Web Supplements to

Reaching for returns in retail structured investment

Doron Sonsino, Yaron Lahav and Yefim Roth

Contents:

Supplement A.1:
Retail-oriented structured instruments - discussion and examples

This appendix roughly discusses the market for structured investment products that provide full or limited capital protection plus a possibility to enjoy the performance of an underlying risky asset or a basket of underlying risky assets. A comprehensive survey of the market seems implausible as many instruments are offered by private banks or investment firms and the variety of tradeable products is huge (see the counters at http://www.StructuredRetailProducts.com). The survey extends beyond the relatively simple deposits that are studies in the paper (e.g., referring to instruments with yearly coupons), but motivates some of the design choices made for the experiment (limiting the annual returns to the -10%,22% range, in particular).

First, a distinction between non-tradable structured deposits, notes or certificates and structured instruments that are listed for trade maybe useful. Except for the tradability aspect, the terms of tradeable and non-tradeable instruments may be quite close, but our impression is that the deposits are somewhat less complicated or exotic in structure and terms. The next paragraphs separately discuss the two types of instruments.

Structured deposits and non-tradable notes and certificates

Structured deposits that offer full or limited capital protection with the possibility to participate in strong performance of the underlying are commonly offered to private cliental by banks and asset management firms. In selected cases, the provider tailors the deposit to the needs of the client. The *3-year FTSE100 deposit* discussed at the first paragraph of Section 2 of the paper is an example to a non-tradeable structured deposit that fully protects the invested capital (see example 1 below for more details on this product). In January 2020, one of the leading Israeli banks was offering 6 types of customary structured deposits to the cliental. An 18-months US dollar deposit launched in February 2020, for instance, provides 100% capital protection with a possibility to participate in the average (adjusted) return on 6 international stocks. The return on each stock is capped at 33% and reduced to 5% when the cap applies, so the return is effectively capped at 33% (see example 2 below for details). For general discussion of structured deposits, see also the Citibank brochure at https://www.citibank.com.sg/global_docs/prod/id/structured_deposits.pdf. Notes and certificates not listed for trade are essentially similar to structured deposits (see, for instance, example 5 below).

Principal protected notes, certificates and funds

Principal protected notes (PPNs) are considered an especially popular class of retail-oriented investment products. In early January 2020, for example, the Deutsche Bank site listed 102 PPNs issued by the bank (https://www.xmarkets.db.com/BE/Product_Overview/Principal_Protected Notes?ref=pl). The 5-years *US Technology Note USD 2023*, for instance, was issued in June 2018 with a maturity date 26 June 2023. The investment capital is 100% guaranteed. The underlying is the NASDAQ100 index (see https://www.xmarkets.db.com/BE/Product_Detail/XS1594221605 for more details). Our impression from casual inspection of distinct providers' sites is that full capital protection is most common, but limited protection is also available. The 90% protection rate appears especially common, but instruments with 95%, 99%, and 80% capital protection rates are also available (Blümke, 2009). The first paragraph of Section 2 of the paper refers to the *90% Capital Protection EURO STOXX certificate* issued by USB. The 4-year return on the certificate is capped at 26%. More details on this certificate are provided under the title example 3 below. Examples 4 and 5 also refer to instruments with limited 95%-90% protection.

Risk management by the issuer

Providers generally build structured products by opening long and short positions in bonds and options. To manage the risk of a capital protecting instrument the issuer may invest in a zero-coupon bond that brings the guaranteed payback at the maturity date. The participation in gains of the underlying is covered using call options with an appropriate exercise price. Caps, limited protection, and other advanced features (such as buffers on losses) can be implemented using short positions in call or put options with the right exercise price. Pricing formulas are provided in some of the mispricing papers cited in the paper including Bernard and Boyle 2008; Bernard et al. 2011; Henderson and Pearson 2011; Jørgensen et al. 2011; Deng et al. 2015 and other studies focusing on the risk management and the pricing of structured instruments.

More complex capital protecting structured instruments (beyond the scope of the current study)

The paper studies simplified discrete-return capital protecting deposits to make the point that non-standard preferences emerge even when terms are simple and clearly defined. In the field, the terms of capital protecting instruments are sometimes more complex:

-The participation in positive performance of the underlying is sometimes limited or leveraged Example 6 below presents a 90% capital protection note building on S&P500 low volatility index with 89% participation rate. The return on the note is 8.9% when the underlying increases by 10%.

-Some products include an option for early redemption/call when certain conditions regarding the performance of the underlying arise or early redemption upon discretion of the issuer (example 7).

-Some instruments pay fixed coupons similarly to bonds (example 8).

-Some products include a buffer against losses within limited range (so the capital is protected if the underlying decreases within the buffer limits, but the losses realize if the decrease is steeper).

-Structured instruments with caps on the return of the underlying asset/assets, also differ in terms of the period where the cap is applied. Some instruments apply small caps on monthly basis (if the monthly cap is 1%, then the return in months where the underlying increase by more than 1% is decreased to 1% in calculating the investment period return). Others apply larger caps on quarterly, annual or full-investment-period basis.

<u>Example 1</u> (100% capital protection + fixed return depending on positive performance of the underlying)

<u>Reference code:</u> DP3890000000

<u>Name:</u> FTSE 100 3 Year Deposit Plan 12

<u>Underlying:</u> FTSE 100

<u>Currency:</u> Sterling

<u>Terms:</u> If the FTSE 100 is higher than 100% of its starting level on the Final Maturity Date, the Plan will repay your initial investment plus a 15% return. If, on the Final Maturity Date, the FTSE 100 is equal to or lower than 100% of its starting level, you will receive back your initial investment with no return.

<u>Investment start date:</u> 29/04/2019

<u>Maturity date:</u> 29/04/2022

<u>Minimum return at maturity:</u> 100%

<u>Link for more details:</u>

https://www.investec.com/content/dam/united-kingdom/cib/isp-launch-upload/deposits/ftse-100-3-year-deposit-plan.pdf

<u>2020 version of the same deposit</u> (with the 3-year return decreases to 13%):

https://www.investec.com/content/dam/united-kingdom/cib/isp-launch-upload/deposits/ftse-100-3-year-deposit-plan.pdf

Example 2 (100% capital protection + cap)

Identifier: Bank Leumi product 1113

Name (translated): 18 months US dollar structured deposit

Underlying: A basket of six equally weighted stocks (1/6 weight for each stock) as follows:

16.666666666666664%	KONINKLIJKE AHOLD DELHAIZE N	AD NA
16.666666666666664%	CISCO SYSTEMS INC	CSCO UW
16.666666666666664%	CVS HEALTH CORP	CVS UN
16.666666666666664%	ELECTRONIC ARTS INC	EA UW
16.666666666666664%	FACEBOOK INC-A	FB UW
16.666666666666664%	TESCO PLC	TSCO LN

Currency: USD

Terms: the return on investment is derived from the average *adjusted performance* of the 6 stocks in the basket. If the investment period return on the stock is smaller than 33%, then adjusted return is equal to the realized return. Otherwise, if the investment period return on the stock exceeds the limit of 33%, then the adjusted return on the stock is set at 5%. If the average adjusted return of the 6 stocks in the basket is negative, the investors receives the 100% protected investment amount. Otherwise, the investor receives the average adjusted return on the stocks in the basket.

Investment start date: 10/2/2020

Maturity date: 10/8/2022

Minimum return at maturity: 100%

Link for more details: (probably restricted to the bank clientele)

https://www.leumi.co.il/Lobby/structured_products/35496/

Example 3 (90% capital protection + cap)

ISIN: DE000UBS1GE8

Name: Capped Performance Certificate with 90% Capital Protection auf EURO STOXX 50

Underlying: EURO STOXX 50

Currency: EURO

Terms:

Maximum Refund	126.0000 EUR
Issue Price	100 EUR

Notional Amount	100 EUR
Currency	EUR
Automatic exercise	Yes
Settlement method - Physical delivery	Cash
Minimum Trading Size	1

Investment start date: 10/12/2019

Valuation date: 4/12/2023

Minimum return at maturity: 90%

Link for more details:

https://www.boerse-frankfurt.de/derivative/de000ubs1ge8-capped-performance-certificate-with-90-capital-protection-auf-euro-stoxx-50

<u>Example 4</u> (95% capital protection)

<u>Name:</u> 95% Capital Protected JP Morgan Global Macro Opportunities Fund

<u>Underlying:</u> JP Morgan Global Macro Opportunities Fund

<u>Currency:</u> USD

<u>Terms:</u> There are 2 potential outcomes when the product reaches its scheduled Final Valuation Date:

i) If the JP Morgan Global Macro Opportunities Fund is greater than its Strike Level, the Note returns 95% of capital invested plus 100% x growth in the JP Morgan Global Macro Opportunities Fund.

ii) If the JP Morgan Global Macro Opportunities Fund is equal to or less than 100% of its Strike Level, the Note returns 95%

<u>Investment start date:</u> 23/1/2017

<u>Maturity date:</u> 23/1/2023

<u>Minimum return at maturity:</u> 95%

<u>Link for more details:</u>

http://avifundsolutions.com/wp-content/uploads/2016/11/Factsheet-JPM-Global-Macro-Fund-95-percent-protected-USD-AVI.pdf

Example 5 (90% capital protection + 40% cap)

ISIN: XS1487745959

Name: Commerzbank 6 Year 90% Capital Protected Participation Notes

Underlying: Swiss Market Index & Euro Stoxx 50 Index

Currency: GBP

Terms: There are 2 potential outcomes when the product reaches its scheduled Final Valuation Date:

i) If the least performing Index is greater than its Strike Level, the Note returns 90% of capital invested plus 100% x Percentage Growth in the least performing Index. Capped at 50% growth. The maximum total redemption value is 140% (90% + 50%).

ii) If the least performing Index is equal to or less than 100% of its Strike Level, the Note returns 90%

Issue date: 7/10/2016

Maturity date: 7/10/2022

Minimum return at maturity: 90%

Link for more details:

https://www.portman-associates.com/wp-content/uploads/2016/10/Commerzbank90CapitalProtected-FactSheet.pdf

Example 6 (95% capital protection + 89% participation rate)

ISIN: XS1849217234

Name: USD Equity Linked Note Nov 2023

Underlying: S&P500 low volatility index

Currency: USD

Terms: Where the Market Performance is positive, the gain will be 89% of the Market Performance. Where the Market Performance is negative, the loss will be 100% of the Market Performance subject to a maximum loss of 5%

Investment start date: 13/11/2018

Maturity date: 27/11/2023

Minimum return at maturity: 95%

Link for more details:

https://international.standardbank.com/static_file/Wealth%20International/PDFs/Structured%20Products/Pricing/2019/2019%20End%20of%20March%20Prices.pdf

<u>Example 7</u> (100% capital protection + early redemption possibility)

<u>Identifier reference:</u> GS00SD000524

<u>Name:</u> Goldman Sachs callable deposit plan

<u>Underlying:</u> FTSE 100 index

<u>Currency:</u> Sterling

<u>Terms:</u> This is a 7 year 2 week Deposit Plan based on the performance of the FTSE™ 100 Index. The Deposit Plan is constructed to offer a potential return of 8.00% per annum to the redemption date if the Deposit Taker calls the investment early (please refer to the 'Callable Feature' below), or 250% participation in any growth of the FTSE™ 100 Index at maturity. If the Deposit Plan is not called early, at maturity, the investor receives a return of 250% of any positive growth in the FTSE™ 100 Index. For example, at maturity, if the FTSE™ 100 Index had risen 10% from the Initial Index Level, the investor will receive 100% of their investment back plus a 25% growth payment(10% X 250%).

