DEUTSCHE BÖRSE
MARKET DATA

Index-based longevity risk transfer to capital markets

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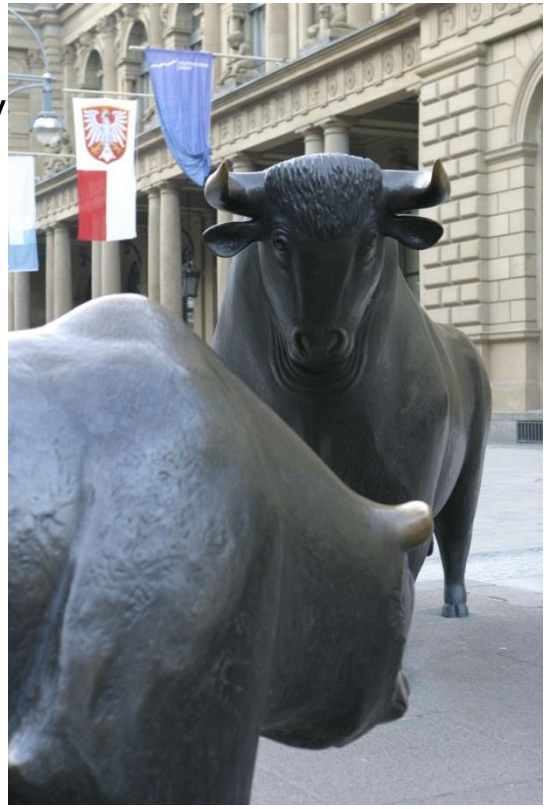
Agenda

1. Deutsche Börse AG Longevity Index Business
2. Population Longevity Indices
3. Sociodemographic Longevity Indices
4. Longevity Forward Curves
5. Longevity Products

Deutsche Börse & Longevity – How does it match?

Expertise in making risk transparent and trade-able

- **Xpect®** started in 2007
- Provide underlyings (indices) as prerequisite for trade-ability
- Establish longevity as a new asset class
- Create investment vehicle used for long-term durations
- Commit to basic index principles such as:
  - **Transparency:** market-proven models, historical data
  - **Robustness:** accuracy in procedures and processes
  - **Objectivity:** independent calculation, no moral hazard
  - **Reliability:** ongoing long-term index production



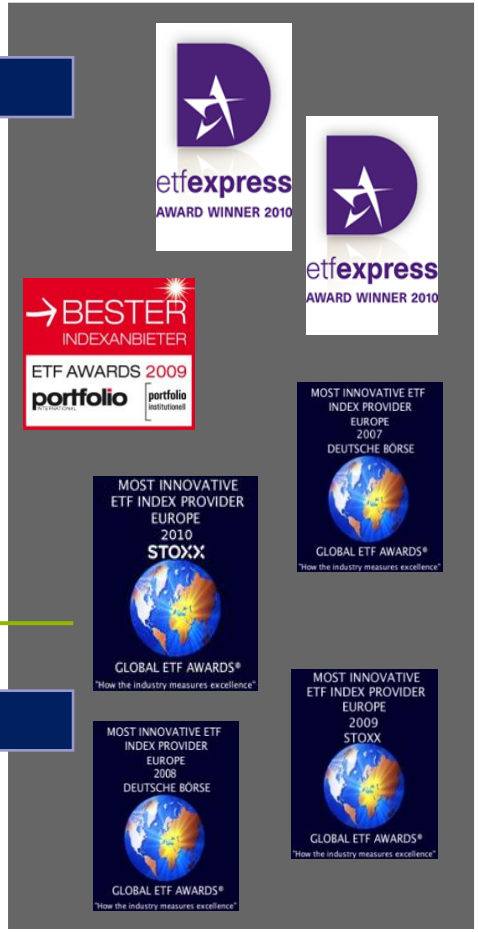
STOXX
A proven innovator in the last decade and the future

Innovation in indexing

- First index provider using free-float market cap weighting throughout its index family
- First index provider offering an optimized investability (by considering borrowing availability) for both sector & country indices
- Offering access to direct dividend investments ("dividend point indices")
- Leading provider of European volatility concepts

Innovative financial products

- First pan-European equity, size, and sector ETFs, and futures and options
- First buy-write ETFs globally, first dividend point, and volatility strategy ETFs



