Investment in Financial Structured Products from a Rational Choice Perspective

Moran Ofir*
Zvi Wiener**

Abstract
Structured products (SP) are synthetic investment instruments tailored to meet specific needs that cannot be met from the investments in standard financial instruments. Despite of the large sums invested in SP, regulation, that adequately addresses issues pertinent to investment in these packaged financial instruments, which do not necessarily arise regarding 'plain vanilla' stocks, bonds and mutual funds, is lacking. We argue that the current supply of structured products is commonly designed to exploit some common behavioral biases in the area of decision making under uncertainty. We identify several main features of structured products, each associated with a specific behavioral bias. The examined behavioral biases include: loss aversion, the disposition effects, herd behavior, probability distortion, the ostrich effect and the hindsight bias. We perform an experiment that examines investor decision-making in relation to investments in SP. Our findings demonstrate that investors tend to be affected by these behavioral biases, favoring SP investments. Accordingly, regulation dealing specifically with SPs may be warranted to improve investor protection.

*PhD Candidate, School of Business Administration and the Center for Rationality, The Hebrew University of Jerusalem and Junior Faculty Member, Radzyner School of Law, The Interdisciplinary Center, Herzliya.
**Head of Finance Department, School of Business Administration, The Hebrew University of Jerusalem.
Introduction

Structured products are investment products which characterize in pre-packaging of securities and derivatives in a single derivative instrument. One of the key characteristics of structured products is that the return is not determined by active investment but rather by a pre-specified formula, which sets out the product’s performance in any possible future scenario.

The structured products market has existed for over ten years but has grown significantly over the last few years as the decline in global equity markets has stimulated demand for various types of alternative investments. Large retail markets for structured products exist in all major European countries as well as in North America, Asia, Australia and New Zealand. Structured products have also been introduced in many emerging markets such as Eastern Europe and South Africa.¹

Structures typically use derivatives to create tailored returns. These derivatives can be plain vanilla or exotic and can be linked to a variety of indices, commodities. Investors in structured products range from retail investors, high-net worth individuals, institutional investors, and corporations.

Derivatives constitute an essential ingredient of any structured product, since they enable the generation of specific return profiles. Accordingly, investment banks active in derivative markets have traditionally generated new product development and have provided retail product vendors the ability to hedge exposure when new products are launched. These include retail banks, building societies, and fund managers, which market financial products either directly to existing customers or via third party distributors such as financial advisers.

Structured products have no exact definition, neither in a business context nor in a regulatory context. U.S., regulators such as the SEC² and FINRA³ employ a broad

¹ Source: Structured Retail Products.com.
² SEC Rule 434.
definition. Under this definition, a *structured security* is a security derived from or based on another security, basket of securities, index, commodity, or foreign currency. This definition covers a wide range of products, including equity-linked or commodity-linked debt, collateralized debt obligations (CDO), reverse convertibles, and credit-default swaps (CDS). The European Union's Markets in Financial Instruments Directive (MiFID) defines the concept of 'non-complex' financial instruments. A non-complex product must be liquid investments and it must not comprise any actual or potential liability which exceeds the cost of the instrument, and there must be adequate information about them available publicly\(^4\). The definition of complex financial instruments includes bonds or securitized debts that embed a derivative, but it does not offer an exact definition to structured product.

Interest in structured products has grown in recent years and a non negligible proportion of investor capital has been invested in structured products as either a method of portfolio diversification or as a sole investment. The growth in new structured product issues in the U.S. market between the years 2003–2007 is demonstrated in Figure 1:

**Figure 1:** U.S. Structured Products: New Issues, 2003–2007 (USD billions)

---

\(^3\) FINRA Regulatory Notice 08-81; NASD Notice to Members 05-59.

\(^4\) MiFID, Article 39.
Relative to the European market, the U.S. market is far behind in the penetration of structured products in retail markets. As Figure 2 demonstrates, the size of the U.S. retail market is approximately half that of the European market.

**Exhibit 2:** Gross Sales of Structured Products to Retail Investors in 2005 (USD billions)

![Bar chart showing gross sales of structured products to retail investors in 2005 by region: Europe, United States, Canada, Asia. Europe has the highest sales at over $180 billion, followed by the United States at $160 billion, Canada at $80 billion, and Asia at $40 billion.]


Recent evidence suggests a growing propensity for retail investors in the United States purchase structured products listed on public exchanges. The American Stock Exchange reported an 18 percent increase in the number of listed structured products issues in 2005 over 2004, bringing the notional amount of structured products on the AMEX to over $13 billion. The New York Stock Exchange reported $14 billion in new listings in corporate-issued structured products in 2005. Exchange-traded structures are only one segment of the structured products market; another important segment is the non-negotiable structures market, distributed primarily by investment and commercial

---

5 SPA Chairman’s Letter, February 2006, p. 2.

Structured products enable financial institutions to better serve their customers by offering them a broader menu of financial instruments and greater flexibility in building portfolios to match individual needs and outlooks. The primary objective for issuers marketing structured products is to increase profit margins. The packaging of securities often enables issuers to obscure commissions and fees. In addition, these financial instruments are normally crafted to signal that the issuing bank is a reliable and highly sophisticated financial firm, with the hope of generating even greater demand for its other services.

