ECON 343
Lecture 5 : Simple forecasting of major asset prices

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Outline – Lecture 5

1. Reminder: Forecasting accuracy
2. USA: Forecasting the 2001 recession: the role of leading indicators
3. USA: Dow Jones index simple forecasting
4. Lebanon: BDL's Composite Index and its future trend
5. Lebanon: Seasonal adjustment of airport arrivals

1. Forecasting accuracy

- The evaluation of forecasting models is based on the desire to produce forecasts that are unbiased and accurate
- Mean Absolute Deviation (MAD) is one common measure of forecast accuracy

$$MAD = \frac{\sum \left| Y_t - Y_t^F \right|}{n}$$

- Cumulative sum of Forecast Errors (CFE) is a common measure of forecast bias

$$CFE = \sum (Y_t - Y_t^F)$$

- "Better" models would have lower MAD and CFE close to zero

1. Forecasting accuracy

- Forecasts are made with error. With a properly specified equation there are two sources of forecast error:
- The first arises because the residuals in the equation are unknown for the forecast period
  - The best you can do is to set these residuals equal to their expected value of zero
  - In reality, residuals only average out to zero and residual uncertainty is usually the largest source of forecast error
  - The equation standard error (called "S.E. of regression" in the output) is a measure of the random variation of the residuals

1. Forecasting accuracy

- The second source of forecast error is coefficient uncertainty
  - The estimated coefficients of the equation deviate from the true coefficients in a random fashion
  - The standard error of the coefficient, given in the regression output, is a measure of the precision with which the estimated coefficients measure the true coefficients
  - Since the estimated coefficients are multiplied by the exogenous variables in the computation of forecasts, the more the exogenous variables deviate from their mean values, the greater forecast uncertainty

1. Forecasting accuracy

- In a properly specified model, the realized values of the endogenous variable will differ from the forecasts by less than plus or minus two standard errors 95 percent of the time
- A plot of this 95 percent confidence interval is produced when you make forecasts in EViews
- Once forecasts are made they can be evaluated if the actual values of the series to be forecast are observed
- Since we computed ex post forecasts we can compute forecast errors and these errors can tell us a lot about the quality of our forecasting model

1. Forecasting accuracy

Let Y_t = actual values, f_t = forecast values, $e_t = Y_t - f_t$ = forecast errors and n = number of forecasts.. Eviews reports the following evaluation statistics if forecasts are computed ex post.

Root Mean Square Error

$$RMSE = \sqrt{\sum \frac{e_t^2}{n}}$$

Mean Absolute Error

$$MAE = \frac{\sum |e_t|}{n}$$

Mean Absolute Percentage Error

$$MAPE = \frac{1}{n} \cdot \sum \frac{|e_t|}{Y_t}$$

Goal: achieve lower error

Reminder: Time series functions in Eviews

Name	Function	Description
`d(x)`	first difference	$(1-L)X = X - X(-1)$ where L is the lag operator.
`d(x,n)`	n-th order difference	$(1-L)^n X$.
`d(x,n,s)`	n-th order difference with a seasonal difference at s	$(1-L)^n(1-L^s)X$.
`dlog(x)`	first difference of the logarithm	$(1-L)\log(X) = \log(X) - \log(X(-1))$.
`dlog(x,n)`	n-th order difference of the logarithm	$(1-L)^n \log(X)$.
`dlog(x,n,s)`	n-th order difference of the logarithm with a seasonal difference at s	$(1-L)^n(1-L^s)\log(X)$.
`@movav(x,n)`	n-period backward moving average	@movav(x, 3) $= (X + X(-1) + X(-2))/3$
`@movsum(x,n)`	n-period backward moving sum	@movsum(x,3) $= (X + X(-1) + X(-2))$

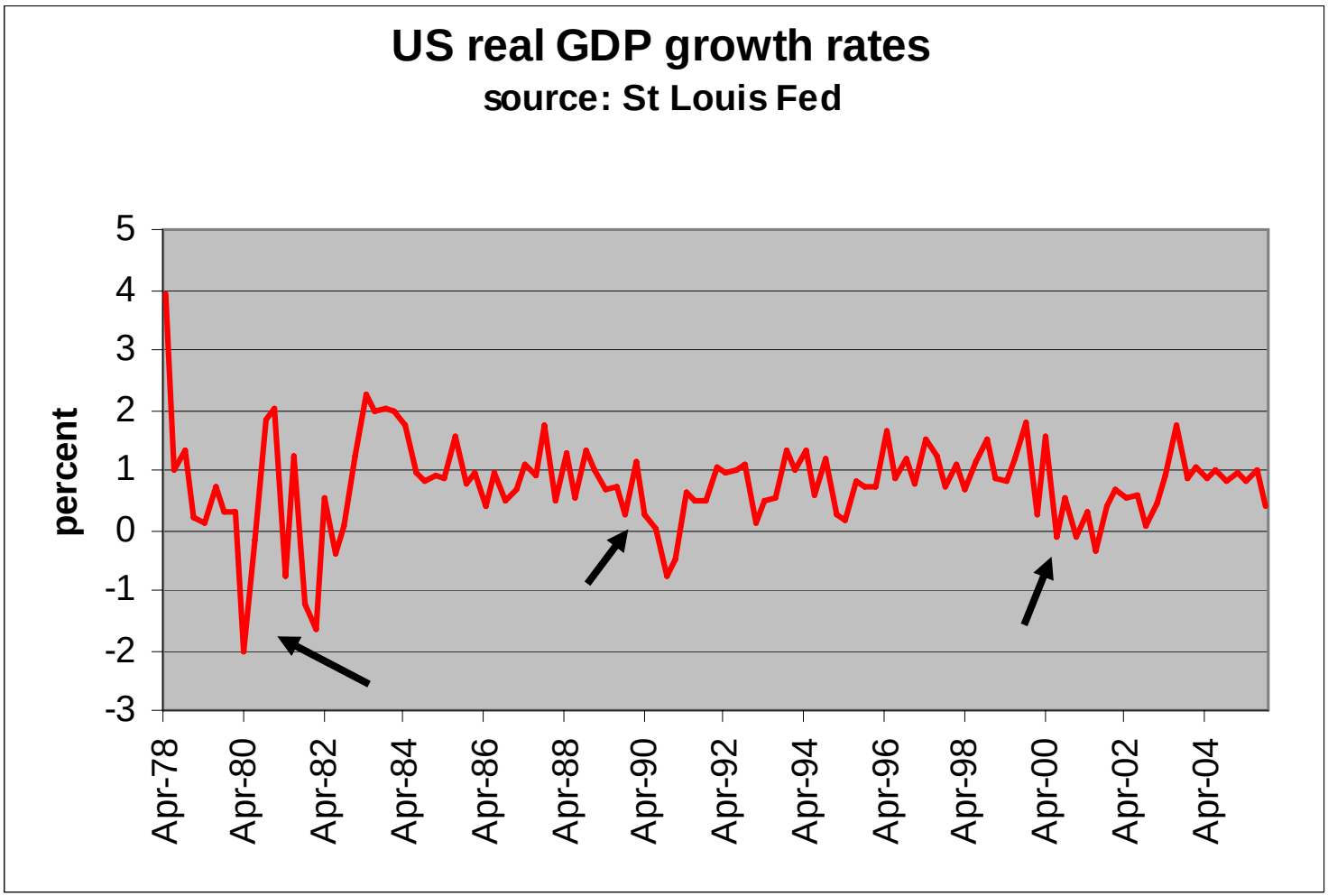
Reminder: Time series functions in Eviews

Name	Function	Description
`@pc(x)`	one-period percentage change (in percent)	equals `@pch(x)*100`
`@pch(x)`	one-period percentage change (in decimal)	$(X - X(-1))/X(-1)$
`@pca(x)`	one-period percentage change-annualized (in percent)	equals `@pcha(x)*100`
`@pcha(x)`	one-period percentage change-annualized (in decimal)	$@\text{pcha}(x) = (1 + @\text{pch}(x))^n - 1$ where n is the lag associated with one-year ($n = 4$) for quarterly data, etc.).
`@pcy(x)`	one-year percentage change (in percent)	equals `@pchy(x)*100`
`@pchy(x)`	one-year percentage change (in decimal)	$(X - X(-n))/X(-n)$, where n is the lag associated with one-year ($n = 12$) for annual data, etc.).

