Seasonal Modeling and In-Sample Forecasting

Course: Econometrics of Seasonality

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Presentation Layout

- Introduction
- Data
- Graphical Analysis
- Regression with Seasonal and Trend Effects and ARMA Models
- Forecasting (In-Sample)
- Results Comparison
- References

Introduction

Present study compares two statistical models for regressing and forecasting for the macroeconomic variable.

Model 1: In this model estimation has been done on the trend and seasonal impacts.

$$Y_t = \beta_1 (TIME_t) + \sum_{i=1}^{s} \gamma_i D_{it} + \varepsilon_t$$

Model 2: In this model cyclical effects are also incorporated in the model along with the trend and seasonal impacts.

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-i} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}.$$

Note: imports and exports Y = Log(y)

Data

Data for three important macroeconomic variables i.e. Import, Export and Manufacturing Production for Pakistan has been used for the analysis.

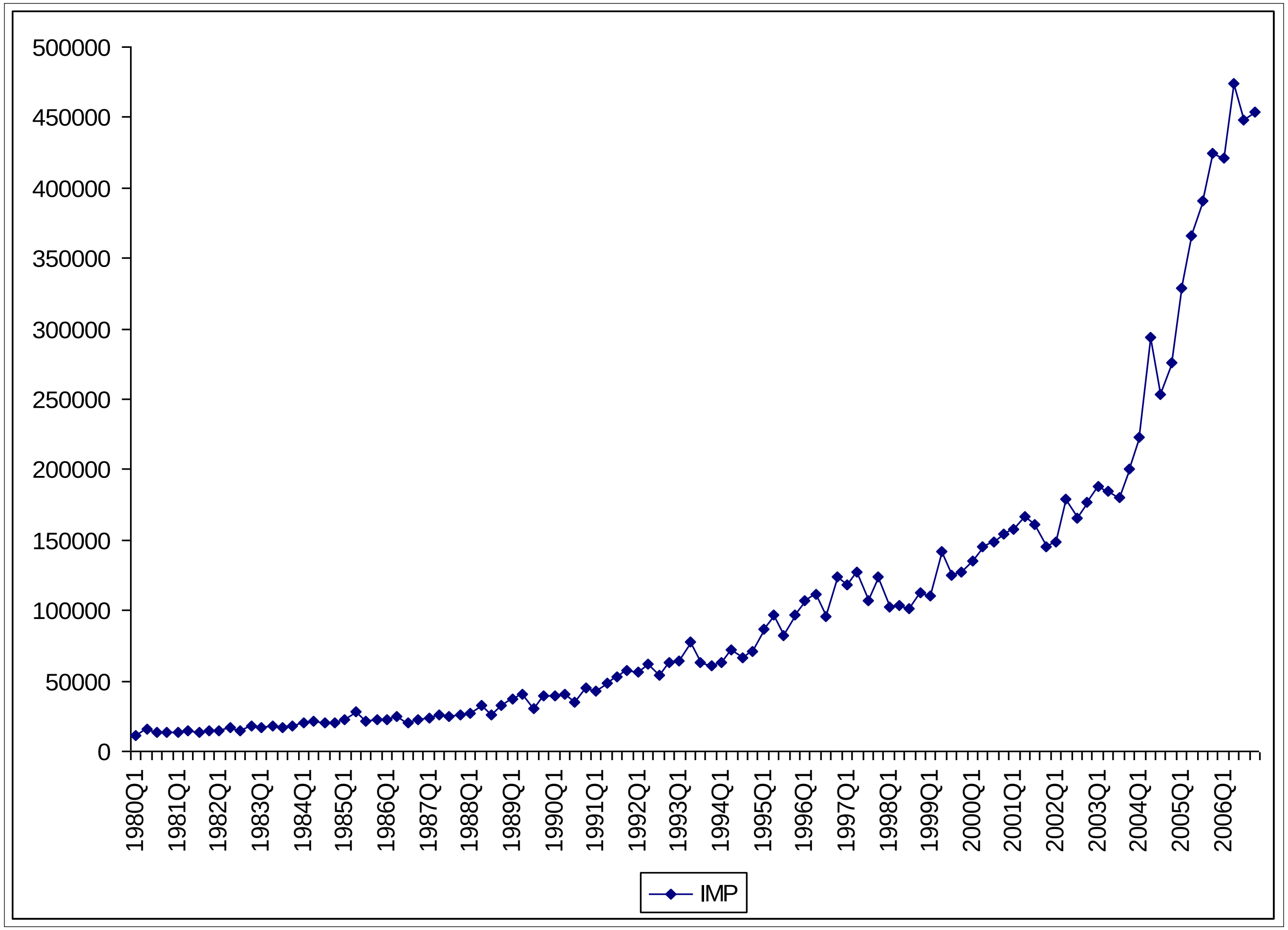
Sample: 1980-2006

Source: International Financial Statistics, February 2008

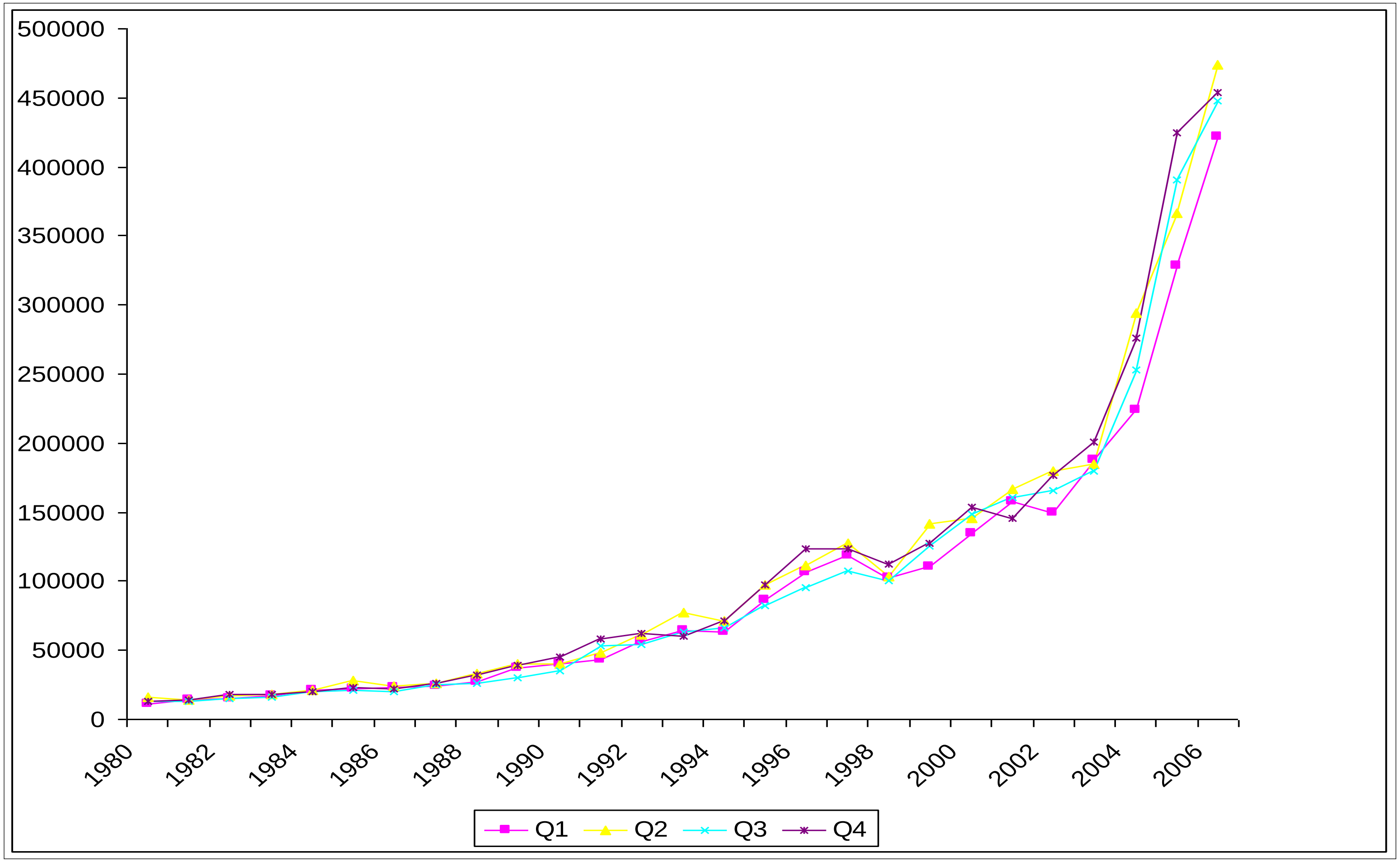
Units of Measurement: Import in Millions of Rupees
Manufacturing as Index

