Analysis of Cotton Price Volatility

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International Cotton Advisory Committee (ICAC)

USDA Economists Group Seminar

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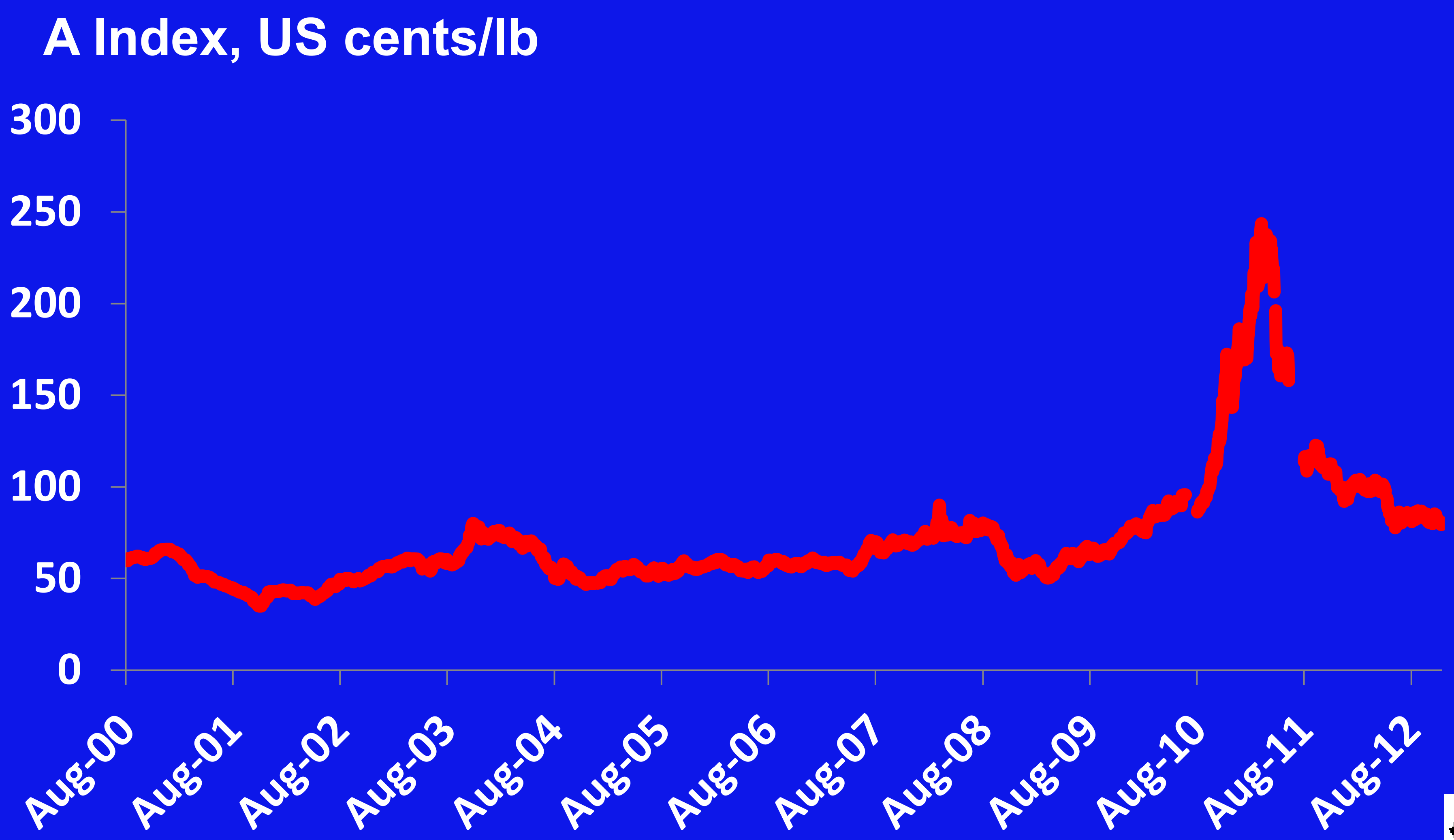
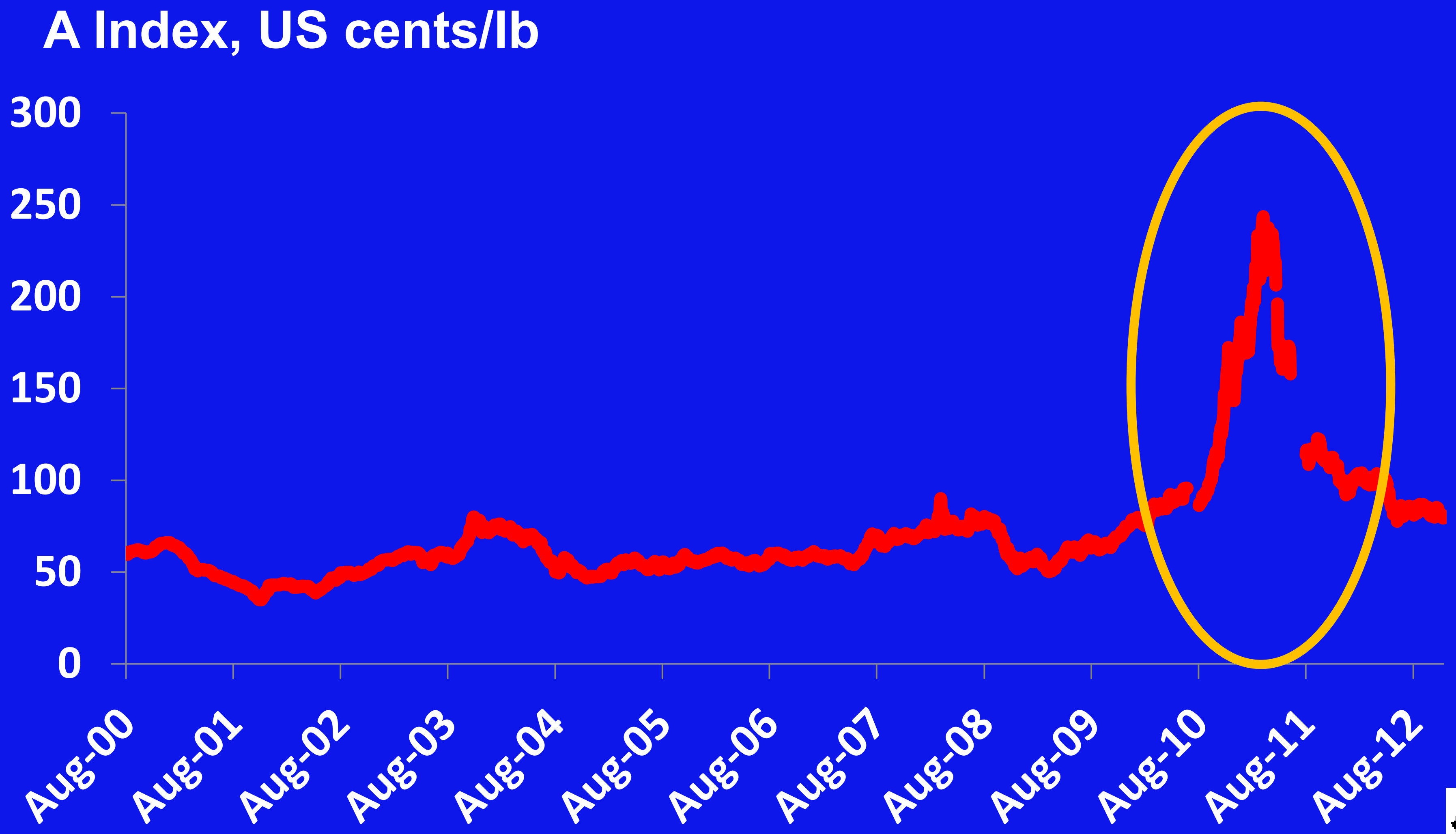
Cotlook A Index
Aug 2000 – Nov 2012



Cotlook A Index
Aug 2000 – Nov 2012



Cotlook A Index
Aug 2009 – Nov 2012

Contents

- Definition
- Challenges in Measuring Volatility
- Methods and Estimates of Cotton Price Volatility
- Overview of Methods
- Caveats

Price Volatility

Degree of dispersion/concentration of prices:

