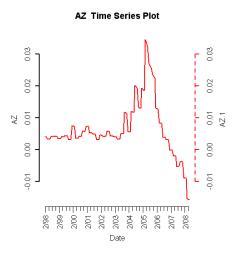
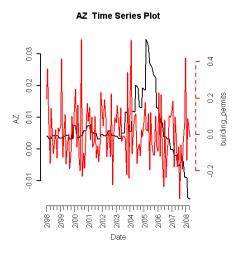
# I. PHASE I AND PHASE II RESULTS – ARIZONA (AZ)

# A. Plots of Predictors vs. HPI (simple returns)

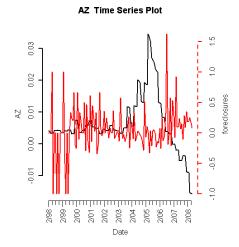
#### Original HPI Series



# **Building Permits**

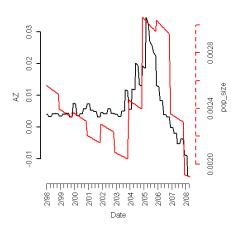


# **Foreclosures**



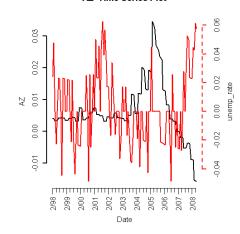
# Population Size

#### **AZ Time Series Plot**



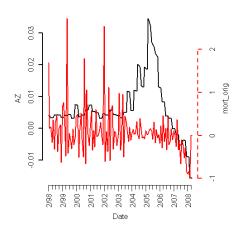
#### **Unemployment Rate**

**AZ Time Series Plot** 



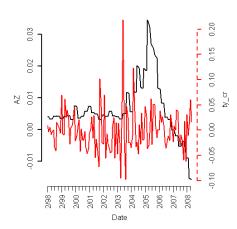
# Mortgage Originations

AZ Time Series Plot



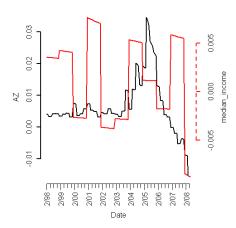
# 30-Year Commitment Rate

# AZ Time Series Plot



#### Median Income

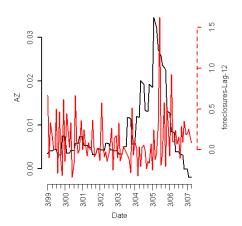
#### AZ Time Series Plot



B. Plot of Lagged Predictors vs. HPI (simple returns)

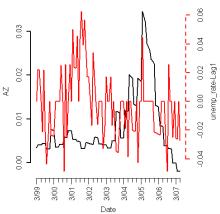
# Foreclosures (lagging 12 months)

#### AZ Time Series Plot



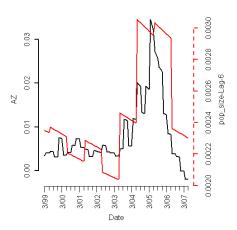
# <u>Unemployment Rate (leading 1 month)</u>

AZ Time Series Plot



# Population Size (lagging 6 months)

#### **AZ Time Series Plot**



#### C. Final RLM Model

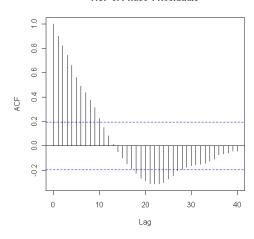
# Robust Linear Model (significant predictors only)

Coefficients:					
	Value	Std. Error	t-value		
Popluation Size (Lag 0)	3.07	0.19	16.56		
Foreclosures (Lag -12)	-0.003	0.002	-2.03		
Unemployment Rate-(Lag 1)	-0.04	0.02	-1.88		