2. USA: Forecasting the 2001 recession: The role of leading indicators

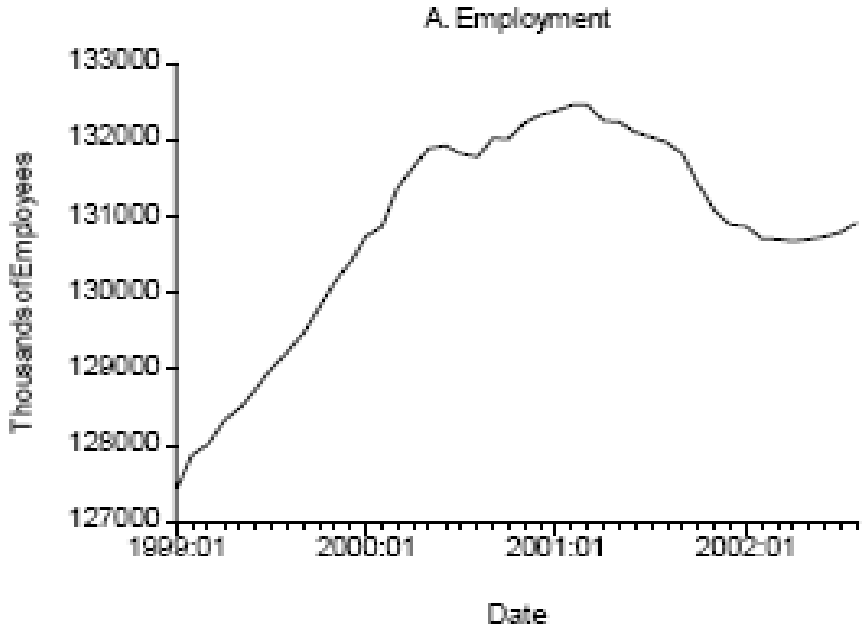
- The recession that began in March, 2001 differed in many ways from other US recessions of the past three decades
  - The twin recessions of the early 1980s occurred when the Federal Reserve Board acted decisively to halt the steady rise of inflation during the 1970s, despite the substantial employment and output cost to the economy
  - Although monetary tightening had reduced the growth rate of real activity in 1989, the proximate cause of the recession of 1990 was a sharp fall in consumption, a response by consumers to the uncertainty raised by Iraq's invasion of Kuwait and the associated spike in oil prices
  - The recession of 2001 started in the boardrooms of corporate America as businesses sharply cut back on expenditures – most notably investment associated with information technology – in turn leading to declines in manufacturing output and in the overall stock market.

2. USA: Forecasting the 2001 recession: The role of leading indicators

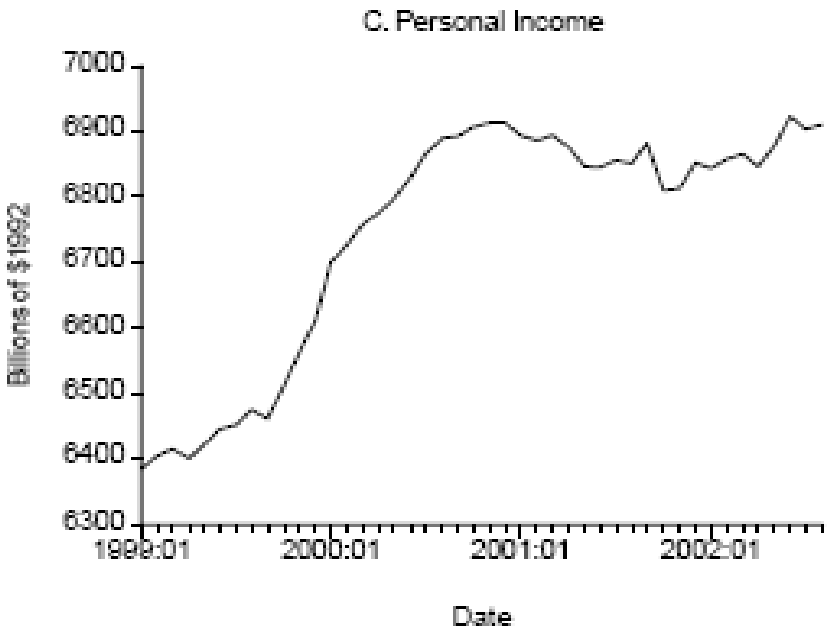


The 2001 recession

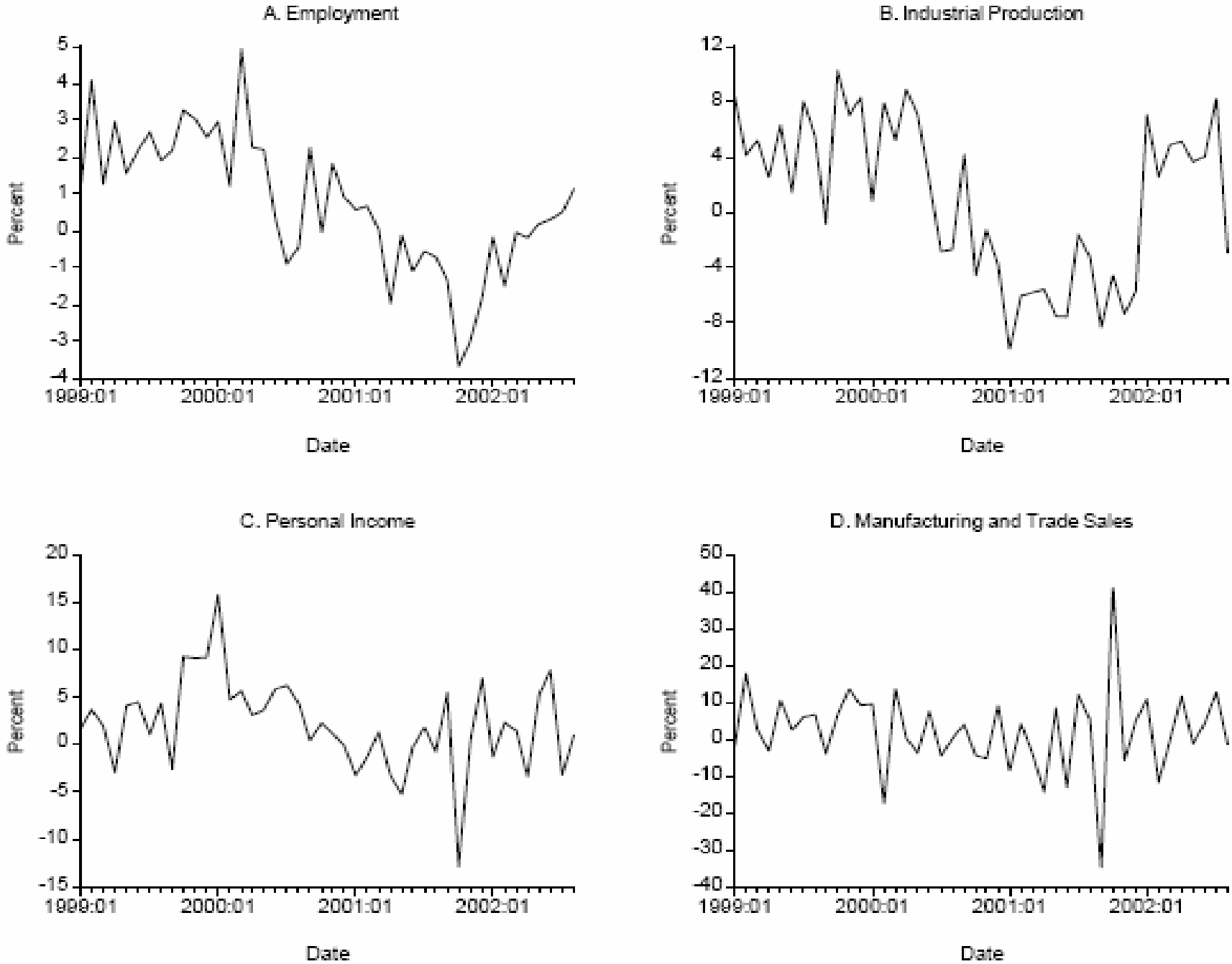
- Four coincident indicators that constitute The Conference Board's Index of Coincident Indicators:
  - employment in nonagricultural businesses
  - industrial production
  - real personal income less transfers
  - Real manufacturing and trade sales
- Also used by NBER Business Cycle Dating Committee to establish its business cycle chronology