The benefits structured products offer investors can include: principal protection on equity market-linked investments; opportunities to realize enhanced returns within an investment; additional alternatives for risk management; tax-efficient access to fully taxable investments; and accounting advantages. While investors may be able to replicate investment strategies on their own, investments in structures obviate the need for active management of complex investment strategies. Structured products can be used as an alternative to direct investments in financial assets, as a means to mitigate risk exposure of a portfolio, or as a way of exploiting market trends. Structured products allow market participants who opt for a specific schedule of payments over time to access this schedule, while hedging certain risks. Structured products also enable investors to more fully to diversify their investment portfolios, since they can access asset classes that may not otherwise be available to them.

Structured products have no specific regulation, in spite of the large volume of funds investment in them. Indeed, unlike traditional financial instruments such as stocks, bonds, and mutual funds, structured products raise important concerns about investor protection. Regulators around the world have considered reforms in securities regulation for structured products in the recent few years.
While structures contribute to the completeness of modern financial markets by enhancing alternatives open to investors, they have a downside as well. We argue that most structured products currently available on the market are designed to exploit a number of common behavioral biases observed in the area of decision-making under uncertainty. It is highly likely that unsophisticated investors ("noise" traders) often fall prey to manipulative marketing techniques and ultimately make sub-optimal investment decisions. Therefore, we believe that specific regulation for structured products is warranted in order to protect retail investors.

When investors make up their minds whether to invest in structured products, their decision patterns often fall short of conforming with von Neumann and Morgenstern's axioms. Since investors do not satisfy these axioms, they do not behave as if they assign utilities to consequences and alternatives and then pursue the alternatives that associated with their greater subjective expected utility. Hence, wealth is transferred from the investor to the issuer of structured products. The first part of our paper demonstrates the transfer of wealth from the investor to the issuer for a typical structured product.

We identify several features of structured products, and show how these are associated with specific behavioral biases. Our insights are derived from theories associated with various aspects of decision theory: loss aversion, the disposition effect, herd behavior, probability distortion, the ostrich effect and hindsight bias (Appendix 1 summarizes selected structure features and the corresponding behavioral biases).

Examines the investors’ decision-making in relation to the investment in structured products, we conduct an experiment. The experiment examines each bias individually to determine whether investors are influenced by a given bias to such an extent that they favor investment in a structured product over a more suitable product.
An economic analysis of typical structured product

This analysis illustrates the riskless transfer of wealth from the investor to the issuer for a typical structured product. The description of the structure was translated from the website of one of Israel’s leading commercial banks as follows:

“This structured deposit yields a 9.54% interest rate, payable unconditionally after one year. The principal will either be paid in full or converted to "Teva" shares traded on NASDAQ, if the share price declines as follows:

At maturity the investor will receive a high, unconditional, 9.54% annual interest rate.

The principal will be paid in full if at least one of the following does not occur:

1. The share price of Teva Pharmaceuticals decreases at least once during the deposit period by 25% or more, relative to the share price set on the day the deposit is opened.

2. The closing share price of Teva Pharmaceuticals on the deposit’s maturity date is lower than its price on upon initial opening of the deposit.

If both of the above-mentioned conditions are fulfilled, the principal will be converted into Teva shares according to the deposit's opening-day share price, and the investor will receive the shares and the 9.54% interest on the principal.”

This structured product consists of the following underlying assets:

The issuer sells (writes) a one-year knock-in put option triggered at a share price 25% lower than the price on the day the option is issued.
The premium to this option, according to Bloomberg’s calculator is 11.51%\(^6\).

The premium and the principal are invested in twelve-month T- Bills (annual return on the date of issue was 5.16%).

Assuming an investment of US$100,000:

\[
\text{Premium}=11.51\% \times \text{US}\$100,000 = \text{US}\$11,510
\]

\[
\text{FV of T- Bills}=\text{US}\$111,510 \times 1.0516 = \text{US}\$117,264
\]

\[
\begin{align*}
\text{If} & \quad & \text{Investor} & \quad \text{Issuer} \\
\text{P}_{\text{TEVA}} \text{ decreases within the year by 25% or more} & \quad & \text{Shares} & \quad \text{US}\$7,724 \\
\text{and if} & \quad & + & \quad \text{US}\$9,540 \\
\text{P}_{\text{TEVA}} \text{ at time 1} & \quad & \text{Otherwise} & \quad \text{US}\$109,540 \quad \text{US}\$7,724
\end{align*}
\]

The issuer receives the same amount, regardless of the situation at maturity which represents a 7.7% effective fee on the fund invested in the structured product. The investor receives 9.54% and either the principal or the shares, which embody the losses accrued during the deposit period.