<u>Strike date:</u> 3 April 2019

<u>Maturity date:</u> 10 April 2026

<u>Early redemption dates:</u> 12 April 2021; 12 July 2021; 11 October 2021; 10 January 2022, 11 April 2022; 11 July 2022; 10 October 2022; 10 January 2023; 11 April 2023; 10 July 2023; 10 October 2023; 10 January 2024; 10 April 2024; 10 July 2024; 10 October 2024; 10 January 2025; 10 April 2025; 10 July 2025; 10 October 2025; 12 January 2026

<u>Annual coupon in case of early redemption</u>: 8%

<u>Minimum return at maturity:</u> 100%

<u>Link for more details:</u>

https://www.idad.biz/wp-content/uploads/2019/02/IDAD-The-Callable-Deposit-Plan-Brochure-April-2019.pdf

Example 8 (90% capital protection + 25% cap + annual coupon)

ISIN: AT0000A292E7

Name: Capital Protection Certificate 0,5% Europa Dividendenaktien Winner 90%

Underlying: EURO STOXX® Select Dividend 30 Price Index

Currency: EUR

Terms: Tradeable unit 1000 EURO. Strike price: 90% of current market price. Cap on return: 25%. Annual coupon: 0.5%.

Issue date: 2/09/2019

Maturity date: 2/09/2024

Minimum return at maturity: 90%

Fixed interest rate annually: 0.5%

Link for more details:

https://www.rcb.at/en/produkt/certificate/?ID_NOTATION=262357293&ISIN=AT0000A292E7

For more examples see:

http://structured products.org

https://www.fidelity.com/fixed-income-bonds/structured-products

https://www.gbm.hsbc.com/solutions/markets/structured-products

<u>Supplement B.1: The instructions</u>

{pages are separated as in the PPP and the distributed handout}

Welcome to an experiment on the valuation of structured investment instruments!

Structured investment instruments have become quite popular over the recent years, although the market in Israel is still small.

The common feature of such instruments is the derivation of the return-on-investment from the return on some underlying assets.

Structured investment instruments are frequently quite complex.

This experiment however deals with “structured deposit certificates” whose structure is simple.

First, very simple, example to a "structured deposit certificate":

Structured deposit certificate "UK+"

The investment amount is 100,000 NIS

The investment period is the 12 months between 1/7/2017 to 30/6/2018

The return on investment would be derived from the performance of "FTSE all shares" – the index representing the price of stocks traded at the London Stock Exchange.

-If "FTSE all shares" increases by at least 10% in the investment period, the deposit will pay 7% annual return

-If "FTSE all shares" increases by less than 10% or decreases in the investment period, the deposit will not bear any interest, but the investment capital will be fully paid back (0% return)

In words, an investor that had invested at the beginning of July 2017 100,000 in the "UK+" certificate, will receive 12 months later 107,000 NIS (7% return) if "FTSE all shares" rises by 10% and more along the investment period. The payment would be 100,000 NIS (0% return) if "FTSE all shares" does not rise by at least 10%.

General information about the experiment

The experiment aims at checking the willingness of potential investors to invest in such structured deposits.

To abbreviate, we henceforth use the term “deposits”, although we are not dealing with standard deposits, but studying structured deposits whose return is derived from the performance of underlying assets.

All the deposits presented along the experiment have the following common features:

-The investment amount is 100,000 NIS.

-The investment period is the 12 months between 1/7/2017 and 30/6/2018.

-The underlying asset from which the return on the deposit is derived is the “FTSE all shares” index.

For convenience, we henceforth use the symbol FTSE to abbreviate “the return on FTSE all-shares between 1/7/2017 and 30/6/2018”.

Shorter description of the deposits

Deposits similar to "UK+" that pay positive return when some condition holds but bring 0% return otherwise, would be henceforth presented in a shortened form as follows:

Structured deposit certificate "UK+" (shortened presentation)

The deposit pays 7% return if FTSE $\geq$ 10%

The abbreviated form does not mention the 0% return when the condition (FTSE all shares return of at least 10% in the investment period) does not hold.

When deposit certificates are presented in the abbreviated form, always assume that when the condition for obtaining the positive return does not hold, the investment capital is fully returned with no interest; i.e., return of 0%.

Another example:

The next example presents a more complicated deposit whose return can take 3 distinct values.

For your convenience, we tabulate the return structure, using the left column of the table to present the FTSE condition and the right column to present the return on investment.

Structured deposit certificate "UK++"

The investment amount is 100,000 NIS

The investment period is the 12 months between 1/7/2017 to 30/6/2018

The return on investment is derived from the performance of "FTSE all shares" in the investment period, as follows:

Return on FTSE all shares	Return on the deposit certificate
FTSE ≥ 15%	12%
5% ≤ FTSE < 15%	6%
FTSE < 5%	-2%

In words,

-If FTSE all shares return along the investment year is at least 15%, then the deposit will pay 12% yearly return. The investor will receive 112,000 NIS at the end of June 2018.

-If FTSE all shares return along the investment year is smaller than 15% but at least 5%, then the deposit will pay 6% yearly return. The investor will receive 106,000 NIS at the end of June 2018.

-If FTSE all shares return along the investment year is smaller than 5%, then the deposit will lose 2% yearly return. The investor will receive 98,000 NIS at the end of June 2018.

Is the structure of the deposits clear?

Quiz

To verify that you understood the return structure on such deposits, we ask you to answer 2 multi-choice problems referring to the UK++ as presented in the preceding page.

Students with difficulties should call the experimenter for assistance.

Quiz problem 1:

What will be the annual return rate that an investors in "UK++" will receive if FTSE increases by 21% in the investment year (between 1/7/2017 and 30/6/2018)?

a. 12%
b. 21%
c. 15%
d. 6%
e. None of the above

Quiz problem 2:

What will be the annual return rate that an investor in "UK++" will receive if FTSE decreases by 3% in the investment year (between 1/7/2017 and 30/6/2018)?

a. None of the above
b. -3%
c. 6%
d. 12%
e. 2.5%

Choices between deposits – Part (a) of the experiment

*The computerized phase of the experiment is divided into two parts: (a) and (b).

*In part (a) the program will present binary choice problems between two deposit certificates that are presented in a shortened form.

Example 1 to a binary choice problem

Choose between deposit certificates A and B by marking the alternative that you prefer

□ Deposit certificate A pays 5% yearly return if FTSE ≥ 10%

□ Deposit certificate B pays 5% yearly return if FTSE < 10%

In fact, in such a choice problem, you are requested to judge which event is more probable: "FTSE return at least 10%" or "FTSE return smaller than 10%".

If you think that the chances for "FTSE return at least 10%" are larger, you should choose deposit A. If you vice versa think that the chances for "FTSE return smaller than 10%" are larger, you should choose deposit B.

Choices between deposits and given fixed rates – Part (b) of the experiment

In part (b) of the computerized phase of the experiment, the program will sequentially present to each participant twenty distinct structured deposits.

For each deposit, the program will present few binary choice problems, between the deposit and given (fixed) yearly return rate. For example, you may be sequentially asked to choose between some deposit and fixed annual return rates of 5%, -2%, 1% etc.

The next test box provides an example to such a binary choice problem, using the UK++ deposit as introduced in the preceding pages. For your convenience, the deposit is presented again just before the choice problem.

Reminder: Structured deposit certificate "UK++"

The investment amount is 100,000 NIS and the investment period is between 1/7/2017 and 30/6/2018.

The return is derived from the performance of "FTSE all shares" in the respective year, as follows:

Return on FTSE all shares	Return on the deposit certificate
FTSE ≥ 15%	12%
5% ≤ FTSE < 15%	6%
FTSE < 5%	-2%

Example 2 to a binary choice problem

Choose between the next two investment possibilities:

□ Investment in structured deposit UK++ (as described above)

□ Fixed yearly return rate of 7.5%

The problem above asks you to choose between the structured deposit and yearly fixed return rate of 7.5%. In each binary choice problem of this type, you must mark one of the two options. Marking both options is impossible.

Negative interest rate

In some of the choice problems that you will face along the experiment, the fixed interest rate may be negative. Here's an example:

Example 3 to a binary choice problem

Choose between the next two investment possibilities:

□ Investment in structured deposit UK++ (as described above)

□ Fixed negative yearly return rate of -1.5%

In this problem, choosing the fixed negative yearly return of -1.5% suggests that you "dislike" deposit UK++ to the extent of preferring a certain loss of -1.5% to investment in the deposit.

Trivial choice

It is possible that in few cases the choice problem will be trivial (admitting an obvious solution). For example,

Example 4 to a binary choice problem

Choose between the next two investment possibilities:

□ Investment in structured deposit UK++ (as described above)

□ Fixed negative yearly return rate of 12%

Since the return on deposit UK++ is smaller or equal to 12% (page back to recall the terms of the deposit if necessary), it is obvious that the investment in a fixed rate of 12% (with no risk) is preferred to investment in the deposit.

An optional strategy for the evaluation of the deposits

*Here's a possible strategy for the evaluation of the deposits that will be presented in part (b) of the program (possible, but not mandatory).

Whenever the program presents a new structured deposit, check the return structure carefully.

Think what is the minimal interest rate such that, if you are offered a higher rate you will prefer the fixed rate to the deposit, but if you are offered a lower rate you will prefer the deposit to the fixed rate.

We call this threshold rate "**the equivalent interest rate**".

When the fixed rate that is offered in some binary choice problem (between the deposit and the fixed rate) is smaller than "**the equivalent interest rate**", you should prefer the deposit to the fixed rate.

When the fixed rate that is offered in some binary choice problem (between the deposit and the fixed rate) is larger than "**the equivalent interest rate**", you should prefer the fixed rate to the deposit.

An extra bonus to be paid in July/August 2018:

In addition to the participation rate hat you receive at the end of the session, we will pay in August 2018 an additional bonus that will be derived from one of the binary choices you make along the experiment.

The "**selected problem**" for calculating the bonus will be randomly drawn from the dozens of problems composing the experiment.

In July 2018, when "FTSE all shares" return in the investment period can be determined, we will calculate the return that you earned in the "**selected problem**".

Let R% represent the return that you have earned in that problem.

Your additional bonus will be 40+300*R%.

The maximal gain on the deposits that would be presented along the experiment is 22% and the maximal loss is -10%. The extra bonus amounts would thus range between 10 and 106 NIS.

The research assistants would hold two special reception hours where you or your representatives can collect the additional bonus.

General instructions:

For the choices you make along the experiment, please detach completely from your economic condition and ignore your financial holdings (if any) in reality.

Assume that your economic condition is stable and you have a budget of 100,000 NIS for investment, while you keep working and accumulating pension savings etc.

The choice problems that are presented along the experiment deal with two alternative investment possibilities for this budget.

Consider your choices carefully and pick the alternative that you would have chosen in reality in such circumstances.

The random selection of one problem (the “selected problem”) to derive the extra bonus amount, is meant to direct you to consider each choice independently

Consider each choice seriously and independently from all others!

More information regarding the experiment:

*The experiment consists of three parts

*The first two parts are computerized. In these parts you will be asked to make choice in series of binary choice problems, as illustrated in the preceding slides. Each choice problem is presented on a separate page.

*The last part is printed questionnaire. In the questionnaire, you will be asked to provide standard information concerning your personal and academic background and fill-in a “personal characteristics” questionnaire.

*The computerized parts must be completed before the printed questionnaire.

*With the printed instructions and the consent form, we have also distributed an information leaf regarding FTSE’s performance over the recent years. Please examine the information leaf now.

*Throughout the experiment, you are allowed to return to the printed handouts at your discretion. Raise your hand to call the experimenter if any questions arise.

* Surfing the Web, taking notes or using draft pages, and communicating with other participants is strictly forbidden.

Last few comments:

*Assume that the investment alternatives are offered by a “credible licensed issuer”, so that the terms of the deposit are guaranteed and there are no investment risks beyond the distribution of returns.

*You are requested to ignore the “risk management” and other considerations of the provider that offers the investment alternatives.

*The experiment does not test your abilities or knowledge. The problems do not have a “textbook solution” *(except for cases of trivial choice as explained precedingly).*

***The “right choice” depends on the personal tastes of each participant.**

*The organizers guarantee the confidentiality of the data. We have no interest in analysing the data on personal basis. The goal of the experiment is to generally characterize the tastes of investors in structured investment. If we publish the data, we will conceal your names and other identifying items, in line with the confidentiality statement.