Graphical Analysis

Imports (Million Rs) 1980-2006

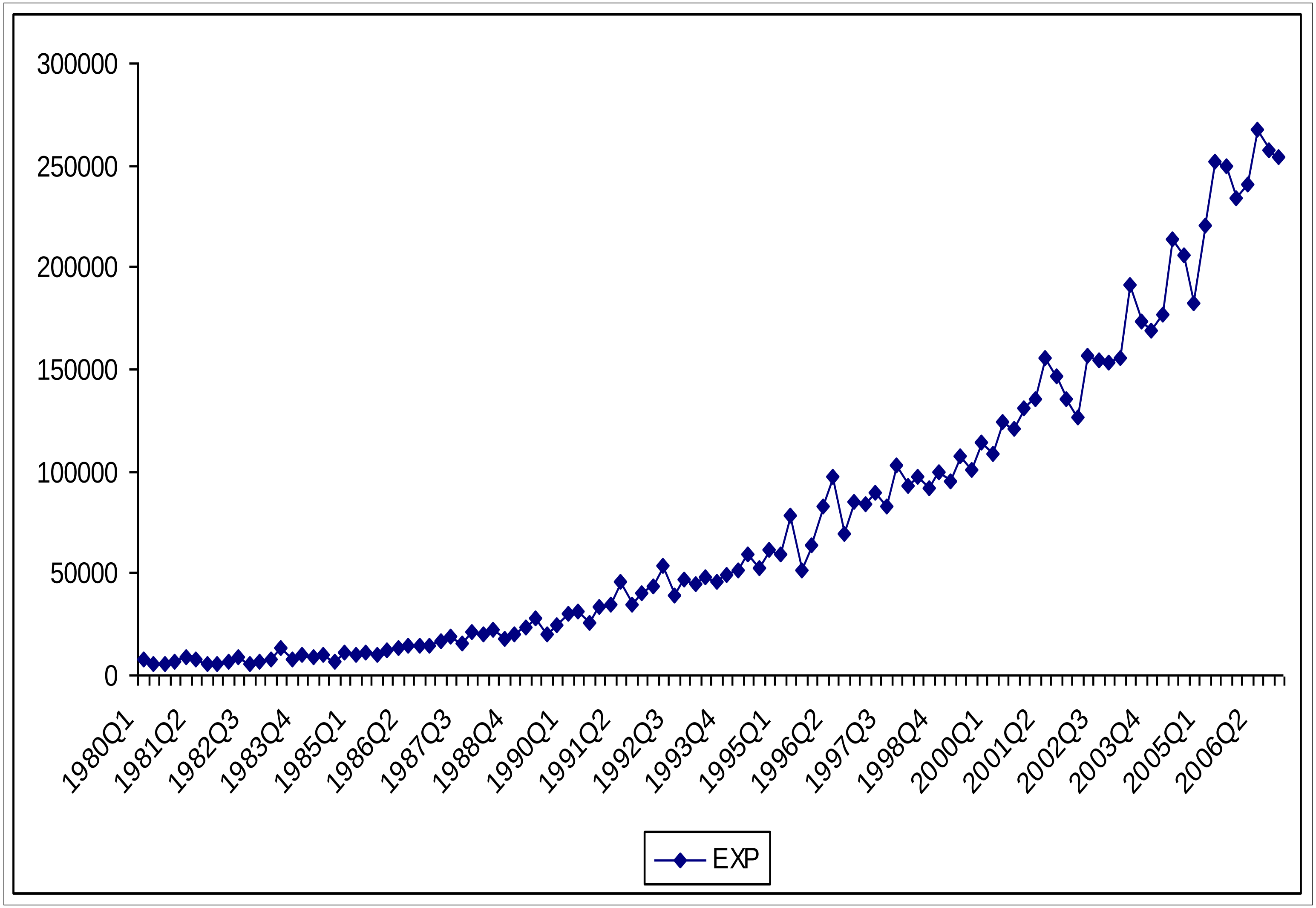


Imports (Million Rs) 1980-2006

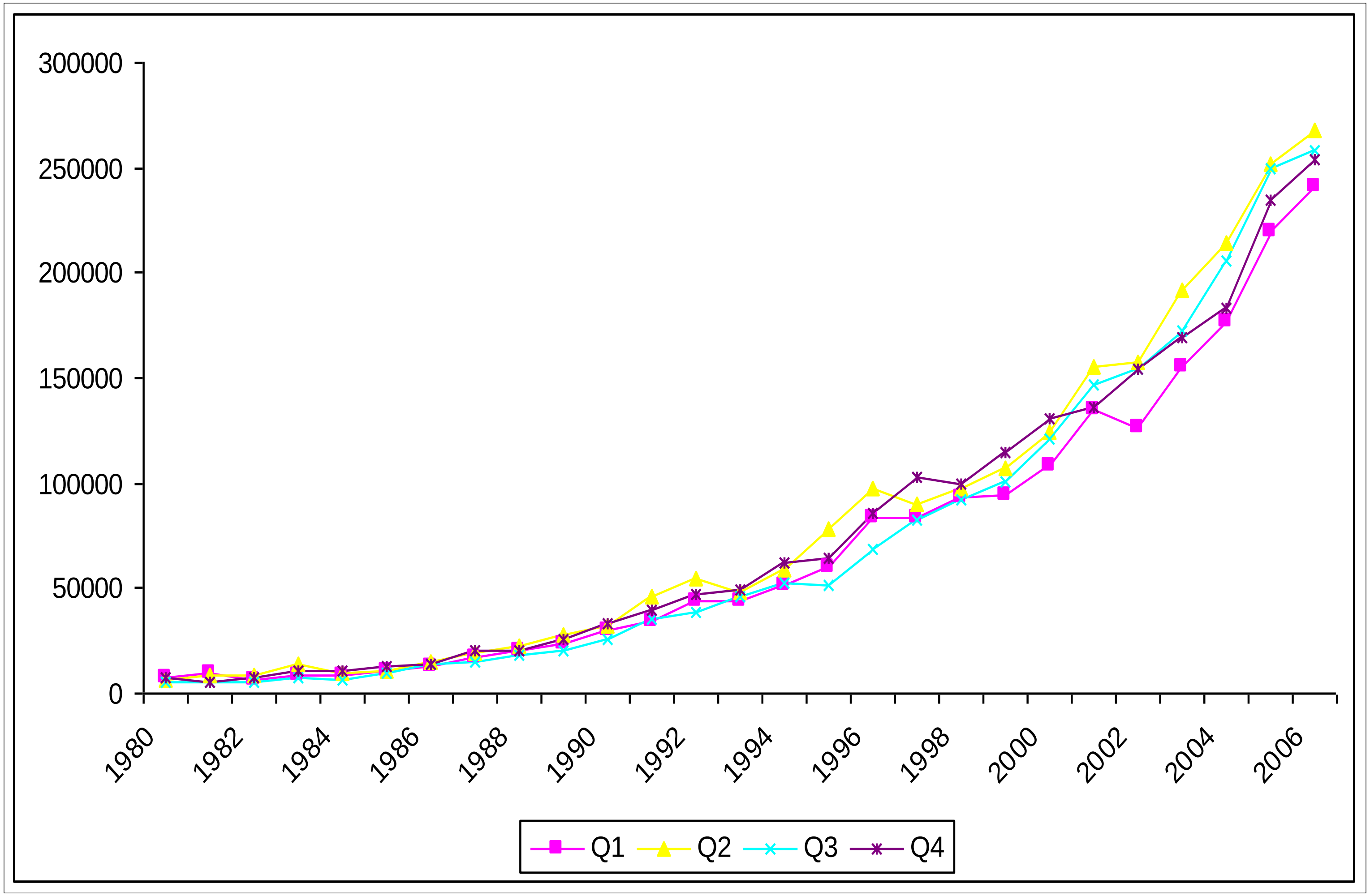


- 4th quarter is mostly dominated although there are crossing present in the data.

