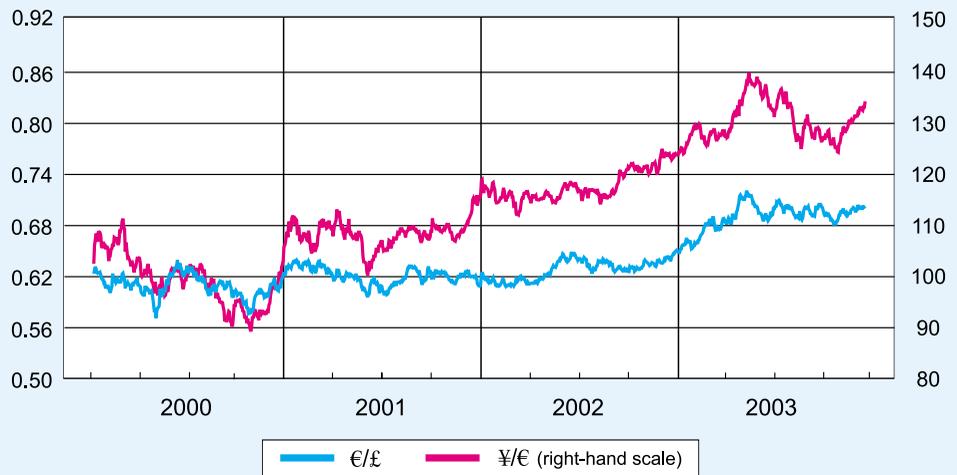- S&P 500
- NIKKEI 225

SOURCE: Bloomberg.

Figure 1.5

a. Exchange Rates against the US$, 2000–03

b. Exchange Rates against the Euro, 2000–03

SOURCE: Bloomberg.

The benchmark

*The yield and risk of the benchmark*: The holding-period rate of return of the benchmark was 1.9 percent in 2003, and its volatility 0.8 percent. Given the developments in the markets, the benchmark is the major factor in determining the holding-period rate of return of the portfolio, because of the relatively low risk taken via active management of the portfolio—risk that arises from deviations of the actual portfolio from the benchmark.

The holding-period rate of return of the benchmark was 1.9 percent in 2003, and its volatility 0.8 percent.

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Figure 1.6

Yield Curves of Government Bonds, December 2002 and 2003

(percent)

a. US

b. Eurozone

c. UK

d. Japan

December 2002   December 2003
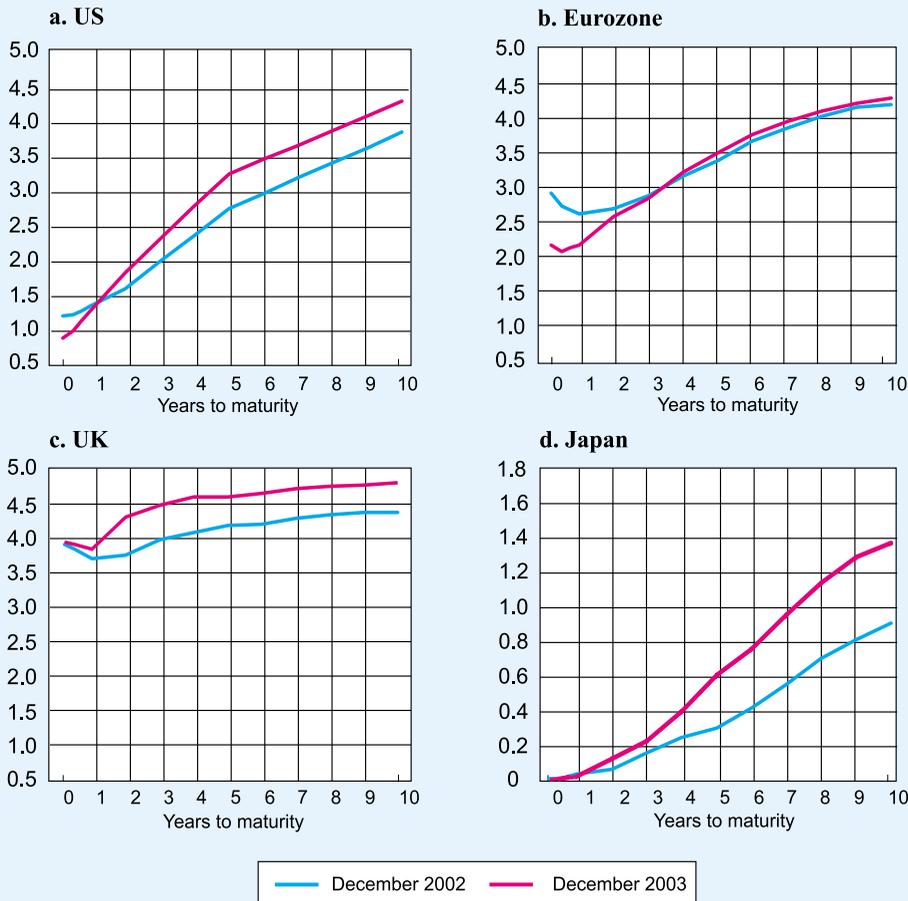
SOURCE: Bloomberg.

Figure 1.8 shows the holding-period rate of return of the benchmark and of the portfolio and their volatilities for each year since 1993; it can be seen that the rate of return of the portfolio and its volatility were very close to those of the benchmark every year. The figure also highlights the fluctuations in the annual holding-period rates of return of the benchmark and of the portfolio that result from market developments in the different years. The relative stability of intra-year volatility stands in sharp contrast to the fluctuations in the holding-period rates of return. In 2003,

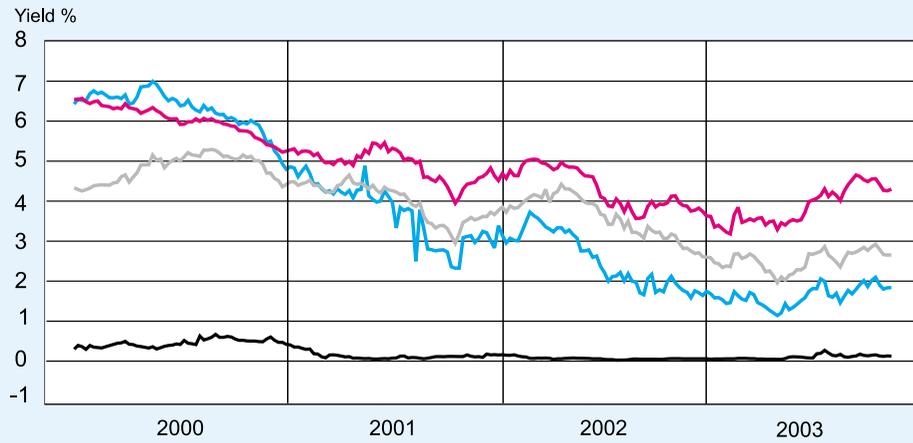2003 was notable for a combination of an exceptionally low holding-period rate of return and a higher volatility than in previous years.

Figure 1.7

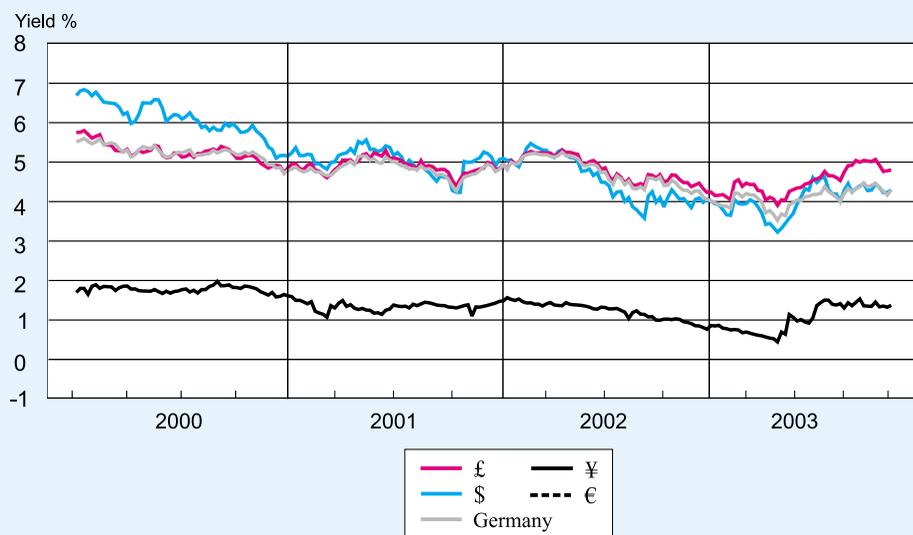**a. Interest Rates on 6-Month Eurodeposits, 2000–03**
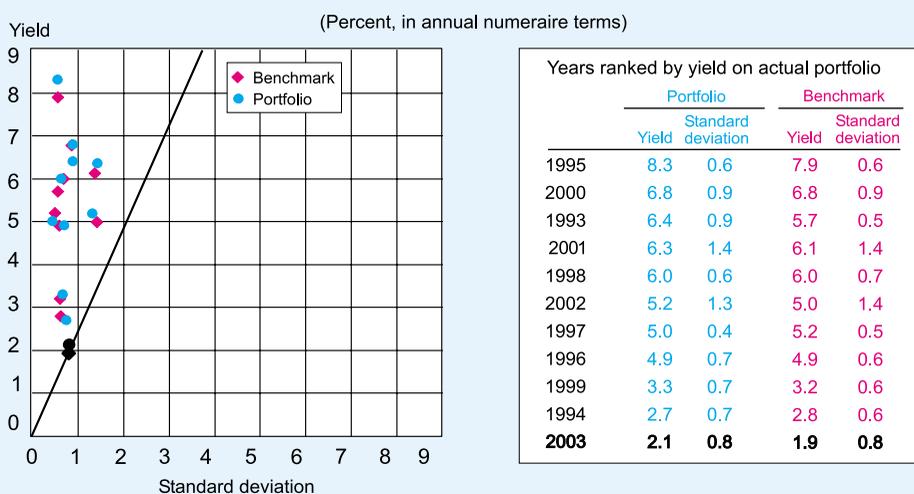
Interest %
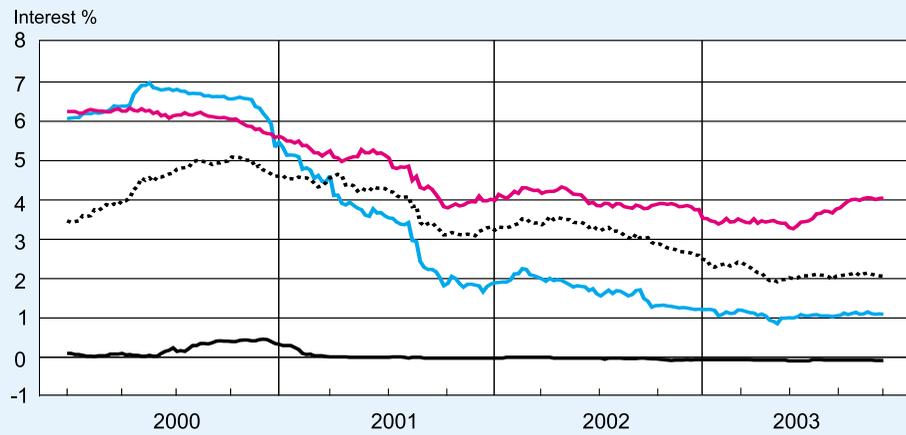
b. Yields on 2-Year Government Bonds, 2000–03

Yield %

c. Yields on 10-Year Government Bonds, 2000–03

Yield %

£	¥
$	€
Germany	

SOURCE: Bloomberg.

Figure 1.8
Distribution of Yields of the Portfolio and the Benchmark, 1993–2003

(Percent, in annual numeraire terms)

Years ranked by yield on actual portfolio	Portfolio		Benchmark	
	Yield	Standard deviation	Yield	Standard deviation
1995	8.3	0.6	7.9	0.6
2000	6.8	0.9	6.8	0.9
1993	6.4	0.9	5.7	0.5
2001	6.3	1.4	6.1	1.4
1998	6.0	0.6	6.0	0.7
2002	5.2	1.3	5.0	1.4
1997	5.0	0.4	5.2	0.5
1996	4.9	0.7	4.9	0.6
1999	3.3	0.7	3.2	0.6
1994	2.7	0.7	2.8	0.6
2003	**2.1**	**0.8**	**1.9**	**0.8**

SOURCE: Bank of Israel.

however, due to the low holding-period rate of return, the ratio of the return to the intra-year volatility was low, reflecting a certain rise in market risks compared with their level in previous years. As a result of market developments in 2003, that led to a combination of an exceptionally low holding-period rate of return and a higher volatility than in previous years, the benchmark yield/risk ratio was lower than in previous years. This can be seen in Figure 1.8, in which the observations for all the previous years are above the line joining the observation for 2003 with the origin of the graph.

