

Biennial Convention 2007

# Adventures in Risk

23-26 September 2007 • Christchurch, New Zealand

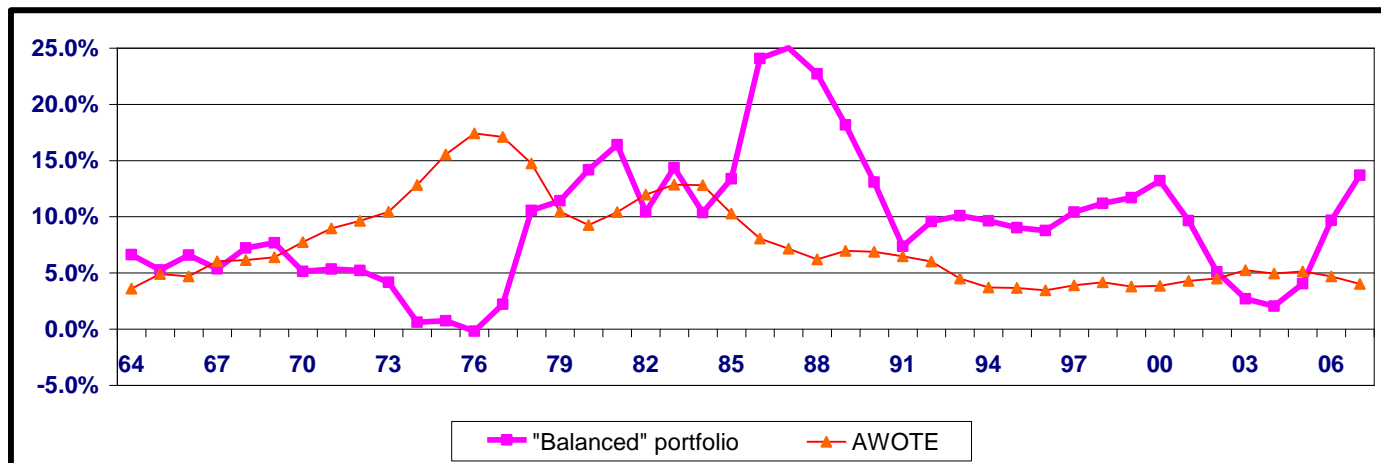


Institute of Actuaries of Australia



# Australian Investment Performance 1960 to 2007 (and Investment Assumptions for Stochastic Models)

Colin Grenfell



Historical 4-year (ending 30/6/64 to 30/6/07) compound average annual returns

Source: *Austmod*, gross of tax, gross of fees



## Presentation

- **What?**
- **Why?**
- **How? ... briefly**
- **Results ... 16 of 61 charts**
- **Acknowledgments**



## What?

- (1) Australian investment performance  
30 June 1960 to 30 June 2007**
- and**
- (2) Investment assumptions for  
stochastic (and deterministic) models**



## What? Growth Securities

- **S Australian shares**
- **I International shares (unhedged)**
- **Q Property trusts**
- **P Direct property**



## What? Interest Income

- **F Australian fixed interest**
- **J International fixed interest (hedged)**
- **G Government semis (0 to 3 yrs)**
- **N Inflation linked bonds (0 + yrs)**
- **L Loans (floating rate)**
- **M Mortgage trust**
- **C Cash**



## What? Financial Indicators

- **X** **CPI**Index (annual increase)
- **W** **A**W**O****T****E** (annual increase)
- **B** **90** day **b**i**l**l rates (mid-year)
- **D** **10** year **b**o**n****d** rate (mid-year)



# “Backdating”

## (1) Different data series

<u>CODE</u>	<u>PRIOR</u>	<u>SERIES</u>
I	1988	MSCI accumulation index
I	1970	S&P500 +3% +\$AU/\$US
F	1985	G (Government) sector
W	1981	AWOTE males
W	1974	AWE all males, total earnings
S	1971	E (Equities) sector
B	1959	13 wk treasury note + 1.37%



# “Backdating”

## (2) Method of least squares

<u>CODE</u>	<u>PRIOR</u>	<u>FORMULA</u>
N	1991	$71.38\%X + 62.99\%F - 195.05\%d$
M	1988	$77.48\%C + 34.49\%L$
J	1986	$76.74\%C + 19.25\%F$
C	1979	$22.68\%B_{-2} + 27.44\%B_{-1}$ $+ 22.82\%B + 25.76\%B_{+1}$
Q	1977	$52.06\%F + 30.42\%S + 18.59\%M$
P	1971	$88.58\%C + 50.02\%X - 23.89\%F$
F	1965	$87.09\%D + 14.33\%B - 673.02\%d$





## What? Statistics

- **Risk margins (over 10 year bond rates)**
- **Coefficients of variation (of rates)**
- **Skewness (of forces)**
- **Kurtosis (of forces)**
- **Cross-correlations (of forces)**
- **Auto-correlations (of forces)**



## Also ...

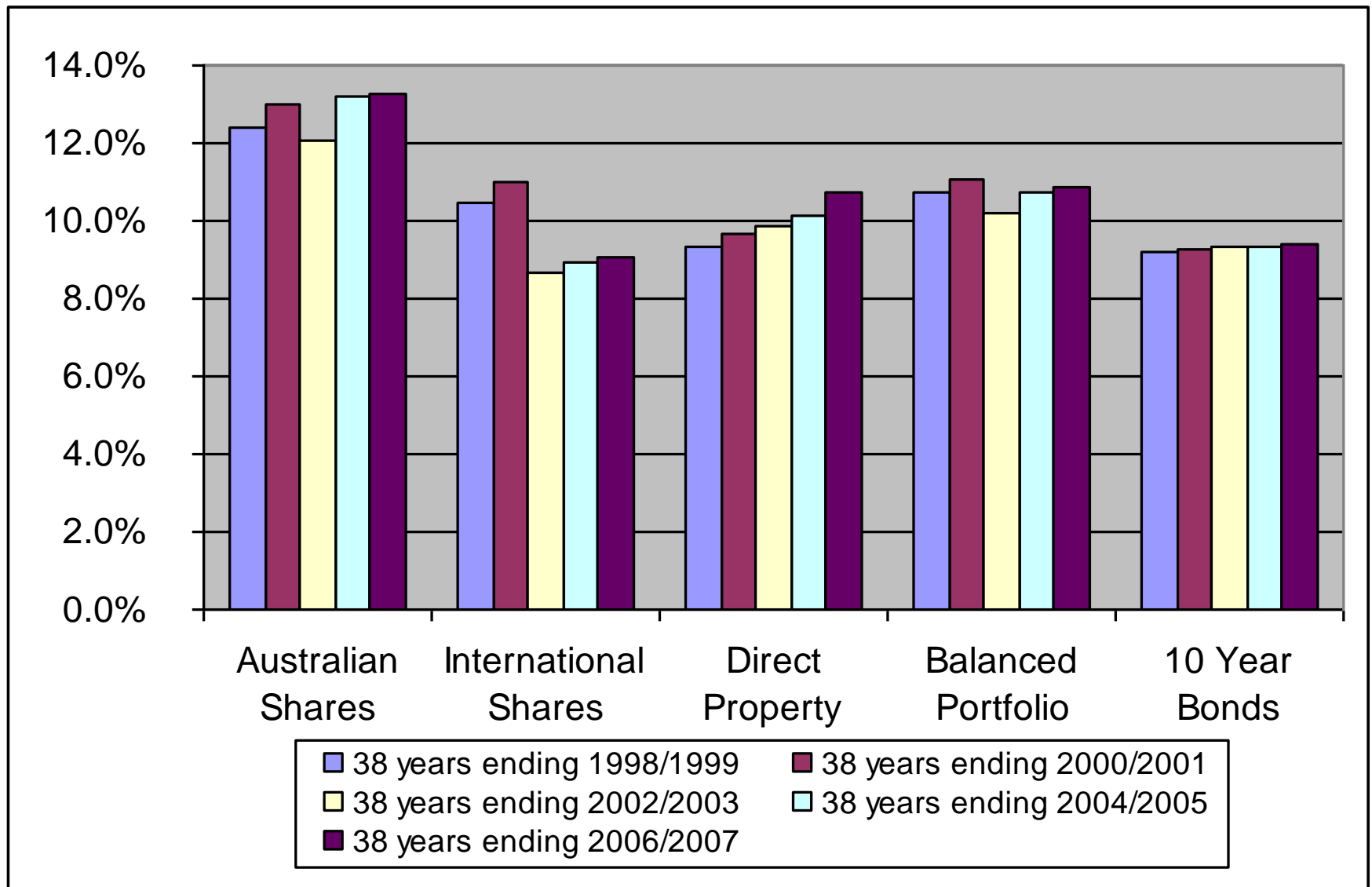
- **Arithmetic means (38 years)**
- **Compound means (38 and 24 yrs)**
- **Standard deviations (38 years)**
- **“Balanced” and “Capital stable”**
- **Gross/net of superannuation tax**
- **Gross/net of wholesale passive fees**