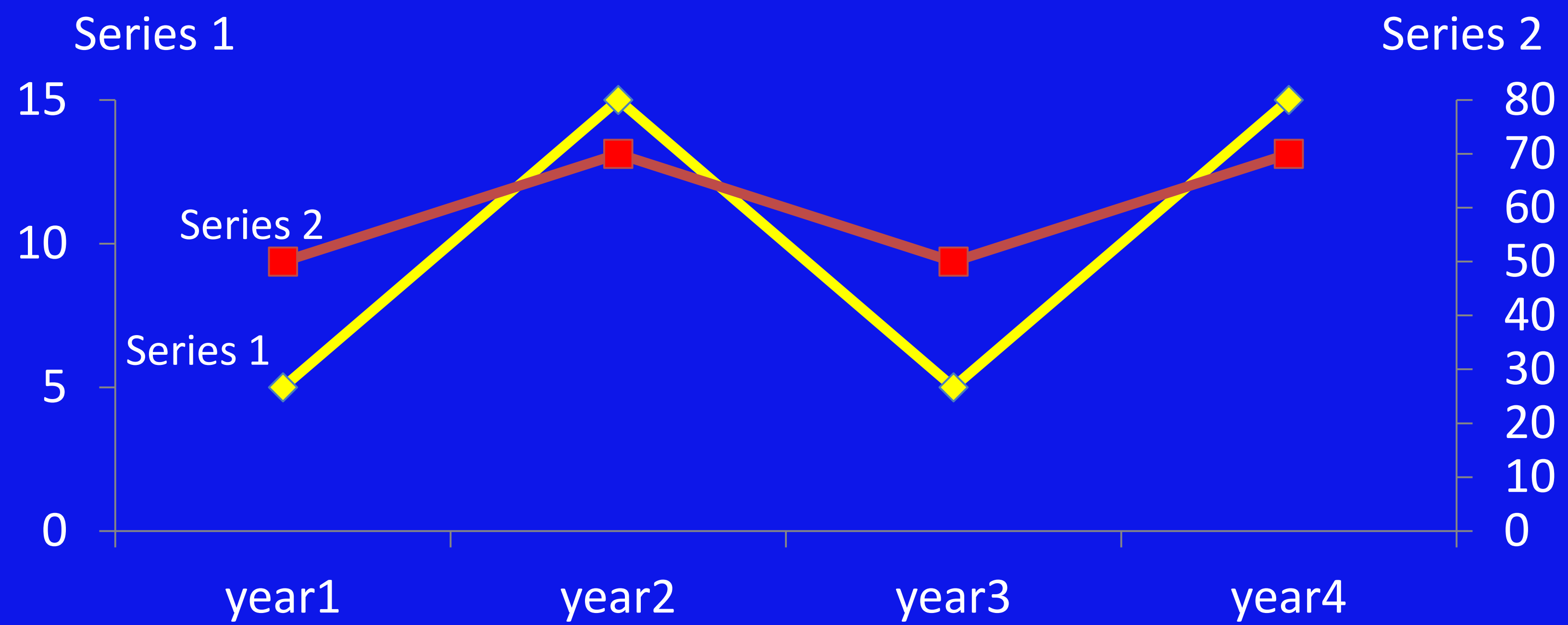
- High volatility: high dispersion (low concentration)
- Low volatility: low dispersion (high concentration)
- Volatility ≠ Level of prices

Challenges in Measuring Volatility

- Scale effect
- Path dependency
- Trends
- Frequency of data

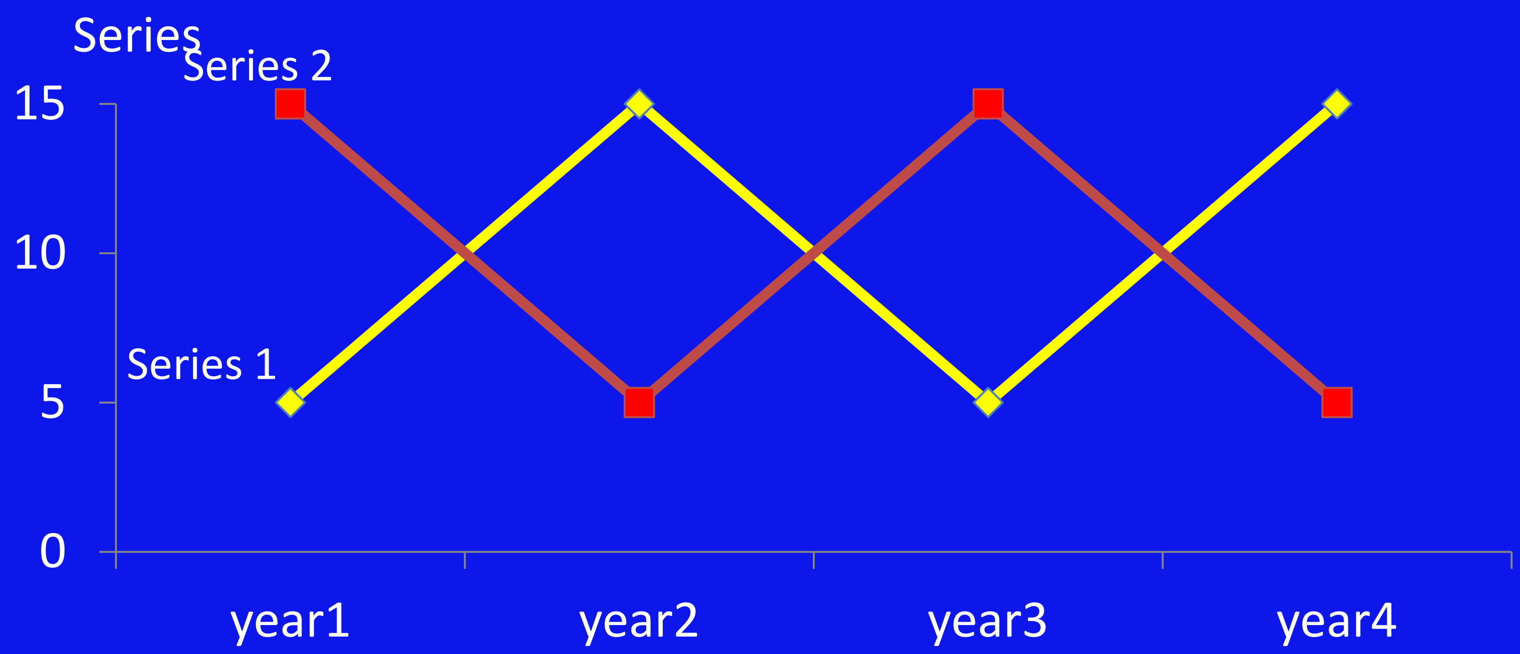
Scale Effects

- Range = highest – lowest
- Range Series 1 = $10
- Range Series 2 = $20
- Which series is more volatile?



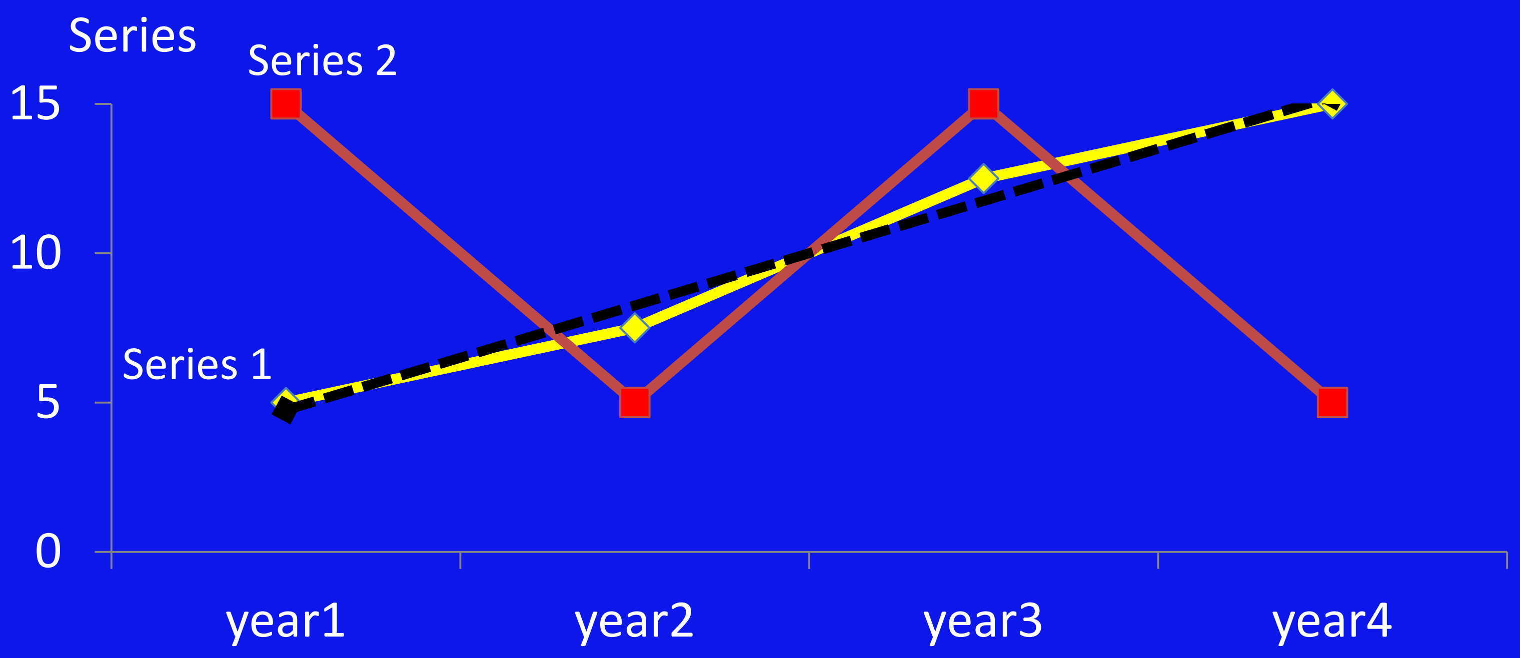
Path Dependency

- Same Range
- Same Average
- Which series is more volatile?



