



The balance sheet approach for financial stability surveillance:
A tool for analyzing the resilience of the Israeli economy to exchange rate risk
Yair Haim*, Roeel Levy*

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* Financial Stability Area, Bank of Israel

yairhaim@boi.gov.il , roeel@boi.gov.il

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תחום היציבות הפיננסית, בנק ישראל, ת"ד 780, ירושלים 91007.

Financial Stability Area, Bank of Israel, POB 780, Jerusalem 91007, Israel

<http://www.boi.gov.il>

Abstract

This paper presents a framework for analyzing an economy's resilience to exchange rate risk using the balance sheet approach (BSA), which is gaining prominence worldwide in the surveillance of financial stability. The framework is applied to Israel's economy, by using a combination of new national balance sheet data and foreign currency balance sheet data.

The analysis using the BSA shows that Israel's economy was highly vulnerable to a depreciation of the shekel in 1997, but from then until 2005 it became more resilient. The improvement was due mainly to the lowering of the business sector's high level of exposure to depreciation and its greater financial strength. This, together with higher capital adequacy in the banking system, made the latter more resilient to indirect damage that could be caused by depreciation. The analysis shows further that despite the heavy exposure of the economy as a whole and most sectors within it to appreciation of the shekel at the end of 2005, the economy was quite resilient to such appreciation, as the private sector and the banks suffered little direct or indirect damage through it. The analysis stresses the central, but not exclusive, role played by the banks' resilience in the economy's financial stability, and thus also favors the continuation of the process of reducing the banks' dominance in financing the business sector, so that their indirect exposure to financial risks will fall. The findings yielded by the BSA are highly significant, because an analysis using the traditional approach leads to very different results, viz., that in 1997 the economy was not vulnerable to changes in the exchange rate, and that in 2005 it was highly vulnerable to shekel appreciation.

The conclusions in the paper support the use of the balance sheet approach as an important instrument in surveillance of financial stability, the formulation of other similar frameworks for analyzing financial risks, and the provision of more detailed data in the national balance sheet that would enable a deeper analysis of overall economic risks and the risks in the major sectors.

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1. INTRODUCTION

The **Balance Sheet Approach** to analyzing financial stability is a sectoral approach to analyzing the financial risks of the economy as a whole, based on the assets and liabilities of each sector in the economy (national balance sheet accounts). The novelty of this approach is that it does not focus solely on the activities and financial robustness of the economy as a whole vis-à-vis abroad, as is the traditional approach, but also looks at activities within the economy; the focus is on the heterogeneity of the sectors regarding their levels of exposure to various financial risks and their financial strengths, and on the relationships between the sectors, which could intensify shocks and cause financial crises. In addition, besides the usual macroeconomic data such as GDP, budget deficit and inflation, which are usually flows of data, greater attention is also placed on stocks of data, that is financial assets/liabilities held by the various sectors. These are designed to reflect the possible influence of shocks on the economy through their influence on financial aggregates and various indices from the balance sheets of the different sectors.

The **national balance sheet** accounts—used for implementing the balance sheet approach—present the balance sheets of financial and non-financial (real) assets and liabilities of each sector in the economy vis-à-vis every other sector, as a complete and closed data system, and as part of the data in the National Accounts according to the standards set by international institutions. The major sectors usually included in the national balance sheet are: the financial sector (banks, institutional investors and others), the business sector (non-financial companies), the household sector (individuals), the government and the central bank, though sub-sectors of these could also be presented. In addition to the interactions between these domestic sectors, the national balance sheet also includes data on the interactions of all of these vis-à-vis the nonresident sector.

In recent years greater world-wide attention has been given to the importance of the balance sheet approach and of national balance sheet data for analyzing financial stability. This is reflected in the publications of both central banks, and international institutions such as the International Monetary Fund (IMF) and the European Central Bank (ECB), and by academic writing on financial crises. As a result, the availability of such national balance sheet data has expanded and the use of these for analyzing financial stability based on the BSA continues to grow. Many countries have begun publishing national balance sheet accounts (most of them only partial) in recent years, and the balance sheet approach for current analyses of economies has already been adopted, particularly by the IMF. Despite the improvement in the data infrastructure of national balance sheets, it still does not meet most requirements for analyzing financial stability. What is more, as the usage of BSA for analyzing financial stability is still in its infancy, there is no acceptable analysis framework, that clearly and systematically defines the use of national balance sheet accounts and their contribution to the understanding of changes in financial stability.

In **Israel** we are also at the very start of the road on the subject of national balance sheets and the BSA: In 2002 the Central Bureau of Statistics published, for the first time, **Israel's National Balance Sheet Accounts** for 1995, and only recently, with the encouragement of Bank of Israel, has completed preparing data for the national balance sheets for 2001-2004, with the intention of publishing these regularly in the future¹. Despite the importance of the publication of Israel's national balance sheet and its importance in analyzing the financial activity of the economy, the level of detail and classification of assets and liabilities presented in the accounts today do not allow for the measurement of various sectors' exposure to important financial risks such as exchange-rate, liquidity and interest-rate risk. However the Foreign Exchange Activity Department of the Bank of Israel has for some time regularly produced a detailed "**foreign currency balance sheet**" of assets and liabilities in foreign currency (denominated in, or indexed to, foreign currency, including derivatives) of all sectors in the economy vis-à-vis other sectors, similar to national balance sheet accounts, as well as data on foreign currency flows by sector. These data make it possible, *inter alia*, to calculate the various sectors' exposure to the exchange rate. Naturally, no one has yet used the new national balance sheet data and the BSA, while the foreign currency balance sheet data is used regularly by the Bank of Israel mainly to analyze developments in the foreign exchange market, by sector (See Hecht, Haim, Schreiber, 2002). Analyzing the foreign currency balance sheet showed that great changes in certain sectors' exposure to the exchange rate risk took place over the past decade, but the significance of these changes to financial stability has yet to be thoroughly investigated.

This paper uses for the first time a combination of national balance sheet data and foreign currency balance sheet data, in order to demonstrate analyzing financial stability by the BSA. To do this we develop a framework for analyzing the resilience of the economy to exchange rate risk, as part of the analysis of financial stability by the BSA, and apply it to Israel. This paper is set out as follows: as background to the analysis, in Part 2 we expound on the BSA and national balance sheets worldwide, and in Part 3 we describe the changes in the structure of exposures to the exchange rate in Israel in 2005 compared to 1997. In Part 4 we present the framework we developed to analyze the economy's resilience to exchange rate risk while the findings of applying this analysis in Israel compared to 1997 are presented in Part 5. Finally in Part 6 we conclude and discuss policy conclusions. The three appendices present and explain the national balance sheet accounts and the foreign currency balance sheet as well as additional data used to support our analysis of resilience to exchange rate risk.

¹ Data on particular segments within the national balance sheet accounts have been available before, such as the public's assets portfolio, the capital stock in the economy, the economy's assets and liabilities vis-à-vis abroad (the International Investment Position), but each stood alone and was not published as part of a comprehensive and consistent set of data.

2. BACKGROUND – THE BALANCE SHEET APPROACH AND NATIONAL BALANCE SHEETS AROUND THE WORLD

a. In recent years there has been increasing international recognition of the importance of the balance sheet approach and of national balance sheets in analyzing financial stability. Many articles and publications reflect this growing recognition, though the major work on this subject was produced by the IMF in 2002 (See Allen et al., 2002). This paper asserts that the division of the economy into sectors, and viewing assets and liabilities by sector in terms of size, dispersion and quality, has many advantages and is very important in analyzing financial stability. Furthermore, this paper upholds that existing problems or weaknesses in the balance sheet of any particular sector could spill over into other sectors of the economy and could become so strong that it affects the financial system; in this way problems registered in the financial balance sheets of various sectors translate finally into a financial crisis, for example in the balance of payments or the banking system, which amplifies the harm to the economy. While these problems could continue for some time and have no substantial effect, a shock of some kind to the economy could lead to a sudden change which could presage a crisis. The BSA places an emphasis not only on identifying the balance sheet weaknesses of various sectors, but also on identifying and understanding the source of these weaknesses, and also on the policy steps that should be taken to strengthen the balance sheet and prevent crisis scenarios. It thereby becomes an approach for both understanding and analyzing financial stability and for influencing it too.

The IMF paper presents four types of basic weakness that could appear in the balance sheets, and could lead to a crisis: 1) *liquidity and interest-rate risks* – where a mismatch in maturity and times of interest-rate changes of assets and liabilities could create exposure to changes in demand for liquidity or in interest rate; 2) *foreign currency risk* – where the gap between assets and liabilities in foreign currency creates exposure to changes in the exchange rate and affects capital flows; 3) *dangerous capital structure* – where high financial leverage reflects a heavy dependence on debt and credit as means of finance and not on equity. Such a financing structure expresses high sensitivity to shocks in the economy, high credit risks and low capital adequacy; 4) *solvency problems* – where assets no longer cover liabilities, and net worth becomes negative. Such a solvency problem could stem from the other three problems, though could also arise from other circumstances.

The paper claims that in *post factum* analysis of financial crises of recent years in various countries (in East Asia, Mexico, Turkey and Russia, for example), one could find these basic weaknesses in the financial balance sheets of certain sectors in these economies. These weaknesses were generally a major and important factor in the realization of risks in these countries, and which eventually ended in crisis. As an example, the paper presents an analysis of the financial balance sheet of Thailand at the end of 1996 and in mid-1997, prior to the financial crisis there (a currency crisis and a banking crisis). Thailand's financial balance sheet was divided into the major sectors of the economy, between local and foreign currencies, and between short- and

long-term assets and liabilities. Analyzing Thailand's financial balance sheet prior to the crisis shows a number of exposures and weaknesses in the financial system which became more and more significant in a process that ended in crisis; for example, central bank reserves and liquid assets in foreign currency in other sectors were insufficient to cover the economy's short-term foreign currency liabilities; the banks were highly exposed indirectly to the exchange rate through credit to the business sector which, itself, was exposed to a depreciation of the currency and was also highly leveraged.

In a paper written by the head of the statistics department of the ECB [Mink (2004)], it is claimed that the financial balance sheets of the different sectors in an economy are an important tool for monitoring the financial activities of an economy, and for analyzing financial stability. These balance sheets need to be the main source for building financial stability indicators (FSI), a subject still in development, but should take a major role in analyzing financial stability. These indicators and other data from the financial balance sheets indicate the health and resilience of a financial system, and its various components, the relationship between the sectors and their weaknesses and sensitivities, the structure of the system, the channels of financial transmission and the link to the real economy.

The BSA appears widely in **academic literature** too; Rosenberg et al. (2005) survey BSA's reflection in the literature and point to the increasing use of it in several contexts: the "third generation" models which explain financial crises and their roots are based on this approach [see for example Dornbusch (2001) and Krugman (1999)]; articles on countries' debt crises—including those that refer to the "original sin," i.e. the inability to borrow long-term in local currency—use it in their balance sheet analysis of the public sector [see for example Eichengreen, Hausmann and Panizza (2003)]; articles on dollarization use the analysis of the foreign currency component of various sectors' balance sheets, and refer also to domestic debts in foreign currency and not only to external debts of the entire economy [see Goldstein and Turner (2004)].

Gray, Merton and Bodie (2002) take the balance sheet approach one step further; they propose a framework of analyzing macro-financial risks using assets and liabilities by sector, as in the BSA, but according to the theory of contingent claims analysis (CCA). In effect, in addition to the national balance sheet data, this approach uses data on asset prices and changes in them, while using theories of financial derivatives (options). Assets and liabilities are taken at market value and not according to historical cost. Furthermore, they use the financial markets to derive volatilities and to price financial risks. This analysis framework, according to the authors, allows a systemic analysis of the financial risks including an estimate of the exposure in various sectors, a measure of the correlation between assets and liabilities of different sectors, identification of transmission mechanisms and transfer of risks between sectors, an analysis of each sector's asset portfolio's sensitivity to external shocks and the quantification of each sector's vulnerabilities. The authors believe that this systemic analysis should be conducted without divorcing itself from the "traditional"

economic data (GDP, inflation, unemployment etc.). In addition to the assets and liabilities portfolios in each sector, a financial analysis should also take account of non-balance sheet positions on assets and liabilities, and the existence of disclosed or hidden guarantees between sectors such as the hidden government guarantee for the public's deposits held at the banks.

The authors also stress certain subjects that they believe are very important in a systematic financial analysis, for example: currency and interest rate risks between the sectors in the economy and vis-à-vis abroad, credit given between sectors, intersectoral relationships, and liabilities vis-à-vis abroad. The authors believe it important to clearly identify the risk, its source and to where it is being transferred. For example, a high exposure by the private sector to various risks (such as foreign currency, liquidity, interest rate) becomes a credit risk to the banking system as these risks could lead to the private sector being unable to meet its liabilities to the banks (return of credit), and therefore could lead to a banking crisis. In the next stage, according to the analysis, ways are found to reduce the exposure, to transfer the risks and contain them, for example, through insurance, diversification or hedging using financial instruments.

b. In recent years the forming of national balance sheet data has expanded as did their usage for financial stability analysis by the balance sheet approach. The increasing recognition of the importance of the BSA, together with the increasing interest in the subject of financial stability in recent years, have led many developed countries and international organizations—foremost of which, the IMF—to apply and improve the national balance sheet data infrastructure as well as the use of the BSA. Today, due to the insufficient data infrastructure, only a few countries such as Canada and Australia regularly publish full and complete national balance sheets as part of their national accounts publications, while other countries publish only part of them. For example, the European Union countries today publish sector-based financial balance sheets quarterly, including, in addition to data on assets and liabilities, their movements and changes too. However these financial balance sheets are only partial, as they do not include classification of assets and liabilities by counterparty sectors, and most of them are presented without discounting for activities within a sector.