Deutsche Börse offers a wide range of access to regions and various asset classes

DAX index universe – indices of Deutsche Börse AG

German Indices

DAX

Blue chip indices

- DAX
- MDAX
- SDAX
- TecDAX
- Mid Cap Market

Selection indices

- RX REIT/Real Estate
- ökoDAX
- GEX
- Entry Standard Index

All Share indices

- Technology All Share
- Classic All Share
- Prime All Share

Sector indices

- DAXsupersector (9)
- DAXsector (18)
- DAXsubsector (64)
- DAXall

Strategy indices

DAXplus

Investment strategies

- DivDAX
- DAXplus Seasonal Strategy
- DAXplus Export Strategy
- DAXplus Max. Dividend
- DAXplus Risk Trigger
- Dividend Point Indices
- DAXplus Family

Markowitz indices

For GER, CH, F, US, JAP

- DAXplus Minimum Variance Indices
- DAXplus Maximum Sharpe Ratio Indices

Derivative Strategy Indices

- ShortDAX (1x, 2x, 4x)
- LevDAX (2x, 4x)
- DAXplus Covered Call
- DAXplus Protective Put
- Monthly Lev
- Short TecDAX

Global indices

DAXglobal

Country indices

- DBIX India Index
- DAXglobal Russia (2x)
- DAXglobal Vietnam
- DAXglobal China/sect.
- DAXglobal Austria

Regional indices

- DAXglobal Asia/sectors
- DAXglobal Africa
- DAXglobal LatAm
- DAXglobal GCC
- DAXglobal BRIC
- DAXglobal Emerging-11
- DAXglobal Short Indic.

Global Industries

- DAXglobal Alt. Energy
- DAXglobal Nucl. Power
- DAXglobal Agribusiness
- DAXglobal Water
- DAXglobal Sarasin Sustainability (D, CH)

Alternative indices

CX

Commodity indices

- CX Commodity
- CX Energy
- CX Industrial Metals
- CX Precious Metals
- CX Agriculturals
- CX Livestock

Volatility indices

- VDAX-NEW
- VDAX

Longevity indices

- Xpect® Cohort Indices
- Xpect ® Customised Indices (for DE/NL/UK)

Fixed income ind.

Tradable indices

- eb.rexx Government indices
- eb.rexx Jumbo Pfandbrief indices
- eb.rexx Money Market
- EUROgov Indices