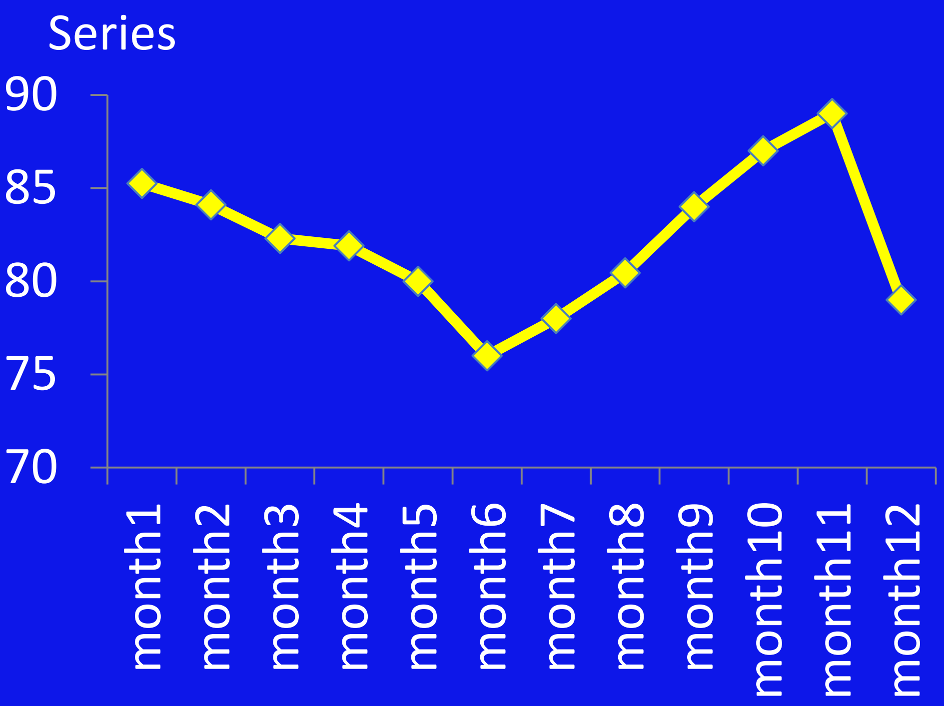
Trends

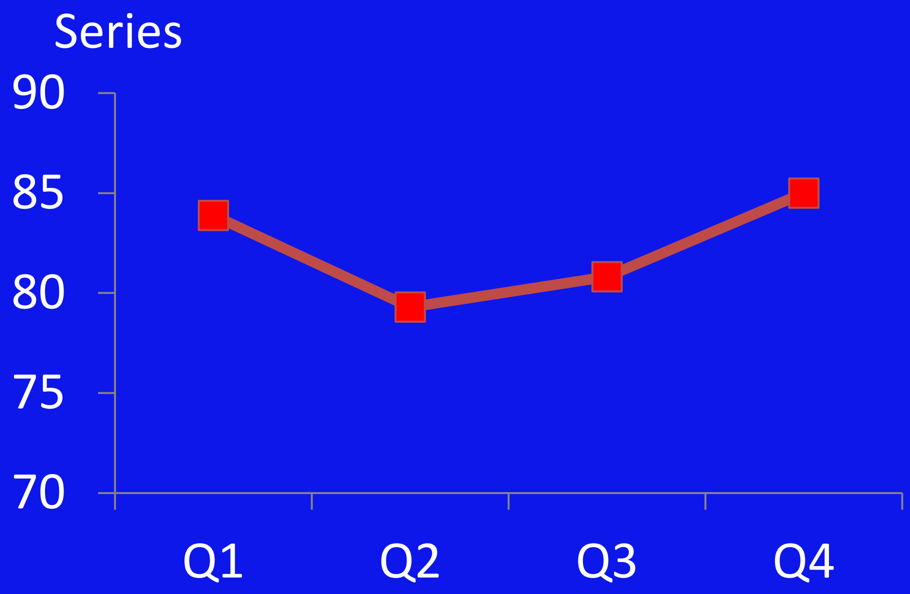
- Same Range
- Same Average
- Series 1 has a trend
- Which series is more volatile?



Data Frequency

- Data Aggregation (monthly, quarterly, etc.):
- Same Averages
- Lose information on distribution
- Which series is more volatile?





Methods to Gauge Volatility

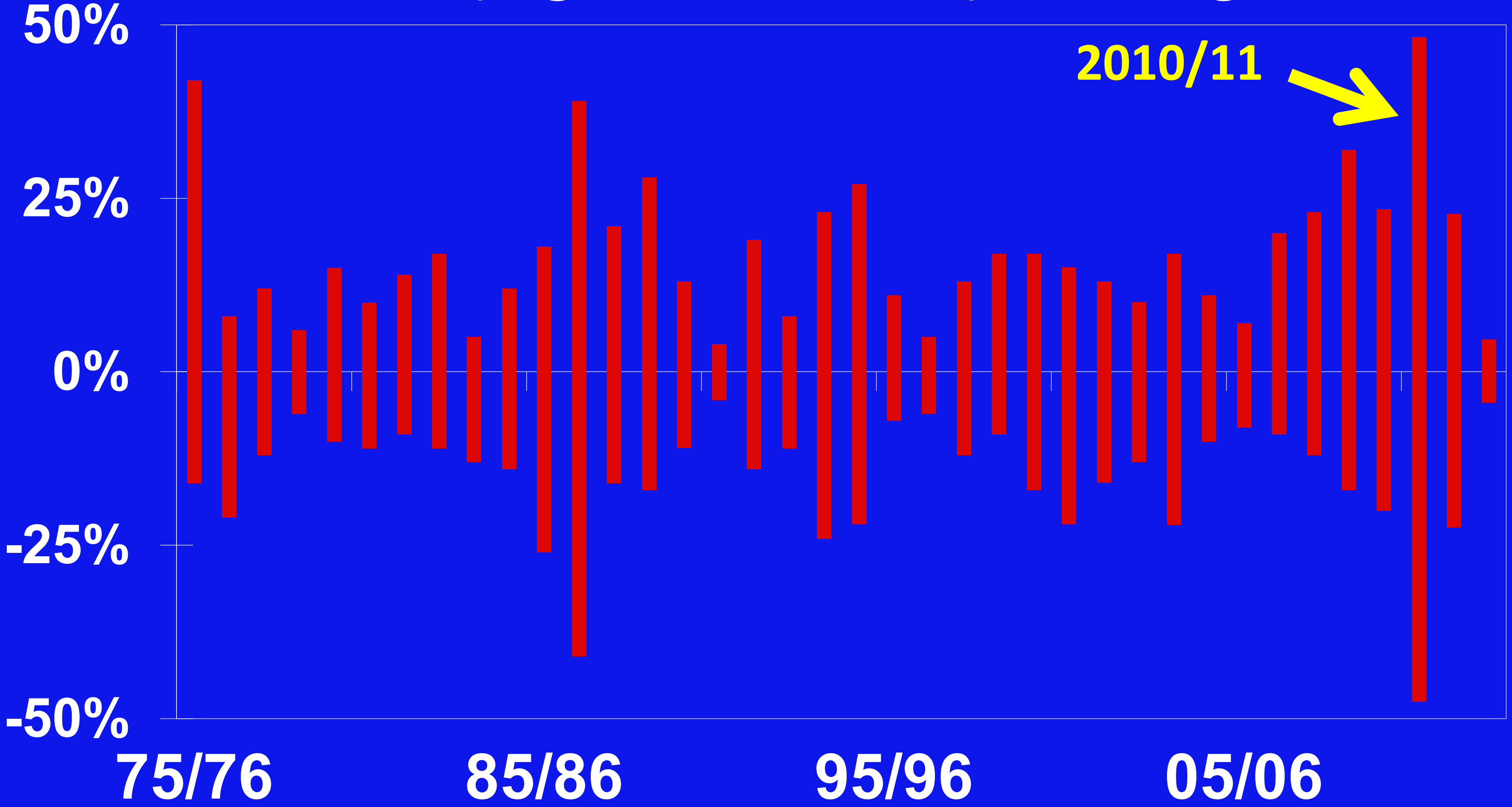
1) Relative Spread
2) Coefficient of Variation
3) Mean Absolute Percentage Forecast Error
4) Standard Deviation of Log Difference in Prices

Relative Spread

- RS = (highest – lowest) / average
- Advantages:
  - Easiest to communicate
  - No scale effect
  - Path neutral
- Disadvantages:
  - NO use of info on distribution of prices
  - Only extreme values and mean
  - Does not account for trends