Have you filled-in the consent form?

If so, you may start the computerized part of the experiment.

Supplement B.2: The FTSE handout

FTSE All-Share Indexes

The FTSE All-Share Index represents the performance of all eligible companies listed on the London Stock Exchange's (LSE) main market, which pass screening for size and liquidity. The index captures 98% of the UK's market capitalisation. The FTSE All-Share Index is considered to be the best performance measure of the London equity market, with the vast majority of UK-focused money invested in funds which track it. The index is suitable as the basis for investment products, such as funds and exchange-traded funds (ETFs).

Year	2007	2008	2009	2010	2011
Annual return	+5.3%	-29.9%	+30.1%	+14.5%	-3.5%

Year	2012	2013	2014	2015	2016
Annual return	+12.3%	+20.8%	+1.2%	+1.0%	+16.8%

Supplement B.3: The sample

Few more details on the sample (N=73).

	Mean	P10	P90	Correlation with avg(CE)
Indicator for already earning BA	81.9%	-	-	-0.06
Indicator for pursuing MBA	63.0%	-	-	-0.02
Indicator for male	63%	-	-	+0.04
Age	28.8	25	35	-0.16
Lickert 1-7 rank of knowledge in finance	4.3	3	6	-0.01
Lickert 1-7 rank of familiarity with the local capital market	3.8	2	6	+0.02
Financial industry experience	15%	-	-	-0.18
1-10 rank of willingness to take risk in personal and professional life	5.8	3	8	+0.17
1-10 rank of personal affluence (1 for extremely poor)	5.1	3	7	+0.04

*N=11 subjects reported financial industry experience. The average years of experience was 4.36 (ranging between 1 year and 15 years)

*The column on the right shows the Pearson correlation of each variable with the average CE (across the twenty deposits). Equality to zero could not be rejected for any of the variables.

*The avg(CE) of males slightly exceeds the one of females but equality could not be rejected (median avg(CE) 3.99 vs. 3.75; p=0.74 by Pitman test)

Supplement B.4: The paired deposits

This next table presents the twenty deposit pairs as defined to the program. One deposit of each pair was randomly selected for the first block of the elicitations and the ten deposits were present at random order. The remaining deposits were presented at the same order at the second block of the elicitations (so the pair numbers in the table have no meaning). Deposit pairs 1-3 and 5-9 were constructed by shifting returns across the FTSE conditions so that the expected return on both deposits are equal. Deposit pair 4 consists of the deposits (20% or 0%) and (20% or -5%), so that together the (20% or -10%) deposit of pair 3 the experiment presents 3 deposits at pays 20% in the FTSE≥P50 state but bring zero or a loss in the complementary state. The "Symbol" column presents the deposit names as used in Tables II-IV of the paper.

Pair no	Symbol	FTSE Condition	Return	E(R)	Elicited CE	Sign-test
Pair 1	1A	*FTSE ≥ P75*	*6%*	4%	3.75% (1.1%)	p<0.01 (17/46)
		P50 ≤ FTSE < P75	*4%*			
		FTSE < P50	*3%*			
	1B	*FTSE ≥ P75*	*9%*	4%	4.5% (2.1%)	
		P50 ≤ FTSE <P75	*7%*			
		FTSE < P50	*0%*			
Pair 2	2A	*FTSE ≥ P50*	*6%*	4.5%	4.25% (1.2%)	p<0.06 (20/35)
		FTSE < P50	*3%*			
	2B	*FTSE ≥ P50*	*9%*	4.5%	5.0% (2.0%)	
		FTSE < P50	*0%*			
Pair 3*	3B	*FTSE ≥ P50*	*10%*	5%	5.0% (3.1%)	p<0.07 (42/26)
		FTSE < P50	*0%*			
	4A	*FTSE ≥ P50*	*20%*	5%	4.0% (5.9%)	
		FTSE < P50	*-10%*			
Pair 4*	3A	*FTSE ≥ P50*	*20%*	10%	8.0% (4.6%)	p<0.01 (52/11)
		FTSE < P50	*0%*			
	4B	*FTSE ≥ P50*	*20%*	7.5%	6.0% (5.6%)	
		FTSE < P50	*-5%*			
Pair 5	5A	*FTSE ≥ P50*	*7%*	3.75%	4.0% (1.6%)	p<0.03 (34/17)
		P25 ≤ FTSE < P50	*1%*			
		FTSE < P25	*0%*			
	5B	*FTSE ≥ P50*	*7%*	3.75%	3.25% (1.4%)	
		P25 ≤ FTSE < P50	*3%*			
		FTSE < P25	*-2%*			
Pair 6	6A	*FTSE ≥ P50*	*10%*	5.25%	4.0% (2.6%)	p<0.02 (22/42)
		P25 ≤ FTSE <P50	*1%*			
		FTSE < P25	*0%*			
	6B	*FTSE ≥ P50*	*10%*	5.25%	5.5% (2.6%)	
		P25 ≤ FTSE <P50	*9%*			
		FTSE < P25	*-8%*			

Pair no	Symbol	FTSE Condition	Return	E(R)	Elicited CE	Sign-test
Pair 7	7A	*FTSE ≥ P50*	*14%*	4.5%	2.0% (4.2%)	p=0.27 (22/31)
		P25 ≤ FTSE < P50	*-4%*			
		FTSE < P25	*-6%*			
	7B	*FTSE ≥ P50*	*14%*	4.5%	2.75% (4.1%)	
		P25≤ FTSE < P50	*0%*			
		FTSE < P25	*-10%*			
Pair 8	8A	*FTSE ≥ P75*	*22%*	3%	2.25% (6.0%)	p=0.81 (32/35)
		P50 ≤ FTSE <P75	*-2%*			
		FTSE < P50	*-4%*			
	8B	*FTSE ≥ P75*	*22%*	3%	2.75% (5.5%)	
		P50≤ FTSE < P75	*0%*			
		FTSE < P50	*-5%*			

Deposit	Symbol	FTSE Condition	Return	E(R)	Elicited CE	Sign-test
Pair 9	9A	*FTSE ≥ P75*	*12%*	3%	5% (4.3%)	p<0.01 (48/15)
		P50 ≤ FTSE < P75	*10%*			
		P25 ≤ FTSE < P50	*0%*			
		FTSE<P25	*-10%*			
	9B	*FTSE ≥ P75*	*14%*	3%	2% (4.3%)	
		P50 ≤ FTSE <P75	*8%*			
		P25 ≤ FTSE < P50	*-4%*			
		FTSE<P25	*-6%*			
Pair 10	10A	*FTSE ≥ P50*	*6%*	3%	3.5% (1.4%)	p=0.89 (29/27)
		FTSE < P50	*0%*			
	10B	*FTSE ≥ P50*	*8%*	3%	2.75% (2.4%)	
		FTSE < P50	*-2%*			

* Pairs 3 and 4 were rearranged for the paper discussions as the no-gain deposits are discussed in Table II and the single-loss deposits in Table III.

Supplement B.5: The exchangeability method

The example builds on the choices of subject 15003. The elicited FTSE forecasts of this subject (rounded to the nearest 0.5) were:

L	P25	P50	P75	H
-5%	11.5%	15.5%	18%	30%

First, we present the sequence of choice problem that elicit the median forecast P50. A verbal explanation is provided below the table.

Step	Alternative A	Alternative B	Choice	P50 Interval	midpoint
1	Deposit that pays 5% when FTSE ≥ 12.5%	Deposit that pays 5% when FTSE < 12.5%	A	[12.5%, 30%]	21.25%
2	Deposit that pays 5% when FTSE ≥ 21.5%	Deposit that pays 5% when FTSE < 21.5%	B	[12.5%, 21.25%)	16.875%
3	Deposit that pays 5% when FTSE ≥ 17%	Deposit that pays 5% when FTSE < 17%	B	[12.5%, 16.875%)	14.6875%
4	Deposit that pays 5% when FTSE ≥ 14.5%	Deposit that pays 5% when FTSE < 14.5%	A	[14.6875%, 16.875%)	15.78125%
5	Deposit that pays 5% when FTSE ≥ 16%	Deposit that pays 5% when FTSE < 16%	B	[14.6875%, 15.78125%)	15.234375%
6	Deposit that pays 5% when FTSE ≥ 15%	Deposit that pays 5% when FTSE < 15%	A	[15.23438%, 15.78125%)	15.50781%

Note: The deposits are presented after rounding to nearest 0.5 – as presented in the experiment, but the intervals and midpoints are presents in (approximately) exact terms as copy pasted from the output files.

Since the subject provided lower and upper bounds of -5% and 30%, the initial bounds for P50 are [-5%,30%]. The midpoint of the [-5%,30%] interval is 12.5%, so the first problem in the elicitation presents a choice between deposit A that pays 5% return when FTSE increases by at least 12.5% and deposit B that pays 5% return when FTSE's return in the investment period is smaller than 12.5%. As the subject preferred alternative A to alternative B in this case, the perceived likelihood of the FTSE≥12.5% appears larger than the perceived likelihood of FTSE<12.5% event. The lower bound for P50 is thus increased from -5% to +12.5% and the interval for P50 is updated to [12.5%,30%]. The exact midpoint of the updated [12.5%, 30%] interval is 21.25%, but the program rounds all the numbers to 0.5% (as in Baillon 2008), so the next problem in the sequence presents a choice between deposit A that pays 5% when FTSE increases by at least 21.5% and deposit B that brings the 5% return when FTSE's return is smaller than 21.5%. As the subject preferred B to A in this case, the upper bound for the P50 is changed to 21.25% and the interval for the P50 is updated to [12.5%, 21.25%). The updated midpoint is 16.875%, so the next binary choice problem (problem 3) employs a cutoff of 17%. The program proceeds generating binary choice problems and updating the interval for P50, up to the point where the distance between the lower and upper bounds is smaller than 1. The elicited median P50=15.5078125% is rounded to 15.5% for representing the deposits that build on P50 at the next steps of the program.

The elicitations of P75 and P25 followed the same algorithm. To elicit P75 we use the exchangeability method to divide the [15.5%,30%] interval into exchangeable events [15.5%,P75] and [P75,30%]. The elicitation of P25 similarly divides the [-5%,15.5%] interval into exchangeable events [-5%,P25] and [P25,15.5%]. The exact process of the elicitations is illustrated at the next two tables. To save space, we represent each alternative by presenting the FTSE event that brings the 5% return, but the program still used deposits that pay 5% return in the respective events (e.g., deposit A of the first choice problem below was presented as a deposit that pays 5% when 15.5%≤FTSE≤23%). Each problem was presented on a separate page.