Exports (Million Rs) 1980-2006

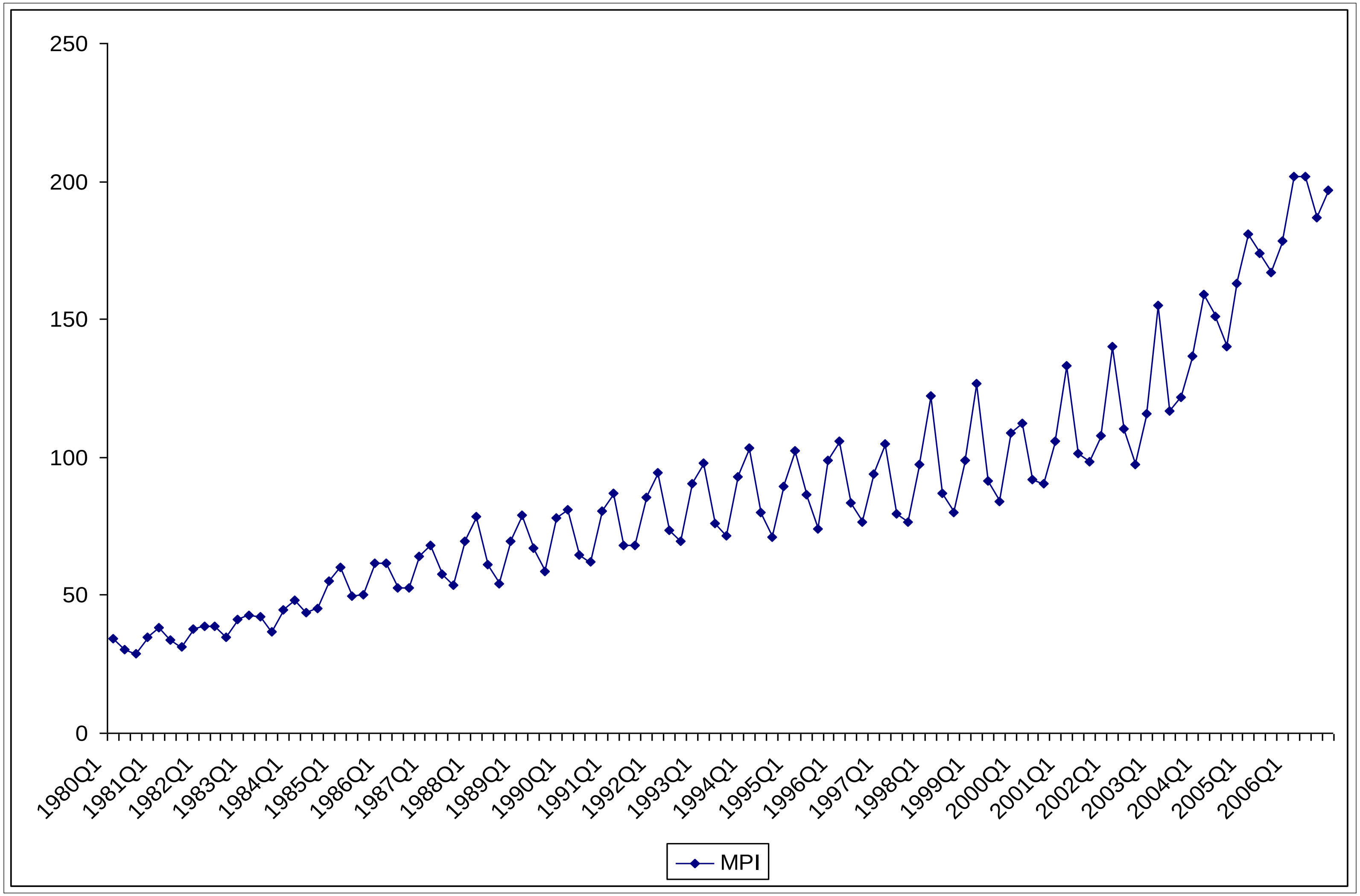


Exports (Million Rs) 1980-2006

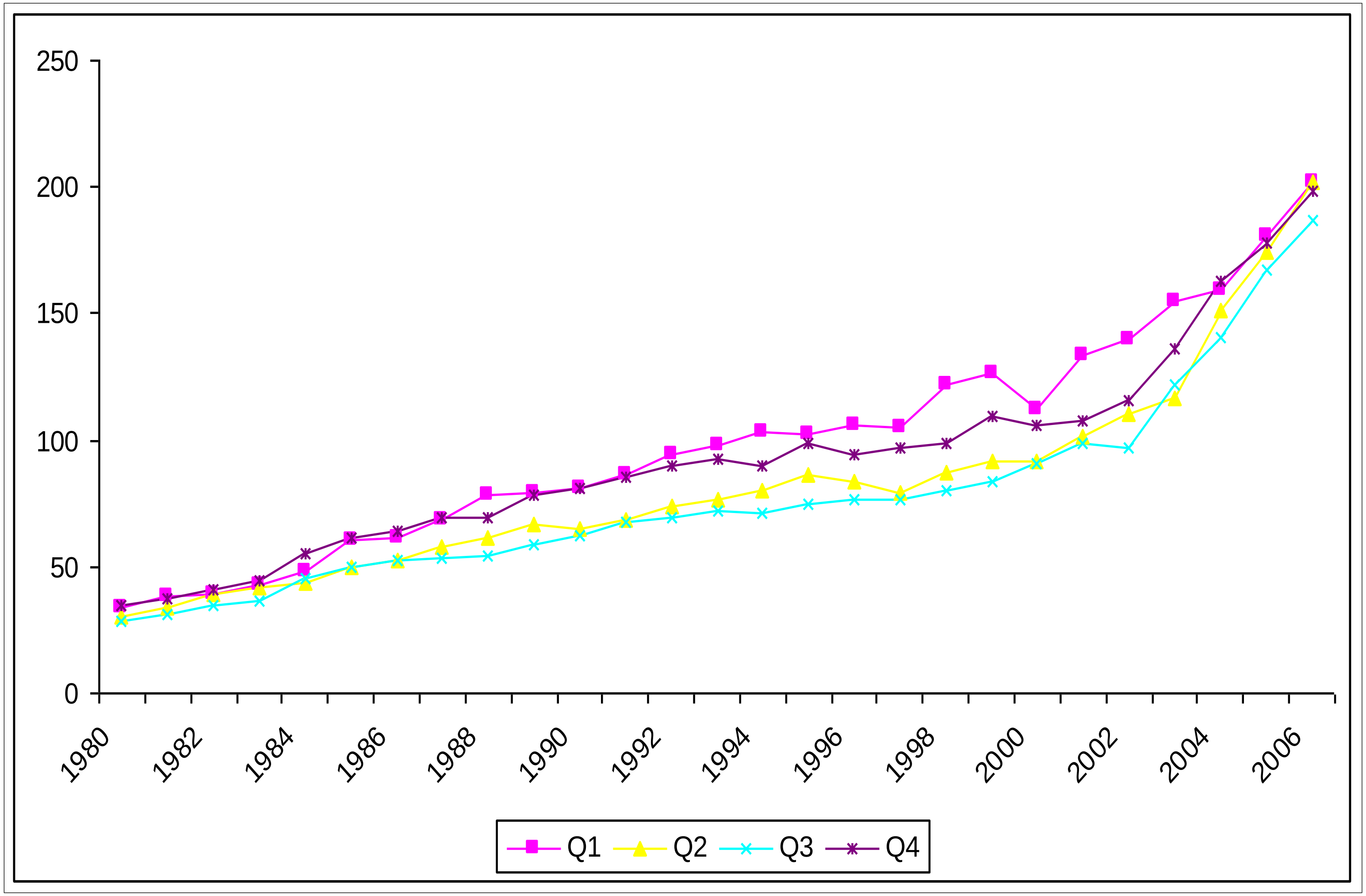


- 2nd quarter is mostly dominated although there are crossing present in the data.