A partial advance in solving the lacking-infrastructure problem of national balance sheet data leads to initial experiments in applying the BSA for analyzing financial stability in various countries: An article submitted while this paper was being written [see Mathison, Pellechio (2006)] details existing data systems internationally, based on which national balance sheets could be constructed, at a minimum level needed to apply the BSA. The article presents a basic matrix of seven sectors (a 7x7 matrix), with defined listing of financial instruments, which serves as the basis of a BSA. The authors estimate that there are available data for some 40 countries, including the emerging economies (Israel is not included in this list) to draw up such a matrix. The authors refer briefly to examples of BSA analysis using the matrix for South Africa, Belize and Georgia though they do not include systematic presentation of the analysis framework or the method of application.

Another article [see Rosenberg et al. (2005)] focuses on the application of the BSA among emerging economies. It analyzes developments in recent years on sector-based balance sheets in a sample of 25 countries taken together, illustrates the contribution of weaknesses in the balance sheets to recent crises in three countries (Argentina, Uruguay and Turkey) and contrasts them with three other countries whose balance sheet structure helped them to avoid such crises. This article also presents a way of examining the vulnerability of an economy as a whole using graphs of several indicators together for different countries and over time. The article claims that though the BSA cannot be applied using only a small number of indicators, one can obtain important insights into the exposures and their channels of contagion in the economy, even where the data is limited. The article calls for further work on the BSA to allow future simulation of the effect of shocks on the balance sheet.

The IMF is promoting the process of making the balance sheet approach an operational tool in its assessments of various economies. For example, in mid-2003 the IMF management discussed the BSA and encouraged its development and regular use. In a further meeting at the beginning of 2005, it concluded that: "A sectoral look at currency and maturity mismatches...and the analysis of inter-sectoral linkages can provide useful insights as a diagnostic tool for detecting potential vulnerabilities, notwithstanding data limitations" (See IMF 2005d). Therefore the IMF plans to apply the balance sheet approach in its surveillance of 11 emerging and developing economies, and has also published partial sectoral analysis in its two semiannual reports on global financial stability in 2005.

c. Despite the improvement in data infrastructure of national balance sheets, it still does not satisfy in most cases the requirements of an analysis of financial stability by the balance sheet approach. As already mentioned, the existing data infrastructure in most countries today does not fully support the production of national balance sheets, though there are moves to improve this both on a national and international level. According to the international standard (SNA93), the national balance sheet should include data on balance sheet assets and liabilities of each sector in the economy, broken down by counterpart sector. In most countries, meeting this standard poses a great challenge for the authorities dealing in national statistics, as noted in other papers previously mentioned [Allen et al. (2002), and Mink (2004)].

We believe that the full implementation of the BSA in monitoring and analyzing financial stability in the manner described in Part a. above, requires a broader and deeper data infrastructure than that needed to prepare the national balance sheets according to current international standards. 1) To measure exposure to different risks, data are needed on assets and liabilities of all sectors, including breakdown by characteristics such as currency and terms to maturity, as well as details on non-balance sheet assets and liabilities, by type; 2) To identify and quantify the relationships between the sectors and the transfer of risks between them, assets and liabilities of each sector and their exposure to different risks need to be detailed by counterpart sector; 3) To analyze the balance sheet and exposure thoroughly there

should ideally be data on flows and changes in values of assets and liabilities; 4) To regularly monitor and analyze the above, data must be available on an annual basis, and some at least on a quarterly basis too. These demands set a daunting challenge to the authorities that deal with national and international statistics, concerning data collection and processing. However, this is a challenge that can be met in light of the improved information infrastructure in many countries today following the expanding information standards and requirements on the part of international organizations and in light of improved information technology.

d. Despite the increasing use of the balance sheet approach to analyze financial stability, there is still no definite analysis framework. As already mentioned, using the BSA for analyzing financial stability is becoming more popular, and with it the preparation of national balance sheets. Most of the articles above were event-driven analyses of financial crises using the BSA, but the IMF has begun regular analysis of national balance sheets in order to identify and quantify weaknesses in developing and emerging economies. These event-driven analyses and regular analyses were conducted in each case according to the available data and exposure and based on many varied indicators; there is still no analysis framework that clearly defines the use of national balance sheet account data for identifying and quantifying weaknesses of an economy that could upset financial stability. The above articles call for the continued development of the BSA in a more operative direction, recognizing its importance and usefulness. For example, Mathison and Pellechio (2006) write that the full potential of the BSA in analyzing financial stability has yet to be reached, and they believe that such an analysis in the future will allow routine and continuous pinpointing of changes in exposure in the balance sheet which would allow early identification of problems and the expansion of policy options to deal with them.

In Israel, as mentioned, the Central Bureau of Statistics began recently to draw up regular national balance sheets and the Bank of Israel has for some time prepared full and detailed data on foreign currency balance sheet, which allows for analysis of sectoral exposure to exchange rate risk. This paper uses, for the first time, all these data together for a financial stability analysis by the BSA based on a new analysis framework.

3. BACKGROUND – THE CHANGES IN EXPOSURE TO EXCHANGE RATE RISK IN ISRAEL BETWEEN 2005 AND 1997

This section describes the main changes in exposure to exchange rate risk of the different sectors in the Israeli economy between 1997 and 2005, as a background to analyzing the changes in the economy's resilience to this risk by the balance sheet approach. This period was chosen due to the availability of data as well as the significant changes in exposure to the exchange rate that occurred during the period. As we will see in Part 5, the changes in sectoral exposure are just one of the factors in the changes in the economy's resilience. Note that the data on exposure to exchange rate are part of the foreign currency balance sheet based on the database of the Foreign Exchange Activity Department of the Bank of Israel. (See Appendix B).

The Israeli economy moved from **exposure to depreciation** of the shekel at the end of 1997 to **exposure to appreciation** of the shekel at the end of 2005 (See Table 1); the sectors of the economy together (Israeli residents vis-à-vis nonresidents) held at the end of 1997 a **surplus of liabilities** in foreign currency over assets in foreign currency of \$ 12 billion; while at the end of 2005 they held a **surplus of assets** of \$ 43 billion. This change in exposure of \$ 55 billion over the eight years stemmed mainly from a **net accumulation of assets** in foreign currency (\$ 49 billion).

Finding out how such a large change in the exposure of the Israeli economy to the exchange rate took place requires answering two questions: 1) What were the sources that allowed the economy to accumulate assets abroad of such large amounts, and 2) Under what conditions were these sources created?

1) **The major source to this change was the net sale of local-currency assets to nonresidents**, that is, the economy sold shares of Israeli companies to nonresident investors (this can be regarded as taking on a shekel—not foreign currency—liability to transfer a flow of future profits of companies into foreign hands) of a net sum of \$ 40 billion during the period reviewed; the economy used the proceeds to buy assets in foreign currency (shares, bonds and deposits) abroad². A secondary source was the **capital transfer from abroad** of \$ 4 billion, though it must be pointed out that the current account was fairly balanced over the period as a whole, that is, it did not constitute a source of foreign currency but neither did it consume funds of foreign currency³.

² In effect the \$ 9 billion difference between the net accumulation of assets in foreign currency (\$ 49 billion) and the sale of shekel assets (\$ 40 billion) reflects the net accumulation of assets (in shekels and foreign currency) of the economy vis-à-vis abroad, that is the total financial account of the balance of payments. The difference between the flow data of net accumulation of assets in foreign currency and the data on change in the balance of exposure (\$ 55 billion) stems principally from the changes in values of the stock of assets and liabilities in foreign currency.

³ The balancing number stems mainly from the statistical differences in the balance of payments (\$ 5 billion).

Table 1: Exposure to the Exchange Rate¹ in Israel, Changes and Sources of Change, 2005 compared to 1997²

(\$ billions)

	<u>Banks</u>		<u>Institutionals Investors</u>		<u>Government</u>		<u>Bank of Israel</u>		<u>Business sector</u>		<u>Households</u>		<u>Economy</u>
	Total	Of which: vis-à-vis abroad	Total	Of which: vis-à-vis abroad	Total	Of which: vis-à-vis abroad	Total	Of which: vis-à-vis abroad	Total	Of which: vis-à-vis abroad	Total	Of which: vis-à-vis abroad	Total for Israelis vis-à-vis abroad
a. Exposure¹													
End of year 2005	1	4	7	5	-28	-30	26	28	11	25	26	10	43
End of year 1997	1	-5	0	0	-23	-25	16	20	-17	-2	10	0	-12
b. Change in exposure¹ between 1997 and 2005	-1	9	7	5	-5	-5	10	8	28	27	16	10	55
c. Sources of changes in exposure													
1. Net accumulation of assets in foreign currency ³		11		5		-4		6		23		9	49
2. Net accumulation of assets in shekels		1		0		-1		0		-41		0	-40
3. Net accumulation of assets abroad (financial account)		12		5		-5		6		-18		9	9

¹ Surplus of assets in foreign currency over liabilities in foreign currency (including those denominated in and indexed to foreign currency, and non-balance sheet items).

² For full details of assets and liabilities of each sector vis-à-vis other sectors, see Tables A.B.1 and A.B.2 in Appendix B.

³ The difference in the change in exposure and the net accumulation between 1997 and 2005 stems mainly from changes in the value of the assets and liabilities.

SOURCE: Based on data from the Foreign Exchange Activity Department of the Bank of Israel.

In effect, most of the proceeds from the sale of shares to nonresidents naturally reached the **business sector** (a small part went to the banks and the government) which used the lion's share of it to acquire assets abroad. As a result, the business sector moved during the period reviewed from having **exposure to depreciation** of the shekel (with a surplus of liabilities in foreign currency of \$ 17 billion) to having **exposure to appreciation** of the shekel (with a surplus of assets in foreign currency of \$ 11 billion). The business sector sold the remainder of the foreign-currency proceeds from the sale of shares mainly **to households and institutional investors**; these two sectors used the foreign currency mainly to acquire assets abroad, thereby increasing their surplus of assets in foreign currency and their **exposure to appreciation** of the shekel (from \$ 10 billion to \$ 32 billion). In the period reviewed the banks maintained a low exposure to appreciation while the public sector balanced itself out.⁴

2) **A combination of processes in the economy created these sources** and allowed the changes in exposure; the central process was the accelerated development of the **high-tech sector** in the period reviewed. Increasing global demand, principally in the US, for new information and technologies in the field of computers and telecoms met

⁴ The Bank of Israel intervened in the foreign currency market only once in the period reviewed at the beginning of 1998; it bought some \$ 500 million in foreign currency from the private sector. Government activity in foreign currency is conducted vis-à-vis the Bank of Israel and not vis-à-vis the private sector.

suitable supply from Israeli companies, which sold their know-how through the sale of their shares to nonresident investors. This happened to take place at the same time as a **reform in the foreign currency market** in Israel took place: the process of **foreign currency liberalization**, which allowed freedom of capital into and out of the country and the free exchange of shekels into foreign currency and vice versa, as well as a more flexible **exchange rate** regime, which permitted the Bank of Israel to end its intervention in the foreign exchange market. At the beginning of the period reviewed, the process of **disinflation** was completed, which led, *inter alia*, to a narrowing of the interest rate differential between the shekel and the dollar, and to a reduction in the attractiveness of taking loans in foreign currency instead of shekels. As a result of all these processes, Israel attracted a vast inflow of foreign currency (following the sale of shares in Israeli high-tech companies to nonresidents) which was not bought by the Bank of Israel as in the past but stayed with the private sector. For the companies, it was now more attractive to close their exposure to depreciation of the shekel, which was created in the period of disinflation and the Bank of Israel's intervention in the foreign exchange market, when it had been worth their while to take loans in foreign currency rather than in shekels. The companies sold the surplus foreign currency they had accumulated—after first reducing their exposure to depreciation—to households and institutional investors, which for the first time could invest overseas.

The developments described above brought about a significant change in the **structure of exposure in the economy**; at the end of 1997 two sectors—the private sector and the government—were considerably exposed to depreciation, while households and the Bank of Israel were exposed to appreciation. In contrast, in 2005, only the government was left significantly exposed to depreciation, while the private sector in general and in all its separate parts—the business sector, households, and institutional investors—and the Bank of Israel were all considerably exposed to appreciation. As will be explained in Part 5 below, this change in the structure of exposure *by sector* helped reduce the economy's vulnerability to depreciation, above and beyond the reduction in vulnerability as a result of the economy as a whole changing from being exposed to depreciation to being exposed to appreciation.

4. A FRAMEWORK FOR ANALYZING THE ECONOMY'S RESILIENCE TO EXCHANGE RATE RISK ACCORDING TO THE BALANCE SHEET APPROACH

As already mentioned, despite the worldwide advance in producing national balance sheet data and the use of the BSA, there is no formulated framework for analyzing resilience and vulnerability of economies based on these data and approach. In this section we present the **principles** that guided us in analyzing Israel's resilience and vulnerability to exchange-rate risk by the BSA, as well as the **process of implementation** for the national balance sheet data and the foreign currency balance sheet data that we had. One could regard these principles and process of implementation as a framework of analysis on resilience to risks using the BSA:

A. Guiding Principles

- 1. The sectors.** The analysis is based on dividing the Israeli economy into six sectors: the banks, the business sector, households, institutional investors, the government and the Bank of Israel. Dividing the economy into (no less than) these sectors is essential for analyzing the economy's resilience. This is because each of them takes an active and central role in the financial activity of the economy, though mainly it is because each sector is unique in terms of activities, motivation and behavior, particularly in the context of analyzing the resilience of the sector and its implications for the other sectors. These sectors act with each other, as well as vis-à-vis abroad, that is with nonresidents, who are not analyzed as a sector. Examining the six sectors together (ignoring the inter-sectoral activities) means in effect analyzing the economy as a whole vis-à-vis abroad, only, which is the traditional method of analysis. As the business sector is greatly heterogeneous in its exposure to the exchange rate, and given its great importance in the analysis of resilience and vulnerability, we divided this sector into two sub-sectors (within the confines of the limited data available): those companies exposed to depreciation and those with exposure to appreciation.
- 2. Exposure to the exchange rate.** Analyzing exchange rate risk by the BSA is based on the sectors' exposure to changes in the exchange rate. This exposure is measured using an accounting method as the surplus of assets over liabilities in foreign currency (based on foreign currency balance sheet data), and includes off-balance sheet items (NIS/\$ forward and option transactions), as well as items indexed to foreign currency and not just those denominated in foreign currency; these additional items significantly affect the exposure and therefore the analysis.
- 3. "Event method".** The analysis is based on the assumption that one of two extreme events occurs: either an exceptional depreciation or an exceptional appreciation of the shekel. The aim is to identify and quantify the negative effects of the exceptional depreciation/appreciation on the sectoral balance sheets and consequently on the economy. Event method analysis is a theoretical exercise, intended to measure the economy's sensitivity to changes in the exchange rate, solely in the context of financial stability. This event method could serve as a preparatory stage for stress testing, though it differs from a description of a crisis scenario, which tries to predict the evolution of events as they happen at the time of the shock.