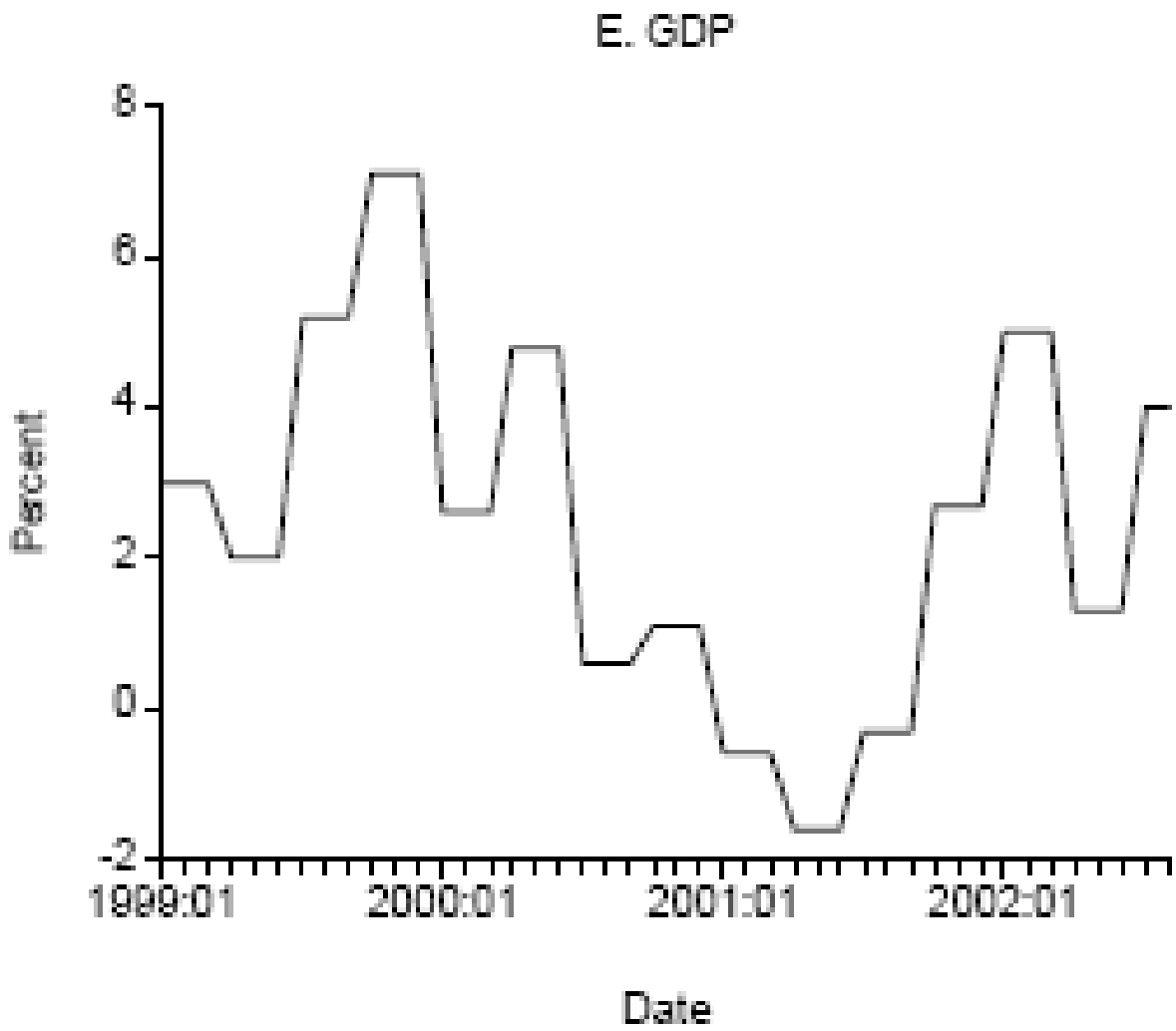

A. Employment
Thousands of Employees
133000
132000
131000
130000
129000
128000
127000
1999:01
2000:01
2001:01
2002:01
Date


B. Industrial Production
Index (1992=100)
118
116
114
112
110
108
106
1999:01
2000:01
2001:01
2002:01
Date


C. Personal Income
Billions of $1992
7000
6900
6800
6700
6600
6500
6400
6300
1999:01
2000:01
2001:01
2002:01
Date


D. Manufacturing and Trade Sales
Billions of $1996
870
860
850
840
830
820
810
800
790
1999:01
2000:01
2001:01
2002:01
Date


A. Employment
Percent
5
4
3
2
1
0
-1
-2
-3
-4
1999:01
2000:01
2001:01
2002:01
Date
B. Industrial Production
Percent
12
8
4
0
-4
-8
-12
1999:01
2000:01
2001:01
2002:01
Date
C. Personal Income
Percent
20
15
10
5
0
-5
-10
-15
1999:01
2000:01
2001:01
2002:01
Date
D. Manufacturing and Trade Sales
Percent
50
40
30
20
10
0
-10
-20
-30
-40
1999:01
2000:01
2001:01
2002:01
Date


E. GDP
8
6
4
2
0
-2
Percent
1999:01
2000:01
2001:01
2002:01
Date

Professional Forecasts During 2000 and 2001

- In the second month of every quarter, the Research Department of the Federal Reserve Bank of Philadelphia surveys a large number of professional forecasters

  (in the first quarter of 2000, 36 forecasters or forecasting groups participated)

  and asks them a variety of questions concerning their short-term forecasts for the U.S. economy.
- An examination of the one quarter ahead forecasts (for example, the 2000Q3 forecast of 2000Q4 growth) and the current quarter forecasts (the 2000Q4 forecast of 2000Q4 growth) reveals that the forecasters failed to predict the sharp declines in real GDP, even as they were occurring

Table 1. Median Forecasts of the Percentage Growth in Quarterly GDP from the Survey of Professional Forecasters

Target date:		Forecasts made in:							
	Actual	2000				2001			
Quarter	growth	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
'00Q4	1.1	2.9	3.1	**3.2**	3.2				
'01Q1	-0.6	2.8	2.6	3.0	**3.3**	0.8			
'01Q2	-1.6		2.9	2.7	3.2	**2.2**	1.2		
'01Q3	-0.3			3.2	3.3	3.3	**2.0**	1.2	
'01Q4	2.7				3.2	3.7	2.6	**2.8**	-1.9
'02Q1	5.0					3.7	3.1	2.7	**0.1**
'02Q2	1.3						3.6	3.0	2.4
'02Q3	4.0							3.9	3.6

Notes: Entries are quarterly percentage growth rates of real GDP, at an annual rate. One-quarter ahead forecasts appear in bold. Actual GDP growth is from the February 28, 2003 GDP release by the Bureau of Economic Analysis. Forecasts are the median forecast from the Philadelphia Federal Reserve Bank's Survey of Professional Forecasters (various issues; see www.phil.frb.org/econ/spf).

Table 2. Probabilities of a Quarterly Decline in Real GDP from the Survey of Professional Forecasters

Target date:		Forecasts made in:							
	Actual	2000				2001			
Quarter	growth	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
'00Q4	1.1	13%	9%	**7%**	4%				
'01Q1	-0.6	17	15	13	**11**	37%			
'01Q2	-1.6		18	16	17	**32**	32%		
'01Q3	-0.3			17	19	23	**29**	35%	
'01Q4	2.7				19	18	23	**26**	82%
'02Q1	5.0					13	18	20	**49**
'02Q2	1.3						13	16	27
'02Q3	4.0							15	18

Forecast entries are the probability that real GDP growth will be negative, averaged across SPF forecasters. The forecasted probability that growth will be negative in the quarter after the forecast is made (that is, the one-quarter ahead forecast) appears in bold. See the notes to Table 1.

