GUY CARPENTER

The Workers Compensation Reserve Cycle:
Navigating the Mysteries, Myths and Misperceptions

Jessica Leong, FCAS, FIAA, MAAA

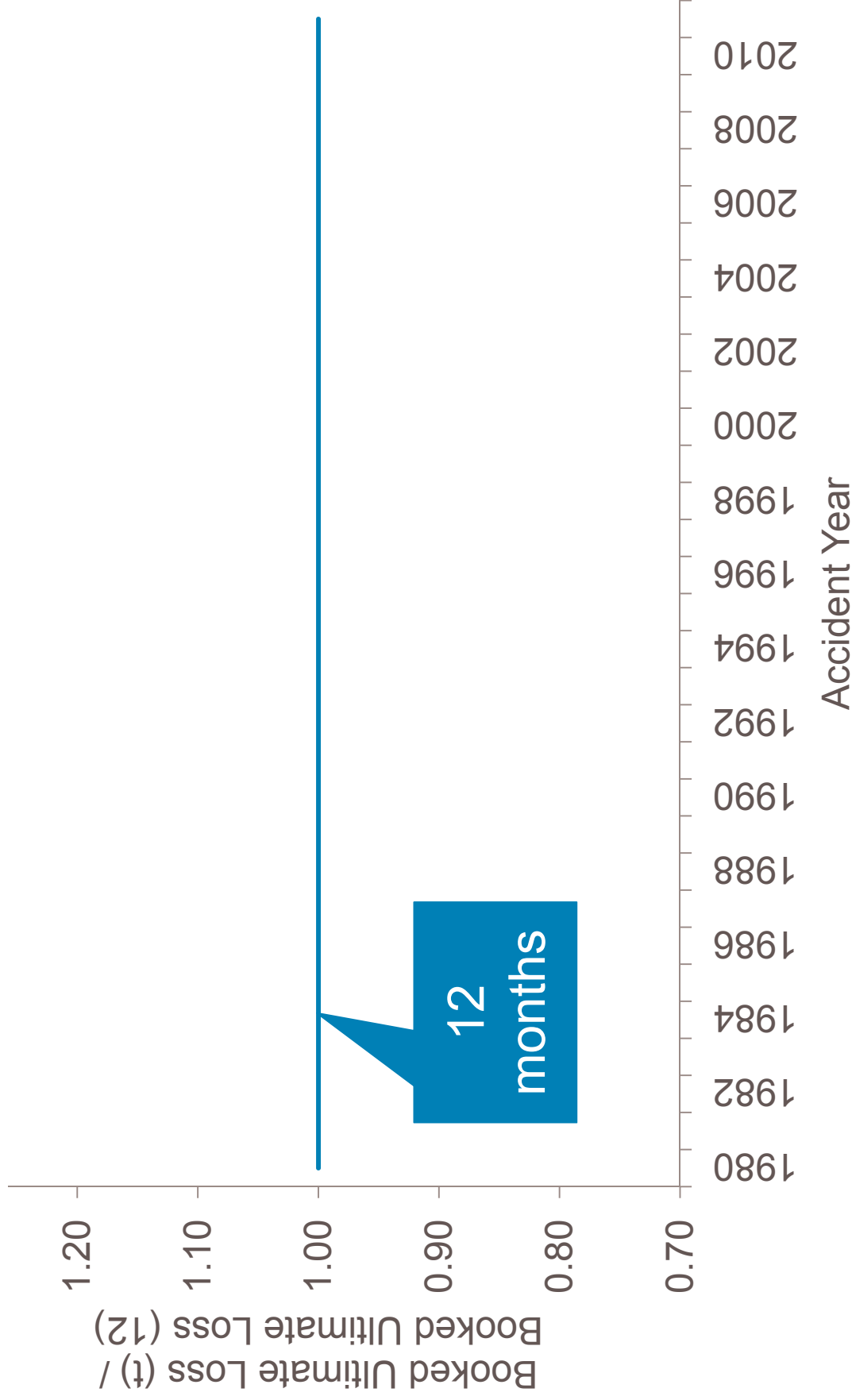Lead Casualty Specialty Actuary

GUY CARPENTER

1. What is the workers compensation cycle?

2. What causes it?

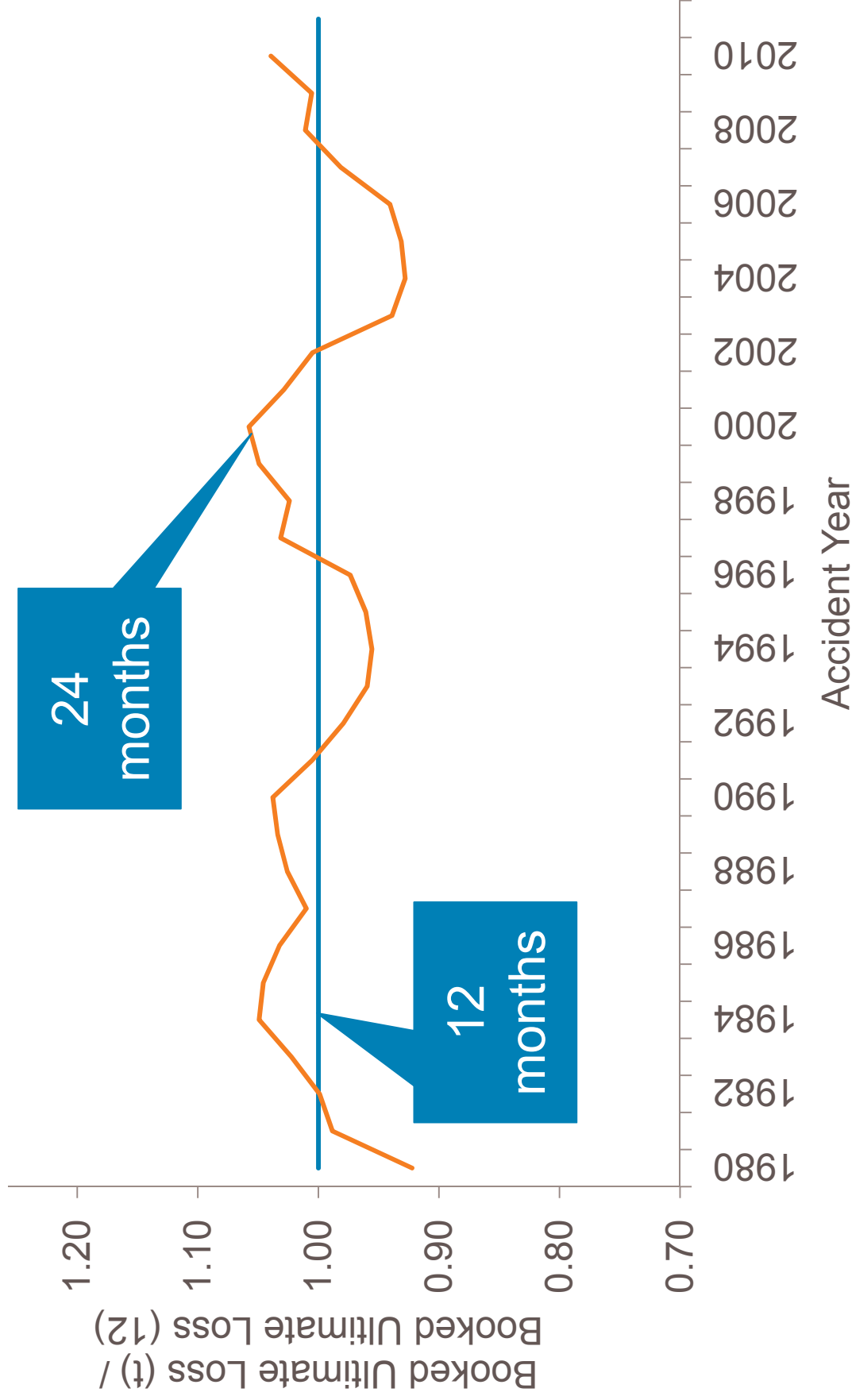3. What can we do about it?

GUY CARPENTER

1. What is the workers compensation cycle?

2. What causes it?

3. What can we do about it?

Workers Compensation Cycle

12 months

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

1.20
1.10
1.00
0.90
0.80
0.70

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

Workers Compensation Cycle

24 months

12 months

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

1.20 1.10 1.00 0.90 0.80 0.70

Workers Compensation Cycle

36 months

Y-axis: Booked Ultimate Loss (t) / Booked Ultimate Loss (12)
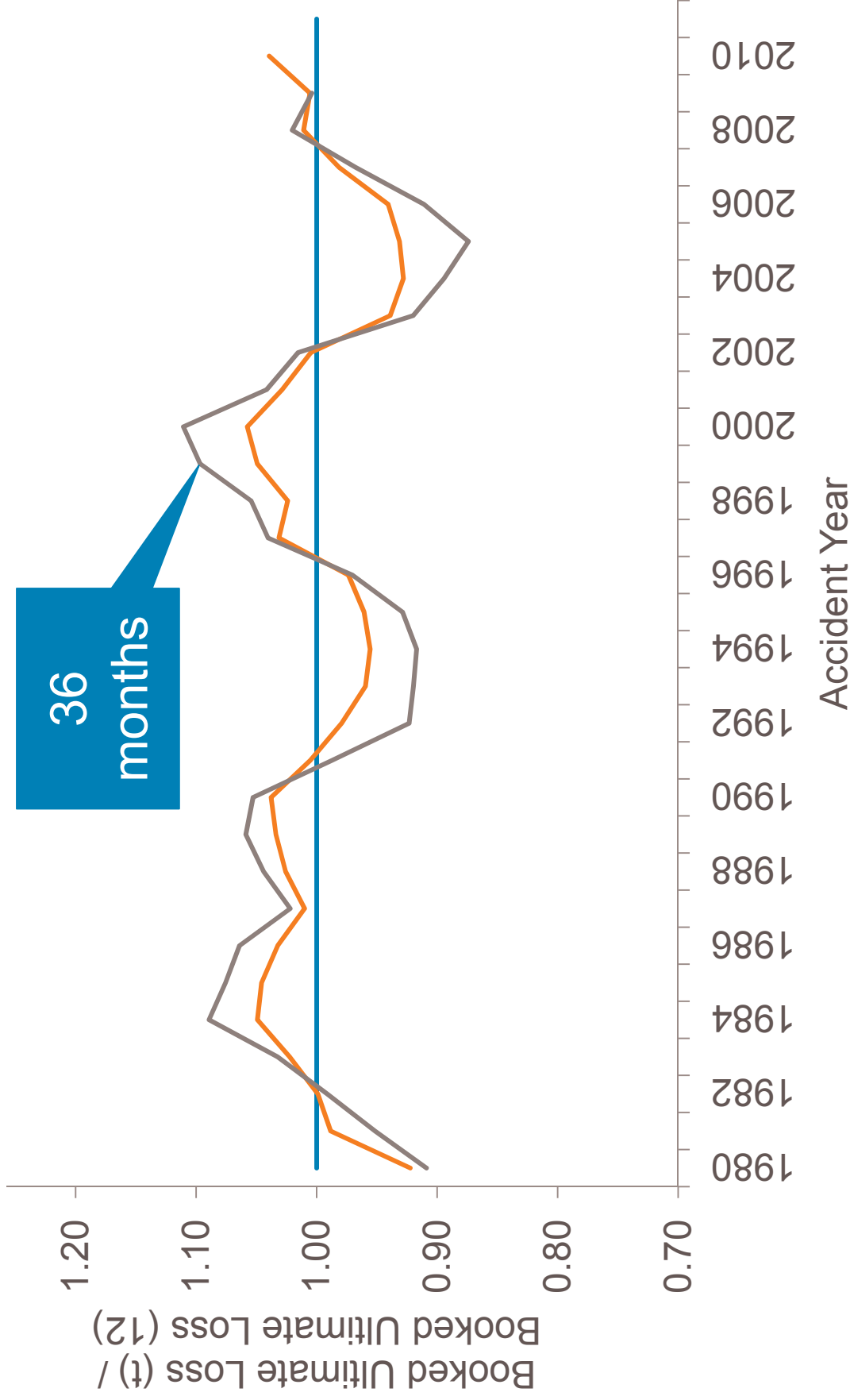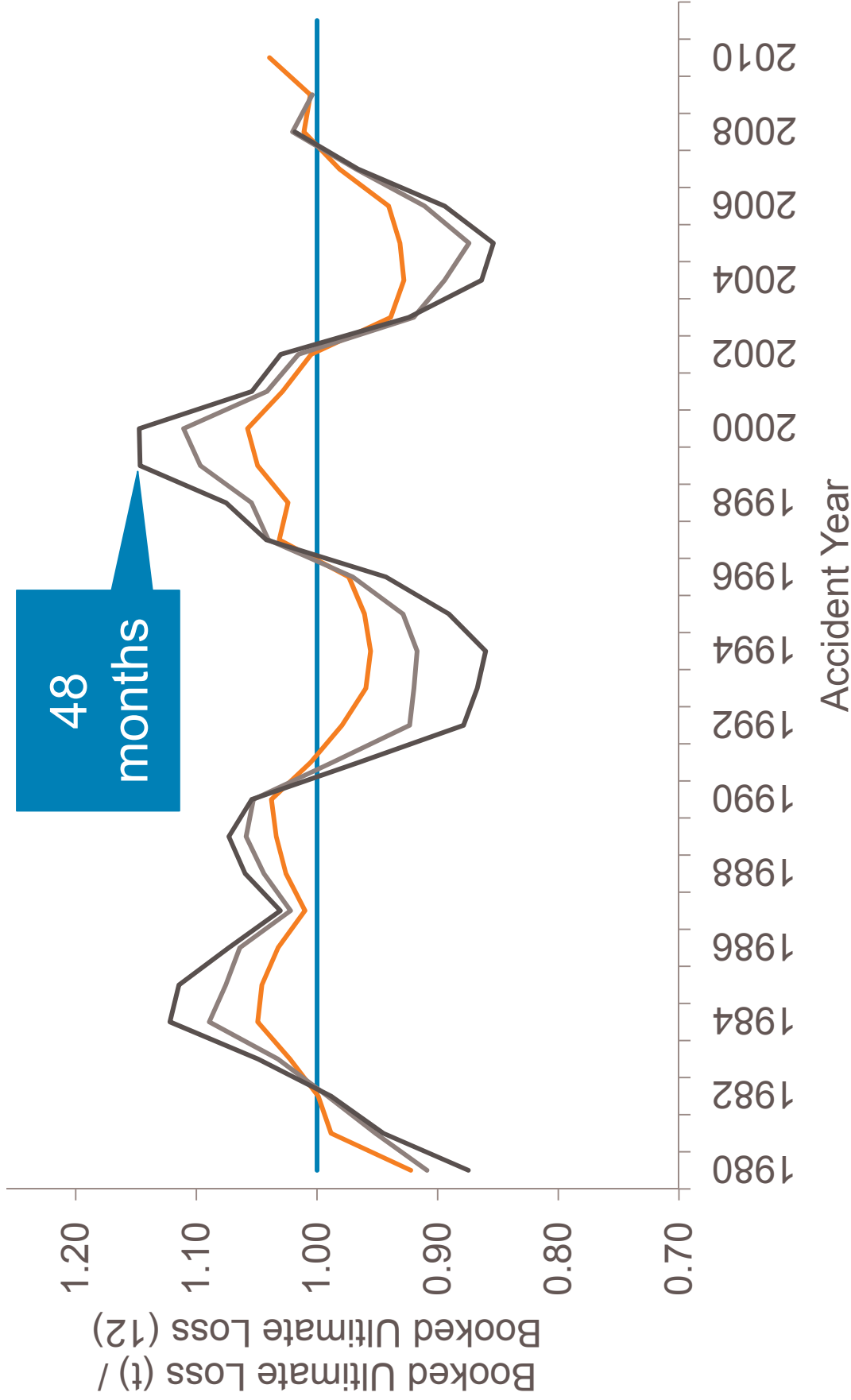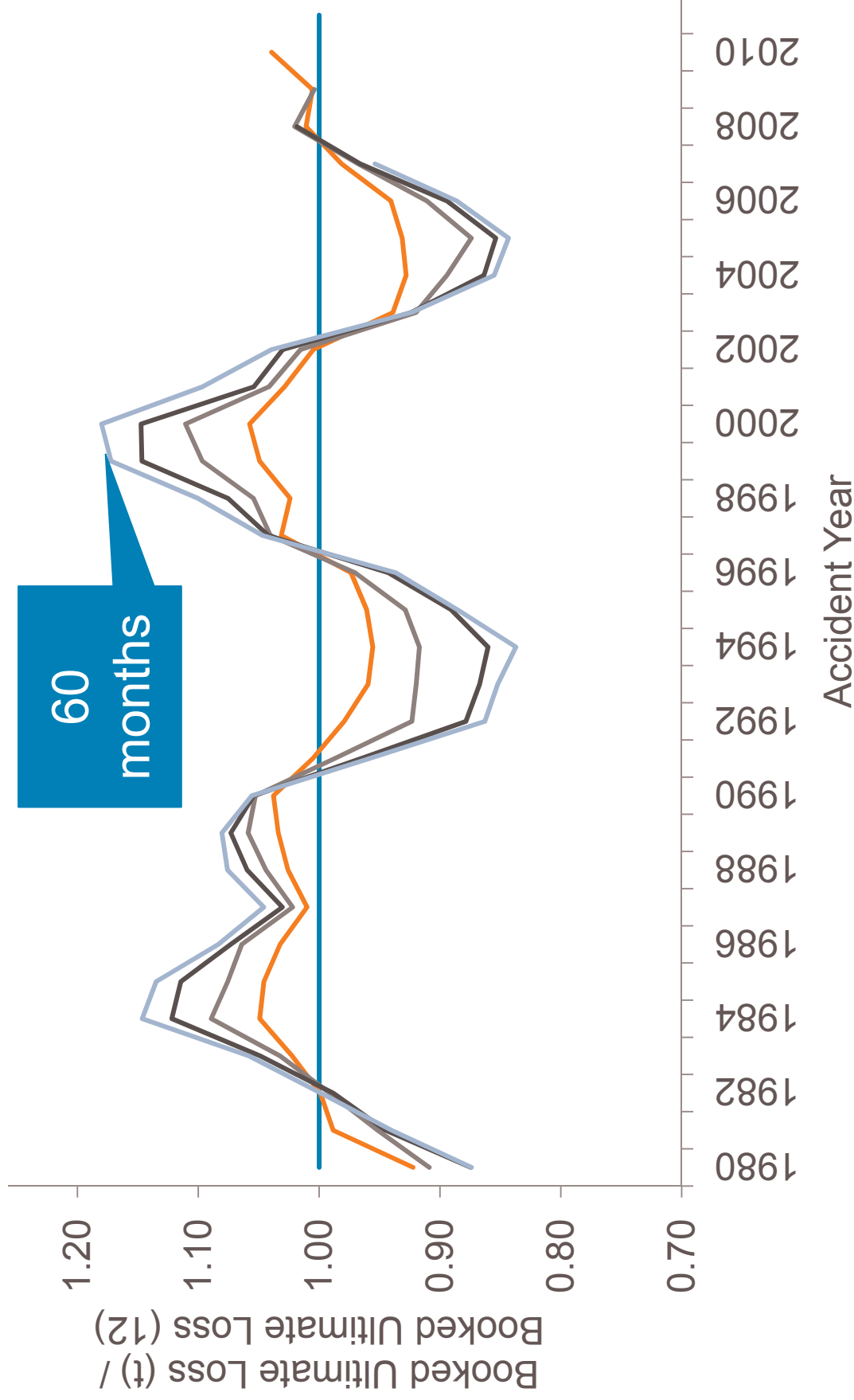
X-axis: Accident Year

Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

Workers Compensation Cycle

48 months

y-axis: Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

1.20 1.10 1.00 0.90 0.80 0.70

x-axis (Accident Year): 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

Workers Compensation Cycle

60 months

Vertical axis: Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Horizontal axis: Accident Year

1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010
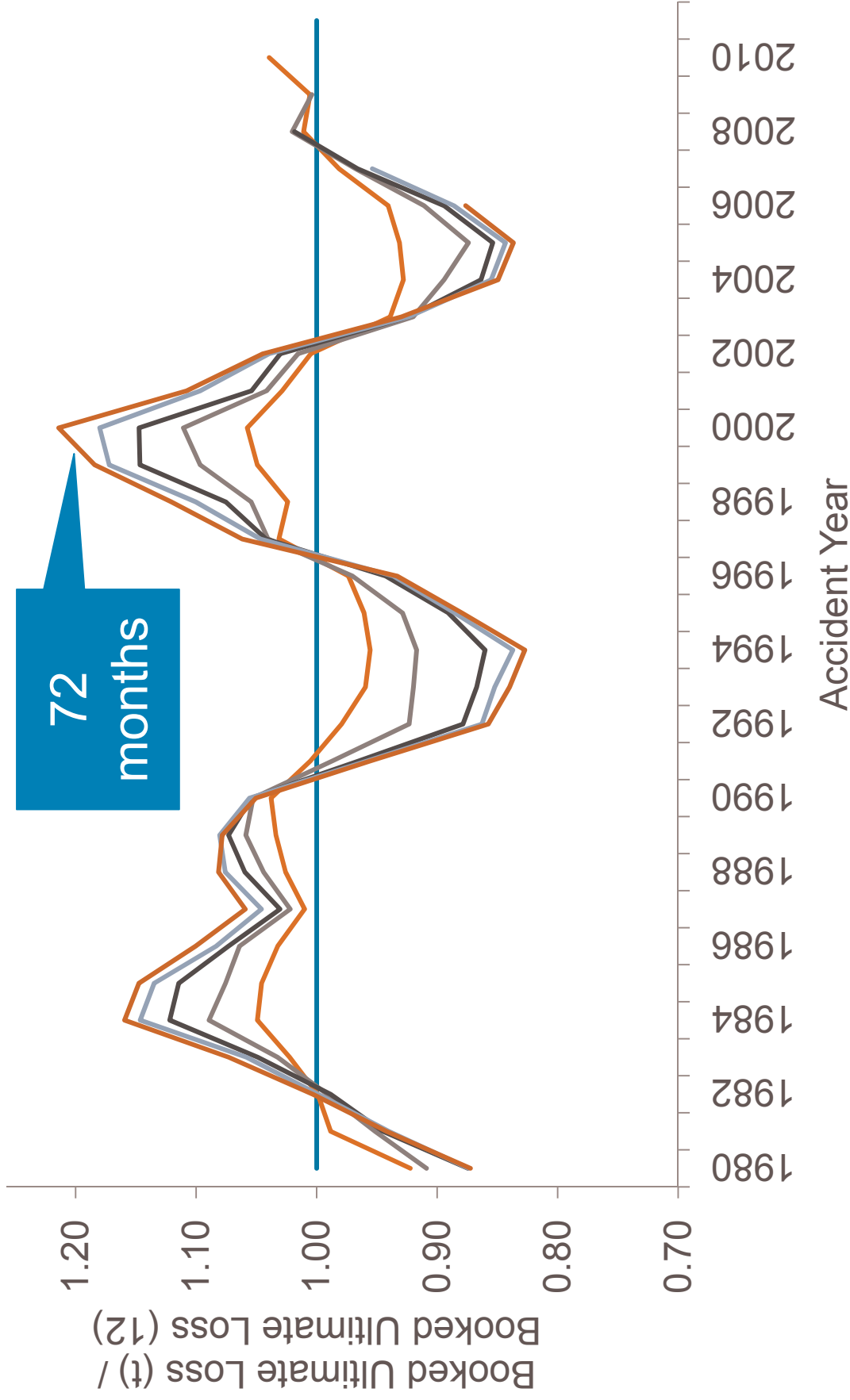
0.70, 0.80, 0.90, 1.00, 1.10, 1.20

Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

Workers Compensation Cycle

72 months

Booked Ultimate Loss (t) /
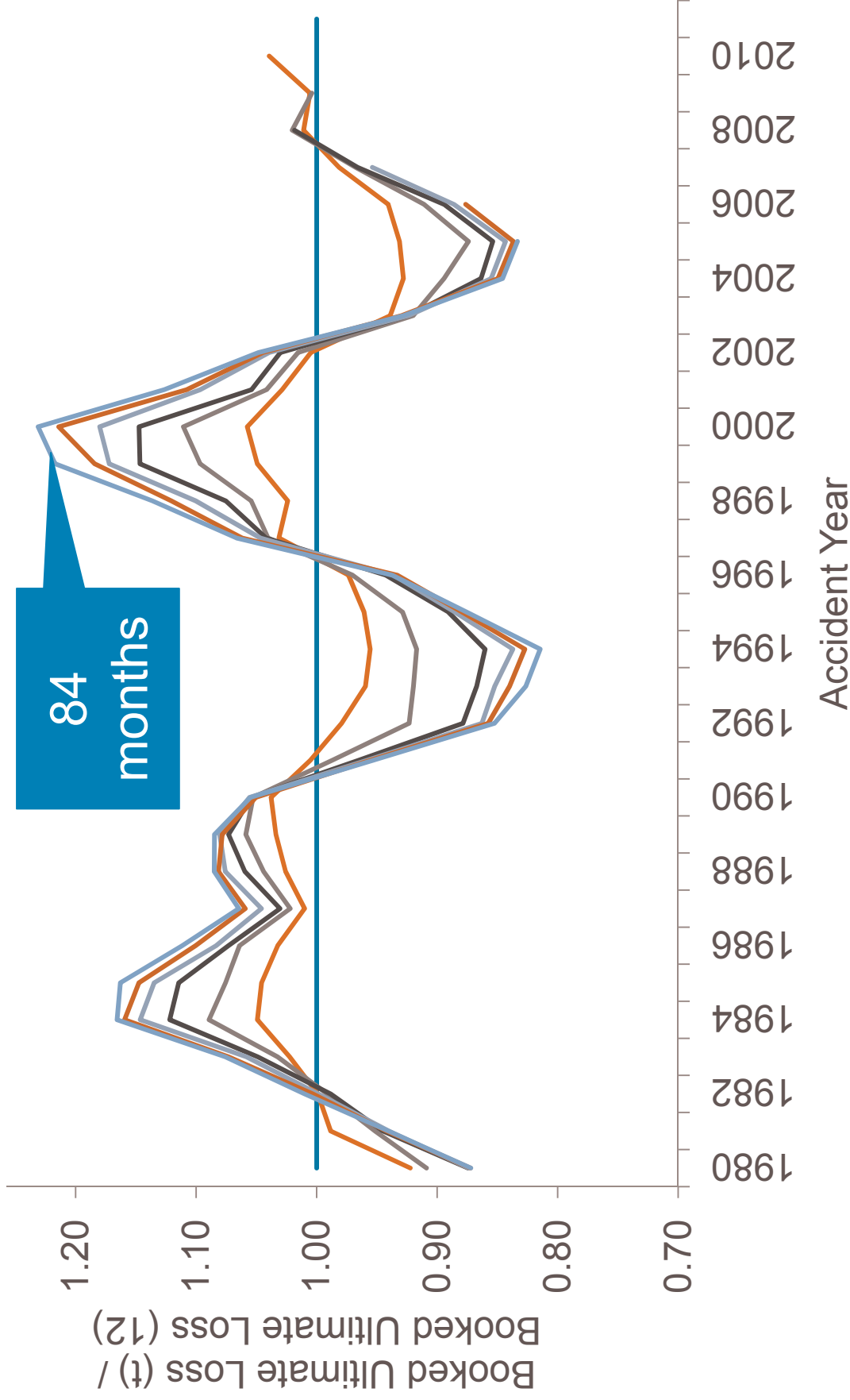Booked Ultimate Loss (12)

Accident Year

Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

Workers Compensation Cycle

84 months

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010
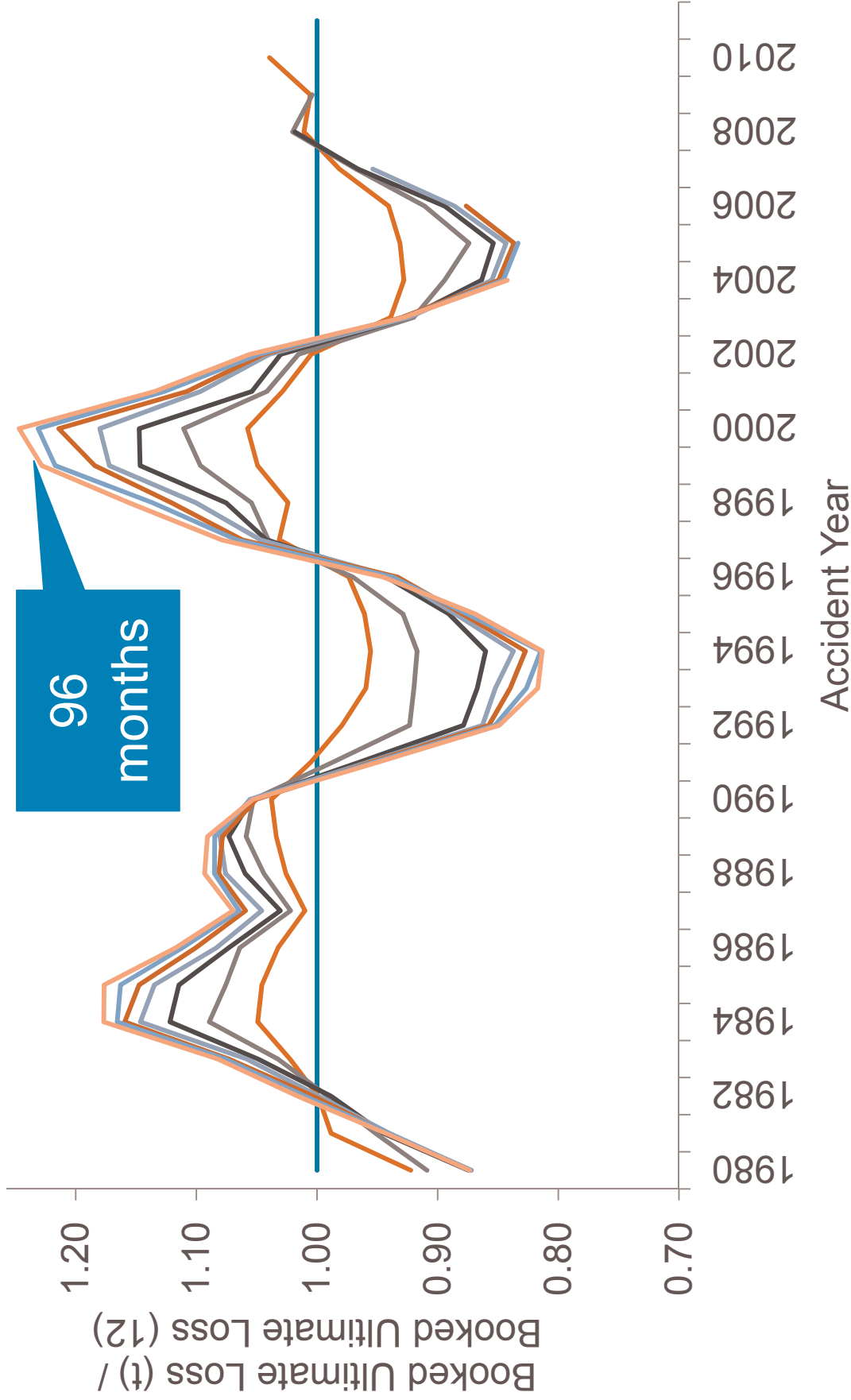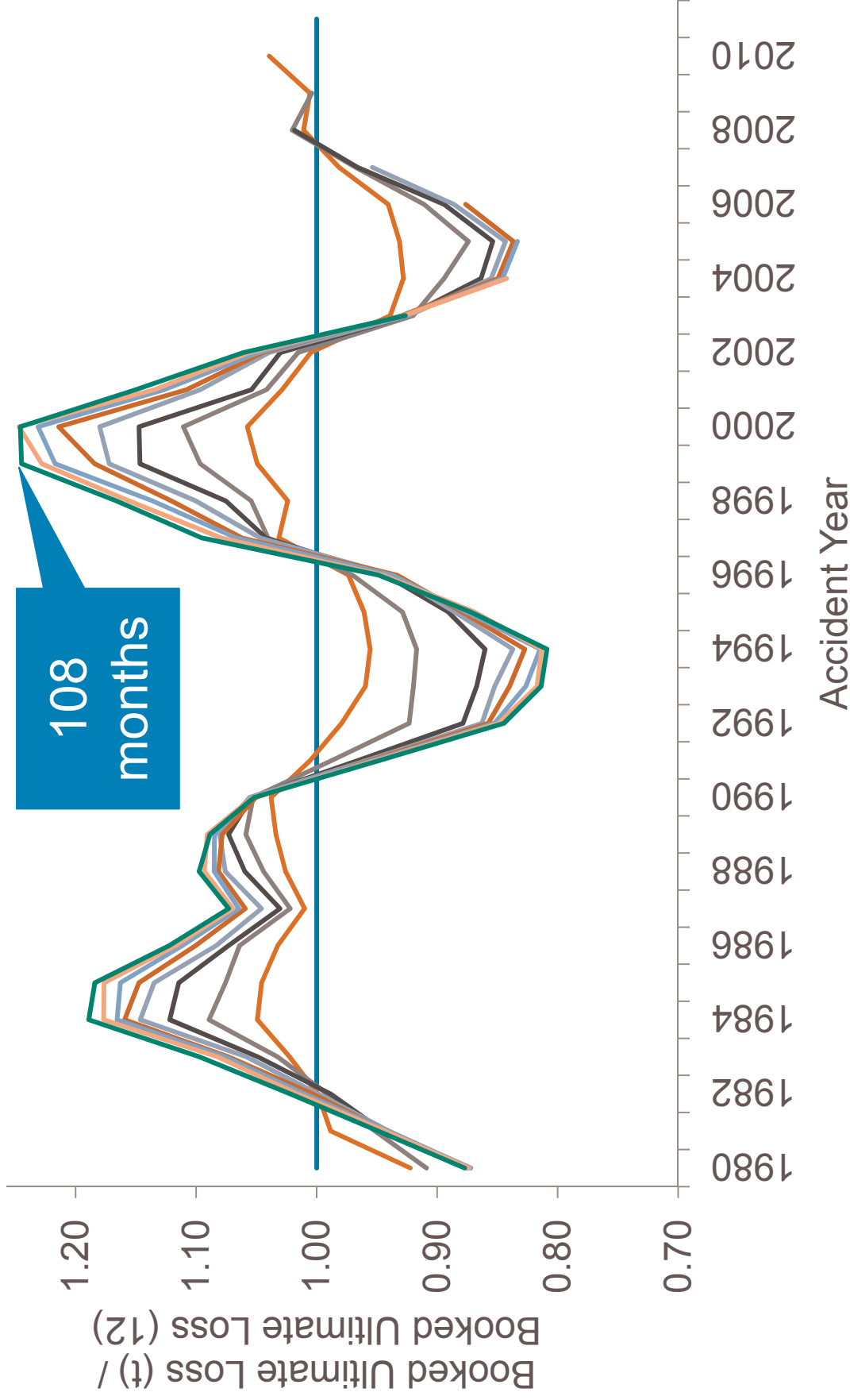
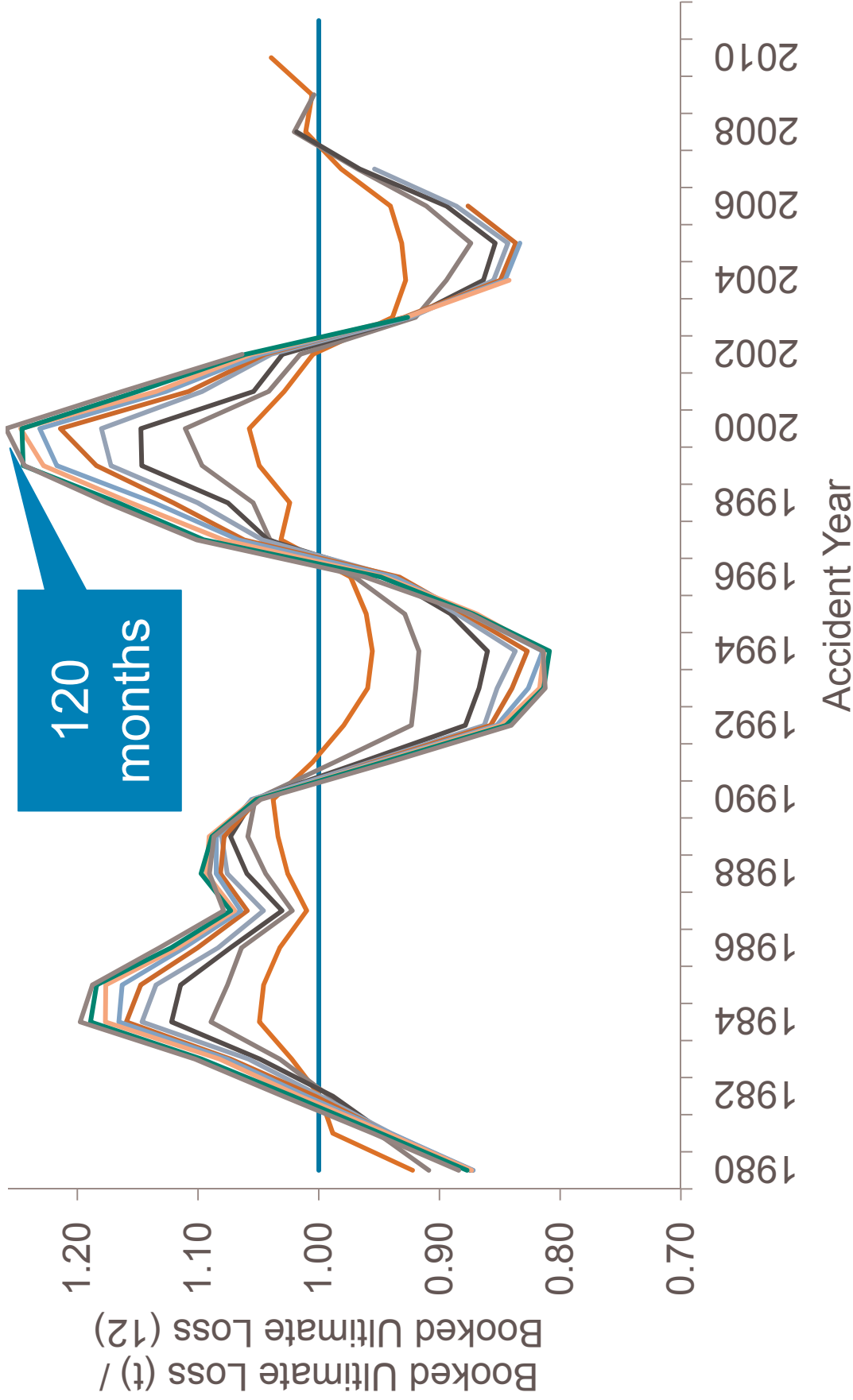0.70 0.80 0.90 1.00 1.10 1.20

Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

Workers Compensation Cycle

96 months

Accident Year

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

0.70 0.80 0.90 1.00 1.10 1.20

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

Workers Compensation Cycle

108 months

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

1.20 1.10 1.00 0.90 0.80 0.70

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

Workers Compensation Cycle

120 months

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010
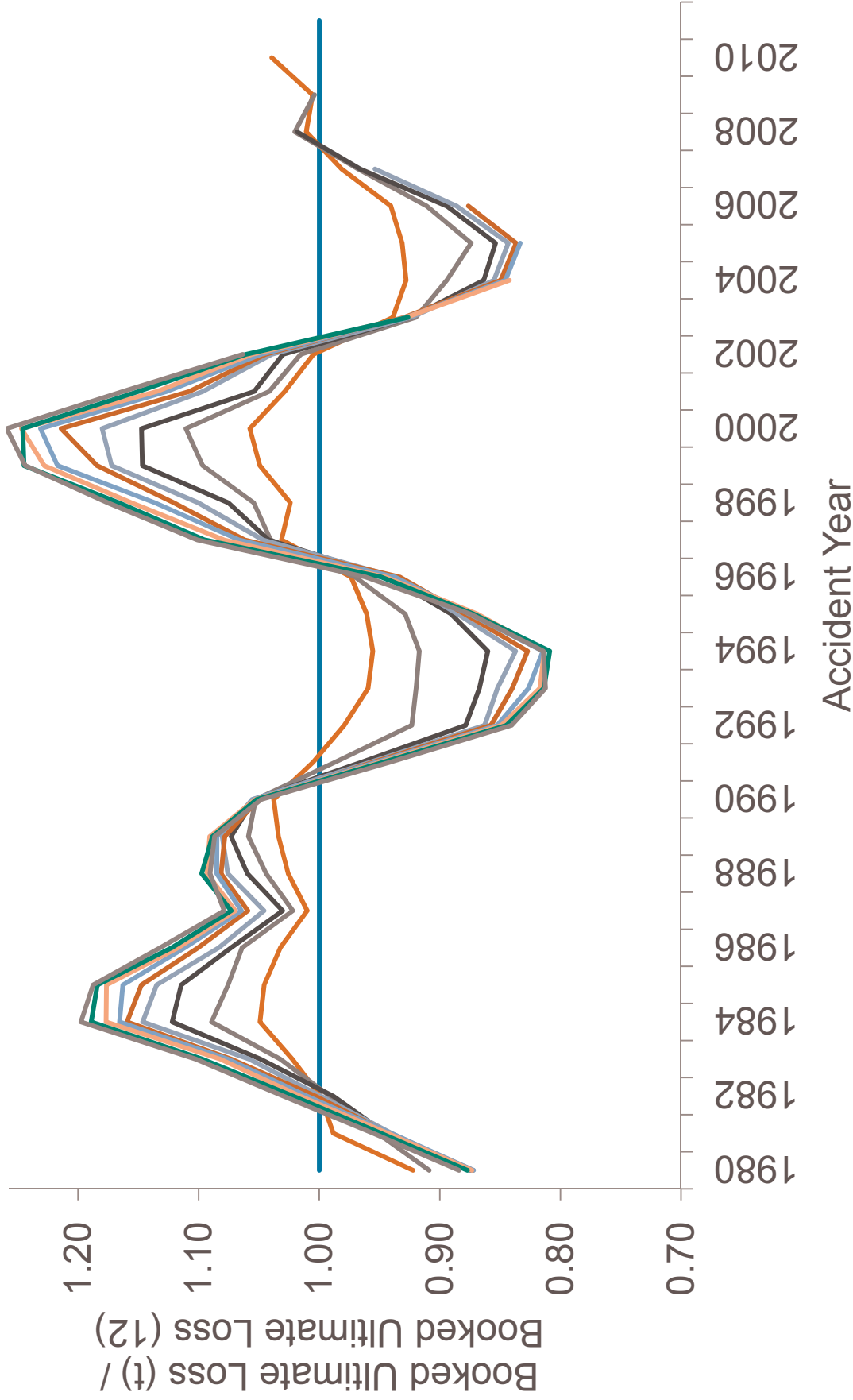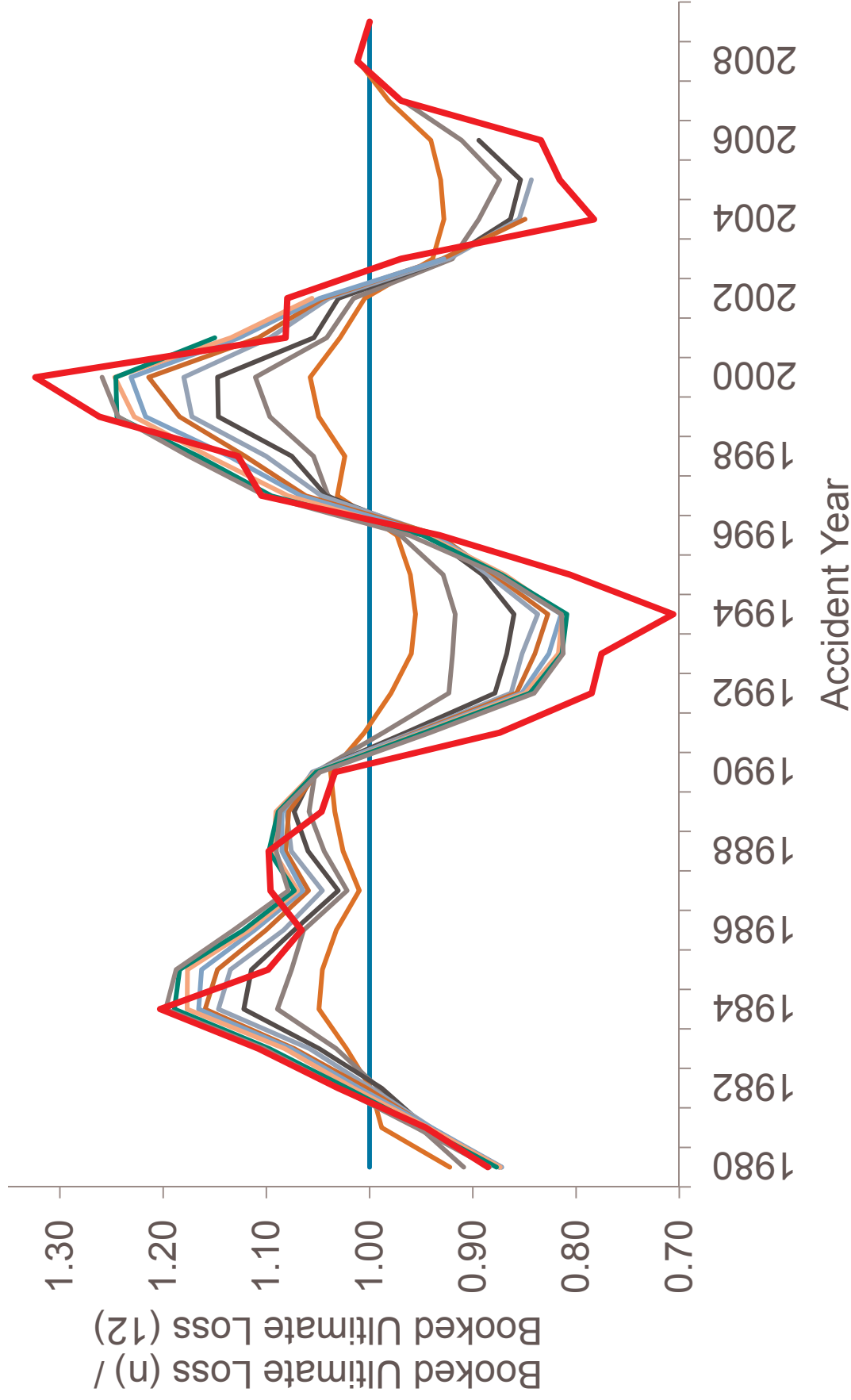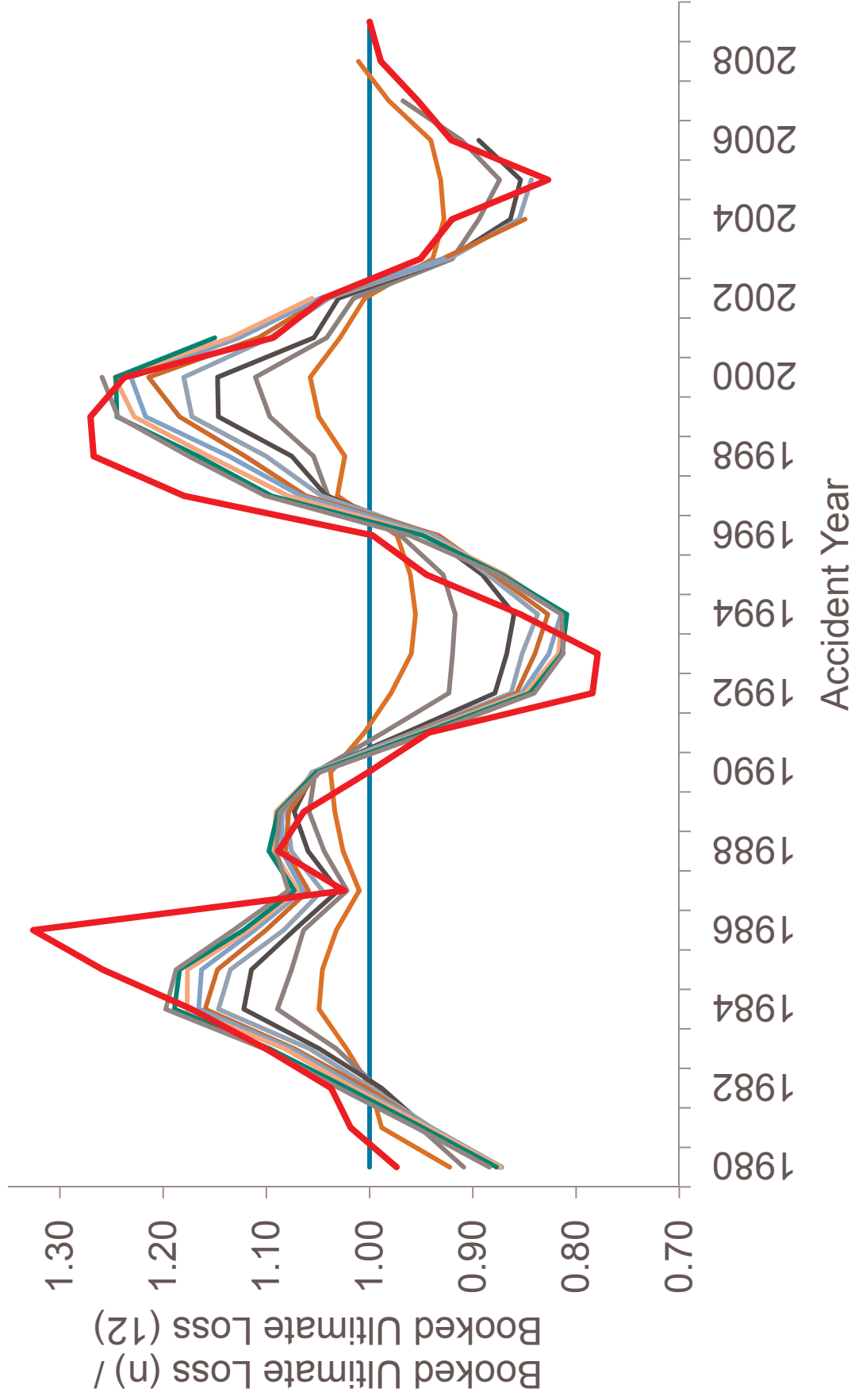
0.70 0.80 0.90 1.00 1.10 1.20

Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

Workers Compensation Cycle

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

Workers Compensation Cycle – Company A

Booked Ultimate Loss (n) / Booked Ultimate Loss (12)

Accident Year

Workers Compensation Cycle – Company B

Booked Ultimate Loss (n) / Booked Ultimate Loss (12)

Accident Year

Workers Compensation Cycle – Company C

Workers Compensation Cycle – State Funds
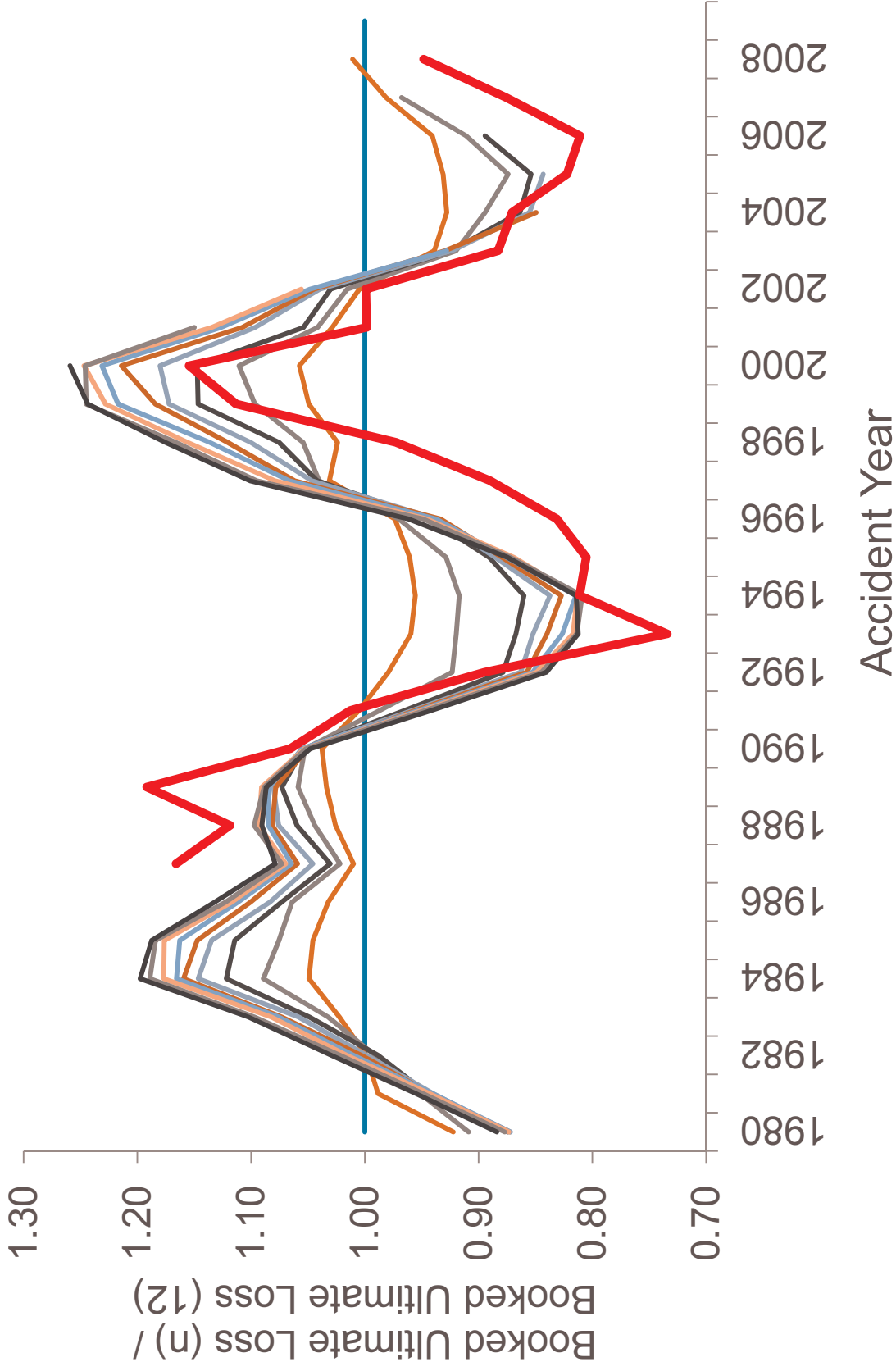
Booked Ultimate Loss (n) / Booked Ultimate Loss (12)

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008

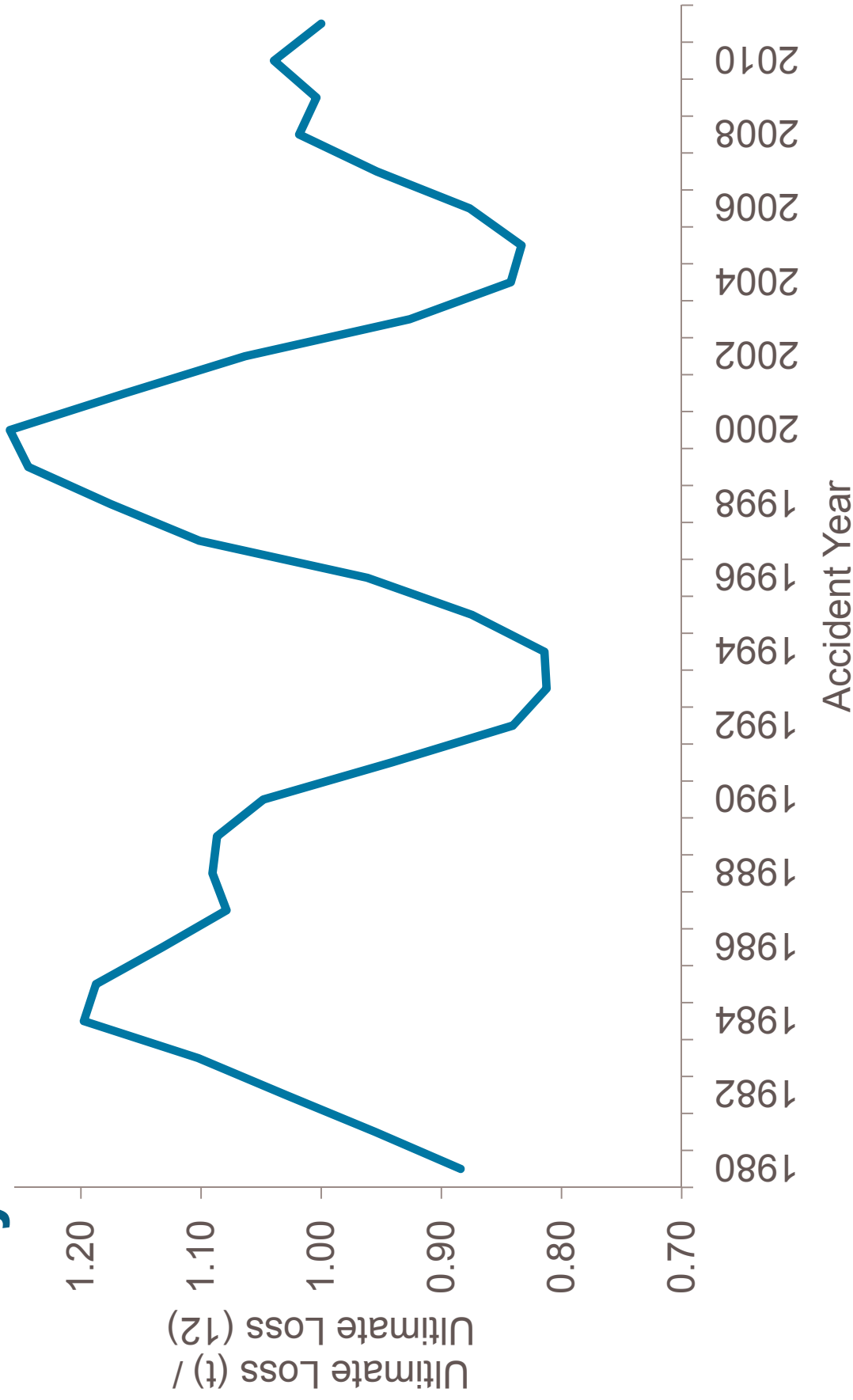1.30 1.20 1.10 1.00 0.90 0.80 0.70

GUY CARPENTER

1. What is the workers compensation cycle?
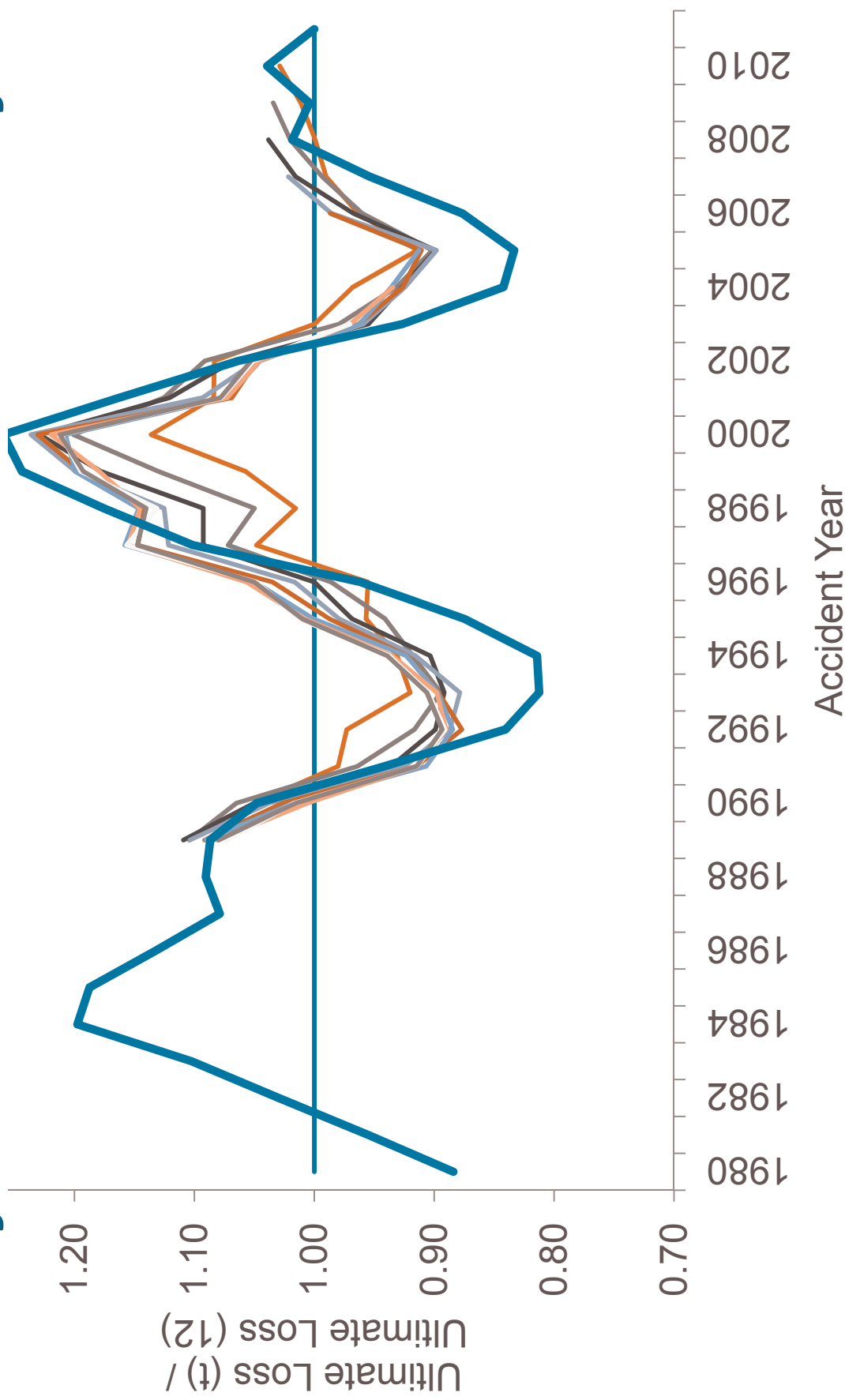
2. What causes it?

3. What can we do about it?

GUY CARPENTER

1. What is the workers compensation cycle?

2. What causes it?

3. What can we do about it?

WC Cycle outline

Accident Year (x-axis): 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

Ultimate Loss (t) / Ultimate Loss (12) (y-axis): 0.70, 0.80, 0.90, 1.00, 1.10, 1.20

WC Cycle outline + Incurred chain-ladder cycle

Accident Year

Ultimate Loss (t) / Ultimate Loss (12)
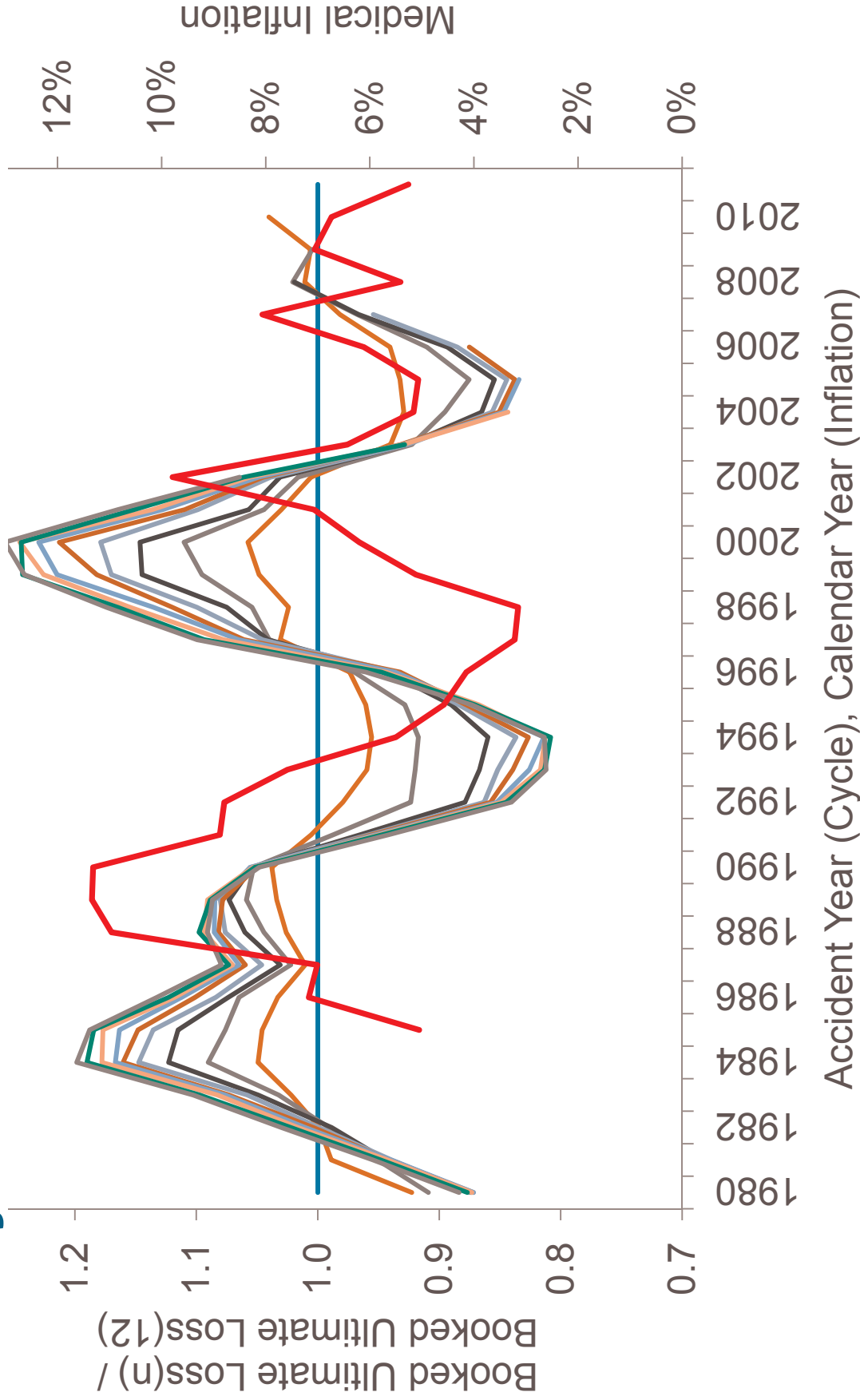
Incurred chain-ladder cycle uses an all year weighted average of 10x10 year Incurred Loss & ALAE triangles (paid + case reserve).
Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