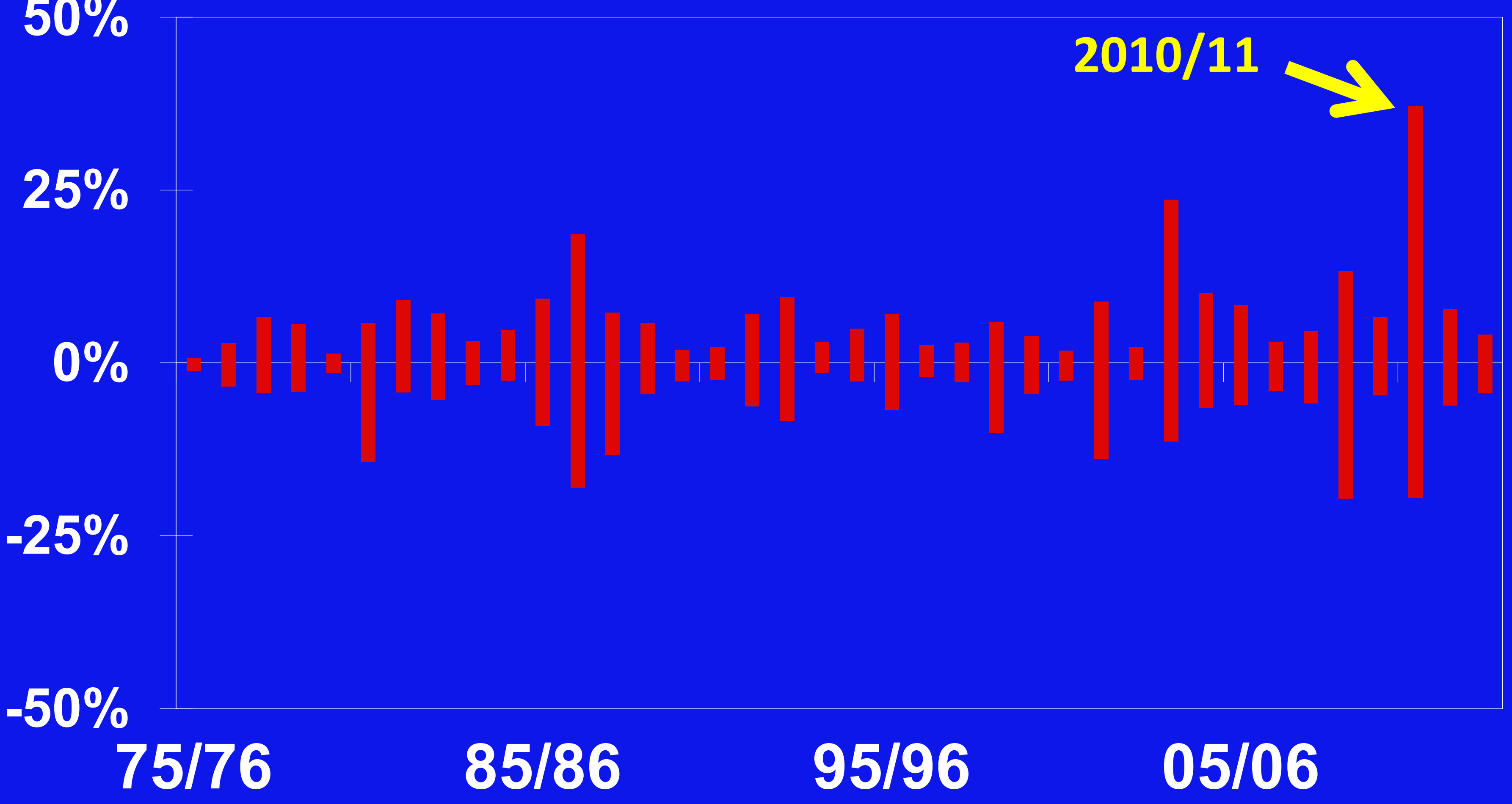
Relative Spread: A Index by Crop Year Daily Quotations

RS = (highest – lowest) / average



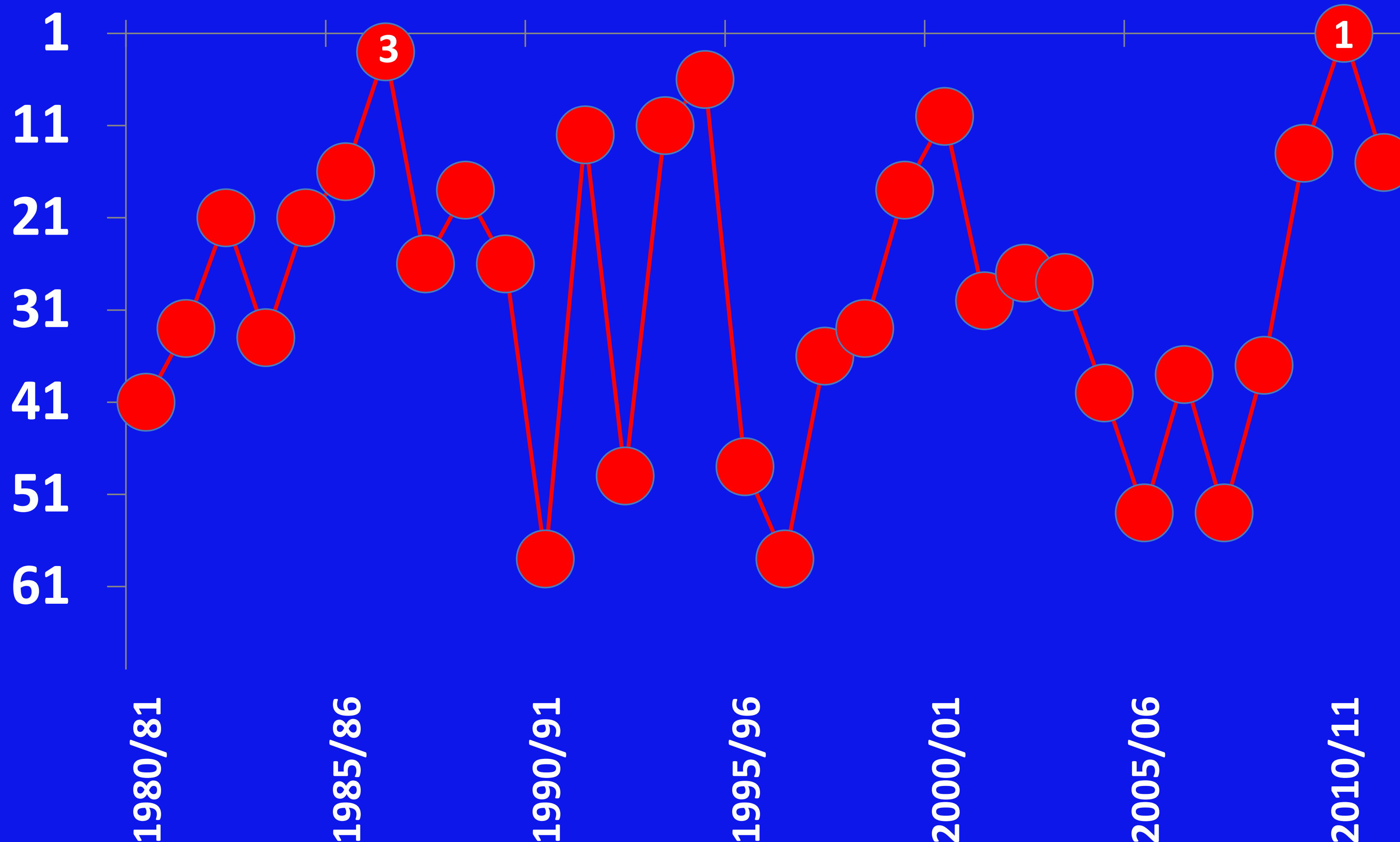
2012/13: August – November

Relative Spread: A Index, First 3 Months of Each Crop Year Daily Quotations



2012/13: August – November

Ranking of Cotton Price Volatility among 64 Commodity Prices (RS)