\(^6\) This option is not traded; therefore the estimated premium can also compute as 0.9\times 11.51\% = 10.36\%. In this case the issuer receives 6,514\$ on every 100,000\$ invested in the structured product, regardless of the situation at maturity.
A behavioral analysis of structured products

The paper focuses on six features commonly found in structured products, and the behavioral biases associated with them. In this section we outline these behavioral biases and analyze the relation between each bias and the corresponding feature.

A. Loss Aversion
Loss aversion refers to the tendency for people strongly to prefer avoiding losses than acquiring gains. A key conclusion of Kahneman and Tversky’s 1979 study of decision-making under uncertainty is that choices are best explained by assuming that the significant carriers of utility are not states of wealth, but rather changes relative to a neutral reference point, such as the status quo. They also found that losses loom larger than gains. Empirical estimates of loss aversion show that the disutility of loss is twice as great as the utility of gain (Tversky and Kahneman, 1991).

Myopic loss aversion, as articulated by Benartzi and Thaler (1995), describes the process of mental accounting\(^7\) regarding the flow of information, in which a tendency of individuals to be more sensitive to reductions in the level of well-being than to increases is revealed. Myopic loss aversion predicts that dynamic aggregation rules influence investor attitudes toward risk. The frequency with which the information is presented can have an impact on the willingness of an investor to undertake risky investments. Frequent reporting leads to a preference for less risky portfolios.

Structured products are considered by investors as less risky investments, primarily because most promise principal protection. Principal protection enables loss-averting investor to avoid losses and enjoy gains in some circumstances. Investors, especially retail investors, consider principal protection a very attractive feature, and their decision whether to invest in a structured product is strongly affected by it.

\(^7\) Mental accounting, as presented in Benartzi and Thaler (1995), refers to the implicit methods individuals use to code and evaluate financial outcomes.
It is well worth noting in this context that principal protection is usually nominal and not real, and it does not carry any compensation for the time value of money. Moreover, in some structured products the principal protection is in foreign currency units, which exposes the principal to foreign currency exchange rate risks. In short, principal protection is not necessarily what one would wish it to be, nor perhaps what retail investors assume it to be.

B. The Disposition Effect

Identified by Kahneman and Tversky (1979), the disposition effect refers to an aversion to loss realization. Shefrin and Statman (1985) examine this feature within the context of financial markets. Specifically, they examine decisions to realize gains and losses in a market setting. They develop a descriptive theory of capital gain and loss realization in which investors tend to “sell winners too early and ride losers too long,” relative to the prescriptions of the normative theory. Using evidence that suggests that this tendency applies in real-life financial markets, Shefrin and Statman demonstrate how the tendency to sell winners and ride losers emerges in prospect theory in the following example:

Consider an investor who purchased a stock one month ago for $50 and who finds that the stock is now selling at $40. The investor must now decide whether to realize the loss or hold the stock for one more period. To simplify the discussion, assume that there are no taxes or transaction costs. In addition, suppose that one of two equiprobable outcomes will emerge during the coming period: either the stock will increase in price by $10 or decrease in price by $10. According to prospect theory, our investor frames his choice as a choice between the following two lotteries:

A. Sell the stock now and realize a $10 loss.
B. Hold the stock for one more period, given 50-50 odds between losing an additional $10 or “breaking even.”

Since the choice between these lotteries is associated with the convex portion of the S-shaped value function, prospect theory implies that B will be selected over A. That
is, the investor will ride his losing stock. An analogous argument demonstrates how prospect theory accounts for a propensity towards profit-taking.

In our research, the relevant behavioral phenomenon is the aversion to loss realization, or in other words, the disposition to “ride losers,” as presented in the numerical example. Many structured products include mandatory conversion provisions. Conversion is triggered when the price of the underlying asset falls past a predetermined threshold during the investment period. If the price does not cross this threshold, the investor receives the principal plus a relatively high return. The conversion into the “losing” asset is typically at a higher price than the market price of the asset at the time of the structured product’s maturity.

The mandatory conversion feature is activated by the investor tendencies to “ride losers” because the conversion into “losing” assets puts off the realization of losses. Investors will continue to ride the losing asset in the near future and will not realize the loss caused by the investment in the structured product.

C. Herd Behavior
Herd behavior can explain the phenomenon of large numbers of people acting in the same way at the same time. Large stock market trends, bubbles, and crashes often begin and end with periods in which a large number of investors buy or sell stocks. Individual investors join the crowd of others in a rush to get in or out of the market.

The literature on herd behavior is extensive. Leibenstein (1950) defined it as the extent to which demand for an asset is increased due to the fact that others also purchase the asset. He explained the motivations underlying herd behavior as “the desire of people to purchase a commodity in order to get into ‘the swim of things’; in order to conform with the people they wish to be associated with; in order to be fashionable or stylish; or, in order to appear to be ‘one of the boys.’”
Herd behavior has also been explained in terms of a network effect. Network effect was first defined by Katz and Shapiro (1985) as follows: “There are many products for which the utility that a user derives from consumption of the good increases with the number of other agents consuming the good. … The utility that a given user derives from the good depends on the number of other users who are in the same ‘network’ as he or she.” The main assumption underlying the network effect is the existence of complete information. It is assumed that individuals had identical motivations and expectations regarding the benefits of goods.