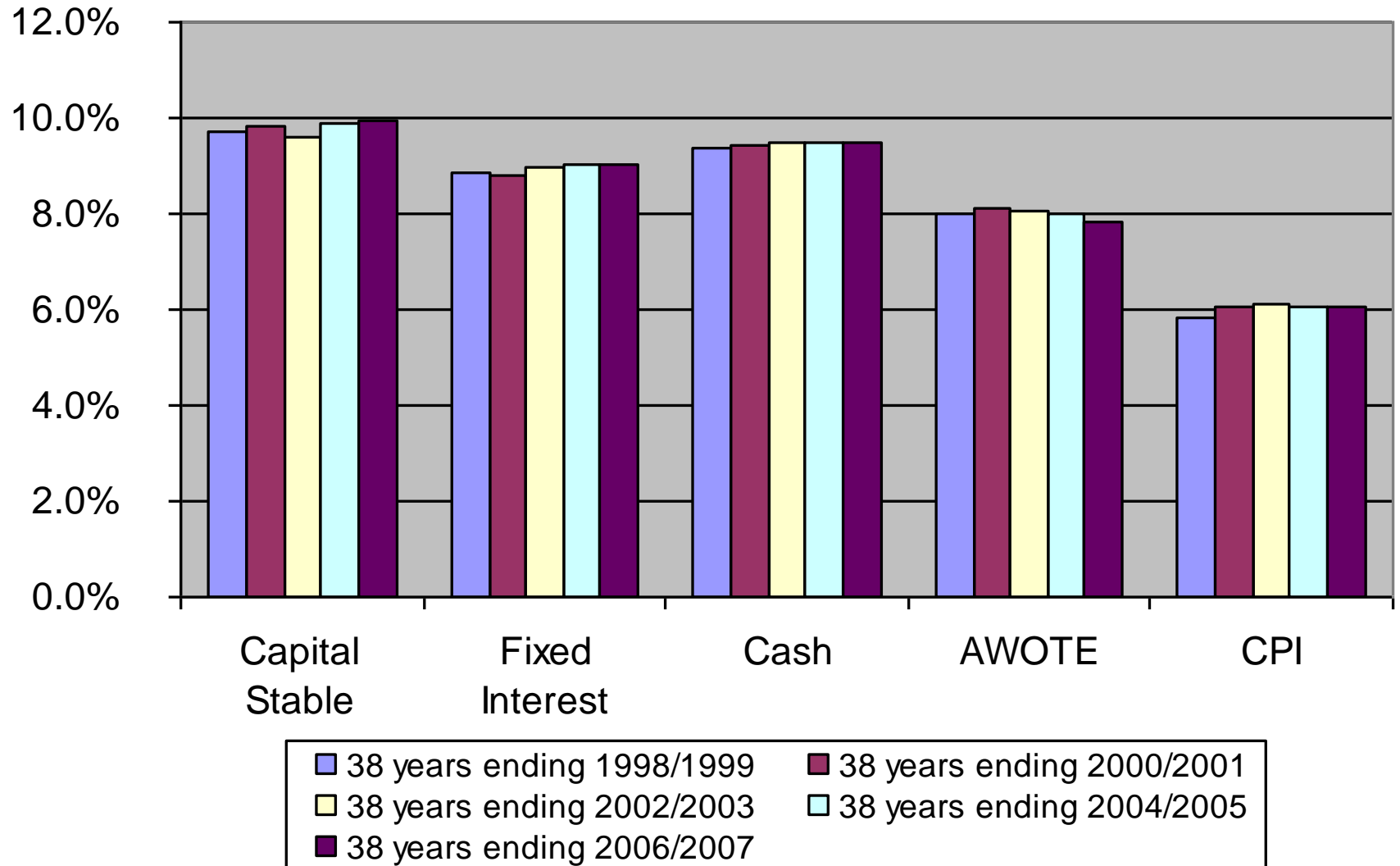
## Why?

- Demand versus supply gap
- EFG investment system = 42 yrs
- Valuable long-term database
- Importance of auto-correlations
- Importance of economic cycles

# Average (compound) Returns pa.

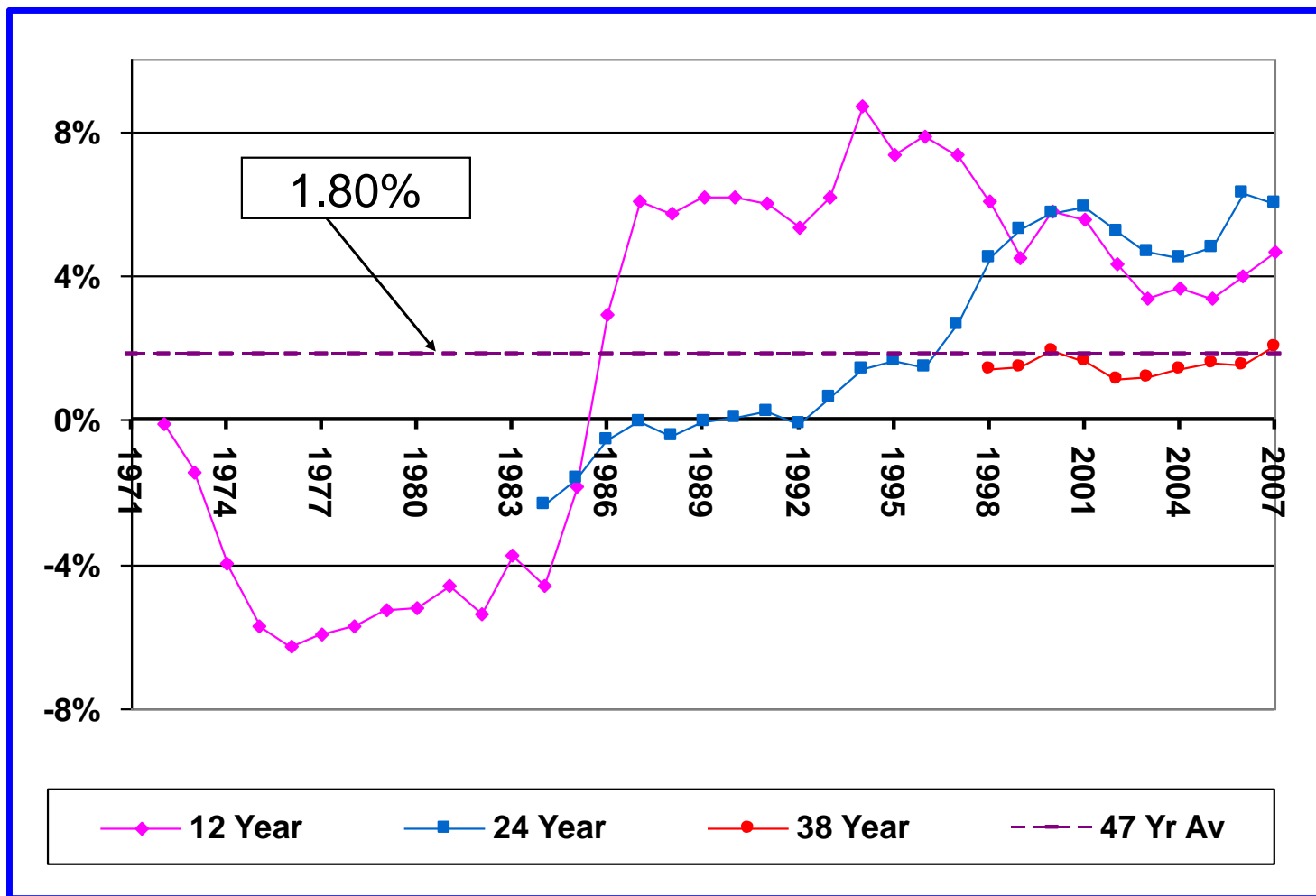


# Average (compound) Returns pa.





## Rolling Average Real “Balanced” Returns pa



Net of Tax and Fees, Real over AWOTE, to 30/6/07



## Why? another reason

- **1979**      **Pace of funding**      **deterministic**
  - **1992/7**    **Investment models**      **stochastic**
  - **2003**      **Auto-correlations**      **correlations**
  - **2004**      **Skewness/kurtosis**      **3<sup>rd</sup>/4<sup>th</sup> moments**
  - **2005/7**    **Benefit projections**      **+ sensitivity**
-



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**all**      **need data and assumptions**