Forecasting by using 12 leading indicators

- A measure of the term spread (the ten year Treasury bond rate minus the federal funds rate); the federal funds rate; the paper-bill spread (the 3-month commercial paper rate minus the Treasury bill rate; the high yield "junk" bond spread (the difference between the yield on high-yield securities4 and the Aaa corporate bond yield); the return on the S&P500; and the real price of oil.
- New claims for unemployment insurance; housing starts (building permits); the University of Michigan index of consumer expectations.; industrial production of business equipment; new orders for capital goods; the growth rate of real M2

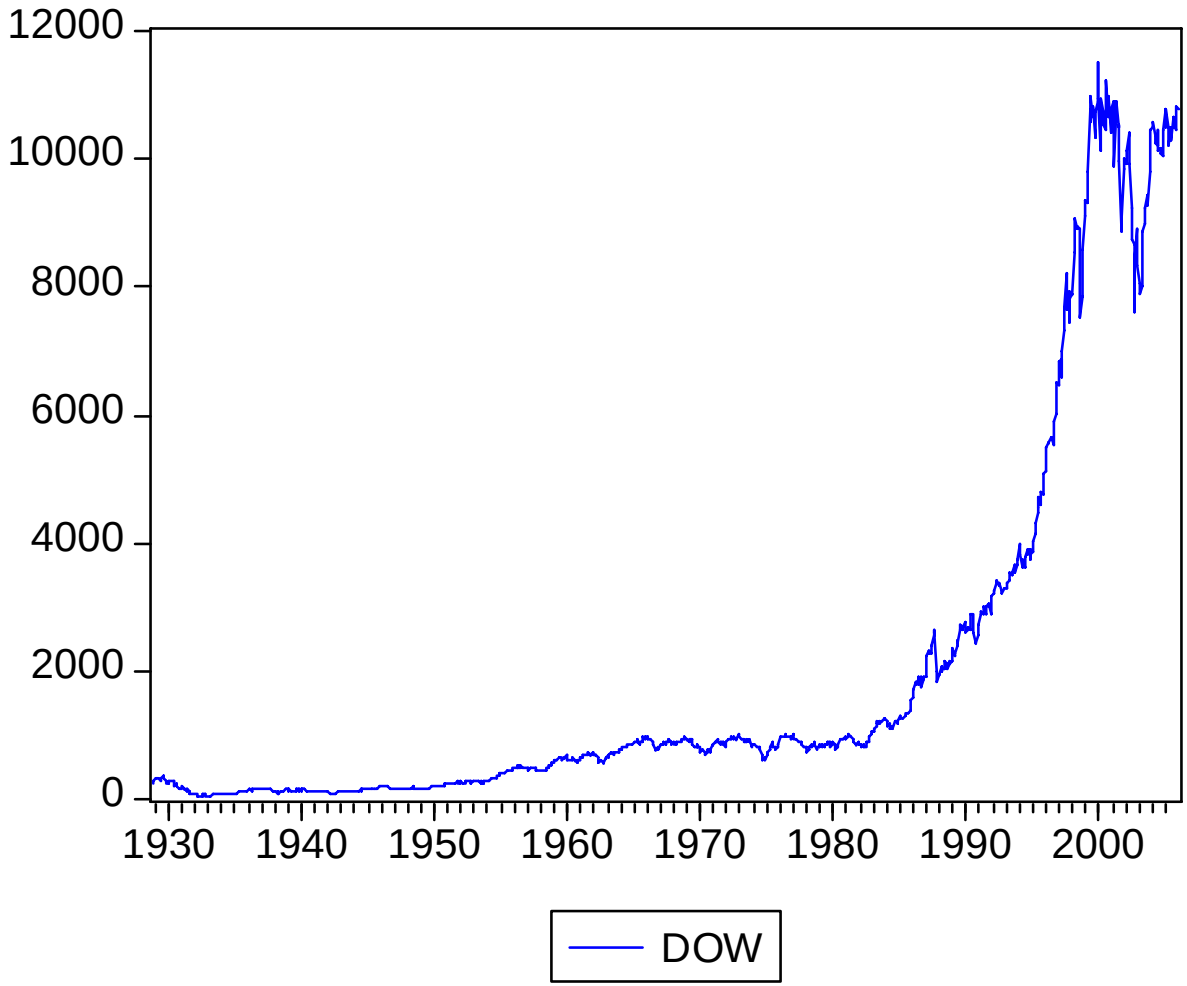
Table 3. Relative MSFEs of Individual Indicator Forecasts of U.S. Output Growth, 1999:I – 2002:III

Predictor	Transfor-mation	GDP		IP	
		h = 2	*h* = 4	*h* = 2	*h* = 4
		Root Mean Square Forecast Error			
Univariate Autoregression		2.06	2.03	4.34	4.92
Predictor		*MSFE Relative to Univariate AR Model*			
random walk	level	1.26	1.11	1.56	1.17
Interest Rates					
federal funds	Δ	1.01	0.71	0.97	0.78
90-day T-bill	Δ	1.01	0.76	1.02	0.88
1-year T-bond	Δ	1.17	0.96	1.22	1.06
5-year T-bond	Δ	1.37	1.24	1.38	1.23
10-year T-bond	Δ	1.36	1.26	1.21	1.23
Spreads					
term spread (10year – Fed. Funds)*	level	0.86	0.65	0.77	0.72
term spread (10 year – 90-day T-bill)	level	0.87	0.62	0.70	0.62
paper-bill spread (comm. paper – T-bill)	level	1.31	1.17	1.96	1.43
junk bond spread (high yield – AAA corp)	level	0.76	0.65	0.67	0.58

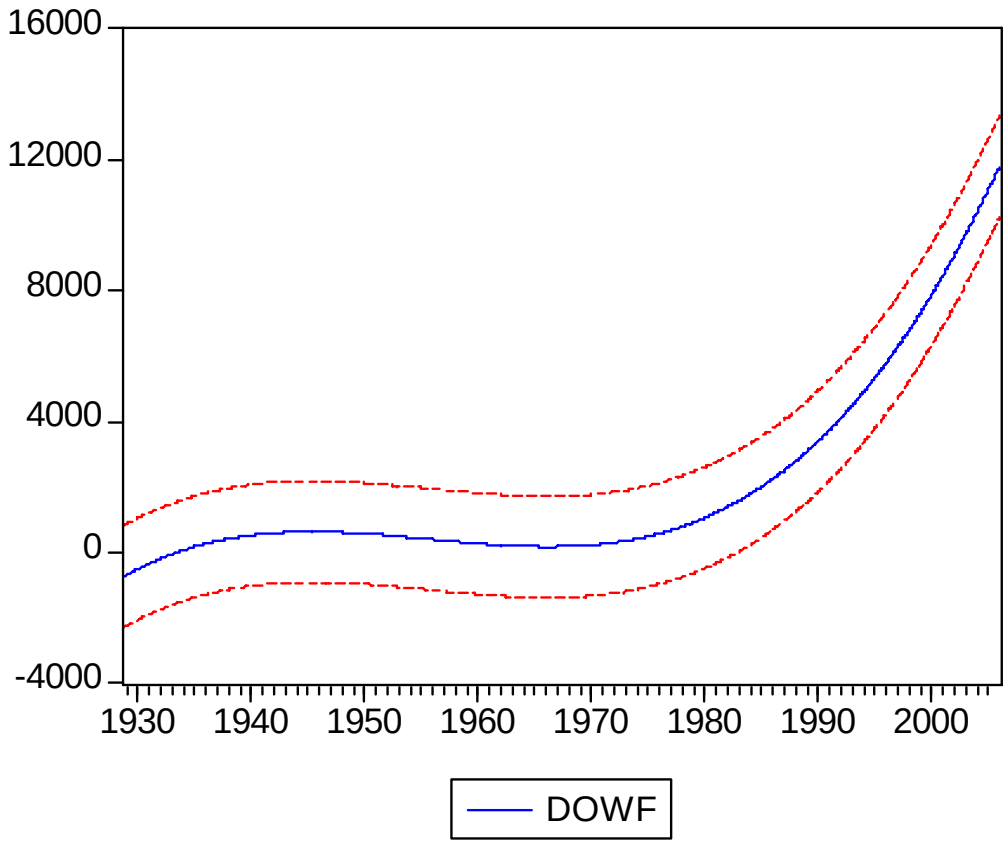
Predictor	Transfor-mation	GDP		IP	
		h = 2	*h* = 4	*h* = 2	*h* = 4
		Root Mean Square Forecast Error			
Univariate Autoregression		2.06	2.03	4.34	4.92
Predictor		*MSFE Relative to Univariate AR Model*			
Other Financial Variables					
exchange rate	Δln	0.85	0.87	0.85	0.80
stock prices*	Δln	0.83	0.93	0.64	0.71
Output					
real GDP	Δln			0.92	0.96
IP – total	Δln	0.98	1.01		
IP – products	Δln	1.03	0.99	1.03	0.96
IP – business equipment	Δln	1.00	1.01	1.05	1.06
IP – intermediate products	Δln	0.89	0.90	0.89	0.88
IP – materials	Δln	0.97	1.01	1.04	0.98
capacity utilization rate	level	0.91	1.01	0.85	1.03
Labor Market					
employment	Δln	0.96	1.00	0.96	0.99
unemployment rate	Δ	1.24	1.08	1.31	1.09
average weekly hours in manufacturing*	level	0.87	0.75	0.72	0.87
new claims for unemployment insurance*	Δln	0.75	0.84	0.74	0.81