Volatility is symmetrical as a risk index, and therein lies its drawback: it expresses the possibility of obtaining a return significantly different from the average, either higher or lower. Another index of risk, that estimates the risk of a loss, is provided by the value at risk (henceforth VaR), an estimate of the maximum capital loss that could be incurred within a certain time period and with a certain probability. The VaR of the currency components of the benchmark provides an estimate of market risk in the main markets in which the reserves are invested. Figure 1.9 shows the movements of the VaR of these components.

The following points emerge from the figure:

• The VaR of the benchmark portfolio in 2003 is estimated at between 0.20 percent and 0.30 percent of the value of the portfolio.[7] This means that in 2003 the risk of a capital loss in excess of $ 65 million in one week was smaller than 5 percent.

• The downward trend in the VaR of the dollar benchmark portfolio that had started in the last quarter of 2002 continued in January and February 2003, and then the risk level in the US market rose again somewhat, and then stabilized. As a result, it was low

VaR also serves as an estimate of market risk of the reserves. The VaR of the benchmark indicates that in 2003 the risk of a capital loss in excess of $ 65 million in one week was smaller than 5 percent.

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[7] The calculation does not take into account correlations between the different markets, and is thus a conservative estimate of the risk.

Figure 1.9
VaR of Various Benchmarks, 1999–2003

Basis points   (one-week horizon, 95% confidence level)

SOURCE: Bank of Israel.
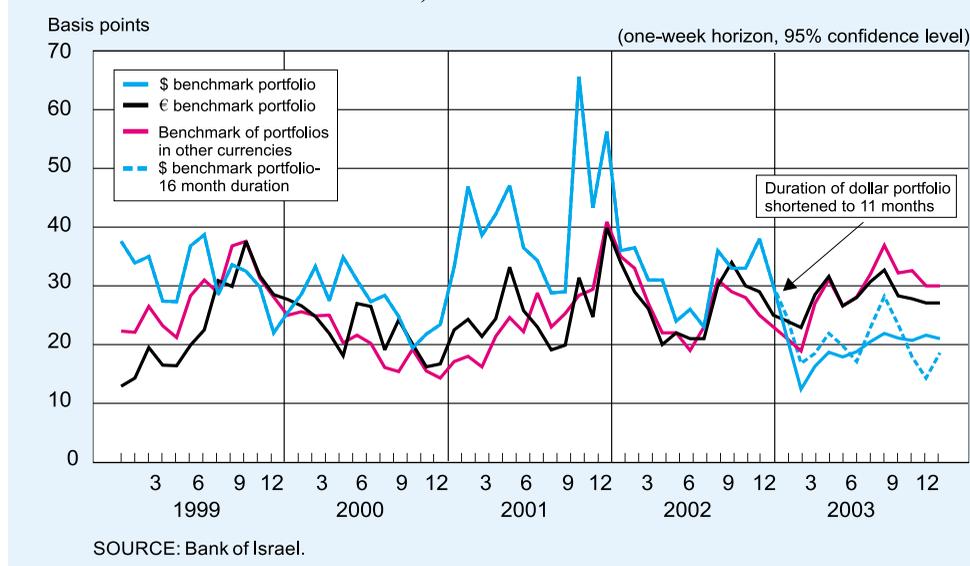
during 2003, relative to other markets and relative to the level in previous years. This decline is explained only in part by the switch in December 2002 from a 16-month duration in the dollar portfolio (the dotted line in the figure) to an 11-month duration. The announcement by the Fed that the short-term interest rate was expected to remain low for "a considerable period" also reduced investor uncertainty, and apparently contributed to the lowering of the VaR.

- The geopolitical risk both before and after the invasion of Iraq by the US and its allies did not have any significant effect on the VaR, in contrast to the terrorist attacks of 11 September 2001.

The effect of changes in the structure of the benchmark: The target duration of the benchmark in all currencies was set in 1999 at a constant 16 months, on the basis of research that showed that benchmarks with that duration were expected to give annual holding-period rates of return higher than the desired minimum threshold with a probability of 95 percent (the 'shortfall' approach). The desired minimum threshold was defined as half the yield on a 3-month T-bill in the US market and as half the return on a one-month deposit in other markets. Towards the end of 2002 it was decided to shorten the duration of the dollar benchmark from 16 months to 11 months (see Section 4c in Chapter 1 of the 2002 Annual Report of the Foreign Currency Department). The background to the decision was the low level of holding-period rates of return prevailing in the US bond market. When returns are so low, a relatively small rise in them is likely to result in capital losses greater than the interest income, thus raising the risk of negative holding-period rates of return on the reserves portfolio. At the

The geopolitical risk before and after the invasion of Iraq by the US and its allies did not have any significant effect on the VaR.

The target duration of the benchmark in all currencies was set in 1999 at a constant 16 months; towards the end of 2002 it was decided to shorten the duration of the dollar benchmark from 16 months to 11 months.

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same time as the decision was made to shorten the duration of the benchmark, it was also decided to reduce the maximum time to maturity of the assets in it from five years to three, to avoid a situation in which the share of long assets in the new benchmark would be too small.

Decisions on the structure of the benchmark should normally be reviewed only after sufficient time has elapsed, in order to check whether the benchmark in fact reflects the long-term investment strategy. However, it is appropriate to monitor the effects of the decision to shorten the duration of the dollar benchmark, since it was made in reaction to conditions that were exceptional and expected to be temporary, i.e., the very low holding-period rates of return. The dollar benchmark with the 11-month duration actually used gave a holding-period rate of return of 150 basis points, while the benchmark with the previous 16-month duration gave a return of 163 basis points. It thus transpires that the concern which led to the change of the benchmark was not realized, as both the selected benchmark and the alternative benchmark that reflects the Bank's long-term decision gave holding-period rates of return greater than zero. On the other hand, the cost of the decision in terms of the return that was lost, i.e., 13 basis points, turns out in retrospect to have been reasonable. Both benchmarks also met the minimum threshold criterion, defined in the US market as half the holding-period rate of return on an investment in 3-month T-bills, that came to only 57 basis points in 2003.

The dollar benchmark with the 11-month duration actually used gave a holding-period rate of return of 150 basis points, while the benchmark with the previous 16-month duration gave a return of 163 basis points.

Box 1.2
Transaction Costs in the Reserves Portfolio Benchmark

The Bank of Israel uses the yield spread between the reserves portfolio and the benchmark to assess the contribution of active portfolio management. The gap derives mainly from deviations of the composition of the portfolio from that of the benchmark. The deviations result from active portfolio management involving decisions about the portfolio's currency composition, its duration, the assets in it and their dispersal along the yield curve. However, the size of the gap is affected by another factor, i.e., transaction costs, or the bid-offer spread in transactions in the portfolio; this cost does not exist in transactions 'performed' in the benchmark. Due to the different approach to transaction costs in the portfolio and in the benchmark, a gap would be created between the returns on the portfolio and on the benchmark, to the disadvantage of the former, even if the portfolio were managed passively, i.e., even if it were a copy of the benchmark. This gap should be taken into account in comparing the two returns.

A short description follows of the structure of the benchmark and its transactions, and an estimate of the effect of transaction costs on its holding-period rate of return.

The structure of the benchmark: The overall benchmark consists of several benchmarks in different currencies. The currency composition of the overall benchmark is the same as the composition of the currency numeraire of the reserves portfolio, and its size is adjusted to match the size of the actual portfolio at the beginning of each month. The size of the reserves portfolio and the composition of the currency numeraire therefore dictate the total balance of the benchmarks for each one of the currencies included in the numeraire, and the size of each benchmark within a currency group is determined such that the group's overall duration is neutral.

The benchmarks of each of the numeraire currencies are hypothetical portfolios, each containing government bonds of the country with that currency, in a given market segment defined by the bonds' period to maturity, in proportions similar to those in the market. These assets have characteristically low risk and high liquidity, features that reflect the Bank's long-term investment strategy.

Adjustment of the benchmarks: At the beginning of each month the benchmark portfolios are adjusted as follows:

• Securities which due to their shortened term-to-maturity over the month no longer fit into the definition of the relevant market segment are excluded from the benchmark; long securities which due to their shortened term-to-maturity now fit into the market segment are added to the benchmark, Newly issued securities in the relevant market segment are also added.

• The size of the overall benchmark is adjusted to that of the actual portfolio, as stated above, and the sizes of the benchmarks included in it are thus also adjusted. The size of the benchmark requires adjustment because of flows into and out of the reserves portfolio, the result of actions taken by the government and the domestic banks.

• The quantities of all the assets in the various benchmarks are adjusted according to the distribution of assets in the relevant market segment.

Adjustments in the different benchmark portfolios are carried out via sales and purchase transactions. Due to the changes in the size of each benchmark, and due to the need to match the composition of the assets included in each benchmark with the distribution of assets in the market, transactions take place in nearly all assets included in the benchmark.

For technical reasons all adjustment transactions in the benchmark, whether sales or purchases, are carried out at the lowest market (i.e., bid) price. Hence the benchmark does not pay the bid-offer spread on the assets in the transactions carried out in it, so that its holding-period rate of return has an upward bias by the amount of the transaction costs.

Estimate of transactions costs in the benchmark: To evaluate the effect of transaction costs on the benchmark holding-period rate of return, the costs were estimated as follows: the total volume of sales and purchases in each benchmark was calculated, and this amount was multiplied by half of the characteristic bid-offer spread in the relevant market segment of government bonds. The result of the calculation shows that the transaction cost in the overall benchmark portfolio totaled 1.8 basis points of the value of the portfolio in 2002, and 1.5 basis points in 2003. Hence the yield spreads between the portfolio and the benchmark were greater by those amounts in those years than the spread obtained directly and shown in this report.

Box 1.3

The Duration of the Neutral Benchmark: Update of the Results of the Model

An update of the study that provided a basis for setting the duration of neutral duration of the dollar benchmark as 16 months is given below. The decision taken at the end of 2002 to reduce the duration to 11 months is examined in the light of the results of the update.

The background

The duration of the currency portfolios in the Bank of Israel's reserves reflects the neutral position of the portfolio manager with regard to interest risk. In 1999 it was decided to determine the neutral duration on the basis of the shortfall method, i.e., a target duration would be set for the benchmark portfolio that would give annual holding-period rates of return higher than the minimum threshold levels with a 95% probability.[1] The minimum level is defined as half the rate of return on 3-month T-bills. Based on research carried out by the Bank of Israel, it was decided that the duration of the dollar portfolio should be set at 16 months. The research was based on a 14-year period (from June 1984 to June 1998), and the results were checked over a longer period, dating back to the 1950s. The outcome of the research was the lengthening of the neutral duration from 12 to 16 months.

Since it was decided to increase the neutral duration, many changes have taken place in the holding-period rate-of-return trends in the US bond market. Some of the most notable changes occurred in last few years, with the steep decline in rates of return all along the yield curve that brought them to the

[1] For a detailed explanation see the 2001 Annual Report of the Bank of Israel Foreign Currency Department.

lowest levels in about fifty years (Figure 1). At such low interest rates, a small upward shift in the curve can lead to large capital losses relative to the low current interest rate. Thus there was a higher probability of obtaining annual holding-period rates of return on the portfolio below the minimum threshold (i.e., failure to meet the shortfall criterion), or even negative rates of return. In such a situation, keeping a duration of 16 months would have exposed the portfolio to a yield/risk ratio lower than previously. Assuming that the Bank's preference regarding this ratio had not changed, and to maintain the ratio at its past level, it was decided at the end of 2002 to reduce the duration of the dollar benchmark portfolio temporarily to 11 months.[2] At the same time it was decided to reexamine the desired duration of the dollar benchmark using the shortfall approach, basing the analysis on a longer sample period that would include the latest developments in the dollar bond markets—from June 1984 to August 2003. A retrospective examination would also be carried out on the performance of the portfolio with the 16-month duration over the last five years, using the shortfall criterion.