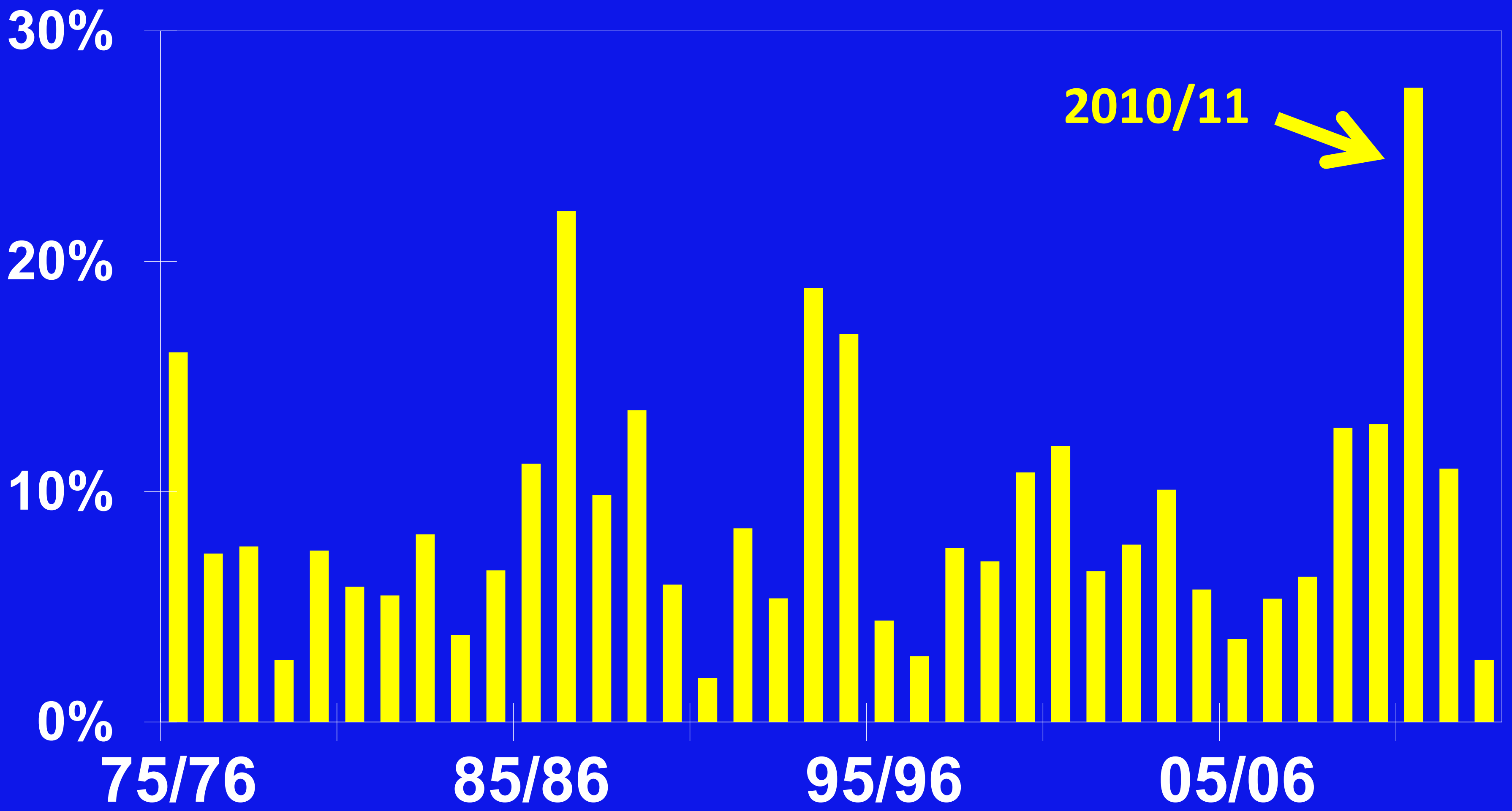


2011/12: August - December

Coefficient of Variation

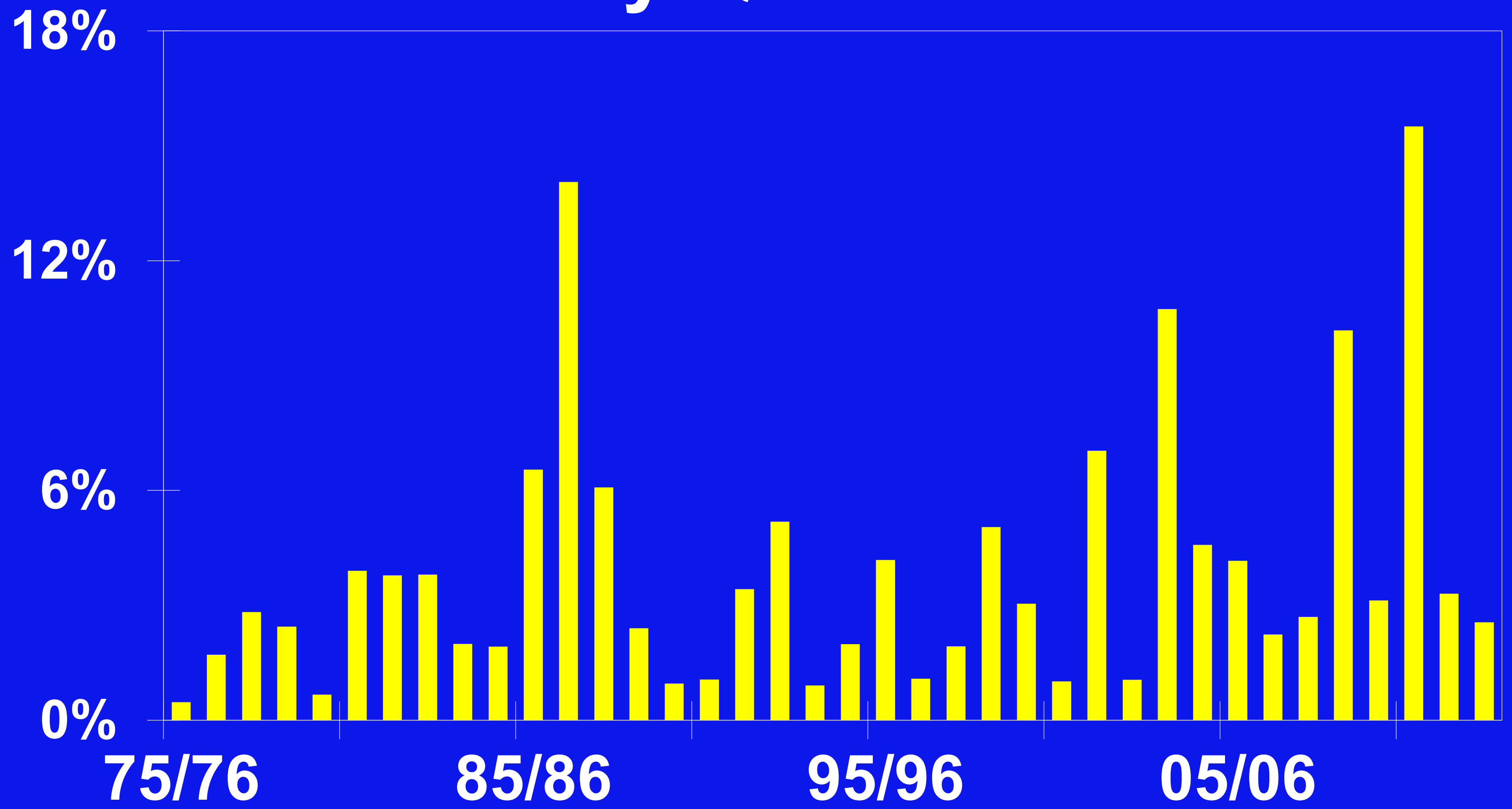
- CV = standard deviation / average
- Advantages:
  - Easy to communicate
  - No scale effect
  - Path neutral
  - Uses entire distribution of prices
- Disadvantages:
  - Does not account for trends