Bikhchandani, Hirschleifer, and Welch (1992) modeled herd behavior under imperfect information. In their model, herd behavior occurs “when it was optimal for an individual, having observed the actions of those ahead of him, to follow the behavior of the preceding individual without regard to his own information.” The decision-maker observes the actions of others and assumes that they hold more valuable information than he/she.

The most common explanation regarding herd behavior in financial markets is this last one. Nonprofessional investors follow the behavior of other investors, assuming that they hold more valuable information on the market conditions and trends. In our research we concentrate on the first and the last explanations.

Investment in structured products enables the investor not only to follow valuable information held by others, but also to conform to the people with whom they wish to be associated, without risking one’s entire funds in a specific investment. If, on the one hand, investors are motivated solely by the information presumably held by other investors, they would invest directly in the underlying asset. If, on the other hand, investors are motivated by a desire to be fashionable and are uncertain about the value of third-party information, they would invest in structured products, which provide only partial exposure to the underlying asset. We cannot rely entirely on the last explanation, because investment in structured products may be motivated by a combination of factors.
Structured products, providing investors exposure to emerging markets and to exotic financial products can exploit herd behavior. For example, index-linked notes expose investors to emerging markets indices. Investors who buy index-linked notes can conform to people with whom they wish to be associated without exposing the entire fund to the risk of the specific emerging market.

D. Probabilities Distortion
Kahneman and Tversky (1979) found that individuals tend to distort probabilities, particularly extreme probabilities. Because people are limited in their ability to comprehend and evaluate extreme probabilities, highly unlikely events are either ignored or overweighted, and the difference between high probability and certainty is either neglected or exaggerated.

In Kahneman and Tversky’s study, participants were presented with a complete description of a choice problem and asked to make one selection among the possible options. The participants did not receive any feedback concerning the outcomes of past decisions. In our case, decisions are made according to feedback obtained from similar situations in the past and investors do not receive a complete description of the outcomes and the probabilities for these outcomes.

Baron and Erev (2003) show that when decision-makers rely on feedback they tend to underweight rare outcomes. This tendency is a mirror image of the overweighting of rare outcomes they observed in complete description studies. As they explained in their findings, because rare events are rare, they are less likely to affect actual outcomes and, for that reason, are expected to be underweighted.

Many types of structured products are based on worst-case scenarios bearing low probabilities. This worst-case scenario can reflect significant changes in interest rates, foreign exchange rates, or stock prices. In such cases, investors receive feedback based on market history data. They do not receive a complete description of the outcomes, nor the probabilities for these outcomes. For instance, accrual range notes are structured
products that provide investors with high yields if the interest rate at maturity is set in a predefined range. While a forward interest rate on the date of issue is usually found in the range, the distribution tails of interest rates are located outside this range. The worst-case scenario for the investor depends on events with low probability. We argue that investors tend to distort the low probability of the distribution tails and thus ignore these probabilities in their decision-making process.

E. The Ostrich Effect
The impact of liquidity on the prices of financial assets occupies center stage in the finance literature. The rational pricing of financial assets supports the assessment of a positive correlation between liquidity and prices; i.e., illiquidity has an adverse affect on asset value. When compared with otherwise identical illiquid assets, liquid assets should have a lower yield-to-maturity, given the opportunity to liquidate the position at any juncture and the possibility to realize even a larger return in the market without risking the locked-in return if held to maturity.

Galai and Sade (2006) found that investors prefer to hold illiquid assets and are even willing to pay a premium for them. They attribute this seemingly anomalous behavior to an aversion to receiving information on potential interim losses. The ostrich effect is defined as avoiding apparently risky financial situations by pretending they do not exist. In other words, certain individuals, when faced with uncertainty, prefer investments for which the risk is unreported to similar investments (as far as risk and return are concerned) for which the risks are reported frequently. Support for ostrich effect behavior can be found in various types of financial markets and countries.  

Most structured products are non-negotiable, and hence illiquid. Investors can avoid apparently risky financial situations throughout the lifetime of an illiquid structure by assuming these situations do not exist. The only situation with which the investors are concerned is the one occurring at maturity.

---

8 As demonstrated in Galai and Sade (2006, Section IV, part C).
F. Hindsight Bias

Hindsight and foresight differ formally in the information available to the observer. Hindsightful decision-makers possess knowledge regarding past outcomes. Foresightful decision-makers do not possess this knowledge. Initially documented by Fischhoff (1975), the hindsight bias refers to the tendency to alter perceptions of the inevitability of an event once the outcome is known.

Fischhoff found that reporting an outcome’s occurrence increases its perceived probability of occurrence, and that decision-makers who have received outcome knowledge are unaware of the change in the perceived probability of occurrence. Therefore, reporting an outcome produces an unjustified increase in its perceived predictability, for it seems to have appeared more likely than it actually was.