Manufacturing Production (Million Rs) 1980-2006



Manufacturing Production (Million Rs) 1980-2006



- 1st quarter is mostly dominated although there are crossing present in the data.

Regression Models

Imports

Model 1

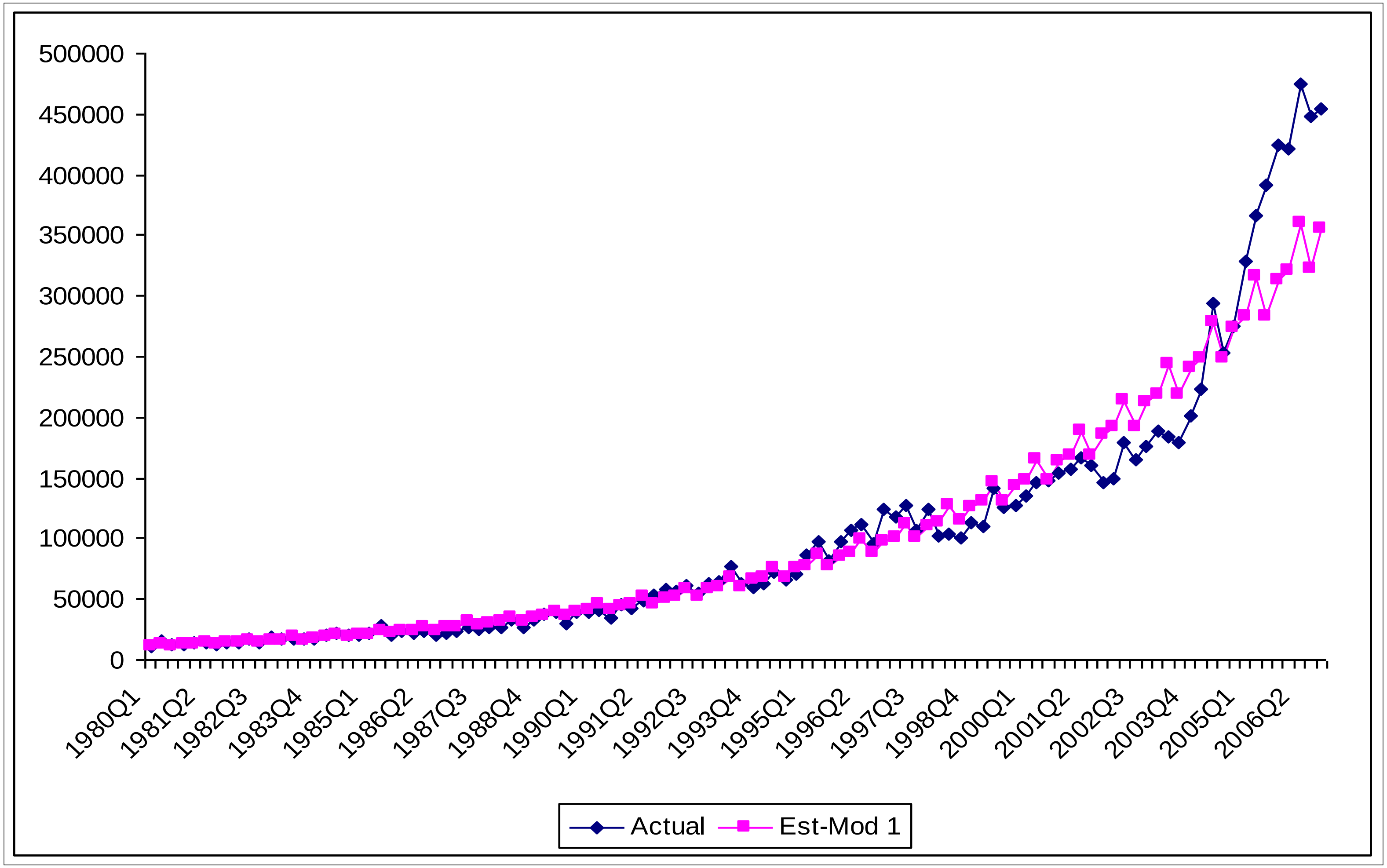
Dependent Variable: LOG(IMP)
Method: Least Squares
Date: 05/17/10 Time: 14:04
Sample: 1980Q1 2006Q4
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.988132	0.048161	165.8634	0.0000
TIME	0.032382	0.000421	76.95285	0.0000
D1	-0.003492	0.037103	-0.094127	0.9252
D2	0.078322	0.037091	2.111608	0.0371
D3	-0.064721	0.037084	-1.745252	0.0839

R-squared	0.982950	Mean dependent var	11.05077
Adjusted R-squared	0.982288	S.D. dependent var	1.023752
S.E. of regression	0.136247	Akaike info criterion	-1.103499
Sum squared resid	1.912024	Schwarz criterion	-0.979326
Log likelihood	64.58894	F-statistic	1484.530
Durbin-Watson stat	0.416200	Prob(F-statistic)	0.000000

In-Sample Forecasting Imports

Model 1:



Imports

Model 2:

Dependent Variable: LOG(IMP)
Method: Least Squares
Date: 05/17/10 Time: 14:26
Sample: 1980Q1 2006Q4
Included observations: 108
Convergence achieved after 9 iterations
Backcast: 1979Q4

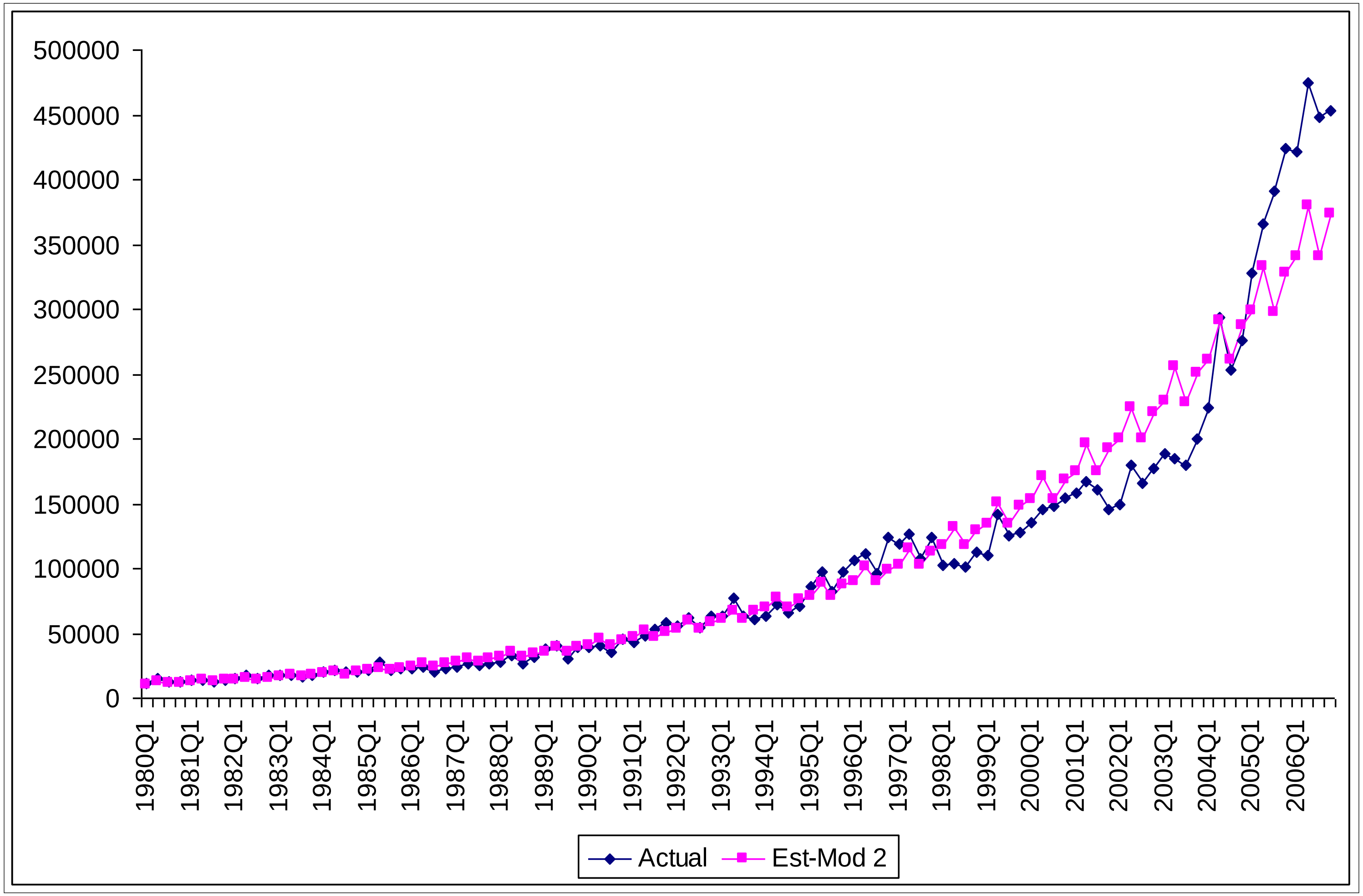
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.919454	0.175536	45.11593	0.0000
TIME	0.033193	0.001676	19.80210	0.0000
D1	0.005684	0.014784	0.384483	0.7014
D2	0.082909	0.017655	4.696003	0.0000
D3	-0.061700	0.014612	-4.222505	0.0001
AR(2)	0.541892	0.102702	5.276371	0.0000
AR(3)	0.191104	0.097599	1.958047	0.0530
MA(1)	0.694238	0.095039	7.304800	0.0000

