An Evaluation Model for the Comparison of Three NYSE Indexes

Presented by:

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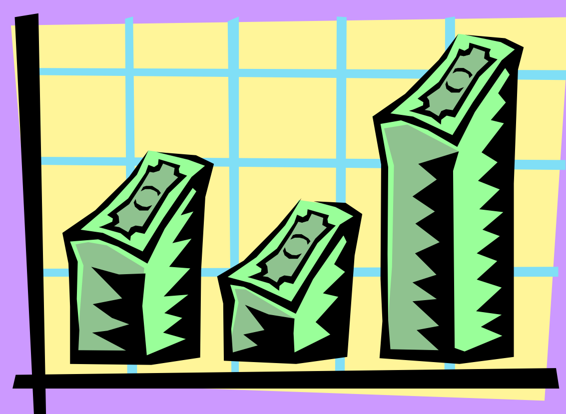


Outline of the presentation

- Introduce time series and the transformation
- Remove noise introduced by seasonality and stock market fluctuations
- Estimate the linear trend (long term)
- Model the short term by AR(1)

Data: Daily close value

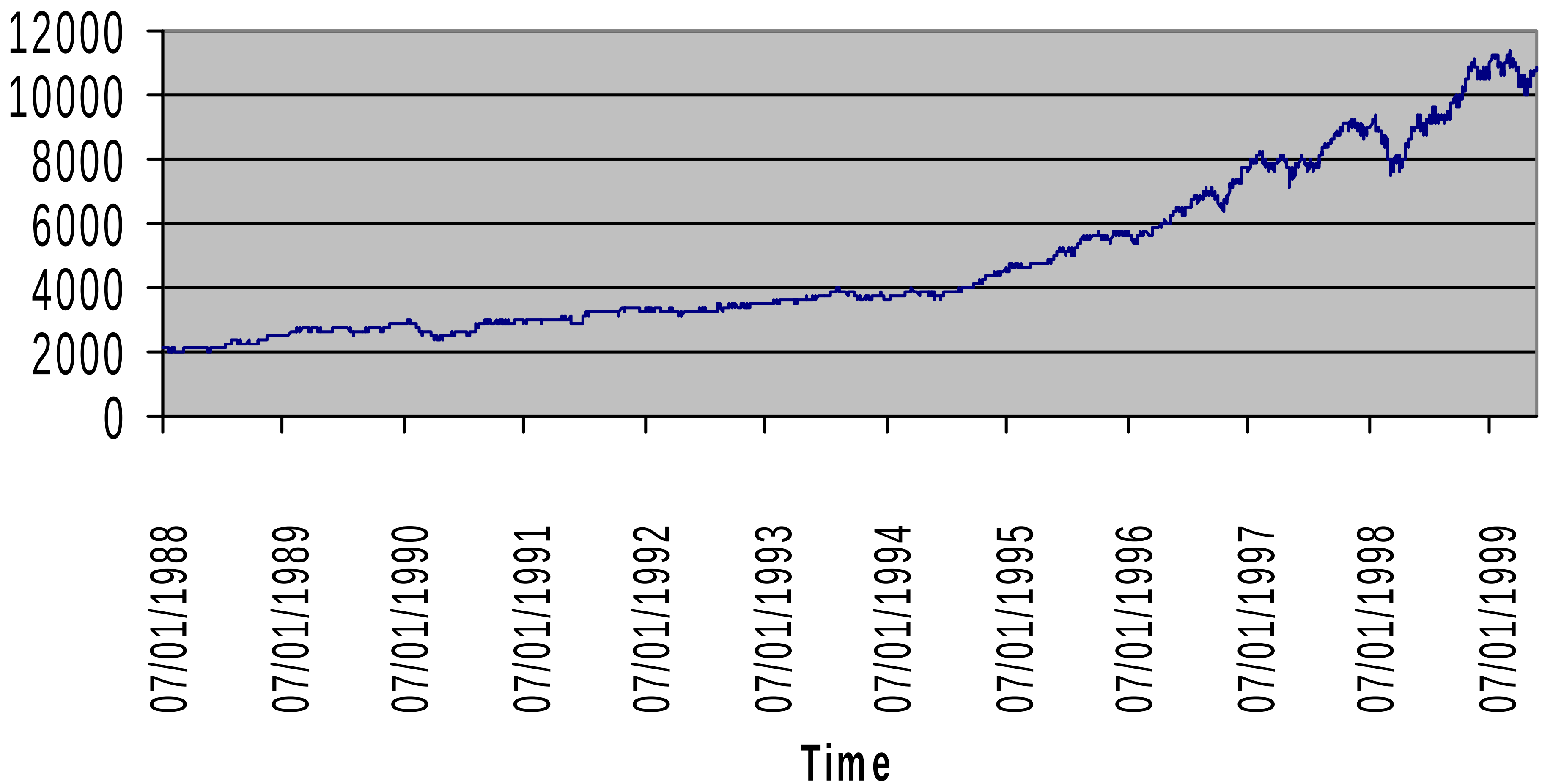
November 89- November 99

Dow Jones Industrial Average

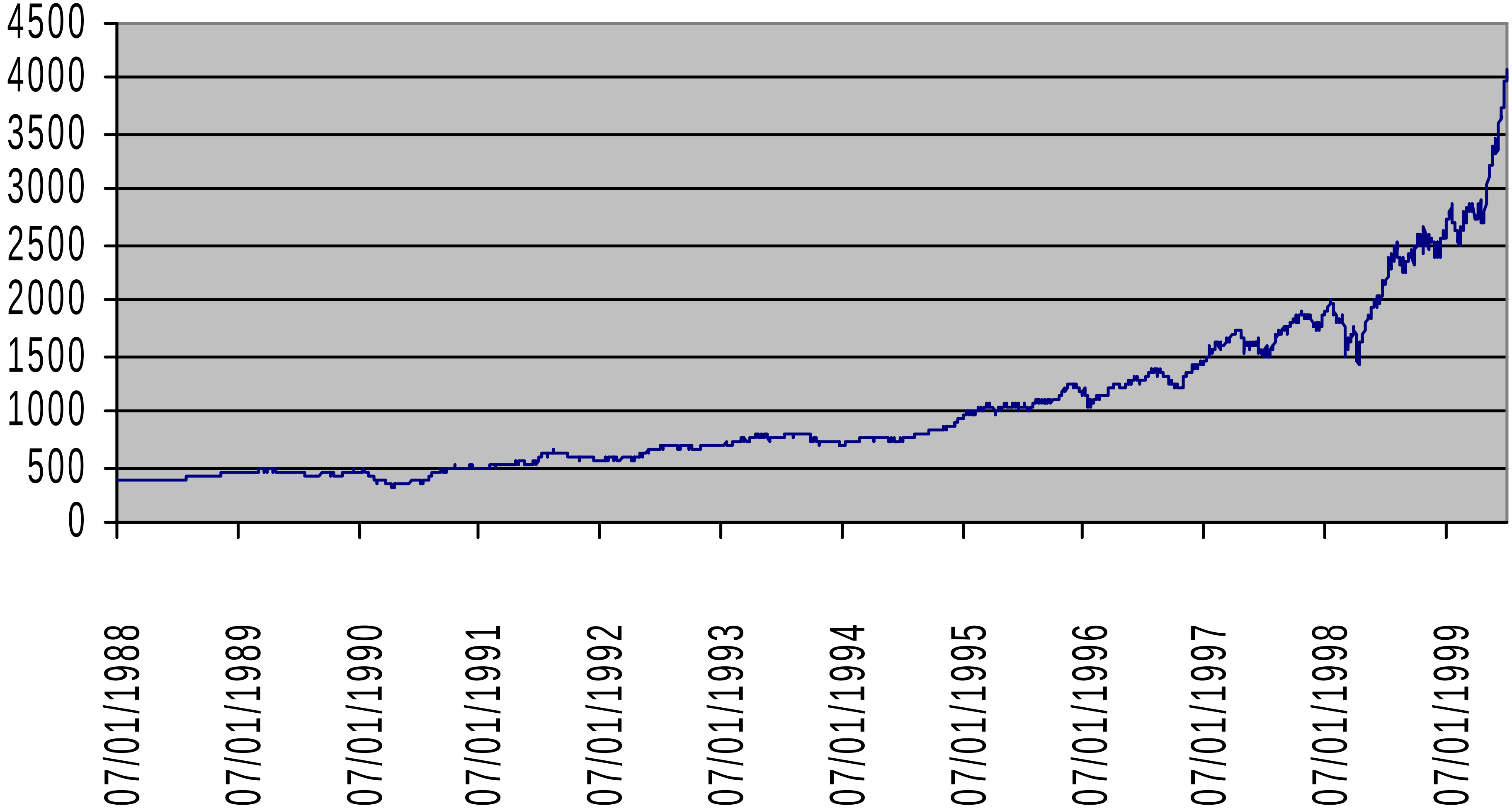
Nasdaq Composite Index

S&P 500 Composite Index