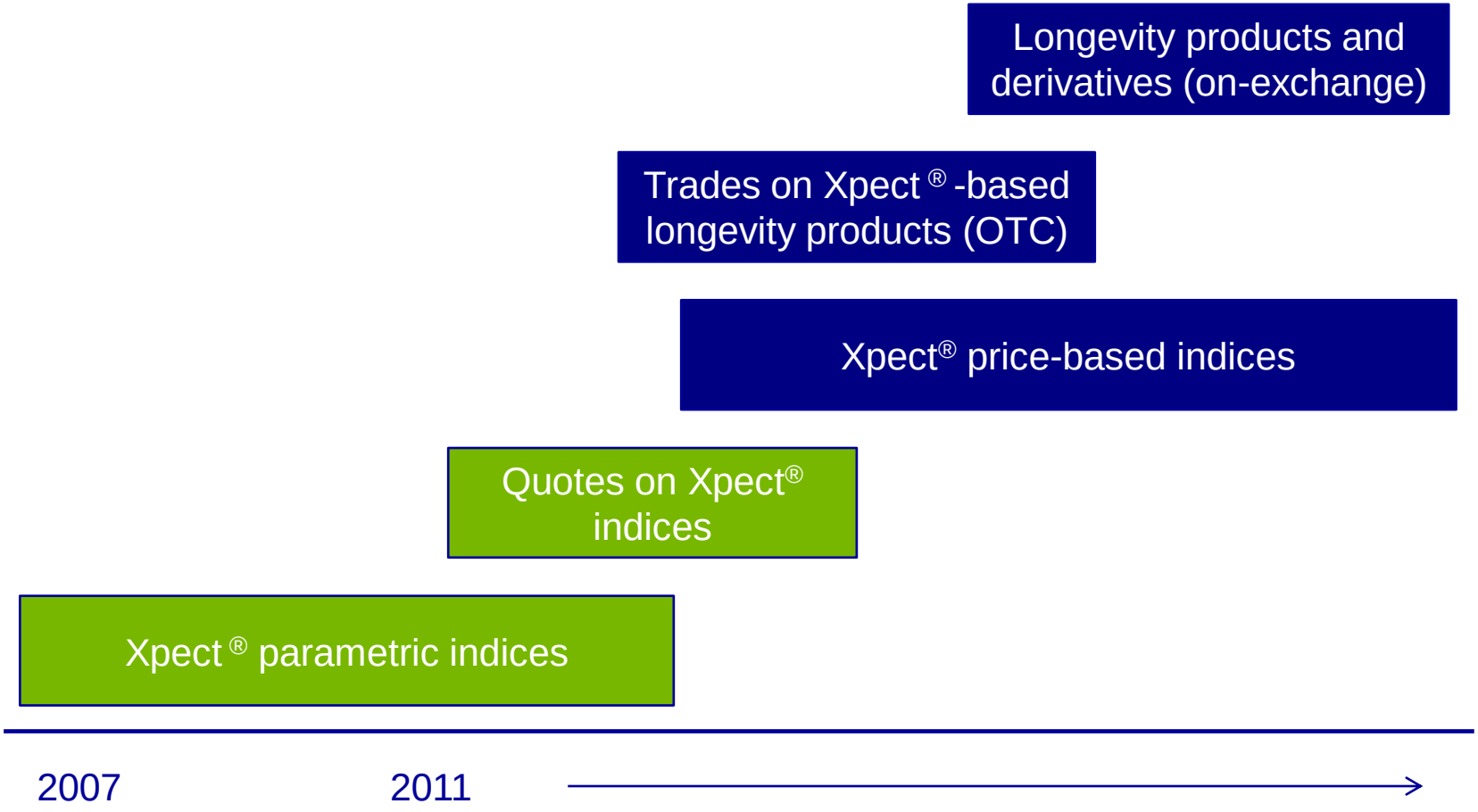
Corporate Bond indices

- RDAX

Synthetic Indices

- REX

Deutsche Börse is on track of it's roadmap to establish longevity as a tradeable asset class



Due to the absence of transparent longevity prices the index to transfer longevity risks was defined as parametric

1. **Indices (parametric)**
   - **Amount of survivors represents and monitor longevity trends**
     ►monthly update also to cover collateral requirements
   - **A cohort view is closest to longevity liabilities**
     ► because actuaries have also adapted their longevity assessment from period to cohort view
   - **Must be standardised and easy to be tradable**
     ► one figure per index !
2. **Forward Curves (parametric)**
   - Simulated future index run based on mortality projections
   - Provide indicative prices for longevity products

There are different longevity index concepts Xpect® covers all of them to support a longevity market

Population-based Longevity index

- Xpect® Population

Subgroup Longevity index

- Xpect® ClubVita

Portfolio Longevity index

- Xpect® Custom

- basis risk
- Liquidity on index trading

- Portfolio coverage

Xpect® Generation Life Tables deliver longevity risk parameter

realised

modeled

Country: DE	Reporting y: 2011	Reporting m: Apr	Gender: M	Cohort: 1980	
x	qx	px	lx	dx	ex
0	0.01415	0.98585	100000	1415	84.47
1	0.00090	0.99910	98585	89	84.67
2	0.00052	0.99948	98496	51	83.75
3	0.00042	0.99958	98445	41	82.79
29	0.00064	0.99936	97245	62	57.62
30	0.00076	0.99924	97183	74	56.65
31	**0.00066**	0.99934	**97108**	64	55.70
32	0.00067	0.99933	97045	65	54.73
33	0.00064	0.99936	96980	63	53.77
90	0.05909	0.94091	49661	2935	6.00
91	0.08866	0.91134	46726	4143	5.34
92	0.12355	0.87645	42584	5261	4.82
93	0.14053	0.85947	37323	5245	4.42
94	0.17059	0.82941	32078	5472	4.07
95	0.16024	0.83976	26605	4263	3.80
96	0.18334	0.81666	22342	4096	3.43
97	0.20933	0.79067	18246	3819	3.09
98	0.23844	0.76156	14427	3440	2.77
99	0.27086	0.72914	10987	2976	2.48
100	0.30674	0.69326	8011	2457	2.22
101	0.34614	0.65386	5554	1922	1.98
102	0.38904	0.61096	3631	1413	1.77
103	0.43528	0.56472	2219	966	1.57
104	0.48453	0.51547	1253	607	1.40
105	0.53630	0.46370	646	346	1.25
106	0.58987	0.41013	299	177	1.11
107	0.64429	0.35571	123	79	1.00
108	0.69842	0.30158	44	31	0.89
109	0.75097	0.24903	13	10	0.81
110	0.80055	0.19945	3	3	0.73
111	0.84583	0.15417	1	1	0.67