R-squared	0.993870	Mean dependent var	11.05077
Adjusted R-squared	0.993441	S.D. dependent var	1.023752
S.E. of regression	0.082909	Akaike info criterion	-2.070969
Sum squared resid	0.687383	Schwarz criterion	-1.872293
Log likelihood	119.8324	F-statistic	2316.362
Durbin-Watson stat	1.968447	Prob(F-statistic)	0.000000

Inverted AR Roots	.87	-.44-.17i	-.44+.17i
Inverted MA Roots	-.69		

In-Sample Forecasting Imports

Model 2:



In-Sample Forecasting Imports

Comparison

Exports

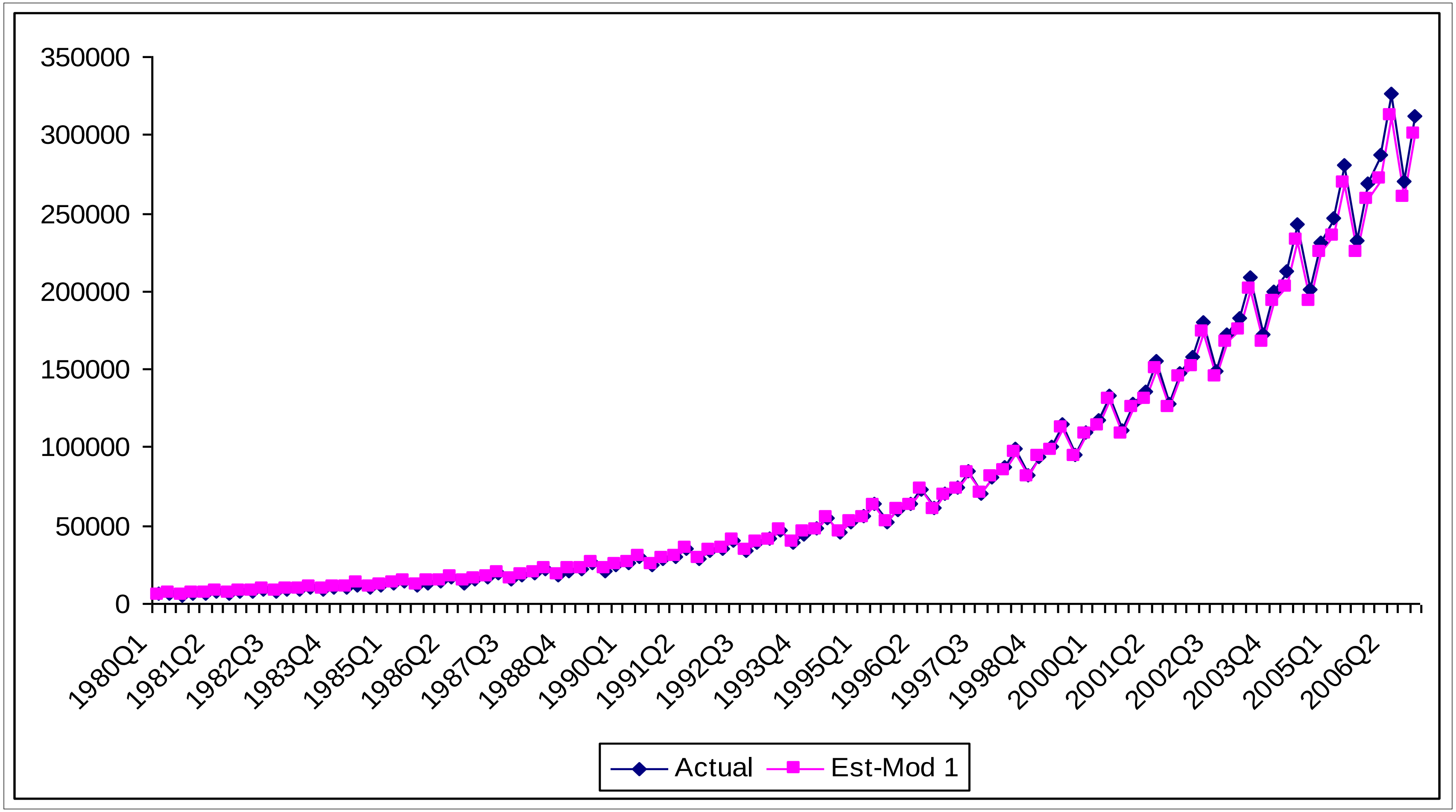
Dependent Variable: LOG(EXP01)
Method: Least Squares
Date: 05/17/10 Time: 17:34
Sample: 1980Q1 2006Q4
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.133809	0.054050	131.9842	0.0000
TIME	0.037277	0.000472	78.93329	0.0000
D1	0.027228	0.041641	0.653868	0.5147
D2	0.120380	0.041627	2.891861	0.0047
D3	-0.105606	0.041619	-2.537437	0.0127

R-squared	0.983800	Mean dependent var	10.66703
Adjusted R-squared	0.983171	S.D. dependent var	1.178714
S.E. of regression	0.152909	Akaike info criterion	-0.872757
Sum squared resid	2.408259	Schwarz criterion	-0.748585
Log likelihood	52.12890	F-statistic	1563.801
Durbin-Watson stat	0.859563	Prob(F-statistic)	0.000000

In-Sample Forecasting Exports

Model 1:



Exports

Model 2:

Dependent Variable: LOG(EXP01)
Method: Least Squares
Date: 05/17/10 Time: 16:49
Sample: 1980Q1 2006Q4
Included observations: 108
Convergence achieved after 14 iterations
Backcast: 1979Q2 1979Q4