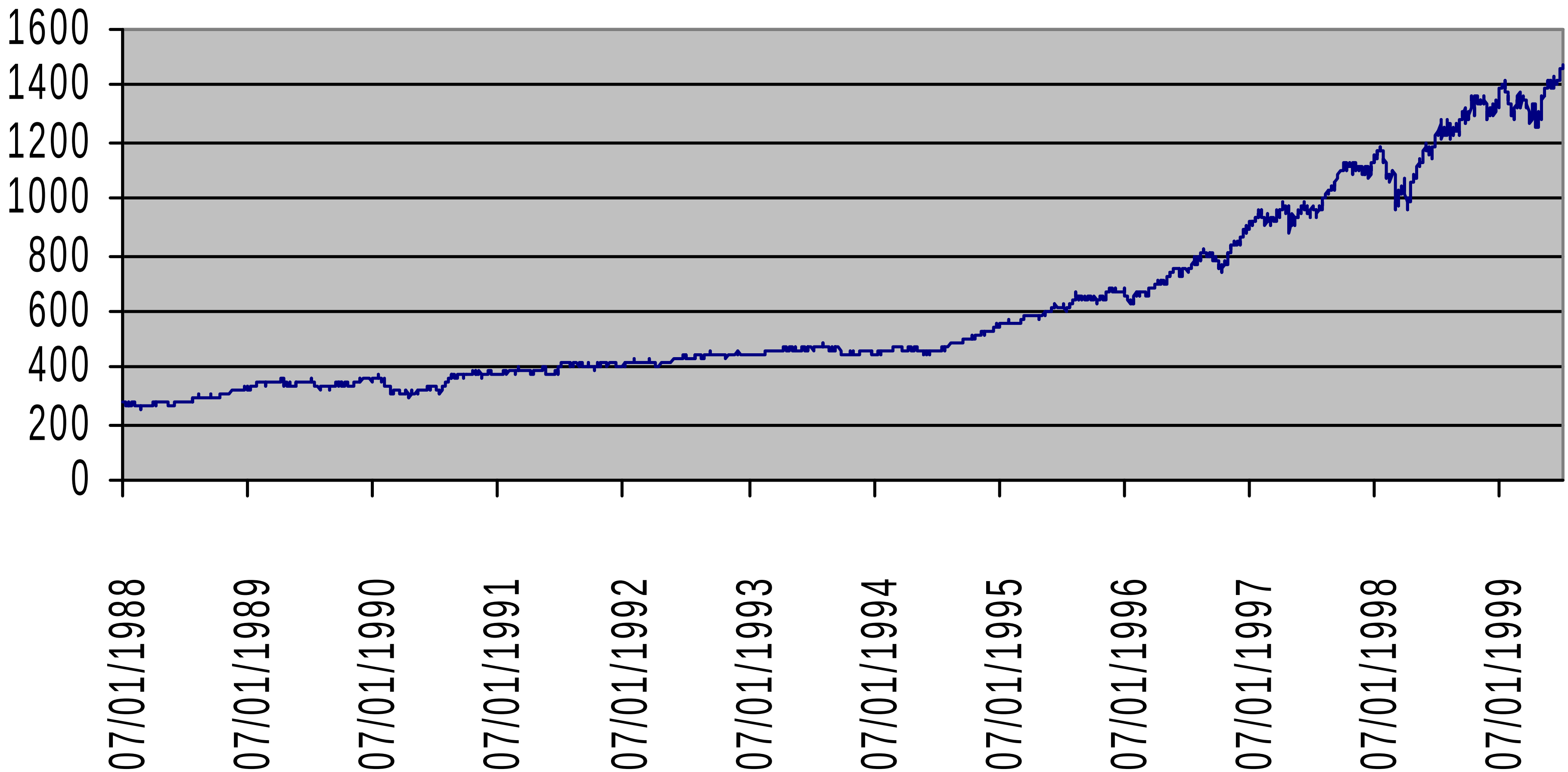
Dow Jones Industrial Average



Nasdaq Composite



S&P 500



1600
1400
1200
1000
800
600
400
200
0
07/01/1988
07/01/1989
07/01/1990
07/01/1991
07/01/1992
07/01/1993
07/01/1994
07/01/1995
07/01/1996
07/01/1997
07/01/1998
07/01/1999

Rao and Zurbenko (1994)

$$X(t) = LT(t) + SE(t) + ST(t)$$

$X(t)$: LN of the original stock price close value
$LT(t)$: long-term (trend)
$SE(t)$: seasonal change
$ST(t)$: short-term variation

Kolmogorov-Zurbenko (KZ) filter

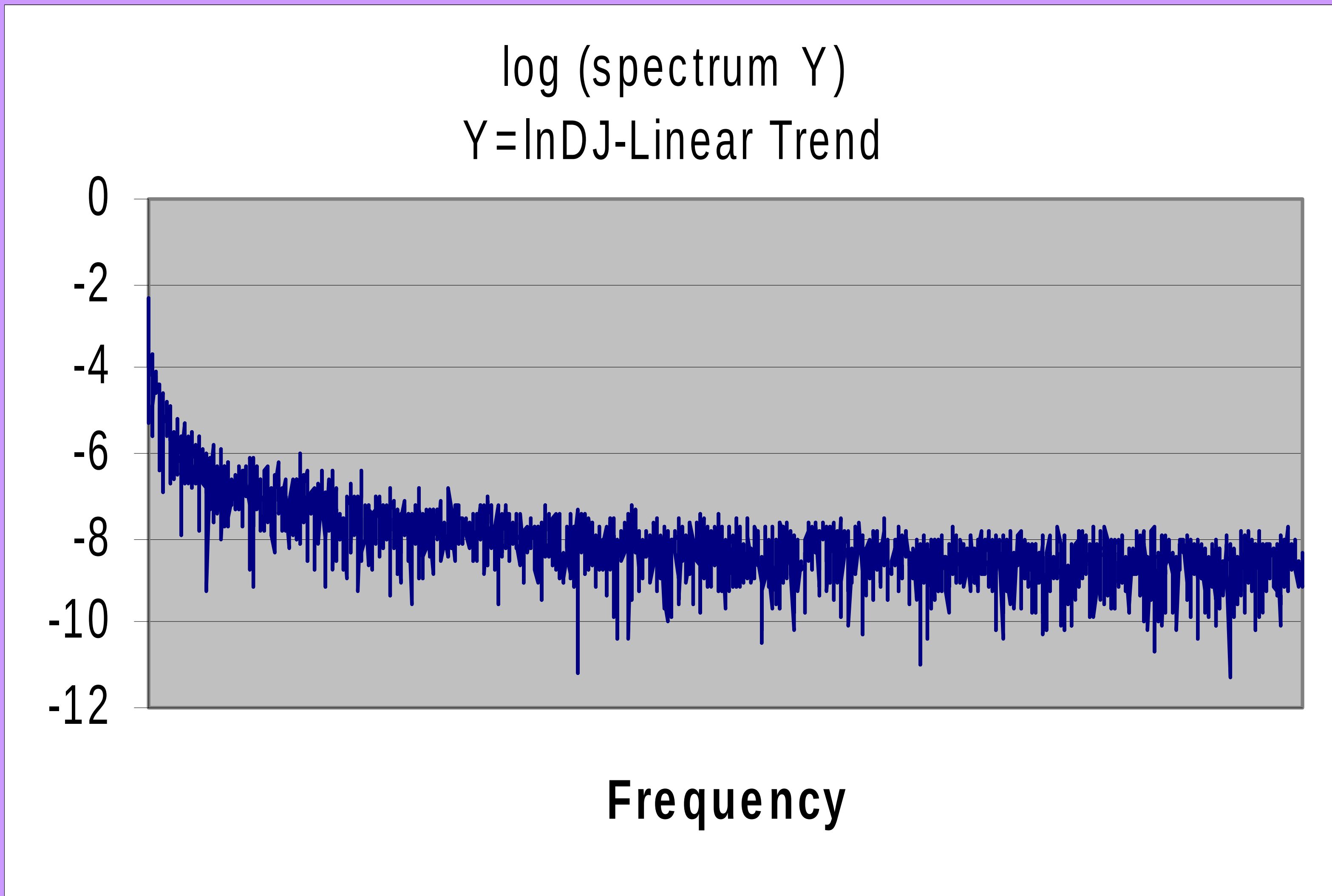
$$Y_t = \sum_{s=-k(m-1)/2}^{k(m-1)/2} \alpha_s X_{t+s}$$