Legend

x : age

q_x : mortality rate

p_x : survivor rate

l_x : sum of survivors

d_x : number of deceased

e_x : rest life expectancy

Source: Deutsche Börse AG Xpect Generation Life Table

Xpect® Cohort Indices for E&W, NL and DE are published monthly since 2008

www.xpect-index.com

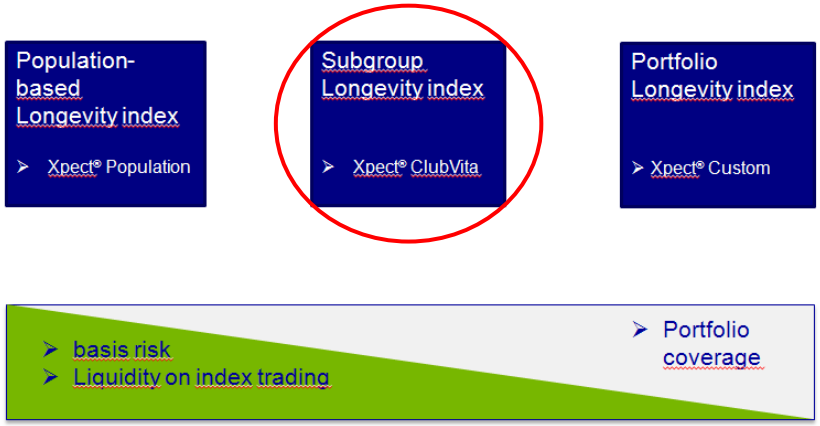
GERMANY | NETHERLANDS | ENGLAND & WALES

Index Overview

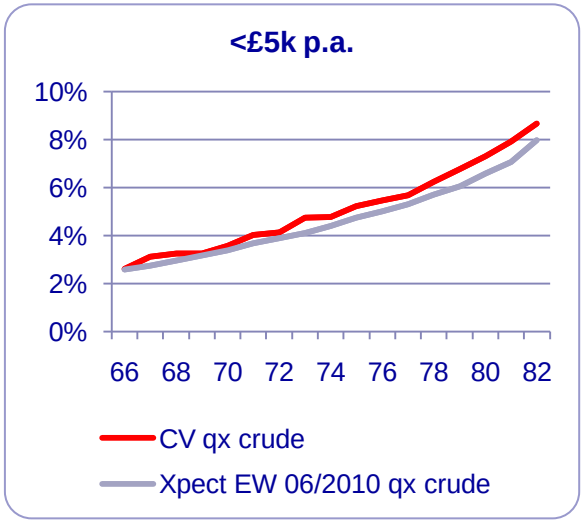
Name	ISIN	To Previous Month	Current Index Value
XPECT EW COHORT 1935 - 1939 M	DE000A1EZMW4	-0.195%	65.087
XPECT EW COHORT 1940 - 1944 M	DE000A1EZMX2	-0.121%	75.342
XPECT EW COHORT 1945 - 1949 M	DE000A1EZMY0	-0.075%	83.628
XPECT EW COHORT 1950 - 1954 M	DE000A1EZMZ7	-0.048%	88.346
XPECT EW COHORT 1935 - 1939 F	DE000A1EZM04	-0.125%	75.443
XPECT EW COHORT 1940 - 1944 F	DE000A1EZM12	-0.076%	82.854
XPECT EW COHORT 1945 - 1949 F	DE000A1EZM20	-0.047%	88.560
XPECT EW COHORT 1950 - 1954 F	DE000A1EZM38	-0.031%	92.119