Predictor	Transfor-mation	GDP		IP	
		h = 2	*h* = 4	*h* = 2	*h* = 4
		Root Mean Square Forecast Error			
Univariate Autoregression		2.06	2.03	4.34	4.92
Predictor		*MSFE Relative to Univariate AR Model*			
Other Leading Indicators					
housing starts (building permits)*	$\Delta \ln$	1.30	1.07	1.52	1.14
vendor performance*	level	1.02	0.97	1.19	0.97
orders – consumer goods and materials*	$\Delta \ln$	0.77	0.83	0.81	0.83
orders – nondefense capital goods*	$\Delta \ln$	1.02	1.03	0.92	1.09
consumer expectations (Michigan)*	level	1.96	2.14	1.33	1.49
Prices and Wages					
GDP deflator	$\Delta^2 \ln$	1.00	0.94	0.94	0.84
PCE deflator	$\Delta^2 \ln$	1.01	1.05	0.99	0.99
PPI	$\Delta^2 \ln$	1.01	1.02	0.96	0.99
earnings	$\Delta^2 \ln$	1.00	1.01	0.89	0.98
real oil price	$\Delta^2 \ln$	1.13	1.18	1.07	1.11
real commodity price	$\Delta^2 \ln$	1.04	1.00	1.12	1.09
Money					
real M0	$\Delta \ln$	2.13	2.84	1.41	1.73
real M1	$\Delta \ln$	1.09	1.07	1.57	1.12
real M2*	$\Delta \ln$	2.06	1.82	2.13	1.94
real M3	$\Delta \ln$	1.81	2.23	2.05	2.15

3. USA: Dow Jones index simple forecasting



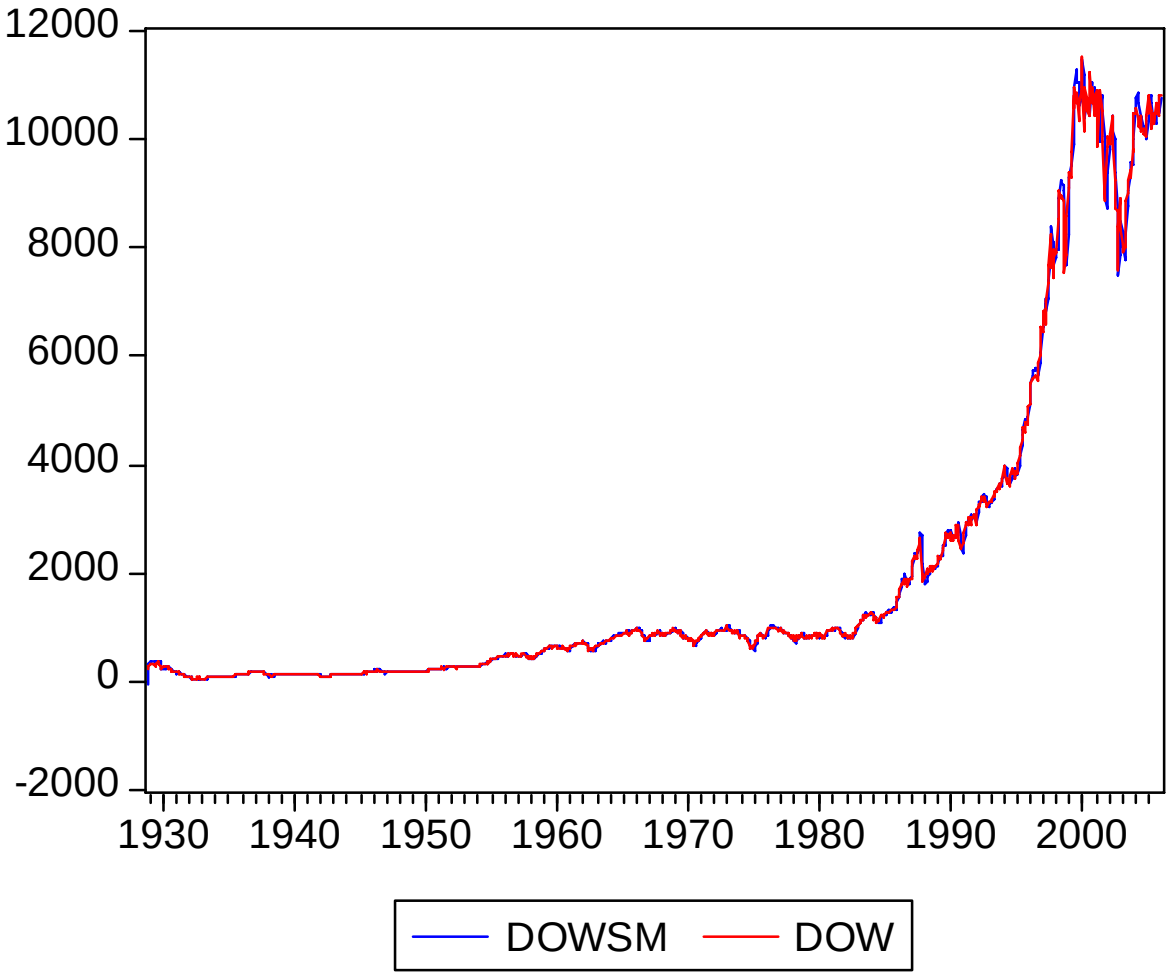
3rd polynomial trend



Forecast: DOWF
Actual: DOW
Forecast sample: 1928M10 2005M12
Included observations: 927

Root Mean Squared Error	769.6206
Mean Absolute Error	577.0012
Mean Abs. Percent Error	101.2575
Theil Inequality Coefficient	0.108608
Bias Proportion	0.000000
Variance Proportion	0.017038
Covariance Proportion	0.982962

Double Exponential smoothing



Root Mean Squared Error		**170**
End of Period Levels:	**Mean**	**10770.26**
	Trend	**60.84858**

4. Lebanon: BDL's Composite Index and its future trend

- There have been no official GDP estimates for Lebanon for many years
- Although the country has experienced more than a decade of peace and economic progress since the 1991 Ta'if Accord, the Lebanese statistical institute has been reluctant to start work on national accounts until better basic statistics are in place
- In the absence of official GDP figures, the Lebanese central bank - Banque du Liban (BDL) - has published a composite coincident indicator for Lebanon since 1994 as a measure of overall economic development
- In 2002 the OECD was asked to advise the BDL on how this indicator could be improved as a measure of monthly GDP