# 1. Phase I

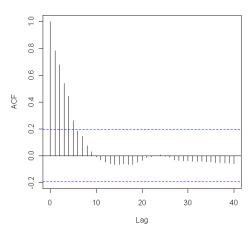
# ACF of Residuals

#### ACF of Phase 1 Residuals



# ACF of Sq-Residuals

#### ACF of Phase 1 Sq-Residuals

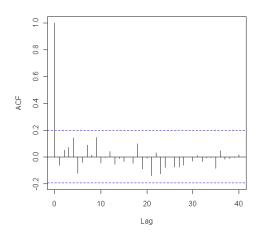


#### 2. Phase II

Estimates:			
	Value	Std. Error	t-value
$\phi_1$	0.91	0.04	23.16

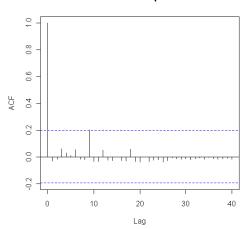
# ACF of Residuals

#### **ACF of Phase 2 Residuals**



# ACF of Sq-Residuals

#### ACF of Phase 2 Sq-Residuals

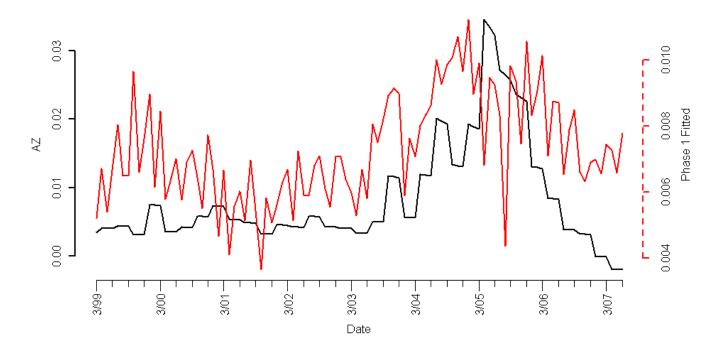


# 3. Model Checking Diagnostics

	Lag	Test-Statistic	p-value	Adj. Dof
After Phase 1				
ADF	1	-1.66	< 0.1	
Box-Ljung Residuals	12	374.15	0.0	12
d-Estimate (GPH)		0.91		
After ARMA(1,0)				
Box-Ljung Residuals	12	8.70	0.65	12-1
Box-Ljung SqResiduals	12	6.16	0.91	12