where the α_s weights are defined as

k convolutions of the

m uniform weights 1/m

Spectral Analysis



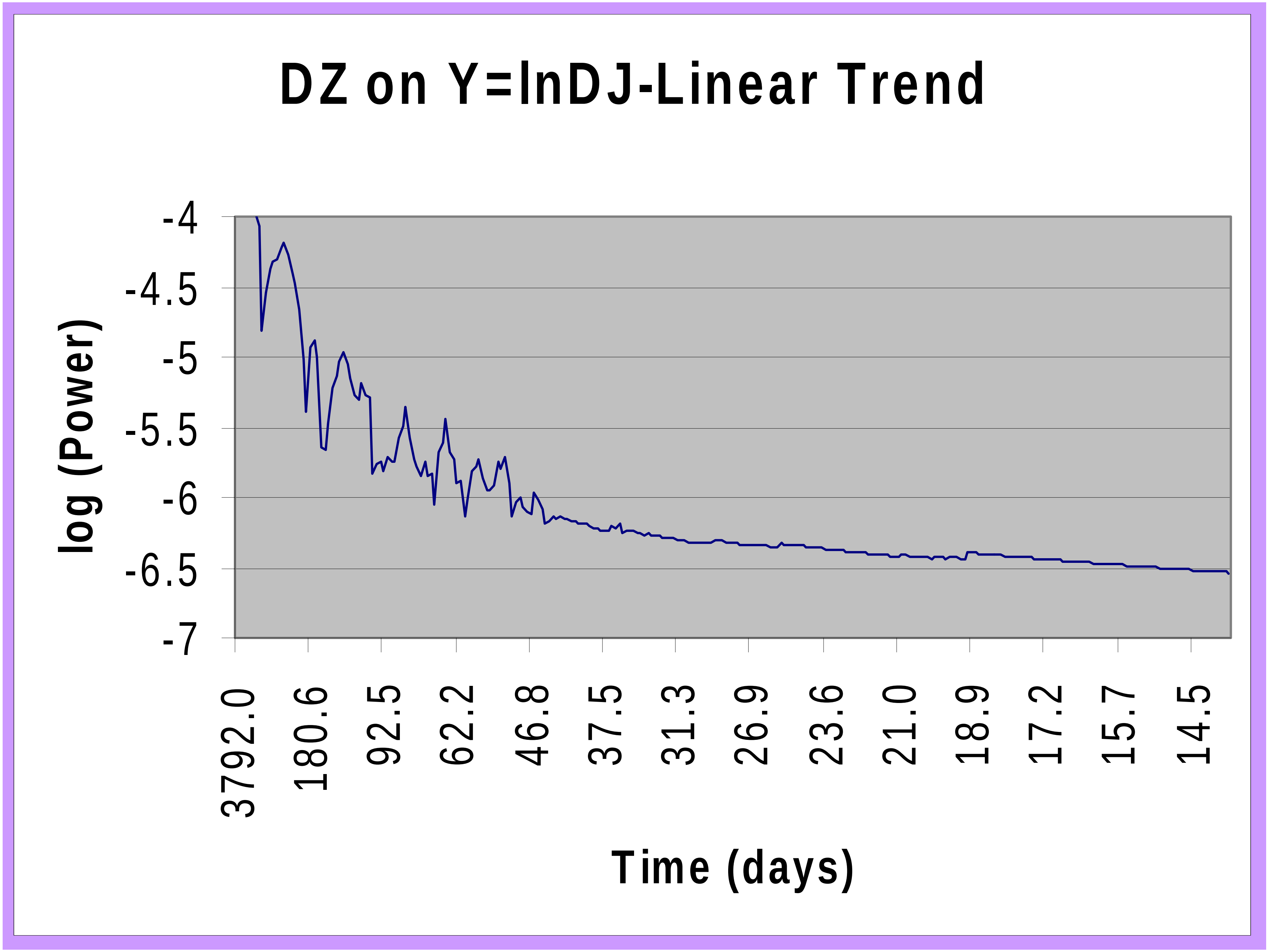
Semi-Adaptively Smoothed Periodogram Method

$$\hat{f}_N(\lambda_k) = \frac{1}{2m_k + 1} \sum_{j=-m_k}^{m_k} I_N(\lambda_{k+j})$$

k=-N/2+1,……,N/2

where m_k is the largest positive integer satisfying

$$\sum_{j=-m_k}^{m_k - 1} \{ I_N(\lambda_{k+j+1}) - I_N(\lambda_{k+j}) \}^2 \leq C_{\lambda_k}$$


DZ on Y=lnDJ-Linear Trend
log (Power)
-4
-4.5
-5
-5.5
-6
-6.5
-7
3792.0
180.6
92.5
62.2
46.8
37.5
31.3
26.9
23.6
21.0
18.9
17.2
15.7
14.5
Time (days)

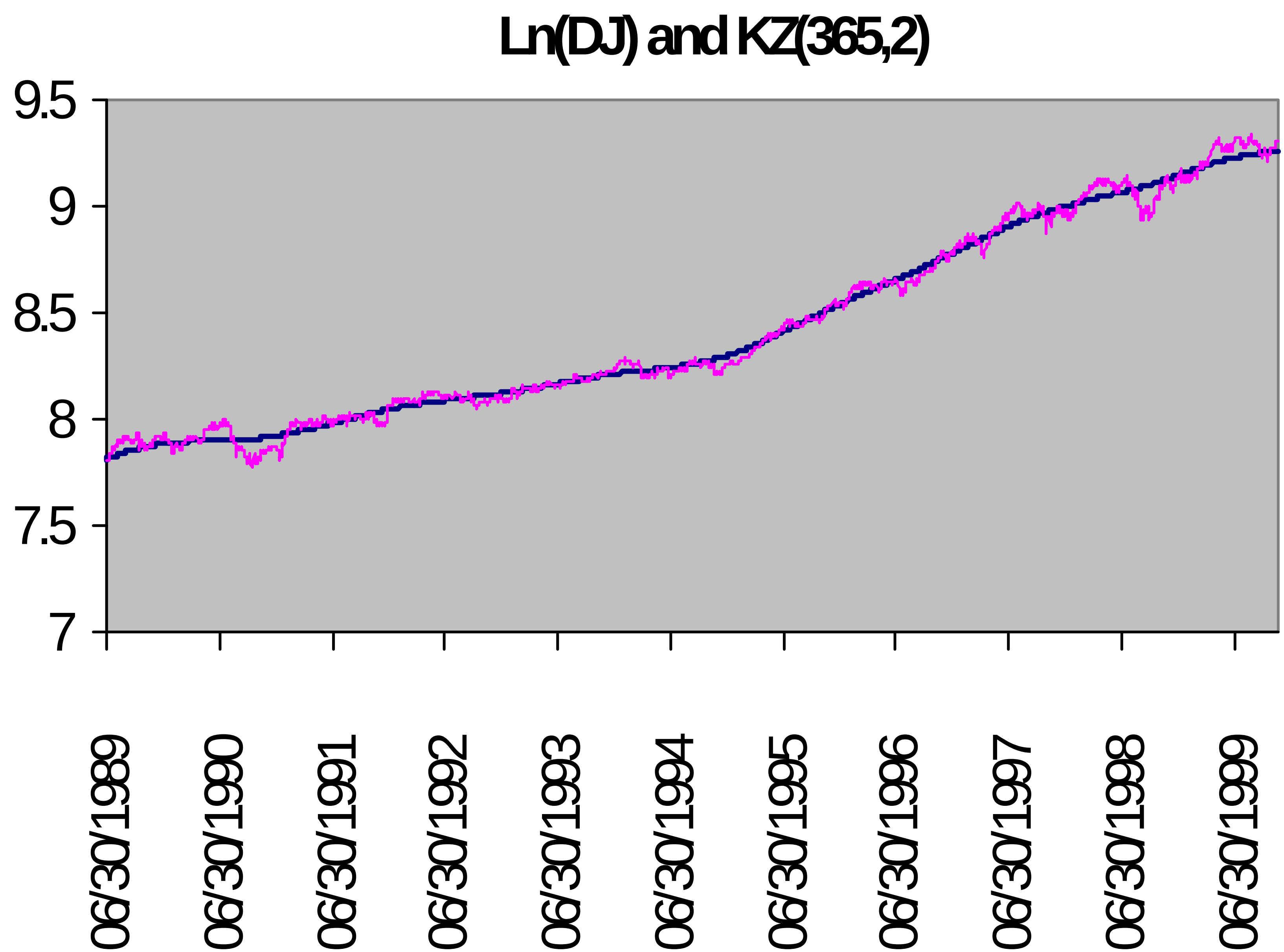
Rao *et al.* (1997)
Space and Time Series in Ambient Ozone Data