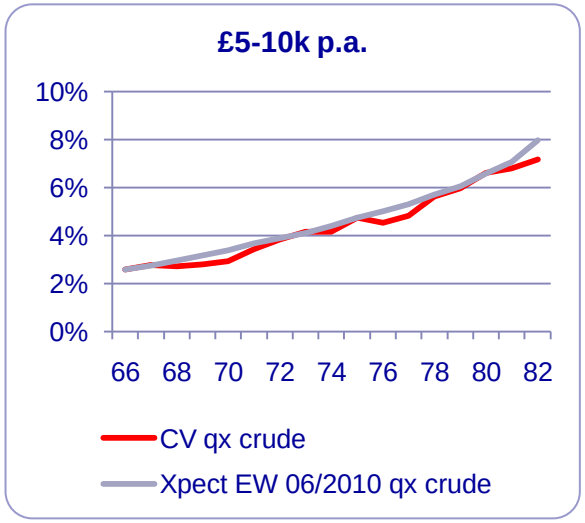
Xpect® ClubVita Indices cover sociodemographic mortality

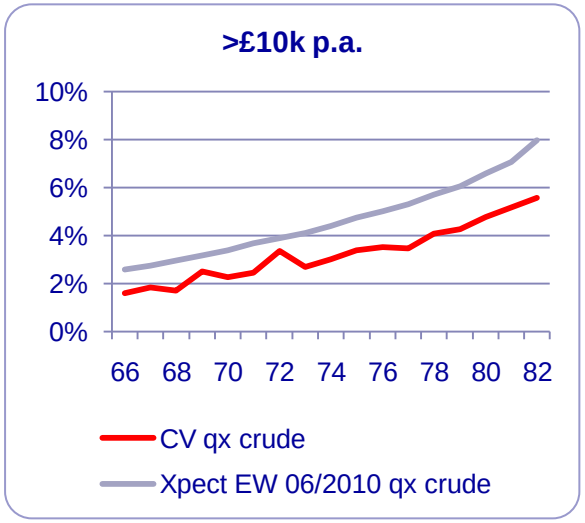
- Based on effective mortality rates from Club Vita database (> 100 UK pension schemes)
- Three pre-defined sociodemographic groups :
  - Pension <£5k p.a.
  - Pension £5k-10k p.a.
  - Pension >£10k p.a.
- Index metric is survivor rate
- Index calculated monthly based on monthly Xpect EW data and Club Vita mortality rates



Analysis on crude q_x show differences in mortality rates related to amount of pension versus population