The elicitation of P75:
(starting from the interval [15.5078125%,30%] with midpoint 22.75390625%)

	Alternative A (5% return event)	**Alternative B (5% return event)**	**Choice**	**P75 interval**	**midpoint**
1	15.5%≤FTSE≤23%	23%≤FTSE≤30%	A	[15.5078125%, 22.75390625%)	19.130759%
2	15.5%≤FTSE≤19%	19%≤FTSE≤30%	A	[15.5078125%, 19.130759%)	17.319336%
3	15.5%≤FTSE≤17.5%	17.5%≤ FTSE≤30%	B	[17.319336%, 19.130759%)	18.22509%
4	15.5%≤FTSE≤18%	18%≤FTSE≤30%	A	[17.319336%, 18.22509%)	17.7722168%

The elicitation of P25:
(starting from the interval [-5%,15.5078125%] with midpoint 5.253906%)

	Alternative A (5% return event)	**Alternative B (5% return event)**	**Choice**	**P25 interval**	**midpoint**
1	-5%≤ FTSE ≤5.5%	5.5%≤FTSE≤15.5%	B	[5.253906%, 15.5078125%)	10.380859%
2	-5%≤ FTSE≤10.5%	10.5%≤FTSE≤15.5%	B	[10.380859%, 15.5078125%)	12.9443359%
3	-5%≤ FTSE≤13%	13%≤FTSE≤15.5%	A	[10.380859%, 12.94433594%)	11.6625976%
4	-5%≤ FTSE≤11.5%	11.5%≤ FTSE≤15.5%	A	[10.380859%, 11.6625976%)	11.0217285%
5	-5%≤ FTSE≤11%	11%≤ FTSE≤15.5%	A	[11.0217285, 11.6625976%)	11.3421631%

Supplement B.6: Consistency tests

The two-phase process of the experiment rests on the assumption that the participants hold consistent probabilistic beliefs regarding FTSE's performance in the investment period. To test the consistency of expectations we used the three binary choice problems that are presented in the table below. In Problem 1, the subjects choose between a deposit that pays 5% return when FTSE turns greater than P50-3% and a deposit that pays 5% when FTSE return is smaller than P50-3%. About 80% of the subjects preferred the first deposit to the second, passing the consistency test for P50. Choice problems 2 and 3 similarly shift the P25 or P75 forecasts by 3% or 2%. The consistency rates are presented at the right column of the table. The rate for the P75 problem is again close to 80%, but the rate is lower 66% for the P25 problem. The lower consistency rate for the P25 problem is intriguing since the subjects show especially strong risk receptiveness for deposits with single 0.25 loss (Section 4.2). However, comparison of the elicited CEs or the estimation results for the N=25 subjects that violated consistency at the P25 problem and all others did not reveal significant differences. The model (d) estimated loss weighting parameters were almost similar (median $PR1_L$ estimates 1.68 and 1.67; p=0.65).

Alternative A	Alternative B	Consistent Choice	% Consistent
FTSE< P50-3%	FTSE ≥ P50-3%	B	79%
L ≤ FTSE < P25+3%	P25+3% ≤ FTSE < P50	A	66%
P50 ≤ FTSE < P75-2%	P75-2% ≤ FTSE ≤ H	B	82%

*Each line presents one of the consistency binary choice problems. The "Alternative A" and "Alternative B" columns present the event upon which the deposit pays 5% return. The "Consistent Choice" column shows the option that should be preferred under consistency and "% Consistent" is the proportion showing consistency.

Over all three problems, the average consistency rate was 75.8%. N=13 subjects (18%) violated consistency in more than one test, N=26 (36%) violated consistency exactly once, and N=34 (46%) did not violate consistency. The consistency rates appear similar to those reported in comparable studies; e.g., Baillon (2008) reports a consistency rate of 70.5% in repetitions of exchangeability method binary choices, and comparisons of the main results for subjects that violated consistency and others do not reveal significant differences. The next table reports the results of spitting the sample between subjects that violated consistency and those that never violated consistency. The Pitman test is used to compare the certainty equivalents and the estimated parameters for the two groups. Equality could not be rejected in all of the tests.

	Some violations (N=39)	**No violations** (N=34)	**Pitman test**
Elicited CEs			
All twenty deposits	3750	3987	p=0.76
Gain-Only deposits	4944	4486	p=0.37
Gain-Loss deposits	2955	3727	p=0.96
Deposits with 0.5 Loss	3625	3625	p=0.69
Deposits with 0.25 Loss	4125	4219	p=0.98
Estimation results (model d)			
ρ_G	1.41	1.53	p=0.59
a_G	0.0083	0.0071	p=0.95
λ	2.16	1.82	p=0.68
PR_G	0.54	0.71	p=0.60
PR_L	1.75	1.59	p=0.70
σ	0.21	0.19	p=0.77
-2LL (individual)	80.99	80.66	p=0.18

*The table presents the median statistic for each sample

Supplement B.7: The CEs elicitations

- The deposits were presented sequentially in two blocks. The program randomly selected an order of presentation and one of the deposits of each pair for the first block. The 10 remaining deposits were presented at the same order in the second block.[1]

-For the elicitations, we define initial bounds L and H for the CE of each deposit and use a bisection algorithm to sequentially define tighter bounds Lt and Ht for the CE, up to the point where (Ht-Lt)≤1%. The midpoint of the final interval defines the CE of the deposit.

-We use the same initial bounds L and H and the same initial fixed rate (0.9*E(R), rounded to nearest 0.5) for the two deposits of each pair, so that subjects that make the same sequence of choices (e.g., preferring the deposit to the fixed rate first, preferring the fixed rate to the deposit in the next problem etc) would converge to an identical CE.

-To start the algorithm, we take the maximal return - across the two deposits composing the pair - as the initial upper bound H, and the minimal return across the two deposits of the pair as the initial lower bound L.

-For simplicity consider the (9% or 0%) deposit which was paired with the (6% or 3%) deposit. The initial H and L bounds for the deposits in this pair were 9% and 0%. The expected return on the two deposits is 4.5%; 0.9 of the expected return is 4.05% and the rounding to nearest 0.5 gives an initial rate of 4%. So, in the first step of the elicitation, the subject was asked to choose between the deposit and a fixed rate of 4%. If the subject preferred the deposit to the 4% rate, then the lower bound for the CE was changed from 0% to 4%, while the upper bound stayed 9%. The next problem used the midpoint of the [4%,9%] interval, asking the subject to choose between the deposit and a fixed rate of 6.5%. If the subject preferred the fixed rate in this case, the upper bound for the CE was updated to 6.5%, so the interval for the CE was changed to [4%, 6.5%] and the next problem asked the subject to choose between the deposit and a fixed rate of 5% (5.25% which is the midpoint of the interval, rounded to the nearest 0.5)…

[1] Pairs 3 and 4 were rearranged for the discussion. In the program, (3A and 4B) formed one pair and (3B and 4A) another.

-The use of H (L) that exceed or fall below the maximal (minimal) return that the deposit may bring opens a possibility that the program would generate fixed rates that dominate or are dominated by the deposit. For example, when eliciting the CE of the (6% or 3%) deposit, if the subject preferred the fixed 4% at the first choice problem, then the bounds for the CE change to [0%,4%], and the next problem in the sequence asks the subject to choose between a fixed rate of 2% and a dominating (6% or 3%) deposit. The instructions forewarn the subjects that trivial choice problems may emerge (see supplement B.1). Fixing the bisection algorithm to avoid such dominance could affect convergence, so we chose to open space for trivial choice problems in order to apply exactly the same elicitation algorithm to the two deposits of each pair.

-In fact, the deposit dominated or was dominated by the fixed rate in 5.3% of the choice problems (347 problems out of 6542). The subjects violated dominance in less than 0.5% of the problems (in only 32 cases). N=63 subjects (86%) never violated dominance; 8% violated dominance more than once. Column IV of the table in supplement D.3 illustrates that the estimation results are robust to ignoring the choice sequences where subjects violated monotonicity. Column V shows robustness to removal of the N=10 subjects that violated monotonicity.

-In addition, violations of dominance could occur between deposits; e.g., when the CE of the (9% or 0%) deposit exceeds the CE of the (10% or 0%) deposit. The twenty deposits of the experiment generate 31 pairs where one deposit dominates the second (the complete list will be provided on request). The median number of dominance violations was 6 (19% of the 31 possible violations). Column VI of supplement D.3 shows that the estimation results are robust to the removal of the subjects with the largest number of dominance violations.

Supplement B.8:

The gaps between FTSE conditions and structured returns

To measure the gap between the underlying FTSE conditions and the structured returns, let $D = < L_i, H_i, r_i >_{i=1,2\ldots m}$ represent a deposit that pays r_i when $L_i \leq FTSE \leq H_i$ for i=1,2….m (the returns are sorted in decreasing order so that $r_1 > r_2 > \cdots r_m$ and $H_1 = H$ and $L_m = L$ represent the upper and lower bounds provided at the start of the FTSE forecasts elicitations).

The gap for deposit D is then defined as $GAP = \sum_{i=1}^{m} P([L_{i,} H_i]) * ((H_i + L_i)/2 - r_i)$, where $P([L_{i,} H_i])$ denotes the probability of the $[L_i, H_i]$ interval,.

The gap for the (9% or 0%) deposit, for example, is 0.5∗[(H+$P$50)/2−9]+0.5∗[($P$50+L)/2−0].

The gap for the (14%, 14%, -4%, -6%) deposit, is
0.5∗[(H+$P$50)/2−14]+0.25∗[($P$50+P25)/2 - (-4)]+0.25*[(P25+L)/2 - (-6)].

When $GAP > 0$, the deposit pays, on average, less than the underlying FTSE returns.
When $GAP < 0$, the deposit pays, on average, more than the underlying FTSE return.

When the 20 gaps are averaged on individual basis, the median average GAP is 3.3.
The average GAP is positive for N=58 subjects and negative for only N=15.
The median average |GAP| is 5.01%.

To test robustness with respect to gaps we have run the model (d) individual-level estimations removing the binary choice sequences for deposits with gap ≥ 11.066 or gap ≤ -4.859 (the 5% most extreme positive and negative gaps). The results are reports in column III of supplement D.3, showing robustness.

The results are similarly robust to removal of the choice data for the deposits with the 10% largest gaps (gap ≥ 9.373) or the choice data for the deposits with the 10% smallest gaps (gap ≤ -2.9218).

Supplement C.1: Extension of Table I

*The "Gain-Only deposits" are 1A,1B,2A,2B,3A,3B,5A,6A,10A

*The "Gain-Loss deposits" are 4A,4B,5B,6B,7A,7B,8A,8B,9A,9B,10B

*The "Deposits with (single) 0.5 loss" are 4A,4B,8B,10B

*The "Deposits with (single) 0.25 loss" are 5B,6B,7B,9A

The closeness of the certainty equivalents to the expected return also shows in terms of relative deviations:

Let DEV=(CE-E(R))/E(R)

The table below extends Table I by presenting the median avg(DEV) for each type of deposits and showing the results of a signed-rank (Wilcoxon) test of the hypothesis DEV=0

	E(R)	**Elicited CEs**	**Sign-test CE=E(R)**	**DEV**	**Wilcoxon test DEV=0**
All the deposits	4.5%	3.8% (2.5%)	p=0.10 (29/44)	-10.6%	p=0.42
Gain-Only deposits	4.9%	4.7% (1.6%)	p=0.48 (33/40)	-0.0%	p=0.63
Gain-Loss deposits	4.1%	3.5% (3.3%)	p=0.10 (29/44)	-11.9%	p=0.35
Deposits with 0.5 Loss	4.6%	3.6% (4.2%)	p=0.15 (29/42)	-11.3%	p=0.50
Deposits with 0.25 Loss	4.1%	4.1% (2.4%)	p=0.99 (36/35)	+6.1%	p=0.95

Supplement C.2:

Fixed effect regressions of (CE-ER)/ER on ER

This supplement provides more details regarding the regression of (CE-ER)/ER on ER, referenced in discussing the switch from risk-preference to risk-aversion when the expected return on the gain-only deposits increases (section 4.4 of the paper).

The estimated equation is

$$DEV_{i,j} \equiv \frac{CE_{i,j} - ER_j}{ER_j} * 100 = a_i + \beta * ER_j$$

Where the index i is for the subject and the index j for the deposit, so that $CE_{i,j}$ is the elicited certainty equivalent of subject i for deposit j.

The panel OLS regression is run on 657 observations (N=73 subjects; 9 gain-only deposits).

The median intercept a_i is 15.8 (with median p value p=0.048) and the estimated β is -3.24 (T=-4.68; p<0.01), suggesting that 1% increase in the expected return decreases (on average, taking individual effects into account) the CE deviation from the expected return by approximately 3.2%. The R^2 is 51.6%. Since the expected return on the gain-only deposits ranged between 3% to 10%, the regression results suggest that increase in returns from 3% to 10% decreases the deviations of the certainty equivalents from the expected return by approximately 22%. A direct comparison comparably reveals a negative median proportional deviation of -12.7% for the deposits with E(R)>4.5%, compared to positive +7.1% for the deposits with E(R)<4.5% (p<0.01).