When the hindsight bias is operating, events that occurred are retrospectively seen as having been more likely to occur and events that did not occur are retrospectively seen as having been less likely to occur. Investors tend to be unaware of the role outcome knowledge plays on their perceptions. Thus, investors tend to believe that seemingly inevitable outcomes were largely apparent in foresight, and these investors tend to invest in products that rely on realized outcomes.

Most structured products rely on an outcome that occurred in the recent past, and are based on the presumed increase in the probability that the same outcome will reoccur in the near future. These structured products guarantee the investor high returns should a recent outcome reoccur at maturity. The hindsight investor assesses higher probability to this and tends to favor investment in the structured product.
Testing Behavioral Biases in Structured Product Investments

We designed a controlled experiment to test our hypothesis concerning the application of behavioral anomalies to investment decisions involving structured products. The purpose of the experiment is to find the influence of each behavioral bias on the investment decision in structured products. Each behavioral bias is examined separately. The original experiment was drafted in Hebrew; a translation of the experiment to English is provided in Appendix 4).

Method

The experiment comprises nine investment decisions, each involving a binary choice between two investment alternatives. The distinction between the two investment alternatives is based on the behavioral bias tested in the specific investment decision.

The experiment also contains three additional ranking questions in order to neutralize the potential impact of other values on the investment decisions.

The general instructions describe a situation in which the subjects are in possession of a certain amount of money that they wish to invest in the best possible investment. The participants were instructed to choose only one out of the two investment alternatives for each investment decision. They were told that each investment decision should be considered separately and that in each investment decision, the same amount of money is available to them.

Our subject population consists of 122 investment advisor candidates, 104 executive MBA students at the Jerusalem School of Business Administration, and 42 employees from various industries (other than the financial services industry) for a total of 268 subjects. The subject population reflects nonprofessional investor households.

---

9 The investment advisor candidates participated in the experiment during their licensing exams, administered by the Israel Securities Authority.
A. Loss Aversion
In order to examine the impact of loss aversion on the investment decision in structured products, the subjects faced two investment decisions. Both investment decisions offer the investor a choice between a risky investment in a one-year deposit that is dependent on the exchange rate between the Swiss Franc and the Israeli Shekel, and a safe investment in a one-year deposit that ensures the investor a certain return independent of the aforementioned exchange rate.

The two investment decisions can be drawn as follows:

Investment decision 1
- A = -60
- B = -60

Investment decision 2
- a = -80
- b = -80

One of the risky investments was designed such that with some probability there is a possibility for loss (a). The other risky investment does not face the investors with a possible loss (A). The outcome of the two risky alternatives is equal and the outcome of the two riskless alternatives is equal. We would expect risk averse investor to prefer the riskless investment to the risky one in both investment decisions, or in other words, to reduce the variance of their investment’s outcomes in both decisions. We would also expect risk lover investor to prefer the risky investment to the safe one in both decisions.
Choosing the risky investment in the first decision and the riskless investment in the second decision can be only explained by loss aversion.

**Results**

The subjects’ choices in the two investment decisions are summarized in Table 1. The rows reflect the choice between a risky investment with no potential losses (denoted as A) and a safe investment (denoted as B). The columns reflect the choice between a risky investment with potential losses (denoted as a) and a safe investment (denoted as b).

Table 1

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>27.61%</td>
<td>33.21%</td>
</tr>
<tr>
<td>B</td>
<td>8.21%</td>
<td>30.97%</td>
</tr>
</tbody>
</table>

The findings show that 33.21% of the subjects preferred the risky investment to the safe one when there were no potential losses, and preferred the safe investment to the risky one when there were potential losses. The results yielded a significant chi square statistic $\chi^2(1)=16.6$, $p<0.001$. Consequently, loss aversion did influence a substantial part of the subjects in their decision.

**B. The Disposition Effect**

In order to examine the impact of the disposition effect on the investment decision in structured products, the subjects faced two investment alternatives. Both alternatives represent two very similarly structured products. The only difference between the alternatives is that in the first in the worst-case scenario, the initial fund is mandatorily converted into equity, while in the second alternative, in the worst-case scenario the investor is given a cash settlement. The subjects informed that the conversion rate is in higher rate than the market price of the share at maturity.
Should the majority of investors prefer the mandatory conversion structure to the cash alternative, this would constitute evidence of the prevalence of the disposition effect on investment decision-making.

**Results**

The subjects’ choices are summarized in Table 2. The left column represents the percentage of investors who preferred the mandatory convertible structure product to the nonconvertible one.

Table 2

<table>
<thead>
<tr>
<th>Shares</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>71.27%</td>
<td>28.73%</td>
</tr>
</tbody>
</table>

As reported in Table 2, 71.27% of the subjects preferred the mandatory conversion to liquidation. The results yielded a significant chi square statistic $\chi^2(1)=48.49$, $p<0.001$. Apparently, the disposition effect played a role in decision-making for a majority of the subjects.

**C. Herd Behavior**

To test the impact of herd behavior on investment decision-making for structured products, the subjects faced two investment decisions. Both investment decisions offer the investor a choice between two structured products. In one of the investment alternatives, the return is linked to the performance of a “fashionable” financial asset, and in the other investment alternative, the return is linked to the performance of an “unfashionable” financial asset.