WC Cycle

Accident Year (Cycle), Calendar Year (Inflation)

Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

0.7 0.8 0.9 1.0 1.1 1.2
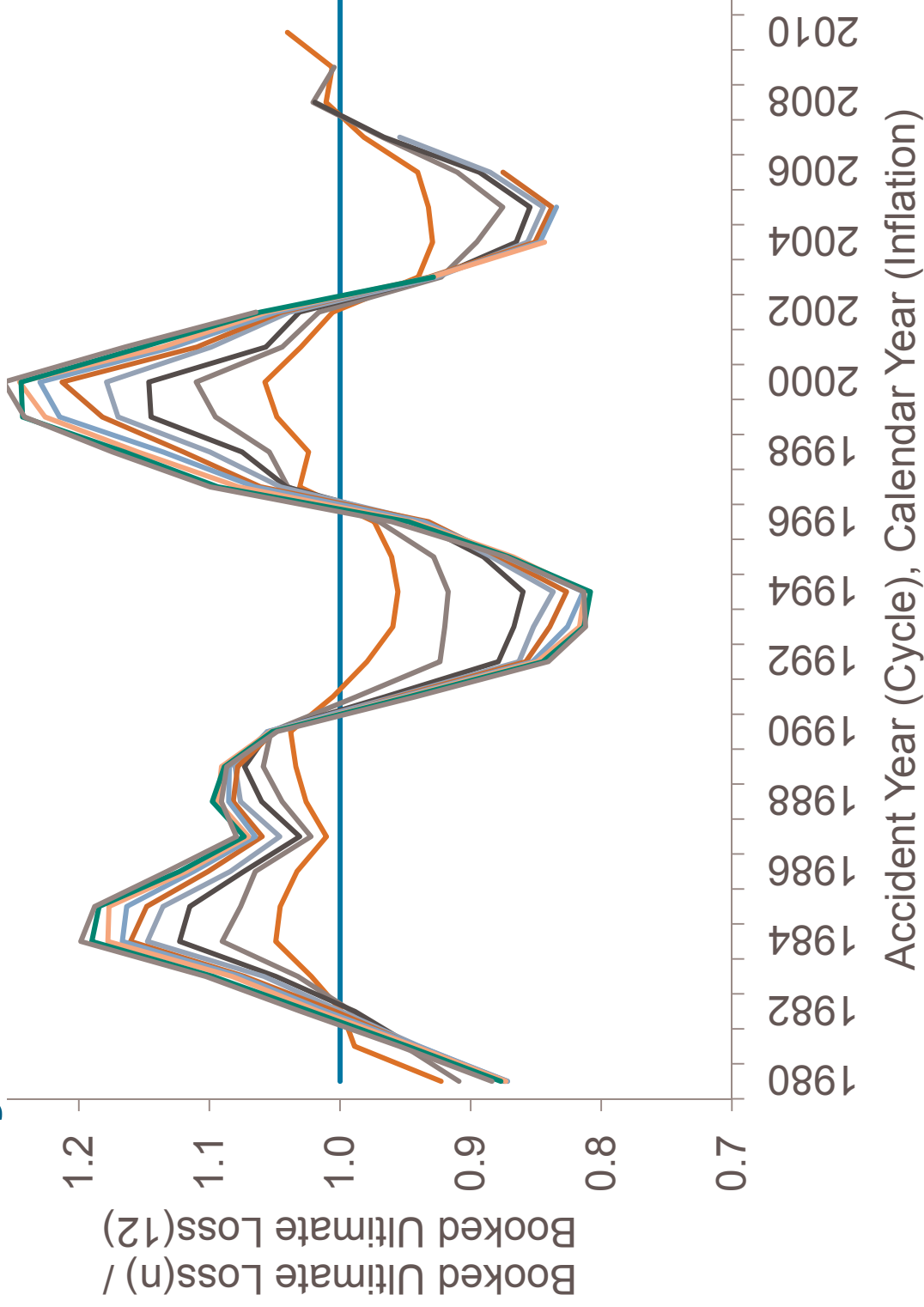
WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
Medical CPI is from US CPI Urban Consumers Hospital & Related Services NSA

WC Cycle & Medical Inflation

Medical Inflation

Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

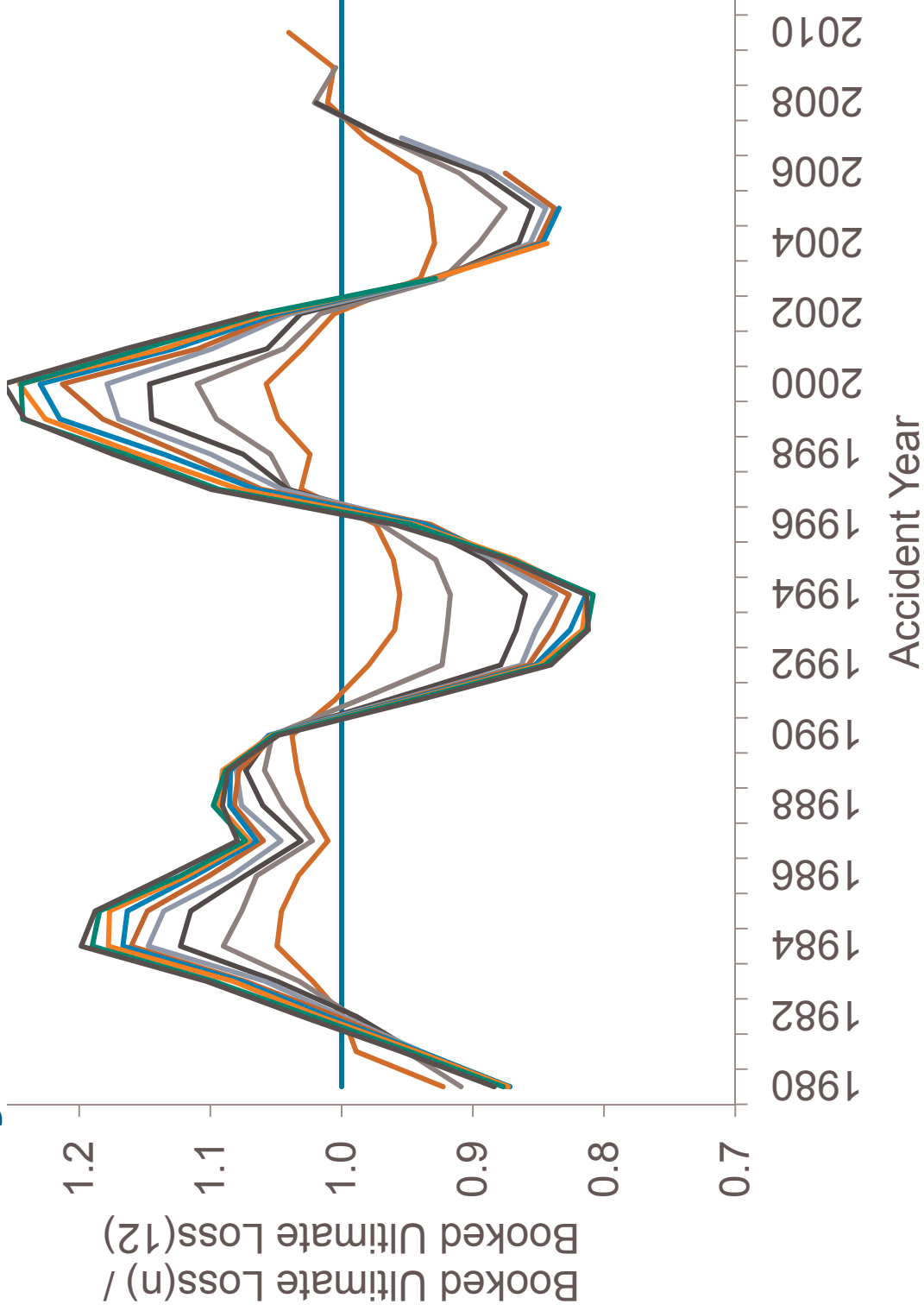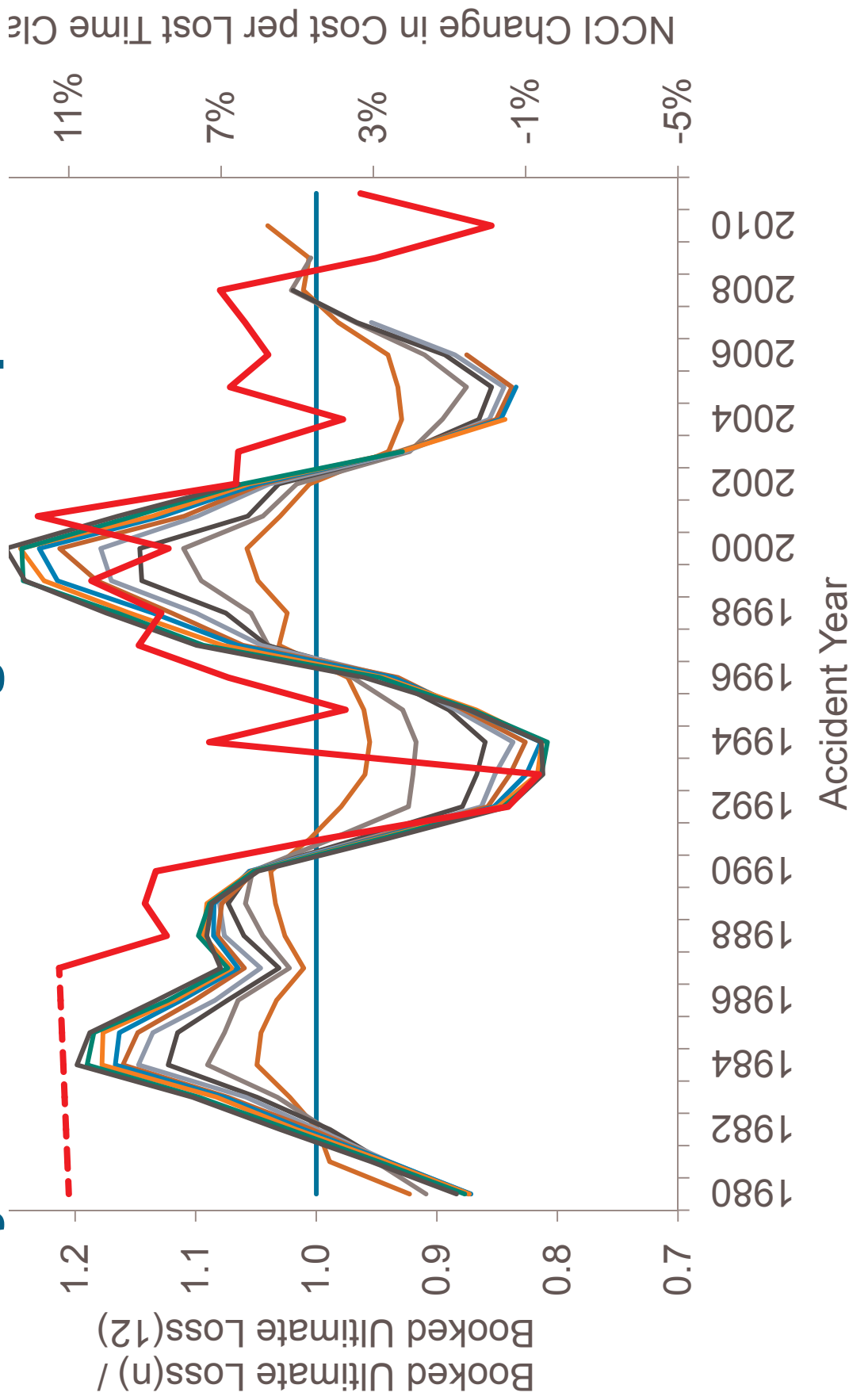Accident Year (Cycle), Calendar Year (Inflation)

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
Medical CPI is from US CPI Urban Consumers Hospital & Related Services NSA

WC Cycle

X-axis: Accident Year — 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

Y-axis: Booked Ultimate Loss(n) / Booked Ultimate Loss(12) — 0.7, 0.8, 0.9, 1.0, 1.1, 1.2

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database

WC Cycle & NCCI Change in Cost per Claim

Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

NCCI Change in Cost per Lost Time Claim

Accident Year: 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
NCCI Change in Cost per Lost Time Claim = (1+ Indemnity Change in Cost) x (1+ Medical Change in Cost) - 1

Guy Carpenter

What causes it?

- Usage

- Duration of temporary total

GUY CARPENTER

1. What is the workers compensation cycle?

2. What causes it?

3. What can we do about it?

GUY CARPENTER

1. What is the workers compensation cycle?
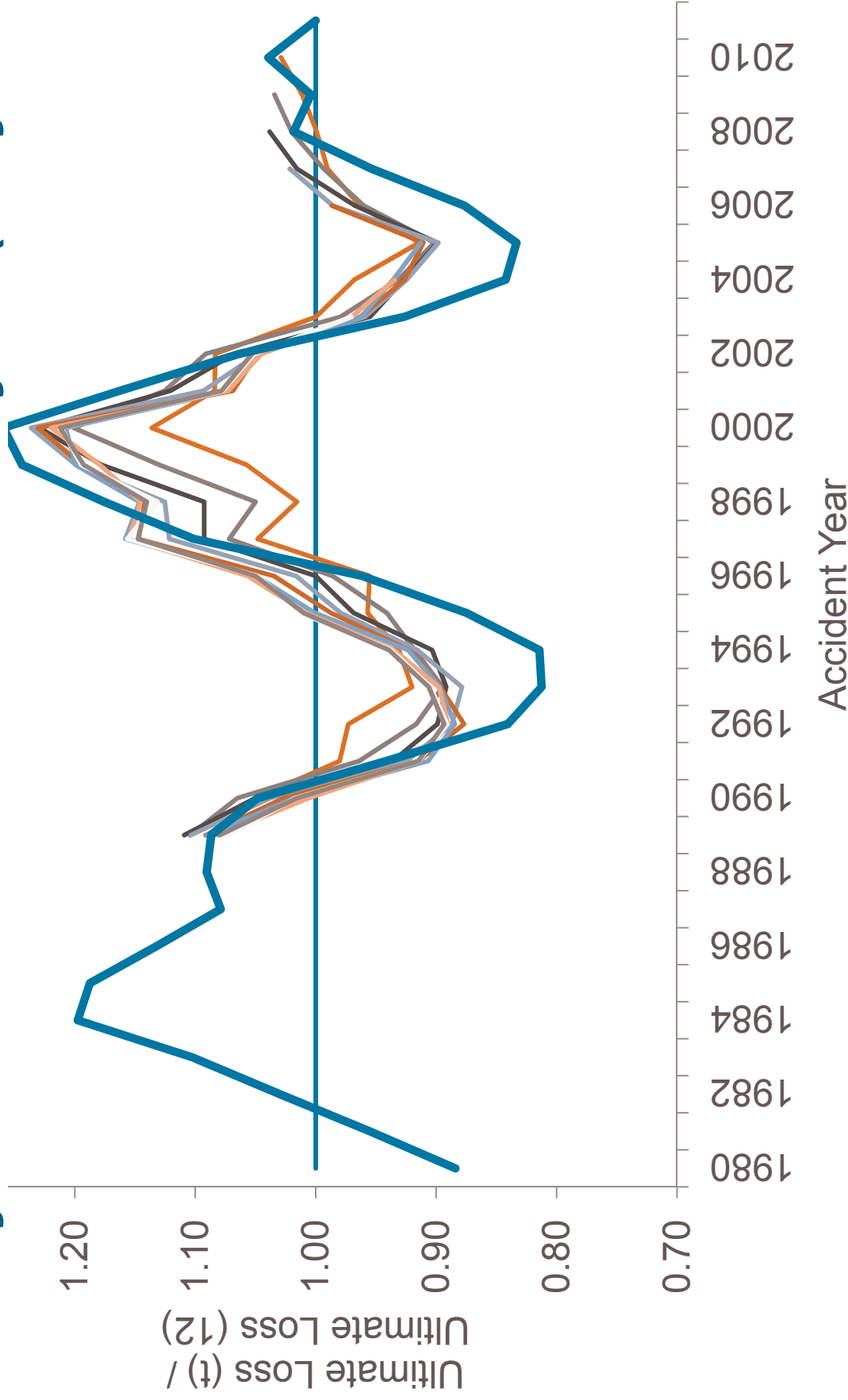
2. What causes it?

3. What can we do about it?

What can we do about it?

- Reserving

- Underwriting
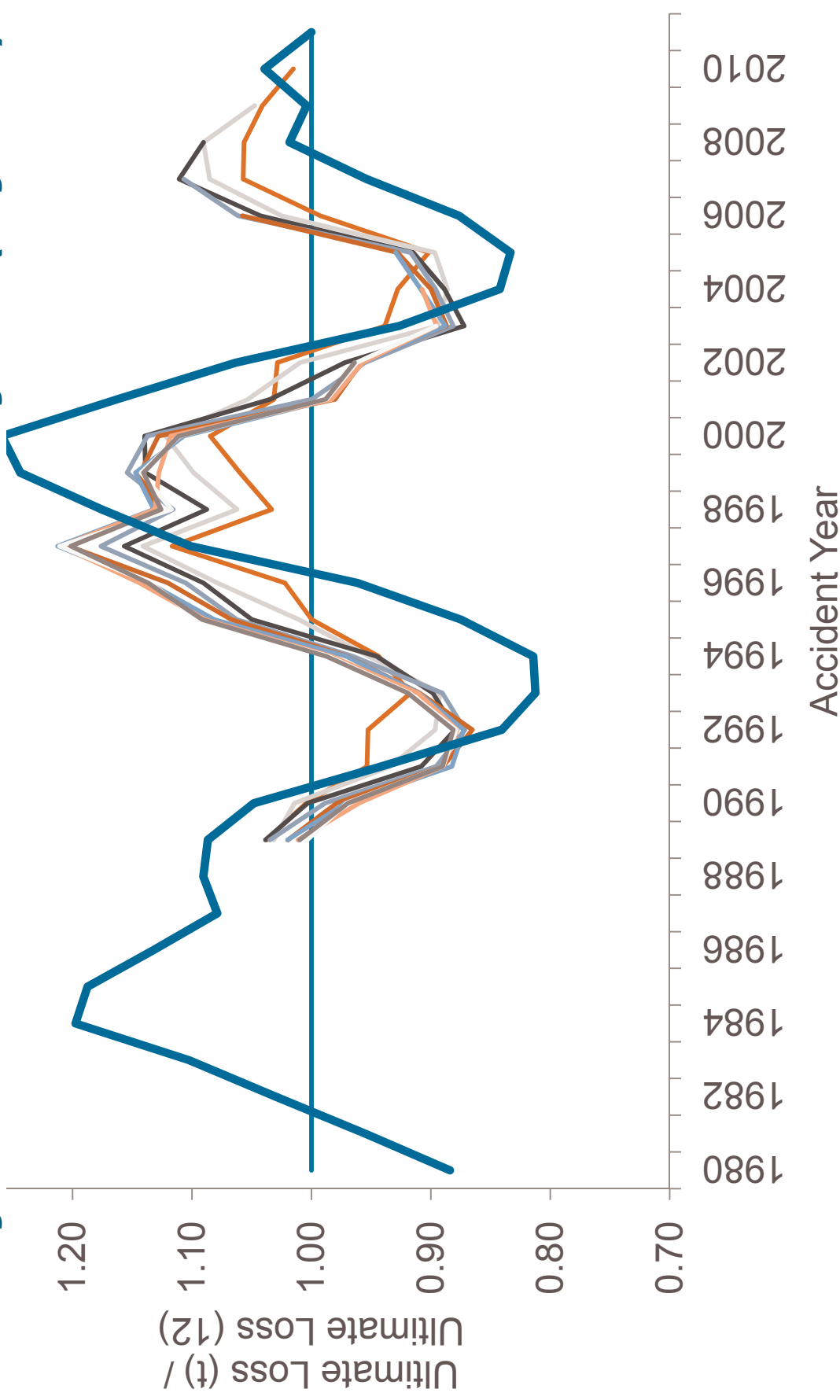
- ERM

What can we do about it?