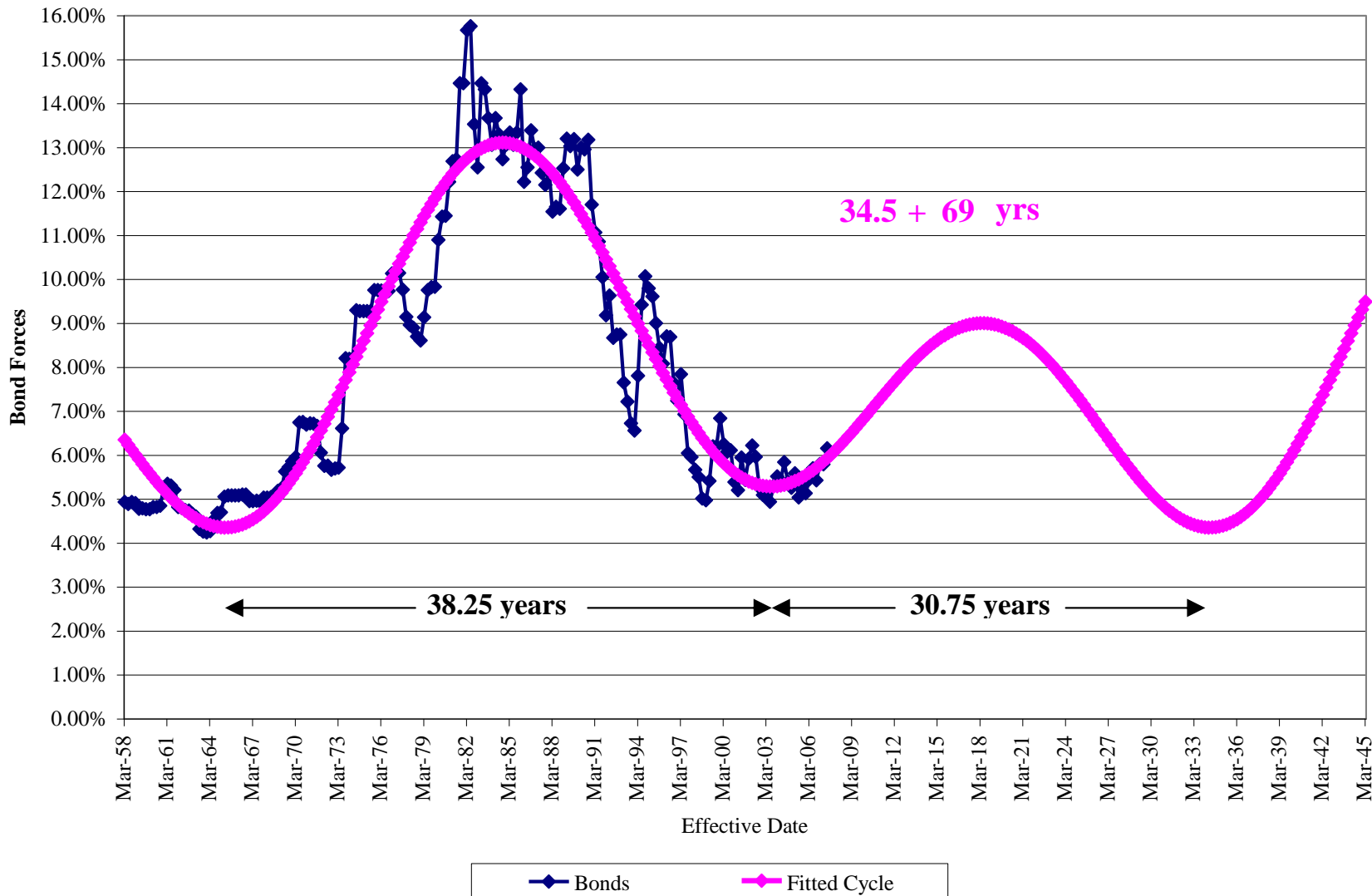
## How? Methodology

- **Step 1** Sep, Dec, March, June data
- **Step 2** determine calculation periods
- **Step 3** annual statistics
- **Step 4** 9 “running” averages (of 4)
- **Step 5** trend and 6 year projection
- **Step 6** year - 2 (and judgment)