A financial asset is considered “fashionable” due to its appearance in the mass media. We chose two different “fashionable” financial assets. One of them is a “green”
fund that invests in companies that are engaged in technological developments designed to help protect the environment. The other fashionable financial asset is an emerging market index. In each investment decision, the subjects were asked to choose between a “fashionable” structured product and an “unfashionable” one, all the other conditions being equal. The subjects were informed that both underlying assets in every investment decision (the “fashionable” and the “unfashionable”) had the same performance measures in the past year.

The experiment also contained three ranking questions in order to ensure that the investment decisions were not affected by other values. The subjects were asked to rank the values appearing in every investment alternative according to importance. We did not find any significant difference between the importance rankings of the different values. Therefore, these values appear not to provide a satisfactory explanation of the investor choice.

Should a majority of investors prefer the “fashionable” over the “unfashionable” structure in each case, this would support the hypothesis that herd behavior comes into play in investor decision-making.

**Results**

Investment decision preferences are summarized in Tables 3a and 3b. Table 3a represents the choice between a structured product specializing in “cleantech” environmental enterprises and a structured product whose return is linked to the performance of a fund specializing in start-ups, all other conditions being equal. Table 3b represents the choice between a structured product tracking an emerging market index and one tracking a developed market index\(^\text{10}\), all other conditions being equal.

Table 3a

---

\(^{10}\) The experiment was conducted before the financial crisis, at a time when emerging markets investments were extremely popular.
As reported in Table 3a, 72.39% of the subjects preferred the “fashionable” cleantech product to the “unfashionable” one. The results yielded a significant chi square statistic $\chi^2(1)=53.73$, $p<0.001$. As reported in Table 3b, 82.46% of the subjects preferred the “fashionable” emerging market product to the “less fashionable” developed market alternative. The results yielded a significant chi square statistic $\chi^2(1)=112.97$, $p<0.001$. Consequently, herd behavior apparently did affect the decision of a majority of subjects.

### D. Probabilities Distortion

In order to examine the influence of probabilities distortion on the investment decision in structured products, the subjects faced two investment decisions. Both investment decisions offer investors a choice between a risky investment in a one-year deposit that provides the investors with high yield whenever the interest rate set by the central bank is within a predefined range. In all other cases, the principal is refunded in full without interest. The second investment alternative for both decisions is a risk-free investment in a one-year deposit that ensures the investor the interest rate set by the central bank.

In the risky investment of one investment decision, the probability of the worst-case scenario is very low, while in the risky investment of the second investment decision, the probability of the worst-case scenario is substantially higher. The range of interest rates entitling investors to higher returns of the first risky alternative is twice as
large as that of the second. However, half the expected rate of return of the second risky investment.

The investors are also informed of interest rates set by the central bank in the previous six months. This information reflects feedback given to the investors prior to the evaluation of probabilities.

Should a substantial segment of investors prefer the risky investment with the very low worst-case probability over the safe investment in the first investment decision, and prefer the safe investment to the risky one with the higher expected return and higher worst-case probability in the second investment decision, this would provide evidence of probability distortion. In this case, investors opting for the low-probability risky investment tend to discount risk by underweighting the low probability of failure. Thus constitute evidence of the influence of probabilities distortion on the investors’ decision.

Results
The subjects’ selections in the two investment decisions are summarized in Table 4 below. The rows reflect the choice between a risky investment with very low probability of the worst scenario (denoted as A) and a safe investment (denoted as B). The columns reflect the choice between a risky investment with higher probability of the worst scenario (denoted as a) and a safe investment (denoted as b).

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>38.06%</td>
<td>29.85%</td>
</tr>
<tr>
<td>B</td>
<td>10.82%</td>
<td>21.77%</td>
</tr>
</tbody>
</table>
Table 4 reveals that 29.85% of the subjects preferred the risky investment to the safe investment in low worst-case probability case scenario, but preferred the safe investment to the risky one when the probability of the worst-case scenario was higher, despite the fact that an alternative rendered a higher expected return. The results yielded a significant chi square statistic $\chi^2(1)=11.64$, $p<0.001$. A larger group of investors (38.06%) chose the risky investment in both investment decisions. This result does not contradict the underweighting of small probabilities. It appears that investors distort the probabilities in both risky investments by underweighting them. Consequently, probability distortion evidently had an impact on decision-making for a substantial segment of the subjects.

E. The Ostrich Effect

To examine the impact of the ostrich effect on structured product investments, the subjects faced two alternatives. Both alternatives are similar structured products. The only difference between the two alternatives is that the first is non-negotiable and the second is a highly liquid product, which can be redeemed by the issuer or traded on a secondary market. All the other conditions are equal.

When compared with an otherwise identical illiquid asset, a liquid asset should have a lower yield to maturity, given the opportunity to liquidate the position on demand and the possibility of realizing larger market returns without jeopardizing the locked-in yield-to-maturity. Accordingly, we would expect rational investors to prefer liquid over non-negotiable structures.