$$\omega_0 \approx \frac{\sqrt{6}}{\pi}\sqrt{\frac{1-(1/2)^{1/2k}}{m^2-(1/2)^{1/2k}}}$$

m and k were selected to optimize the desired separation for the various components

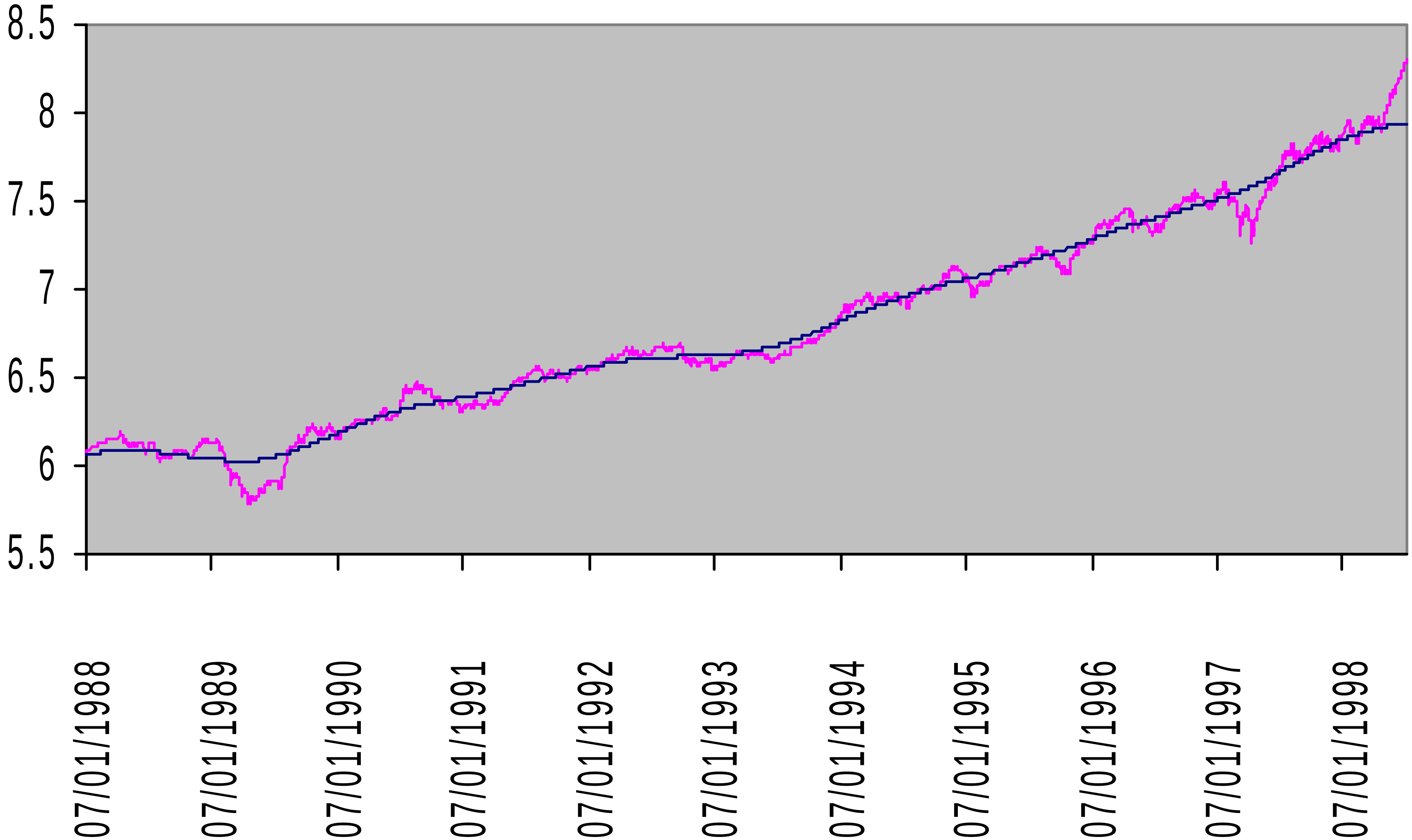
$$LT(t) = KZ_{365,2}[\ln(X(t))]$$

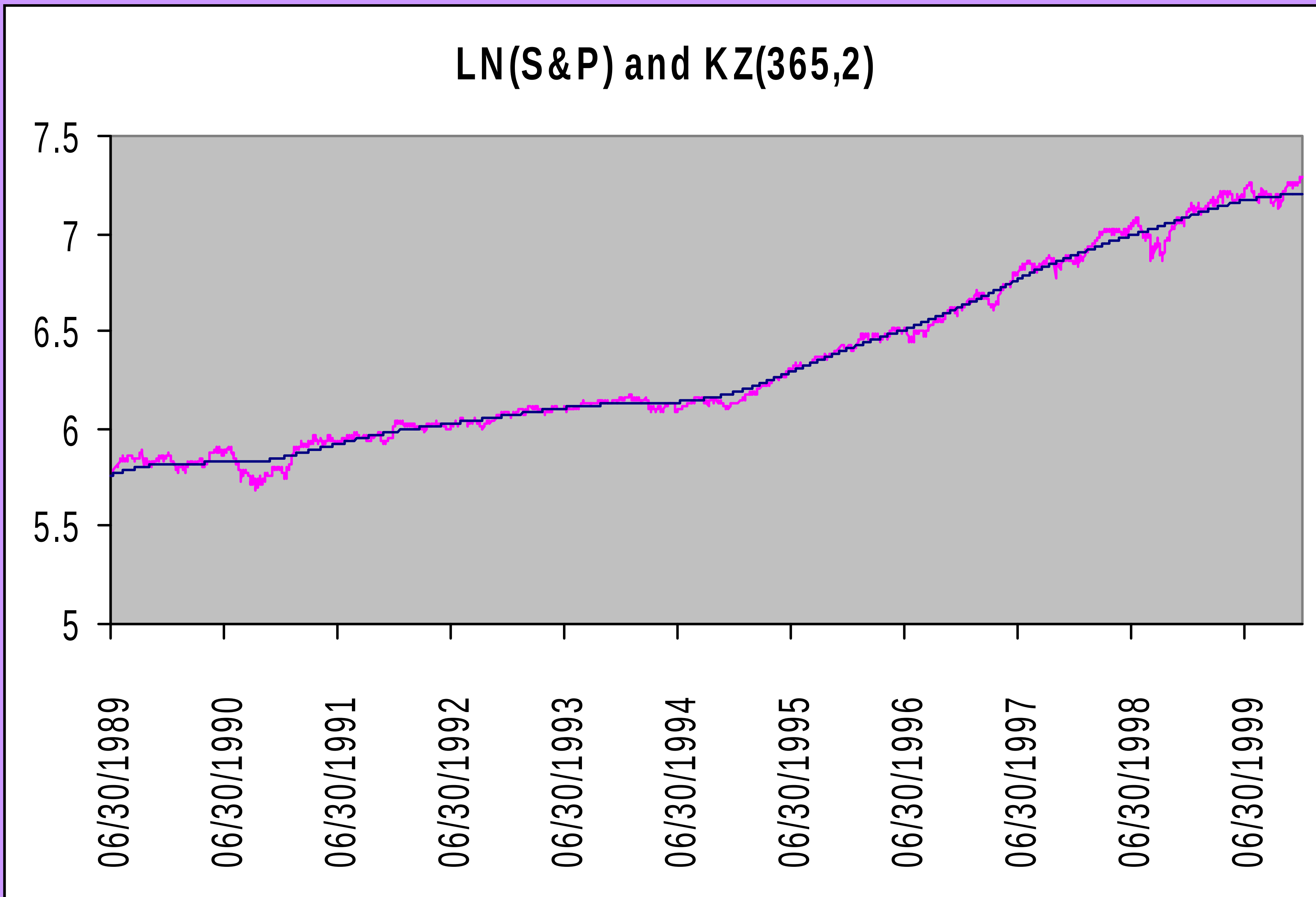
$$ST(t) = \ln(X(t)) - KZ_{21,3}[\ln(X(t))]$$