## Bonds

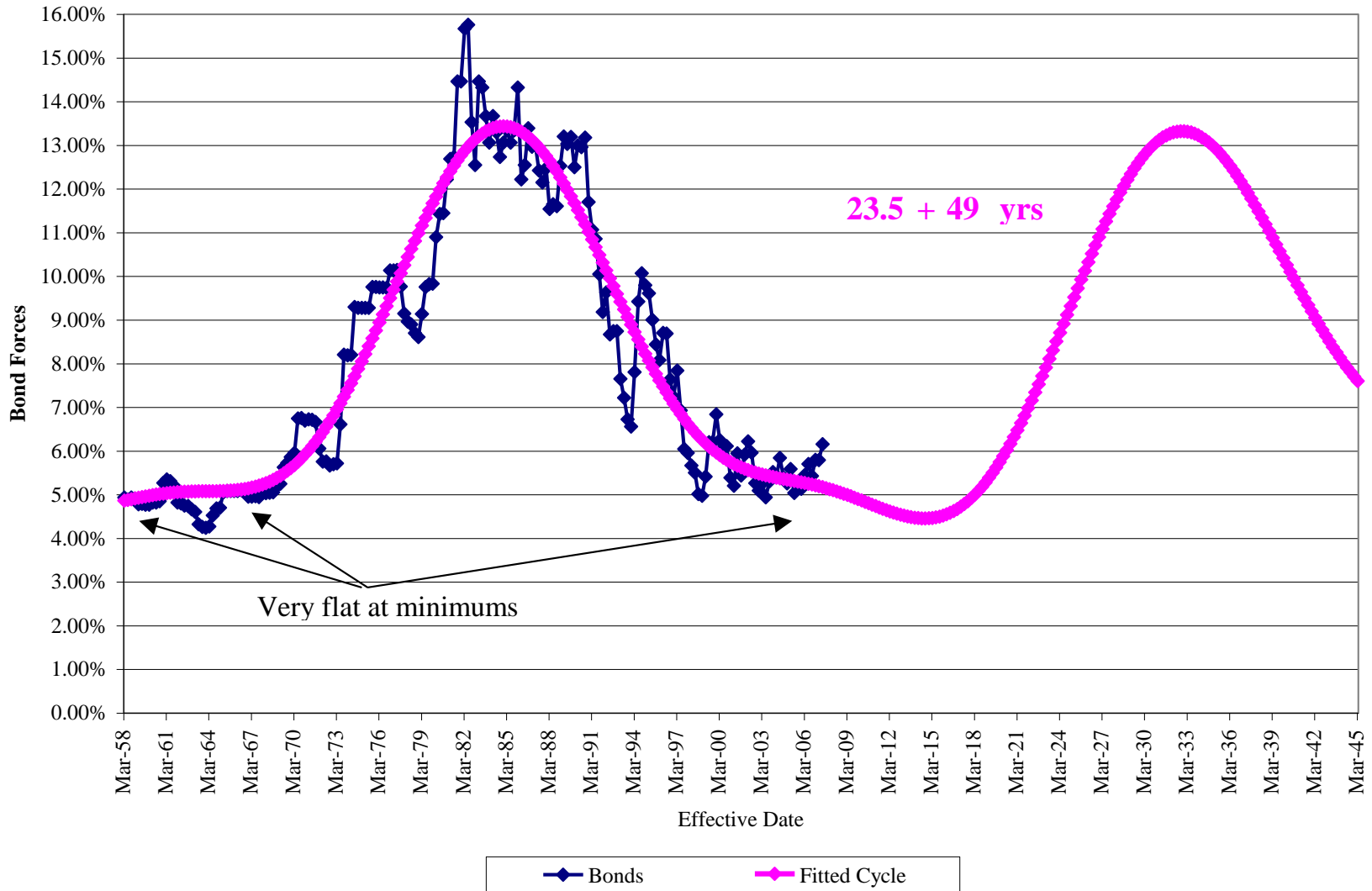
### Fig 5.1





## Bonds

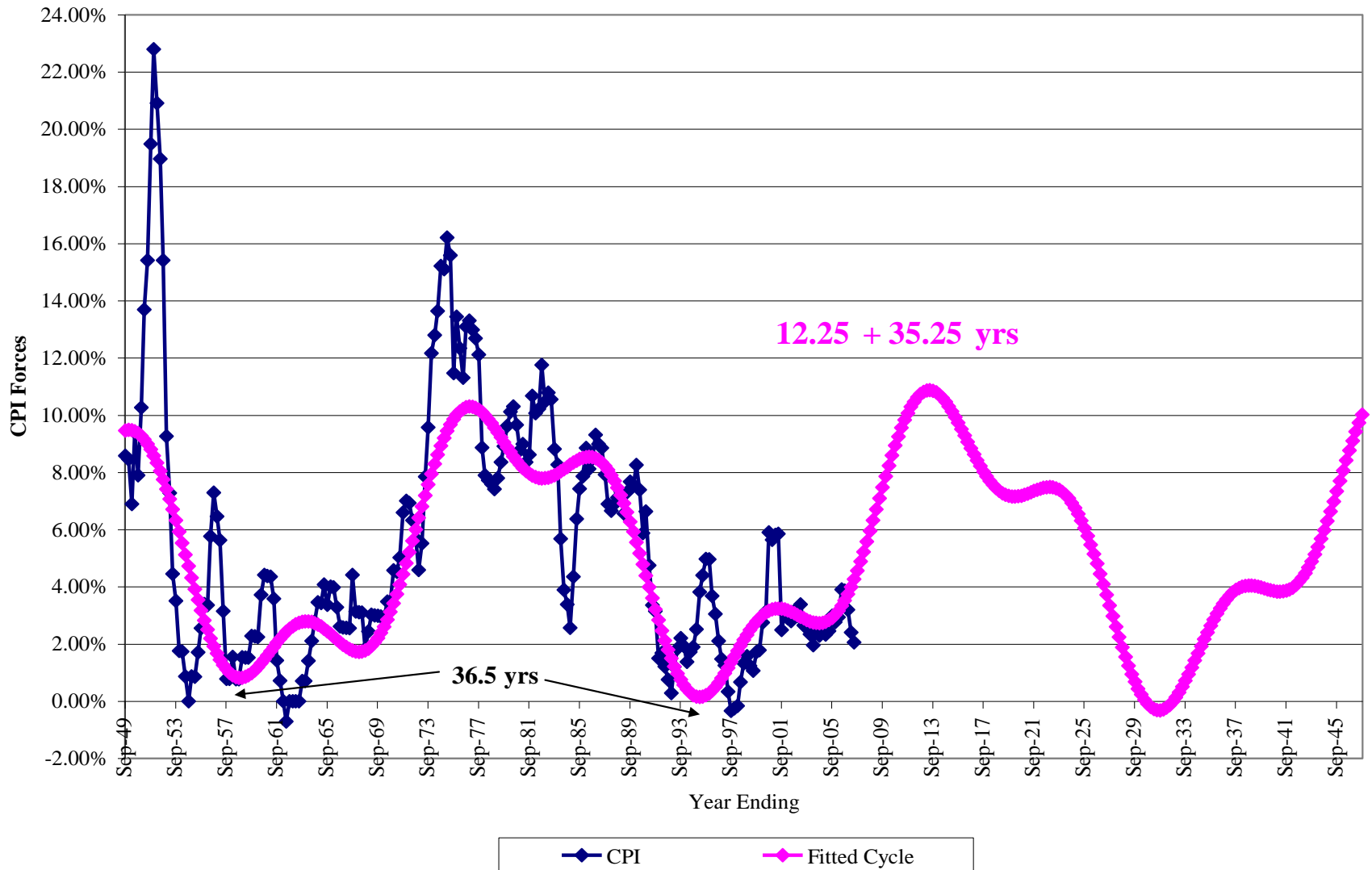
## Para 5.7





## CPI

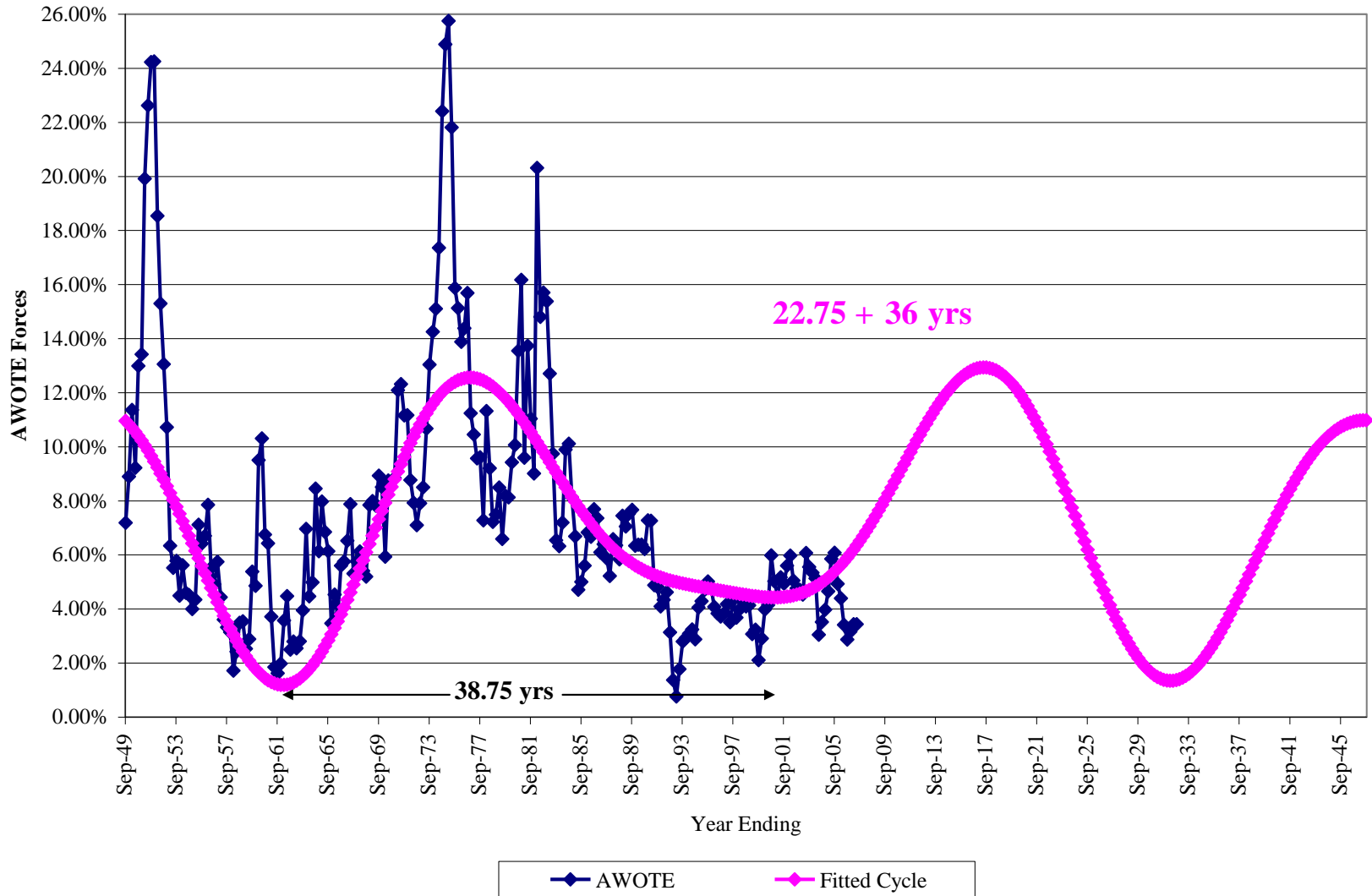
### Fig 5.2





## AWOTE

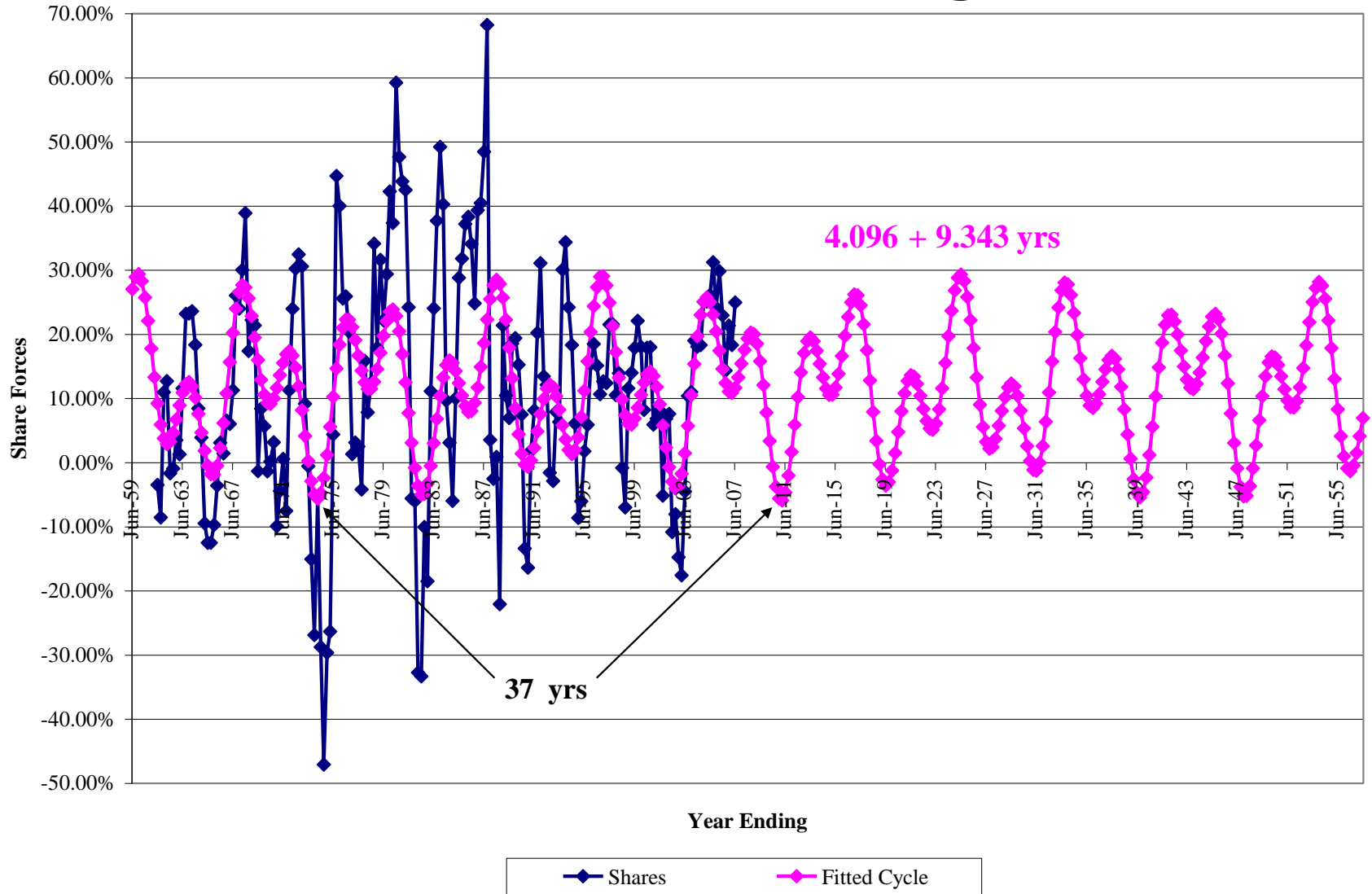
### Fig 5.4





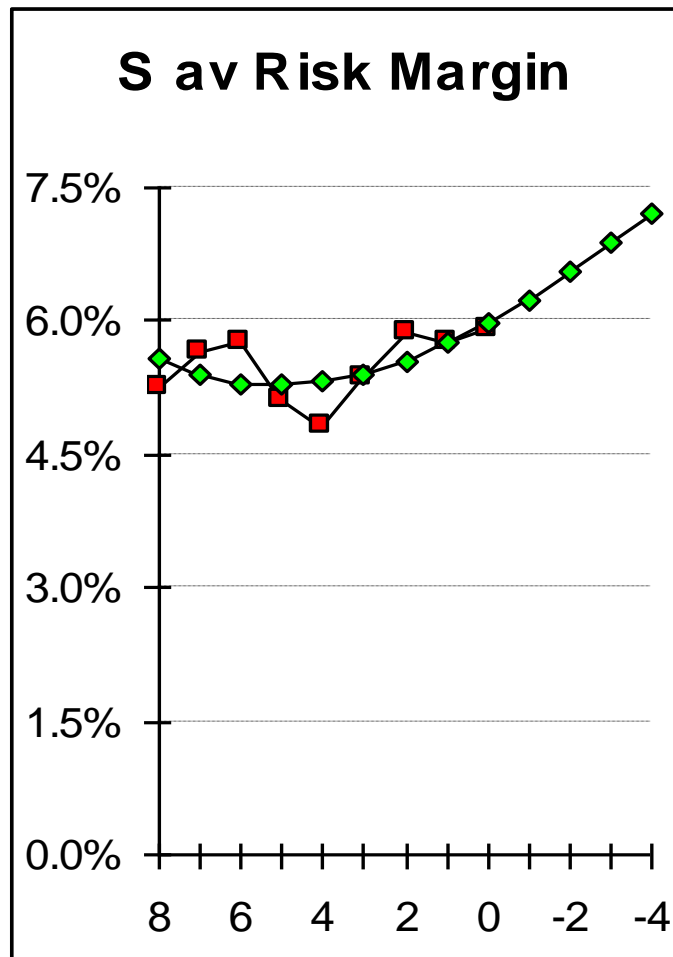