Here we note some characteristics of the event method:

- the event method focuses deliberately on events with a low probability of exceptional depreciation/appreciation;
- the analysis treats an exceptional depreciation and appreciation alike, whether they occur cumulatively over time or within a short period (within a fixed or floating exchange rate regime). That is to say that the analysis **does not** presume that only an exceptional depreciation within a short time when a fixed exchange rate regime is collapsing could harm financial stability;

- the starting point of the analysis is the materialization of an exceptional depreciation/appreciation, without any reference to the reasons or conditions that led to it or the probability of it occurring;⁵
 - The analysis is static, not dynamic: it assumes that the balance sheet effects are instantaneous, that is it ignores reactions and processes over time that lead to the balance-sheet results, and it also does not deal with policy responses to changes in the exchange rate (either expected or recommended);⁶
 - The focus is on the negative effects, ignoring the positive effects;
 - The focus is only on the financial effects, that is on the capital losses arising from the exposure to the exchange rate and on their effects on the different sectors, including the financial sector. The analysis ignores the effect of the depreciation/appreciation on real activity and the GDP, and the effect on inflation or on the value of other assets.
- 4. Channels of contagion.** Identifying and quantifying the negative financial effects of exceptional depreciation/appreciation on the economy can be divided into two; first, the direct effects on the sectors exposed to depreciation/appreciation, and secondly, the indirect effects on other sectors and on the economy in general given the damage to those exposed sectors and the relationships between them and other sectors. The links between sectors create channels of contagion between them, with the main channel being "**the credit risk channel**"; Harming the financial strength of those sectors exposed to the exchange rate harms their repayment ability (even stretching them to bankruptcy limits), and thus the other sectors that lend to them (the creditors), foremost, the banks.⁷ The first reference is to the damage in the business sector, being the major debtor sector, but also to the damage to households. In addition, one should also note the harm to the government: damage to the financial strength of the government harms other sectors and the economy beyond the direct impact on the sectors that lend to it as the government serves as a symbol of the state of the economy, particularly in the eyes of nonresident investors. It is understood that if the banks are considerably exposed to exchange rate risk (directly or indirectly), their suffering at the hands of an exceptional change in the exchange rate would harm sectors that deposit with them (for example, households—that deposit directly with the banks and indirectly through

⁵ It seems that in reality, the probability of an exceptional depreciation is also dependent on the players' sensitivity to depreciation, i.e. the extent of their exposure to depreciation at a time of external shocks. An analysis of the dynamics in the foreign exchange market and the conditions for instability in the market are beyond the scope of analysis according to the BSA.

⁶ In reality, events occur simultaneously and over time. For example, the exceptional depreciation in the second half of 1998 occurred during changes in the balance sheets and exposure of the various sectors, to which (and during which) the Bank of Israel adjusted its interest rates.

⁷ We ignore here secondary channels such as "the equity channel," where—similar to the "credit risk channel"—harming real companies (the business sector) and financial companies (banks and institutionals) that are exposed to the exchange rate, though are not bankrupt, harms their shareholders (mostly households and institutionals).

institutional investors—and nonresidents). A severe shock to the banks or/and the government could cause a "run on the banks or/and the markets" by the depositors and investors (Israelis or/and nonresidents), that is, it could strengthen the damage to the financial system and the economy leading even to a financial crisis.

5. **Indices and parameters.** The analysis of the effect of depreciation/appreciation uses two types of indices: i) **indices of the magnitude of exposure to the exchange rate.** In addition to the level of exposure to exchange rate, these measure the exposure relative to equity (net value or market value of shares) of the sector and also relative to GDP. They also measure the ratio of liabilities/assets in foreign currency to the total liabilities/assets of the sector; and ii) **indices of the strength of the damage.** These measure the changes in the accepted indices for examining the financial strength of each sector, following an exceptional depreciation/appreciation. The concrete definition of the indices is tailored for each sector though they all include: level of debt, assets and capital, ratio of debt to sector output, financial leverage, profits and debt burden. For the banks, these indices will also include problem loans, loan loss provisions and capital adequacy ratio. Quantifying the effects of the depreciation/appreciation require, under the "events method", setting **parameters** that reflect assumptions on the strength of relationships between indices of financial strength of the various sectors. The major parameters used here are: growth rate of problem loans of the banks and their loan loss provisions as a result of a given worsening in the indices of financial strength of the business sector and of households. Setting these parameters is based on past data and estimates, but the sensitivity of the results of the analysis to the parameters can be varified. Future development in using stress testing will require statistical estimations of the parameters.

B. Implementation

1. **Data infrastructure.** Analyzing the Israeli economy's resilience to exchange rate risk is based on combining new national balance sheet data and foreign currency balance sheet data: the national balance sheet data, supplied by the Central Bureau of Statistics, are for 1995 and 2004 (not final data); we do not have data for the years 1997 and 2005—the years reviewed by this paper—but the assumption is that the changes in the balance sheet during a year or two are not significant for the needs of the analysis of changes in resilience over a period of a decade. The foreign currency balance sheet data, produced by the Foreign Exchange Activity Department of the Bank of Israel, are for the years 1997 and 2005⁸. See

⁸ In the process of implementation, we refer to the two data systems—the national balance sheet and the foreign currency balance sheet—as if they were one closed and consistent data system. It is reasonable to assume that the two systems are sufficiently matched, for our purposes, as the CBS produces the national balance sheet data based, *inter alia*, on data from the Foreign Exchange Activity Department, which produces the foreign currency balance sheet data.

Appendix A for explanations and details on the national balance sheet, and Appendix B for the foreign currency balance sheet.

2. **Stages of analysis.** In applying the guiding principles on the national balance sheet data and foreign currency balance sheet data, in order to analyze the economy's resilience to exchange rate risk, we applied the following order of stages: **a) identifying those sectors with considerable exposure.** This involved calculating the exposure to the exchange rate of each sector based on its foreign currency balance sheet, identifying which sectors are exposed to depreciation and which to appreciation; and calculating indices of the strength of exposure of each of the sectors exposed to the exchange rate in order to identify those sectors with considerable exposure in terms of the economy; **b) quantifying the direct impact on exposed sectors.** This involved calculating the indices of the strength of direct damage in each of the sectors with considerable exposure, based on a combination of the national balance sheet data and the foreign currency balance sheet data for the same sector, assuming an exceptional depreciation/appreciation, in order to identify those sectors that would be harmed significantly and the scope of this damage; **c) identifying and quantifying the relationships between the sectors** that would be considerably harmed and the other sectors based on the national balance sheet data of each sector in order to identify those sectors exposed indirectly to the exchange rate via credit they extended to the exposed sectors (the credit risk channel); **d) quantifying the indirect effect.** Calculating indices of the strength of the indirect damage in each of the sectors indirectly exposed, based on the national balance sheet while using the parameters for the strength of the intersectoral effects; **e) overall assessment.** The assessment of the overall impact on the sectors and the economy at a time of an exceptional depreciation or appreciation, based on the quantified direct and indirect impacts, while also addressing the indirect damage through the channels of contagion and the effect that has not been quantified; **f) sensitivity analysis** of the results for the parameters chosen.

5. THE ISRAELI ECONOMY'S RESILIENCE TO EXCHANGE RATE RISK – THE FINDINGS

In this section we present the findings of our analysis of the resilience and vulnerability of the Israeli economy to hypothetical exceptional changes in the exchange rate in 2005 compared to the year 1997. We chose an exceptional rate of 20 percent for our analysis in the event of depreciation and appreciation, in light of the experience in Israel⁹ and abroad, though we also checked other rates (see section 6 below). This was based on the analysis framework according to the BSA and the stages outlined above.

a) Identifying those sectors with considerable exposure

In Part 3, we described the significant change that occurred in the structure of sectoral exposure to the exchange rate between 1997 and 2005, its sources and reasons. This subsection examines more closely the exposure to the exchange rate of each sector in each of the two years, in order to identify those sectors whose exposure to the exchange rate was significant in terms of financial stability. The following analysis of the data and the various indices (see Tables 2 and 3) shows that three sectors—banks, institutional investors and the Bank of Israel—were not significantly exposed to the exchange rate, but the three other sectors were; the business sector in 1997, and the government in both years, were considerably exposed to a **depreciation** in the shekel, while the business sector in 2005 and the households in both years, were significantly exposed to **appreciation**:

1. The sectors with insignificant exposure

The banks. In both years in question the banks were not exposed to the exchange rate (the measured exposure was close to zero) and therefore were not directly vulnerable to depreciation or appreciation. This is an important finding that testifies to the high resilience to exceptional changes in the exchange rate: the banks have a decisively important role in the financial system as a whole, and in particular in the payments and clearing system, and therefore any damage to them could have critical repercussions, even leading to a financial crisis.

The institutional investors. The institutional investors were not exposed at all to the exchange rate in 1997, and in 2005 their exposure to appreciation was just \$ 7 billion, equivalent to 6 percent of GDP, and only 6 percent of their total assets.

⁹ In Israel in recent years, the shekel has depreciated by an exceptional 18 percent twice, between August and October 1998 and in the second half of 2002. During both periods, depreciation of around 10 percent occurred in even shorter periods of time. An exceptional appreciation of 13 percent occurred in the first half of 2003. In this analysis we chose events where the exchange rate shock from depreciation and appreciation was symmetrical and more exceptional, irrespective of the period of time it took to happen.

Table 2: Exposure to Exchange Rate (Surplus of Assets in Foreign Currency) and Size of Exposure in Terms of GDP, by Sector, 1997 and 2005

	Exposure (\$ billions)		Exposure in terms of GDP (%)	
	1997	2005	1997	2005
Banks	1	1	1	1
Institutionals Investors	0	7	0	6
Government	-23	-28	-23	-23
Bank of Israel	16	26	16	22
Business sector	-17	11	-16	9
Households	10	26	10	21
Economy	-12	43	-12	35

SOURCE: Based on data from the Foreign Exchange Activity Department of the Bank of Israel.

Bank of Israel. The Bank was exposed to appreciation in both periods due to its large holdings of foreign currency reserves of \$ 16 billion in 1997 and \$ 26 billion in 2005, which constituted 16 percent and 22 percent in terms of GDP respectively. Despite the high level of this exposure, a fall in the shekel value of the foreign currency reserves of the Bank of Israel at a period of appreciation has little influence on the economy, and therefore can be ignored.

2. The sectors with significant exposure

The business sector. The business sector was significantly exposed to depreciation in 1997 and slightly exposed to appreciation in 2005: in 1997 the sector's exposure to depreciation stood at \$ 17 billion, constituting 17 percent of GDP and 31 percent of sector equity, while the debt in foreign currency constituted 60 percent of the sector's total debt. In 2005, the exposure switched and moderated; the sector was exposed to appreciation of the amount of \$ 11 billion, 9 percent of GDP and only 6 percent in terms of its equity.

Households. Households already held high levels of surplus assets in foreign currency in 1997—\$ 10 billion, constituting 10 percent in terms of GDP—and this increased considerably up to 2005—reaching \$ 26 billion, 21 percent of GDP. However, the level of their exposure in relation to their balance sheet appeared far lower; assets in foreign currency constituted less than 10 percent of their total assets in both years, and their exposure constituted only 6-7 percent of their net value.

Table 3: Level of Exposure in Proportion to Balance Sheet Data of Sectors Significantly Exposed to Depreciation/Appreciation, 1997 and 2005 (%)

	Total exposure (surplus of assets) as share of equity ¹ /net value		Total assets in foreign currency ² as share of total financial assets		Total liabilities in foreign currency ¹ as share of total liabilities (debt)	
	1997	2005	1997	2005	1997	2005
Government ³			19	11	34	26
Business sector	-31	6	41	50	59	39
Households	6	7	8	9	2	6
Economy (net total)⁴	-10	20				

¹ The business sector equity is taken from the market value of shares issued (both tradeable and nontradeable), and so reflects an "economic" equity value and not the accounting value of the sector's equity. We note that as the national balance sheet accounts include different valuations in some of their items, mostly on the assets side (real and financial), the net value--assets less liabilities--does not reflect the accounting equity value of these sectors but the "estimated net value".

² Balance-sheet assets and liabilities only.

³ As the government's net value in the national balance sheet is negative, we have not shown the level of exposure here as a share of net value.

⁴ For the economy in general we have shown the exposure only as a share of national property (physical assets and net assets abroad).

SOURCE: Based on data from the Foreign Exchange Activity Department of the Bank of Israel and the Central Bureau of Statistics (National Balance Sheet Accounts).