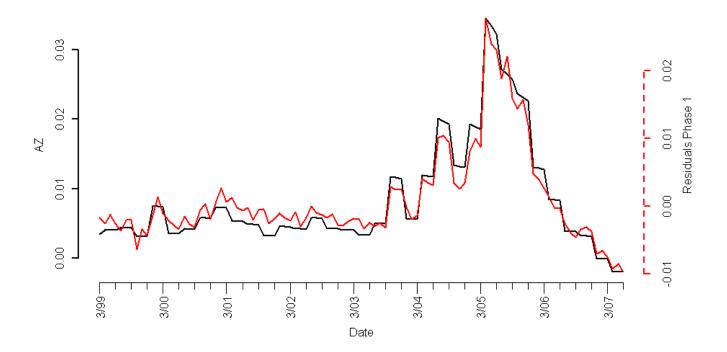
# Fitted Phase 1 Fitted Values vs. HPI

**AZ Time Series Plot** 

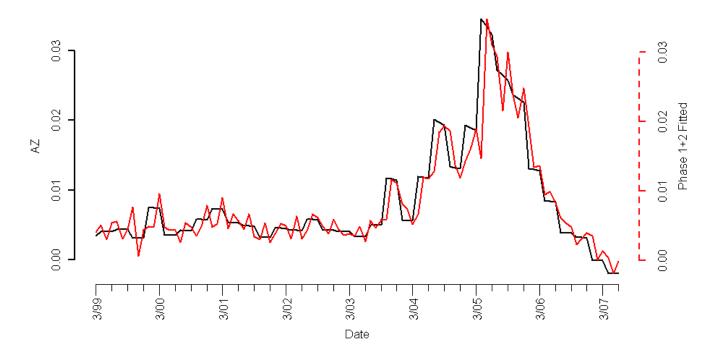


# Phase1 Residuals vs. HPI

**AZ Time Series Plot** 

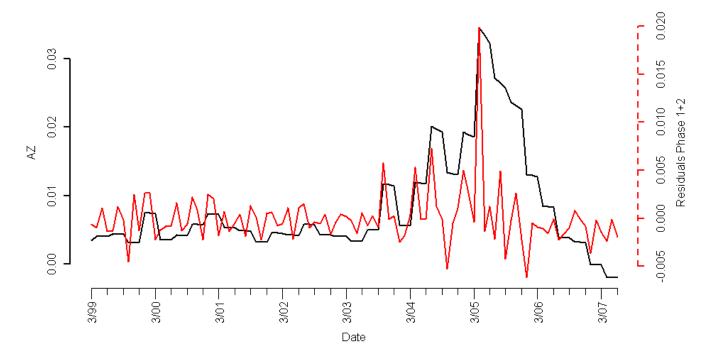


# **AZ Time Series Plot**



Phase 2 Residuals vs. HPI

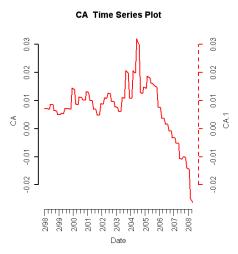




# II. PHASE I AND PHASE II RESULTS - CALIFORNIA (CA)

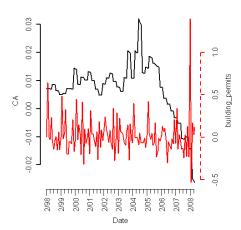
# A. Plots of Predictors vs. HPI (simple returns)

#### Original HPI Series



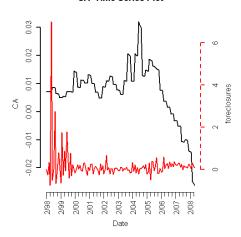
# **Building Permits**

#### **CA** Time Series Plot



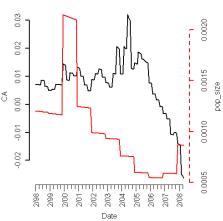
## **Foreclosures**

**CA Time Series Plot** 



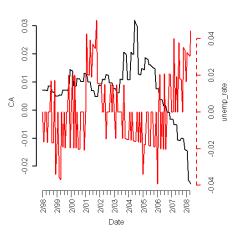
#### **Population Size**

**CA Time Series Plot** 



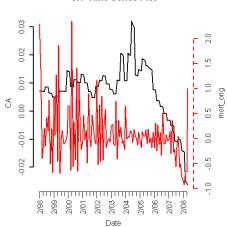
#### **Unemployment Rate**

**CA Time Series Plot** 



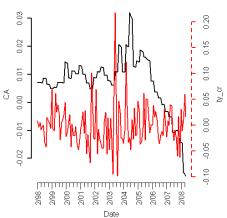
#### **Mortgage Originations**

CA Time Series Plot



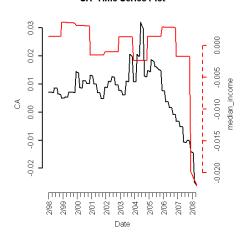
# 30-Year Commitment Rate

# CA Time Series Plot



#### Median Income

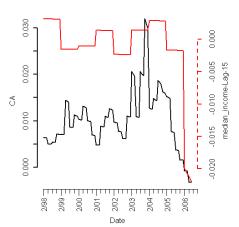
#### **CA Time Series Plot**



# B. Plot of Lagged Predictors vs. HPI (simple returns)

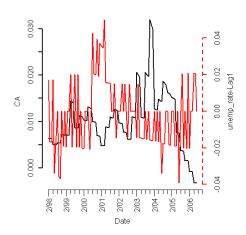
#### Median Income (lagging 15 months)

#### **CA Time Series Plot**



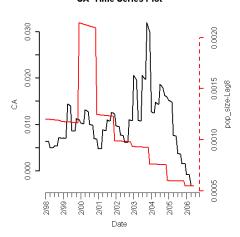
# Unemployment Rate (leading 1 month)