## SHARES

### Fig 5.5

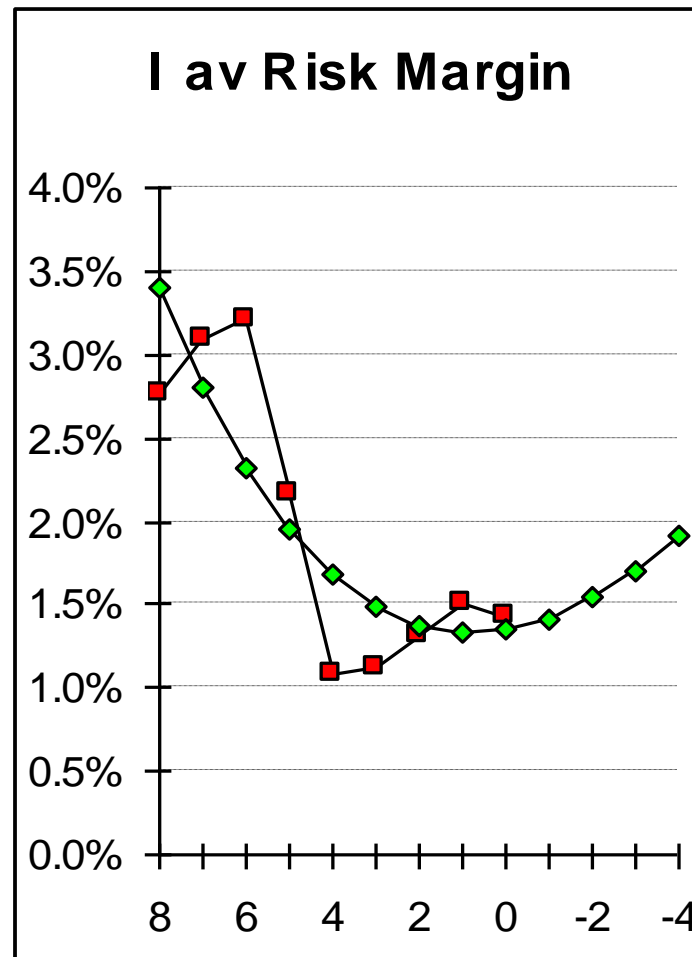




## Figure 6.1 Risk margins over 38 years



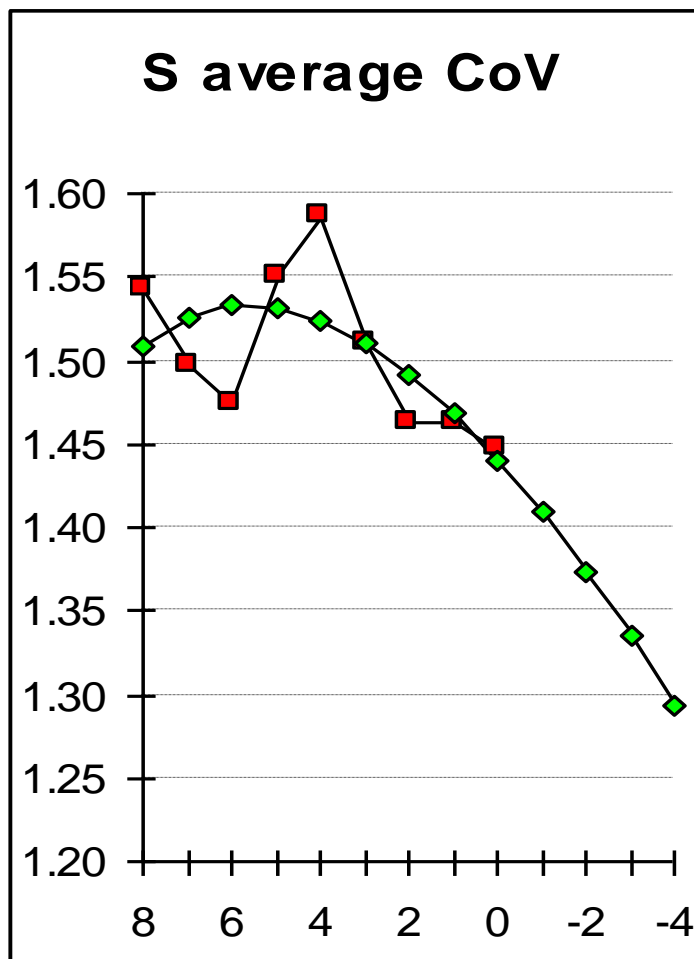
[ 4.5% ]



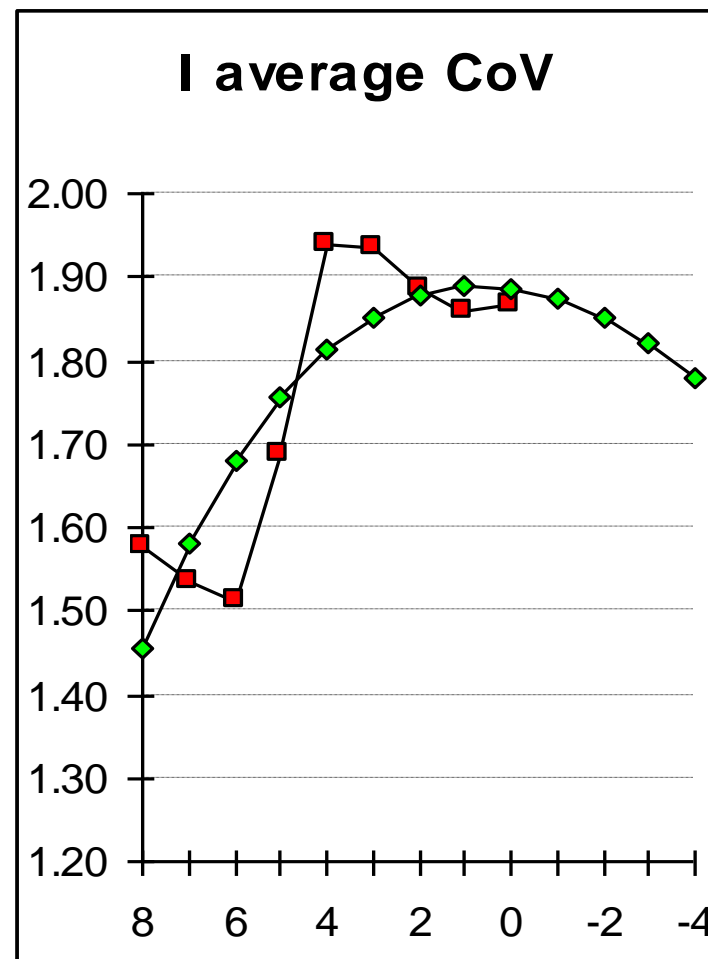
[ 4.2% ]



## Figure 7.1 CoV's over 38 years



[ 1.533 ]