The government. The government, whose debt is in large part in foreign currency (34 percent in 1997 and 26 percent in 2005) was considerably exposed to depreciation in both 1997 and 2005; the government's surplus of liabilities stood, in both years, at the high rate of \$ 23 billion and \$ 28 billion, respectively, some 23 percent of GDP in both years. Note that when the government is examined together with the Bank of Israel (i.e. the public sector) its exposure to depreciation is low in both years. However this view is less relevant for financial stability analysis, as even if the Bank of Israel were to profit from depreciation, this would not reduce the damage to the government and consequently to the economy; the public sector as a whole also is of little significance to domestic and foreign investors, who tend to examine the financial strength of the government separately from that of the central bank.

b) Quantifying the direct impact on significantly exposed sectors

After identifying the three sectors significantly exposed to the exchange rate, in this section we check the level of the expected harm that would have come to each of them in the case of an exceptional depreciation or appreciation in the shekel, in order to identify those sectors that would have been harmed directly and significantly at a time of an exchange rate shock. In the following analysis using various indices of levels of impact (see Tables 4 and 5) we found that only two of these sectors would have been significantly harmed: the business sector in 1997 and the government in both years, and both these sectors in a case of an exceptional depreciation.

Harm to the business sector. As mentioned earlier, the business sector moved from a state of high exposure to depreciation in 1997 to a state of exposure—albeit to a lesser extent—to appreciation in 2005. As a result, the

strength of the impact also contracted, and changed directions: from a loss of 3.3 percent in terms of GDP in 1997 in a case of exceptional depreciation, to 1.8 percent in 2005 in the case of exceptional appreciation. The heavy impact that would have come to the business sector in 1997 in terms of GDP was also reflected in the strong impact on its financial strength: a depreciation of 20 percent would have caused the business sector to lose 6 percent of its equity and to increase its debt by 12 percent, and consequently to increase its financial leverage (the debt ratio of its balance sheet) from 51 percent to 55 percent, which attests to a heavy exposure to depreciation in the business sector. Harm to the business sector is significant to the economy as a whole, firstly because any damage to the sector reflects a concrete effect on GDP, and secondly because any damage to its financial strength could harm its lenders (the banks) indirectly.

In 2005, the impact on the business sector's financial strength in the case of an appreciation of 20 percent would have been more modest: a loss of only 1 percent in equity, debt would not have increased but would actually have contracted, and financial leverage would not have changed. From this we see that in addition to the drop in level of the business sector's exposure to appreciation in 2005 compared to its exposure to depreciation in 1997, its improvement in financial strength in the period, and in particular the fall in leverage, all led to diminish its financial strength in 2005 in the event of an exceptional appreciation being significantly lower than in the case of exceptional depreciation in 1997. Overall the business sector increased its resilience to changes in the exchange rate

Table 4: Level of Direct Damage¹ in Terms of GDP, by Sector, in the Event of Depreciation or Appreciation of 20%, 1997 and 2005

	1997	2005
Banks	0.3	0.1
Institutionals Investors	0.0	1.1
Government	-4.6	-4.7
Bank of Israel	3.2	4.4
Business sector	-3.3	1.8
Households	2.0	4.3
Total economy (net)	-2.4	7.1

¹ The direct damage (the loss) is calculated as 20 percent (rate of the depreciation/appreciation) of the level of exposure (assets surplus) and is expressed in terms of GDP: a positive ratio represents the damage from appreciation and a negative value, the damage in the event of depreciation.

SOURCE: Based on data from the Foreign Exchange Activity Department of the Bank of Israel.

Harm to the government. The government's high exposure to depreciation, similar in both years, was reflected in the expected harm that would have come in the case of exceptional depreciation, of about 5 percent in terms of GDP. The harm to the government's financial robustness would also have been high (similar in both years in question) and this was reflected in various indices: in 2005 for example, a depreciation of 20 percent would have led to a

rise of more than NIS 20 billion in government debt, almost 6 percent in terms of GDP, and the debt to GDP ratio would have reached 107 percent. A rise in government debt would also be expected to lead to a rise in annual debt payments (principal and interest) and in the deficit¹⁰ of NIS 3.3 billion, almost 1 percent of GDP. These data attest to the significant harm to the government's financial robustness both in 1997 and in 2005. Such harm could affect the ability and price of government borrowing, which would be expressed for example in a rise in yields on government shekel and dollar bonds.

Table 5: The Direct Damage to the Financial Strength of Sectors Significantly Exposed to Depreciation or Appreciation, 1997 and 2005 (%)

		Depreciation of 20%		Appreciation of 20%	
		1997	2005	1997	2005
Business sector	Loss in terms of equity ¹	-6.1			-1.2
	Expected debt growth rate	11.8			None (debt is declining)
	Change in financial leverage (debt as share of balance sheet ²)	from 51 to 55.4			Unchanged - 38.9
Government	Growth of government debt in terms of GDP	5.9	5.3		
	Expected growth in debt payments (deficit) in terms of GDP	0.9	0.9		
	Increase in debt to GDP ratio	from 101 to 107	from 100 to 105		
Households	Rate of fall in value of financial assets			-1.4	-1.7
	Loss in terms of net value			-1.2	-1.4
	Growth of debt in terms of net value (leverage)			from 25.7 to 25.9	Unchanged - 16.8

¹ The business sector equity is taken from the market value of shares issued (both tradeable and nontradeable), and so reflects an "economic" equity value and not the accounting value of the sector's equity. We note that as the national balance sheet accounts include different valuations in some of their items, mostly on the assets side (real and financial), the net value--assets less liabilities--does not reflect the accounting equity value of these sectors but the "estimated net value".

² Ratio of debt to the "reassessed" balance sheet, that is debt relative to debt *plus* market value of shares (estimate of equity), which differs from debt *plus* net value.

SOURCE: Based on data from the Foreign Exchange Activity Department at the Bank of Israel and the Central Bureau of Statistics (National Balance Sheet Accounts).

Harm to households. As mentioned earlier, households' exposure to appreciation and the level of exposure increased considerably between 1997 and 2005. As a result, there was also a rise in the level of harm that would have more than doubled in the case of appreciation of 20 percent, from 2 percent of GDP to 4.3 percent. Despite this, the harm to households' financial strength would not have been significant in either period: the impact on asset value and loss to net value of households in the event of an exceptional appreciation would have been low in both periods (less than 2 percent) and there would have been no harm to leverage in either of the two years as a result of the appreciation. Note that despite the rising level of households' exposure to appreciation in the period reviewed, the level of harm that would

¹⁰ This refers only to the budget deficit of the government. Note that today, unlike in 1997, Bank of Israel profits from differences in exchange rates on foreign currency reserves in a case of depreciation do not contribute to a rise in government income and hence to a reduction in the budget deficit.

have occurred in the event of exceptional appreciation fell due to a significant improvement in the sector's financial strength: leverage (ratio of debt to net value) stood at 17 percent in 2005 compared to 26 percent in 1997¹¹.

c) Identifying and quantifying the links between the sectors

After identifying two sectors that could be harmed directly and significantly at a time of exceptional depreciation of the shekel—the business sector and the government—we now wish to check if there are other sectors that could be harmed indirectly. To do so we first have to identify the links between these two sectors and the other sectors. We chose to concentrate on the links that are related to the credit risk channel which is the main channel of contagion, in other words we concentrated on the indirect damage to those sectors that are creditors to these two sectors: the major lenders to the government are the institutional investors, nonresidents and households, while the business sector's major lenders are the banks, and also the institutionals, nonresidents and households. We chose to quantify only the indirect impact on the banks given their high exposure to the business sector's credit risk, and their centrality and importance to the financial system and economic stability: the banks' share of the business sector's debt in the two years remained unchanged at around 70 percent, though its share of total bank credit rose from 43 percent in 1997 to 53 percent in 2005 (Table 6).

The indirect impact on the banks in the case of an exceptional depreciation or appreciation of the shekel reflects only those companies in the business sector which were exposed to depreciation or appreciation, that is the exposed business sub-sectors, whose financial robustness and ability to repay debts would be harmed as a result. Therefore even when the business sector is not exposed as a whole and so not expected to be harmed from changes in the exchange rate (such as an appreciation in 1997 or depreciation in 2005), part of it *is* exposed to the exchange rate and could be harmed, and consequently the banks too could be affected¹².

The level of exposure of the exposed business sub-sector to depreciation in the two periods stood little changed, at \$ 16 billion in 1997 and at \$ 14 billion in 2005 but the degree of minimal harm¹³ fell between the two periods: in 1997 a depreciation of 20 percent would have led to a loss of 4.6 percent in business sector product or at least 6 percent in its equity and a rise in debt of at least 8 percent, whereas in 2005 it would have caused a loss of 3.2 percent in business

¹¹ In this analysis we have ignored households' further exposure to appreciation through institutional investors: In 2005 the institutionals held a surplus of assets in foreign currency of \$ 7 billion, and this exposure was clearly an indirect exposure for households as losses on the institutionals' portfolios due to changes in the exchange rate would mostly be accounted to the debts of their fund holders and not to the institutional investors themselves (except for the "yield guaranteed life insurance plans" where the public's assets are not dependent on the market yields or the exchange rate).

¹² We did not divide the business sector into two in the first place as we do not have full data on their balance sheets, but rather only estimates of their exposure to the exchange rate.

¹³ As we do not have full data on balance sheet assets and liabilities of this group within the business sector we calculated the expected damage as a ratio to the business sector's balance sheet, and that is the minimal level of expected harm for the sub-sector.

sector product or at least 1.5 percent in its equity, and its debt would have risen by at least 4.8 percent. The exposure of the exposed sub-sector to appreciation was very low in 1997 and the sub-sector therefore was not expected to be harmed at a time of exceptional appreciation. In 2005 however the sub-sector's exposure to appreciation had grown significantly and had reached \$ 25 billion. As a result, the minimal harm of this group in 2005 at a time of an appreciation of 20 percent, would have been relatively high in terms of business sector product—5.7 percent—though less considerable in terms of equity—2.7 percent, due to the significant improvement in the business sector's financial robustness between the two years.

Table 6: Indirect Damage to Banks' Stability, via Direct Damage to the Business Sub-sector Exposed to Depreciation or Appreciation, 1997 and 2005

		Depreciation of 20%		Appreciation of 20%	
		1997	2005	1997	2005
Banks' exposure to the business sector	Banks' share of business sector debt (%)	71	67	71	67
	Credit to business sector as share of total bank credit (%)	43	53	43	53
Minimum damage¹ to exposed business sub-sector²	Total exposure (surplus of assets, \$ billions)	-16.2	-13.7	4.2	24.5
	Loss in terms of business product	-4.6	-3.2	-1.2	-5.7
	Loss in terms of equity ³	-6.0	-1.5	-1.5	-2.7
	Expected growth rate of debt	8.0	4.8	None (debt is declining)	
Indirect damage to banks	Growth of problematic debt as percentage of total credit risk ⁴	from 10 to 15.5	from 6.8 to 9.3	from 10 to 10.3	from 6.8 to 7.5
	Expected loss as share of equity ³ (%)	-21	-10	-1	-3
	Fall in capital adequacy ⁵	from 10 to 8.6	from 11.1 to 10.4	from 10 to 9.9	from 11.1 to 10.9

¹ This is the minimum damage as we have measured it relative to the entire business sector, because we have no further data on the business sub-sectors exposed to depreciation and appreciation, other than the assets and liabilities in foreign currency. (The national balance sheet accounts are not split into these sub-sectors).

² The indicators of damage in each case refer to the sector exposed to that event: the business sub-sector exposed to depreciation includes the group with surplus liabilities in foreign currency in the business sector excluding the Israel Electric Corporation, and the business sub-sector exposed to appreciation includes the group with surplus assets in foreign currency in the business sector.

³ The business sector equity is taken from the market value of shares issued (both tradeable and nontradeable), and so reflects an "economic" equity value and not the accounting value of the sector's equity. We note that as the national balance sheet accounts include different valuations in some of their items, mostly on the assets side (real and financial), the net value--assets less liabilities--does not reflect the accounting equity value of these sectors but the "estimated net value".

⁴ Assuming total credit risk remains unchanged, while problematic debt increases (see the calculation of estimated damage to the banks in Appendix C).

⁵ Assuming that risk assets remain unchanged, and that only the (regulatory) capital changes in the numerator - drops by the sum of loss to the banks.

SOURCE: Based on data from the Foreign Exchange Activity Department and Supervisor of Banks at the Bank of Israel and the Central Bureau of Statistics (National Balance Sheet Accounts).

d) Quantifying the indirect effect on the banks

In order to estimate the indirect harm to the banks, through their exposure to the business sub-sector's credit risk in the event of depreciation or appreciation, we first estimated the balance of bank credit of each of the sub-sectors exposed to depreciation or appreciation in each of the periods, and in order to calculate the loss to the banks we used two parameters: first, the level

of credit classified by the banks as problem loans due to the harm from the business sub-sector, which converts the level of damage to the financial strength of the business sub-sector exposed to the exchange rate into difficulties in repaying banking credit; and second, the additional loan loss provisions following the increase in problem loans, which converts the difficulties in repaying bank credit of the exposed sub-sector into losses for the banks. We set the first parameter based on information and experience that we had and in accordance with the level of damage to the financial strength of the sub-sector exposed to depreciation or appreciation in each of the years. Therefore in 1997 in the case of exceptional depreciation, the case with the most substantial hit to the exposed business sub-sector, we assumed that 20 percent of bank credit extended to the sub-sector would be classified as problem loans, compared to only 10 percent in the event of depreciation or appreciation in 2005 and only 5 percent in the case of appreciation in 1997. In Appendix C full details of the calculations of the indirect damage to the banks are presented, and in section f below, we present the results of sensitivity tests for this important parameter. The second parameter is set at 20 percent, based on historical data from the recession of 2001-2003, when there was a significant growth in banks' problem loans and in their loan loss provisions.

The damage to the banking system in the event of exceptional **depreciation** would have been considerable in 1997, though far less so in 2005 (see Table 6): in 1997 our estimate for the expected growth in loan loss provisions that would have resulted from a sharp depreciation reached NIS 4.3 billion, reflecting a growth of more than 30 percent in annual loan loss provisions and an increase in 55 percent in levels of problem loans. As a result, problem loans as a ratio of total credit risk would have been expected to rise considerably from 10 percent to 15.5 percent. The implications of this loss on the banking system would have been significant and indicate considerable harm to stability: the loss would have reached 21 percent of equity and the banks' capital adequacy would have fallen from 10 percent to 8.6 percent. In 2005 the indirect effect on the banks was expected to have been more moderate: a loss of 10 percent of equity, and a drop in capital adequacy from 11.1 percent to 10.4 percent. The improved resilience of the banking system in the face of an exceptional depreciation during the period stems from the growth in its "cushion" (the increased capital adequacy), as well as an improvement in the business sector's financial robustness, and all of this, despite no contraction in the banks' exposure to the business sector's credit risk.