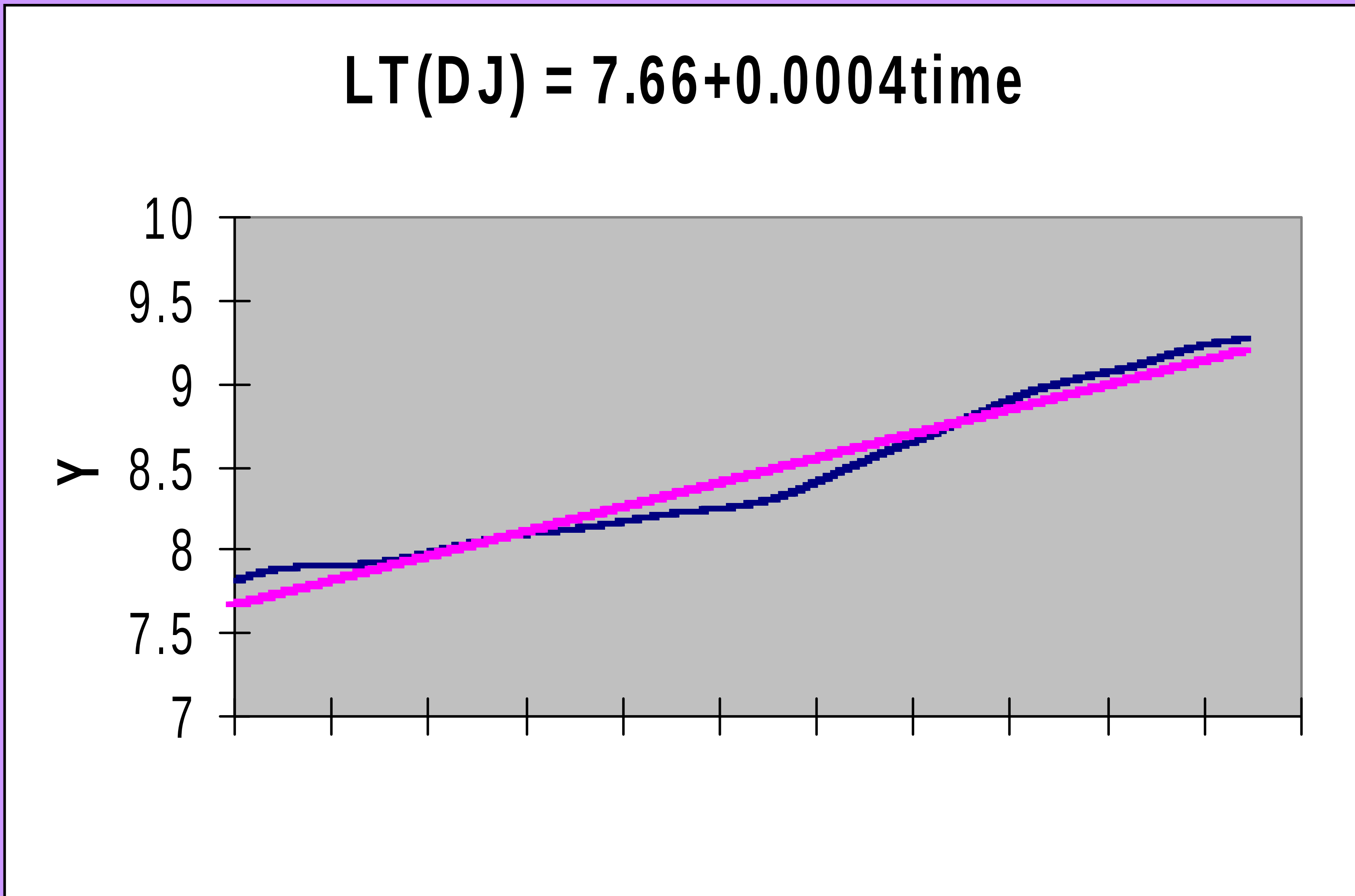


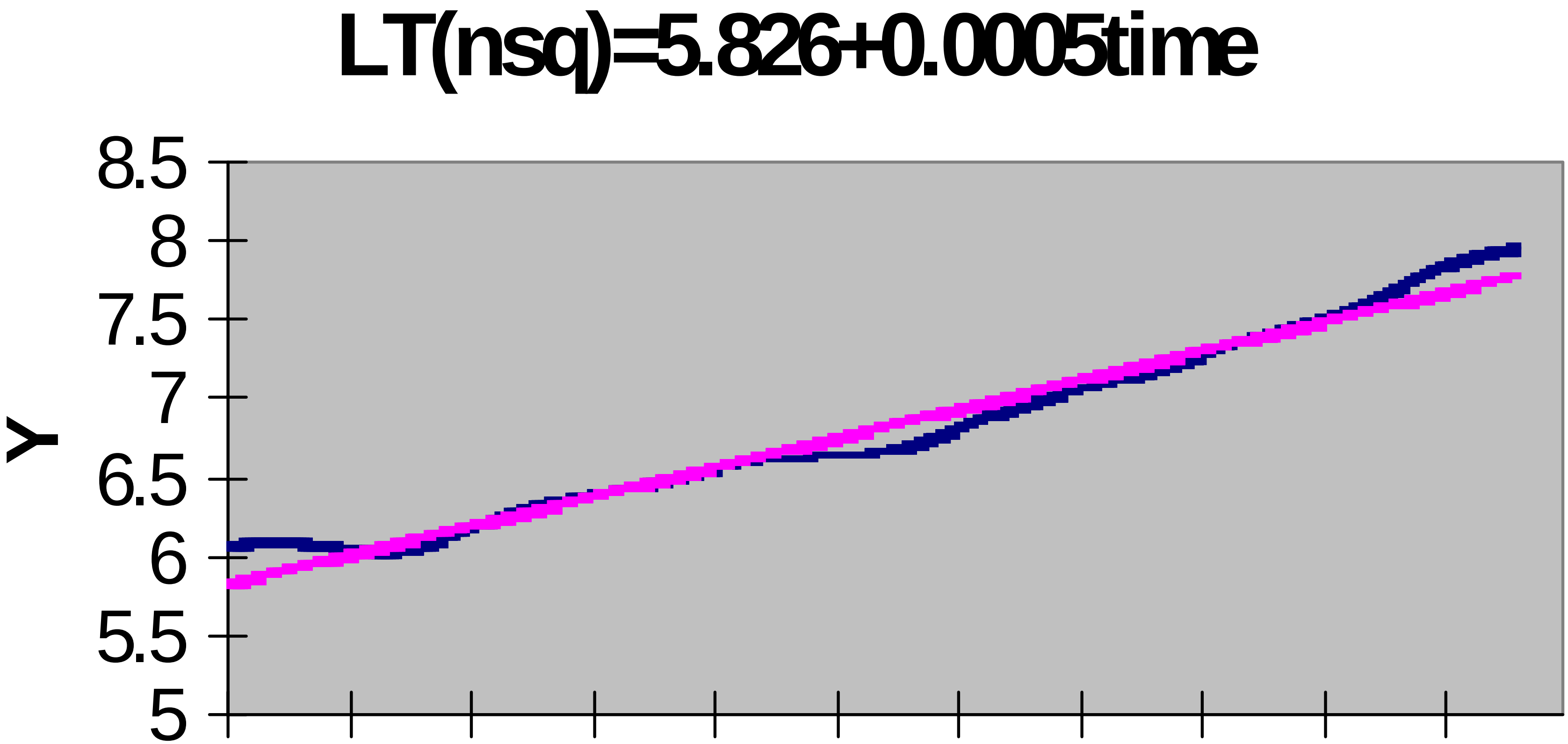
Ln(DJ) and KZ(365,2)
9.5
9
8.5
8
7.5
7
06/30/1989
06/30/1990
06/30/1991
06/30/1992
06/30/1993
06/30/1994
06/30/1995
06/30/1996
06/30/1997
06/30/1998
06/30/1999