Unlike all the other investment decisions in our experiment, present investors with two alternatives to which they should be indifferent, this investment decision includes a superior alternative. Should any significant segment of investors prefer the inferior illiquid to the liquid structure, this would provide evidence supporting the existence of the ostrich effect on investor decision-making.
**Results**

Investor selections are summarized in Table 5. The left column represents the percentage of investors who preferred the illiquid structure product to the liquid one.

<table>
<thead>
<tr>
<th>Illiquid Investment</th>
<th>Liquid Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.58%</td>
<td>64.42%</td>
</tr>
</tbody>
</table>

As reported in Table 5, 35.58% of the subjects preferred the non-negotiable over the liquid structure. This finding yielded a significant chi square statistic $p<0.001$. Consequently, the ostrich effect did have an apparent impact on decision-making for a significant segment of the subjects.

**F. Hindsight Bias**

To examine the possible impact of hindsight bias on investments in structured products, the subjects faced two investment alternatives, comprising two similar structured products. The sole distinction between the alternatives is that returns on the first are contingent on an outcome that has occurred in the recent past, while those of the second are contingent on an outcome not recently experienced. All other conditions are equal.

The existence of a hindsight bias is supported if a majority of investors prefer the investment whose return depends on an outcome that has recently occurred.

**Results**

Investor selections are summarized in Table 6. The left column represents the percentage of investors who preferred the “hindsight” structured product over the other.
Table 6

<table>
<thead>
<tr>
<th>Outcome that has recently occurred</th>
<th>Outcome that did not occur</th>
</tr>
</thead>
<tbody>
<tr>
<td>77.24%</td>
<td>22.76%</td>
</tr>
</tbody>
</table>

Table 6 reveals that 77.24% of the subjects preferred the hindsighted structured. The results yielded a significant chi square statistic $\chi^2(1)=79.53$, $p<0.001$. Consequently, the hindsight bias does apparently come into play in investor decision-making.

**Summary**

Structured products are synthetic investment instruments specially designed to meet specific needs that cannot be met by acquiring standard financial instruments available in the markets. Structured products can be used as an alternative to direct investments in financial assets, as a means to mitigate risk exposure of a portfolio, or as a way of exploiting market trends. Interest in these investments grown in recent years and a significant portion of investor capital has been invested in structured products.

We outlined several key features embedded in various structured products and associated each with specific behavioral bias identified in the literature of decision theory. These include: loss aversion, the disposition effect, herd behavior, probabilities distortion, the ostrich effect, and hindsight bias.

We performed an experiment to test the possible impact of each behavioral bias on decisions pertaining to investments in structured products. Our findings reveal that, to varying degrees, the examined behavioral biases affect investor decisions in a manner favoring the investment in structured products.

In demonstrating the impact of these behavioral biases on investors, our results can justify the institution of specific regulation for structured products to improve investor
protection. Such regulation can enforce the issuers reveal the effective fees to the investors. In disclosing the effective fees the investors will be able to compare between investment alternatives and will be able to decide if they are willing to sacrifice this amount for the recognized behavioral bias.
## Appendix 1: Association between Structured Product Features and Behavioral Biases

<table>
<thead>
<tr>
<th>Feature</th>
<th>Behavioral Bias</th>
<th>References</th>
<th>Examples</th>
</tr>
</thead>
</table>
Appendix 2- The Experiment

Instructions:
- A given sum of money is at your disposal for, investment in the best possible investment.
- You are presented with a number of investment decisions. You must choose only one of the mutually-exclusive investment alternatives for each decision.
- The investment decisions are not related and each should be considered separately.
- The funds available to you are equal for each decision, and hence for each mutually-exclusive investment alternative.

Investment decision 1

a. Investment of the money at your disposal in a one-year deposit that is contingent on the exchange rate between the Israeli Shekel (NIS) and the Swiss franc. For every NIS 60 invested in the deposit, at the end of the year you will receive either NIS 130 if the NIS/Swiss franc increases, or NIS 60 if the NIS/Swiss franc decreases.

b. Investment of the money in a one-year deposit. For every NIS 60 invested you will receive NIS 90 at the end of the year.

The amount to be remitted at the end of the year includes the principal and no additional amounts shall be received.

Investment decision 2

a. Investment of the money at your disposal in a one-year deposit with a guaranteed interest rate of 9% at the end of the year. The outcome of the principal is contingent on the rate of return on Teva shares during the year. If the price of Teva shares fall by 15% or more in relation to the quoted price of the shares on the date of investment during this period, the principal of the deposit will be converted into Teva shares, based on their value at the beginning of the year. The conversion will take place at the end of the year and you will receive an additional 9% interest. If this condition is not fulfilled, the principal will be returned in full with an additional 9% interest.

b. Investment of the money in a one-year deposit with a guaranteed interest rate of 9% at the end of the year. The outcome of the deposit principal is contingent on the quoted price of Teva shares. If the price of Teva falls over the year by 15% or more in relation to the quoted price of the shares on the date of investment, 85% or less (accordingly) of the initial amount invested will be paid in cash with an additional 9% interest. If this condition is not met, the principal will be returned in full with an additional 9% interest.