The indirect damage to the banking system from an exceptional **appreciation** would have been far lower than from an exceptional depreciation, in both years: in 2005, banks' problem loans would have grown moderately in terms of total credit risk from 6.8 percent to 7.5 percent, loan loss provisions would have increased by less than 5 percent and the rate of loss would not have been significant, reaching only 3 percent of equity. As a result, the capital adequacy would have fallen slightly from 11.1 percent to 10.9 percent. In 1997, when

the exposure of the sub-sector to appreciation was far lower, the harm to the banks would have been even less and could hardly have been felt despite the banks' resilience in 1997 being lower than in 2005.

In summary, in the event of an exceptional appreciation, in 2005 and in 1997, the banks would not have been expected to be considerably harmed, and their stability would have been preserved, in contrast to an exceptional depreciation when the banks would have been expected to be significantly harmed in 1997 to the point of jeopardizing stability, and more moderately harmed—though still harmed—in 2005.

e) Overall Assessment

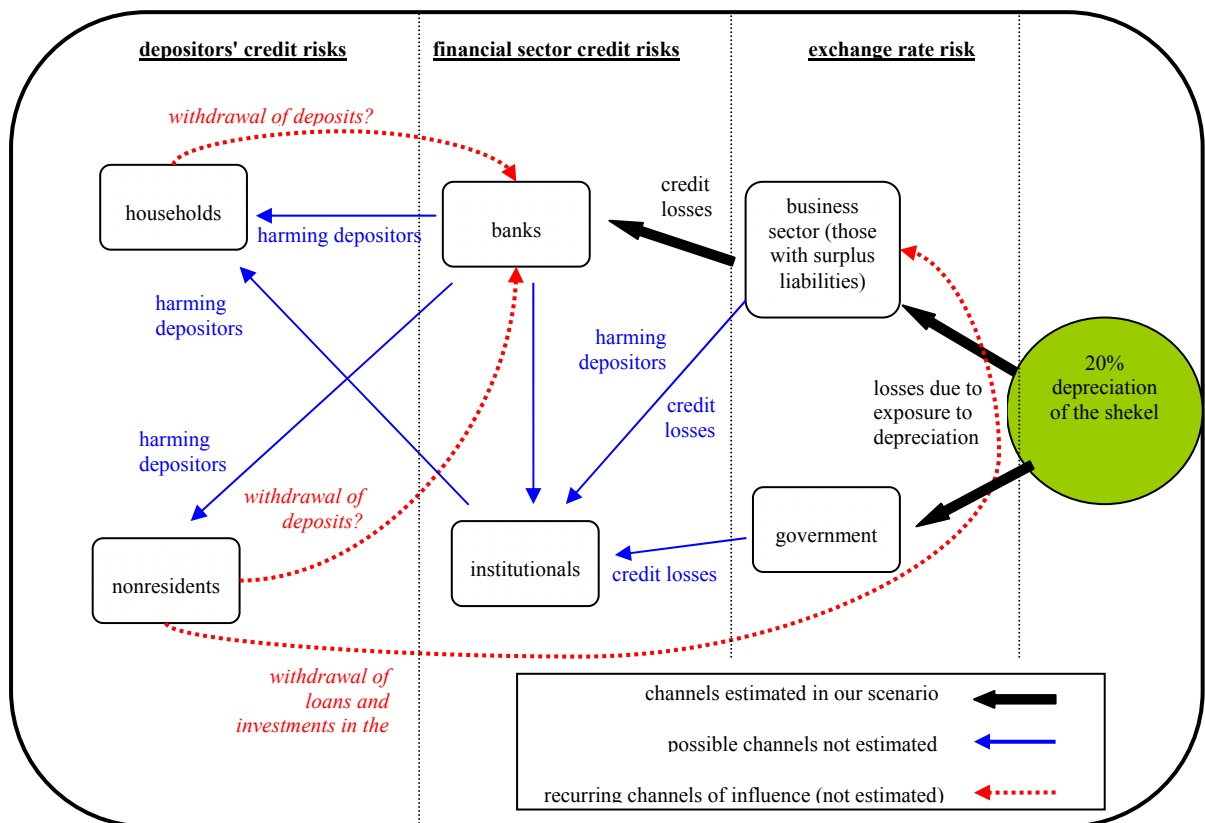
After estimating the direct impact on the sectors exposed to changes in the exchange rate and the indirect impact on banks, we evaluate in this section the overall impact and the economy's resilience, according to the balance sheet approach, in the event of exceptional depreciation and exceptional appreciation, while comparing between 1997 and 2005.

1. In the event of an exceptional depreciation

The analysis above shows the economy's high vulnerability to exceptional depreciation in 1997, which lessened—though did not disappear altogether—by 2005; part of the business sector and the government were significantly exposed to depreciation especially in 1997. The exposure of these two sectors was expected to affect their financial robustness in the event of an exceptional depreciation, and through this also affect other sectors of the economy primarily the banks, which were not directly exposed to the depreciation but were exposed to the business sector's credit risk. In 1997 the estimate of the expected damage from an exceptional depreciation on the business sector and through it, on the banks that lend to it, was significant.

In addition to the direct and indirect impacts that we have estimated, there are additional indirect impacts that we have not estimated (see Figure 1): the impact through "the credit risk channel" in institutional investors that lend to the government and the business sector (drop in bond value), and the impact on households through the damage to their savings and rights held with the institutions. These direct and indirect impacts were expected to be heavy in 1997 and could even have led to negative feedbacks that could have undermined the stability of the financial system ("financial crisis"): significant damage to the banks, as was expected in 1997, could under certain conditions have dented the confidence of depositors at the banks (both domestic and nonresident). For example, when one bank is more exposed than others to companies hit by depreciation, then the heavy impact will lead to withdrawals from that bank and possibly from other banks ("domino effect"). The effect on the government's financial robustness, and in particular the increase in government debt and its indices, could have considerable impact on the economy at a time of depreciation, *inter alia*, because of their importance as signals for the state of the economy for both

foreign and local players. The latter may react by withdrawing money from the banks, from institutional investors and from the securities and foreign exchange markets and by transferring them into cash and/or overseas. It is important to note that the impact on the economy in the process described here is almost unaffected by the fact that certain sectors (households and the Bank of Israel) hold surplus assets in foreign currency and would actually benefit from the depreciation¹⁴.



2. In the event of an exceptional appreciation

The analysis above shows the economy's low vulnerability (high resilience) to exceptional appreciation in both years: In 1997 only households and the Bank of Israel were exposed to appreciation, albeit to a small extent and not significant for the economy. In contrast, in 2005 all sectors, except the government, were exposed to appreciation, some of them very much so, and nevertheless the impact on the economy at a time of exceptional appreciation would have been low. The explanation for this is two-fold: firstly, the drop in value of the financial assets of the two sectors that accounted for most of

¹⁴ In the second half of 1998 there was a "crisis event" in Israel's financial markets, which included an exceptional depreciation of the shekel. An analysis of this "crisis event" is beyond the scope of this paper, but it appears that although the trigger for it came from outside Israel, the business sector's and the government's heavy exposure to depreciation contributed to the negative developments in the markets. The apparently slight harm to the economy in this case, as opposed to that described here, stems from, *inter alia*, the steps taken by the authorities which halted the depreciation and which created an appreciation at a certain cost to the economy.

the exposure to appreciation—Bank of Israel and households—would have been less significant in terms of their effect on the economy. And secondly, the financial strength of households and the business sub-sector exposed to appreciation, would hardly have been affected despite the losses from the appreciation, and therefore the indirect effect on the banks would also not have been significant, and their resilience—which in any case was greater in 2005 than in 1997—would have prevailed. Given that the total estimated effect, direct and indirect, is low, it follows that the additional indirect effects that are not estimated, are also low.

In conclusion, the balance sheet approach shows that between 1997 and 2005 the Israeli economy's resilience to exceptional changes in the exchange rate increased. This was due to changes in sectoral exposure structure and to the improved financial strength of the sectors. Specifically the economy was highly vulnerable to exceptional depreciation in 1997, and far less vulnerable in 2005, due to the business sector's move from being highly exposed to depreciation to being moderately exposed to appreciation, as well as due to a rise in the banking system's capital adequacy. There is no full immunity anyway: at the end of 2005 some of the business sector could have been hurt by an exceptional depreciation that could have hit the creditor banks. The government's exposure to depreciation, which did not diminish during the period reviewed, would have increased the effect on the economy in the event of an exceptional depreciation. On the other hand, despite the high exposure to appreciation of the Bank of Israel, households and some of the business sector at the end of 2005, the effect of an exceptional appreciation on the banks and on the economy in such an event would have been low.

In order to better assess the contribution the balance sheet approach, note that the traditional analysis would have led to completely different conclusions: the economy as a whole, whose exposure to the exchange rate is the net total of the exposure of all sectors (see Tables 2-4 above), moved from a situation of low exposure and vulnerability to exceptional depreciation at the end of 1997 to a situation of full immunity to depreciation, but high exposure and vulnerability to exceptional appreciation in 2005 (a loss of more than 7 percent of GDP). The significant difference in the conclusions of the two approaches comes from the traditional approach's disregard for the great heterogeneity between the sectors in their exposure to the exchange rate and for the differences in significance to the economy of similar exposures of differing sectors. These differences stem from the status of the sector in the economy and its relationships with other sectors as well as its financial strength.

f) Evaluating the sensitivity of the results

1. **Sensitivity of the direct impact.** The only parameter that can change the size of direct damage in those sectors exposed to the exchange rate, as

presented in section b) above, is the rate of depreciation/appreciation. The amount of damage to the various sectors following a depreciation/appreciation is proportional to the depreciation/appreciation rate: we examined cases of 20 percent appreciation or depreciation, but had we taken for example depreciation/appreciation of 10 percent, the direct damage in each of the sectors would have been half of what we found, and had we taken, likewise, depreciation/appreciation of 30 percent, the direct damage would have been 1.5 times what we found.

2. **Sensitivity of the indirect impact on the banks.** When we estimated the indirect damage to the banks [section d) above], we used two parameters in addition to the rate of depreciation/appreciation: the rate of credit classified as problem loans at the banks because of the impact on the exposed business sub-sector, and the growth rate of loan loss provisions following the growth in problem loans. We chose to focus on a test of sensitivity to changes in the first parameter of problem loans and the rate of depreciation/appreciation (see Table 7).

Table 7: Sensitivity of Banks' Capital Adequacy Ratio¹ to Rate of Depreciation or Appreciation, and to the Banks' Problematic Debt, 1997 and 2005 (%)²

		Rate of depreciation or appreciation	Share of credit to the business sub-sector that is classified as problematic debt by banks				
			5%	10%	15%	20%	30%
Depreciation of...	1997	10%	9.6	9.3	9.0	8.6	8.0
		20%	9.6	9.3	8.9	8.6	7.9
		30%	9.6	9.2	8.9	8.5	7.7
	2005	10%	10.7	10.4	10.0	9.7	9.0
		20%	10.7	10.4	10.0	9.6	8.9
		30%	10.7	10.3	10.0	9.6	8.9
Appreciation of...	1997	10%	9.9	9.8	9.7	9.7	9.5
		20%	9.9	9.8	9.8	9.7	9.5
		30%	9.9	9.8	9.8	9.7	9.6
	2005	10%	11.0	10.8	10.7	10.6	10.4
		20%	11.0	10.9	10.7	10.6	10.4
		30%	11.0	10.9	10.8	10.7	10.5

¹ The capital adequacy ratio stood at 10 percent in 1997 and at 11.1 percent in 2005.

² The highlighted values in the table show the capital adequacy ratios that we obtained after analysis using the parameters that were chosen in each of the years and for each scenario.

SOURCE: Based on data from the Foreign Exchange Activity Department and Supervisor of Banks at the Bank of Israel and the Central Bureau of Statistics (National Balance Sheet Accounts).

- a. **Sensitivity to the rate of depreciation/appreciation.** Examination shows that the results are not sensitive to the rate of depreciation/appreciation; for a given increase in problem loans, the capital adequacy ratio remains almost unchanged as the rate of change of the exchange rate varies. The reason for this is that a change in the rate of depreciation or appreciation of the shekel affects mainly the

size of direct damage to the exposed sub-sector, while the indirect effect on the banks is determined mostly by the exposed sub-sector's balance of bank credit and the two parameters: the level of credit that will be classified as problematic and the increase in loan loss provisions.

- b. Sensitivity to the level of credit classified as problem loans.** It was found that the results are not sensitive to the rate of problem loans in the event of appreciation, though they are somewhat sensitive in the event of depreciation: the banks' capital adequacy ratio changes in both years by around half a percentage point in the event of appreciation ranging between 10 percent and 30 percent and at problem loan levels of between 5 percent and 30 percent. That is, the results we obtained on the low indirect impact on banks in the event of appreciation is stable and not dependent on our chosen parameters. In contrast, in the event of depreciation, in both years the capital adequacy ratio would change significantly had we chosen a different rate of problem loans. In any case, in order to change our conclusions on the banks' vulnerability to depreciation, the level of problem loans would have had to be far from the level we assumed: in 1997, the rate of problem loans would have had to be close to 5 percent instead of the 20 percent we assumed, such that the capital adequacy ratio would have fallen just half a percentage point (from 10 percent to a reasonable rate of around 9.5 percent), and only then would we change our conclusion on the sharp impact on the banks. In 2005, the rate of problem loans would have had to be close to 30 percent instead of the 10 percent we assumed in order to see a significant drop in capital adequacy ratio of 1.5 percentage points to a rate below 9 percent, and only then would we change our conclusion on the insignificant impact on the banks.