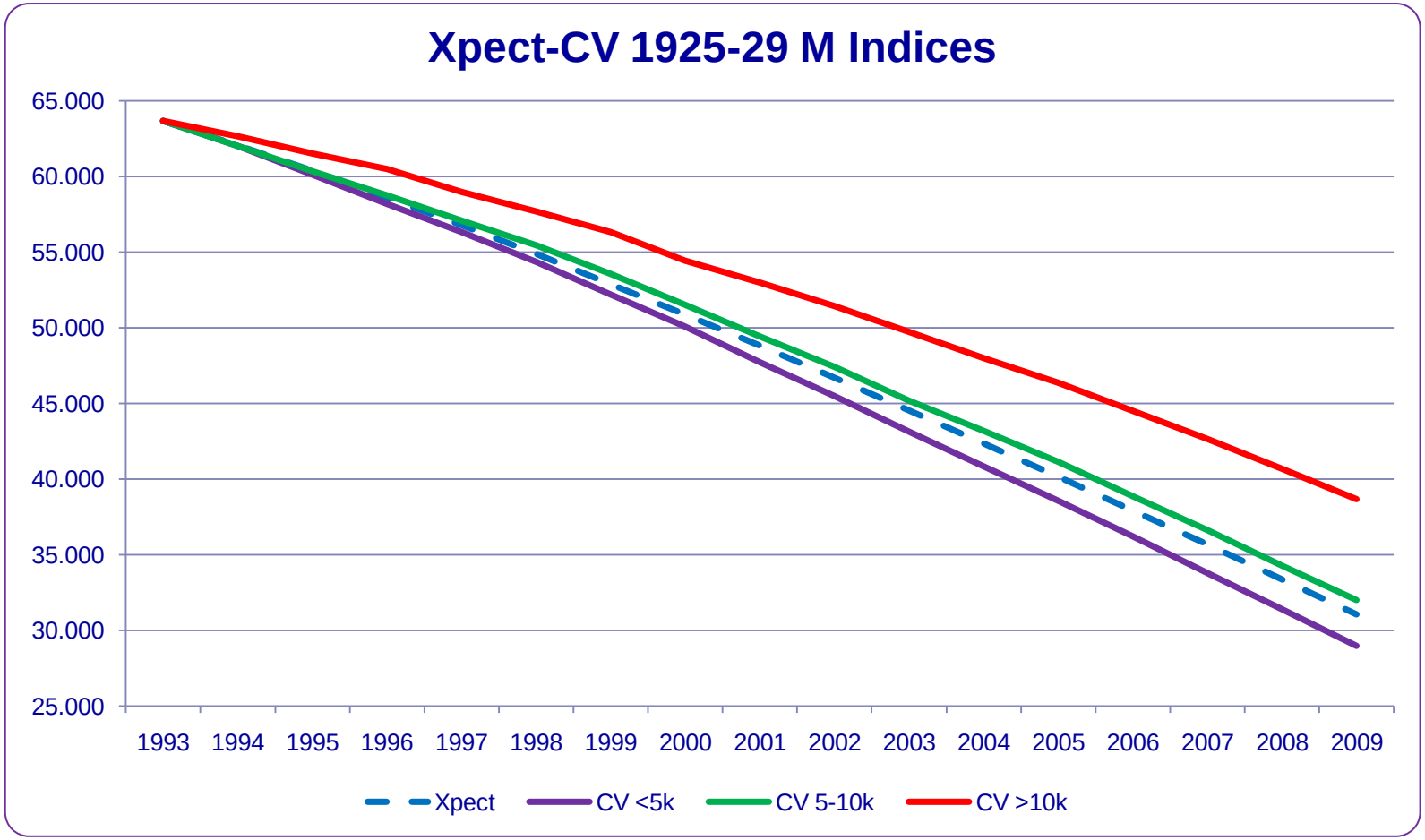






- Sociodemographic indices reduce the basis risk of an index-based longevity risk transaction
- provide basis risk assessment as delta between population and sociodemographic indices

Xpect®-ClubVita Index metric is survivor rate, for each 5-year cohort, per defined sociodemographic groups



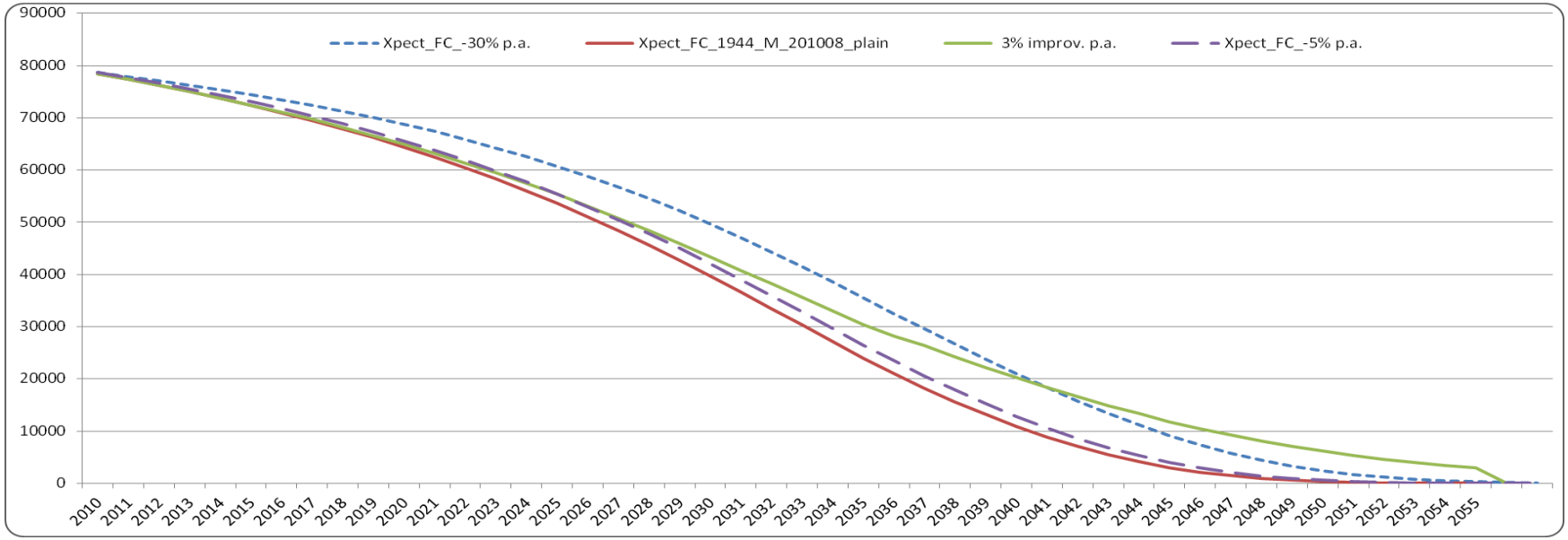
Different mortality projection models deliver different future Xpect® Index runs as Xpect® Forward Curves