Ln(Nasdaq) and KZ(365,2)

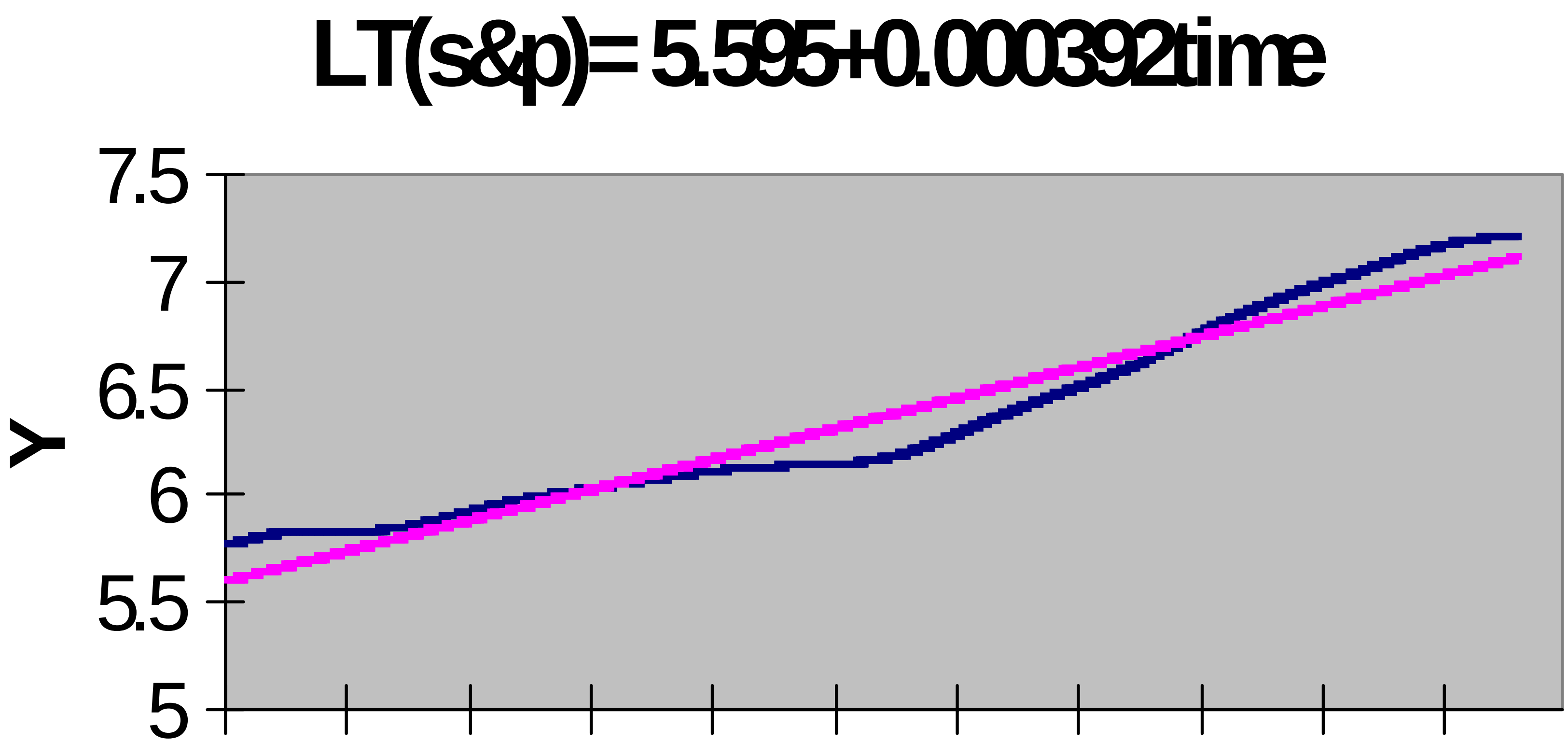


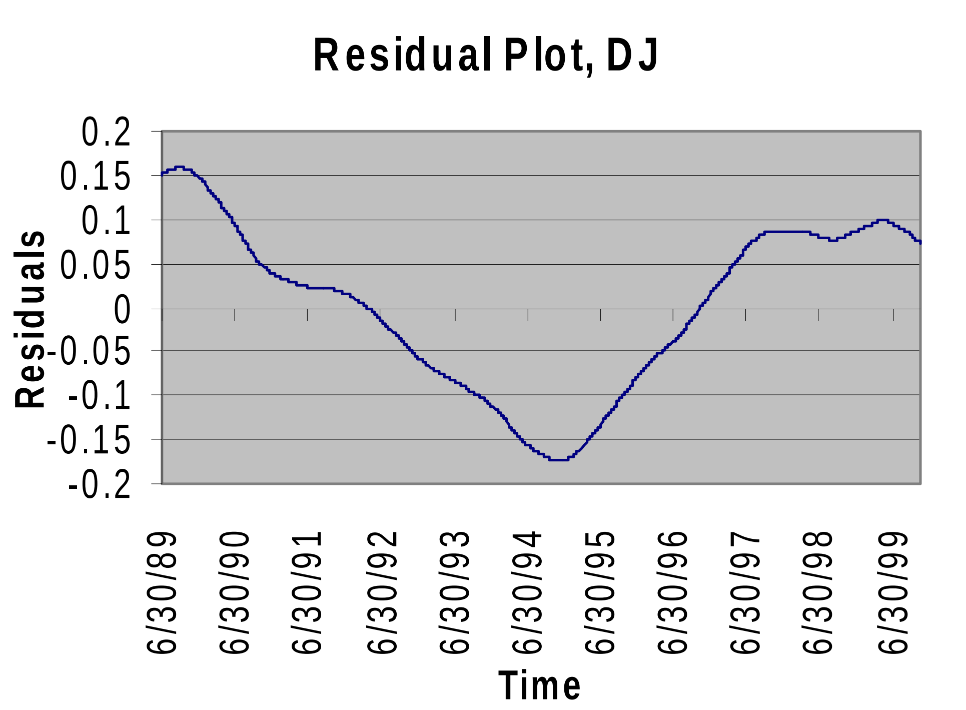

LN(S&P) and KZ(365,2)
7.5
7
6.5
6
5.5
5
06/30/1989
06/30/1990
06/30/1991
06/30/1992
06/30/1993
06/30/1994
06/30/1995
06/30/1996
06/30/1997
06/30/1998
06/30/1999