Coefficient of Variation: A Index by Crop Year, Daily Quotations



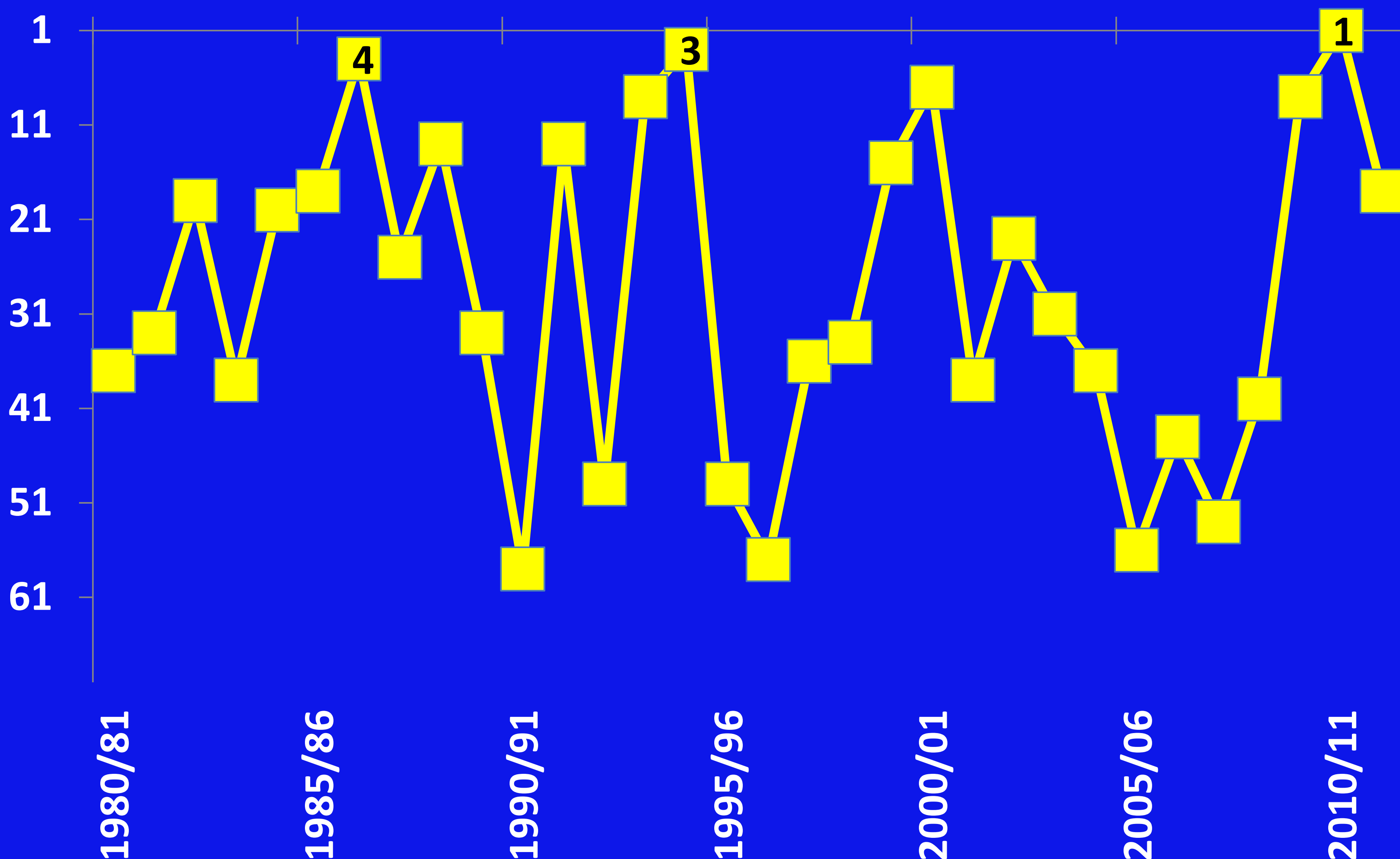
2012/13: August – November

Coefficient of Variation: A Index First 3 Months of Each Crop Year Daily Quotations



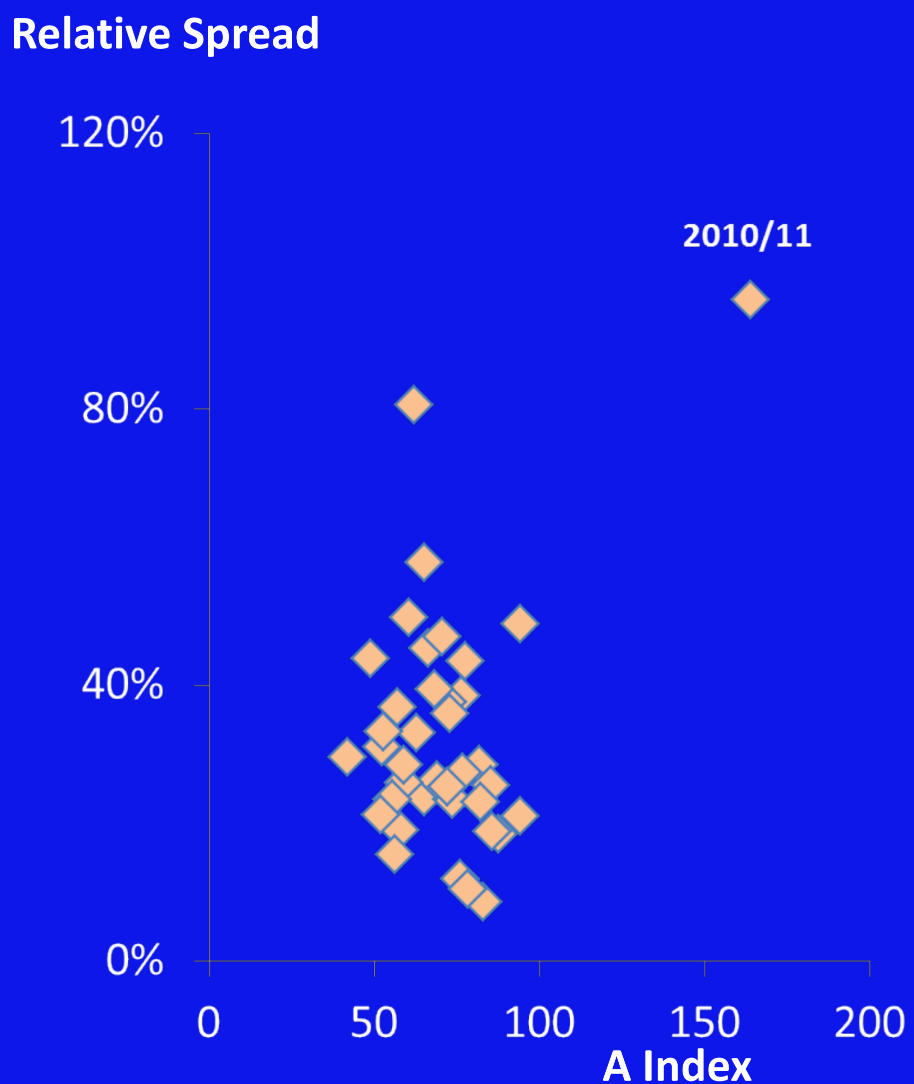
August - October

Ranking of Cotton Price Volatility among 64 Commodity Prices (CV)



2011/12: August - December

Average A Index vs. Volatility Measures by Seasons



Mean Absolute Percentage Forecast Error

- MAPFE = Mean absolute value of the % difference between the one step ahead forecast produced with a constant and a trend, and the observed price.

$$\sum_{t=1}^{T-1} \left| \hat{p}_{t+1} - p_{t+1} \right| \Big/ (T-1)$$

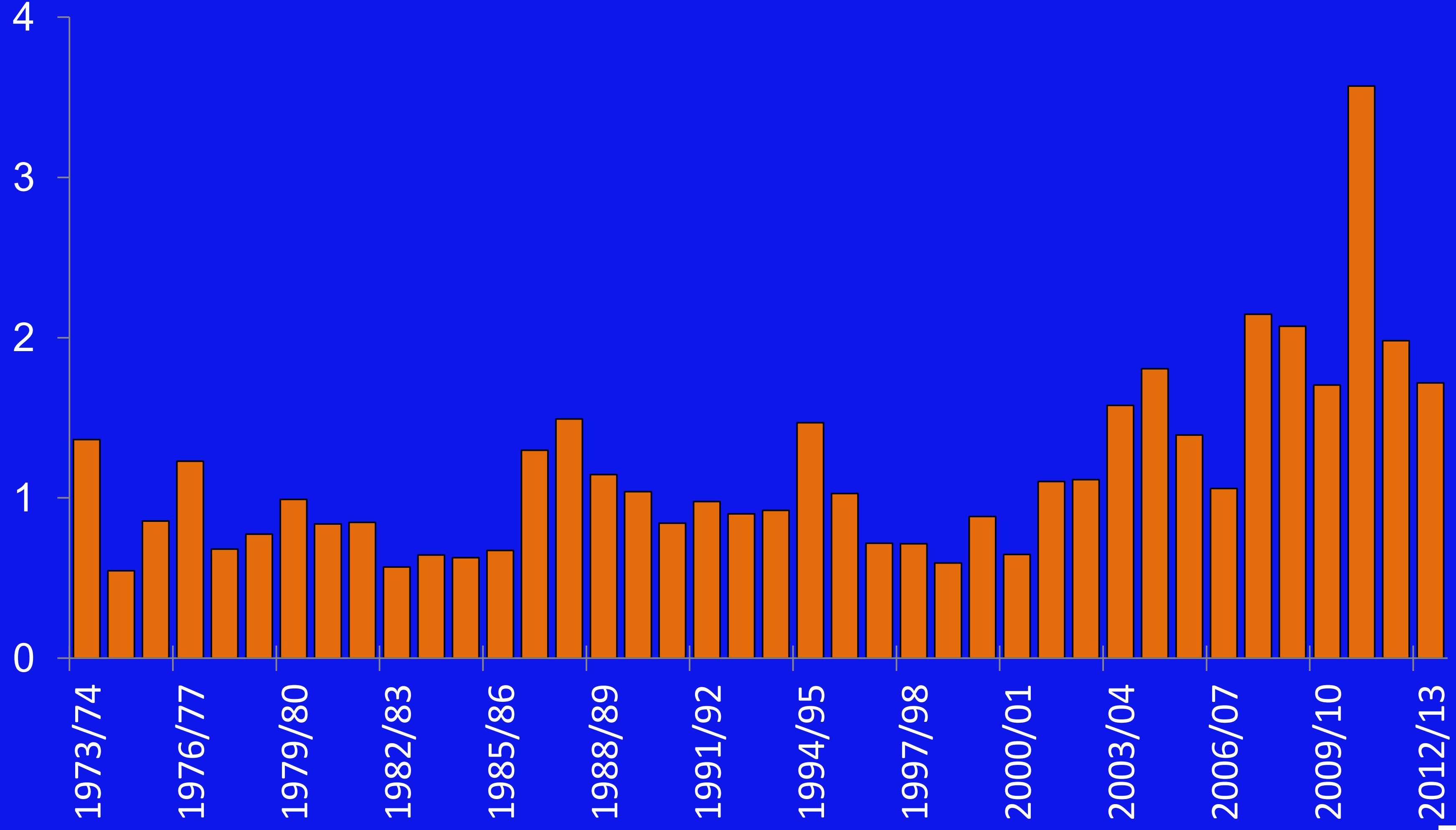
$$p_t = \alpha_0 + \beta Trend_t + \varepsilon_t$$