Forward Curve projections are based on future mortality rate assesments:

I. Lee-Carter (or CBD) modelled future q_x values could be shifted by x% improvement rates: Xpect

II. yearly age-related future q_x improvement rates

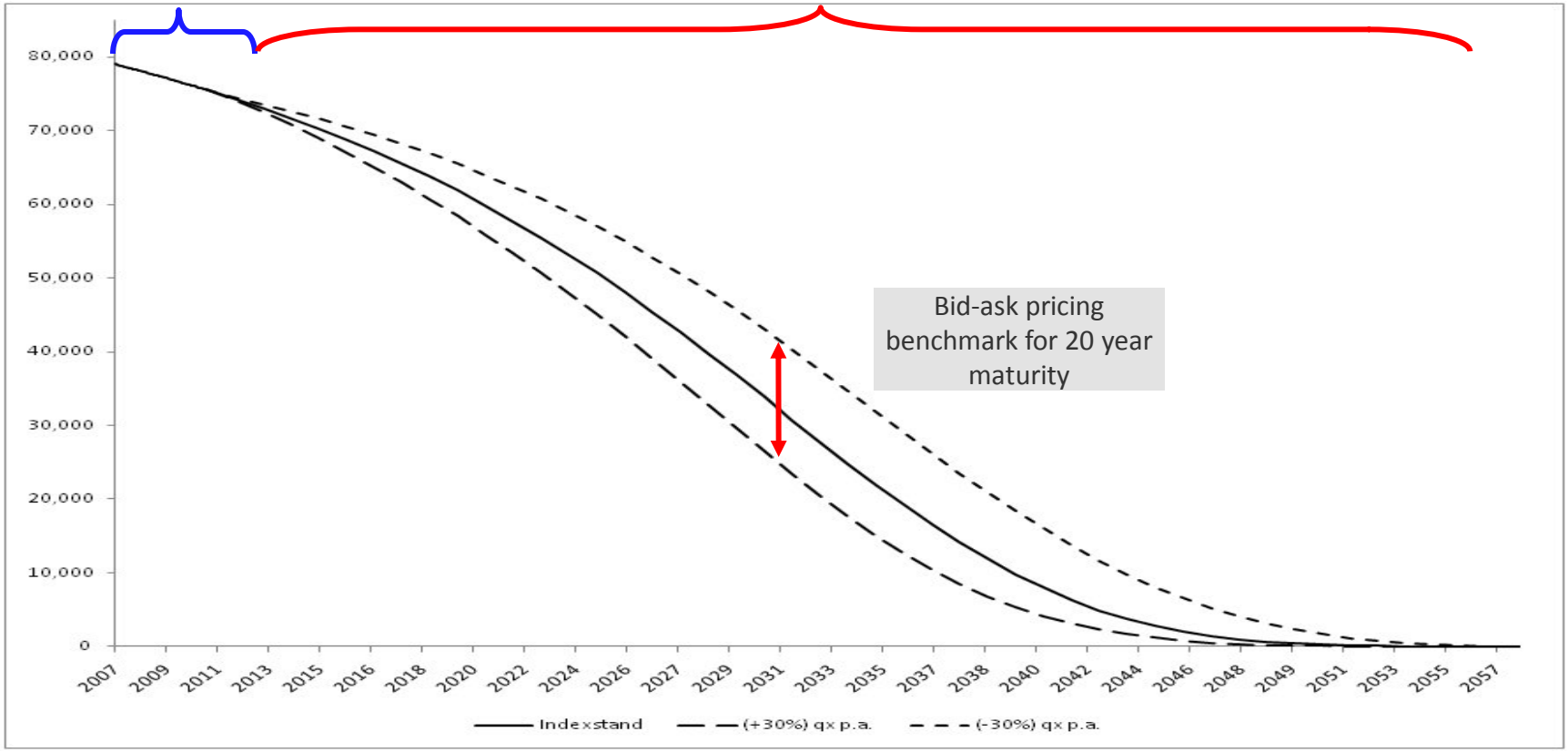
III. Other future q_x rates assessment techniques