Supplement C.3: Consistency across pairs

Using CE(ij) for the certainty equivalent of deposit ij, we test two definitions of consistency: strict and weak.

Subjects are classified as showing (strict) consistency in deposit pairs 1-2 if
[CE(1A)>CE(1B) and CE(2A)>CE(2B)] or
[CE(1A)=CE(1B) and CE(2A)=CE(2B)] or
[CE(1A)<CE(1B) and CE(2A)<CE(2B)]

Subjects are classified as showing (strict) consistency in deposit pairs 7-8 if
[CE(7A)>CE(7B) and CE(8A)>CE(8B)] or
[CE(7A)=CE(7B) and CE(8A)=CE(8B)] or
[CE(7A)<CE(7B) and CE(8A)<CE(8B)]

Subjects are classified as showing weak consistency in deposit pairs 1-2 if
[CE(1A) ≥CE(1B) and CE(2A)≥CE(2B)] or
[CE(1A) ≤CE(1B) and CE(2A)≤CE(2B)]

Subjects are classified as showing strong consistency in deposit pairs 7-8 if
[CE(7A) ≥CE(7B) and CE(8A)≥CE(8B)] or
[CE(7A) ≤CE(7B) and CE(8A)≤CE(8B)]

The (strict) consistency rates are 59% for deposit pairs 1-2 and 38% for deposit pairs 7-8. The weak consistency rates are 86% for deposit pairs 1-2 and 66% for deposit pairs 7-8. The consistency rates for deposit pairs 7-8 are therefore close to 50%, in line with the estimations that show that linearity with respect to losses cannot be rejected and that relaxing the linearity assumption does not improve the fit of the model significantly (see the results for models (f) (h) and (i) in Supplement D.1).

Supplement D.1: More estimations

This section reports the estimation results of seven additional models.

To continue from columns (c) and (d) of Table V, the models are addressed as (e)-(k).

First we introduce the utility or event-weighting functions that are tested in some of the additional estimations.

Models (e), (f), (h) assume power utility for gains and for losses, so that

$$u(r) = \begin{cases} r^{\rho_G} & if\ r \geq 0 \\ -|r|^{\rho_L} & if\ r < 0, \end{cases}$$

for ρ_G, ρ_L>0.

Model (i) assumes expo-power utility for gains and for losses, so that

$$U(r) = \begin{cases} \frac{1}{\alpha_G} * (1 - EXP(-\alpha_G * r^{\rho_G})) & if\ r \geq 0 \\ \frac{-1}{\alpha_L} * \left(1 - EXP(-\alpha_L * (-r)^{\rho_L})\right) & if\ r < 0\ , \end{cases}$$

for $\alpha_G, \alpha_L \neq 0$, ρ_G, ρ_L>0.

Models (g) and (j) assume the Prelec (1998) two-parameters weighting function for gains and for losses, so that

$$\begin{cases} W^+(p) = EXP\left[-PR2_G * \left(-LN(p)\right)^{PR_G}\right] \\ W^-(p) = EXP\left[-PR2_L * \left(-LN(p)\right)^{PR_L}\right] \end{cases}$$

for $PR_G, PR_L, PR2_G, PR2_L > 0$.

Model (k) assumes the Goldstein and Einhorn (1987) two-parameters weighting function for gains and for losses, so that

$$\begin{cases} W^{+}(p) = \dfrac{b_G * p^{a_G}}{b_G * p^{a_G} + (1-p)^{a_G}} \\ \\ W^{-}(p) = \dfrac{b_L * p^{a_L}}{b_L * p^{a_L} + (1-p)^{a_L}}, \end{cases}$$

for parameters $a_G, a_L, b_G, b_L > 0$.

We now describe the estimated models. The results are presented in the table below:

Models (c) and (d) are as in Table V.

Model (e) is similar to model (c), except for assuming $\rho_G \equiv \rho_L$ (instead of $\rho_L \equiv 1$).

Model (f) is similar to model (c), except for removing the $\rho_L = 1$ restriction, so that ρ_G, ρ_L, PR_G, PR_L, λ and σ are estimated on individual basis.

Model (g) is similar to model (c), except for assuming the Prelec two-parameters weighting function, so that ρ_G, PR_G, $PR_L, PR2_G$, $PR2_L, \lambda$ and σ are estimated on individual basis.

Model (h) is similar to model (d), except for removing the $\rho_L \equiv 1$ restriction, so that $\alpha_G, \rho_G, \rho_L, PR_G$, PR_L, λ and σ are estimated on individual basis.

Model (i) is similar to model (d), except for assuming expo-power utility for losses, so that $\alpha_G, \rho_G, \alpha_L, \rho_L, PR_G$, PR_L, λ and σ are estimated on individual basis.

Model (j) is similar to model (d), except for assuming the Prelec two-parameters weighting function, so that α_G, ρ_G, PR_G, $PR_L, PR2_G$, $PR2_L, \lambda$ and σ are estimated on individual basis.

Model (k) is similar to model (d), except for assuming the Goldstein Einhorn (1987) two-parameters weighting function, so that α_G, ρ_G, a_G, a_L, b_G, b_L, λ and σ are estimated on individual basis.

For all these models we report the estimation results and the median ratios

$$W25r = \frac{W^{+}(0.25)}{W^{-}(0.25)}$$

$$W50r = \frac{W^{+}(0.5)}{W^{-}(0.5)}$$

$$LGR5 = \frac{-\lambda * u(-5)}{u(5)}$$

The results as presented at the next table show the robustness of models (c) and (d). In particular,

- the hypothesis $\rho_L = 1$ cannot be rejected and the median ρ_G significantly exceeds 1 in all the best fitting models.

- the W25r (representing the relative weighting of 0.25 gain compared to the weighting of a 0.25 loss) are significantly larger than 1, with the median ratios ranging between 1.46 and 1.85

- the W50r (representing the relative weighting of 0.50 gain compared to the weighting of a 0.50 loss) always fall below the W25r, with the median ratios ranging between 0.69 and 1.05

- the median LGR5 ratios range between 1.30 and 1.97

model	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**	**(k)**
-2LL	6683	5927	6250	6047	6119	5764	5642	5541	5553
AIC	7413	6803	6970	6923	7141	6786	6810	6709	6721
ρ_G	1.21*** (49/24)	1.50*** (56/17)	1.04 (40/33)	1.06 (38/35)	1.12* (45/28)	1.51*** (54/19)	1.55*** (58/15)	1.79*** (54/19)	1.71*** (55/18)
a_G	-	0.0078*** (54/19)				0.0063*** (53/20)	0.0054*** (54/19)	0.0032*** (55/18)	0.0042*** (56/17)
ρ_L	-	-	$\equiv \rho_G$	1.11 (41/32)	-	1.11 (41/32)	1.55 (42/31)	-	-
a_L	-	-	-	-	-	-	0.0127*** (48/25)	-	-
λ	2.31*** (73/0)	2.01*** (54/19)	1.37** (47/26)	1.25 (42/31)	2.33** (72/1)	2.48** (47/26)	1.59* (45/28)	3.45*** (58/15)	4.62*** (64/9)
PR_G	0.79*** (19/54)	0.69*** 22/51	0.69*** 18/55	0.70*** 20/53	0.80*** 19/54	0.69*** 25/48	0.44*** 18/55	0.61*** 23/50	-
PR_L	1.20*** (55/18)	1.68** 47/26	2.05*** 61/12	1.78*** 53/20	1.31** 46/27	1.81*** 54/19	1.46** 46/27	1.44** 47/26	-
$PR2_G$	-	-	-	-	1.02 37/36	-	-	0.94 36/37	-
$PR2_L$	-	-	-	-	1.34*** 49/24	-	-	1.31 41/32	-
a_G									0.67*** 23/50
a_L									1.71*** 50/23
b_G									0.74 31/42
b_L									1.03 37/36
σ	0.23	0.20	0.19	0.18	0.18	0.19	0.18	0.15	0.16
W25r	1.19	1.46	1.83	1.63	1.85	1.71	1.46	1.55	1.85
W50r	0.91	0.81	0.72	0.69	1.05	0.77	0.78	0.87	0.99
LGR5	1.70	1.20	1.37	1.32	1.97	1.30	1.47	1.75	1.71

*Since we report the median W25r, W50r, and LGR5 based on the individual estimates, the numbers do not exactly match the median estimated parameters in the upper panel of the table.

Supplement D.2: Non-zero reference points

The CPT estimations of table V assume a reference point of 0%. To test the robustness of the results with respect to this assumption, we tested few models where the reference point is a parameter of the model or takes other fixed values such as the median FTSE forecast of the participant (P50). The generalization of the CPT valuation function to cases where the reference point takes arbitrary values is direct. The next paragraph, for example, presents the CPT value of deposit 7A of Table IV (with the return structure 14%,14%, -4%,-6%), assuming a reference point refP which can take positive, zero, or negative values.

If $\text{refP} \leq -6\%$ then

$$\begin{gathered} \mathrm{W}^{+}(0.5) * \mathrm{u}(14-\mathrm{refP}) + \\ \left(\mathrm{W}^{+}(0.75)-\mathrm{W}^{+}(0.5)\right) * \mathrm{u}(-4-\mathrm{refP}) + \\ (1-\mathrm{W}^{+}(0.75) * \mathrm{u}(-6-\mathrm{refP}) \end{gathered}$$

If $-6\% \leq \text{refP} \leq -4\%$ then

$$\begin{gathered} \mathrm{W}^{+}(0.5) * \mathrm{u}(14-\mathrm{refP}) + \\ \left(\mathrm{W}^{+}(0.75)-\mathrm{W}^{+}(0.5)\right) * \mathrm{u}(-4-\mathrm{refP}) + \\ \mathrm{W}^{-}(0.25) * \lambda * \mathrm{u}(-6-\mathrm{refP}) \end{gathered}$$

If $-4\% \leq \text{refP} \leq 14\%$ then

$$\begin{gathered} \mathrm{W}^{+}(0.5) * \mathrm{u}(14-\mathrm{refP}) + \\ \mathrm{W}^{-}(0.25) * \lambda * \mathrm{u}(-6-\mathrm{refP}) + \\ \left(\mathrm{W}^{-}(0.5)-\mathrm{W}^{-}(0.25)\right) * \lambda * \mathrm{u}(-4-\mathrm{refP}) \end{gathered}$$

If $\text{refP} \geq 14\%$ then

$$\begin{gathered} \mathrm{W}^{-}(0.25) * \lambda * \mathrm{u}(-6-\mathrm{refP}) + \\ \left(\mathrm{W}^{-}(0.5)-\mathrm{W}^{-}(0.25)\right) * \lambda * \mathrm{u}(-4-\mathrm{refP}) + \\ (1-\mathrm{W}^{-}(0.5)) * \lambda * \mathrm{u}(14-\mathrm{refP}) \end{gathered}$$

The next table presents the results of estimating models (c) or (d) assuming the reference point can take values different from zero. For comparability, the results for models (c) and (d) – with 0% reference point - are copy pasted from table V at the leftmost columns of the table.

The column "refP model I" reports the results of estimating model (d) with refP ≥ 0 as an additional parameter. Since this model generalizes model (d), the fit must improve. Indeed, the log likelihood score of the model is about 5827 compared to the log likelihood score of 5927 for model (d). The 100 points improve in log likelihood, however, is not large enough to compensate for the estimation of 73 more parameters (the individual refP estimates) in terms of the Akaike Information Criterion. The AIC of "refP model I" is 6849, 46 points larger than the AIC of model (d). The estimated refP is about 0 for N=26 subjects (35%), but it is positive exceeding 2% for a similar proportion (N=27). The mean refP estimate is 1.47 with median 0.82.

As an additional robustness test, column "refP model II" reports the results of estimating model (d) assuming refP ≡ 2.5%. The results for this and other arbitrary refP values are evidently weak. The -2LL of the estimations assuming refP ≡ 2.5% is 6578 and the AIC is 7454.