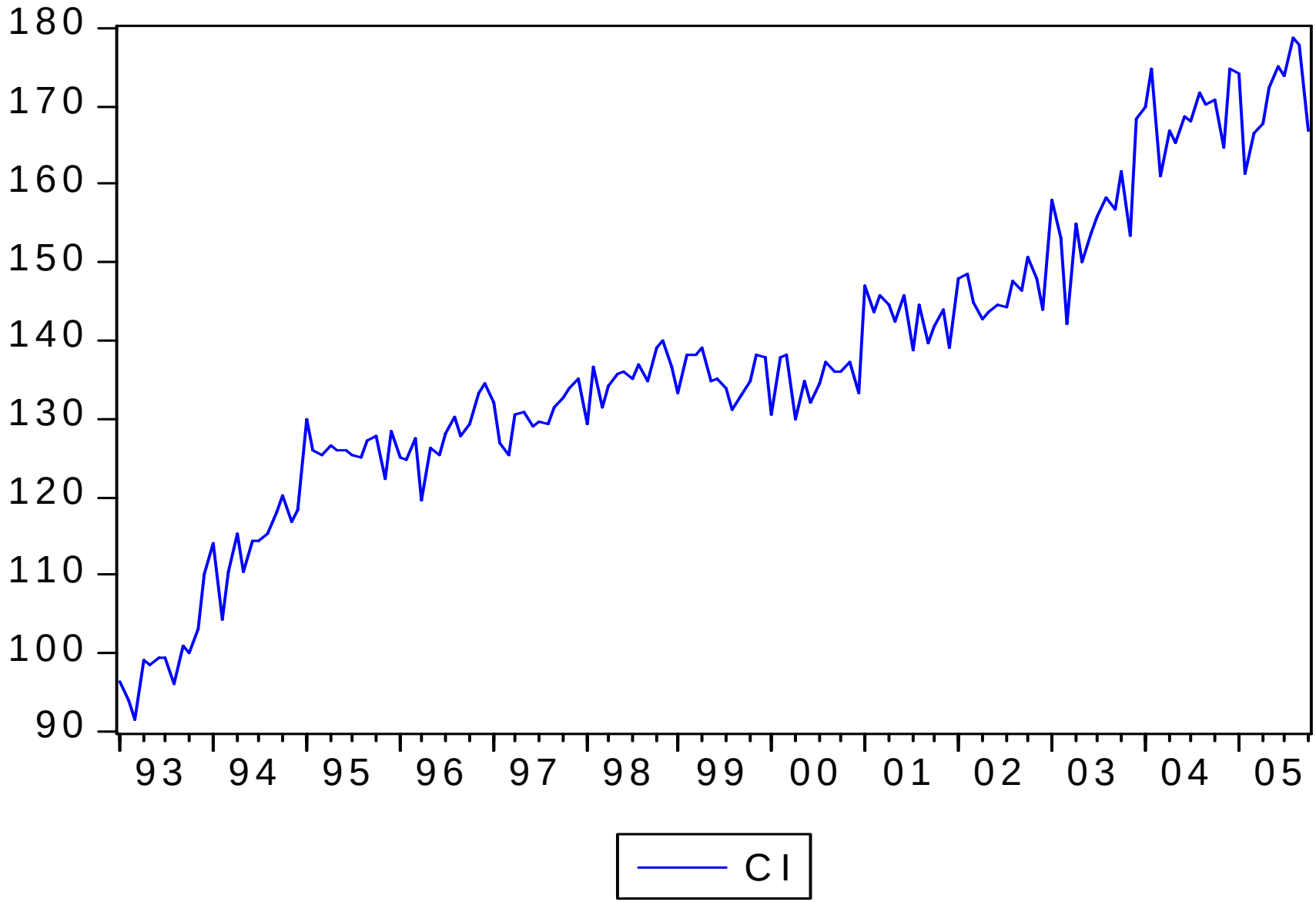
4. Lebanon: BDL's Composite Index and its future trend

- For several years the OECD Statistics Directorate has been constructing composite leading indicators (CLI) for its member countries
- These are designed to predict turning points in the growth rate of a target variable – the index of industrial production in this case - with a lead of about 6 months
- The same techniques can be used to construct a composite coincident indicator (CCI) – i.e. one whose movements coincide with those of the target variable

	Time span	Pre-adjustment		ARIMA Model	Disturbance from irregular component	Identifiable seasonality		Combined quality statistics
		TRD	EAST	ID	MCD	Mov	Comb	Q value
Quantitative Indicators								
(1) Petroleum products	1993-August 2001	No	**Yes**	Fixed	**12**	No	**No**	**1.74**
(2) Electricity production	1993- August 2001	No	No	Fixed	4	No	Yes	0.61
(3) Cheques cleared	1993-August 2001	No	**Yes**	Fixed	1	**Yes**	**No**	**1.51**
(4) Cement deliveries	1993-August 2001	No	No	Fixed	5	No	Yes	0.45
(5) Passengers flows	1993-August 2001	No	**Yes**	Fixed	**8**	**Yes**	Yes	0.61
(6) Imports	1993-August 2001	No	No	Fixed	7	No	Yes	0.98
(7) Exports	1993-August 2001	No	No	Fixed	**12**	No	Yes	**1.32**
(8) MoneyM3	1993-August 2001	No	No	Fixed	1	No	Yes	0.36
Qualitative Survey Indicators								
(9) Production tendency in industry	1995-Quaretr 4 2000	No	No	Fixed	1	No	Yes	0.39
(10 Order situation in industry	1995-Quarter 4 2000	No	No	Fixed	1	No	Yes	0.27
(11) Sales volume tendency in commerce	1995-Quarter 4 2000	No	No	Fixed	1	No	Yes	0.28

TRD = Trading day regression
EAST = Easter adjustment
ID = ARIMA model selected from fixed set of 5 models
MCD = The number of months it takes the change in the trend-cycle to surpass the amount of change in the irregular component
Mov = Moving seasonality
Comb = Combined test for the presence of identifiable seasonality
Q value = Overall monitoring and quality statistics. The Q value is in the range 0 to 3 with an acceptance region from 0 to 1.

Indicator	*Coincident relationship with:*
Petroleum products	Cement deliveries, imports and production tendency in industry
Cheques cleared	Production tendency in industry and sales volume in commerce
Cement deliveries	Petroleum products, imports, production tendency in industry and sales volume in commerce
Passenger flows	Sales volume in commerce
Imports	Petroleum products, cement deliveries and sales volume in commerce
Production tendency in industry	Petroleum products, cheques cleared, cement deliveries and sales volume in commerce
Sales volume in commerce	Cheques cleared, cement deliveries, passenger flows, imports and production tendency in industry


180
170
160
150
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130
120
110
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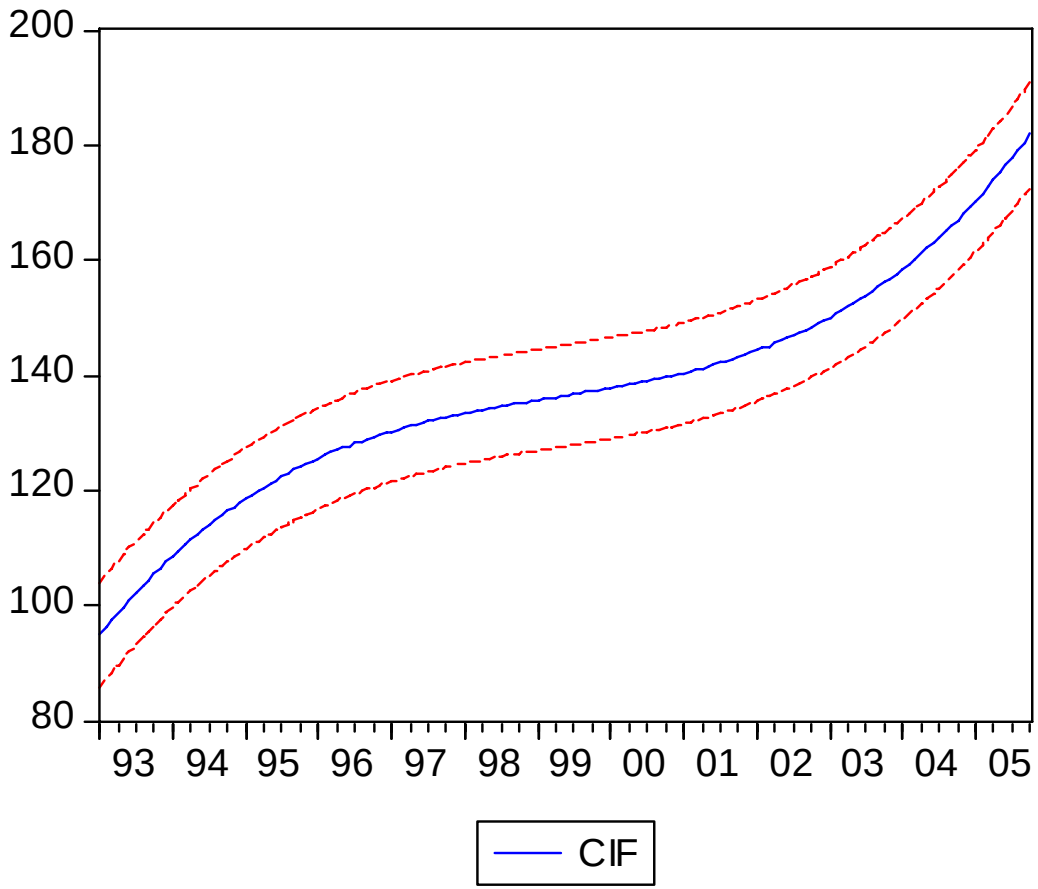
05
CI