It should be noted that the level of problem loans is not a random variable that can take any value; it is dependent, *inter alia*, on the strength of the exposure of the sectors that borrow from the banks, on the financial strength of the borrowers and on the rate of depreciation/appreciation. So for example the greater the rate of depreciation/appreciation, the larger the impact on the exposed business sub-sector and the lower its ability to repay, and so the higher the rate of problem loans. This is the reason why when we estimated the indirect damage to the banks, we chose different levels of problem loans in line with level of exposure, the size of the damage and the level of the business sector's financial robustness that prevailed at the time.

In summary our conclusions on the vulnerability or resilience of the banks to exceptional depreciation or appreciation, in the two years reviewed, are not dependent on the major parameter: the rate of problem loans. This non-trivial result stems from the fact that the

central data in the BSA analysis were very distinct in the analyzed years: for example, the banks' lack of exposure to the exchange rate in both years, the business sector's very high exposure to depreciation in 1997 and the high financial strength of the business sector and the banks in 2005.

6. SUMMARY AND CONCLUSIONS

The balance sheet approach is gaining prominence worldwide in the surveillance of financial stability, against the background of greater accessibility to balance sheet data. International organizations—foremost among them the IMF—and central banks are encouraging the production and dissemination of balance sheet data on assets and liabilities of various sectors and have even begun to use them in analyzing economies. This is based on the understanding of the added value of the data on sectoral exposure to various financial risks in analyzing the resilience of the financial system and the economy to shocks.

The contribution of this paper is twofold:

Firstly, we present a new framework for analyzing the economy's resilience to exchange rate risk, which reflects the added value of the BSA and of the national balance sheet data for financial stability analysis. This framework is also suitable for analyzing the economy's resilience to other financial risks: the principles of the analysis and the implementation process we have described account for a) the sectoral differences—regarding the direction and the level of their exposure to exchange rate risk, and the damage to their financial strength caused by exceptional depreciation or appreciation, and b) the relationships and the channels of contagion between the sectors. These inter-sectoral differences and relationships, measured using the national balance sheet data, could lead to a financial crisis even in a situation where according to the traditional approach the economy as a whole and the banking system in particular, are not directly exposed to exchange rate risk.

Secondly, we use this analysis framework and Israel's foreign currency balance sheet data and the new national balance sheet data to demonstrate an analysis of the Israeli economy's resilience to exchange rate risk in 2005 compared to 1997, using the balance sheet approach; the analysis shows that between 1997 and 2005 the economy became more resilient to exceptional changes in the exchange rate. This was due to structural changes in the economy's exposure, as well as to an improvement in the sectors' financial strength, which improved their resilience. Specifically, the economy was very vulnerable to exceptional shekel depreciation in 1997, and far less vulnerable in 2005, due to the business sector's move from high exposure to depreciation to slight exposure to appreciation, as well as to the banking sector's increased capital adequacy. Also, despite the considerable growth in exposure of the households and part of the business sector to appreciation during the same period, the

expected damage from exceptional appreciation to the private sector, the banking sector and the economy was still low. In any case, there is no full immunity: at the end of 2005, part of the business sector and the government would have been harmed by an exceptional depreciation in a way that could have adversely affected the creditor banks and the economy, though according to our estimate, not significantly. Our sensitivity test showed that these findings and conclusions were quite stable. It must be stressed that an analysis by the traditional approach would have resulted in completely different conclusions, showing the economy moving from a situation of low exposure and vulnerability to depreciation at the end of 1997 to a situation of full immunity from depreciation, but of high exposure and vulnerability to appreciation in 2005.

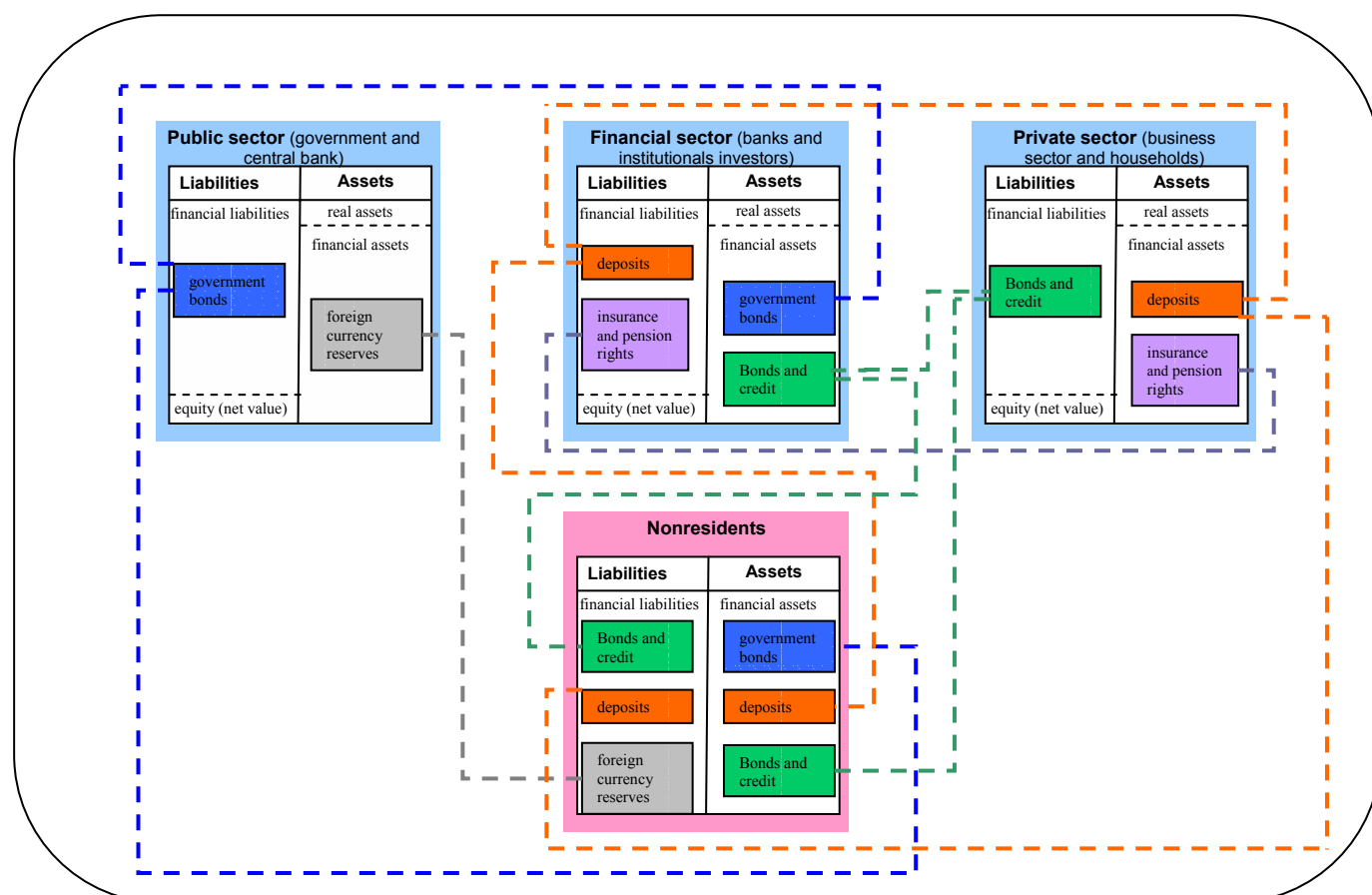
Two **policy implications** stem from the analysis: 1) the significant improvement in structural exposure to the exchange rate derived from the change in the incentive structure as a result of the transition to a flexible exchange rate regime and the liberalization of the foreign currency market. This meant that the very policy that increased the possible fluctuation in the exchange rate acted to improve the economy's resilience to such fluctuations, as it affected the behavior of the market players. However, it seems that this policy alone is insufficient, as there are still parts of the business sector highly exposed to depreciation or appreciation. 2) The balance sheet approach demonstrates the decisive—but not exclusive—importance of the banks to the economy's resilience to shocks; though banks' adequate capital and low direct exposure to market risks are essential for their stability, this stability strengthens as banks' dominance in financing the business sector diminishes and credit risk is more widely spread in the economy, as this reduces banks' direct exposure to credit risk and also their indirect exposure to market risks.

This paper proposes the following steps for **future development**: 1) wide use of the BSA for monitoring financial stability and of in-depth analysis of crisis processes; 2) development of an analysis framework for other financial risks (such as liquidity and interest rate risks) based on the principles and implementation process presented here; 3) expanding the infrastructure of national balance sheet data that will support regular calculations of sectoral exposure to various risks, for example using the surplus of assets over liabilities for the short term as an estimate of exposure to liquidity risk or the surplus of assets over liabilities by time to maturity (times of changes in interest rate) as an estimate of exposure to interest rate risk. It would also be preferable for the data to reflect non-balance-sheet activities (derivatives); 4) further research on estimation of inter-sectoral relationships, such as the link between indices of financial strength of the business sector and banks' capital adequacy, which would make the balance sheet approach more practical and useful and would allow for stress testing.

APPENDIX A: National Balance Sheet – Explanation and Data for 1995 and 2004.

This appendix explains the principles of the national balance sheet and presents the aggregated data of Israel's national balance sheets for the years 1995 and 2005. These data were used in the paper to analyze Israel's resilience to exchange rate risk, and specifically to build indicators for the exposures of various sectors and their damages at times of changes in the exchange rate. More detailed data and explanations on Israel's national balance sheets, including definitions and methodology, can be found on the Central Bureau of Statistics' website and in the booklet "National Balance Sheet 1995", Publication No. 1168.

Figure A.A.1: General Structure of National Balance Sheet Accounts – Major Items and Relationships



The **national balance sheets** present the balance of financial and non-financial (real) assets and liabilities of each sector in the economy vis-à-vis every other sector, in detail, as a complete and closed data system, and as part of the national data as recommended by international organizations.¹⁵ The national balance sheets are

¹⁵ Based on the System of National Accounts' recommended national accounts standards of 1993.

comprised of three basic sections: the sector that holds an asset or issues a liability; the type of asset or liability (type of instrument); and the counterparty, that is the sector where the asset is held or the sector to which the liability was issued.

Figure A.A.1 shows the general structure of the national balance sheet: it presents Israelis (the economy) as divided into the three major sectors, the public sector (government and the central bank), the financial sector (banks, institutional investors and others) and the private sector (business sector and households). These sectors operate among themselves and vis-à-vis nonresidents. Each sector has a separate balance sheet of assets and liabilities which reflects its activities vis-à-vis the other sectors. This balance sheet includes on the assets side the real assets (real estate, equipment etc.) and financial assets (deposits, credit, securities etc.) which are held against other sectors in Israel or nonresidents (and registered respectively under the latter's liabilities). Simultaneously, the liabilities side includes the financial liabilities (credit, bonds) of each sector against other sectors, and its capital or net value.

This appendix also includes two tables containing aggregate data only, based on detailed data infrastructure of Israel's national balance sheet in the years 1995 and 2004, which the Central Bureau of Statistics built together with the Bank of Israel. **Table A.A.1** presents assets and liabilities of the major economic sectors by major types at year-end for 1995 and 2004. **Table A.A.2** presents for these two years total assets and total liabilities of the major economic sectors vis-à-vis each of the other sectors, and vis-à-vis nonresidents too.

The split of the sectors in these tables relied on the initial division of sectors as appears in the Central Bureau of Statistics data, while combining some of them for convenience and relevance.¹⁶ In practice, the economy was split into six major sectors which operate among themselves and vis-à-vis nonresidents (similar to the seven sectors presented by the IMF), namely: the banks, institutional investors, the government, the Bank of Israel, the business sector and households. Note that the financial assets and liabilities in both tables are shown net, that is activities within each sector are not included. For example, securities issued by Israeli companies and held by other Israeli companies are not included in the business sector balance sheet. Also note that in Table A.A.2 real assets and shares on the assets side, and the net value on the liabilities side, are shown separately for each sector, with no counter-sector.

¹⁶ The division and definition of the sectors is based on an aspiration to make each sector as homogeneous as possible—each sector would include players with similar activities, which behave and react to external factors in a similar fashion—while at the same time, striving to make each sector heterogeneous to each other. In choosing the number and identities of the sectors, we must strike a balance between these two aspirations, while taking into account the limited data and the complexity of presenting and analyzing too many sectors.

Table 1: National Balance Sheet Accounts - Assets and Liabilities of the Major Economic Sectors, 1995 and 2004

(\$ billions, current prices)

	Banks		Institutionals investors		Government		Bank of Israel		Business sector		Households	
	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004
Total assets	388	814	220	502	169	204	42	129	408	1,076	750	1,941
Total non-financial assets	5	7	2	1	51	52	0	0	261	578	246	514
Total financial assets	383	807	218	501	118	153	41	129	147	498	505	1,426
Cash and deposits	39	95	36	74	73	78	26	27	50	174	149	358
<i>Of which:</i> abroad	26	64	0	0	2	4	26	25	2	39	0	10
Insurance and pension rights	0	1			0	1	0	0	6	18	211	478
Government bonds ¹	30	48	122	272			3	5	19	47	2	28
Private bonds ¹	8	17	36	69	1	3	0	93	2	30	1	12
Shares ¹	11	32	16	60	32	57	0	0	9	82	128	483
<i>Of which:</i> Foreign stocks	4	9	1	4	0	0	0	0	5	47	1	3
Credit (incl. accounts receivable)	289	607	7	10	12	14	13	4	59	116	11	38
<i>Of which:</i> To the business sector	141	355	2	1	11	13	0	0			8	28
To nonresidents	6	19	0	0	1	0	1	0	11	66	0	1
Other financial assets	6	7	1	15	0	0	0	0	3	30	3	30
Total liabilities (excl. shares)	353	735	218	504	307	564	55	128	200	534	153	279
Cash and deposits	321	708			41	9	39	55				
<i>Of which:</i> Of nonresidents	47	108										
Insurance and pension rights			216	498								
Bonds (or <i>makam</i>) issued ¹	29	21	0	0	231	478	15	73	9	76		
<i>Of which:</i> Held by nonresidents	0	0	0	0	54	78	0	0	0	26		
Loans (incl. accounts payable)	2	6	0	6	36	76	2	0	191	458	153	279
<i>Of which:</i> From nonresidents	0	0	0	1	19	56	1	0	29	66	0	4
Other liabilities	0	0	217	498	0	0	0	0	0	0	0	0
Net value²	36	78	2	-1	-139	-360	-13	1	208	542	597	1,662
<i>Of which:</i> Shares' market value	21	49	3	22	-	-	-	-	192	841	-	-

¹ Tradeable and nontradeable shares and tradeable bonds assessed according to market value.