Finally, the column "refP model III" reports the results of estimating model (c) assuming refP ≡ P50, the median FTSE forecast elicited in the first phase of the experiment. The estimation of model (d) assuming refP=P50 did not converge or showed strong sensitivity to the initial conditions. We therefore reverted to model (c), assuming power utility instead of expo-power utility for gains. In general, it appears that assuming P50 as an individual reference points distorts the estimation results (see, for instance, the strong drop in the ρ1 and ρ2 correlations). The AIC score of the model is about 600 points higher than the AIC of model (d).

Models with reference point >0 – Experiment 1 (N=73)

	(c)	(d)	refP model I	refP model II	refP model III
-2LL	6683	5927	5827	6578	6677
AIC	7413	6803	6849	7454	7407
refP	-	-	0.82 (>0 for N=47)	≡ 2.5%	≡ P50 (≥ 0 for N=69)
ρ_G	1.21*** (49/24)	1.50*** (56/17)	1.41*** (54/19)	1.43*** (68/5)	1.01 (37/36)
a_G	-	0.0078*** (54/19)	0.0085*** (49/24)	0.0238*** (53/20)	-
λ	2.31*** (73/0)	2.01*** (54/19)	2.02*** (48/25)	2.17*** (73/0)	1.21*** (43/30)
PR_G	0.79*** (19/54)	0.69*** (22/51)	0.63*** (24/49)	0.97** (26/47)	0.31** (26/47)
PR_L	1.20*** (55/18)	1.68*** (51/22)	1.51*** (51/22)	1.02 (40/33)	1.33* (45/28)
σ	0.23	0.20	0.20	0.24	0.31
ρ1	0.70	0.73	0.76	0.67	0.55
ρ2	0.96	0.96	0.90	0.90	0.68

Supplement D.3: Model (d) robustness tests

The table in this supplement reports the results of nine more estimations, testing the robustness of CPT model (d) as presented in Table V of the paper. We describe each of the model before presenting the table with the estimation results.

Column I reports the results of estimating model (d) using the smaller sample of choice problems that fix the CE of each deposit (only 40 choice problems for each subject). In few cases where the subject always preferred the risk free alternative to the deposit, or vice versa always preferred the deposit to the risk free rate, we use the initial bounds H or L for the second choice problem; e.g., if the subject always preferred the deposit to the fixed rate, we keep the last choice problem where the subject preferred the deposit to the highest fixed rate and add an artificial choice problem assuming the subject preferred the bound H to the deposit (but omitting these extra problems does not affect the results).

Column II reports the results of a randomized split-sample robustness test. For each randomization, we randomly divide the set of twenty deposits into two groups, so that the two deposits of each pair are assigned to distinct groups. Model (d) is estimated from the choice problems for the ten deposits in one group and used to predict the certainty equivalents of the ten deposits in the second group. The randomizations were repeated 100 times and the estimated parameters were averaged across the 100 randomizations for each subject. The table presents the median average estimates and reports the sign-test results for the average estimates. The median average correlation between the predicted and elicited CEs was 0.6685.

Column III reports the model (d) estimation results after filtering the deposits with 5% largest and 5% smallest gaps. In particular, we remove the elicitation sequences for deposits with GAP>11.0664063 or GAP<−4.8593750. The restricted sample consists of N=5880 choice problems (compared to 6542 in the full sample) and 71 subjects (two subjects with extreme gaps are removed in this filtering). The results are similarly robust to filtering the deposits with the 10% largest gaps (gap ≥ 9.373) or the deposits with the 10% smallest gaps (gap ≤ -2.9218).

Columns IV-VI test the robustness of the estimation results to removal of choice problems or deposit pairs where subjects violated dominance (see Supplement B.7 general discussion of monotonicity violations). **Column IV** reports the model (d) estimation results ignoring cases where subjects violated dominance. The complete elicitation sequence is removed whenever the subject violates dominance in one of the choice problems of the respective sequence. The restricted sample consists of N=5651 choice problems, compared to the N=6542 choice problems before the filtering. **Column V** reports the model (d) estimation results for the N=63 subjects that never violated dominance. For **Column VI** recall that the 20 deposits of the experiment generate 31 deposit-pairs with dominance relation. This column reports the model (d) median estimation results for the N=61 subjects that obey dominance in at least 2/3 (21 of 31) of the paired comparisons.

Column VII reports the results of estimating model (d) under the assumption that the relative length (LGTH) of the FTSE interval may affect the decision-weight of the respective event. We use the parameter L for the weight of the true probability P (0.25, 0.5 etc), assuming (1-L) represents the weight of the LGTH. The weighting functions are applied to the weighted averages L*P+(1-L)*LGTH. If, for example, H-L=25 and H-P75=10 then the decision-weight of the [P75,H] event is $W^{+}(L * 0.25 + (1 - L) * 0.4)$. The parameter 0≤L≤1 is estimated jointly with the other parameters of model (d). The median estimated L is 0.98 (see the table) with corner estimates L=1 for N=15 (20%) subjects. When the estimations are run forcing L≡0, the -2LL increases by 159 points (6086 compared to the 5927 of model d), so the LGTH-based weighting model is easily rejected.

(The SAS code for LGTH dependent weighting:

```
LGTH1=(H-P75)/(H-L);
LGTH2=(P75-P50)/(H-L);
LGTH3=(P50-P25)/(H-L);
LGTH4=(P25-L)/(H-L);

LGTH25=LGTH1;
LGTH50=LGTH25+LGTH2;
LGTH75=LGTH50+LGTH3;

LGTH25_L=LGTH4; *the _L is for loss-side events;
LGTH50_L=LGTH3+LGTH4;
LGTH75_L=LGTH2+LGTH3+LGTH4;

W25_g=%WP_g(L*0.25+(1-L)*LGTH25);
W50_g=%WP_g(L*0.5+(1-L)*LGTH50);
W75_g=%WP_g(L*0.75+(1-L)*LGTH75);
W25_l=%WP_l(L*0.25+(1-L)*LGTH25_L);
W50_l=%WP_l(L*0.5+(1-L)*LGTH50_L);
W75_l=%WP_l(L*0.75+(1-L)*LGTH75_L);
```

Where %WP_g and %WP_l denote the macros for the Prelec weighting function for gains and for losses.)

Column IIX and Column IX follow Sonsino et al. (2002) testing if subjects show complexity aversion in the valuation of deposits with 3-4 return levels compared to the deposit with only 2 return levels.

Column IIX assumes that when the deposit brings more than 2 return levels, the value adjusted for complexity (VAC) is some fraction (1-COMP) of the value before adjusting to complexity (V, as defined in section 5 of the paper); that is,

$$VAC(D_j) = \begin{cases} V(D_j) & \text{when } \mathrm{D_j} \text{ brings only 2 return level} \\ (1 - COMP) * V(D_j) & \text{when } \mathrm{D_j} \text{ beings at least 3 return levels,} \end{cases}$$

where COMP is an additional parameter of the model

Column IX alternatively tests the possibility that complexity increases the noise in the evaluation, assuming the noise in the evaluation of deposits with 3-4 return levels $\sigma 2$ may differ from the noise $\sigma 1$ in the valuation of deposits with only 2 return levels.

The results of both estimations confirm the two forms of complexity aversion proposed in the 2002 paper.

In the estimations of model IIX, the hypothesis COMP=0 is rejected for COMP>0 as the estimated comp is positive for more than 2/3 of the subjects. The median penalty for complexity is about 3% for the complete sample, but increases to 10% when the subjects with estimated COMP=0 are ignored. The AIC of model (d) however increases from 6803 to 6865 due to the extra parameter.

The estimations of model IX indeed confirm that $\sigma 2 > \sigma 1$ (p≤ 0.01 in a sign test of the paired $\sigma 2 - \sigma 1$ differences). The AIC of model (d) decreases from 6803 to 6717 and the restriction $\sigma 1 = \sigma 2$ is easily rejected in a likelihood-ratio test. We still choose to report the parsimonious version with single σ in the text to refrain from the estimation of one more parameter on individual basis.

model	(d)	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(IIX)	(IX)
-2LL	5927	-	-	-	-	-	-	5824	5843	5695
AIC	6803	-	-	-	-	-	-	6846	6865	6717
ρ_G	1.50*** (56/17)	1.44*** (50/23)	1.34*** (65/8)	1.54*** (58/13)	1.50*** (57/16)	1.47*** (49/14)	1.42*** (48/13)	1.46*** (54/19)	1.41*** (55/18)	1.41*** (55/18)
1000*a_G	7.8*** (54/19)	4.9*** (51/22)	3.5 (40/33)	7.7*** (56/15)	7.7*** (52/21)	7.8*** (47/16)	6.0*** (43/18)	6.6*** (52/21)	6.5*** (53/20)	7.6*** (53/20)
λ	2.01*** (54/19)	1.78* (44/29)	2.52*** (73/0)	1.80*** (48/23)	2.11*** (55/18)	1.84*** (46/17)	1.89*** (46/15)	2.20*** (57/16)	1.92*** (55/18)	2.06*** (52/21)
PR_G	0.69*** (22/51)	0.68** (27/46)	0.72*** (11/62)	0.64*** (23/48)	0.69*** (20/53)	0.69*** (18/45)	0.69*** (18/43)	0.72 23/44	0.65*** (24/49)	0.60*** (22/51)
PR_L	1.68** (51/22)	1.32*** (48/25)	1.69*** (73/0)	1.51** (45/26)	1.75** (52/21)	1.75*** (45/18)	1.72*** (45/16)	1.78*** 51/22	1.79*** (52/21)	1.49*** (48/25)
L	-	-	-	-	-	-	-	0.98		
COMP									0.03*** (63/10)	
σ or $\sigma 1$	0.20	0.35	0.21	0.19	0.20	0.20	0.20	0.20	0.20	0.13
$\sigma 2$										0.21

*The log likelihoods are not reported for models I-VI since these estimations are based on varying numbers of observations.

Appendix references not cited in the text:

Sonsino, D., Benzion, U., & Mador, G. (2002). The complexity effects on choice with uncertainty–Experimental evidence. *The Economic Journal*, *112*(482), 936-965.

Supplement D.4: The model (d) inflection points

The expo-power utility function as introduced in equation (3) of the paper is

$$U(r) = \frac{1}{\alpha_G} * \left(1 - EXP(-\alpha_G * r^{\rho_G})\right)$$

for return $r > 0$ and parameters $\alpha_G \neq 0$; ρ_G>0.

When $\alpha_G * (\rho^G - 1) > 0$ the expo-power utility function has an inflection point at

$$r^* = \left(\frac{\rho_G - 1}{\alpha_G * \rho_G}\right)^{\frac{1}{\rho_G}}$$

In particular, when $\alpha_G > 0$ and $\rho_G - 1 > 0$, the function changes from convex to concave.

When $\alpha_G > 0$ and $\rho_G - 1 < 0$, the function changes from concave to convex.

In the estimations of model (d),

-N=46 subjects shift from convex to concave. The median inflection point for these subjects is $r^* = 6.38\%$

- N=9 subjects shift from concave to convex. The median inflection point for these subjects is $r^* = 3.13\%$

-N=10 subjects are "always convex"

-N=8 subjects are "always concave"

Supplement D.5: Alpha MaxMin estimations

This section reports the results of estimating the alpha MaxMin model of Ghirardato et al. (2004) that has shown the best, or close to the best, fit levels in various studies that compare the descriptive power of alternative models of decision under uncertainty (e.g., Hey et al. 2010; Baillon and Bleichrodt 2015; Carbone et al. 2017).[2]

First, we introduce a formal definition of the model, confining to structured deposits of the type examined in the experiment.