As Xpect® Indices cover effective mortality rates Xpect® Forward Curves provide indicative longevity prices

Indices cover historic & actual mortality

Forward Curves cover future mortality assumptions



Source: Deutsche Börse Xpect, England & Wales, Cohort 1935-1939, Male.

Trading longevity on Xpect®-based products is provided by TullettPrebon

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England & Wales

Male	XPECT EW COHORT 1935 - 1939 M DE000A1EZMW4		XPECT EW COHORT 1940 - 1944 M DE000A1EZMX2		XPECT EW COHORT 1945 - 1949 M DE000A1EZMY0		XPECT EW COHORT 1950 - 1954 M DE000A1EZMZ7	
	Bid	Ask	Bid	Ask	Bid	Ask	Bid	Ask
1Y	-2.98	-2.14	-1.85	-1.33	-1.14	-0.82	-0.73	-0.53
2Y	-3.35	-2.07	-2.05	-1.27	-1.26	-0.78	-0.79	-0.49
5Y	-4.01	-2.27	-2.39	-1.36	-1.45	-0.82	-0.89	-0.51
10Y	-5.15	-2.83	-3.01	-1.66	-1.79	-0.98	-1.08	-0.60
20Y	-8.88	-4.83	-5.18	-2.82	-2.96	-1.61	-1.71	-0.93
30Y	-14.5	-8.14	-9.42	-5.13	-5.64	-3.05	-3.18	-1.72

Female	XPECT EW COHORT 1935 - 1939 F DE000A1EZM04		XPECT EW COHORT 1940 - 1944 F DE000A1EZM12		XPECT EW COHORT 1945 - 1949 F DE000A1EZM20		XPECT EW COHORT 1950 - 1954 F DE000A1EZM38	
	Bid	Ask	Bid	Ask	Bid	Ask	Bid	Ask
1Y	-1.92	-1.38	-1.16	-0.84	-0.74	-0.53	-0.48	-0.34
2Y	-2.19	-1.35	-1.30	-0.81	-0.81	-0.50	-0.52	-0.32
5Y	-2.70	-1.52	-1.56	-0.88	-0.95	-0.54	-0.59	-0.33
10Y	-3.62	-1.99	-2.05	-1.13	-1.20	-0.66	-0.72	-0.40
20Y	-6.91	-3.75	-3.85	-2.09	-2.15	-1.17	-1.22	-0.66
30Y	-12.7	-7.15	-7.80	-4.25	-4.49	-2.42	-2.45	-1.32

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- **Bloomberg**
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Thank you for your attention !

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Xpect®-based longevity swaps are already available

Xpect-based Zero Coupon Swap

- **A** buys the swap
- ***At maturity*** A pays:
  *Notional * [((1+Fixed Rate)^t)-1]*
- Fixed Rate is the trading price
- A is exposed to the risk of people dying younger
  -> A is long longevity

- **B** sells the swap
- ***At maturity*** B pays:
  *Notional * [Index$_t$ / Index$_{t=0}$)-1]*
- B is exposed to the risk of people living longer
  -> B is short longevity

Xpect-based Year on Year Swap

- **A** buys the swap
- ***Each year*** A pays:
  *Notional * Fixed Rate*
- Fixed Rate is the trading price
- A is exposed to the risk of people dying younger
  -> A is long longevity

- **B** sells the swap
- ***Each year*** B pays:
  *Notional * [(Index$_n$ / Index$_{n-1}$)-1]*
- B is exposed to the risk of people living longer
  -> B is short longevity