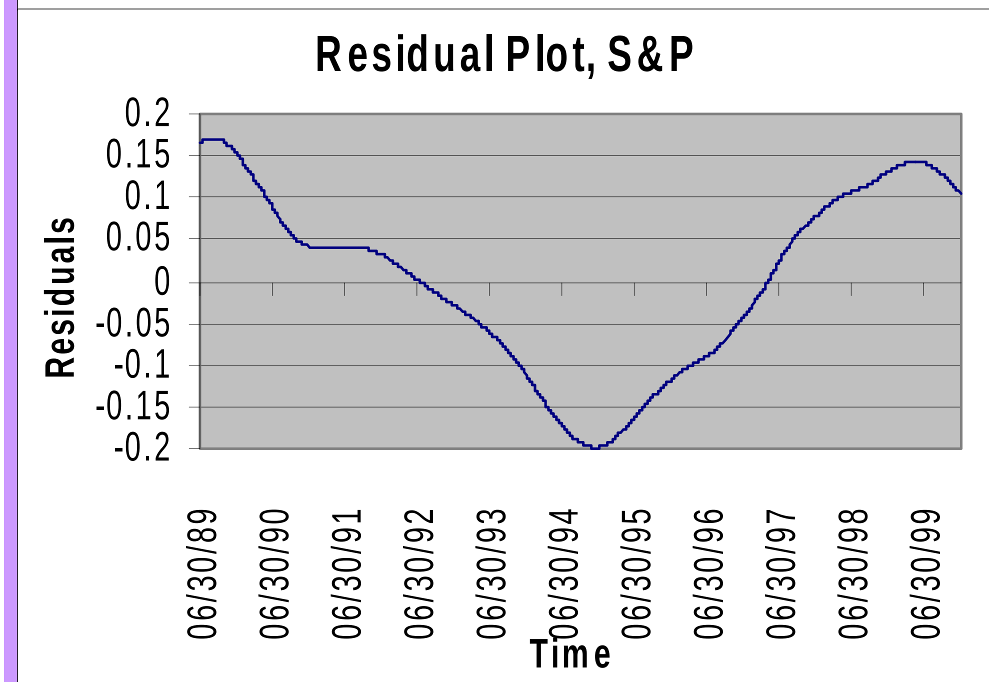

LT(DJ) = 7.66+0.0004time
Y
10
9.5
9
8.5
8
7.5
7

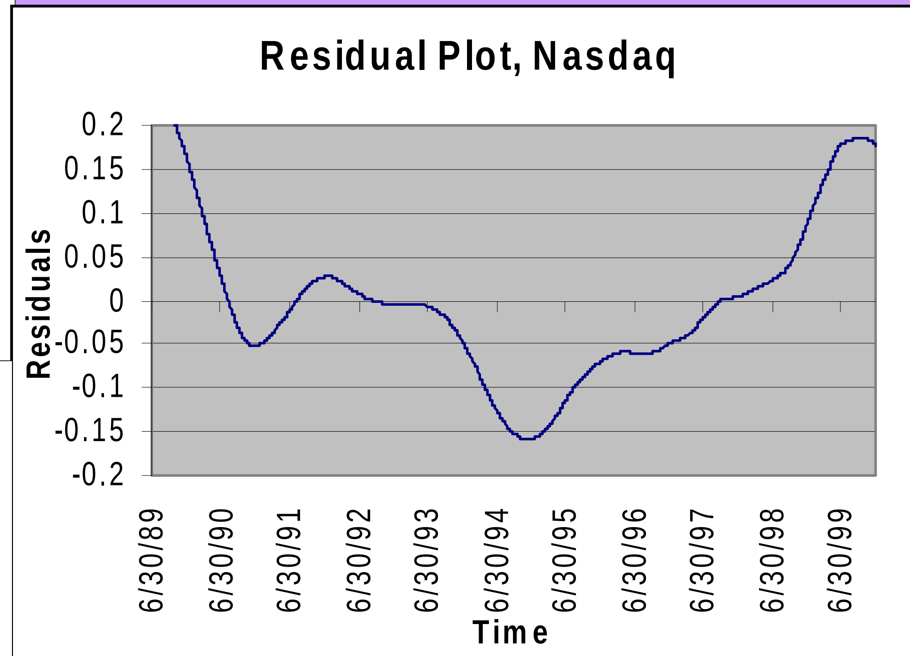


LT(nsq)=5.826+0.0005time
8.5
8
7.5
7
6.5
6
5.5
5
Y


LT(s&p)= 5.595+0.000392time
Y
7.5
7
6.5
6
5.5
5


Residual Plot, DJ
Residuals
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
6/30/89
6/30/90
6/30/91
6/30/92
6/30/93
6/30/94
6/30/95
6/30/96
6/30/97
6/30/98
6/30/99
Time


Residual Plot, S&P
Residuals
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
06/30/89
06/30/90
06/30/91
06/30/92
06/30/93
06/30/94
06/30/95
06/30/96
06/30/97
06/30/98
06/30/99
Time

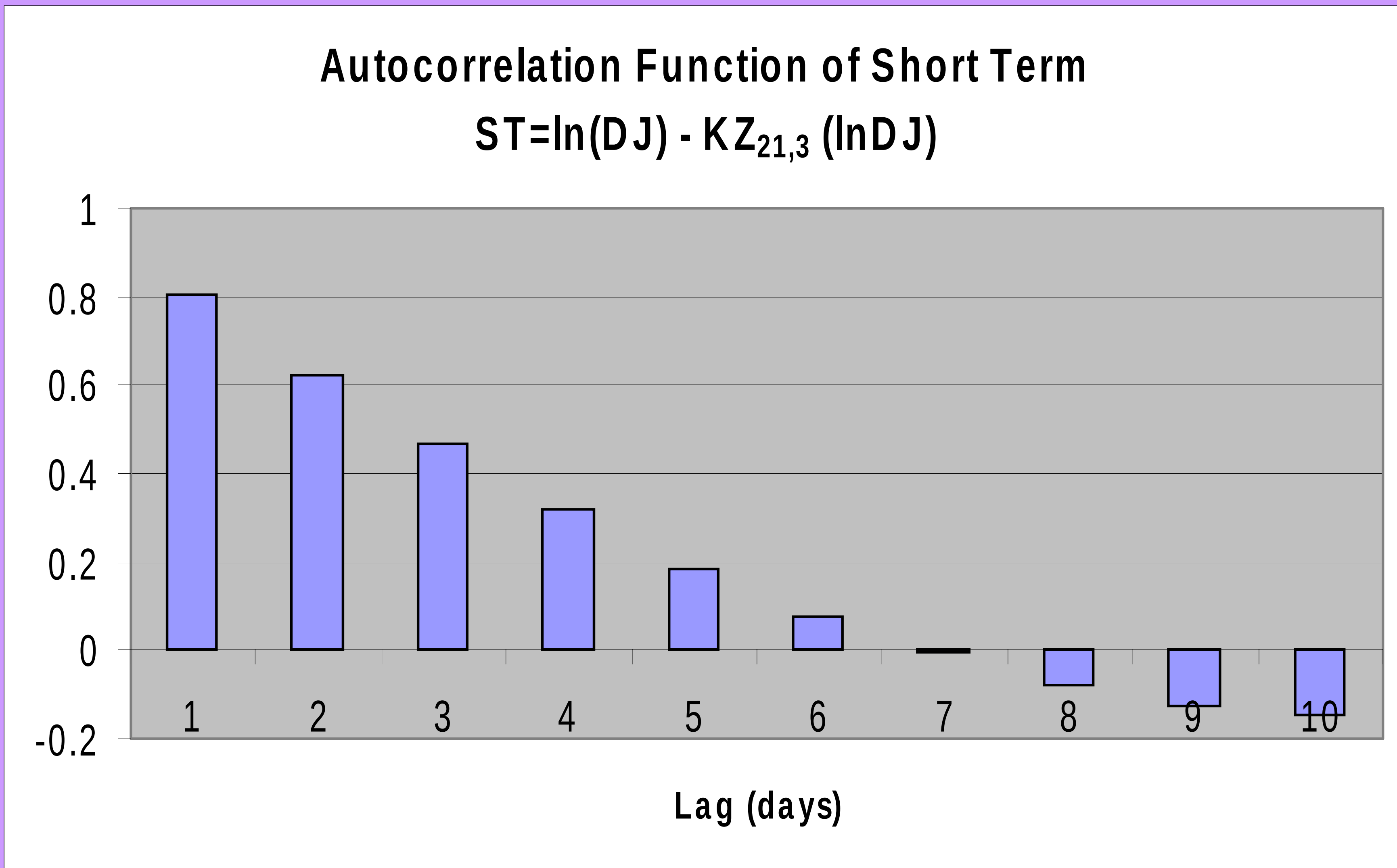

Residual Plot, Nasdaq
Residuals
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
6/30/89
6/30/90
6/30/91
6/30/92
6/30/93
6/30/94
6/30/95
6/30/96
6/30/97
6/30/98
6/30/99
Time

Linear Trends	**Daily % growth**	**Annual % growth**	**Annual % growth < 94**	**Annual % growth > 94**
DJ=0.0004time+7.66	0.0403	14.7	8.6	20.5
NDQ=0.0005+5.83	0.0506	18.5	14	24
S&P=0.00039+5.59	0.0392	14.3	7.9	22

Correlations of Long Term	**Dow**	**Nasdaq**	**S&P**
Dow	1	0.9928	0.9975
Nasdaq		1	0.9918
S&P			1

Correlations of Long Term’	**Dow**	**Nasdaq**	**S&P**
Dow	1	0.8205	0.9666
Nasdaq		1	0.8851
S&P			1