$$\overline{R}^2 = \sum_{t=1}^{T-1} R_{t+1}^2 \Big/ (T-1)$$

Mean Absolute Percentage Forecast Error

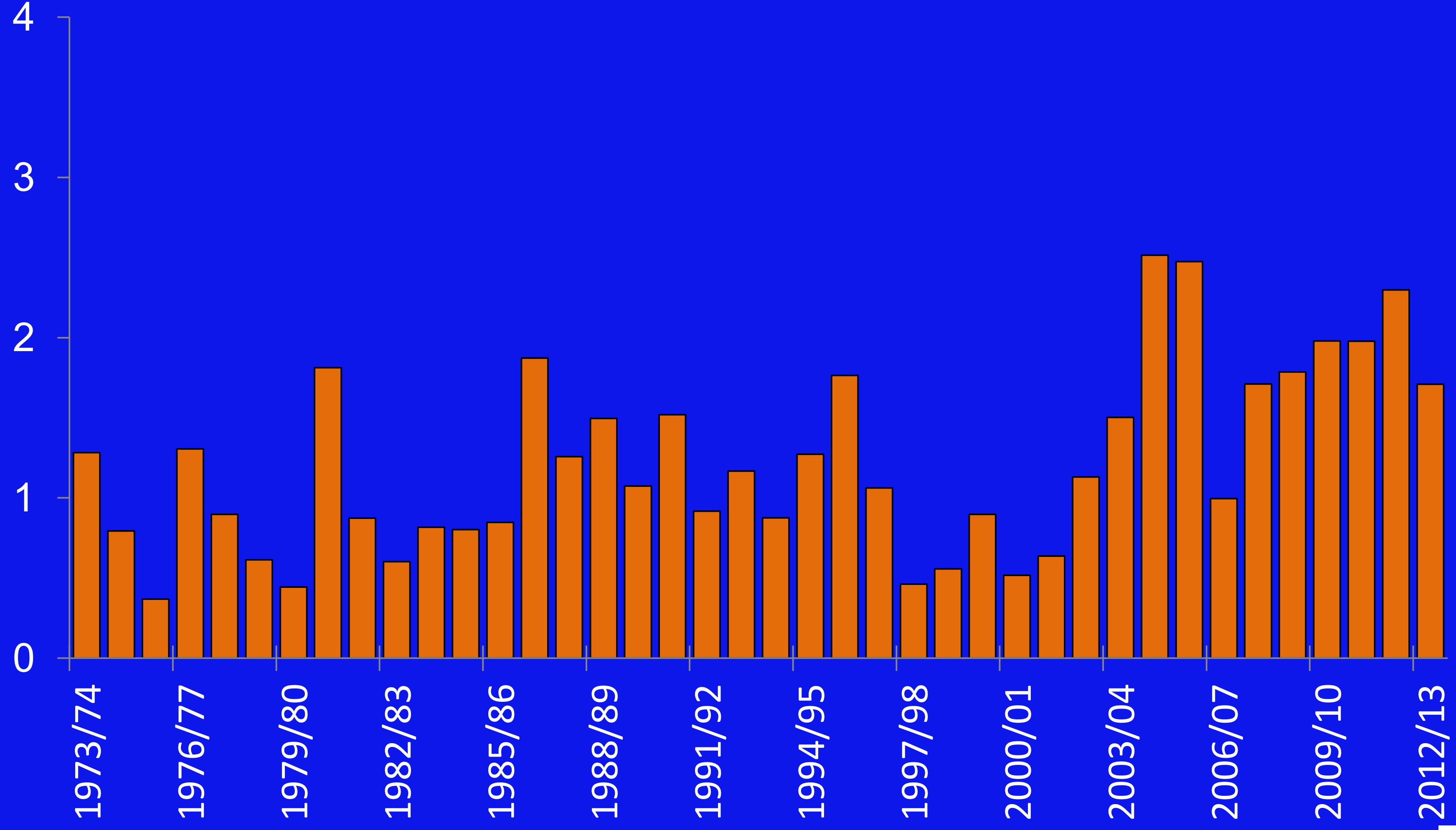
Advantages:
  - No scale effect
  - Does account for trends
  - Uses entire distribution of prices
- Disadvantages:
  - Not so easy to communicate
  - Path dependent
  - If Average R^2 low, MAPFE not relevant

Mean Absolute % Forecast Error: A Index by Crop Year

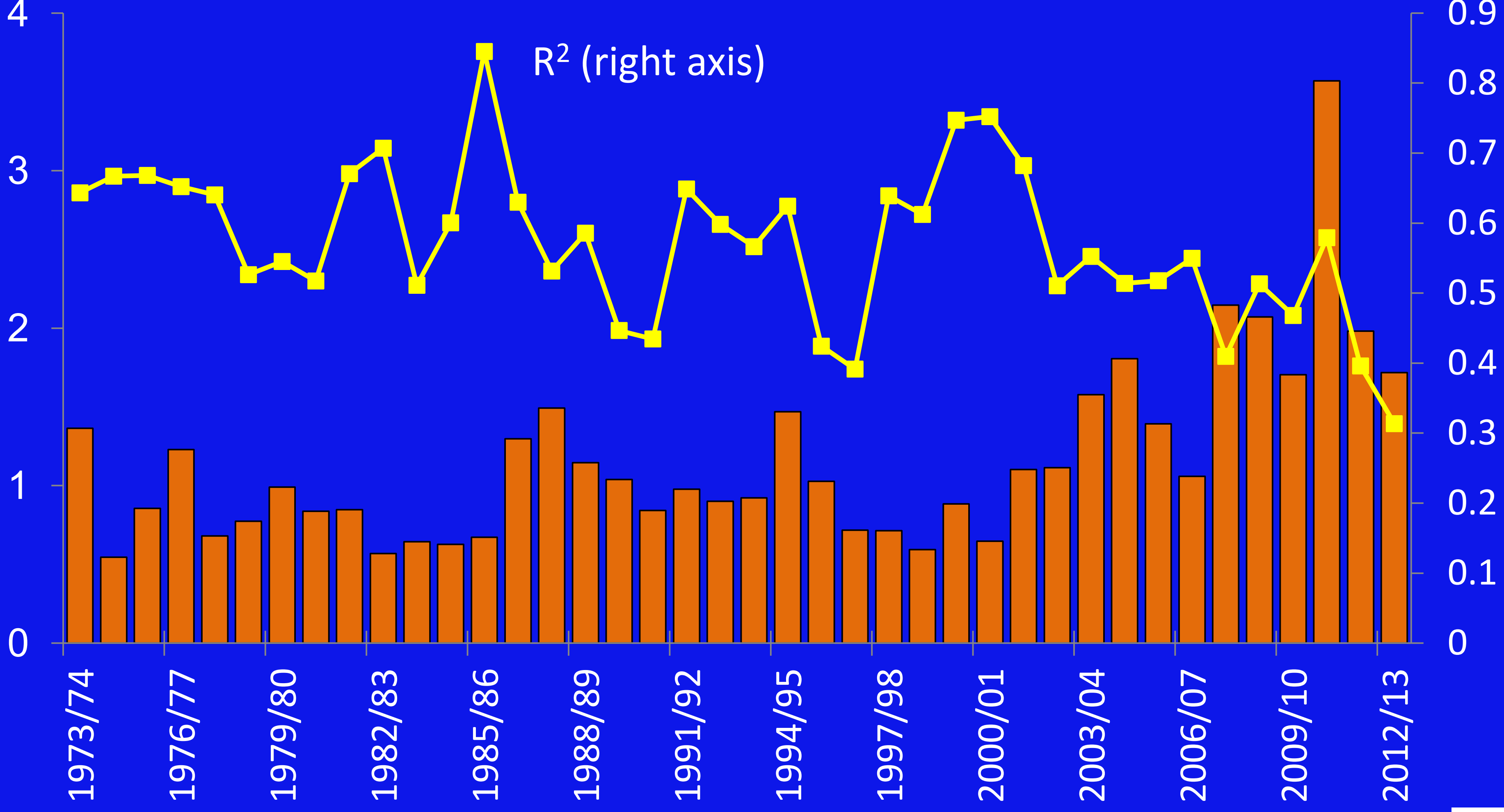


2012/13: 1 August – 17 Nov

Mean Absolute % Forecast Error: A Index, First 3 Months of Season



Mean Absolute % Forecast Error: A Index by Crop Year



2012/13: 1 August – 17 Nov

Standard Deviation of the % Change in Prices: GARCH-M model

- General Autoregressive Conditional Heteroskedastic in mean model
- Model of inter-daily changes in prices:

$$dlog(A_t) = a_0 + \sum_{i=1}^{3} a_1 ddaym_{it} + b_0 dICE_t + \sum_{i=70s,\dots,00s} b_i \, ddecade_{it} + \sum_{i=1}^{j} d_i dlog(A_{t-i}) + g h_t + \varepsilon_{1t}$$