- Reserving
    - Take a different LDF weighted average

- Underwriting

- ERM

WC Cycle outline + Incurred CL cycle (All yr av)
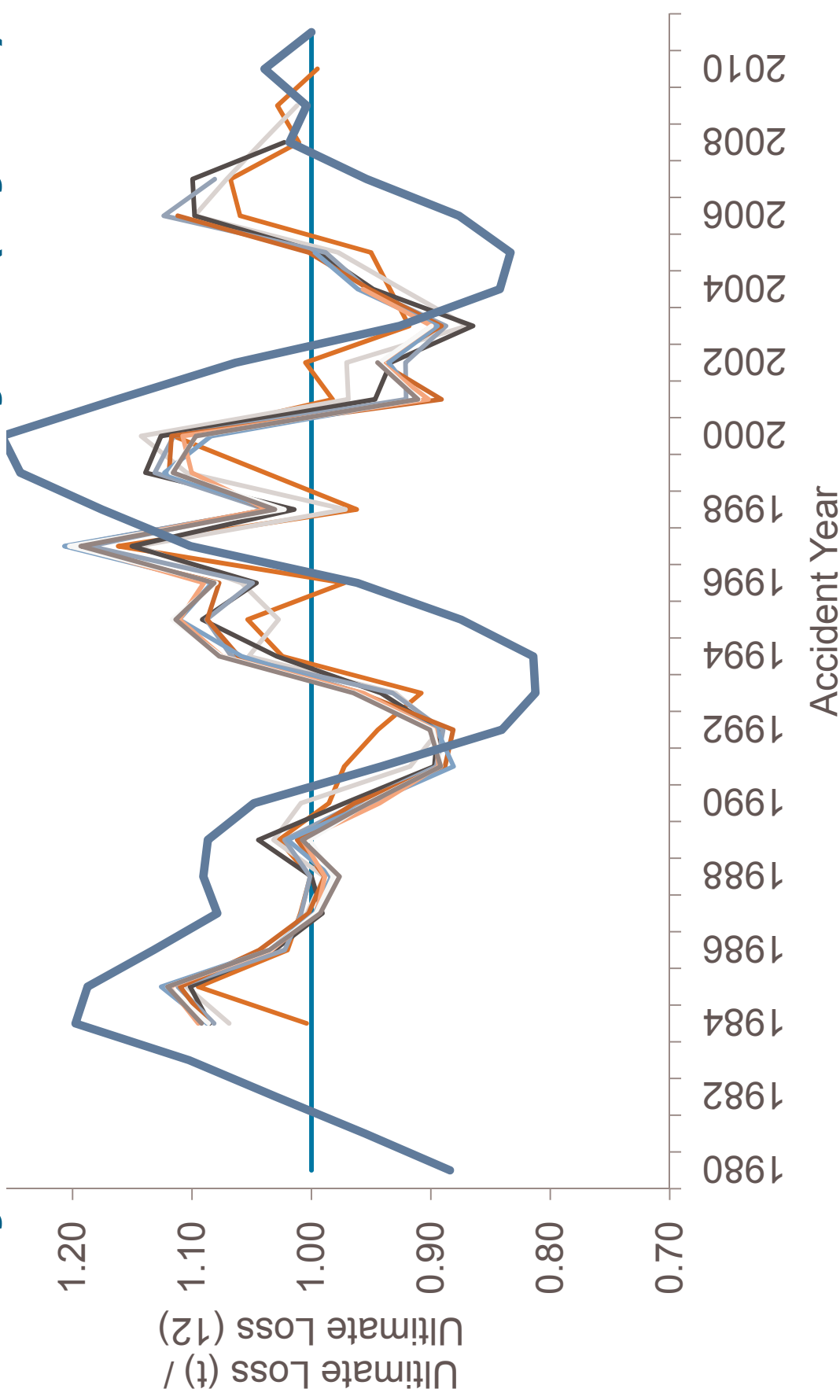

Accident Year

Ultimate Loss (t) / Ultimate Loss (12)

Incurred chain-ladder cycle uses an all year weighted average of 10x10 year Incurred Loss & ALAE triangles (paid + case reserve).
Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using
SNL and subject to change.

WC Cycle outline + Incurred CL cycle (3 yr av)

Y-axis: Ultimate Loss (t) / Ultimate Loss (12)

Y-axis values: 0.70, 0.80, 0.90, 1.00, 1.10, 1.20

X-axis: Accident Year

X-axis values: 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

Incurred chain-ladder cycle uses an 3-year weighted average of 10x10 year Incurred Loss & ALAE triangles (paid + case reserve). Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

WC Cycle outline + Incurred CL cycle (1 yr av)

Axis label (y): Ultimate Loss (t) / Ultimate Loss (12)

y-axis values: 1.20, 1.10, 1.00, 0.90, 0.80, 0.70

Axis label (x): Accident Year

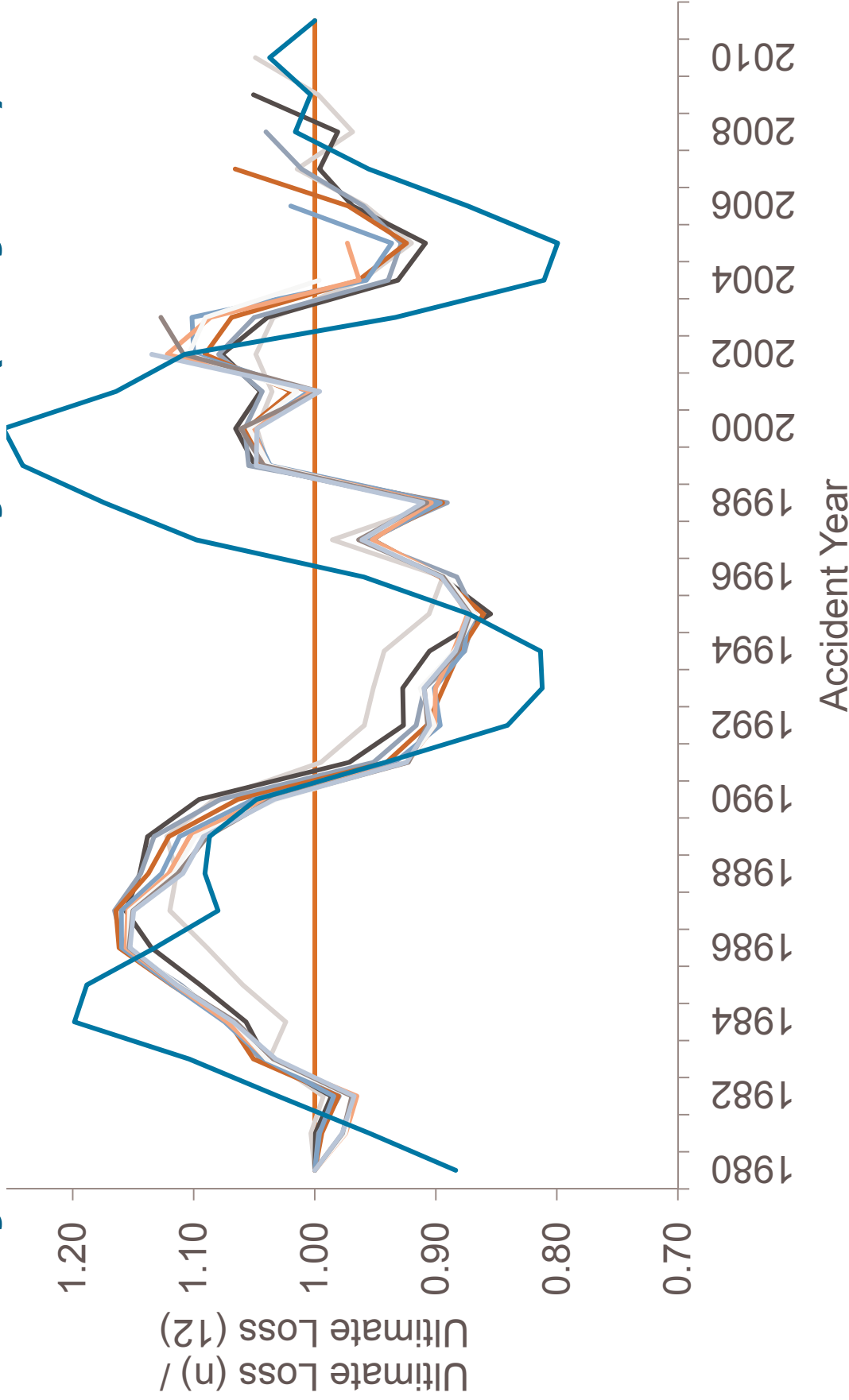x-axis values: 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

Incurred chain-ladder cycle uses an 1-year weighted average of 10x10 year Incurred Loss & ALAE triangles (paid + case reserve). Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

What can we do about it?

- Reserving

  - Take a different LDF weighted average

  - Use the paid chain-ladder

  - Underwriting
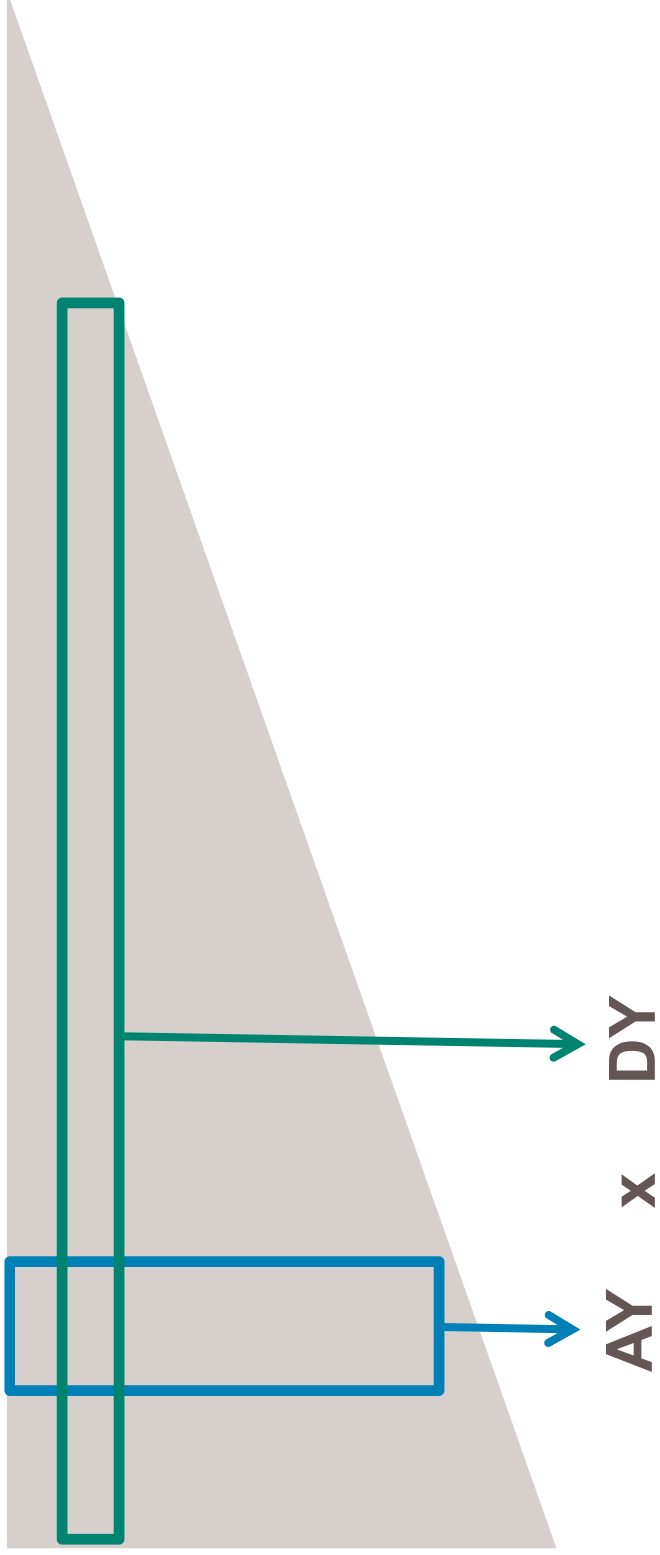
  - ERM

WC Cycle outline + Paid CL cycle (All yr av)

Y-axis: Ultimate Loss (n) / Ultimate Loss (12)

Y-axis values: 1.20, 1.10, 1.00, 0.90, 0.80, 0.70

X-axis: Accident Year

X-axis values: 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

Paid chain-ladder cycle uses an 10-year weighted average of 10x10 year paid Loss & ALAE triangles. Data is from Guy Carpenter and Risk Lighthouse's annual statement database.
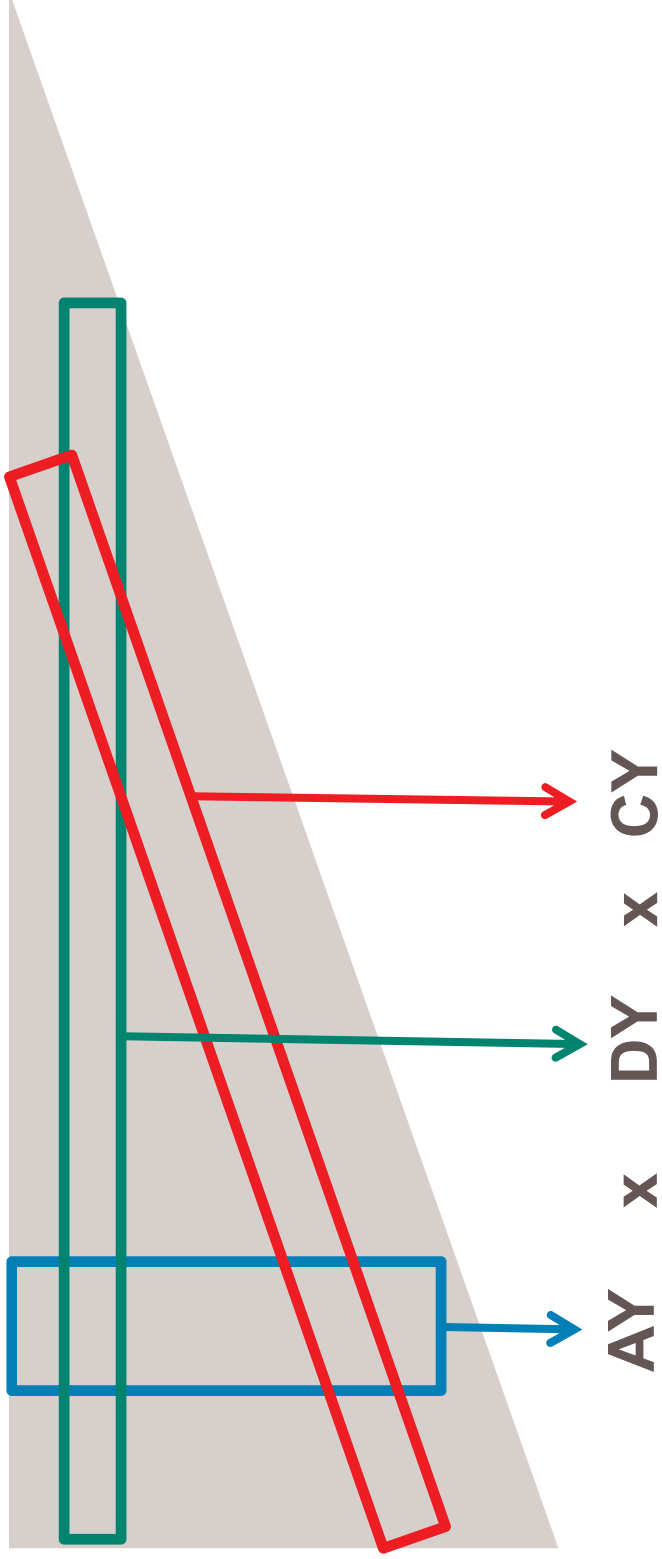
What can we do about it?

- Reserving

  - Take a different LDF weighted average

  - Use the paid chain-ladder

  - Use a GLM to measure and explicitly model a CY trend
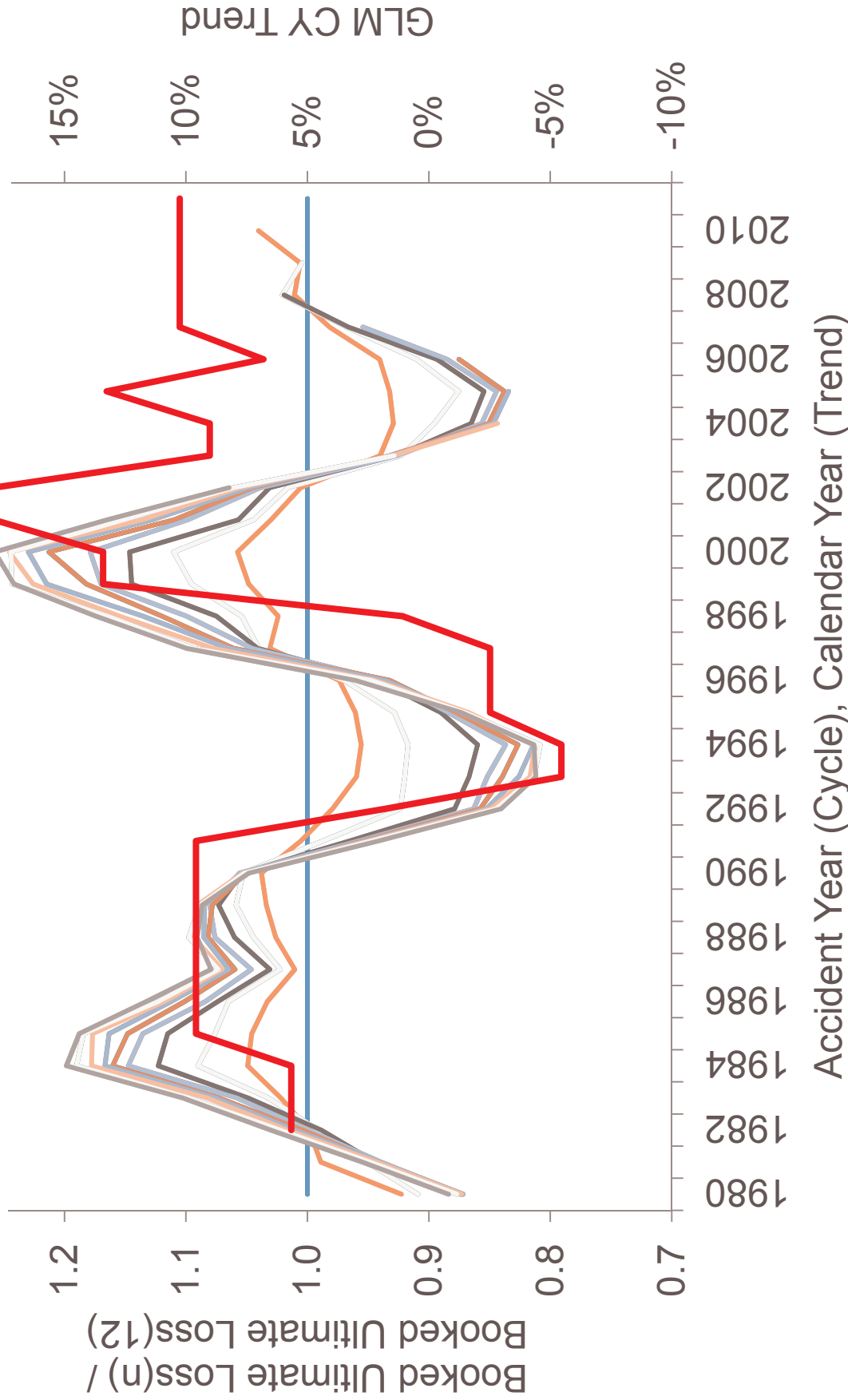
  - Underwriting