Short Term Component



Autoregressive model for Short Term component

AR(1) good fit

$ST_t = 0.8068\ ST_{t-1} + \varepsilon_t$,

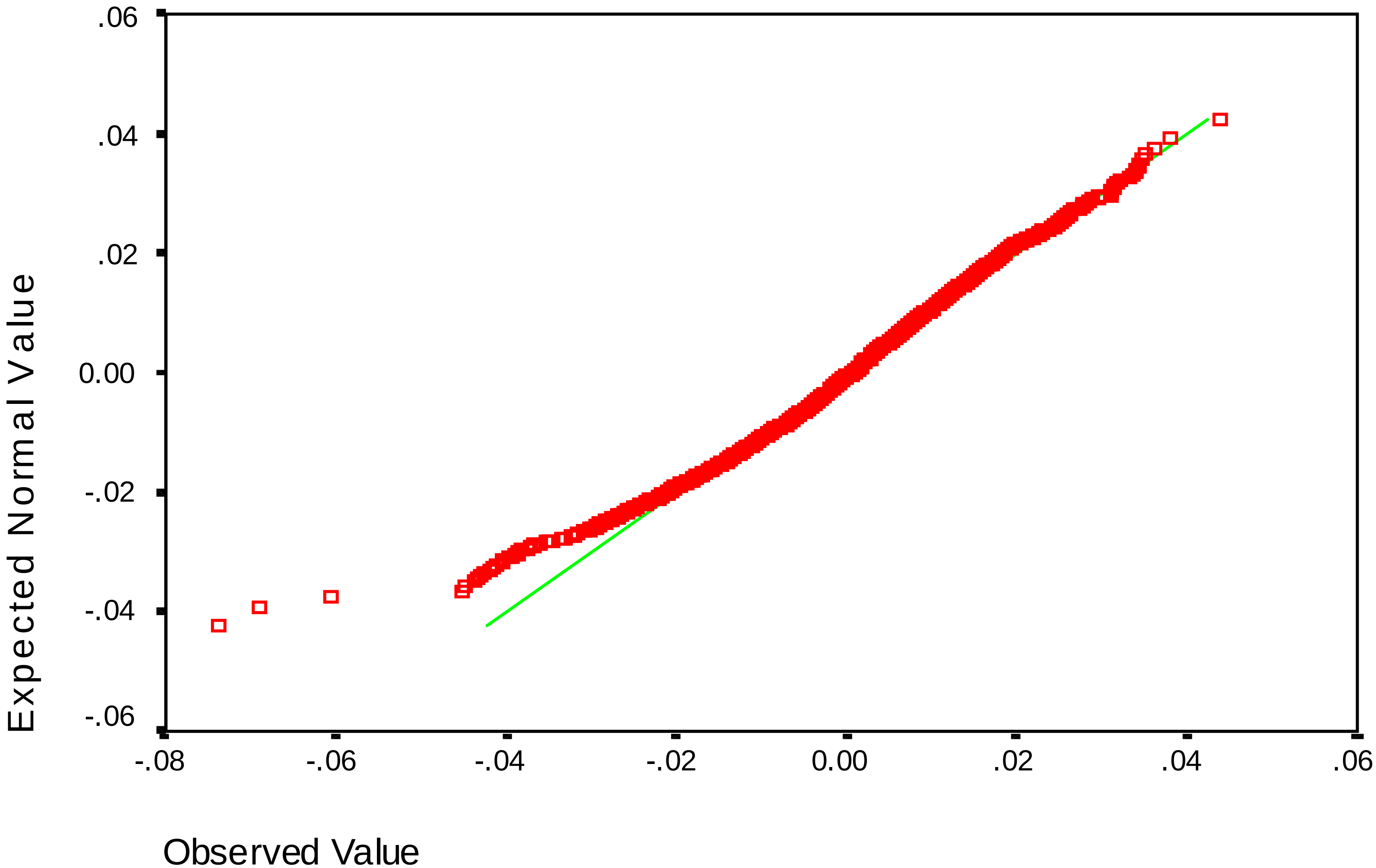
where ε_t follows Normal(0, 0.006976 ^{2})

AR(2) was rejected (φ_2 was not significant)

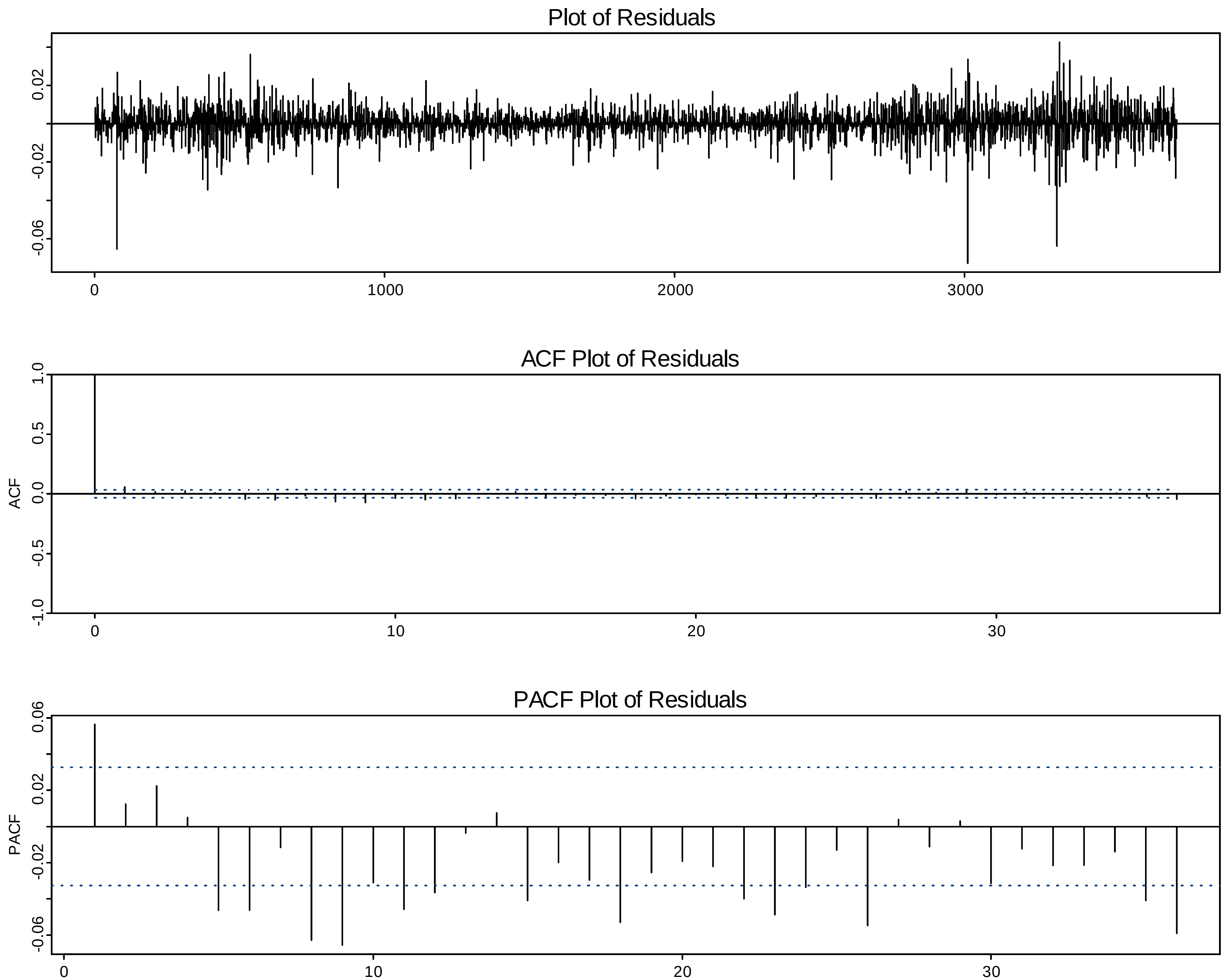
$ST_t = 0.8634\ ST_{t-1} - 0.07034\ ST_{t-2} + \varepsilon_t$,

where ε_t follows Normal(0, 0.006959 ^{2})

Normal Q-Q Plot



ARIMA Model Diagnostics: DJ.ST$ShortT



Results of the comparison of the three indexes

All figures in %	**Range Long Term Residuals**	**Volatility Short Term**
Dow	34	1.179
Nasdaq	39	1.485
S&P	37	1.151

Advantages of this approach

- Robust model (company, index)
- Theoretical + empirical