#### CA Time Series Plot



#### Population Size (leading 8 months)

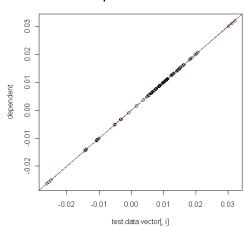
#### **CA Time Series Plot**



# C. Scatterplots (simple return)

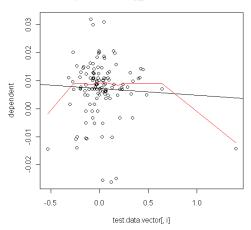
#### HPI vs. HPI

#### Scatterplot of CA Series with CA



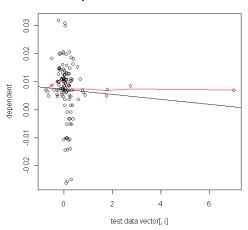
# HPI vs. Building Permits

#### Scatterplot of building\_permits Series with CA



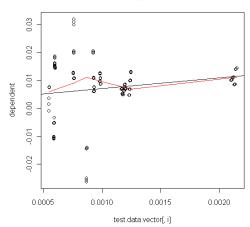
#### HPI vs. Foreclosures

#### Scatterplot of foreclosures Series with CA



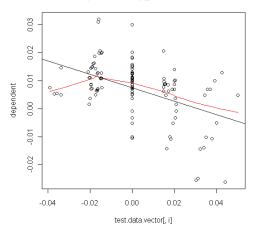
# HPI vs. Population Size

#### Scatterplot of pop\_size Series with CA



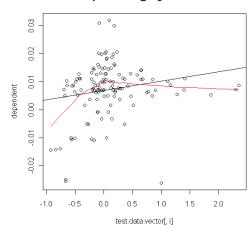
# HPI vs. Unemployment Rate

#### Scatterplot of unemp\_rate Series with CA



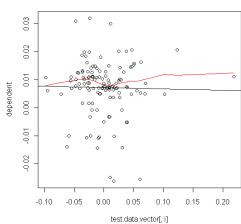
# HPI vs. Mortgage Originations

#### Scatterplot of mort\_orig Series with CA



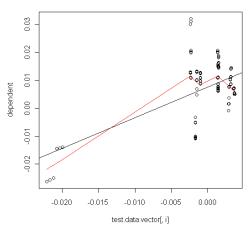
# HPI vs. 30-Year Commitment Rate

#### Scatterplot of ty\_cr Series with CA



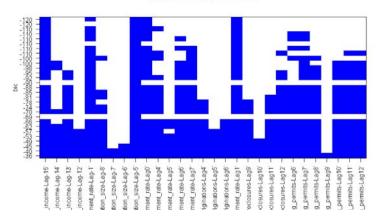
#### HPI vs. Median Income

#### Scatterplot of median\_income Series with CA



#### C. Exhaustive Stepwise Regression

#### Stepwise BIC Regression of CA



#### D. Final RLM Model

# Robust Linear Model (significant predictors only)

Coefficients:			
	Value	Std. Error	t-value
Median Income (lag -15)	0.3219	0.0982	3.2764
Unemployment Rate (lag 1)	-0.0926	0.0297	-3.1174
Population Size (lag 8)	9.0048	0.5141	17.5146

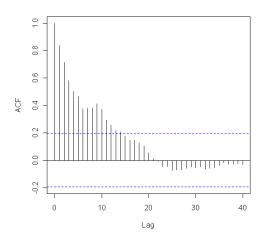
# Robust Linear Model (one of each predictor)

Coefficients:			
	Value	Std. Error	t-value
Median Income (lag -15)	0.2995	0.1146	2.6136
30-Yr Commitment Rate	0.0033	0.0144	0.2303
Mortgage Originations	-0.0016	0.0013	-1.2404
Foreclosures	0.0033	0.0144	0.2303
Building permits	-0.0016	0.0013	-1.2404
Unemployment Rate (lag 1)	0.0033	0.0144	0.2303
Population Size (lag 8)	-0.0016	0.0013	-1.2404

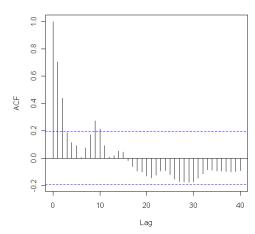
#### 1. Phase I

# ACF of Residuals

#### ACF of Residuals

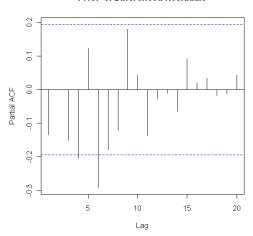


#### ACF of Sq-Residuals



#### PACF and ADF Test

### **PACF** of Differenced Residuals



# 2. Phase II

<b>Estimates:</b>				
	Value	Std. Error	t-value	Pr(> t )
$\phi_2$	0.3295	0.0467	7.06E+00	1.68E-12
$\Theta_1$	0.2399	0.0609	3.9410	0.0001
ω	0.0000	0.0000	5.64E+00	1.67E-08
$\alpha_3$	4.26E-01	1.19E-01	3.58E+00	0.000344