Figure 1

Yields to Maturity on Treasuries with Different Maturities, 1996−2003
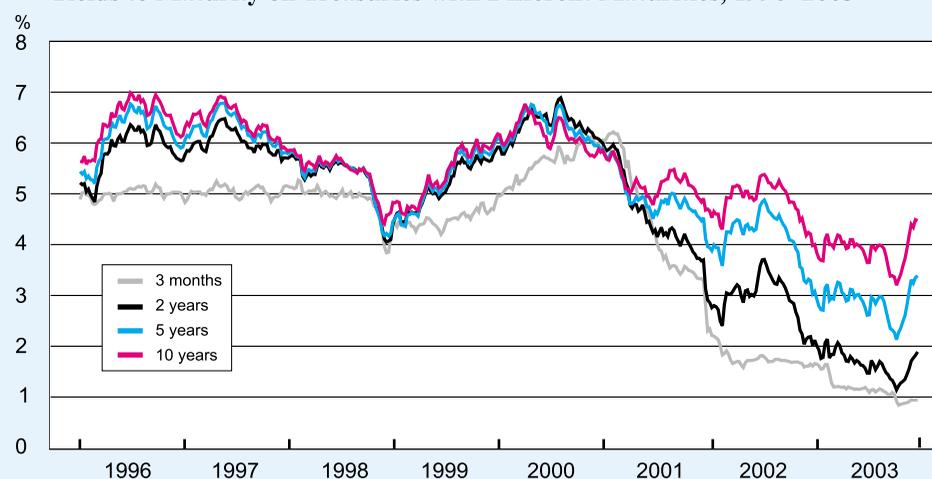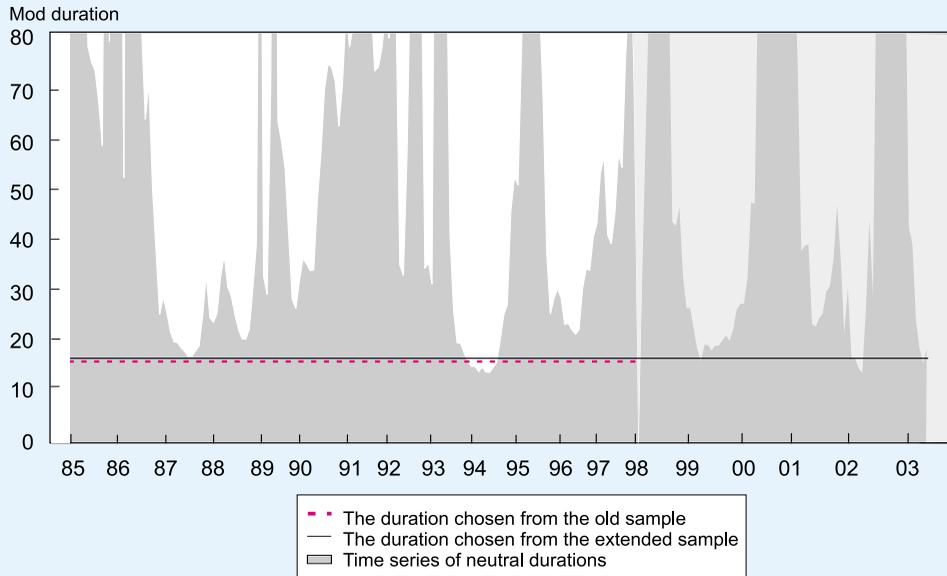

SOURCE: Bank of Israel.

The results

1. Applying the model to the extended sample period yielded results very similar to the previous ones: a neutral duration of 16.1 months compared with 16 months in the old sample (Figure 2). In the light of the drastic

[2] A more detailed description of this decision appears in Chapter 1 of the 2002 Annual Report of the Bank of Israel Foreign Currency Department.

market changes in the last three years this result is somewhat surprising, and it shows that the neutral duration obtained via the model is very stable over time, and is not affected to any significant degree by cyclical volatility in yields to maturity.

Figure 2
The Time Series of Neutral Durations Derived from the Model, and the Selection Criterion Over Time, June 1985–August 2003

Mod duration

- - - The duration chosen from the old sample
— The duration chosen from the extended sample
▭ Time series of neutral durations

SOURCE: Bank of Israel.

Figure 3
Moving Annual Holding-Period Rates of Return on a Portfolio with 16-Month Duration vis-à-vis the Threshhold, 1996 to mid-2003

%

— Portfolio with 16- month duration
— Threshold

SOURCE: Bank of Israel.

25
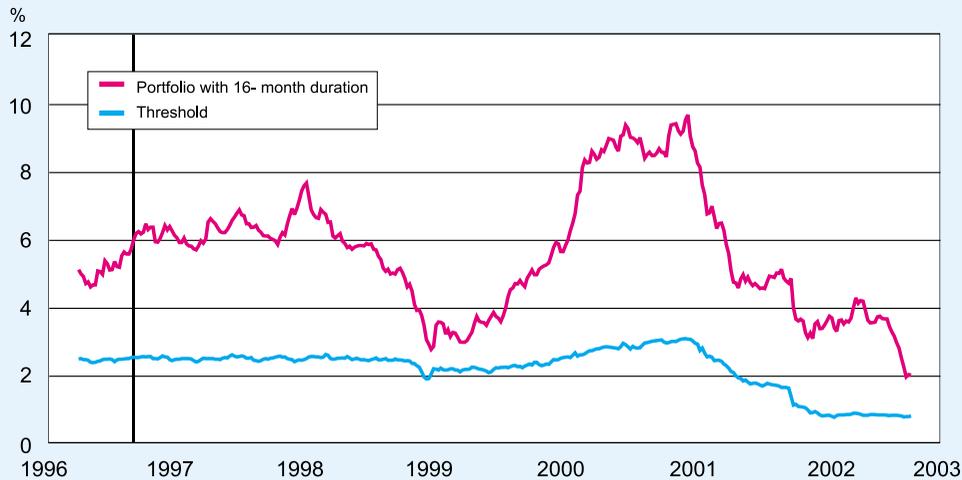
The stability of the results is to some extent due to the way the neutral duration is derived from the model, in which a time series of neutral durations is calculated. The neutral duration at any point in time in the series is derived from the distribution of the changes in the yield to maturity in the year up to that point in time.[3] As this time series is very volatile, and the objective is to choose a duration for the dollar benchmark that will be appropriate over the long term, it was decided to select a duration from the series of neutral durations such that 95 percent of the observations in the series would be above it, i.e., a duration that would satisfy the shortfall criterion for 95 percent of the sample period. Choosing the duration in this manner ensures the relative stability of the results when the model is applied over different overlapping sample periods, most of which are relatively long.

Basing the derivation of the time series of neutral durations on the changes in the yield to maturity in the one year preceding any point in time created a situation in which, in the last three years, when yields to maturity declined, the durations were relatively high. The reason was that a fall in yields leads to capital gains and relatively high holding-period rates of return. Only the stabilization of yields at low levels, or the start of a rise, will result in a reduction of the neutral durations so that they reflect the risk of a possible rise in yields from their low level. The neutral durations derived from the model in the recent past were indeed shorter than 16 months.

The decision to shorten the duration of the dollar benchmark temporarily to 11 months was taken at the beginning of 2003, despite the fact that the model did not yet indicate such a reduction, because of the relatively high risk of obtaining holding-period rates of return lower than the minimum threshold or even negative if the yields to maturity were to start rising. The decision may be seen as 'insurance' against a possible rise in yields. Reducing the duration does not necessarily run counter to the model, because in addition to the 5% probability that the model assigns to the failure to meet the minimum threshold, there is another risk that derives, as stated, from the choice of a duration that satisfies the shortfall criterion for only 95 percent of the time. This means that that there is an additional risk, over and above the 5% probability that the model allows that a portfolio with a 16-month duration will not meet the minimum threshold. The decision to shorten the duration of the dollar benchmark to 11 months was taken due to the assessment that this risk had risen sharply in the recent past.

2. The examination of the performance of the portfolio with the 16-month duration in the last five years using the shortfall criterion showed that throughout the period from 1996 to August 2003 the annual rate of return of the portfolio exceeded the minimum threshold. This means that the Bank of

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[3] The research and the model are described in detail in the 2000 Annual Report of the Bank of Israel Foreign Currency Department.

Israel's dollar benchmark, the duration of which was extended to 16 months as a result of the study referred to, met the shortfall criterion in the last five years. Moreover, a portfolio of US Treasuries with a 16-month duration yielded 5.27 percent in annual terms over the last five years, compared with a yield of only 5.06 percent on a portfolio of US Treasuries with a 12-month duration. Thus, *post factum*, the switch to a longer duration contributed an incremental 21 basis points to the yield while meeting the shortfall requirement, i.e., it did not deviate from the Bank of Israel's market-risk requirement.

Current portfolio management—deviations from the benchmark

Current management of the portfolio contributed 21 basis points to the portfolio yield in 2003, with a volatility of 9 basis points (Tables 1.3 and 1.4, Figures 1.2 and 1.10). The contribution of current management is the spread between the yield on the benchmark and the yield on the actual portfolio. It reflects the effects of decisions taken regarding its currency composition, duration, the assets included in it and their dispersion over the yield curve. In each of these features, the portfolio can either match the neutral benchmark or deviate from it, within the permitted degrees of freedom.

Current management of the portfolio contributed 21 basis points to the portfolio yield in 2003, with a volatility of 9 basis points.

Table 1.4
Contribution of Management Decisions to the Yield Spread
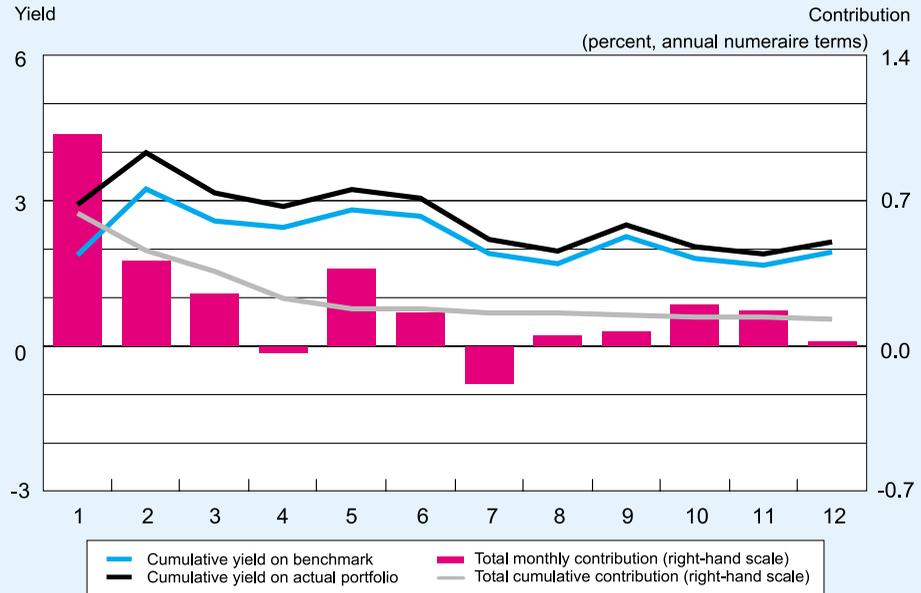**vis-à-vis the Neutral Benchmark, 2003**

(basis points, in annual terms)

	Total contribution	Duration	Investment in the GNMA sector	Asset Selection	Dispersion along curve	Currency Management
Total	**20.9**	**–2.3**	**–1.2**	**20.5**	**–0.5**	**4.4**
Currency portfolios						
Total	**16.5**	**–2.3**	**–1.2**	**20.5**	**–0.5**	
Dollar portfolio	12.9	–2.0	–1.2	17.2	–1.1	
Euro portfolio	3.1	0.2		2.3	0.6	
Other portfolios	0.5	–0.5		1.0	0.0	
Currency positions	**4.4**					**4.4**

SOURCE: Bank of Israel.