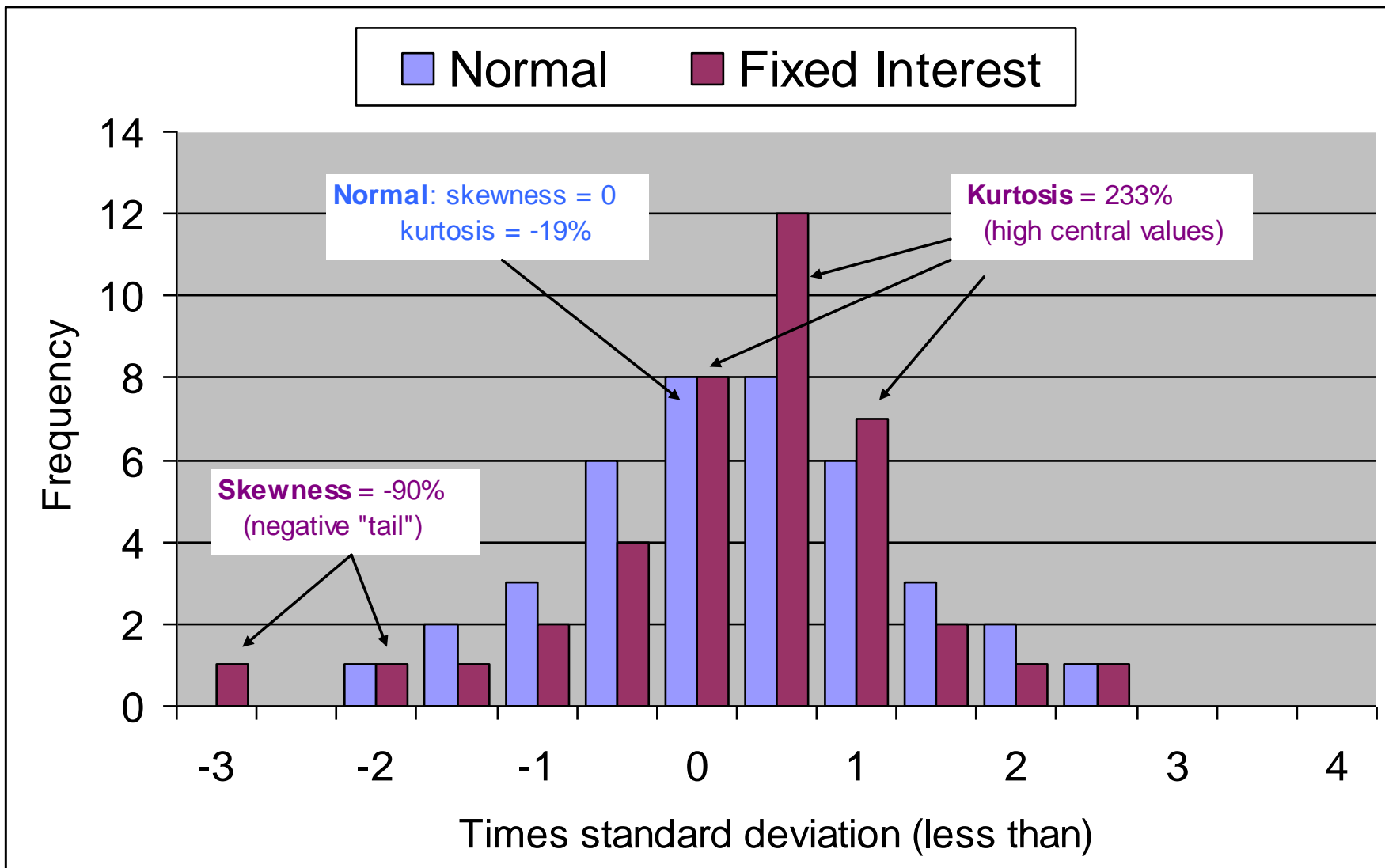


[ 1.539 ]



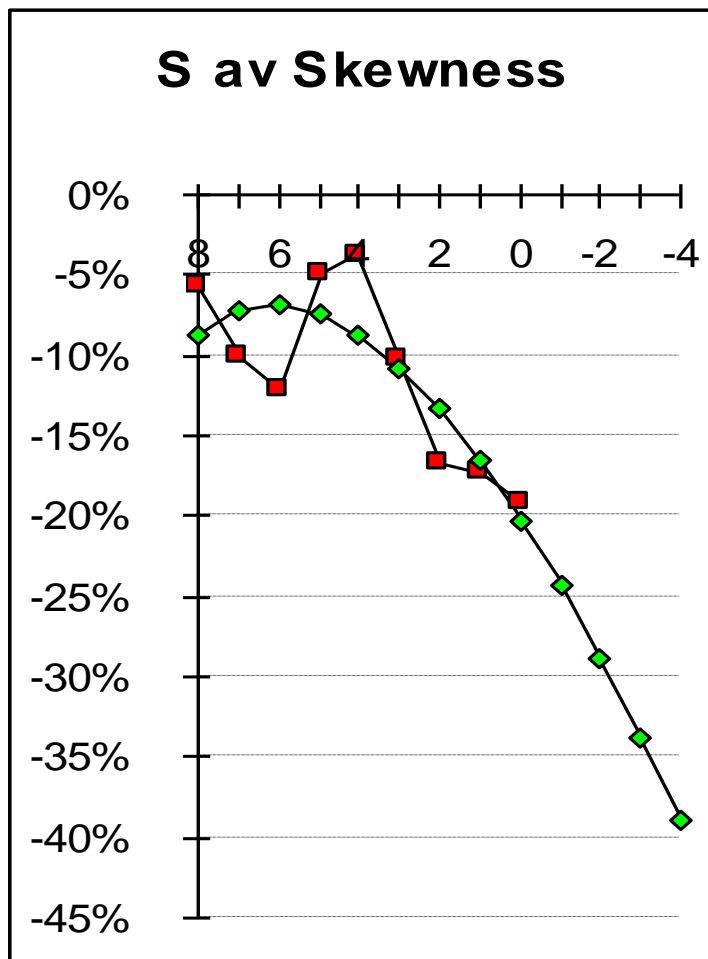


## Skewness and Kurtosis

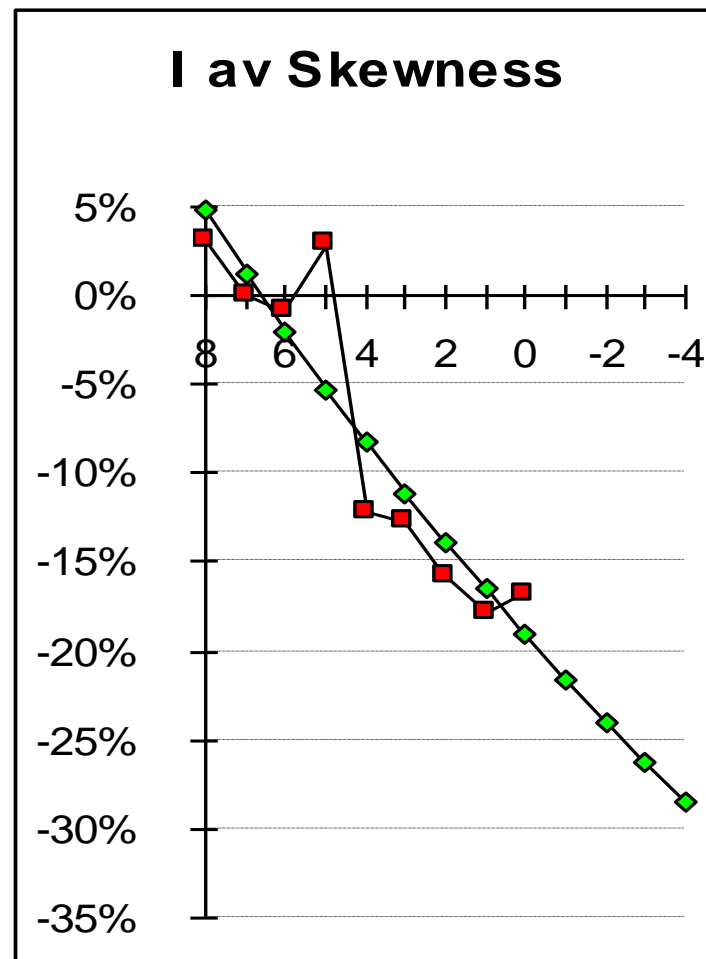




## Figure 10.1 Skewness over 38 years



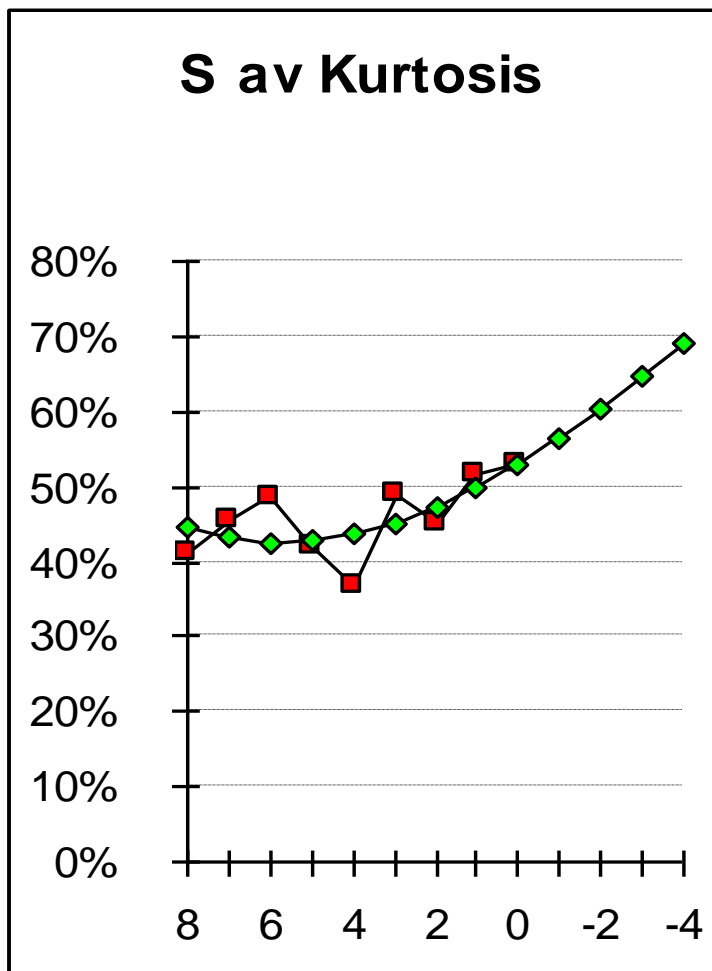
[ -29% ]