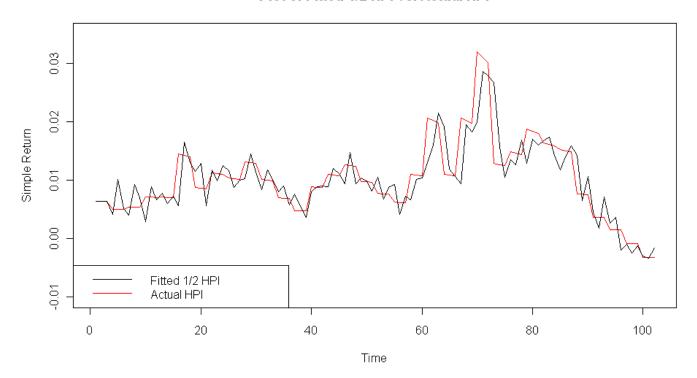
# 3. Model Checking Diagnostics

Coefficients:				
	Lag	Test-Statistic	p-value	Adj. Dof
After Phase 1				
ADF	7	-1.85	< 0.1	
Box-Ljung Residuals	12	316.81	0.0	12
d-Estimate (GPH)		0.53		
After ARMA()/GARCH()				
Box-Ljung Residuals	9	16.3451	0.0600	12-3
Box-Ljung SqResiduals	8	8.8923	0.2828	12-4

# E. Fitted vs. Actual Plots

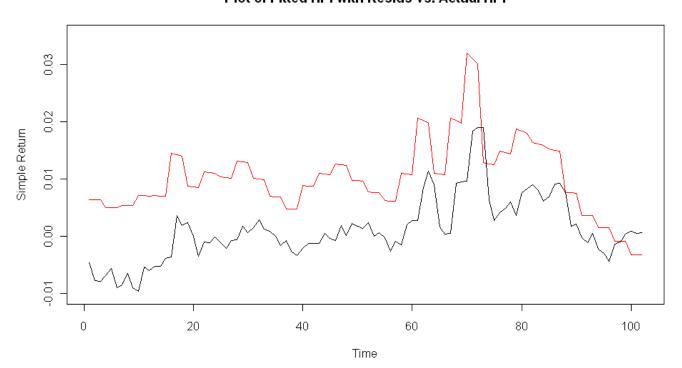
# Fitted Phase 1/2 Values vs. HPI

# Plot of Fitted 1/2 HPI vs. Actual HPI



# Phase2 Residuals vs. HPI

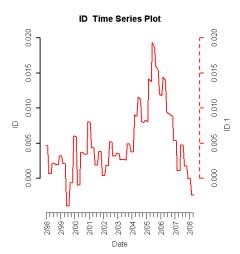
# Plot of Fitted HPI with Resids vs. Actual HPI



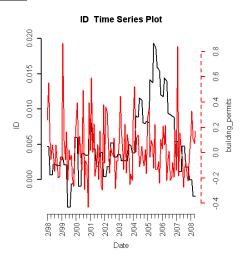
# III. PHASE I AND PHASE II RESULTS - IDAHO (ID)