Recall that we use quadruples $D = (r_1, r_{2,} r_3, r_4)$ with $r_1 \geq r_2 \geq r_3 \geq r_4$ to generically represent a deposit that pays r_i at the event $E_i, i = 1,2,3,4$. The estimations of alpha MaxMin models respectively build on probability distributions $p = (p_1, p_{2,} p_3, p_4)$. Specifically, the model assumes the existence of a subset of probability distributions C, a utility function U, and a parameter $\alpha lpha \in [0,1]$ such that the value of each deposit D, V(D), is represented as

$$V(D) = \alpha lpha * Inf_{p\in C}\, EU_p(D) + (1 - \alpha lpha) * Sup_{p\in C}\, EU_p(D),$$

where $EU_p(D)$ is the expected utility from D assuming the probability distribution p.

In words, the alpha MaxMin model assumes that the value of each deposit is a convex combination of the worst and best possible values the deposit can take, assuming the probabilities over the four events are restricted to some subset C of the probability simplex. The parameter $\alpha lpha$ represents the weight of the worst possible value, while $(1 - \alpha lpha)$ represents the weight of the most optimistic value. When $\alpha lpha = 1$, the model reduces to the MaxMin model (Gilboa and Schmeidler, 1989). The special case where $\alpha lpha = 0$ is addressed as the MaxMax model.

A practical problem with applying the model comes from the need to restrict the set of relevant probability distributions to some subset C. For the current estimations, we follow the approach of Chateauneuf et al. (2007), as implemented – for example - in Dimmock et al. (2015). In particular, we assume a lower bound 0≤Pmin≤0.25 such that the set of prior consists of all probability distributions satisfying the constraint $p_i \geq Pmin$ for $i = 1,2,3,4$. Assuming this structure, it is easily verified that $Inf_{p\in C}\, EU_p(D)$ is reached when p=(Pmin, Pmin, Pmin, 1-3*Pmin) while $Sup_{p\in C}\, EU_p(D)$ is obtained when p=(1-3*Pmin, Pmin, Pmin, Pmin). The worst and best priors are thus symmetric in the sense of putting mass Pmin on all the events except for the most pessimistic/optimistic FTSE event that receives the residual 1-3*Pmin probability (although, as discussed in Dimmock et al. (2015), the 'bands' around the 0.25 benchmark probabilities are asymmetric). With these assumptions, the alpha MaxMin model can be parsimoniously estimated, assuming the parameters Pmin, alpha and some parametric utility function. In reporting the results, we additionally assume, alpha≡0.5 when Pmin=0.25. The model was estimated in two versions. Model I assumes the power utility function on final wealth levels $U(r) = -100 + 100 *$

[2]In Hey et al. (2010) alpha MaxMin outperforms CPT and about ten other models (depending on the level of estimation and noise specification). In Baillon and Bleichrodt (2015) the data is most consistent with Prospect Theory and alpha MaxMIN ranks as one of few second-best models. Carbone et al. (2017) do not estimate Prospect Theory. Conte and Hey, 2013 is an exception as alpha MaxMin shows the best fit for less than 9% of the subjects.

$(1 + r/100)^\rho$ (so that the utility levels range between -10 and 22 when $\rho = 1$). Model II assumes the power utility function on gains U(r)=r^{ρ_G} for $r \geq 0$ and linear utility for losses (U(r)=r for $r < 0$), as in model (c) of table V. In the background work we have also estimated versions of the MaxMin model assuming the expo-power utility function, but the results of these estimations were unstable, showing sensitivity to the initial conditions and the optimization method. We therefore only report the results for alpha MaxMin models assuming the power utility function.

The results of the estimations are presented at the right panel of the table below. For comparability, the left panel copies the results for CPT models (c) and (d) from Table V of the paper. The distribution of the estimated $alpha$ is summarized in a separate table just below the table with the estimation results.

The median alpha in the best fitting alpha MaxMin model II is 0.5, proposing that the subjects assign equal weight to the most optimistic and the most pessimistic priors. The median Pmin is 0.18, with Pmin=0.25 for only 16 subjects so that the multi-prior (ambiguity perception) assumption is clearly supported. The alpha MaxMin model II however is clearly rejected for CPT model (d) in a Clarke (2007) test that corrects for the larger number of parameters of the CPT model (The model (d) corrected log likelihood is larger\smaller than model II corrected log likelihood for 59\14 subjects; p<0.01).

Estimation results – CPT versus Alpha MaxMin (N=73)

	CPT models		Alpha MaxMin models	
	(c)	**(d)**	**model I**	**model II**
-2LL	6683	5927	6643	6407
AIC	7413	6803	7227	6991
ρ_G	1.21*** (49/24)	1.50*** (56/17)		0.87** (26/47)
ρ			0.052*** (20/53)	
a_G	-	0.0078*** (54/19)	-	-
λ	2.31*** (73/0)	2.01*** (54/19)	-	-
PR_G	0.79*** (19/54)	0.69*** (22/51)	-	-
PR_L	1.20*** (55/18)	1.68*** (51/22)	-	-
P_{min}			0.18	0.18
alpha			0.53 (37/28)	0.50 (27/30)
σ	0.23	0.20	0.20	0.19
ρ1	0.70	0.73	0.61	0.66
ρ2	0.96	0.96	0.92	0.93

*The table follows the method of Table V in the paper. The right panel presents the median Pmin and alpha. The lower brackets below the median alpha disclose the number of subjects with estimated alpha larger/smaller than 0.5. The hypothesis alpha=0.5 could not be rejected in both models.

The distribution of estimated alphas

	Alpha MaxMin	
Alpha range	Model I	Model II
[0,0.25)	32%	33%
[0.25, 0.5)	6%	8%
[0.5, 0.75)	22%	32%
[0.75,1]	40%	27%

Appendix references not cited in the text:

Chateauneuf, A., Eichberger, J., & Grant, S. (2007). Choice under uncertainty with the best and worst in mind: Neo-additive capacities. *Journal of Economic Theory*, *137*(1), 538-567.

Conte, A., & Hey, J. D. (2013). Assessing multiple prior models of behaviour under ambiguity. *Journal of Risk and Uncertainty*, *46*(2), 113-132.

Gilboa, Itzhak, and David Schmeidler (1989). "Maxmin expected utility with a unique set of priors." *Journal of Mathematical Economics* 18, 141-153.

Supplement D.6: Aspiration level theory

The switch from risk-preference with respect to small gains to risk aversion with respect to larger gains (Table II) and some of the other paired comparisons intuitively suggest that subjects may respond to implicit aspiration levels. An aspiration level of 5%, for an arbitrary example, may explain the preference for deposit 1B=(9%,7%,0%,0%) over deposit 1A= (6%,4%,3%,3%) and also explain a preference for 6B=(10%,10%,9%,-8%) over 6A=(10%,10%,1%, 0%).

Following Diecidue and Van de Ven (2008) we have estimated several versions of aspiration level theory, testing several utility functions and estimating the aspiration level on individual level together with the other parameters of the model. In the next paragraphs we introduce the estimated model and present the results of an exemplary estimation, including the distribution of the estimated aspiration levels.

The estimated Aspiration Level model

Let $u(r)$ denote the *basic utility* of return *r* and assume the existence of an aspiration level AL≥0 and non-negative constants $\mu \geq 0$ and $\lambda \geq 0$ such that the *final utility* of return *r*, *V(r)*, is

$$V(r) = \begin{cases} u(r) + \mu & if\ r > AL \\ u(r) & if\ r = AL \\ u(r) - \lambda & if\ r < AL \end{cases}$$

For the next estimations, we adopt the power model for the *basic utility*, assuming $u(r) = -100 + 100 * (1 + r/100)^{\rho}$, so that the utility levels when $\rho = 1$ take values between -10 (when r=-10) and 22 (when r=22). The heteroskedastic noise term *(k(D),* as introduced in Section 5.3) is accordingly redefined.

In the case of deposit 7A=(14%,14%,-4%,-6%) of Table IV, using u(7A) for the basic utility from the deposit and AL≥ 0 for the aspiration level, the final utility takes the form:

$$V(7A) = \begin{cases} \mathrm{u}(7\mathrm{A}) + 0.5 * \mu - 0.5 * \lambda & if\ AL < 14 \\ \mathrm{u}(7\mathrm{A}) - 0.5 * \lambda & if\ AL = 14 \\ \mathrm{u}(7A) - \lambda & if\ AL > 14 \end{cases}$$

Results:

The results of individual level estimations of the model are presented in the table below. As in the paper, we present the median estimates for the N=73 participants. The smaller font numbers in brackets show (from left to right) the number of subjects with ρ exceeding and falling below 1 and the number of subjects with AL, μ, and λ exceeding 0 and falling exactly at zero (these parameters take non-negative values). The asterisks accordingly report the results of testing the benchmark hypotheses $\rho = 1$ (linearity of the power utility function), $AL > 0$ (strictly positive aspiration level), $\mu > 0$ (increased utility from payoffs exceeding the aspiration level) and $\lambda > 0$ (decreased utility from payoffs falling below the aspiration level). The distribution of estimated aspiration levels is summarized in a separate table just below the table with the estimation results.

The median estimated aspiration level is 4%, but the estimate is 5% and more for about 40% of the subjects, while it is equal to 0 for only 19%. The log likelihood score of the aspiration level model is -2LL=6928 compared to log likelihood scores of 6683 and 5927 for models (c) and (d) of Table V and tests for the comparison of non-nested models reject aspiration level theory for CPT.

Results of estimating aspiration level theory

Statistic / Parameter	Value
-2LL	6928
AIC	7658
ρ	0.13** (27,46)
AL	4*** (59,14)
μ	0.58*** (56,17)
λ	0.74*** (61,12)
σ	0.50

Note: The predicted CEs cannot be calculated for aspiration level theory because of the discontinuity at the aspiration level. We therefore cannot report the $\rho 1, \rho 2$ correlations for this model.

The distribution of estimated Aspiration Levels in experiment 1

AL	N= (%)
0	14 (19%)
1	7 (10%)
2	5 (7%)
3	6 (8%)
4	11 (15%)
5	23 (32%)
6	6 (8%)
7	1 (1%)

Supplement D.7: Range and sign dependent utility (RSU)

The intriguing results for deposit pairs 5 and 6 (Table III) also bring up the possibility that the range of returns, that varied between the deposits in each pair and between the two pairs, affects the evaluations. Kontek and Lewandowski (2017), illustrate - using the TK92 data - that the second derivative of the utility function, at given amounts, may take positive or negative values, depending on the range of payoffs in the decision context. The range-dependent utility model is developed to take account of range-effects on valuations. Baucells, Kontek and Lewandowski (2019; henceforth BKL) develop the range-dependent model further showing that parsimonious versions of the model, in terms of parametric assumptions, can explain the Allais paradox, preference reversal, time discounting anomalies and more.

The estimation of range dependent models is particularly interesting in the current application since our instructions specified the range of returns on the experimental deposits at the outset (see page 23 of the supplements file). In addition, since the baseline RSU specification as utilized by Baucells et al. (2018) builds on only two parameters, it is interesting to test if such a parsimonious framework is able to approach the fit of CPT in terms of AIC scores, even if the log likelihood score is larger.

At the next paragraph we outline the RDU model as developed in BKL and report the results of estimating two versions of the model on the choice data of experiments 1.