² Defined as the difference between total assets and total liabilities.

SOURCE: Based on Central Bureau of Statistics data (National Balance Sheet Accounts).

Table A.A.2: National Balance Sheet Accounts - Assets and Liabilities¹ of the Major Economic Sectors vis-à-vis Other Sectors, 1995 and 2004

(\$ billions, current prices)

Asset holder	Liability holder						Total Israelis	Non-residents	Total financial assets (excl. shares)		Total assets		
	Banks	Institutionals investors	Government	Bank of Israel	Business sector	Households			Shares	Non-financial assets			
1995	Banks		0	65	19	142	106	334	39	373	11	5	388
	Institutionals investors	61		126	1	9	5	202	0	202	16	2	220
	Government	51	0		20	11	1	83	4	86	32	51	169
	Bank of Israel	4	0	11		0	0	15	26	41	0	0	42
	Business sector	43	7	27	7		42	125	13	138	9	261	408
	Households	146	211	4	7	9		376	0	377	128	246	750
	Total - Israelis	305	218	233	54	171	153		83		195	564	842
	Nonresidents	47	0	74	1	29	0	152			11		
	Total financial liabilities	353	218	307	55	200	153						
	Total net value	36	2	-139	-13	208	597	691					
<i>Of which: Shares' market value</i>	21	3	-	-	192	-							
Total liabilities	388	220	169	42	408	750	842						
2004	Banks		2	50	38	359	230	679	96	775	32	7	814
	Institutionals investors	85		278	5	48	8	424	16	441	60	1	502
	Government	68	1		7	16	1	92	4	96	57	52	204
	Bank of Israel	2	0	9		0	0	11	117	129	0	0	129
	Business sector	131	20	59	40		35	285	131	415	82	578	1,076
	Households	340	480	35	38	32		925	19	944	483	514	1,941
	Total - Israelis	627	502	430	127	455	274		383		714	1,153	2,249
	Nonresidents	108	1	134	0	79	4	327			261		
	Total financial liabilities	735	504	564	128	534	279						
	Total net value	78	-1	-360	1	542	1,662	1,922					
<i>Of which: Shares' market value</i>	49	22	-	-	841	-							
Total liabilities	814	502	204	129	1,076	1,941	2,249						

¹ The shares issued (on the liabilities side) are not split according to counterparty (on the assets side), but are shown separately on the assets side and at the same time under "net value" on the liabilities side.

SOURCE: Based on Central Bureau of Statistics data (National Balance Sheet Accounts).

APPENDIX B: Foreign Currency Balance Sheet – Explanation and Data for 1997 and 2005.

This appendix presents the aggregated data on Israel's foreign currency balance sheet, which we used in this paper to analyze the exposure in the economy to the exchange rate, based on the database of the Foreign Exchange Activity Department of the Bank of Israel.

As with the national balance sheet, the foreign currency balance sheet presents the assets and liabilities of each of the major economic sectors vis-à-vis each of the other sectors, but only those denominated in foreign currency or indexed to foreign currency. In this sense, the foreign currency balance sheet is only a detail or segment of the national balance sheet. However, unlike the national balance sheet, the foreign currency balance sheet includes the off-balance sheet activities (derivatives) in foreign currency, and therefore foreign currency balance sheet data allow us to measure the exposure of each sector to changes in the exchange rate of the shekel, defined as the surplus of assets in foreign currency over liabilities in foreign currency (denominated in or indexed to foreign currency, on and off the balance sheet);¹⁷ when the exposure figure is positive, the sector has a surplus of assets in foreign currency and is exposed to an appreciation of the shekel, and when the figure is negative, the sector has a surplus of liabilities in foreign currency and is exposed to a depreciation of the shekel.

Table A.B.1 presents total assets and total liabilities in foreign currency of each of the six major sectors (see Appendix A), at the end of 1997 and the end of 2005, differentiating between activities vis-à-vis other domestic sectors of the economy and activities vis-à-vis nonresidents. For convenience the table does not detail the types of asset or liability, but does differentiate between balance sheet activity and off-balance sheet activity (forward contracts and shekel/foreign currency options) and between debt and capital. **Table A.B.2** presents total assets and total liabilities in foreign currency for each sector, as shown in Table A.B.1, broken down by counter-sector. **Table A.B.3** presents exposure to exchange rate (surplus assets over liabilities in foreign currency) of each sector vis-à-vis the other sectors, at year-end 1997 and 2005, while **Table A.B.4** presents the changes in exposure during the intervening period.

In addition to the data on balances of assets and liabilities in foreign currency and exposure to foreign currency in the foreign currency balance sheet, there are also data on **flows in foreign currency**, that is accumulation and repayment of assets and liabilities in foreign currency. **Table A.B.5** presents the data on net accumulation of assets in foreign currency of each sector vis-à-vis other sectors, that is the net flows of assets less net flows of liabilities for the eight years between 1997 and 2005. These data are parallel to the data in Table A.B.4 on changes in exposure, and the

¹⁷ This is an accounting definition of exposure to the exchange rate. The economic definition needs to be based on the present value of future net remunerations and payments in foreign currency of each sector, though such an exposure cannot be measured in sector terms.

differences between them express principally changes in the net values of assets and liabilities.

Data on flows in foreign currency of domestic sectors vis-à-vis nonresidents are only one component of the data on capital flows, presented in the financial account of the balance of payments; the complementary data are the data on **shekel** flows between domestic sectors and nonresidents.¹⁸ **Table A.B.6** presents the data on net flows in shekels in the period from 1997 to 2005, as well as the data on balances of assets and liabilities in shekels for each one of the domestic sectors vis-à-vis nonresidents, at year-end 1997 and 2005. As expected in Israel, most of the data in the table are low or close to zero, and the significant data in the table reflects the balances and flows of nonresidents' investments in Israeli corporate shares, which are considered as shekel liabilities of Israelis to nonresidents.

¹⁸ Data on capital flows presented in the balance of payments include activities in shekels and in foreign currency together, are sorted by sector, Israeli or nonresident and according to type of asset (portfolio or direct investment and debt instruments). The International Investment Position (IIP) includes data on balances of assets and liabilities of the economy vis-à-vis abroad, sorted like the capital flows, that is assets in shekel and in foreign currency are presented together. The IIP figures are included in total in the national balance sheet, and only the foreign currency component in the IIP is included in the foreign currency balance sheet.

Table A.B.1: Foreign Currency Balance Sheet - Assets and Liabilities in Foreign Currency of the Major Economic Sectors, By Type, 1997 and 2005

(\$ billions)

		Banks		Institutionals investors		Government		Bank of Israel		Business sector		Households		Total - Israelis	
		1997	2005	1997	2005	1997	2005	1997	2005	1997	2005	1997	2005	1997	2005
<i>Assets and liabilities in foreign currency vis-à-vis domestic sectors</i>	Total assets	26	32	0	2	6	3	1	0	6	16	11	19		
	Balance sheet debt instruments	26	27	0	2	6	3	0	0	6	9	11	18		
	Derivative debt instruments	0	5	0	1	0	0	1	0	0	7	0	1		
	Total liabilities	19	35	0	1	3	1	6	2	21	30	1	3		
	Balance sheet debt instruments	18	28	0	0	3	1	6	2	21	24	1	3		
	Derivative debt instruments	1	7	0	1	0	0	0	0	0	6	0	0		
<i>Assets and liabilities in foreign currency vis-à-vis nonresidents</i>	Total assets	12	31	0	5	1	0	20	28	11	46	0	10	44	121
	Balance sheet debt instruments	11	26	0	2	1	0	20	28	9	35	0	7	41	98
	Derivative debt instruments	0	3	0	0	0	0	0	0	0	0	0	0	0	3
	Capital instruments	1	2	0	4	0	0	0	0	2	10	0	4	3	20
	Total liabilities	17	27	0	0	26	31	0	0	13	21	0	0	56	78
	Balance sheet debt instruments	17	23	0	0	26	31	0	0	13	21	0	0	56	74
Derivative debt instruments	0	4	0	0	0	0	0	0	0	0	0	0	0	4	
<i>Total assets and liabilities in foreign currency</i>	Total assets	38	63	0	8	6	4	22	28	17	62	11	29		
	Balance sheet debt instruments	37	53	0	3	6	4	20	28	15	44	11	25		
	Derivative debt instruments	0	8	0	1	0	0	1	0	0	7	0	1		
	Capital instruments	1	2	0	4	0	0	0	0	2	10	0	4		
	Total liabilities	36	62	0	1	30	32	6	2	34	51	1	4		
	Balance sheet debt instruments	35	51	0	0	30	32	6	2	34	45	1	3		
Derivative debt instruments	1	11	0	1	0	0	0	0	0	6	0	0			

SOURCE: Based on data from the Foreign Exchange Activity Department at the Bank of Israel.

Table A.B.2: Foreign Currency Balance Sheet - Assets and Liabilities in Foreign Currency of the Major Economic Sectors vis-à-vis All Other Sectors, 1997 and 2005

(\$ billions)

<i>Asset holder</i>	<i>Liability holder</i>	Banks	Institutionals investors	Government	Bank of Israel	Business sector	Households	Total Israelis	Nonresidents	Total assets
		1997	Banks		0	2	2	21	1	26
Institutionals investors	0			0	0	0	0	0	0	0
Government	2		0		4	0	0	6	1	6
Bank of Israel	1		0	0		0	0	1	20	22
Business sector	5		0	1	0		0	6	11	17
Households	11		0	0	0	0		11	0	11
Total - Israelis	19		0	3	6	21	1		44	
Nonresidents	17		0	26	0	13	0	56		56
Total liabilities	36	0	30	6	34	1		44		
2005	Banks		1	1	0	27	3	32	31	63
	Institutionals investors	1		0	0	1	0	2	5	8
	Government	2	0		2	0	0	3	0	4
	Bank of Israel	0	0	0		0	0	0	28	28
	Business sector	16	0	0	0		0	16	46	62
	Households	17	0	0	0	2		19	10	29
	Total - Israelis	35	1	1	2	30	3		121	
	Nonresidents	27	0	31	0	21	0	78		78
Total liabilities	62	1	32	2	51	4		121		

SOURCE: Based on data from the Foreign Exchange Activity Department at the Bank of Israel.

Table A.B.3: Foreign Currency Balance Sheet - Surplus of Assets in Foreign Currency of the Major Economic Sectors vis-à-vis All Other Sectors, 1997 and 2005

(\$ billions)

<i>Liability holder</i> <i>Asset holder</i>							Total Israelis	Nonresidents	Total surplus of assets	
		Banks	Institutionals investors	Government	Bank of Israel	Business sector				Households
1997	Banks		0	0	1	16	-10	7	-5	1
	Institutionals investors	0		0	0	0	0	0	0	0
	Government	0	0		4	-1	0	2	-25	-23
	Bank of Israel	-1	0	-4		0	0	-4	20	16
	Business sector	-16	0	1	0		0	-15	-2	-17
	Households	10	0	0	0	0		10	0	10
2005	Banks		0	-1	0	11	-14	-3	4	1
	Institutionals investors	0		0	0	1	0	1	5	7
	Government	1	0		2	0	0	2	-30	-28
	Bank of Israel	0	0	-2		0	0	-2	28	26
	Business sector	-11	-1	0	0		-2	-14	25	11
	Households	14	0	0	0	2		16	10	26

SOURCE: Based on data from the Foreign Exchange Activity Department at the Bank of Israel.

Table A.B.4: Foreign Currency Balance Sheet - Change in Surplus of Assets in Foreign Currency of the Major Economic Sectors vis-à-vis All Other Sectors, 1997 to 2005

(\$ billions)

<i>Liability holder</i> <i>Asset holder</i>							Total Israelis	Nonresidents	Total change in surplus of assets	
		Banks	Institutionals investors	Government	Bank of Israel	Business sector				Households
	Banks		0	-1	-1	-5	-3	-10	9	-1
	Institutionals investors	0		0	0	1	0	1	5	7
	Government	1	0		-2	1	0	0	-5	-5
	Bank of Israel	1	0	2		0	0	3	8	10
	Business sector	5	-1	-1	0		-2	1	27	28
	Households	3	0	0	0	2		5	10	16

SOURCE: Based on data from the Foreign Exchange Activity Department at the Bank of Israel.

Table A.B.5: Foreign Currency Balance Sheet - Net Accumulation of Assets (Movement) in Foreign Currency of the Major Economic Sectors vis-à-vis All Other Sectors, 1997 to 2005

(\$ billions)

<i>Liability holder</i> <i>Asset holder</i>	Banks	Institutionals investors	Government	Bank of Israel	Business sector	Households	Total Israelis	Nonresidents	Total change in surplus of assets
Banks		0	-1	-1	-4	-3	-9	11	2
Institutionals investors	0		0	0	1	0	1	5	6
Government	1	0		-2	1	0	0	-4	-5
Bank of Israel	1	0	2		0	0	3	6	9
Business sector	4	-1	-1	0		-2	0	23	23
Households	3	0	0	0	2		5	9	14

SOURCE: Based on data from the Foreign Exchange Activity Department at the Bank of Israel.