# A. Plots of Predictors vs. HPI (simple returns)

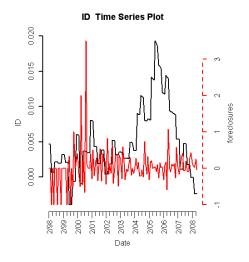
#### Original HPI Series



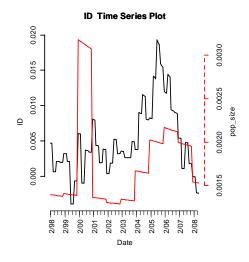
#### **Building Permits**



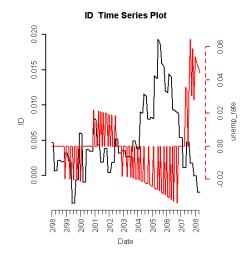
# **Foreclosures**



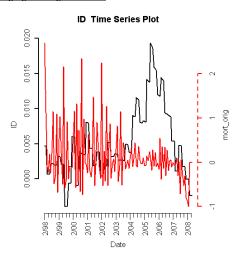
# Population Size



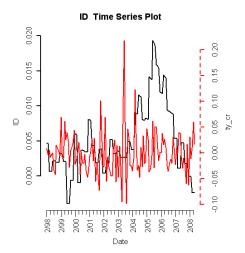
# **Unemployment Rate**



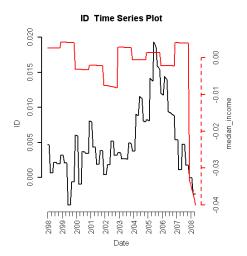
#### Mortgage Originations



# 30-Year Commitment Rate

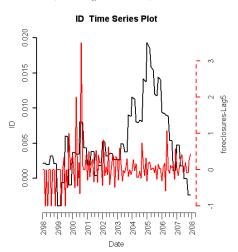


#### Median Income

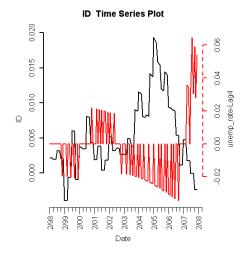


B. Plot of Lagged Predictors vs. HPI (simple returns)

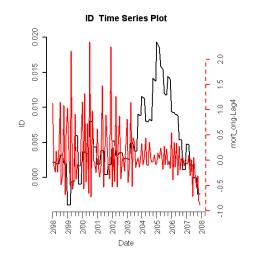
#### Foreclosures (leading 5 months)



# Unemployment Rate (leading 4 months)

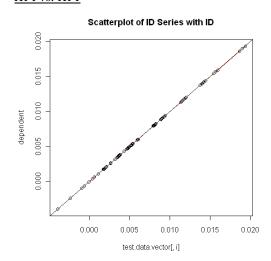


# Mortgage Originations (leading 4 months)



# C. Scatterplots (simple return)

#### HPI vs. HPI

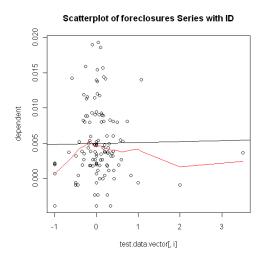


# HPI vs. Building Permits

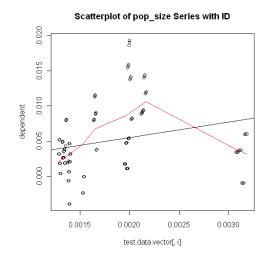
# Scatterplot of building\_permits Series with ID OCCUPATION OF THE PROPERTY OF

test.data.vector[, i]

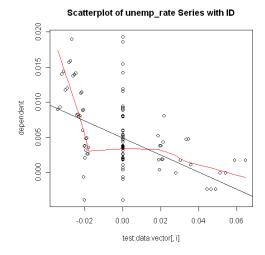
#### HPI vs. Foreclosures



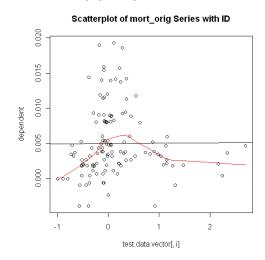
# HPI vs. Population Size



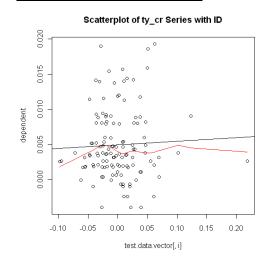
# HPI vs. Unemployment Rate



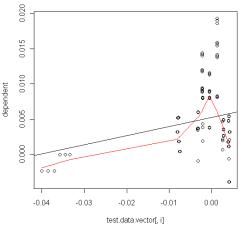
#### HPI vs. Mortgage Originations



# HPI vs. 30-Year Commitment Rate



# Scatterplot of median\_income Series with ID



### C. Final RLM Model

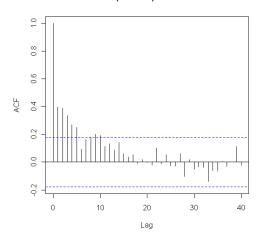
# Robust Linear Model (significant predictors only)

Coefficients:			
	Value	Std. Error	t-value
Median Income (Lag0)	-0.3124	0.0722	-4.3294
Mortgage Originations (Lag4)	0.0019	0.0009	2.1531
Unemployment Rate-(Lag4)	-0.2673	0.0357	-7.4893
Foreclosures (Lag5)	0.0015	0.0010	1.4566