A simple lottery is a list of payoffs and respective probabilities: $L = (x_1, x_2 \ldots x_n; \; p_1, p_2 \ldots p_n)$. A decision context is a finite collect of simple lotteries. The frame within which the lotteries in a decision context are evaluated is a tuple $\langle L, x_0, G \rangle$ indicating a range [L,G], L<G and a reference point $x_0 \in [L, G]$. The symbol G denotes the maximal payoff in the decision context, while L is the minimal payoff in the context. BKL advocate using the max min payoff (when it is non-negative) across the collection of lotteries in the decision context as the reference point, but assume reference point 0 for the baseline specification (page 8 of the paper). In our application the max min is 3% (the minimal return on deposits 1A and 2A). RSU models I and II as described next were estimated using the 3% maxmin as the reference point and a 0% reference point. Since the fit scores were better for the $x_0 = 0\%$ model, we adopt the frame $\langle L, 0\%, G \rangle$ with L=-10% and G=22% henceforth. With these assumptions, the RSU valuation model, attaching real value $v(L)$ to each lottery L in the decision context, is presented as follows:

Let

$$D_G(x) = \exp\left\{-\left(\ln\left(\frac{1}{x}\right)\right)^{\frac{1}{PR_G}}\right\} \qquad D_L(x) = \exp\left\{-\left(\ln\left(\frac{1}{x}\right)\right)^{\frac{1}{PR_L}}\right\}$$

$$D_G^{-1}(p) = \exp\left\{-\left(\ln\left(\frac{1}{p}\right)\right)^{PR_G}\right\} \qquad D_L^{-1}(p) = \exp\left\{-\left(\ln\left(\frac{1}{p}\right)\right)^{PR_L}\right\}$$

$$p^+ = \sum_{\{i;\, x_i > 0\}} p_i * D_G\left(\frac{x_i}{G}\right) \qquad p^- = \sum_{\{i;\, x_i < 0\}} p_i * D_L\left(\frac{x_i}{L}\right)$$

and set $v(L) = G * D_G^{-1}(p^+) + L * \lambda * D_L^{-1}(p^-)$.

The RSU value of deposit 7A of Table IV (with the return structure 14%,14%, -4%, -6%), for example, is calculated as follows:

$$p^+ = 0.5 * \exp\left\{-\left(\ln\left(\frac{22}{14}\right)\right)^{\frac{1}{PR_G}}\right\}$$

$$p^- = 0.25 * \exp\left\{-\left(\ln\left(\frac{10}{4}\right)\right)^{\frac{1}{PR_L}}\right\} + 0.25 * \exp\left\{-\left(\ln\left(\frac{10}{6}\right)\right)^{\frac{1}{PR_L}}\right\}$$

$$v(7A) = G * \exp\left\{-\left(\ln\left(\frac{1}{p^+}\right)\right)^{PR_G}\right\} + L * \lambda * \exp\left\{-\left(\ln\left(\frac{1}{p^-}\right)\right)^{PR_L}\right\}.$$

The next tables present the results of estimating two versions of this model at the individual level: Model I assumes $PR_G = PR_L \equiv PR$, so that the estimated model has only 3 parameters (PR, λ, σ). Model II allows for gain-loss differences, estimating all 4 parameters $(PR_G, PR_L, \lambda, \sigma)$. The results for the two models are presented at the right panel of the table. The left panel copy pastes, for comparison, the results of models (c) and (d) as presented in Table V of the paper.

The individual level estimations again reveal strong heterogeneity across the sample. The hypotheses $PR_i = 1$ and $\lambda = 1$ could not be rejected at p<0.05 across the sample. The $\rho 1$ and $\rho 2$ correlations for the best fit model II approach those of CPT model (d) (see the table), but the fit scores of RSU models in terms of -2LL and AIC exceed those of the best fitting CPT model (d) and the Clarke (2007) test rejects RSU model II for CPT model (d) at p<0.01. It appears that the basic framework of BKL is too parsimonious to effectively capture the idiosyncratic preferences of the subjects over the structured deposits of the current experiment. It is still possible that richer versions of the model (say, departing from the assumed linearity with respect to range-normalized gains and losses) will be able to fit data more effectively.

RSU models I and II

	(c)	(d)	RSU model I	RSU model II
-2LL	6683	5927	6805	6681
AIC	7413	6803	7243	7265
ρ_G	1.21*** (49/24)	1.50*** (56/17)		
a_G	-	0.0078*** (54/19)		
λ	2.31*** (73/0)	2.01*** (54/19)	1.14 (40/33)	1.14 (43/30)
PR or PR_G	0.79*** (19/54)	0.69*** (22/51)	0.94 (34/39)	0.93 (32/41)
PR_L	1.20*** (55/18)	1.68*** (51/22)		1.10 (42/31)
σ	0.23	0.20	0.25	0.24
ρ1	0.70	0.73	0.59	0.63
ρ2	0.96	0.96	0.72	0.83

Supplement E.1: The deposits of Experiment 2

The next table present the 20 deposits of experiment 2.

We use the same order as in supplement B.4 (except for pairs 3 and 4 that are presented now in the order fed to the program; in B.4 we modified the order to match the separate discussion of gain-only and gain-loss deposits in the paper)

The deposits that were slightly modified compared to experiment 1 are marked with an asterisk.

Pair no	Probability	Return	E(R)	Elicited CE	Sign-test
Pair 1	*0.25*	*6%*	4%	3.5% (0.8%)	p<0.01 (13/32)
	0.25	*4%*			
	0.5	*3%*			
	0.25	*9%*	4%	5.0% (2.1%)	
	0.25	*7%*			
	0.5	*0%*			
Pair 2	*0.5*	*6%*	4.5%	4.75% (0.5%)	p=0.19 (19/29)
	0.5	*3%*			
	0.5	*9%*	4.5%	4.75% (2.0%)	
	0.5	*0%*			
Pair 3	*0.5*	*10%*	5%	4.5% (2.9%)	p=0.13 (33/21)
	0.5	*0%*			
	0.5	*20%*	5%	4.5% (4.7%)	
	0.5	*-10%*			

Pair 4	*0.5*	*20%*	10%	9.75% (4.3%)	p<0.01 (44/17)
	0.5	*0%*			
	0.5	*20%*	7.5%	7.0% (4.9%)	
	0.5	*-5%*			
Pair 5*	*0.5*	*7%*	4%	3.75% (1.5%)	p=0.74 (19/16)
	0.25	*2%*			
	0.25	*0%*			
	0.5	*7%*	4%	3.75% (1.5%)	
	0.25	*4%*			
	0.25	*-2%*			
Pair 6*	*0.5*	*10%*	5.5%	5.0% (1.9%)	p<0.01 (16/36)
	0.25	*2%*			
	0.25	*0%*			
	0.5	*10%*	5.5%	5.75% (2.5%)	
	0.25	*9%*			
	0.25	*-7%*			

Pair no	FTSE Condition	Return	E(R)	Elicited CE	Sign-test
Pair 7	*0.50*	*14%*	4.5%	3.0% (3.3%)	p=0.10 (17/29)
	0.25	*-4%*			
	0.25	*-6%*			
	0.50	*14%*	4.5%	4.0% (3.5%)	
	0.25	*0%*			
	0.25	*-10%*			
Pair 8*	*0.50*	*12%*	4%	2.25% (3.1%)	p=0.09 (18/31)
	0.25	*-2%*			
	0.25	*-6%*			
	0.50	*12%*	4%	3.75% (2.9%)	
	0.25	*0%*			
	0.25	*-8%*			

Deposit	FTSE Condition	Return	E(R)	Elicited CE	Sign-test
Pair 9	*0.25*	*12%*	3%	4% (3.1%)	p=0.06 (32/18)
	0.25	*10%*			
	0.25	*0%*			
	0.25	*-10%*			
	0.25	*14%*	3%	4% (3.6%)	
	0.25	*8%*			
	0.25	*-4%*			
	0.25	*-6%*			
Pair 10	*0.50*	*6%*	3%	3.25% (1.3%)	p=0.99 (25/25)
	0.50	*0%*			
	0.50	*8%*	3%	3.25% (2.0%)	
	0.50	*-2%*			

Supplement E.2:

Comparison of model (d) estimates in experiments 1 and 2

The parameter	Experiment 1 (N=73)	Experiment 2 (N=61)	Pitman test
ρ_G	1.50*** (56/17)	1.44*** (42/19)	p=0.15
a_G	0.0078*** (54/19)	0.0024** (40/21)	p=0.97
λ	2.01*** (54/19)	1.71 (37/24)	p=0.41
PR_G	0.69*** 22/51	0.65*** (19/42)	p=0.83
PR_L	1.68*** 51/22	1.18* (38/23)	p=0.11
σ	0.20	0.16	p=0.20
PR_L - PR_G	0.78	0.55	p=0.19
-2LL*	80.8	78.0	p=0.04

* The -2LL row presents the median log-likelihood scores. The comparison interestingly suggests that model (d) log-likelihood scores are significantly smaller when the estimations are run on the choices between risky deposits and fixed return rates (compared to estimations run on the choices between uncertain deposits and fixed rates), but the difference is small in magnitude and may follow from other differences between the two experiments.

Supplement F.1: Comparisons with other CPT estimations

The model (d) estimation results are compared to those of Tversky and Kahneman (1992), Booij et al. (2010), Zeisberger et al. (2012) and L'Haridon and Vieider (2019). Since the estimated models strongly differ in the structural assumptions and the method of estimation, we run the comparisons using the predicted certainty equivalents of (6% or 0%), (10% or 0%) and (20% or 0%) deposits, the predicted loss-gain utility ratios LGR5 and LGR10 and the predicted gain-loss weighting ratios W25r and W50r as defined below:

$$CE6 = u^{-1}(W^{+}(0.5)*\text{u}(6))$$

$$CE10 = u^{-1}(W^{+}(0.5)*\text{u}(10))$$

$$CE20 = u^{-1}(W^{+}(0.5)*\text{u}(20))$$

$$LGR5 = \frac{-\lambda * u(-5)}{u(5)}$$

$$LGR10 = \frac{-\lambda * u(-10)}{u(10)}$$

$$W25r = \frac{W^{+}(0.25)}{W^{-}(0.25)}$$

$$W50r = \frac{W^{+}(0.5)}{W^{-}(0.5)}$$

In the next table,

EXP1 – denotes the median model (d) predicted CEs for the N=73 subjects of experiment 1

EXP2– denotes the median model (d) predicted CEs for the N=61 subjects of experiment 2

TK92 - denotes the ratios implied by Tversky and Kahneman (1992) median estimates

BPK10 – denotes the ratios implied by Booij et al. (2010) aggregate structural estimations

ZVL12 – denotes the ratios implied by Zeisberger et al. (2012) median estimates (across the two repeated sessions of the experiment)

LHV19 - denotes the ratios implied by l'Haridon and Vieider (2019) aggregate estimates for an international panel of 2939 subjects.

	Current results		Benchmark estimations			
	EXP1 (N=73)	**EXP2** (N=61)	**TK92**	**BPK10**	**ZVL12**	**LHV19**
CE6	3.2	3.3	2.2 [1,2]	2.3 [1,2]	2.9 [1]	2.2 [1,2]
CE10	5.1	5.2	3.7 [1,2]	3.8 [1,2]	4.9	3.7 [1,2]
CE20	7.9	9.3	7.5 [2]	7.6 [2]	9.8 [1]	7.4 [2]
LGR5	1.20	1.20	2.25 [1,2]	1.49 [2]	1.20	1.94 [1,2]
LGR10	1.12	1.03	2.25 [1,2]	1.46 [2]	1.12	1.94 [1,2]
W25r	1.46	1.26	0.99 [1,2]	0.81 [1,2]	0.94 [1,2]	1.06 [1]
W50r	0.81	0.87	0.93 [1]	0.86	1.04 [1,2]	1.02 [1,2]

* Note again that the EXP1 and EXP2 columns report the median predicted values by model (d) individual level estimations. The median elicited CEs were quite close to the median predicted CEs: CE6=3.5, CE10=5.0, CE20=8.0 in experiment 1 and CE6=3.2, CE10=4.5, CE20=9.75 in experiment 2.

* The superscripts [1] ([2]) at the left panel of the table mark those cases where a sign-test rejects the equality of the experiment 1 (2) statistics to the statistic calculated assuming the benchmark model. For example, the superscripts 1 and 2 for CE6 in the TK92 column (the 2.2[1,2] at the TK92 column of the "benchmark estimations" panel) show that the hypothesis CE6=2.2 is rejected at $p<0.05$ for experiment 1 (N=73) and for experiment 2 (N=61). To highlight the difference in results, we shade the boxes where the benchmark model is rejected. Dark shading is used when the benchmark estimate is rejected in both experiments and light shading is used when the benchmark estimate is rejected in one of the two models.