- Model of conditional variance of ε_{1t}: $\varepsilon_{1t} = v_t \sqrt{h_t}$

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{1t-i}^{2} + \sum_{i=1}^{p} \beta_i h_{t-i} + \delta_0 \, dICE_t + \sum_{i=80s,\dots,00s} \delta_i \, ddecade_{it} + \varepsilon_{2t}$$

Standard Deviation of the % Change in Prices: GARCH-M model

- Advantages:
  - No scale effect
  - Uses entire distribution of prices
  - Accounts for trends
  - Clear hypothesis testing
  - Focused on confidence intervals of changes in prices
- Disadvantages:
  - Difficult to communicate
  - Path dependent

Variable	Coefficient	Std. Error	z-Statistic	Prob.
g	-0.099265	1.641093	-0.060487	0.9518
a_0	0.000658	0.001439	0.457101	0.6476
a_1	0.000517	0.000283	1.825712	0.0679
a_2	0.003870	0.000314	12.31635	0.0000
a_3	-0.019571	0.000795	-24.61412	0.0000
b_0	4.12E-05	0.000705	0.058416	0.9534
b_{70s}	-0.000486	0.001441	-0.337145	0.7360
b_{80s}	-0.000767	0.001439	-0.533153	0.5939
b_{90s}	-0.000976	0.001440	-0.678036	0.4977
b_{00s}	-0.000687	0.001419	-0.483935	0.6284
d_1	0.104590	0.012003	8.713892	0.0000
d_2	0.034803	0.009093	3.827422	0.0001
d_3	0.084429	0.013524	6.242798	0.0000
d_4	0.090354	0.011591	7.795331	0.0000
d_5	0.071703	0.012048	5.951318	0.0000
d_6	-0.007085	0.011393	-0.621848	0.5340
d_7	0.032844	0.011413	2.877780	0.0040
d_8	0.067176	0.011574	5.804263	0.0000
d_9	0.062531	0.011788	5.304787	0.0000
d_{10}	0.048687	0.010916	4.460110	0.0000
d_{18}	0.024639	0.010750	2.292133	0.0219
Variance Equation				
α_0	1.10E-05	2.32E-06	4.745452	0.0000
α_1	0.092093	0.008199	11.23212	0.0000
α_2	-0.079050	0.008560	-9.234617	0.0000
α_3	0.168941	0.010679	15.82064	0.0000
α_4	-0.057978	0.010006	-5.794390	0.0000
α_5	0.044185	0.006864	6.436878	0.0000
β_1	0.846131	0.005044	167.7458	0.0000
δ_0	1.29E-06	1.51E-06	0.854285	0.3929
δ_{70s}	-1.05E-05	2.32E-06	-4.510208	0.0000
δ_{80s}	-9.95E-06	2.32E-06	-4.293962	0.0000
δ_{90s}	-8.80E-06	2.31E-06	-3.803523	0.0001
δ_{00s}	-8.83E-06	2.31E-06	-3.827284	0.0001

Null Hypothesis	Wald t-Test	Degrees of freedom	p-value
$\delta_{70s} - \delta_{80s} = 0$	-8.33	9345	0.000
$\delta_{70s} - \delta_{90s} = 0$	-17.28	9345	0.000
$\delta_{70s} - \delta_{00s} = 0$	-8.94	9345	0.000
$\delta_{80s} - \delta_{90s} = 0$	-12.97	9345	0.000
$\delta_{80s} - \delta_{00s} = 0$	-6.37	9345	0.000
$\delta_{90s} - \delta_{00s} = 0$	0.17	9345	0.869

GARCH-M model: A Index Daily Quotations

- End of open outcry ICE did not significantly affect volatility
- Volatility increased every decade from the 1970s to the 1990s and it stabilized until 2010/11.
- Volatility in 2010/11 exceeded historical average.

Methods to Gauge Volatility

	Scale Effect	Path Dependency	Accounts for Trends
Relative Spread	No	Neutral	No
Coefficient of Variation	No	Neutral	No
MAPFE: Mean Absolute Percentage Forecast Error	No	Dependent	Yes: short-term trends
StdDev %Change in Prices: GARCH-M model	No	Dependent	Yes: long- and short-term trends

Concluding Remarks

- Volatility depends on:
  - Frequency of data
  - Measurement method
  - Period over which it is measured

- All methods: 2010/11 record volatility

Thank you for your attention

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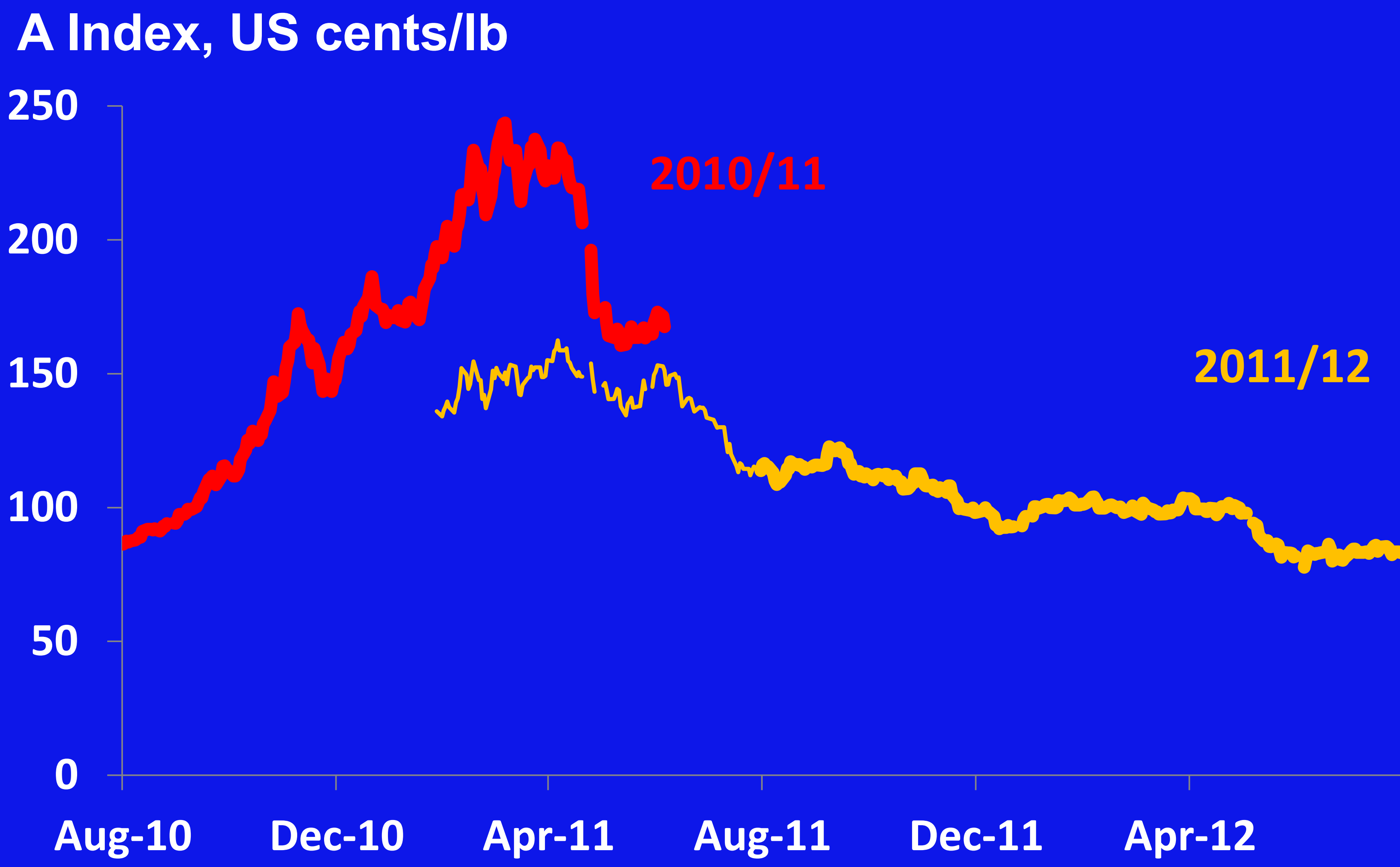
Discover natural fibres 2009

Sources of Volatility in 2010/11

Cotlook A Index
1 August 2010 – 31 July 2012



Factors Affecting Cotton Prices in 2010/11