  - ERM

Measuring CY Trend using a GLM
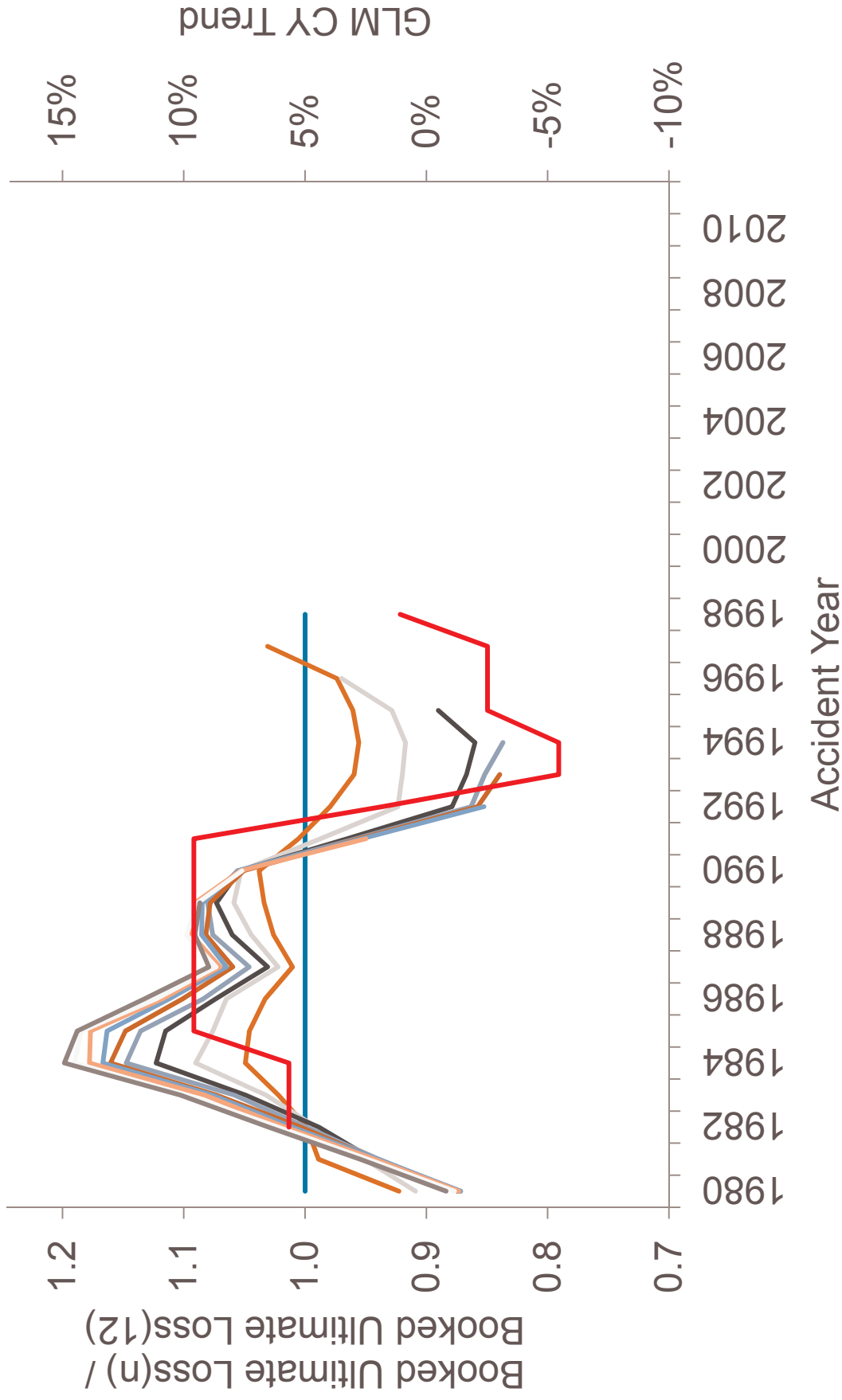
AY x DY

Measuring CY Trend using a GLM

AY x DY x CY

Workers Compensation and GLM CY trend

Axis labels: GLM CY Trend (15%, 10%, 5%, 0%, -5%, -10%); Booked Ultimate Loss(n) / Booked Ultimate Loss(12) (1.2, 1.1, 1.0, 0.9, 0.8, 0.7); Accident Year (Cycle), Calendar Year (Trend) — 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010
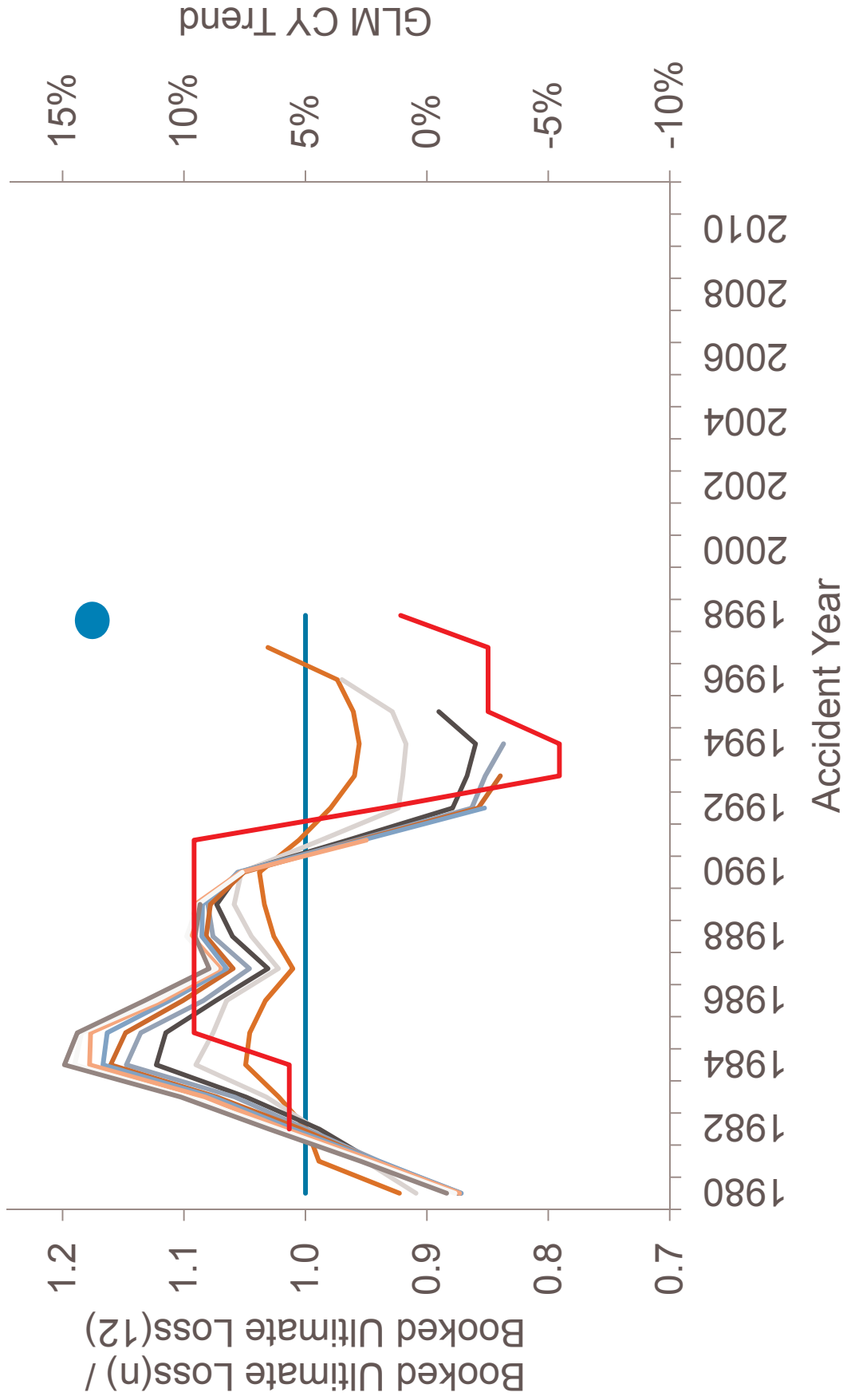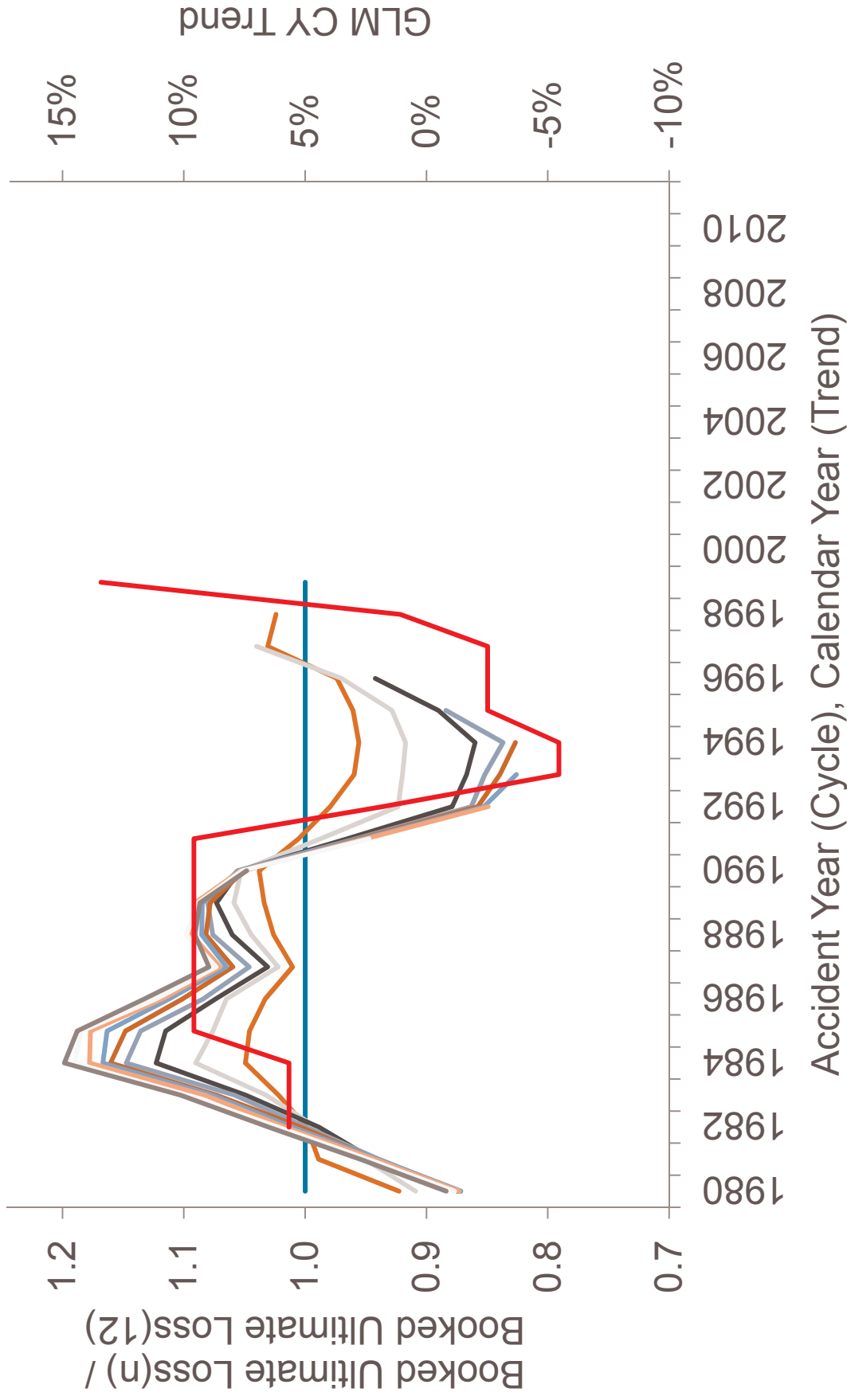
WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

Workers Compensation and GLM CY trend

X-axis: Accident Year (1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010)

Left Y-axis: Booked Ultimate Loss(n) / Booked Ultimate Loss(12) (0.7, 0.8, 0.9, 1.0, 1.1, 1.2)

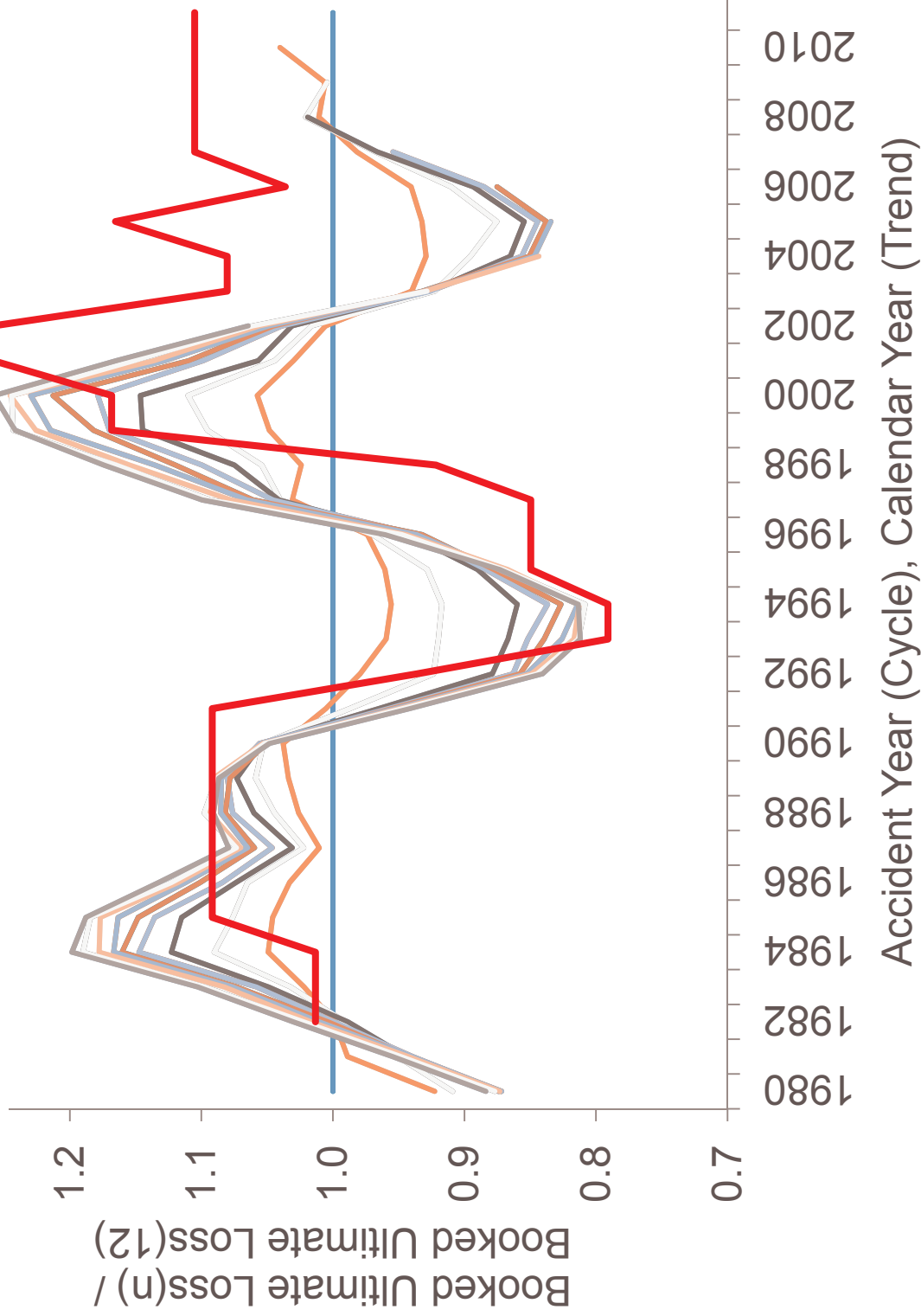**Right Y-axis:** GLM CY Trend (-10%, -5%, 0%, 5%, 10%, 15%)

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers
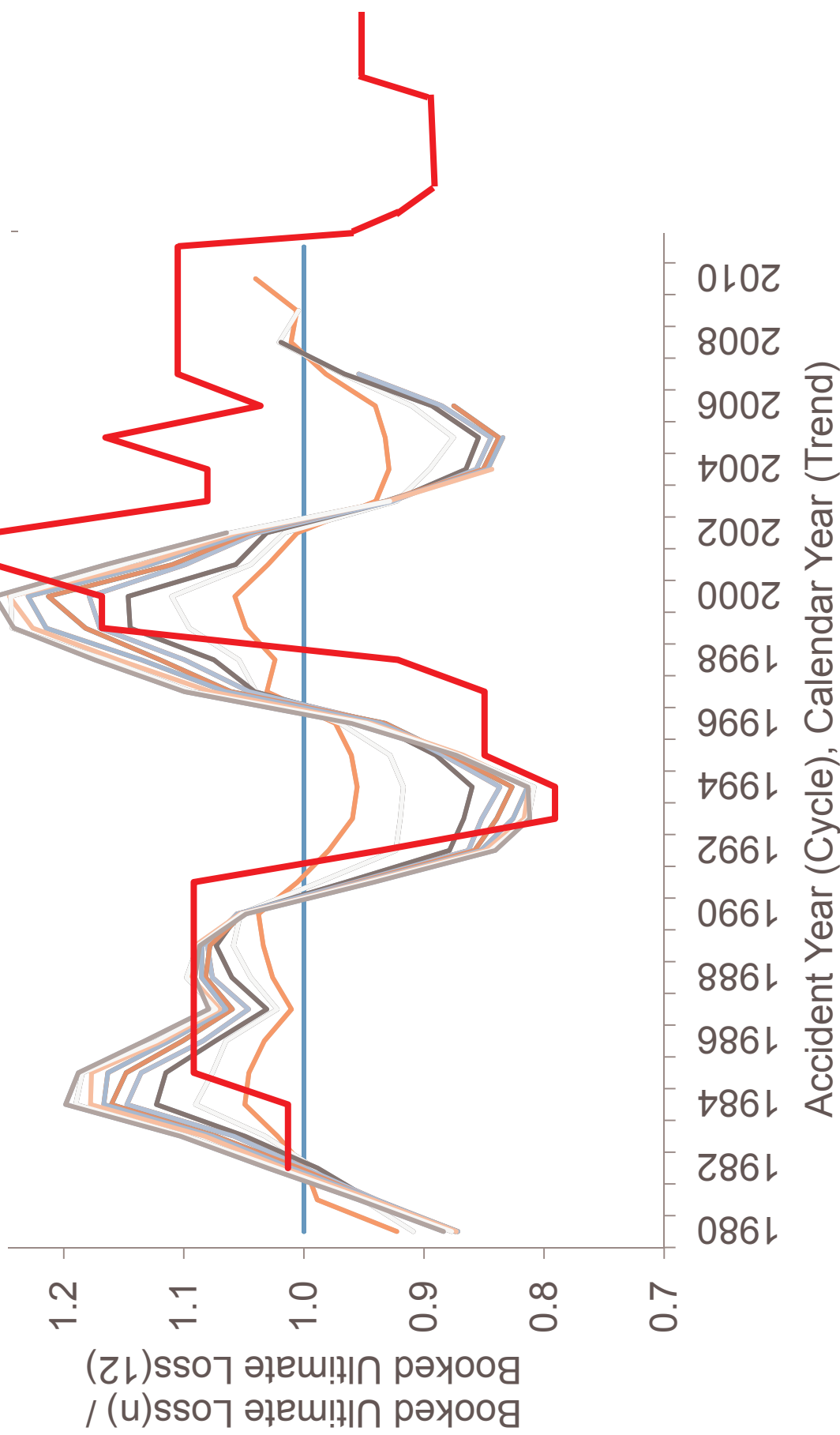
Workers Compensation and GLM CY trend

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

Guy Carpenter

Workers Compensation and GLM CY trend

Accident Year (Cycle), Calendar Year (Trend)

GLM CY Trend

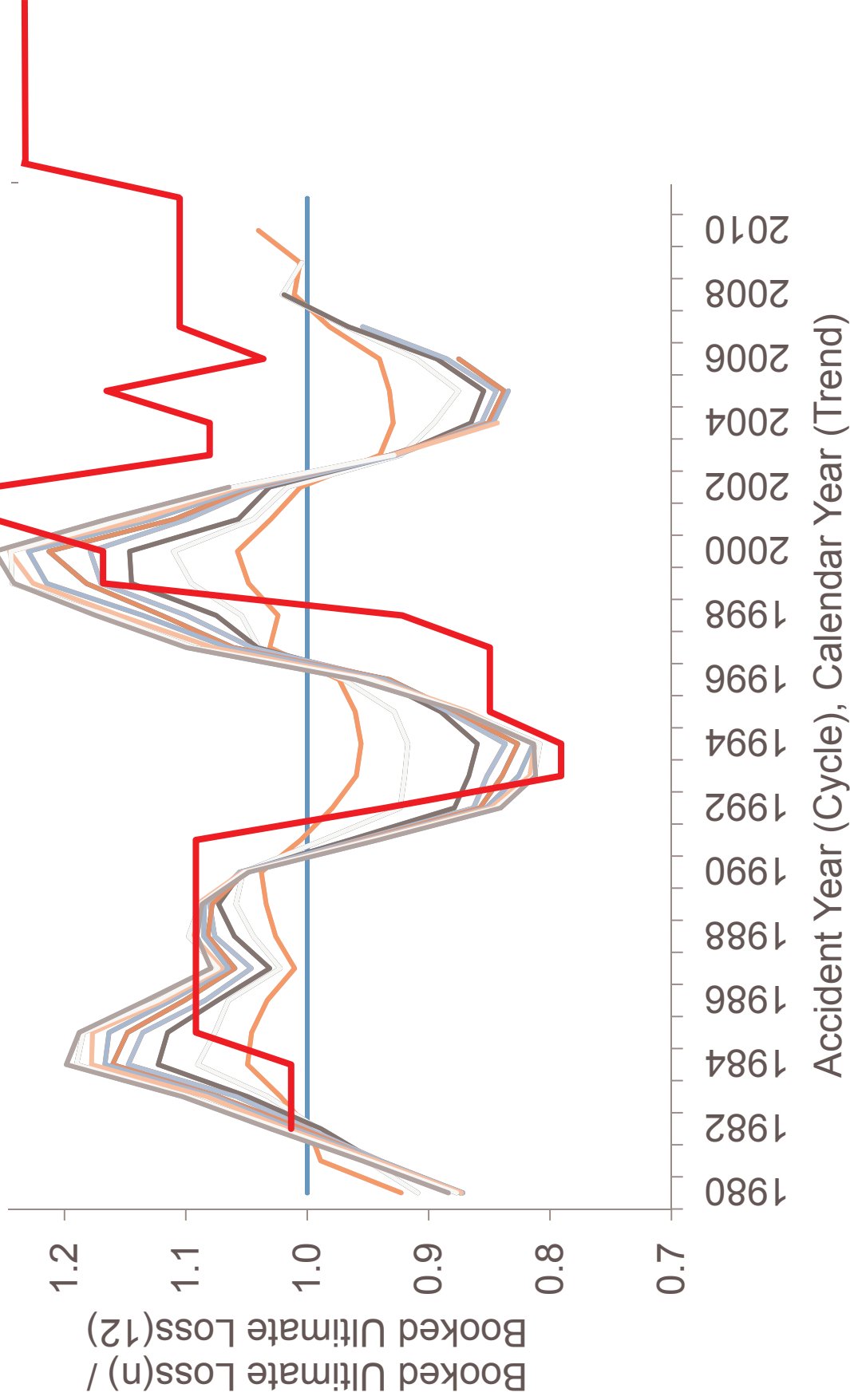Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

Workers Compensation and GLM CY trend

Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

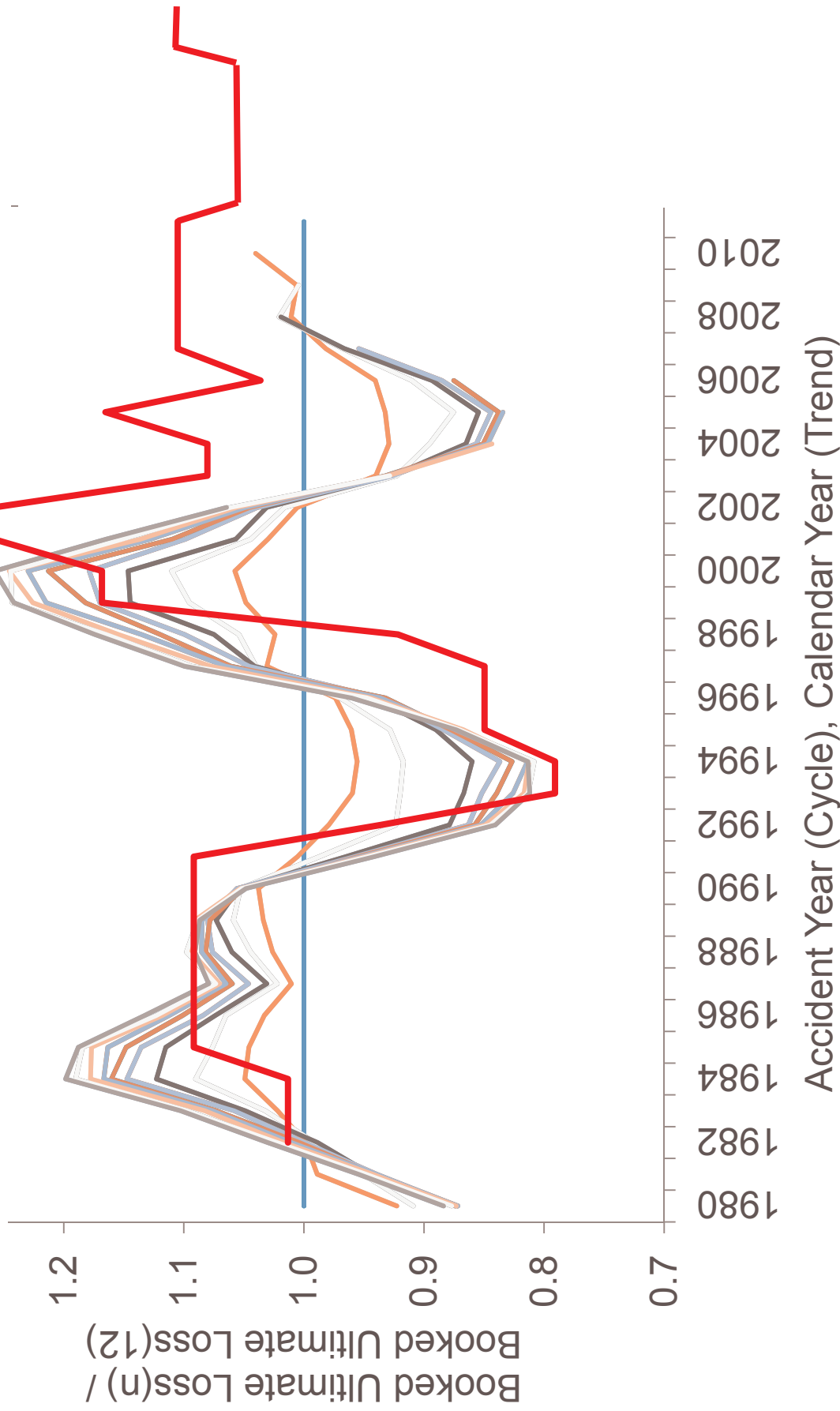Accident Year (Cycle), Calendar Year (Trend)

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

Workers Compensation and GLM CY trend

Y-axis: Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

X-axis values: 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

X-axis label: Accident Year (Cycle), Calendar Year (Trend)

Y-axis values: 0.7, 0.8, 0.9, 1.0, 1.1, 1.2

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

Workers Compensation and GLM CY trend

Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

Accident Year (Cycle), Calendar Year (Trend)

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

1.2 1.1 1.0 0.9 0.8 0.7

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

Workers Compensation and GLM CY trend

X-axis: Accident Year (Cycle), Calendar Year (Trend)

Y-axis: Booked Ultimate Loss(n) / Booked Ultimate Loss(12)

X-axis values: 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010

Y-axis values: 0.7, 0.8, 0.9, 1.0, 1.1, 1.2

WC cycle is from Guy Carpenter and Risk Lighthouse risk benchmark database
GLM CY Trend is a simple average of the GLM calendar year trends from a few large workers compensation writers

What can we do about it?