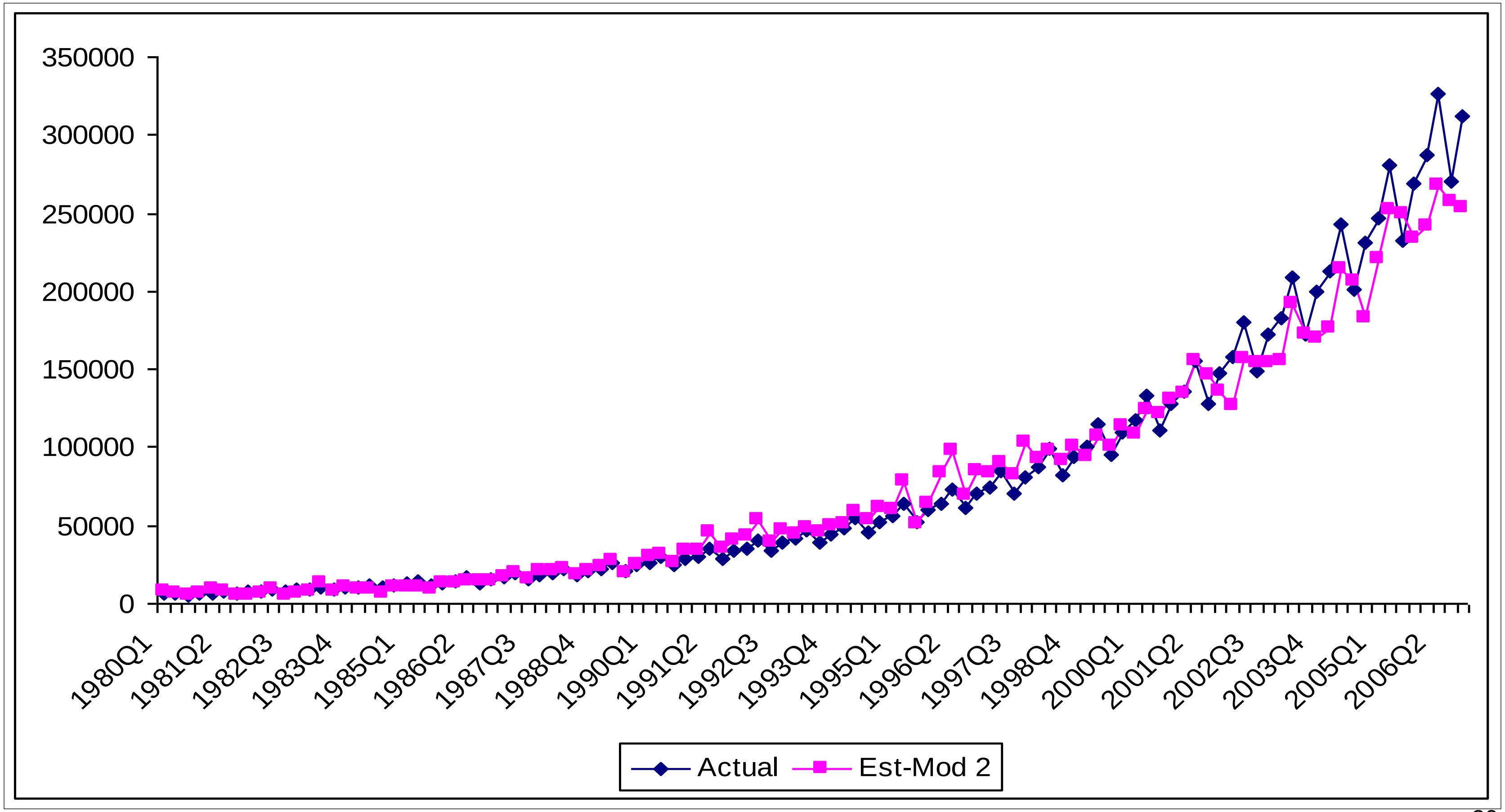
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.220085	0.175463	41.14886	0.0000
TIME	0.036423	0.001620	22.47704	0.0000
D1	0.011033	0.050350	0.219131	0.8270
D2	0.112167	0.045386	2.471378	0.0152
D3	-0.108313	0.049867	-2.172021	0.0322
AR(2)	0.242761	0.102446	2.369659	0.0197
AR(4)	0.445003	0.105066	4.235454	0.0001
MA(1)	0.557417	0.095294	5.849441	0.0000
MA(3)	-0.116808	0.094207	-1.239904	0.2179

R-squared	0.991859	Mean dependent var	10.66703
Adjusted R-squared	0.991201	S.D. dependent var	1.178714
S.E. of regression	0.110567	Akaike info criterion	-1.486737
Sum squared resid	1.210279	Schwarz criterion	-1.263226
Log likelihood	89.28378	F-statistic	1507.683
Durbin-Watson stat	2.146781	Prob(F-statistic)	0.000000

Inverted AR Roots	.89	.00-.75i	-.00+.75i	-.89
Inverted MA Roots	.36	-.46+.34i	-.46-.34i	

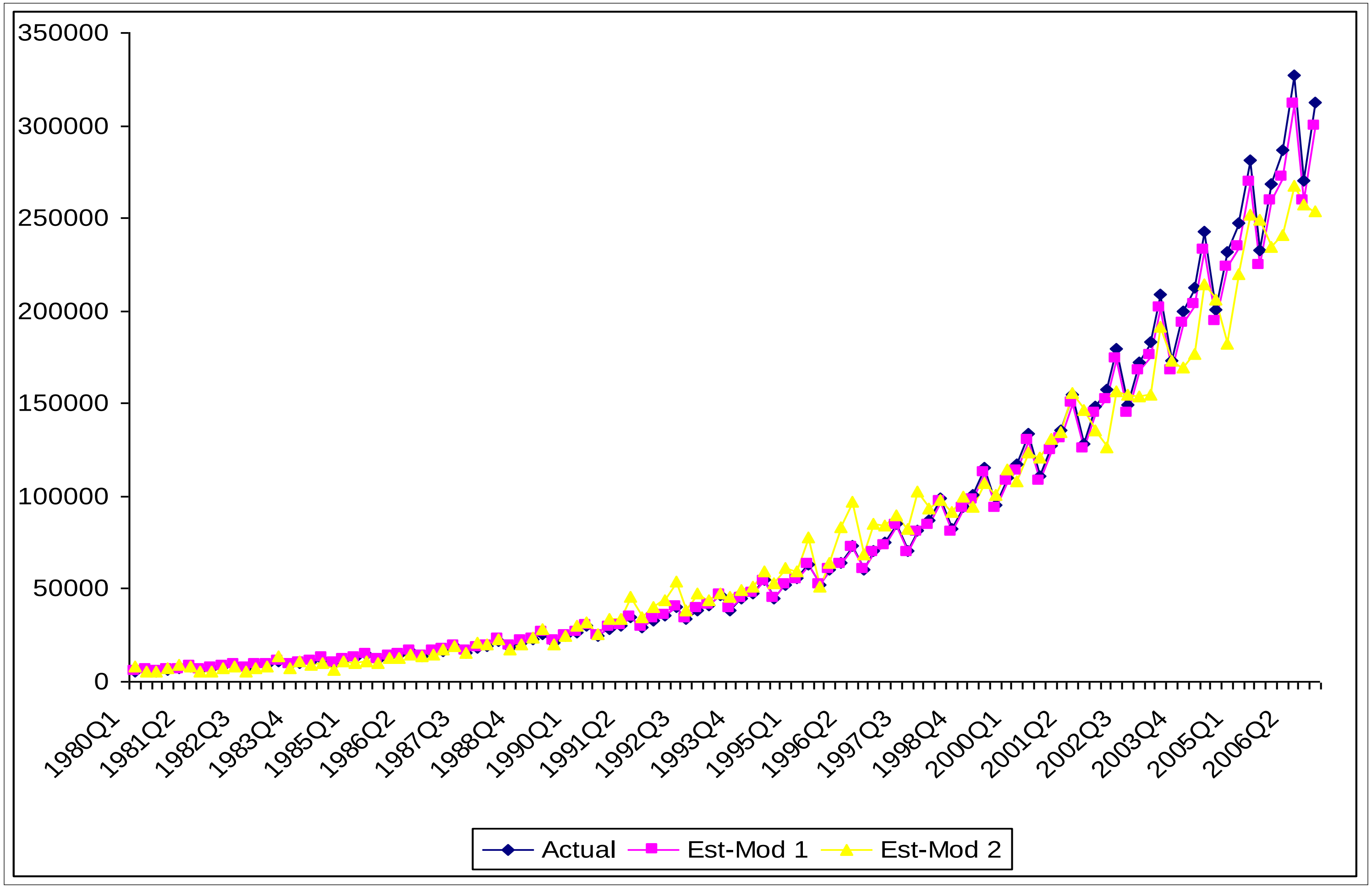
In-Sample Forecasting Exports

Model 2:



In-Sample Forecasting Exports

Comparison



Manufacturing Production

Model 1:

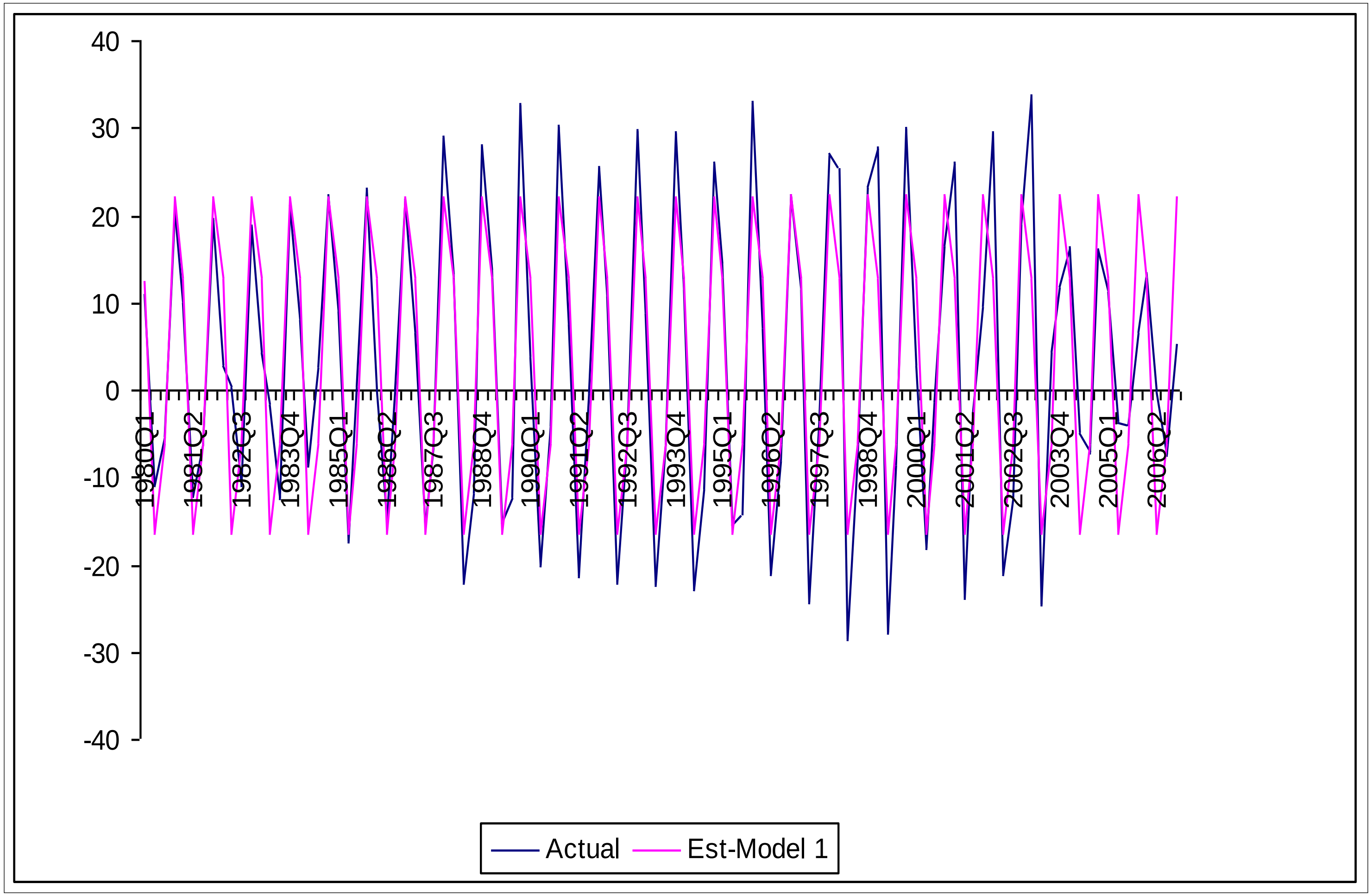
Dependent Variable: GMPI
Method: Least Squares
Date: 05/17/10 Time: 14:30
Sample: 1980Q1 2006Q4
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.17935	2.691855	8.239430	0.0000
TIME	0.000538	0.023520	0.022867	0.9818
D1	-9.655944	2.073813	-4.656130	0.0000
D2	-38.57127	2.073146	-18.60519	0.0000
D3	-28.16850	2.072746	-13.58994	0.0000

R-squared	0.805362	Mean dependent var	3.131245
Adjusted R-squared	0.797803	S.D. dependent var	16.93549
S.E. of regression	7.615265	Akaike info criterion	6.943377
Sum squared resid	5973.204	Schwarz criterion	7.067550
Log likelihood	-369.9424	F-statistic	106.5468
Durbin-Watson stat	2.581119	Prob(F-statistic)	0.000000

In-Sample Forecasting
Manufacturing Production

Model 1:



Manufacturing Production

Model 2:

Dependent Variable: GMPI
Method: Least Squares
Date: 05/17/10 Time: 17:55
Sample (adjusted): 1980Q4 2006Q4
Included observations: 105 after adjustments
Convergence achieved after 10 iterations
Backcast: 1980Q2 1980Q3

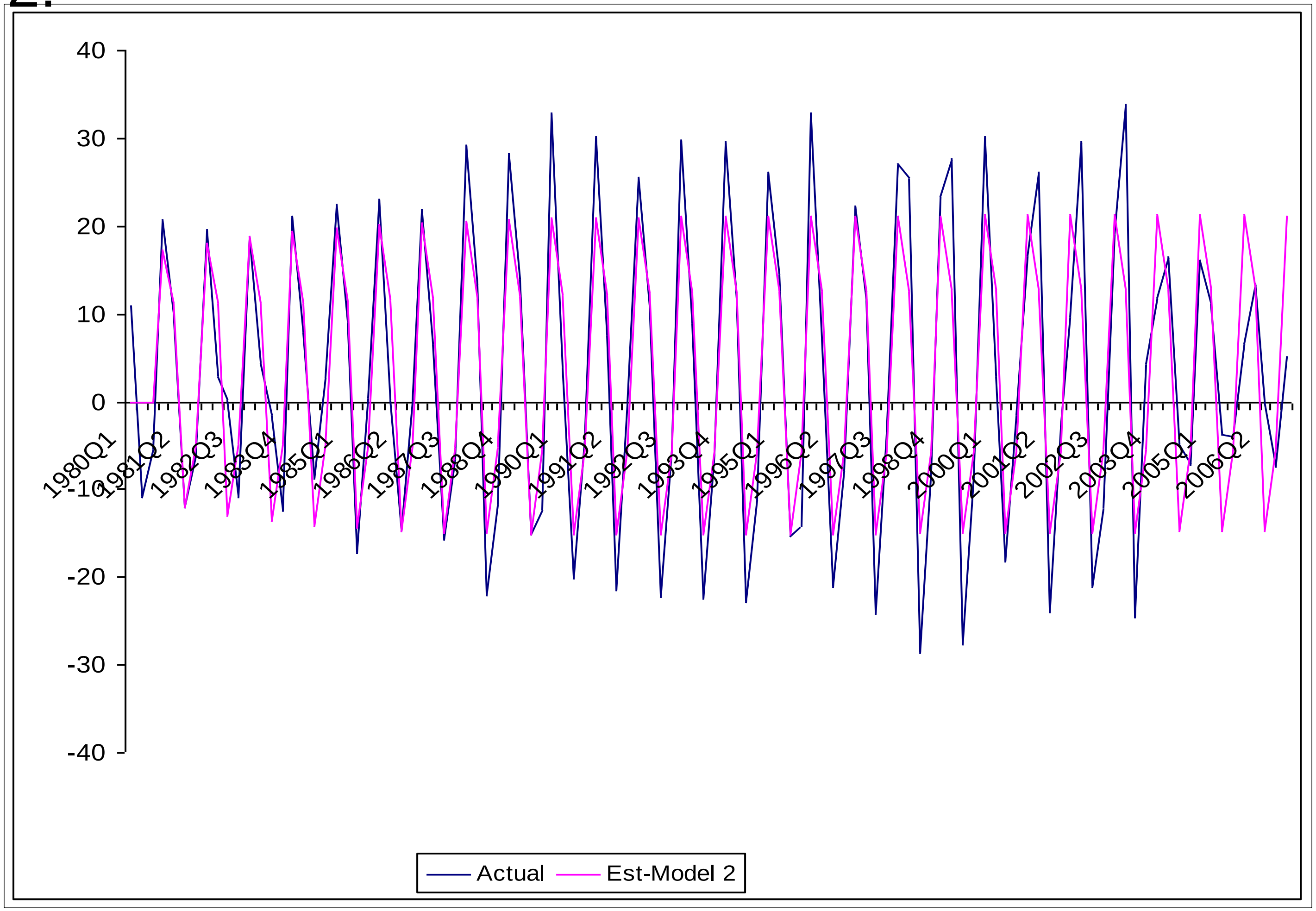
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.45312	3.714561	5.506200	0.0000
TIME	0.006118	0.007028	0.870501	0.3862
D1	-8.586901	5.455290	-1.574050	0.1188
D2	-36.12317	6.896620	-5.237807	0.0000
D3	-26.63737	5.547018	-4.802106	0.0000
AR(1)	-0.665852	0.087598	-7.601256	0.0000
AR(2)	-0.840897	0.087111	-9.653190	0.0000
AR(3)	-0.640592	0.084006	-7.625557	0.0000
MA(2)	0.282305	0.147233	1.917410	0.0582