Table A.B.6: Foreign Currency Balance Sheet - Israelis' Assets and Liabilities in Shekels vis-à-vis Abroad, Balances and Movements, 1997 and 2005

(\$ billions)

	Balance in 1997				Balance in 2005				Net movement between the two years			
	Assets	Liabilities	<i>Of which: capital</i>	Net	Assets	Liabilities	<i>Of which: capital</i>	Net	Assets	Liabilities	<i>Of which: capital</i>	Net
Banks	0	0	0	0	5	3	0	1	4	3	0	1
Institutionals investors	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0		0	0	1		-1	0	1		-1
Bank of Israel	0	0		0	0	0		0	0	0		0
Business sector	0	19	19	-19	0	78	77	-77	0	41	40	-41
Households	0	0		0	0	0		0	0	0		0
Total - Israelis	0	19	19	-19	5	82	77	-77	4	44	40	-40

SOURCE: Based on data from the Foreign Exchange Activity Department of the Bank of Israel.

APPENDIX C: Analysis of Resilience to Exchange Rate Risk – Explanation and Data for 1997 and 2005.

This appendix presents additional data which we used to calculate the indices of the exposure to exchange rate risk of the various sectors, and the size of damage to them and to the economy in the event of an exceptional depreciation/appreciation. The combination of these data with the national balance sheet data and the foreign currency balance sheet data (see Appendixes A and B) allows us to calculate the indices shown in Tables 2-7 in Section 5, in the main body of the text. **Table A.C.1** in this appendix presents the additional data on the business sector, the government, and the whole economy at year-end 1997 and 2005. **Table A.C.2** presents additional data on the banks for these years, as well as the calculation of indirect damage to the banks through the business sub-sectors exposed to depreciation or appreciation. Given the complexity of the calculations for the banking sector, we have added an explanatory note on the calculations, the assumptions and the parameters that we used.

Table A.C.2: Additional Data on the Economy, the Business Sector and the Government, 1997 and 2005

		1997	2005
(\$ billions)			
Economy	Annual GDP (NIS billions)	356.7	555.0
	External debt	56.6	75.6
	Liquid assets in foreign currency	38.9	99.3
	Short-term liabilities in foreign currency	20.1	30.7
	Surplus of liquid assets over short-term liabilities	18.8	68.6
Business sector	Business sector gross product (NIS billions)	250.4	396.1
	Financial leverage, ratio of debt to estimated balance sheet ¹ (before depreciation/appreciation)	51.0	38.9
	Liquid assets in foreign currency	10.9	44.4
	Short-term liabilities in foreign currency	19.3	28.1
	Surplus of liquid assets over short-term liabilities	-8.4	16.3
Of which: Those with a surplus of liabilities in foreign currency²	Assets in foreign currency	6.4	17.7
	Liabilities in foreign currency	22.6	31.4
	<i>Of which:</i> Balance-sheet liabilities in foreign currency	22.6	27.6
	Surplus of liabilities in foreign currency	16.2	13.7
	As share of business sector's total assets in foreign currency (%)	37.8	28.6
Of which: Those with a surplus of assets in foreign currency	As share of business sector's total liabilities in foreign currency (%)	67.4	61.7
	Assets in foreign currency	9.9	35.8
	<i>Of which:</i> Balance-sheet assets in foreign currency	9.9	31.5
	Liabilities in foreign currency	5.7	11.3
	Surplus of assets in foreign currency	5.7	9.6
Government	As share of business sector's total assets in foreign currency (%)	58.4	57.8
	As share of business sector's total liabilities in foreign currency (%)	17.0	22.2
	(NIS billions)		
	Annual interest rate payments on total government debt	20.4	33.4
	<i>Of which:</i> Interest rate payments on external debt	5.2	6.8
Annual (average) principal repayment on total government debt ³	43.5	81.6	
<i>Of which:</i> Annual (average) principal repayment on external debt	11.5	16.9	
Total payments on government debt (principal and interest)	63.9	115.0	

¹ Ratio of debt to the "reassessed" balance sheet, that is debt relative to debt *plus* market value of shares (estimate of equity), which differs from debt *plus* net value.

² Group of companies within the business sector that have a surplus of liabilities in foreign currency, excluding the Israel Electric Corporation.

³ Calculated as the balance of debt divided by the average period to maturity.

SOURCE: Based on data from the Central Bureau of Statistics and the Foreign Exchange Activity Department at the Bank of Israel.

Table A.C.2 shows the additional data we used to calculate the indirect damage to the banks in each of the two years reviewed, in the event of a depreciation and appreciation of 20 percent, followed by parameters that we used to calculate the size of the loss, and the stages in the calculation.

Calculating the banks' losses was conducted in stages assuming that the losses caused to the banks' debtors (the business sub-sectors exposed to the exchange rate) in the event of an exceptional depreciation/appreciation would dent their ability to repay their credit to the banks, and which would eventually lead to an increase in the banks' problem loans, and hence an increase in the banks' loan loss provisions, which in effect is the loss to the banks.

Table A.C.2: Data to Calculate Banks' Losses at Time of Sharp Depreciation or Appreciation, 1997 and 2005

	1997	2005
General data (NIS billions)		
Regulatory capital	30.4	74.4
Risk-based assets	304.9	672.1
Capital adequacy ratio (regulatory capital/risk-based assets) (%)	10.0	11.1
Total credit risk (balance sheet and non-balance sheet)	390.8	937.0
Total problematic debt (balance sheet and non-balance sheet)	39.1	63.4
<i>Of which:</i> Problematic debt of the business sector	28.7	53.5
Ratio of problematic debt to total credit risk (%)	10.0	6.8
Total annual expenditure on loan loss provisions	2.1	4.9
<i>Of which:</i> In respect of the business sector	1.6	4.1
Balance of loan loss provisions (specific and general)	13.3	33.4
Parameters for calculations		
Average growth in loan loss provisions due to increase in problematic debts in a recession	20%	20%
Percentage of credit to the business sub-sector exposed to depreciation, classed as problematic debt	20%	10%
Percentage of credit to the business sub-sector exposed to appreciation, classed as problematic debt	5%	10%
Calculation of bank losses due to business sub-sector exposed to depreciation in the event of a 20 percent depreciation (NIS billions)		
Credit in foreign currency as share of total business sector debt	59.2	38.6
Balance sheet debt in foreign currency of group with surplus of liabilities in foreign currency (before the depreciation)	79.9	127.3
Estimated debt of those with surplus of liabilities in foreign currency (before the depreciation)	134.9	329.8
Estimated debt of those with surplus of liabilities in foreign currency (after the depreciation)	150.9	355.3
<i>Of which:</i> Estimated credit from banks	107.5	238.9
Expected growth in problematic debt of this group for losses in the event of depreciation	21.5	23.9
Expected loan loss provisions (=loss to the banks)	4.3	4.8
Calculation of bank losses due to business sub-sector exposed to appreciation in the event of a 20 percent appreciation (NIS billions)		
Balance sheet debt in foreign currency of group with surplus of assets in foreign currency (before the appreciation)	20.2	44.4
Estimated debt of those with surplus of assets in foreign currency (before the depreciation)	34.0	115.0
Estimated debt of those with surplus of assets in foreign currency (after the depreciation)	30.0	106.1
<i>Of which:</i> Estimated credit from banks	21.4	71.3
Expected growth in problematic debt of this group for losses in the event of appreciation	1.1	7.1
Expected loan loss provisions (=loss to the banks)	0.2	1.4

SOURCE: Based on data from the Supervisor of Banks and the Foreign Exchange Activity Department at the Bank of Israel, and the Central Bureau of Statistics (National Balance Sheet Accounts).

In the first stage, we found the **balance of bank credit** to each of the two business sub-sectors, both of which were exposed either to depreciation or appreciation in each of the two years. As we have no balance sheet data other than their assets and liabilities in foreign currency, the bank credit to the two groups had to be estimated. We assumed that their liabilities in foreign currency as a proportion of their total liabilities (in shekels and foreign currency) were not significantly different than the proportion for the business sector as a whole, and on this basis we estimated the total debt (shekel and foreign currency) of the two exposed sub-sectors. Now we had to estimate the amount of bank debt out of the total debt of each sub-sector. To do this, we derived the bank debt of each of the business sub-sectors assuming that the share of bank credit in their total liabilities was identical to the share of bank credit in the total liabilities of the business sector as a whole. We note that in both periods, the balance of bank debt of the business sub-sector exposed to depreciation was significantly higher than the sub-sector exposed to appreciation, and therefore too in direct proportion, the level of bank exposure to the credit risk of each, and this also has an effect on the level of indirect damage to the banks in each of the events.

In the second stage, we had to estimate how much out of the bank credit to the business sub-sectors would be classified as **problem** loans, following the harm to them in each event. We set these parameters based on our knowledge and experience, and relying on the level of harm that we measured in each of the borrowing sub-sectors in the event of a sharp depreciation or appreciation in the two years in question. We therefore estimated that in the event of an exceptional depreciation in 1997, around 20 percent of the credit to the business sub-sector exposed to depreciation would be classified as problem loans, while in 2005, we lowered our estimate to only 10 percent. This reflects the improvement in the business sector's financial strength between the periods and the lower harm in 2005 in the event of an exceptional depreciation. In the event of appreciation, although in 2005 the size of damage to the business sub-sector exposed to appreciation is a little higher in terms of GDP and equity than in the case of a sharp depreciation in the same year, as the size of debt did not increase but actually fell, we left the parameter of growth in problem loans as it was for the case of depreciation—10 percent. In 1997, however, the level of damage from appreciation was lower and therefore we lowered this parameter to 5 percent.

In the final stage, we estimated the additional **loan loss provisions** following the rise in problem loans, which expresses the loss to the banks in each of the events, via the indirect channel of credit risk. For this we used data from the recession period of 2001-2003, when problem loans grew considerably, and we found that the ratio between additional provisions and the additional problem loans for the business sector stood at 20 percent on average.

BIBLIOGRAPHY

- Allen, Mark, Christoph Rosenberg, Christian Keller, Brad Setser, and Nouriel Roubini (2002). "A Balance Sheet Approach to Financial Crisis", IMF WP/02/210.
- Dornbusch, Rudiger (2001). "A Primer on Emerging Markets Crises", NBER Working Paper No. 8326 (Cambridge, Massachusetts: National Bureau of Economic Research).
- ECB (2002). "Guideline ECB/2002/7." (www.ECB.int)
- Eichengreen, Barry, Ricardi Hausmann and Ugo Panizza (2003). "Currency Mismatches, Debt Intolerance and Original Sin: Why They Are Not the Same and Why it Matters", NBER Working Paper No. 10036 (Cambridge, Massachusetts: National Bureau of Economic Research).
- Goldstein, Morris, and Philip Turner (2004). "Controlling Currency Mismatches in Emerging Markets" (Washington: Institute for International Economics).
- Gray, Dale F., Robert C. Merton and Zvi Bodie (2002). "A New Framework For Analyzing and Managing Macrofinancial Risks", CV Starr/RED Conference on Finance and Macroeconomy, NYU.
- IMF (2004). "Integrating the Balance Sheet Approach into Fund Operations", informal Board discussion (Prepared by the Policy Development and Review Department). (www.imf.org/external/np/pdr/bal/2004/eng/022304.htm)
- IMF (2005a). "Another Tool for Preventing Crises", IMF Survey, Vol. 34, No 6. p. 96. (www.imf.org/external/pubs/ft/survey/2005/040405.pdf)
- IMF, 2005b, "Global Financial Stability Report," pp. 62-91 on "Household Balance Sheets". (www.imf.org/external/pubs/FT/GFSR/2005/01/pdf/chp3.pdf)
- IMF (2005c). "Global Financial Stability Report," pp. 35-50 on "Balance Sheet Developments in Major Mature Markets". (www.imf.org/external/pubs/FT/GFSR/2005/02/pdf/chp2.pdf)
- IMF (2005d). "IMF Executive Board Discusses Balance Sheet Approach to Analysis of Debt-Related Vulnerabilities in Emerging Markets", Public Information Notice (PIN) No. 05/36. (www.imf.org/external/np/sec/pn/2005/pn0536.htm)
- Krugman, Paul (1999). "Balance Sheets, the Transfer Problem, and Financial Crises", in International Finance and Financial Crises: Essays in Honor of Robert P. Flood, Jr., ed. By Peter Isard, Assaf Razin, and Andrew K. Rose (Boston: Kluwer Academic; Washington: International Monetary Fund).
- Lima, Juan Manuel, Enrique Montes, Carlos Varela, and Johannes Wiegand (2006). "Sectoral Balance Sheet Mismatches and Macroeconomic Vulnerabilities in Colombia, 1996-2003", IMF WP/06/5.

- Mathison, Johan, and Antony Pellechio (2006). "Using the Balance Sheet Approach in Surveillance: Framework, Data Sources and Data Availability", IMF WP/06/100.
- Mink, Reimund (2004). "Selected Key Issues of Financial Accounts Statistics", ECB.
- Posen, A. (2001). "A Strategy to Prevent Future Crises: Safely Shrink the Banking Sector," Institute for International Economics. (<http://www.iie.com/papers/posen0601-2/htm>)
- Rosenberg, Christoph, Ioannis Halikas, Brett House, Christian Keller, Jens Nystedt, Alexander Pitt, and Brad Sester (2005). "Debt-Related Vulnerabilities and Financial Crises: An Application of the Balance Sheet Approach to Emerging Market Countries", IMF Occasional Paper No. 240.
- Central Bureau of Statistics, 2002, "National Balance Sheet 1995", Publication No. 1168.
- Hecht, Yoel, Haim Yair and Ben Z. Schreiber, 2002, "Foreign Currency Market Model: Application in Israel", Bank of Israel.
- Levy, Roe, 2005, "Israel's Partial Financial Balance Sheet, 1999-2003: An Analysis from the Financial Stability Perspective," Bank of Israel internal publication. (*Hebrew only*)
- Websites of other central bureaux of statistics with national balance sheet , for example www.statcan.ca of Canada and www.abs.gov.au of Australia.