Yield spreads vis-à-vis the benchmark and their volatilities can provide an indication of management expertise, the ideal being a positive contribution to the yield with relatively low volatility. Figure 1.11 (and Table 1.3) show the average yield spreads between the benchmark and the actual portfolio and their volatilities for every year from 1994 to 2003. The ratio of incremental yield and its volatility (the 'information ratio') is reflected in the figure by the slope of the line for each year. The objective is to achieve a ratio greater than one, because in that situation the incremental yield more
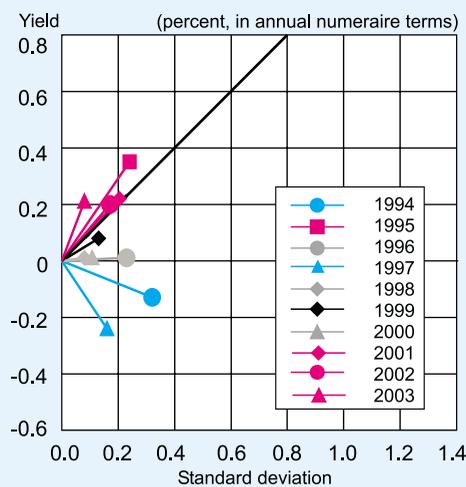
The ratio of incremental yield and its volatility, which indicates the ability to outperform the benchmark over time, was greater than 2 in 2003, its highest level in the last ten years.

Figure 1.10
The Cumulative Yields of the Actual Portfolio and the Benchmark and the Monthly and Cumulative Contribution of Active Management, 2003

Yield

Contribution
(percent, annual numeraire terms)

Cumulative yield on benchmark
Cumulative yield on actual portfolio
Total monthly contribution (right-hand scale)
Total cumulative contribution (right-hand scale)

SOURCE: Bank of Israel.

Figure 1.11
Yield Spreads vis-à-vis the Benchmark, 1994–2003

Yield   (percent, in annual numeraire terms)

1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

Standard deviation

SOURCE: Bank of Israel.

than compensates for the additional risk incurred. The figure shows that in 1995, 2001 and 2002 the ratio was between 1 and 1.5 (as the slope of the lines in those years was greater than that of the dotted upward sloping line which has a slope of 1); in 1996, 1998, 1999 and 2000 the slope was between zero and 1, and negative only in 1994 and 1997. In contrast, the ratio in 2003 was greater than 2, its highest level in the last ten years, and significantly higher than its previous highest level (that in 1995).

The rise in the information ratio in the years from 2001 to 2003 is apparently the result of the change in approach at the beginning of that period. Table 1.3 shows that 2003 was the fourth year in

succession with a contribution of asset and duration management of between 15 and 20 basis points, after six years when the contribution from this source was close to zero. The increase in the contribution since 2000 derives from the decision to increase the resources devoted to asset management on the one hand, and to reduce the exposure reflected in duration management on the other. Since 2001 the exposure reflected in currency management has also been reduced, so that the effect of the change in the approach is evident in the total yield spread between the actual portfolio and the benchmark.

Another index for assessing the risk in various positions vis-à-vis the benchmark is their value at risk (VaR), i.e., the VaR of the spread between the actual portfolio and the benchmark. Figure 1.12 shows the changes in the VaR of the positions from June 2002 to the end of 2003, calculated in various ways.[8] The figure shows that the VaR in the sample period, measured by the parametric method,[9] varied between 2 basis points

The VaR measured by the parametric method, excluding the positions in GNMAs and TIPS, varied between 2 basis points and 6 basis points and its average for 2003 was 3.6 basis points.

Figure 1.12
The VaR of the Portfolio vis-à-vis the Benchmark (the VaR of the Positions), June 2002–December 2003
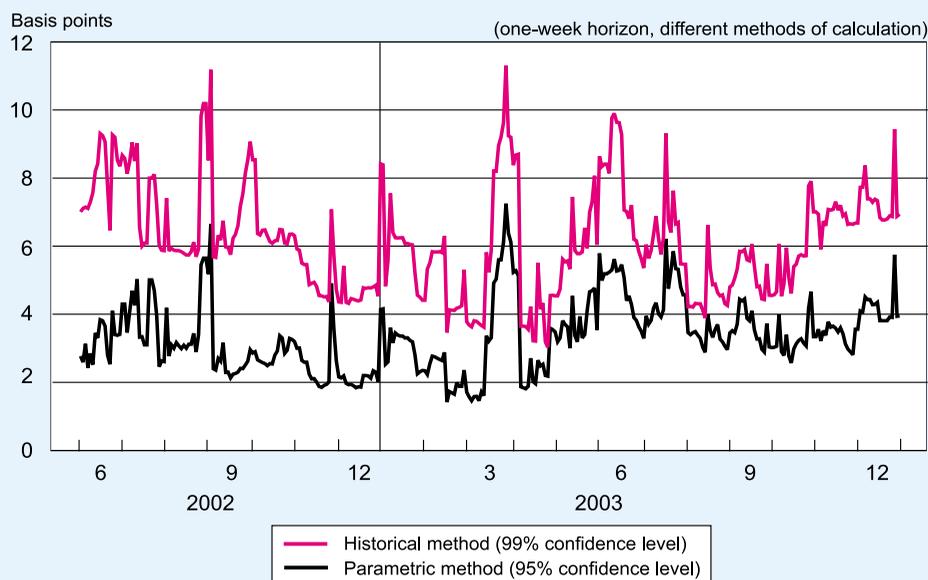
SOURCE: Bank of Israel.

[8] For technical reasons the VaR shown in the figure do not include the VaR of the positions in GNMAs and TIPS. The VaR of these positions in the period under review is estimated at 1.6 basis points on average.

[9] In this method parameters of the distribution are estimated from historical data of the holding-period rates of return of different assets. Assuming that the yield distribution is normal, a link can be established between the estimated standard deviations and the probability of a specified loss or profit. The VaR using the parametric method and shown in Figure 1.12 makes this assumption, and is calculated for a one-week horizon at a 95% confidence level.

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and 6 basis points (hundredths of a percent of the value of the portfolio), and its average for 2003 was 3.6 basis points. This VaR does not include the positions in GNMAs and TIPS; if the estimate of their VaR is included, the VaR of the positions comes to about 5 basis points, on average. This means that the probability of losing more than about $ 12 million in the various positions in the course of one week in the sample period is less than 5%. This should be viewed in the context of the actual incremental return of 21 basis points (about $ 50 million) for the whole year.

The VaR calculated from historical data at a 99% confidence level[10] shows the loss that could be incurred under more extreme circumstances. The data show that in such cases the VaR of the positions opened in the portfolio increased to up to three times that estimated by the parametric method that gives an estimate of VaR in normal times. This approach to the historical VaR is consistent with the estimate of the loss that the positions at the end of 2003 were likely to incur in the worst scene scenario in the markets; the estimate was 0.14 percent of the value of the portfolio. As part of the follow-up of the current risk in the portfolio, the VaR is sometimes estimated for scenarios which duplicate extreme historical conditions that were realized in various market crises (known as historical stress testing).

The relatively low VaR derives from the relatively small actual positions.

The changes in the VaR of the positions reflect the size of the positions and also the changes in risk in the market, described above. The fact that the VaR is relatively low derives from the relatively small actual positions. Full utilization of the degrees of freedom afforded to the Foreign Currency Department in managing the various risks would raise the VaR of the positions to 0.24 percent of the value of the portfolio.

c. The yield on the reserves portfolio compared to that achieved by other managers

Comparing the performances of different portfolios is problematic. Nonetheless, something can be learned from a comparison of similar portfolios.

Comparing the performances of different portfolios is problematic, firstly because they are generally managed against different benchmarks, and secondly because of the different investment policies governing them. Nonetheless, something can be learned from a comparison of similar portfolios.

Information is available relating to the performance of several funds which operated in the US market from 1994 to 2003. The group consists of nine funds which invest mainly in US government bonds. Some are classified as Investors in Short Treasuries, and the others as Investors in Medium Treasuries. The funds do not invest a large part of their portfolios in TIPS, and invest only a very small amount in assets with ratings lower than AA. These features enable the performance of the Bank of Israel's dollar portfolio to be compared with that of the funds, despite the differences between them.

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[10] This method is also based on historical data of holding-period rates of return, but makes no assumption about the distribution. Actual profit-and-loss is graded, and the VaR is determined according to its position in the grading. The VaR using this method and shown in Figure 1.12 is calculated for a one-week horizon at a 99% confidence level.

Figure 1.13
Performance Distribution of Managers of Short- and Medium-Term Funds in US Market, 1994–2003
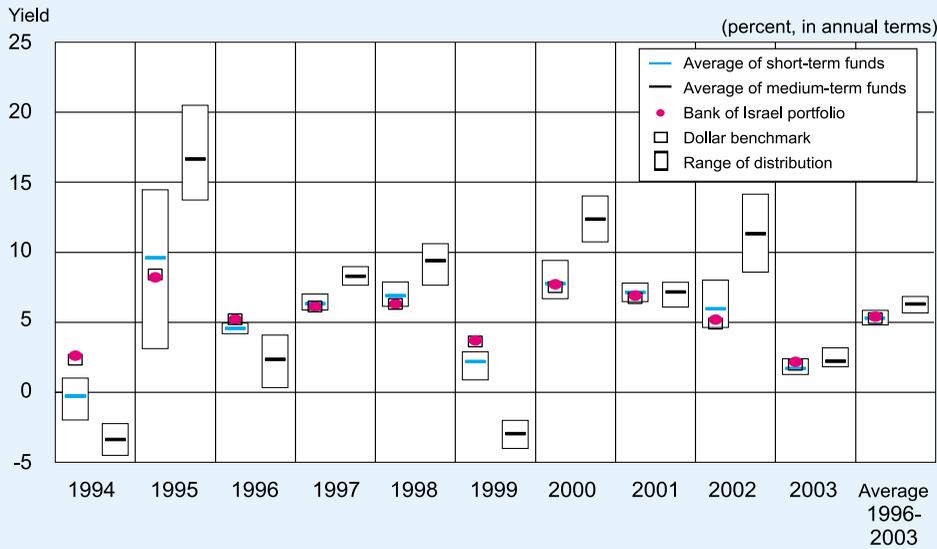
SOURCE: Lipper Inc. via the Wall Street Journal internet site, and Bloomberg.

It must be borne in mind, however, that the performance of the funds is shown after deducting fees that reflect operational expenses, whereas the performance of the reserves dollar portfolio are shown without deducting this type of expense. Figure 1.13 shows the distribution of annual holding-period rates of return of the funds since 1994 for each type of fund, i.e., short and medium-term. For each period the figure shows the lowest and the highest return of the portfolios in that group, the average return for the group, and performance of the dollar portfolio and the dollar benchmark in the appropriate periods. It can be seen from the distribution of returns that the performance of the dollar portfolio throughout the period was within or above the range of the distribution of the funds' rates of return. The years when the dollar portfolio outperformed all the funds (1994, 1996 and 1999) were years when the yield to maturity in the US Treasuries market rose, and the short funds performed better than the medium ones. The better performance of the dollar portfolio in those periods suggests that its duration is shorter than those of the other funds, which would also explain its relatively low standing in the ratings of holding-period rates of return in the last few years when yields to maturity fell.

In 2003 the holding-period rate of return on the dollar portfolio was close to the highest return achieved by the short funds. This result may not reflect differences in duration, because there is only a small difference between the performance of the short funds and that of the medium funds, and it is in favor of the latter. The difference

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should apparently be ascribed to the different asset-management decisions taken by the fund managers and the managers of the reserves dollar portfolio.

Other findings include the wide dispersion of the yields of the funds, that indicates the differences in composition of their investments, and the high volatility of the yields of the medium funds relative to that of the short ones, partly due to the medium funds' longer duration. In 1994 and 1999 all the medium funds had negative yields. Nevertheless, the range of the cumulative yields in each of the groups is very narrow, and the two are similar to each other.[11] It therefore seems that the return that the funds obtain by taking on extra duration is relatively small. This finding is even more noteworthy in light of the average yield of each fund vis-à-vis the volatility of its yield in the years from 1996 to 2003. These are shown in Figure 1.14. The figure also shows the average yield of the dollar portfolio and the volatility of its yield in the same period. The high ratio of the return to risk of the dollar portfolio is notable, higher than the ratio for all the other funds. (This ratio is expressed in the figure by the slopes of the lines connecting the observations to the origin.) The higher ratio of yield to risk in the short funds than in the medium ones is also notable. The differences between the yield/risk ratio of the dollar portfolio and those of the funds were the result of a relatively narrow range of variation of the returns compared with a wider range of variation of their volatilities. It should also be noted that the performance of the dollar portfolio was very close to that of its benchmark, due to the relatively small extent of the positions opened in it.

The high ratio of the return to risk of the dollar portfolio is notable, higher than the ratio for all the other funds. The ratio of yield to risk in the short funds was also markedly higher than in the medium ones.