- Reserving
  - Take a different LDF weighted average
  - Use the paid chain-ladder
  - Use a GLM to measure and explicitly model a CY trend

- Underwriting
  - Underwriting risk – be careful!

- ERM

Underwriting Risk Modeling

Accident Year	ULR at 12/2000 (1)
1991	80%
1992	69%
...	...
1997	72%
1998	76%
1999	79%
2000	77%

Underwriting Risk Modeling

Accident Year	ULR at 12/2000 (1)
1991	80%
1992	69%
...	...
1997	72%
1998	76%
1999	79%
2000	77%
StDev	8%
Mean	78%

Underwriting Risk Modeling

Accident Year	ULR at 12/2000 (1)	ULR at 120 months (2)
1991	80%	80%
1992	69%	68%
…	…	…
1997	72%	79%
1998	76%	90%
1999	79%	97%
2000	77%	96%
StDev	8%	
Mean	78%	

Underwriting Risk Modeling

Accident Year	ULR at 12/2000 (1)	ULR at 120 months (2)
1991	80%	80%
1992	69%	68%
...	...	...
1997	72%	79%
1998	76%	90%
1999	79%	97%
2000	77%	96%
StDev	8%	
Mean	78%	

Underwriting Risk Modeling

Accident Year	ULR at 12/2000 (1)	ULR at 120 months (2)
1991	80%	80%
1992	69%	68%
...	...	...
1997	72%	79%
1998	76%	90%
1999	79%	97%
2000	77%	96%
StDev	8%	14%
Mean	78%	77%

Underwriting Risk Modeling

Accident Year	ULR at 12/2000 (1)	ULR at 120 months (2)
1991	80%	80%
1992	69%	68%
…	…	…
1997	72%	79%
1998	76%	90%
1999	79%	97%
2000	77%	96%
StDev	8%	14%
Mean	78%	77%
99.5%	100%	121%

What can we do about it?

- Reserving
  - Take a different LDF weighted average
  - Use the paid chain-ladder
  - Use a GLM to measure and explicitly model a CY trend
- Underwriting
  - Do not under-estimate underwriting risk
- ERM
  - Use a multi-year capital model

Workers Compensation Cycle

Series of years go bad together
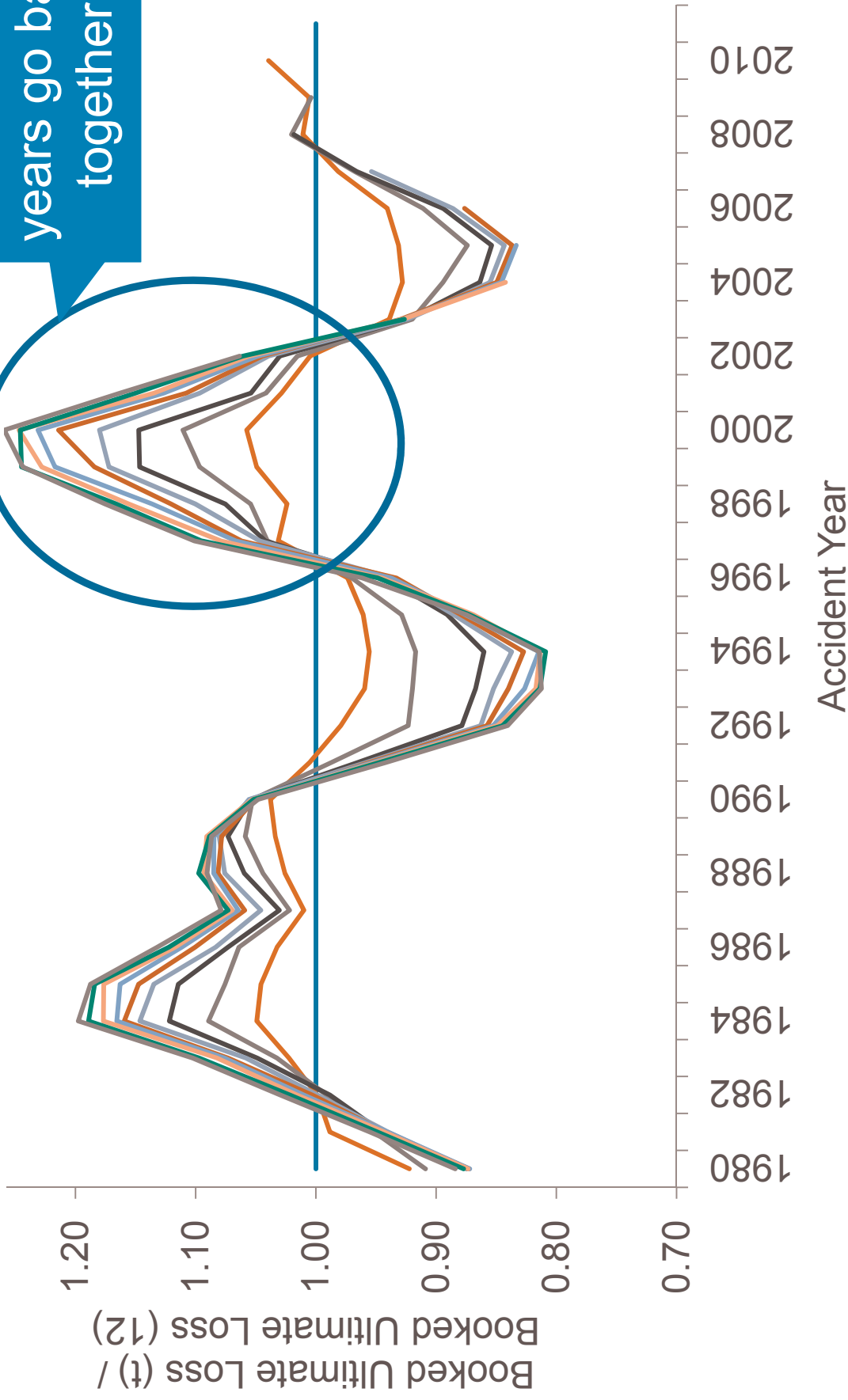
Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

1.20 1.10 1.00 0.90 0.80 0.70

Workers Compensation Cycle

... over a long period of time

Booked Ultimate Loss (t) / Booked Ultimate Loss (12)

Accident Year

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

0.70 0.80 0.90 1.00 1.10 1.20
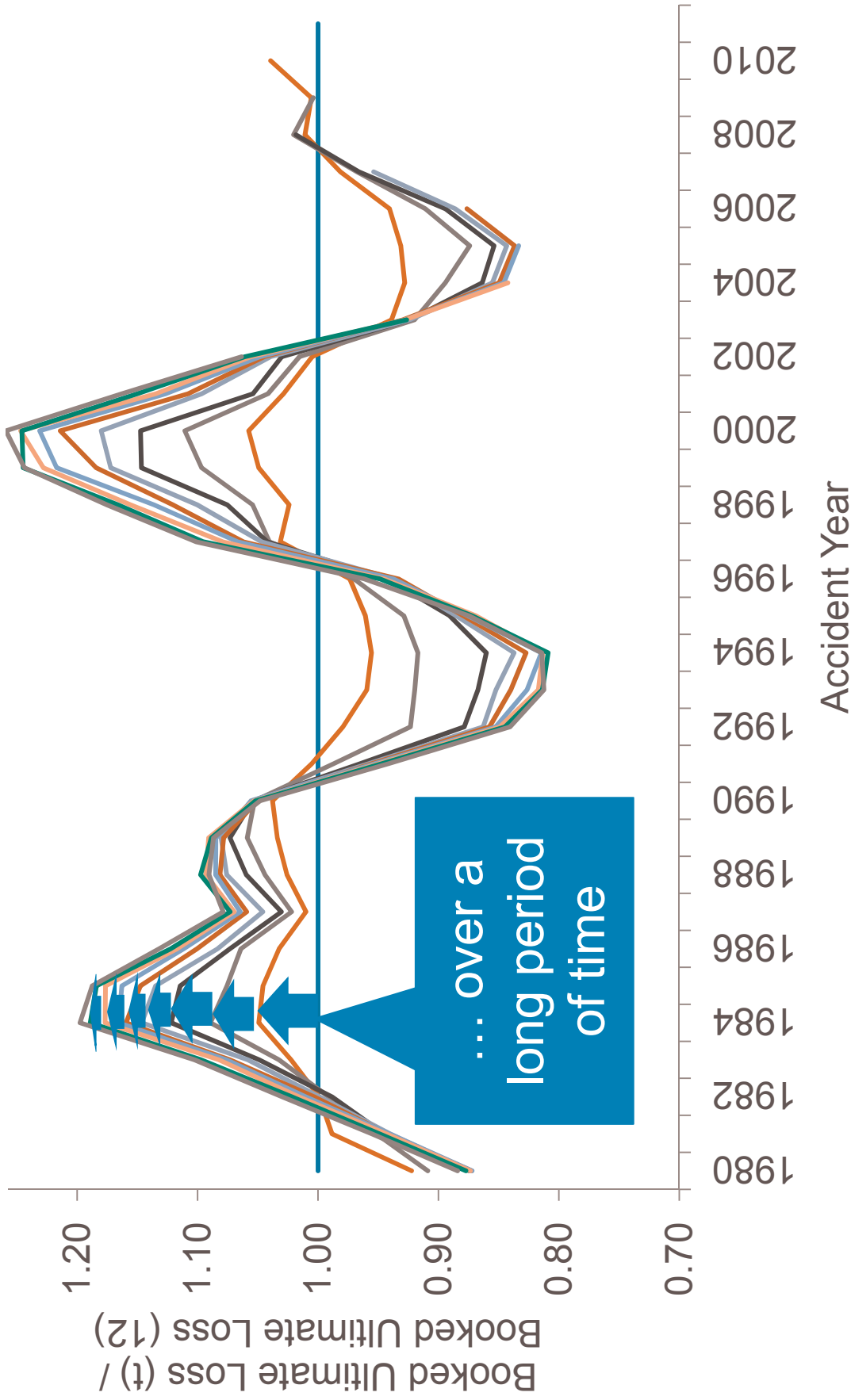
Data to 12/2009 is from cleaned Schedule P database from Risk Lighthouse, and updated for 12/2010 & 12/2011 financials using SNL and subject to change.

WC Ten-Year Reserve Distribution

Accident Year 2000:

Reserve Movement

WC Ten-Year Reserve Distribution

Accident Year 2000:

Estimated $13bn

Reserve Movement

WC Ten-Year Reserve Distribution

Accident Year 2000:

Estimated $13bn

Actual $18bn

Reserve Movement

0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7

WC Ten-Year Reserve Distribution

Accident Year 2000:

Estimated $13bn

Actual $18bn

Actual / Estimate   1.35
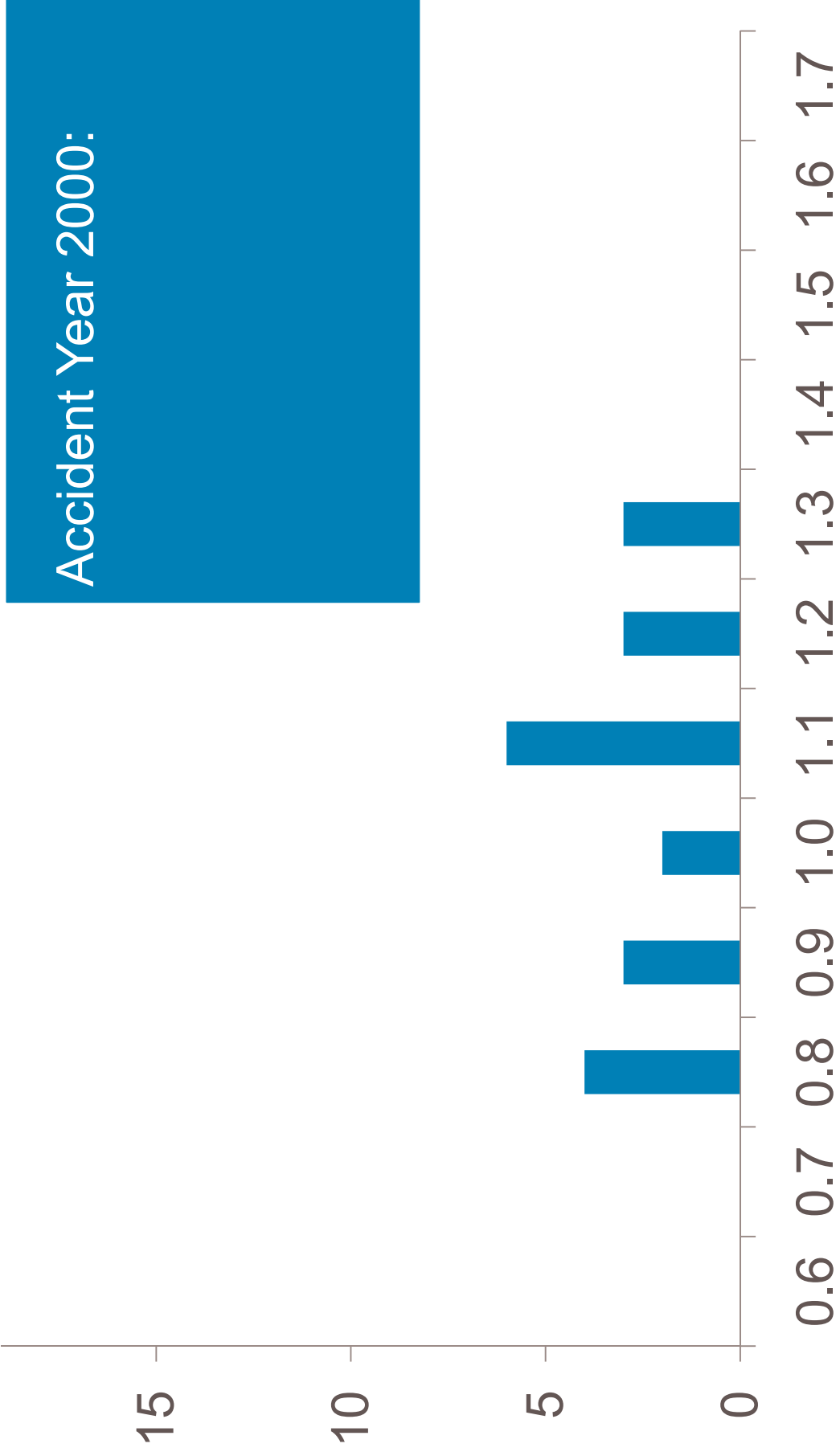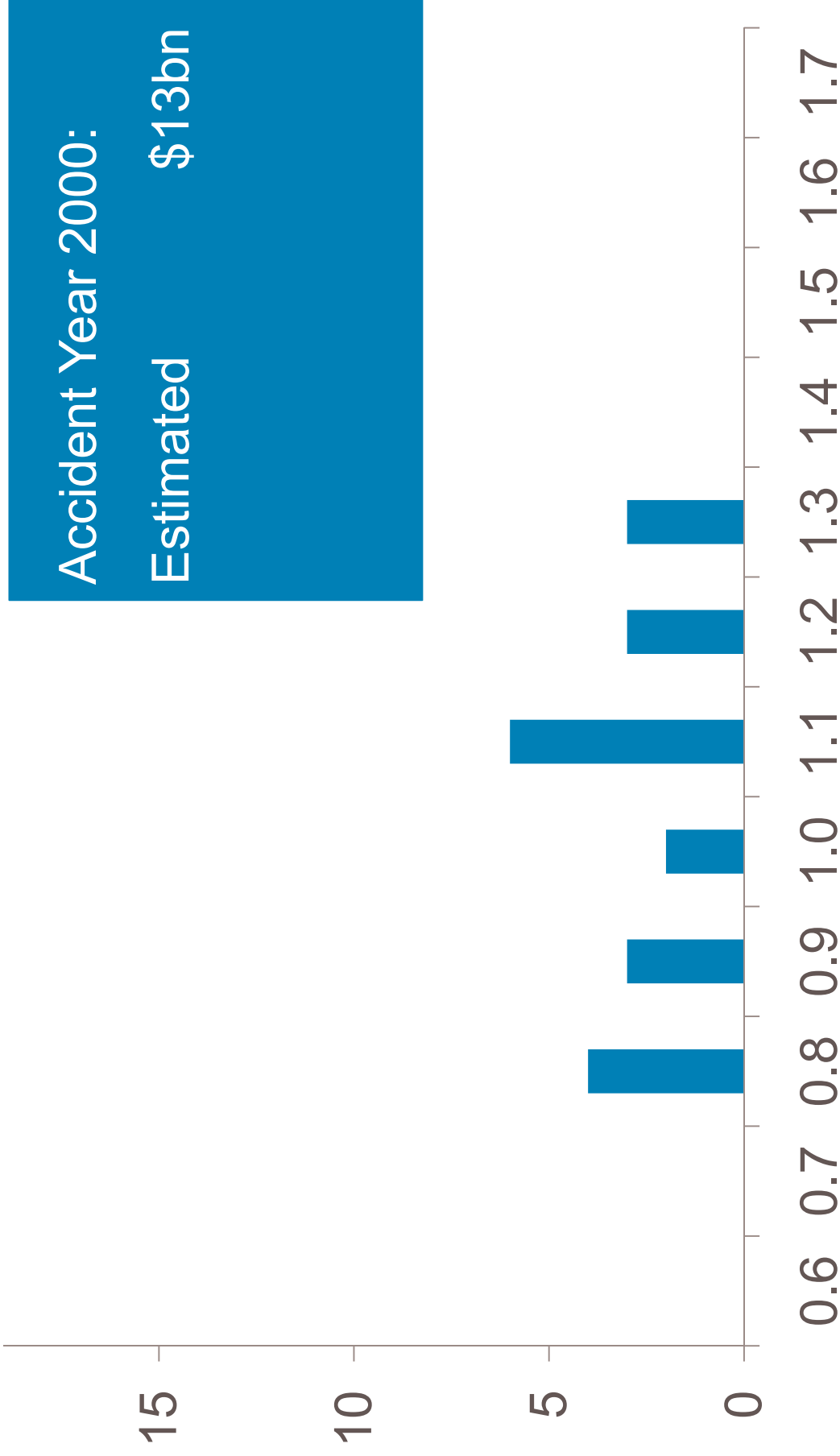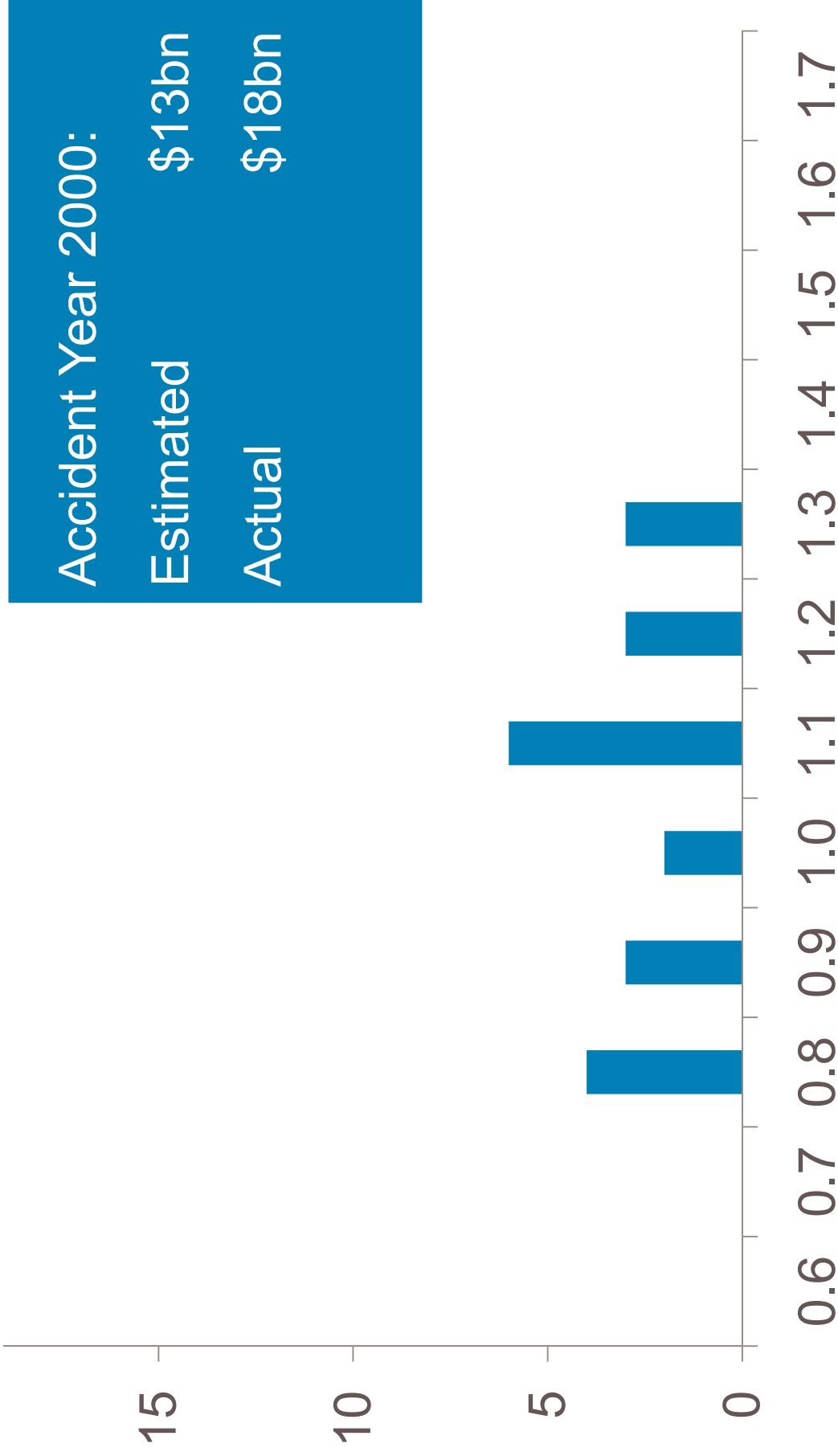
Reserve Movement