R-squared	0.907562	Mean dependent var	3.270134
Adjusted R-squared	0.899859	S.D. dependent var	17.08609
S.E. of regression	5.406903	Akaike info criterion	6.295046
Sum squared resid	2806.522	Schwarz criterion	6.522529
Log likelihood	-321.4899	F-statistic	117.8170
Durbin-Watson stat	2.000399	Prob(F-statistic)	0.000000

Inverted AR Roots	.03+.94i	.03-.94i	-.72

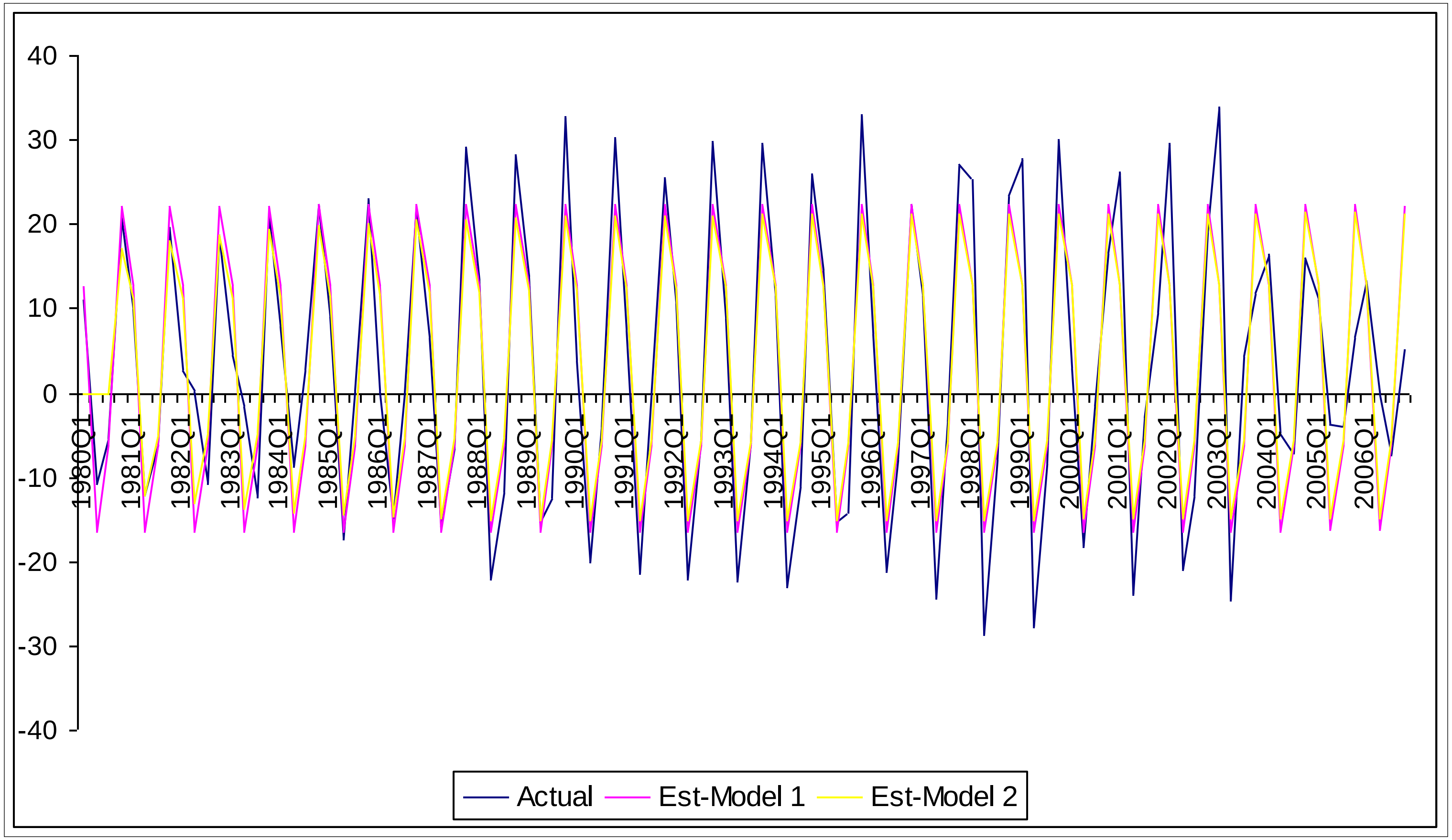
In-Sample Forecasting Manufacturing Production

Model 2:



In-Sample Forecasting Manufacturing Production

Comparison:



Comparison of Regression Results

Imports

Model	**Included values**	**R-Square**	**Adj R-Square**	**Akaike info criterion**	**Schwarz criterion**
Model 1	108	0.98295	0.982288	-1.103499	-0.979326
Model 2	108	0.99387	0.993441	-2.070969	-1.872293

Export

Model	**Included values**	**R-Square**	**Adj R-Square**	**Akaike info criterion**	**Schwarz criterion**
Model 1	108	0.9838	0.983171	-0.872757	-0.748585
Model 2	108	0.991859	0.991201	-1.486737	-0.457864

Production

Model	**Included values**	**R-Square**	**Adj R-Square**	**Akaike info criterion**	**Schwarz criterion**
Model 1	108	0.805362	0.797803	6.943377	7.06755
Model 2	105	0.907562	0.899859	6.295046	6.522529

Results Discussion:

Akaike information criterion was developed by Hirotsugu Akaike to measure the goodness of fit of an estimated statistical model. According to the this model having the lowest AIC value is the best fit for the estimated statistical model.

The comparison of AIC statistics for our macroeconomic variable show that "Model 2" is a better fit then "Model 1".

We get the same results by comparing Schwarz criterion for Import and manufacturing analysis, while in case of exports it shows that "Model 1" is better then "Model 2".

References:

Book: **“Elements of Forecasting”** by Francis X. Diebold, University of Pennsylvania 2nd Edition, University of Pennsylvania

Internet Resources:

http://en.wikipedia.org/wiki/Autoregressive_moving_average_model

http://en.wikipedia.org/wiki/Akaike_information_criterion

http://en.wikipedia.org/wiki/Schwarz_criterion

www.sbp.org.pk (Website of State Bank of Pakistan)

Thank You