Figure 1.14
Yield and Risk: the Dollar Portfolio vis-à-vis Funds in the US Market, 1996–2003
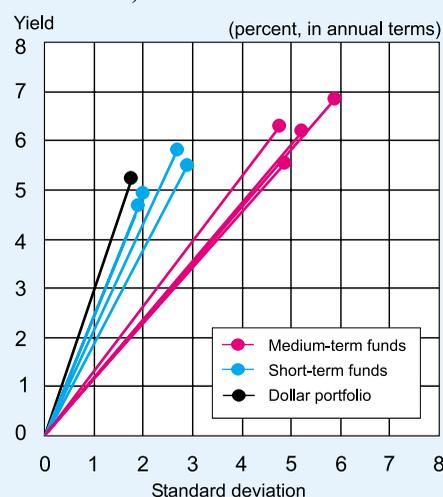
SOURCE: Bank of Israel.

3. RISK MANAGEMENT AND ITS CONTRIBUTION TO THE YIELD ON THE PORTFOLIO

a. Currency management

Decisions in the field of currency management determine the difference between the currency composition of the portfolio and that of the numeraire. This gap is called the

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[11] The cumulative yields are calculated for the period from 1996 to 2003 because no data are available for the years 1994 and 1995 for two of the funds.
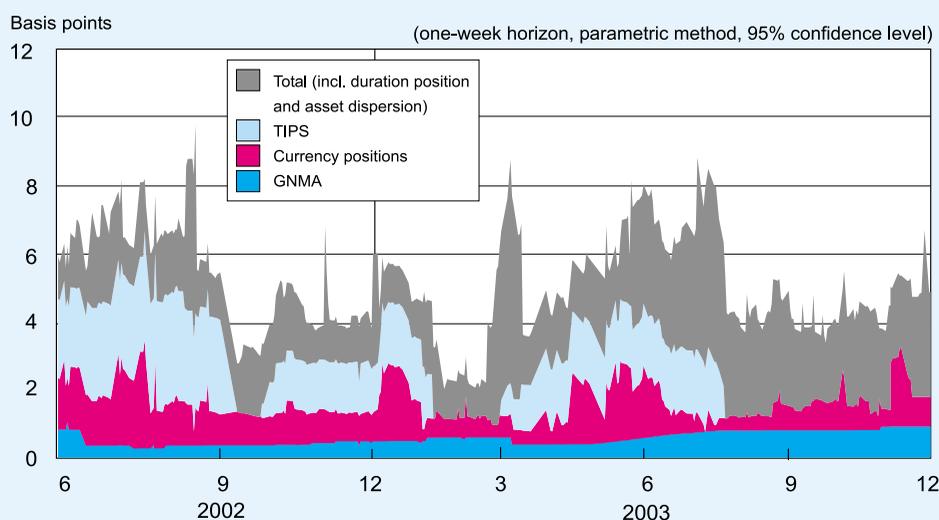
currency position. The currency management contribution, which includes cross-rate differentials, interest, and capital gains on the currency positions, amounted to 4.4 basis points in 2003 (Tables 1.3 and 1.4).

Various currency positions were opened in the course of the year based on tactical considerations and assessments of economic variables. These positions contributed an incremental yield of 3.0 basis points to the yield of the portfolio. Other currency positions were managed with the aid of models—a tool for the management of short-term currency positions used by the Department since mid-2000. The amount invested based on each model is fixed and relatively small. A limit on the accrued losses that might derive from their use was also set when they were introduced; the use of the models would cease if the accrued losses reached this ceiling. In the period since the introduction of these models many positions, held for different periods of time, have been managed with their help. In 2003 this activity resulted in an incremental yield of 1.4 basis points.

The risk inherent in currency positions is higher than the risk of other positions in the portfolio. Figure 1.15 shows the share in VaR of all the positions opened in the portfolio from June 2002 to the end of 2003. In can be seen that despite the relatively small extent of the currency positions opened in 2003 (less than one percent of the total reserves) relative to the total positions opened in that period, their VaR constituted on average more than a quarter of the VaR of all the positions. Their incremental yield, however, was in reasonable proportion to their VaR.

The currency management contribution amounted to 4.4 basis points in 2003. In the course of the year various currency positions were opened based on tactical considerations and assessments of economic variables. Other currency positions were managed with the aid of models.

Figure 1.15
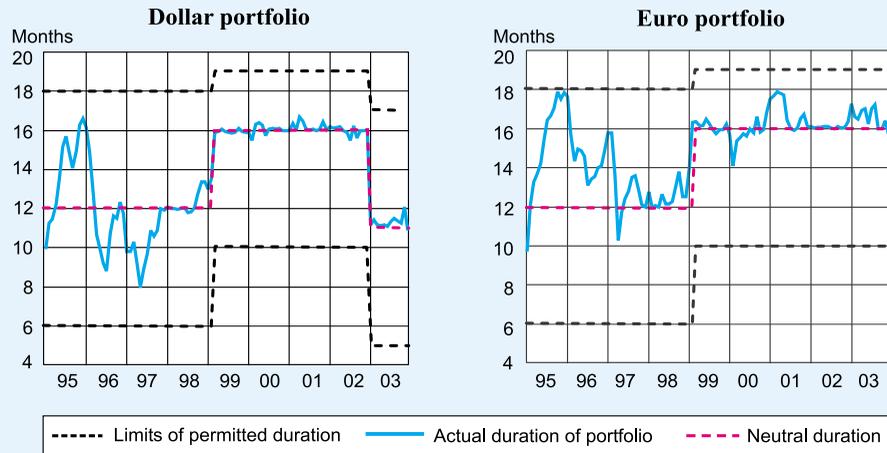**VaR of the Positions, June 2002−December 2003**

SOURCE: Bank of Israel.

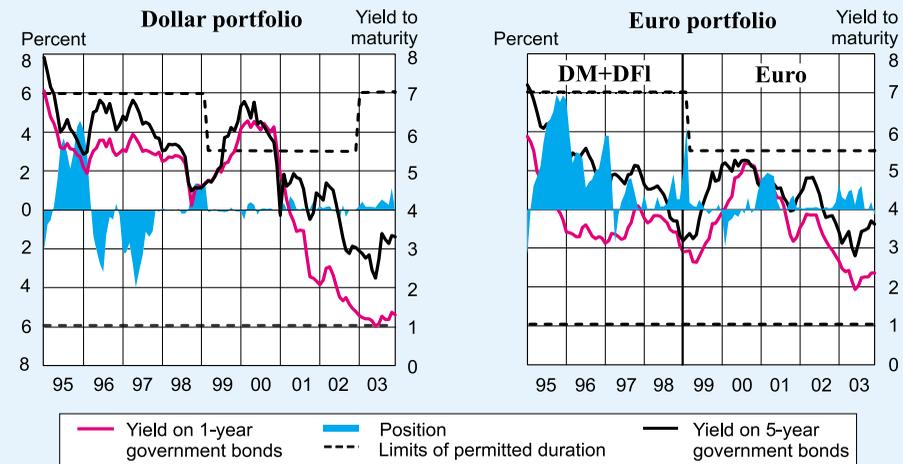**b. Management of duration and of asset dispersion along the curve**

In 2003 small duration positions in the different currency portfolios were opened, and these contributed a negative incremental yield of about 2.3 basis points vis-à-vis the

Figure 1.16

a. Duration of the Major Currency Portfolios, 1995−2003
(monthly averages, percent)

Dollar portfolio

Euro portfolio

Legend: ------ Limits of permitted duration · ▬▬ Actual duration of portfolio · ---- Neutral duration

b. Duration Positions in Various Currency Portfolios, and Yields-to-Maturity in Bond Markets, 1995−2003

Dollar portfolio

Euro portfolio

DM+DFl · Euro

Legend: ▬ Yield on 1-year government bonds · ■ Position · ▬ Yield on 5-year government bonds · ---- Limits of permitted duration

SOURCE: Bloomberg.

Small duration positions in the different currency portfolios were opened in 2003, and these contributed a negative incremental yield of about 2.3 basis points vis-à-vis the benchmark. The dispersion vis-à-vis the benchmark made a negative and small total contribution of 0.5 of a basis point.

benchmark. The dispersion vis-à-vis the benchmark made a negative and small total contribution of 0.5 of a basis point (Table 1.4 and Figures 1.16 and 1.17). Duration positions are reflected in the difference between the duration of a currency portfolio and the neutral duration set for that currency—in the case of the dollar portfolio the neutral duration was 11 months, and for all the other currency portfolios, 16 months. Dispersion positions arise from the purchase of assets in one area of the yield curve and the sale of assets in another part of the curve, and are constructed in such a way as

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Figure 1.17
Contribution of Asset Dispersion, by Partial Duration, 2003
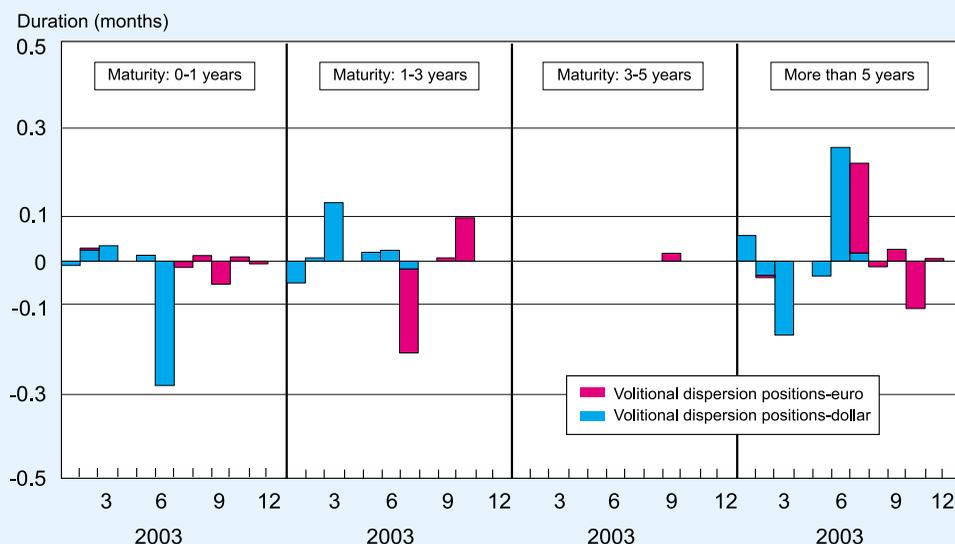
SOURCE: Bank of Israel.

to minimize the effect on their profitability of a parallel shift in the curve, with no change in its slope. The greatest effect on yield of these two types of position derived from activity in the dollar portfolio due to its prominent position in the total reserves. The size of these two types of position in the currency portfolios has contracted significantly in the last few years.

The dollar portfolio
Duration management and management of asset dispersion along the curve resulted in a loss of yield of 3.1 basis points on the reserves portfolio in 2003: a loss of yield of 2.0 basis points was due to duration positions, and the other 1.1 basis points were due to dispersion of assets different from that of the benchmark. Both long and short positions were opened during the year. Underlying the different positions opened during the year were changing assessments by the Foreign Currency Department of expected developments in the yield curve. The background factors included the trends in yields in the Treasury market, which fell in the first half of the year, rose rapidly in July and August, and marked time in the last few months of the year; expectations regarding the rate of recovery in the US economy, that changed during the year; concern in the spring that the US economy might move from the favorable process of disinflation to one of deflation such as that which afflicted Japan's economy over the last ten years; and the steepening of the yield curve in the second half of the year, apparently as the threat of deflation receded and concern emerged that monetary policy was too expansionary.

Duration and asset-dispersion management resulted in a loss of yield of 3.1 basis points in 2003.