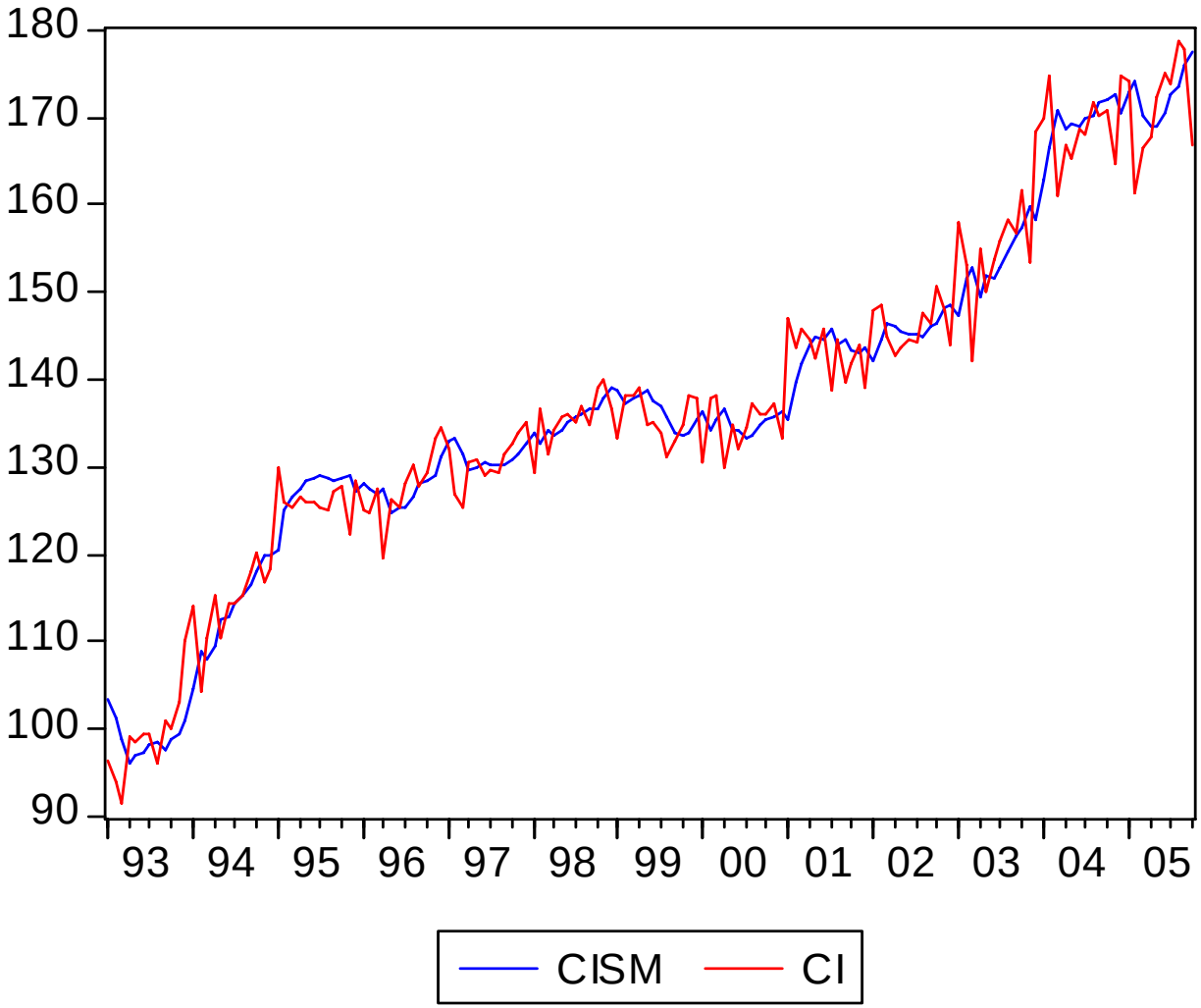
3rd polynomial trend



Forecast: CIF
Actual: CI
Forecast sample: 1993M01 2005M10
Included observations: 154

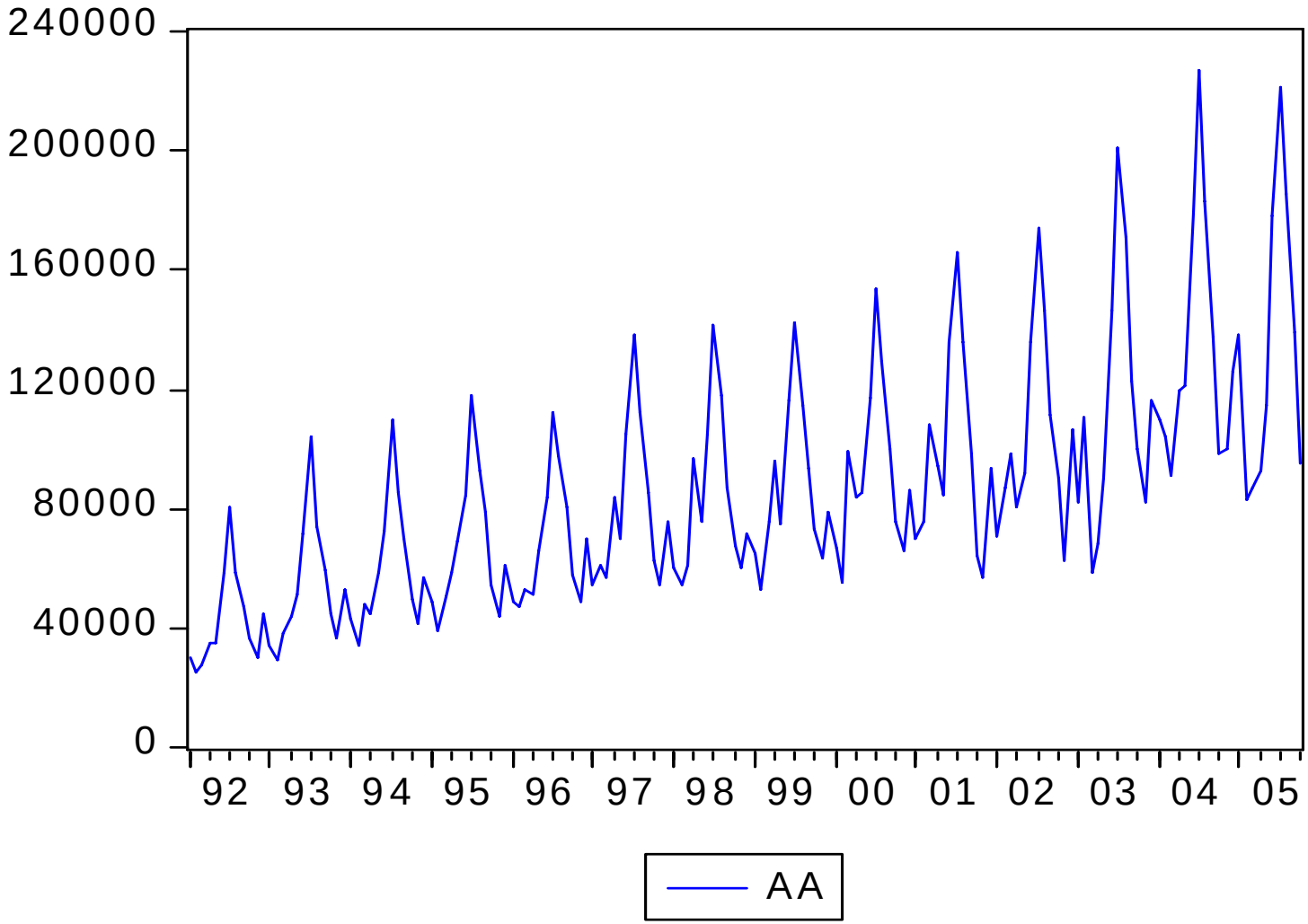
Root Mean Squared Error	4.300455
Mean Absolute Error	3.320487
Mean Abs. Percent Error	2.413381
Theil Inequality Coefficient	0.015525
Bias Proportion	0.000000
Variance Proportion	0.012560
Covariance Proportion	0.987440