# 1. Phase I

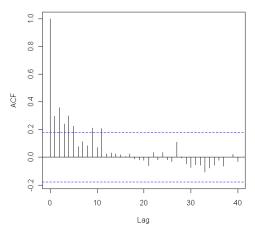
# ACF of Residuals

ACF (Phase 1) Residuals



# ACF of Sq-Residuals

ACF (Phase 1) Sq-Residuals

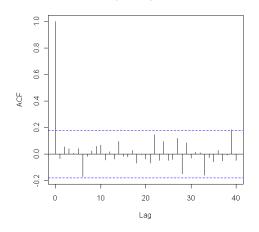


#### 2. Phase II

Estimates:			
	Value	Std. Error	t-value
ar1	0.8740	0.0727	12.0220
ma1	-0.6023	0.1189	-5.0656
intercept	0.0034	0.0011	3.0909

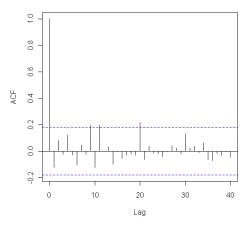
# ACF of Residuals

#### ACF (Phase 2) Residuals



# ACF of Sq-Residuals

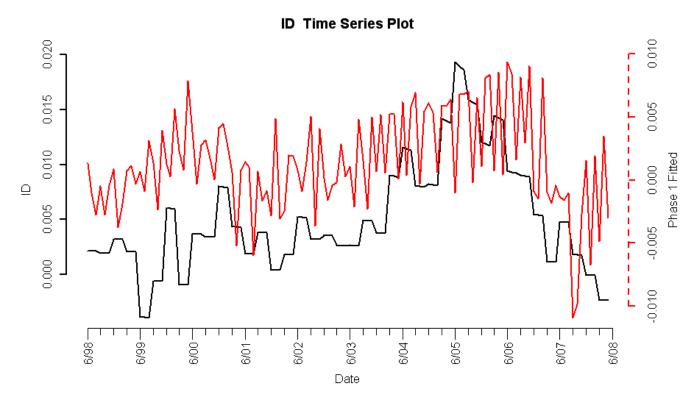
#### ACF (Phase 2) Sq-Residuals



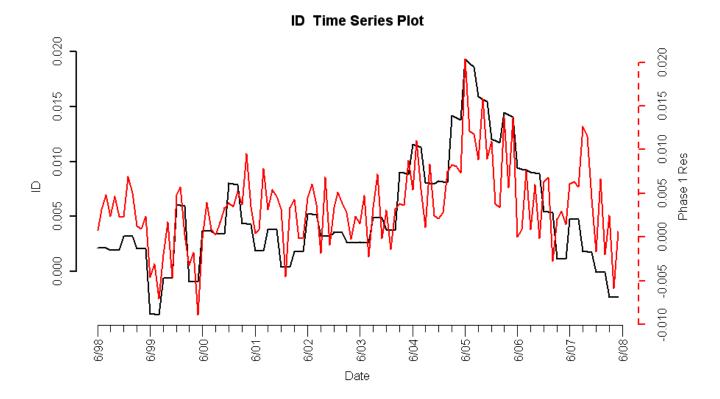
# 3. Model Checking Diagnostics

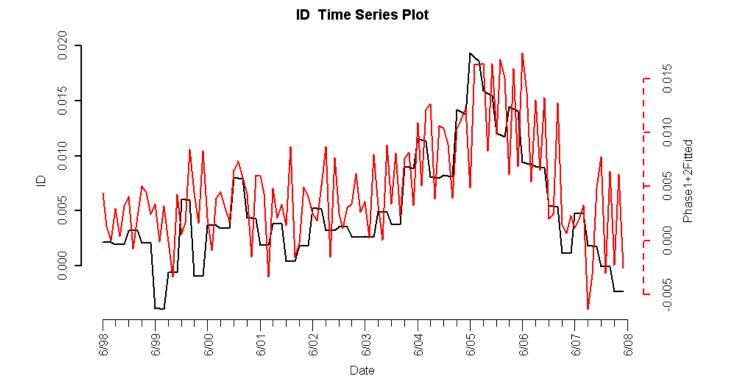
Coefficients:				
	Lag	Test-Statistic	p-value	Adj. Dof
ADF	3	-2.1027	< 0.05	
Box-Ljung Residuals	12	92.3465	0.0000	12
d-Estimate (GPH)		0.4836		
After ARMA(1,1)				
Box-Ljung Residuals	12	6.1028	0.8066	12-2
Box-Ljung SqResiduals	12	18.7766	0.0941	12

# Fitted Phase 1 Fitted Values vs. HPI



# Phase1 Residuals vs. HPI





# Phase 2 Residuals vs. HPI