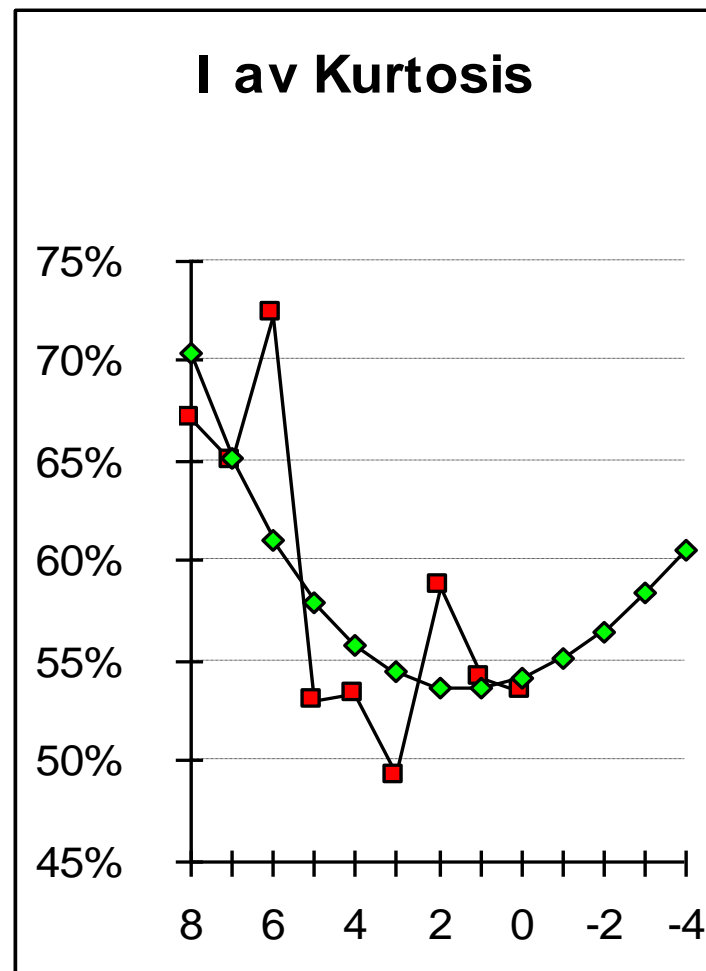
[ -24% ]



## Figure 11.1 Kurtosis over 38 years



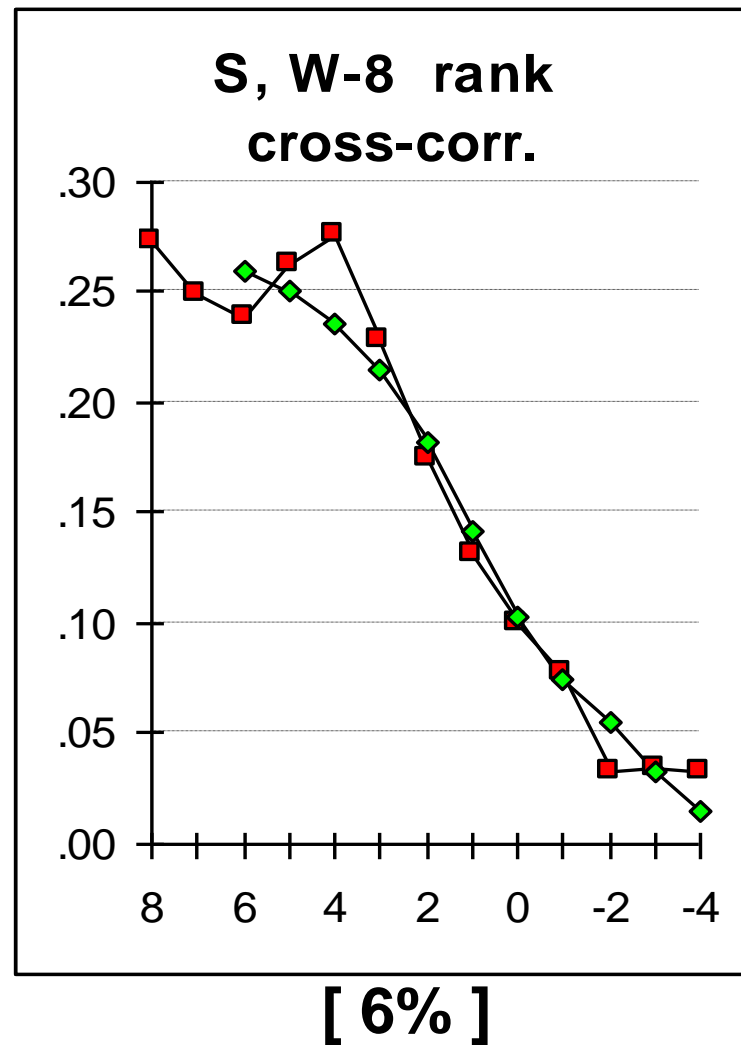
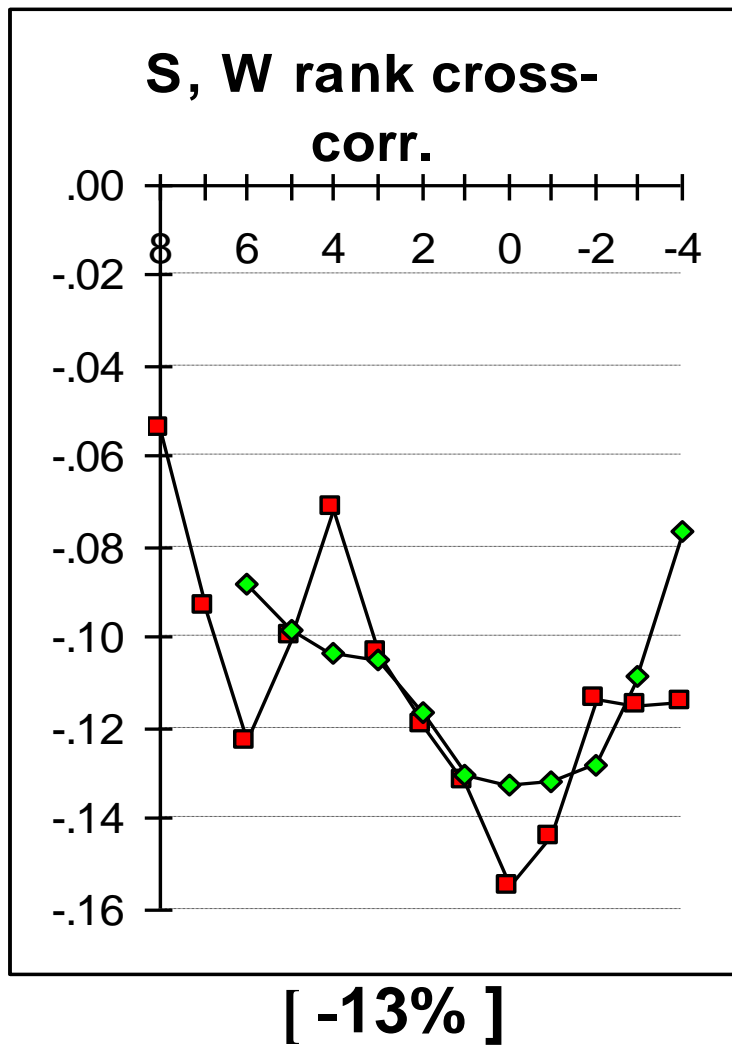
[ 60% ]



[ 57% ]



## Fig 12.1 Cross-correlation over 38 yrs



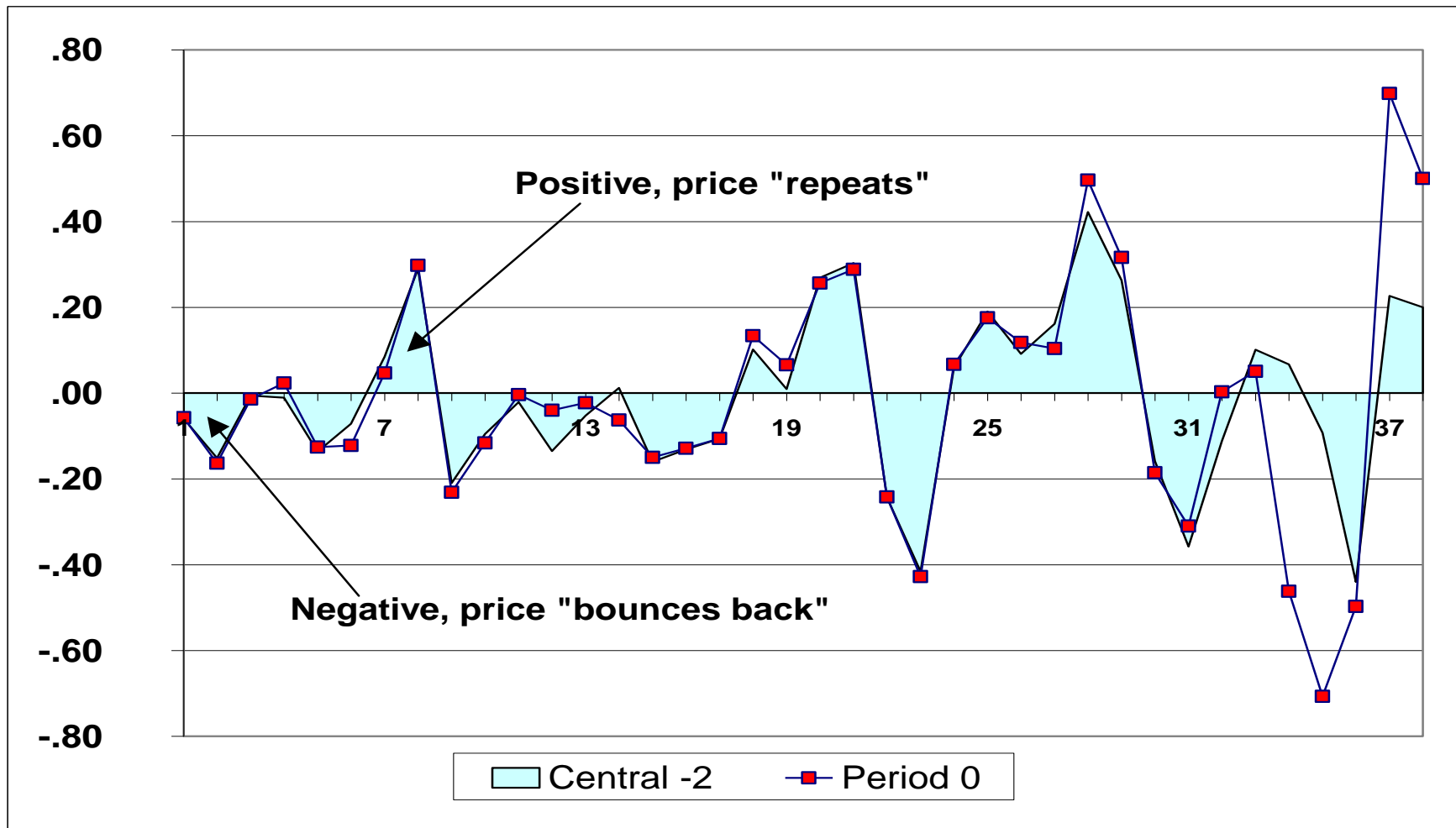
# Cross-correlation Assumptions (abridged)