WC One-Year Reserve Distribution
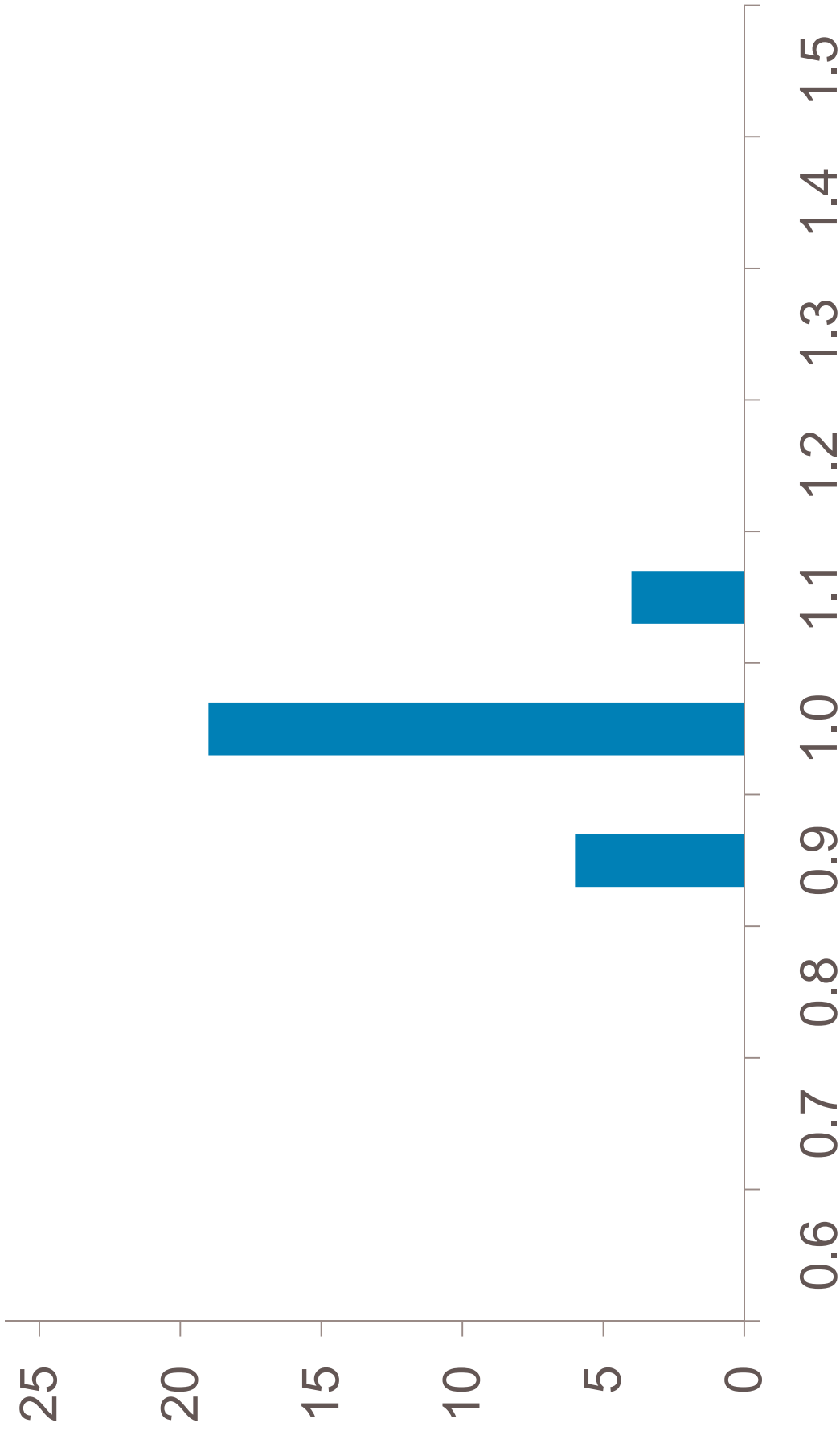
Reserve Movement

CV Reserves: Comparison

WC 1 year Reserve Distn
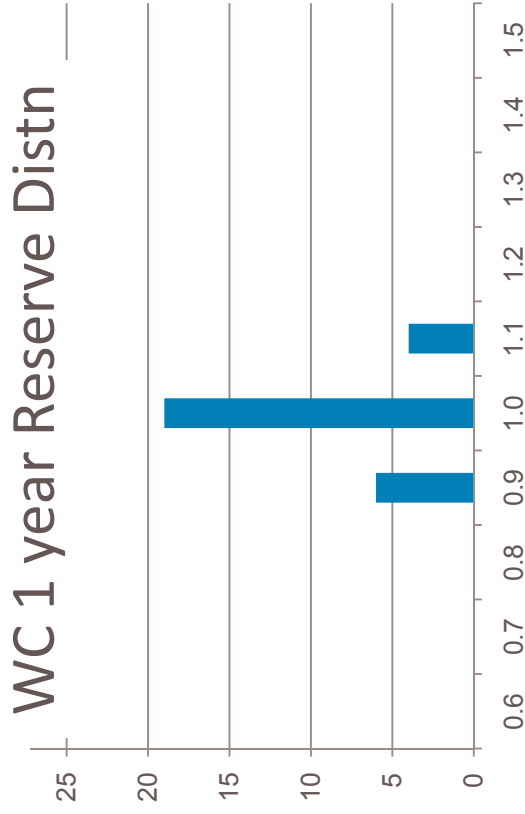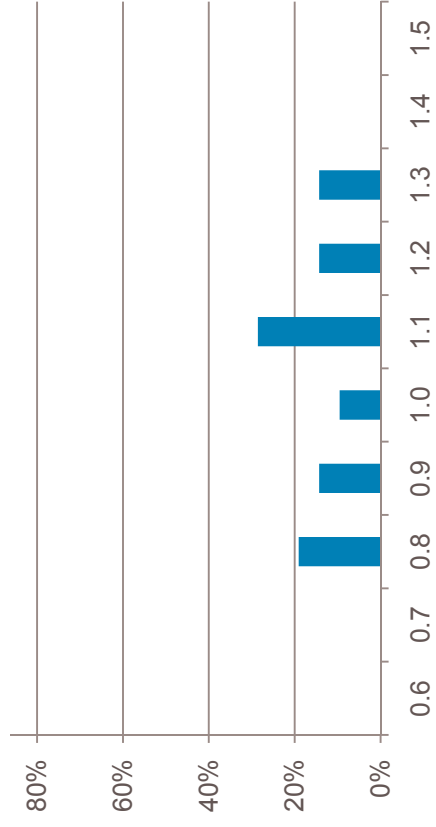

WC 10 year Reserve Distribution

CV Reserves: Comparison
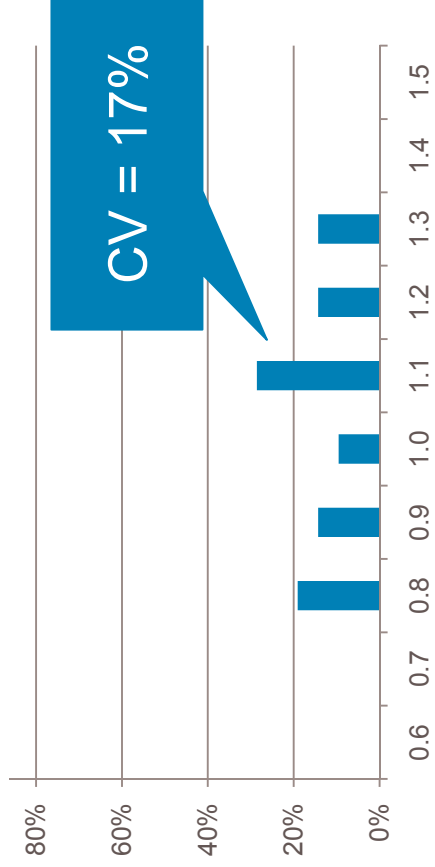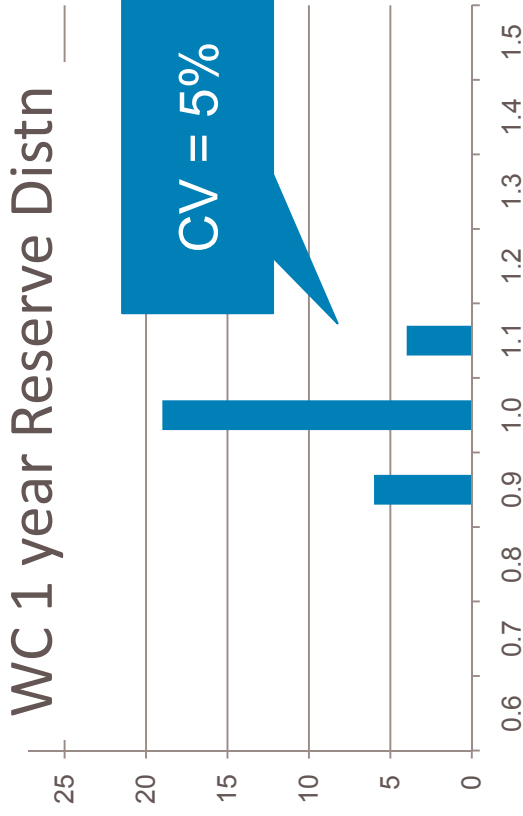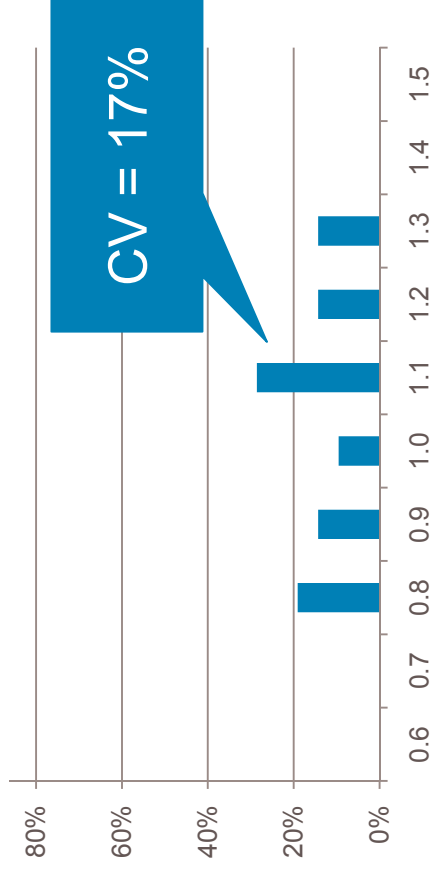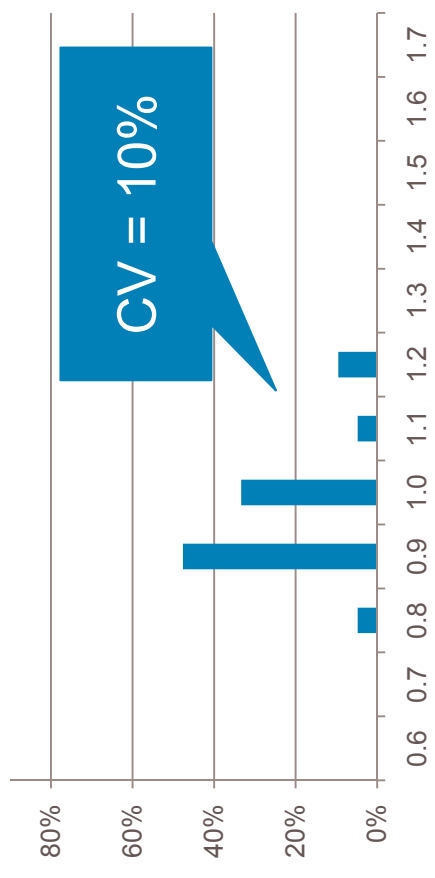
## WC 1 year Reserve Distn

CV = 5%

25
20
15
10
5
0

0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5

WC 10 year Reserve Distribution

CV = 17%

80%
60%
40%
20%
0%

0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5

CV Reserves: Comparison

WC 1 year Reserve Distn

CV = 5%

Homeowners 10 year Reserve Distn

CV = 10%

WC 10 year Reserve Distribution

CV = 17%

CV Reserves: Comparison

Homeowners 1 year Reserve Distn

CV = 8%

WC 1 year Reserve Distn

CV = 5%

Homeowners 10 year Reserve Distn

CV = 10%

WC 10 year Reserve Distribution

CV = 17%
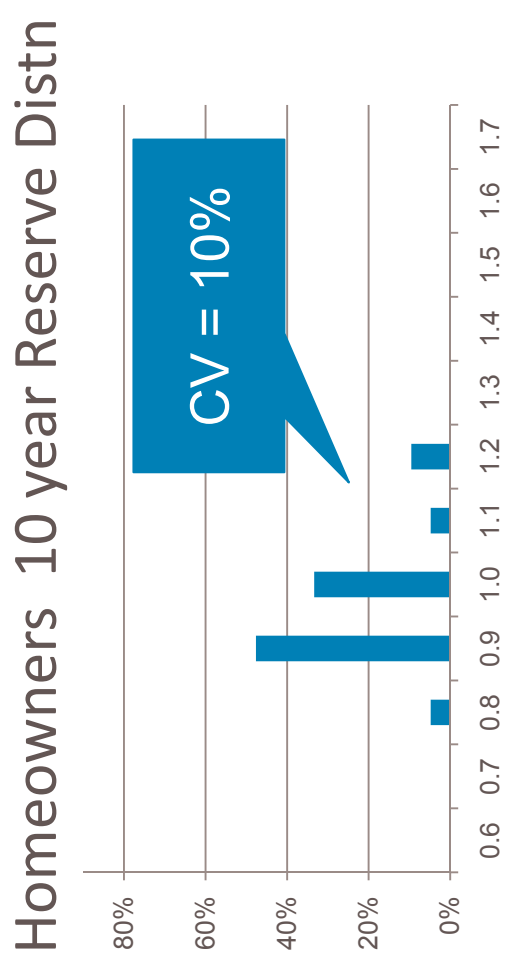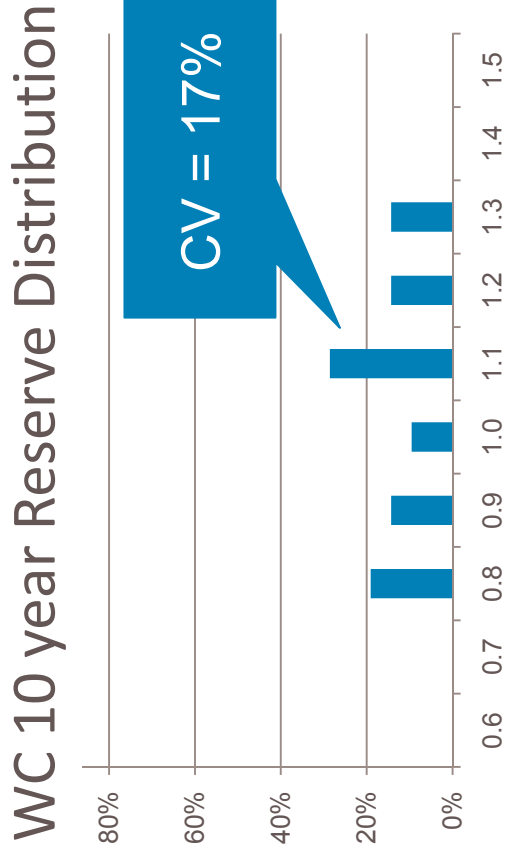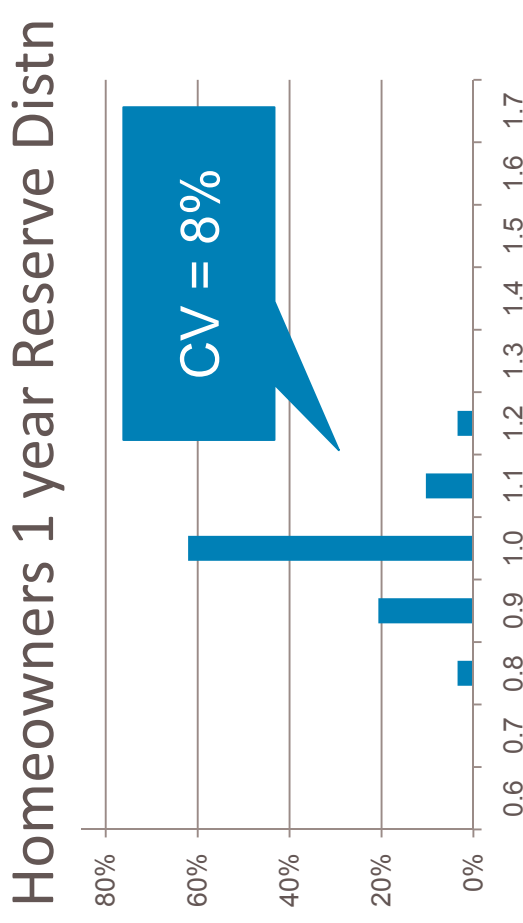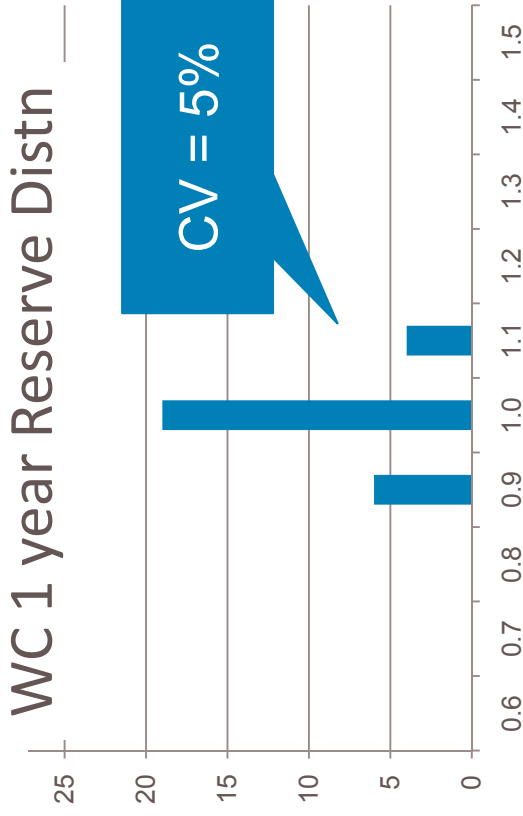
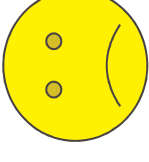# One Year versus Ultimate Reserve Risk

One-year risk

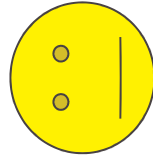1. Increases with increasing ultimate reserve risk

One Year versus Ultimate Reserve Risk

One-year risk

1. Increases with increasing ultimate reserve risk

2. Decrease with increasing uncertainty in the estimate

One Year versus Ultimate Reserve Risk

One-year risk 🙂

1. Increases with increasing ultimate reserve risk 🙂

2. Decrease with increasing uncertainty in the estimate 🙁

GUY CARPENTER

1. What is the workers compensation cycle?

2. What causes it?

3. What can we do about it?

Jessica Leong

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