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The euro portfolio and other currency portfolios

Duration and asset-dispersion management in these portfolios made a net contribution of 0.3 basis points to the incremental yield on the reserves portfolio. This resulted from a loss of 0.3 basis points on the duration positions and a profit of 0.6 basis points on asset-dispersion positions. Both long and short duration positions were opened in these portfolios during the year: some decisions regarding positions were based on the Foreign Currency Department's expectations regarding the economic situation in the countries in which the investments are made, and some were based on the expectations regarding developments in the US bond market. The incremental yield of 0.6 basis points from the management of positions in the area of asset dispersion, on the other hand, derived from activity in the euro portfolio, based on a technical model, and was spread relatively evenly throughout the year.[12]
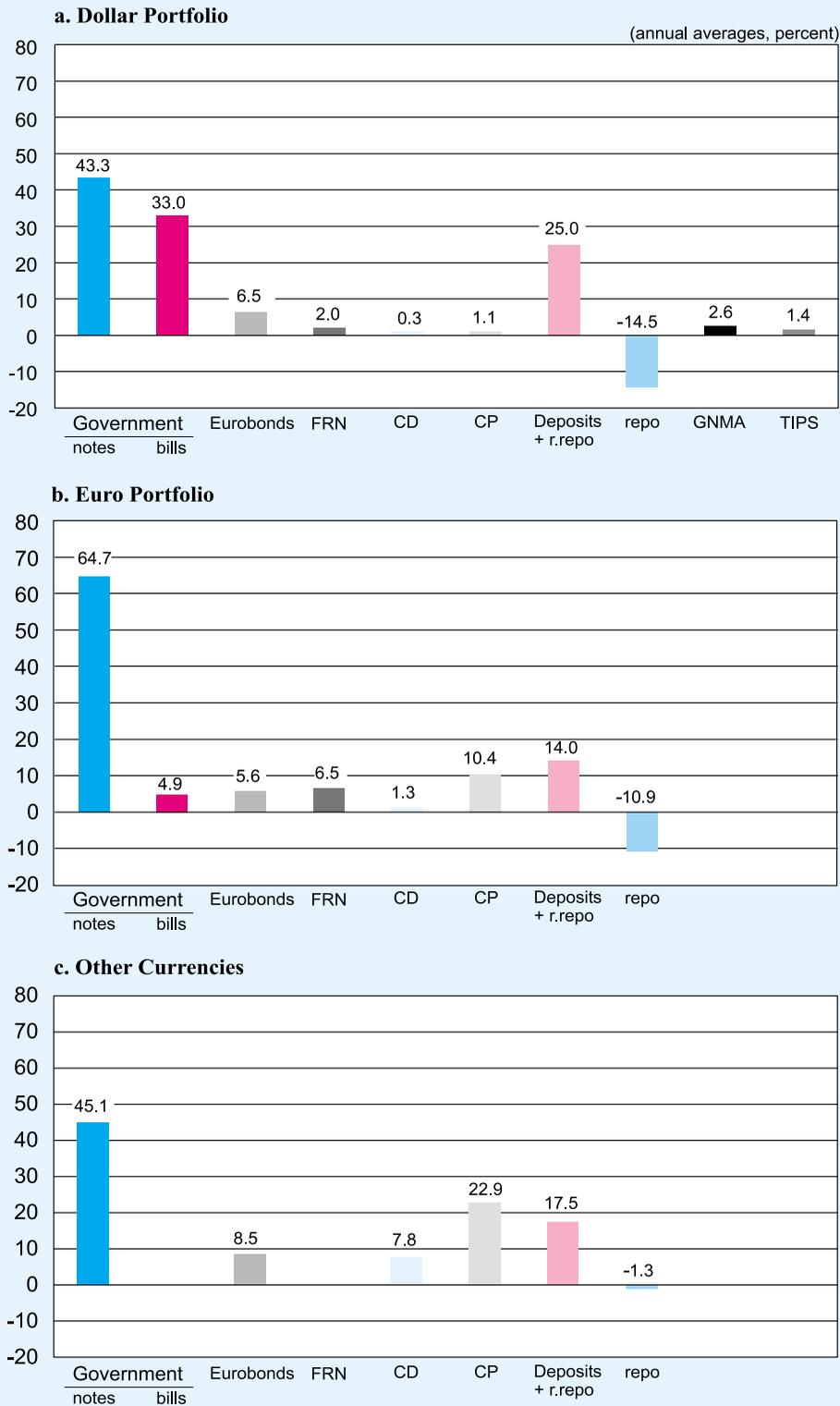
c. Asset selection

Decisions on asset selection contributed 20.5 basis points to the yield on the reserves portfolio. The contribution from the selection of spread assets (i.e., assets not in the benchmark) is measured by the difference between the holding-period rate of return on those assets and that on assets with similar durations included in the benchmark, taking their share in the portfolio into account; this contribution amounted to 13.0 basis points. To this must be added the contribution of 5.8 basis points from the allocation of assets in the benchmark in different proportions from those in the benchmark, and the contribution of 1.7 basis points of the differences in asset dispersion along the curve that arise from decisions on the selection of spread assets, that is not included in the calculation of the dispersion contribution discussed in section 3b above. The main contribution was that of assets selection in the dollar portfolio, the largest of the currency portfolios, particularly the investment in TIPS (Treasury Inflation-Protected Securities), in Eurobonds, and in GNMAs (mortgage-backed securities). Securities lending also contributed incremental yield on the portfolio (Table 1.5 and Figure 1.18). The contribution of 20.5 basis points from asset selection does not include the effect of the strategic decision to invest in the GNMA market (a strategy that was discontinued towards the end of the year). The effect was a negative one of 1.2 basis points (Table 1.4). The relatively large weight of asset positions in the total positions in the portfolio and in total incremental yield of management is also reflected in their relatively large weight in the incremental risk inherent in managing positions. This risk, in VaR terms, is shown in Figure 1.15.

The Bank of Israel, like many other central banks, is more averse to the credit risk inherent in investment in spread assets than it is to other risks, such as interest-rate risk. Controlling and managing credit risk therefore play an important role in the risk management of the reserves. They are achieved by internal restrictions the Bank imposes

Margin note (left): Duration and asset-dispersion management in the euro and other currency portfolios made a net contribution of 0.3 basis points to the incremental yield on the reserves portfolio.

Margin note (left): Decisions on asset selection contributed 20.5 basis points to the yield on the reserves portfolio.

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[12] This model was also used to manage asset-dispersion positions in the dollar portfolio, to a very small extent, but with less success, and its effect on the yield differential in that portfolio was negligible.

Figure 1.18
Asset Distribution of the Currency Portfolios, 2003

a. Dollar Portfolio

(annual averages, percent)

b. Euro Portfolio

c. Other Currencies

SOURCE: Bank of Israel.

Table 1.5
The Contribution of Asset Selection, 2003

(basis points, in annual terms)

		Total reserve portfolio
Dollar deposits, repo, and reverse repo		3.1
of which Securities lending	2.2	
Eurobonds		1.2
TIPS		6.5
GNMA		2.2
of which Internal management	0.3	
External management	1.9	
Other assets		5.8
Dispersion deriving from asset selection		1.7
Total		**20.5**

SOURCE: Bank of Israel.

on itself—quantitative ceilings on exposures to various risks and a system of investment rules—as well as by pricing the risk of tradable spread assets by marking them to market.

The incremental yield from the investment in *Eurobonds* was 1.2 basis points in 2003. The outperformance of the benchmark by these securities derived from their positive spreads compared with Treasuries and from the contraction of those spreads, mainly in the first half of 2003. The background to the narrowing of the spreads and their stabilization in the second half was the assessment by market participants that the economic recovery in the industrialized countries and the low absolute level of yields had lowered the risk of a significant widening of the spreads.

The investment in *TIPS* gave an incremental yield of 6.5 basis points in 2003. Purchases of TIPS, the extent of which varied in the course of the year, were matched against the sale of Treasuries with similar maturities. These positions were opened based on the view that expected inflation implied by the price of TIPS was lower than was considered reasonable. The incremental yield from the investment in TIPS involved incurring additional risk, estimated in terms of VaR as 1.3 basis points on average of the value of the reserves portfolio in the months when TIPS were held—about a quarter of the total risk (in VaR terms) of the positions taken in the portfolio in those months.

The incremental yield of 6.5 basis points on the investment in TIPS followed one of 5.5 basis points in 2002 and 7.0 basis points in 2001. It is worth noting that the operational handling of this asset, like that of GNMAs, is more complex than that of most other assets in which the reserves are invested, and this feature of TIPS apparently had a deterrent effect which slowed the rate at which institutional investors joined the group of potential buyers. It may thus be the case that the institutions that decided to face up to these operational difficulties, including the Bank of Israel, received a certain yield premium, included in the yield that was realized in the years mentioned. This positive effect is not expected to recur in the coming years, because towards the end of 2003 a significant number of institutional investors joined the existing participants in

The incremental yield from the investment in *Eurobonds* was 1.2 basis points in 2003.

The investment in *TIPS* gave an incremental yield of 6.5 basis points in 2003.

the TIPS market. It therefore appears that the contribution of this asset to the incremental yield earned by management of the reserves will fall.

The investment in GNMAs has been greatly reduced in the last few years. In 2003 this activity contributed an incremental yield of 1.0 basis points compared with the benchmark. This contribution is made up of two parts:

- The first is the contribution of the GNMA portfolio under external management: until December 2003 the GNMA portfolio was managed by an external manager against a benchmark consisting of the GNMA market index. Since then it has been managed against the same benchmark as the dollar portfolio, which is managed internally. The yield spread between the benchmark of the external manager and the benchmark of the long part of the dollar portfolio in the months from January to November is attributed to the strategic decision taken by the Foreign Currency Department several years ago to invest a certain part of the reserves portfolio in this type of asset. This yield spread contributed a negative 1.2 basis points to the yield gap between the reserves and their benchmark. In contrast, active management by the external manager earned a yield higher than that of his benchmark that came to an incremental yield of 1.9 basis points on the reserves portfolio. Hence the total contribution of this activity to the yield on the portfolio in 2003 was a positive one of 0.7 basis points.

- The second part of the contribution was that of positions held in GNMAs. In the first few months of 2003 a modest position was opened in GNMAs via purchase for future settlement (TBA). The contribution of this investment is measured by the yield spread between it and Treasuries of one to three years' maturity. This position, which was closed in April, gave a positive incremental yield of 0.3 basis points on the total yield on the portfolio in 2003.

The additional risk entailed by investment in GNMAs over the year was estimated at an average of less than one-hundredth of a percent of the value of the portfolio (in VaR terms). As mentioned, the extent of the investment in GNMAs has contracted greatly, so that the relatively small risk derives from the small size of the position.

The contribution of asset selection includes also the contribution made by *securities-lending activity* by the Foreign Currency Department. This activity, in which the Department has engaged for some years, is performed mainly in dollar securities. The activity consists of linking a pair of transactions—a repo trade with a reverse-repo trade or a bank deposit. In the repo transaction a security is lent. The cash received is 'deposited' in a reverse-repo transaction against another security, or is invested in a bank deposit. The two transactions are for the same period, and have no effect on the duration of the portfolio. The profit from such a pair of transactions arises from the fact that the securities which are lent in the repo transaction are in demand in the market by parties who are prepared to borrow them and to lend the equivalent value in money to the securities lender at a lower rate of interest than they could receive by depositing it elsewhere.

Income from securities lending in 2003 totaled about $ 5 million (about 2 basis points). In most of these transactions the money received in the repo was invested in bank deposits; as a result, this activity used part of the ceiling on the exposure of the

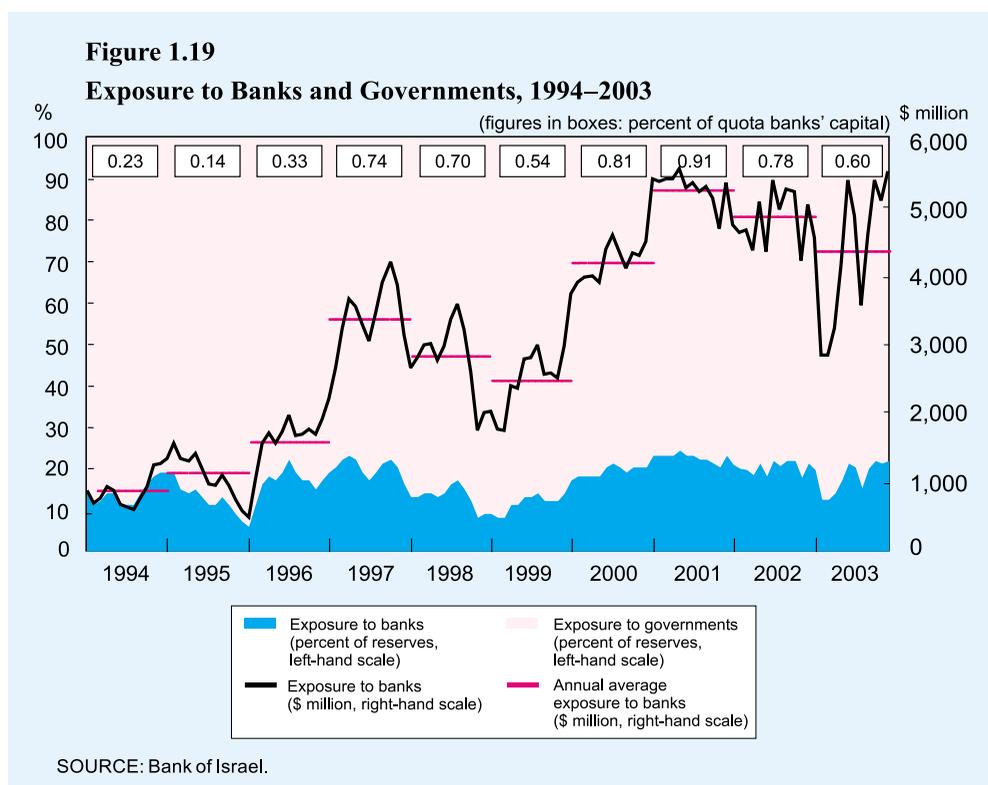The investment in GNMAs in 2003 contributed an incremental yield of 1.0 basis points compared with the benchmark.