**RANK** CROSS-CORRELATIONS @ 2 YRS (5-point average, rounded)

SECTOR	Austr. Shares	Listed Property	Fixed Interest	Cash	Direct Property	CPI	AWOTE
Austr. Shares	<b>1</b>	.54	.09	.12	.10	-.01	-.13
Listed Property	.54	<b>1</b>	.38	.05	.11	-.13	-.13
Fixed Interest	.09	.38	<b>1</b>	.35	-.04	-.04	-.05
Cash	.12	.05	.35	<b>1</b>	.40	.67	.57
Direct Property	.10	.11	-.04	.40	<b>1</b>	.56	.46
CPI	-.01	-.13	-.04	.67	.56	<b>1</b>	.85
AWOTE	-.13	-.13	-.05	.57	.46	.85	<b>1</b>

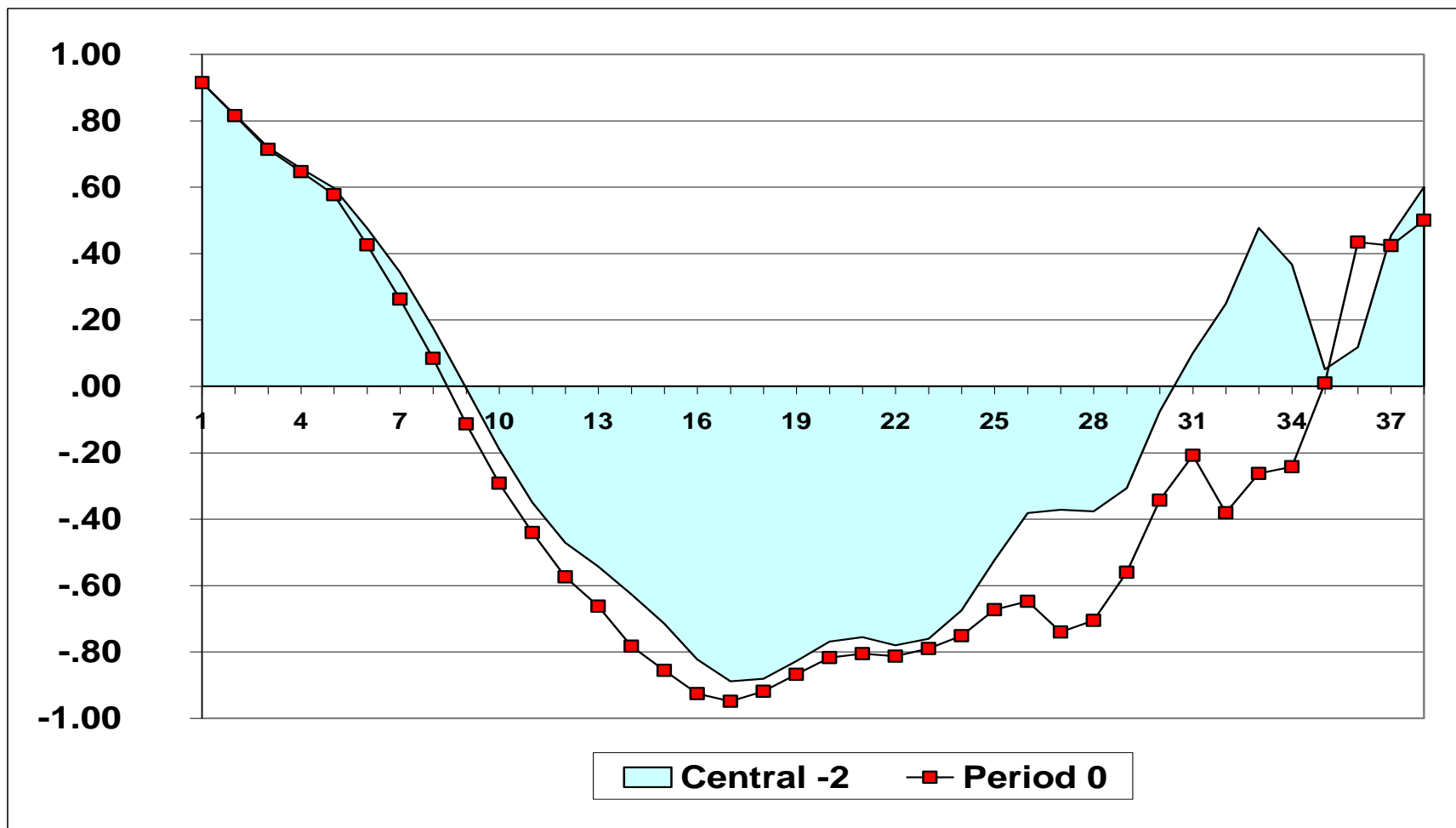


## Figure 14.2 S Sector Auto-correlations over 40 yrs





## Figure 14.3 Bond Auto-correlations over 40 yrs





# Table 15.1 Investment Assumptions

Sector	Risk margin (arithmetic average)	Mean rate (arithmetic average)	Compound average	Coefficient of variation	Standard deviation of rates	Skewness	Kurtosis
S	4.5%	10.5%	9.3%	1.533	16.1%	-29%	60%
I	4.2%	10.2%	9.1%	1.539	15.7%	-24%	57%
Q	3.7%	9.7%	9.0%	1.299	12.6%	-32%	56%
P	2.0%	8.0%	7.7%	0.900	7.2%	-147%	350%
L	1.0%	7.0%	6.9%	0.500	3.5%	54%	-35%
M	1.0%	7.0%	6.9%	0.500	3.5%	68%	-72%
F	0.5%	6.5%	6.4%	0.723	4.7%	-90%	233%
G	0.1%	6.1%	6.0%	0.607	3.7%	11%	-46%
J	0.3%	6.3%	6.2%	0.698	4.4%	-92%	229%
C	-0.4%	5.6%	5.6%	0.500	2.8%	70%	-76%
N	0.5%	6.5%	6.4%	0.800	5.2%	-59%	71%
Balncd	2.7%	8.7%	8.3%	1.082	9.4%	-63%	73%
CapStb	1.1%	7.1%	6.9%	0.673	4.7%	-76%	183%
B	-0.40%	5.60%	5.56%	0.536	3.00%	81%	-38%
D		6.00%	5.97%	0.417	2.50%	38%	-118%
W	-2.20%	3.80%	3.78%	0.552	2.10%	158%	297%
X	-3.50%	2.50%	2.48%	0.720	1.80%	56%	-52%





# Table 17.1 Gross/net of tax/fees

Sector	Mean rate (arithmetic average)			Compound Average rate After tax & IC's After fees
	Before tax Before fees	Before tax After fees	After tax & IC's After fees	
	<b>S</b>	10.50%	10.24%	
<b>I</b>	10.20%	9.91%	9.01%	8.12%
<b>Q</b>	9.70%	9.41%	8.42%	7.80%
<b>P</b>	8.00%	7.18%	6.14%	5.94%
<b>L</b>	7.00%	6.71%	5.70%	5.66%
<b>M</b>	7.00%	6.71%	5.70%	5.66%
<b>F</b>	6.50%	6.32%	5.37%	5.28%
<b>G</b>	6.10%	5.92%	5.03%	4.98%
<b>J</b>	6.30%	6.12%	5.20%	5.13%
<b>C</b>	5.60%	5.41%	4.60%	4.57%
<b>N</b>	6.50%	6.31%	5.43%	5.33%
<b>Balncd</b>	8.68%	8.42%	7.77%	7.44%
<b>CapStb</b>	7.05%	6.83%	6.05%	5.97%
<b>B</b>	5.60%	5.60%	4.76%	4.73%
<b>D</b>	6.00%	6.00%	5.10%	5.08%



## Appendices

- A Modelling Skewness and Kurtosis

Normal power approximation, and  
a gamma exponential variable

- B Modelling Auto-correlations

Shares (S sector) – one extreme  
Bonds (D sector) – other extreme

- C *Austmod* Investment Simulation Model - Inputs

The 26 inputs are described  
“Historical random start” modelling defined



## Acknowledgments

- **Alan Brown**
- **Cary Helenius**
- **Clive Amery**
- **AXA Australia and National Mutual**
- **designers of EFG investment system**



## Paragraph 4.3

*“Of major significance was the introduction in 1965 of a selective investment facility known as the EFG system. Evidence of the success and wide acceptance of this concept, which was pioneered by National Mutual in Australia, may now be seen in the fact that it has since been adopted by a number of other financial institutions as a medium for superannuation investment.”*



**If the next 38 years equal the last 38 years:**

Superannuation Guarantee 9.000%

Net accumulation towards retirement = 6.375%

**'Balanced' Portfolio**

## 40 Year Supn Guarantee Retirement Benefits as a multiple of Final Salary