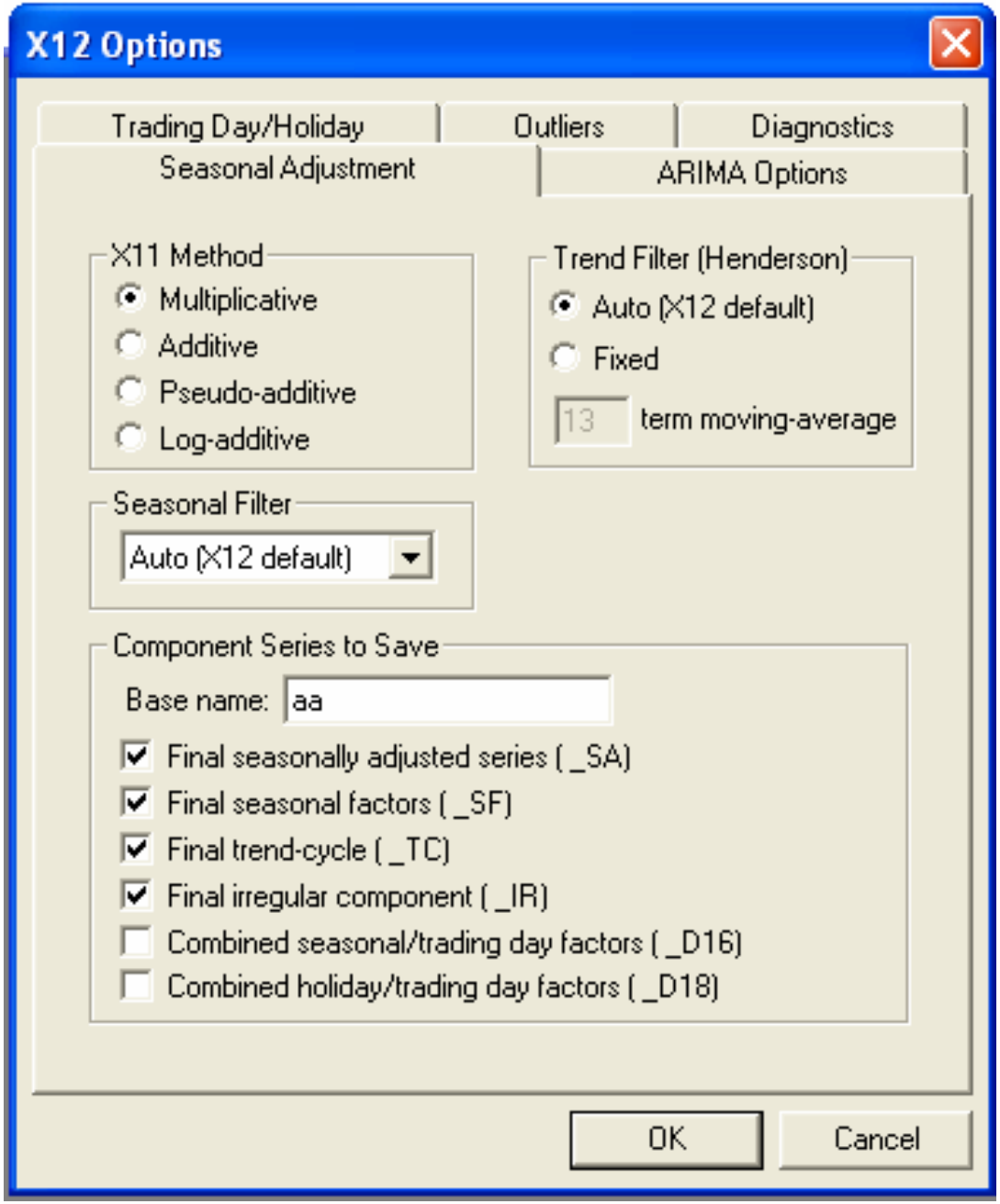
3rd polynomial trend

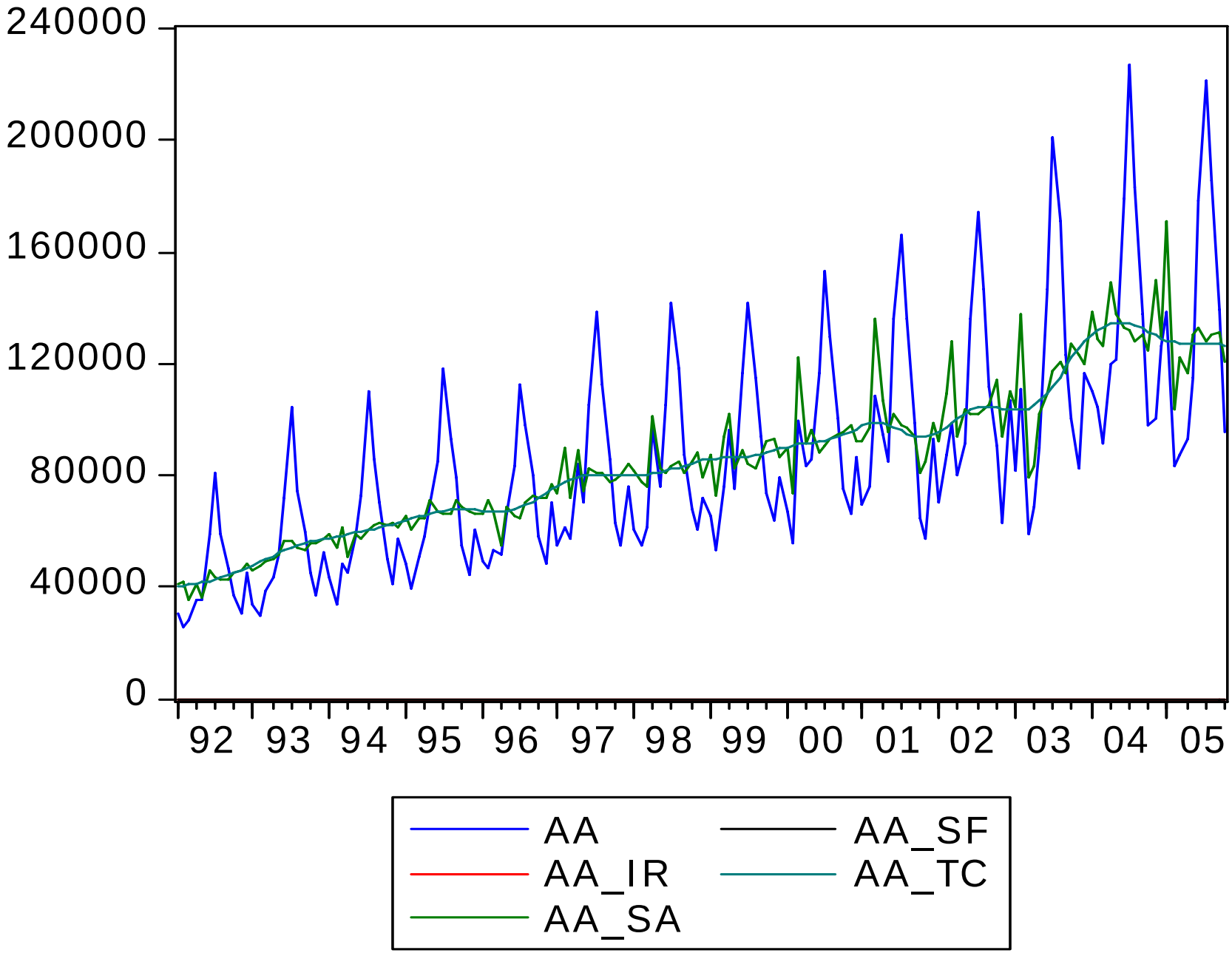


Alpha		**0.19**
Sum of Squared Residuals		**2706.265**
Root Mean Squared Error		**4.192034**
End of Period Levels:	**Mean**	**173.7247**
	Trend	**0.405442**

5. Seasonal adjustment of airport arrivals




X12 Options
Trading Day/Holiday
Outliers
Diagnostics
Seasonal Adjustment
ARIMA Options
X11 Method
Multiplicative
Additive
Pseudo-additive
Log-additive
Trend Filter (Henderson)
Auto (X12 default)
Fixed
13
term moving-average
Seasonal Filter
Auto (X12 default)
Component Series to Save
Base name:
aa
Final seasonally adjusted series (_SA)
Final seasonal factors (_SF)
Final trend-cycle (_TC)
Final irregular component (_IR)
Combined seasonal/trading day factors (_D16)
Combined holiday/trading day factors (_D18)
OK
Cancel


240000
200000
160000
120000
80000
40000
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92
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95
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97
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99
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01
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04
05
AA
AA_IR
AA_SA
AA_SF
AA_TC