Investment decision 3

a. Investment of the money at your disposal in a one-year deposit that is linked to the increase in the Indian share price index. If the share index increases, the principal shall appreciate in accordance with relative increase of the Indian share price index. If the index decreases or remains unchanged, the money invested the principal will be returned at the end of the year with no additional payments.

b. Investment of the money at your disposal in a one-year deposit that is linked to the increase in the Italian share price index. If the share price index increases, the principal will
appreciate in accordance with the relative increase of the index. If the share price index decreases or remains unchanged, the principal will be returned at the end of the year and no additional payments.

The rates of return on the two indexes in the previous year were identical.

**Investment decision 4**

a. Investment of the money at your disposal in a one-year deposit that grants twice the interest set by the central bank of a certain country, provided that at the end of the year this interest falls within a range of 3.00%-4.50% (the current rate of interest is 3.75%). If this condition is not fulfilled, the principal will be returned in full but no additional payments will be made.

b. Investment in a one-year deposit at the rate of interest set by the central bank of the aforementioned country at the end of the year in addition to the full remission of principal.

The interest rate set by the central bank of the aforementioned country in the past six months:

<table>
<thead>
<tr>
<th>Month</th>
<th>November 07</th>
<th>December 07</th>
<th>January 08</th>
<th>February 08</th>
<th>March 08</th>
<th>April 08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest</td>
<td>3.25%</td>
<td>3.50%</td>
<td>4.00%</td>
<td>4.00%</td>
<td>3.75%</td>
<td>3.75%</td>
</tr>
</tbody>
</table>

**Investment decision 5**

a. Investment of the money that is in your possession in a one-year deposit that is dependent on the exchange rate of the Swiss franc. For every NIS 80 invested in the deposit, at the end of the year you will receive either NIS 130, if the exchange rate of the Swiss franc increases, or NIS 60 if the exchange rate of the Swiss franc decreases.

b. Investment of the money that is in your possession in a one-year deposit. For every NIS 80 invested you will receive NIS 90 at the end of the year.

The amount remitted at the end of the year includes the principal and no additional sums will be paid.

**Investment decision 6**

a. Investment of the sum at your disposal in a one-year deposit that is linked to the performance of a fund that invests in technology start-ups. If the value of the fund increases, the principal invested will appreciate in accordance with the relative increase of the value of the fund. If the value of the fund decreases or remains unchanged, the principal will be returned at the end of the year and no additional payments will be made.

b. Investment of the money that is in your possession in a one-year deposit that is linked to the performance of a “cleantech” fund that invests in companies that are engaged in environmental technologies. If the value of the fund increases, the principal invested will appreciate by the relative increase in the value of the fund. If the value of the fund decreases or remains unchanged, the principal will be returned at the end of the year and no additional sums will be received.

In the previous year both funds yielded the same return.

**Investment decision 7**
a. Investment of the money at your disposal in a one-year deposit that grants four times the interest determined by the central bank of a certain country, provided that at the end of the year this interest falls within the range of 3.75%-4.50% (the rate of said interest is currently 3.75%). If this condition is not fulfilled, the money invested will be returned in full and no additional amounts shall be received.

b. Investment of the money in a one-year deposit that grants the rate of interest set by the central bank of the aforementioned country at the end of the year in addition to the full return of principal.

The interest rates set by central bank of the aforementioned country in the past six months:

<table>
<thead>
<tr>
<th>Month</th>
<th>November 07</th>
<th>December 07</th>
<th>January 08</th>
<th>February 08</th>
<th>March 08</th>
<th>April 08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest</td>
<td>3.25%</td>
<td>3.50%</td>
<td>4.00%</td>
<td>4.00%</td>
<td>3.75%</td>
<td>3.75%</td>
</tr>
</tbody>
</table>

Investment decision 8

a. Investment of the money at your disposal in a one-year deposit that grants NIS 110 at the end of the year for every NIS 100 invested, with no option for early withdrawal.

b. Investment of the money in a one-year deposit that grants NIS 110 at the end of the year for every NIS 100 invested. The deposit may be withdrawn during the year at the market value on the date of withdrawal, which may be less than NIS 100.

Investment decision 9

a. Investment of the money at your disposal in a one-year deposit that grants interest at the rate of 10%, provided that the quoted price of a given share increases by at least 10% during the year. In the previous year the quoted share price increased by 10%. If this condition is not fulfilled, the money invested is returned in full and no additional amounts shall be received.

b. Investment of the money in a one-year deposit that grants interest at the rate of 10% provided that the quoted price of a given share increases by at least 10% during the year. In the preceding year the quoted share price did not increase by 10%. If this condition is not fulfilled, the money invested is returned in full and no additional sums will be paid.

To what extent do you identify with each of the following statements?

Rank on a scale of 1-10, with 1 = not at all and 10 = very much

Protection of the environment is important ______
Supporting entrepreneurial start-ups is important ______
Investment in markets of developing countries is important ______
References