Income from securities lending in 2003 totaled about $ 5 million (about 2 basis points).

reserves to the banking system (see below). As the investment horizon in lending transactions was very short, so too was the period of exposure to the relevant banks.

In addition to the above securities-lending activity by the Foreign Currency Department, several financial institutions which hold the Bank's securities in the foreign exchange reserves portfolio in custody also lend some of these securities on behalf of the Bank. This activity is performed using securities denominated in euro and in other currencies (excluding US Treasuries). The risk in lending is very low, and this activity does not harm the Bank's current activity in the securities which have been lent. The income from this lending by the institutions has been falling in the last few years, and in 2003 amounted to only $ 0.3 million.

Bank deposits are one of the spread assets in which the Bank of Israel is permitted to invest under the Bank of Israel Law. The exposure of the reserves to the banking system, which includes exposure to banks both due to deposits placed with them and due to other transactions with them, constitutes a substantial part of the exposure of the reserves portfolio to credit risk. This exposure is restricted to 25 percent of the size of the portfolio.

The annual average exposure of the reserves to the banking system was lower than in the last few years, 18 percent of the reserves compared with 20 percent in 2002 and 21 percent in 2000–2001 (Figure 1.19). The rate of exposure relative to the capital of the banks in which the Bank invests the reserves was also lower than in the last three years.

Figure 1.19

Exposure to Banks and Governments, 1994–2003

(figures in boxes: percent of quota banks' capital)

Boxes values: 0.23, 0.14, 0.33, 0.74, 0.70, 0.54, 0.81, 0.91, 0.78, 0.60

Legend:
- Exposure to banks (percent of reserves, left-hand scale)
- Exposure to governments (percent of reserves, left-hand scale)
- Exposure to banks ($ million, right-hand scale)
- Annual average exposure to banks ($ million, right-hand scale)

SOURCE: Bank of Israel.

The reduction in 2003 in the use made of exposure to the banking system occurred against the background of the very low TED spread in the dollar market. In such a situation the incremental yield for an increase in the risk entailed through banking exposure is small. At the same time, half of the banking exposure was utilized for dollar-securities-lending activity. Due to the very short investment horizon of this activity, the banking exposure it entails is over very short periods. Moreover, the restrictions on credit quality in the reserves portfolio are quite strict, so that the risk to which the portfolio is exposed is very low.

d. The liquidity of the reserves[13]

The reserves' liquidity measure estimates the share of the portfolio that can be realized quickly without its losing value. To enable the overall level of liquidity of the portfolio to be traced over time, the assets in the portfolio are divided into four groups according to their liquidity, i.e., according to the possibility of selling them without the sale itself causing a loss. The criteria employed in classifying securities into different levels of liquidity are the bid-offer spread for tradable assets, and for nontradable assets, their time to maturity. The groups are:
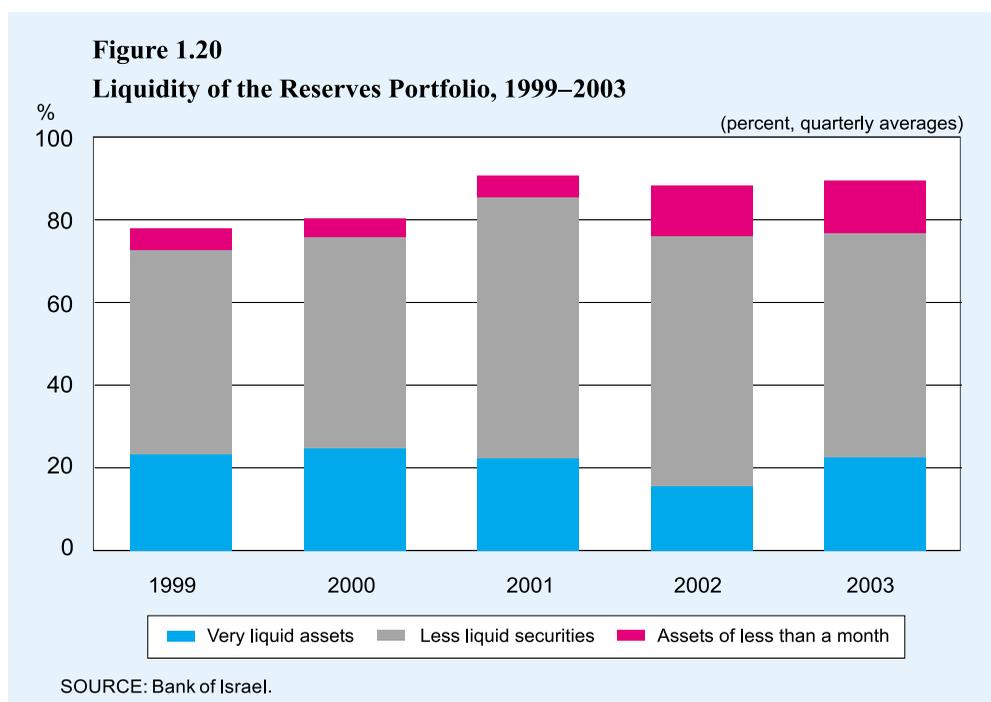1. Very liquid securities, with a bid-offer spread of 0–2 basis points or 0–2 cents;
2. Less liquid securities, with a bid-offer spread of 3–5 basis points or 3–6 cents;
3. Securities with maturities within one month, and deposits, repos and reverse repos shorter than a month;
4. All other assets.

The liquid part of the reserves consists of the first three of these groups. The distinction between the degrees of liquidity of these three groups is not clear-cut: as liquidity is measured using two different criteria—period to maturity and the bid-offer spread—ranking the liquidity of the third group vis-à-vis that of the first two is a matter of judgment. It is clear, however, that the second group is less liquid than the first.

The liquid component of the reserves comprised on average about 89 percent of the total in 2003, compared with 88 percent in 2002 (Figure 1.20). Twenty-three percent of the reserves were invested in the most liquid group of assets, about 54 percent in highly liquid assets less liquid than the first group, and about 12 percent is invested in assets maturing in less than a month. As compared to 2002, the first group grew by about 7 percent, with a matching decline in group 2. This change can be partly attributed to the narrowing of the yield spread between spread assets due to mature soon (CDs and CPs, see Appendix) and Treasuries maturing at the same time. The contraction of this spread and expectations of its widening in the future reduced the attractiveness of investment in short-term spread assets, classified 'less liquid,' and led to some of the investment in them being switched into short-term government bonds, classified 'very liquid.' The shortening of the duration of the dollar benchmark at the end of 2002—

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[13] An extensive discussion of the liquidity of the reserves and their liquidity management appears in Box 1.2 in the 2002 Annual Report of the Foreign Currency Department.

Figure 1.20

Liquidity of the Reserves Portfolio, 1999–2003

(percent, quarterly averages)

Legend: Very liquid assets · Less liquid securities · Assets of less than a month

SOURCE: Bank of Israel.

which increased the share of short Treasuries, classified 'very liquid,' and at the same time reduced the share of Treasuries with longer maturities, part of the 'less liquid' group—was also partly responsible for the above change. About 11 percent of the reserves were invested in 2003 in assets which were not in the liquid part of the reserves because they had relatively low liquidity. About half of this was invested in Eurobond-type securities, and the other half included mainly the money managed externally (invested mainly in GNMA-type securities), bank deposits of more than one month, and US government inflation-indexed bonds (TIPS). The reduction in the extent of activity in the last mentioned from the level in 2002 raised the share of the liquid component of the reserves by one percentage point.

In the light of the objectives of holding foreign exchange reserves and the ability to sell a large part of them in a short time without thereby depressing their value, it appears that their liquidity level is high enough, despite the gap between their actual level and the desired level. The high liquidity of the reserves derives from two main factors: one is the Bank of Israel Law and the investment policy derived from the spirit of the Law that prescribe a conservative approach to the management of financial risks, and in particular of credit risk. This in effect achieves one of the main objectives of the reserves management process. The second factor consists of economic considerations based mainly on the level of financial spreads of the various spread assets and the paths they are expected to follow relative to their inherent risk. In the light of this second factor, the Bank has made only partial use of the degrees of freedom to invest in spread assets with low liquidity during the last few years.

In the light of the objectives of holding foreign exchange reserves and the ability to sell a large part of them in a short time without thereby depressing their value, it appears that their liquidity level is high enough, despite the gap between their actual level and the desired level.

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Box 1.4
Appropriate Assets in which to Invest the Foreign Exchange Reserves:
The International Standpoint

The Bank of Israel Law, 5714–1954 specifies how foreign-currency activities should be carried out via the Bank of Israel, and states that the Bank is authorized to acquire, hold and transfer gold, foreign exchange and foreign government securities, and may enter into foreign-currency transactions with banks outside Israel and with a small group of domestic institutions such as the government and the banking corporations. Legal interpretations of the Law have been given over the years to bring its implementation into line with the changing economic and financial environment. Thus the Bank is currently authorized to invest also in CDs (tradable certificates of deposit) and in bonds fully guaranteed by foreign governments, and to use derivative instruments (such as forwards and options), provided their basis asset is one which the Bank is authorized to hold, and to enter into transactions in securities with investment banks. Internal decisions of the Bank also limit the range of appropriate assets for the investment of the reserves, mainly by limitations on credit risk (see Box 1.7 in the 2001 Annual Report of the Foreign Exchange Department).

Similar to the situation in Israel, in most of the advanced economies the definition of the assets suitable for the investment of the foreign exchange reserves is based partly on the law and partly on the central bank's internal decisions. There is broad international agreement regarding several essential characteristics to make assets worthy of investment of the reserves: naturally, they cannot be liabilities of domestic entities (not even if denominated in foreign currency) or denominated in the domestic currency (not even if the liability is of a foreign entity), and they must be liquid to a certain degree, i.e., they can be realized within a reasonable period of time, a requirement that rules out real estate for example, or investment in private equity.

Nevertheless, the range of acceptable investment practice in central banks and monetary authorities allows different approaches to be adopted regarding the appropriate instruments for the investment of foreign exchange reserves. In March 2003 the IMF published the results of a survey of twenty managers of foreign exchange reserves that included, *inter alia*, information on the types of asset in which they invest. The twenty participants in the survey were not chosen randomly, but rather on the basis that they generally follow the accepted norms regarding the management of foreign exchange reserves.[1] Some of the survey findings are shown in the following table.

[1] The participating countries were: Australia, Botswana, Brazil, Canada, Chile, Colombia, the Czech Republic, Hong Kong (Special Administrative Region), Hungary, India, Israel, (South) Korea, Latvia, Mexico, New Zealand, Norway, Oman, Tunisia, Turkey, and the UK. The results of the survey are available on: http://www.imf.org/external/np/mae/ferm/2003/eng/index.htm, Appendix II.

Investment in/ use of	Number of countries (out of 20)	Permitted to Bank of Israel?
Government bonds	20	Yes
Bank deposits	20	Yes
Bonds of international financial institutions	19	Yes, under certain conditions
Repo transactions	17	Yes
Derivatives	16	Yes, under certain conditions
Securities lending	15	Yes
Bonds of US Federal Agencies and German Pfandbrief securities	15	No
Corporate bonds	6	No
Equities	3	No

SOURCE: Bank of Israel

The table shows that in most areas, the Bank of Israel's policy is similar to that of most of the other participants in the survey. The exceptions are bonds of US Federal Agencies and German Pfandbrief securities. These are debt instruments whose credit risk is generally assessed as being very low, but as they are not backed by a formal country guarantee, nor are they considered like bank deposits, the Bank of Israel may not invest in them under the existing law. The survey also shows that some reserve managers invest in various assets backed by debt assets, such as mortgage-backed securities and securities backed by other types of loan. Of these, the Bank of Israel may invest only in mortgage-backed securities of the GNMA type, as they are the only ones backed by a government (the US government). The practice adopted by most of the countries should not be considered 'the correct' one, as the policy followed by each reserves manager is largely dictated by the economic and organizational framework within which he operates, such as the size of the reserves, both in absolute terms and relative to the desired level, the quality of the resources available for the management of the reserves, etc.

In the last few years managers of foreign exchange reserves throughout the world have tended to support the extension of the range of assets in which their reserves may be invested. This is related partly to the process of accumulating knowledge and experience that raises the level of expertise in the management of investment in complex instruments, and partly to attempts by reserves managers to compensate for at least part of the long-term reduction in current yields that characterized the main markets in the last few years.

Box 1.5
Operational Risk in the Activity of the Foreign Currency Department

The management of the foreign exchange reserves consists of planning and implementing financial transactions vis-à-vis other financial institutions. In addition the Foreign Currency Department provides foreign-currency banking services to the government and the banking system. The operational risk entailed in managing the reserves and in supplying these services lies in the possibility of a loss occurring due to the improper performance (or non-performance) of a financial action, inconsistent with what was planned and decided upon. The loss may derive from simple human error, misconduct, or malfunctioning of support systems within or outside the Bank (computer, communications, electricity, transport, etc.). As is proper for an institution responsible for handling public funds, the Bank of Israel is very sensitive to operational risk, and it constantly invests great efforts to minimize it, implementing the standards that are the norm in the international financial sector and applying reasonable cost/benefit considerations.

The extent of operational risk and the complexity of dealing with it can be illuminated by a brief description of the activity of the operational units in the Department. Settling a trade depends on performing a long list of activities, such as issuing a written confirmation, including all details, to the institution with which the trade is being performed, issuing instructions to correspondent banks regarding the receipt and transfer of money in various currencies and of securities of many and varied types. Some of these tasks, e.g., settling a transaction in GNMAs or TIPS, are highly complex. Trade settlement must be carried out with a high degree of accuracy and within a tight and demanding schedule, because the cost of non-performance or late performance of a transaction ('failure') is likely to be very high. Once the trade has been settled on its value date, several additional financial actions deriving from it must be dealt with: depending on the nature of the asset, receipt of interest payments or coupon; repayment or early repayment of principal; transfer of margin payments;[1] balancing the Bank of Israel's cash accounts, etc. In 2003 the Department dealt with 745 deposits abroad, 635 currency conversions, 65 currency swaps, 452 repos and 615 reverse repos, 388 futures market trades and 737 trades for purchase or sale of securities. To implement the deals required for the management of the reserves in 2003, 10,338 messages were transmitted to institutions abroad.

As mentioned, in addition to the operations deriving from the management of the reserves, the department also provides foreign-currency banking

[1] Margin: a daily payment made or received for derivatives, the purpose of which is to offset the effect of the change in the price of the derivative asset from the price on the previous day.

services to the government (including support units) and the banking system. This includes handling the financial transfers related to the government's essential imports, to the day-to-day activities of Israel's representative offices abroad, to foreign-currency deposits of the commercial banks with the Bank of Israel and the transfer of foreign currency between them (including settlement of NIS/$ transactions) and between them and banks abroad. In 2003 the Foreign Currency Department performed about 34,000 such transactions. Despite the large number of transactions and their complexity, very few errors occur. In 2003, for example, a total of eight mistakes were made, at a total cost of $ 72,033; the financial institutions with which the Department carried out transactions made 18 errors which yielded the Bank of Israel surplus profit of $ 35,816.

One type of operational risk is that of incorrect performance of a financial action by an employee, either in error, or intentionally. Measures taken against this risk include:

Separation of powers. Following industry practice, the Foreign Currency Department compartmentalizes the planning and execution stages of the financial actions required for the management of the reserves in separate units. This approach arises from considerations of developing expertise and concentration of professional knowledge as well as being another means of minimizing the operational risk. The work of each unit requires a different expertise and familiarity with the work environment specific to it. Hence dividing up the process of dealing with transactions between the various units reduces the ability of one person to cause the Bank a loss either accidentally or intentionally.

Documentation and enforcement. The stages of handling transactions and other operations are recorded in compulsory working procedures and are embedded in the Department's computerized systems.

Confirmation of operations. All stages of executing and settling a trade must undergo a verification and authorization procedure, so that no single person can settle a trade, transfer money, or alter the records.

Real-time monitoring. The System Controller, an employee not responsible to the unit that handles trade settlement, is responsible for real-time monitoring of the settlement process from start to finish. His being responsible to another unit is intended to afford the System Controller independence and freedom to draw attention to faults.

Reconciliation after settlement. After the value date of a transaction, matching of the Bank of Israel accounts with those of institutions abroad is checked via a separate procedure. If a question arises over a transaction or other financial transfer, the unit responsible checks it and follows through until the matter is finally clarified. In addition, monitoring is also performed by

authorities from outside the Department, including by the Comptroller's office, the Internal Auditor, and the Bank's external auditor.

Another type of operational risk arises from the possibility of an incursion by an external hostile element into the operational process. The steps described above serve also to reduce this risk. Additional measures taken to counteract this risk include:

Security checks. Employees accepted for positions involving executing and settling trades undergo particularly rigorous security checks over and above those applied to most of the Bank's staff.

Protected computer systems. Guided by the Bank's IT Department, the Department takes the appropriate measures to protect sensitive systems against unauthorized access.

Coded communications. All financial activities take place according to written instructions that are sent using coded communication methods developed for the world banking community.

Physical security. Sensitive locations within the Department are secured by appropriate means over and above those employed to protect the Bank's premises in general.

Another type of operational risk arises from the fact that the Department's activity is dependent on systems for which the Department itself is not responsible, such as the computer systems (the responsibility of the Bank's IT Department), public services (the responsibility of government and private entities) and the physical infrastructure. The Department has its own special back-up systems, and participates in planning and in preparing the Bank for exceptional situations at various levels, such as extreme weather conditions (e.g. snow storms that prevent staff from getting to the Bank with their own vehicles or by public transport), a break in the supply of an essential service (e.g., a power outage), or an even more extreme scenario such as an earthquake. Operational plans for the different scenarios are drawn up with the intention of ensuring continued normal activity as far as possible, with emphasis on the most essential activities on a cost/benefit basis.

The subject of operational risk is under constant consideration by the management of the Department in the Control Forum which meets at least once a month. Periodic updates and consulting with external elements are important additional components in dealing with operational risk that complement the measures described above. Management reviews all the control procedures of reserves management at least once a year. All the findings of the internal and external auditors are submitted to the Bank's and the Department's management in writing, and their recommendations for improving supervision and control are of course treated with due seriousness. Finally, mention should be made of the positive contribution

of international financial institutions and other central banks that share their experience and knowledge of this important subject with the Bank of Israel by means of reciprocal visits, advanced study courses for the Bank's staff and informal counseling over many years.

APPENDIX 1.1: GLOSSARY

Annual terms
The yield that would have been obtained if the rate of change in the period reviewed would have prevailed for a year.

Basis point
A 0.01 percent change or one ten-thousandth part.

Benchmark portfolio
A hypothetical portfolio built according to pre-set rules that serves as a criterion for assessing the performance of an investment manager and as an anchor for managing the portfolio's risks.

Certificate of deposit
A bank deposit with transferable ownership, which can therefore be traded in the money market.

Commercial paper
A non-coupon-bearing bond sold at a discount, with original maturity of less than 270 days. The Bank may invest the reserves in commercial paper provided it is issued or guaranteed by a foreign government.

Credit risk
Exposure to the possibility of loss as a result of the failure to repay debts on time by an issuer, financial institution, or country, or as a result of changes in the assessment of the probability of such an event by market participants (see Box 1.7 on pp. 33–35 of the 2001 Annual Report of the Foreign Currency Department).

Currency risk
Exposure to the possibility of loss as a result of changes in exchange rates.

Currency terms (e.g., US dollar terms)
The yield obtained when the running values of all assets are multiplied by the running exchange rates into a specific currency or basket of currencies.

Duration	Refers to modified duration, unless noted otherwise. The ratio of a small change in the value of a debt instrument, as a percentage of its previous value, to the accompanying change in its yield to maturity (with a reverse sign). It is measured in units of time. See *portfolio duration, partial duration*, below.
Eurobonds	Bonds sold in financial markets outside the country in whose currency they are denominated.
Foreign exchange reserves	Financial assets issued abroad and denominated in foreign currency (including gold) which are owned and controlled solely by the central bank and are not encumbered in any way.
GNMA	Mortgage-backed securities issued by the Government National Mortgage Association and fully guaranteed by the US government.
Holding-period rate of return	Rate of change in the value of an asset or portfolio over a defined period.
Interest-rate risk	Exposure to the possibility of loss as a result of changes in interest rates or yields to maturity.
Investment policy	The standards and procedures set by an investor regarding his investments, in accordance with his long-term preferences, objectives, and strategies.
Legal risk	Exposure to the possibility of a loss as a result of the wording of a contract, in error, to the investor's disadvantage.
Liquidity	The ability to realize assets without delay and without diminishing their value (see Box 1.2 on pp. 32–35 of the 2002 Annual Report of the Foreign Currency Department).
Numeraire	The currency composition set as the benchmark for the reserves portfolio (see Chapter 1.1 and Box 1.1 above).

Neutral
The value of a specific characteristic of a portfolio when it is *risk-free* (see below).

Operational risk
Exposure to the possibility of a loss as a result of system failure, human error, and the like (see Box 1.5).

Portfolio duration, partial duration
The average *duration* of a portfolio of debt instruments (duration of each asset being weighted by its share in the portfolio) is the accepted index for estimating the interest-rate risk of the portfolio. However, as it is defined, duration measures sensitivity to *parallel and small* changes in the yield curve. In practice, shifts in the curve are often accompanied by changes in its slope. The *partial duration* in a specific area of the curve is obtained by multiplying the duration of the assets invested in that area by their weight in the portfolio, and measures the portfolio's exposure to a parallel shift in that area only. The sum of the partial durations over the curve is equal to the duration of the entire portfolio.

Repo, Reverse repo
Abbreviation for Repurchase agreement, i.e., the purchase of a security alongside the undertaking to sell it back at a future date and a known price. In economic terms, the transaction is identical to a collateralized loan. When the Bank of Israel buys a security for future sale the transaction is known as a Reverse repo, and in the opposite case as a Repo.

Risk-free
A situation in which the investor can incur neither losses nor profits.

Spread asset
An asset whose yield to maturity comprises the yield on another asset (e.g., a government bond) *plus* a yield spread that changes, usually continuously and moderately, in accordance with changes in the supply of and demand for assets of that type.

Standard deviation	A statistical measure of the spread of a distribution around its mean; often used as a measure of the extent of exposure to uncertainty (see *volatility* below).
Swap spread	The difference between the yield to maturity on government bonds and the fixed interest that one party pays the other in a *swap agreement* (see above) for a similar period.
TED spread	Treasury-Euro-Deposit spread, i.e., the difference between the yield to maturity on short-maturity government debt and the interest rate on a deposit with the same maturity.
TIPS	Acronym for Treasury Inflation-Protected Security—a CPI-indexed US government bond.
Trade	An agreement to transfer or encumber ownership of financial assets, e.g., foreign currency or securities.
VaR	Acronym for Value at Risk, the greatest loss, with a given probability, that is expected to occur within a defined period of time.
Volatility	The size of the *standard deviation* (see above) of the distribution of the holding-period rates of return on a financial asset, such as a security or portfolio, over a specific period of time (day, week, etc.). It is usually calculated on the basis of the logarithm of the holding-period rate of return, $\log(l + y)$, where y is the simple rate of return.
Yield curve	A series of yields to maturity of bonds with different dates to redemption and with characteristics in common (e.g., government bonds of a specific country in its local currency).
Yield spread	The difference between the yields to maturity of two debt instruments.

Yield to maturity

The holding-period rate of return, in annual terms, that would be obtained by keeping a debt instrument until its final redemption date, if it were possible to invest all its cash flows at the same yield until the final redemption date (also called internal rate of return).