Volatility in Vegetable Market

A US case study

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Nonlinear Timeseries Analysis
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Vegetable Market

- Producers
- Middleman
- Retailers
- consumers

Input Market

- Fertilizer
- Pesticide
- Seed
- Machinery

Indicators:

Efficiency of Market

- Market information
- No. Of intermediaries
- Technology
- Prices
- Govt, Regulation

Risks

- Financial risk (speculation, price fluctuation, hoarding)

- Physical risk (Floods, damage(field to market), pest attack, diseases)

Market stability

- Subsidy on inputs
- Support price to ouput
- Relief to consumers
- Technology

vegetables

- Fresh vegetables: more vulnerable
- Canned vegetables
- Frozen vegetables

Risk Measurment or Market Efficiency

- Volatility:
  - Volatility is found by calculating the annualized standard deviation of daily change in price. If the price of a stock moves up and down rapidly over short time periods, it has high volatility. If the price almost never changes, it has low volatility.

Data:

- Vegetables and Melons Yearbook for 2009, US department of Agriculture
- Economics, Statistics and Market Information System (ESMIS)

http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212

Data

- Producer Price Index PPI (Fresh, Canned and Frozen vegetables)
- Consumer Price Index
- Range: 1979-2009 (1982=100 Base year)
- Monthly Data
- First Month differenced data is used for analysis

GARCH

$$X_t = \sigma_t \varepsilon_t,$$

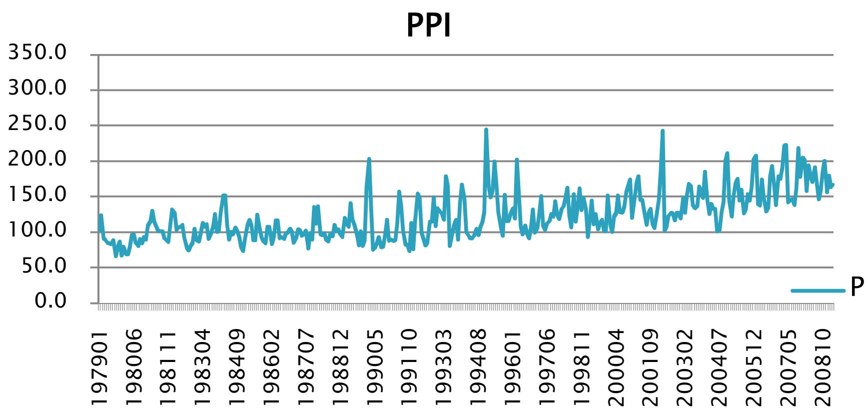
$$\sigma_t^2 = c_0 + \sum_{j=1}^{p} b_j X_{t-j}^2 + \sum_{j=1}^{q} a_j \sigma_{t-j}^2,$$

- The GARCH(p, q) has unique strictly covariance stationary solution iff

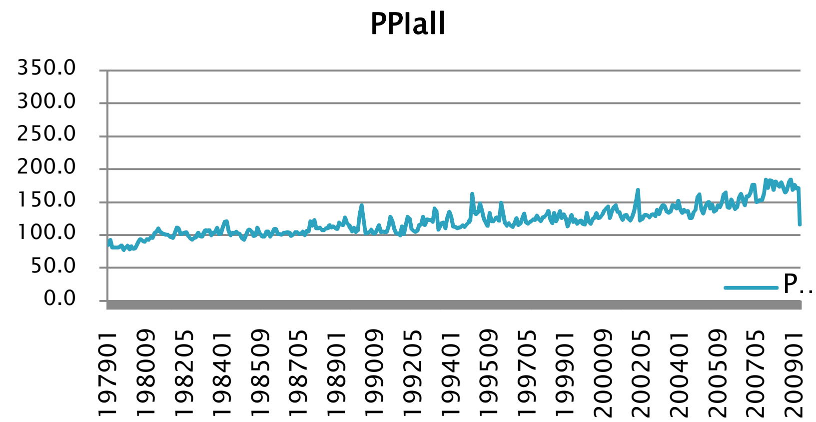
$$\sum_{j=1}^{p} b_j + \sum_{j=1}^{q} a_j < 1.$$

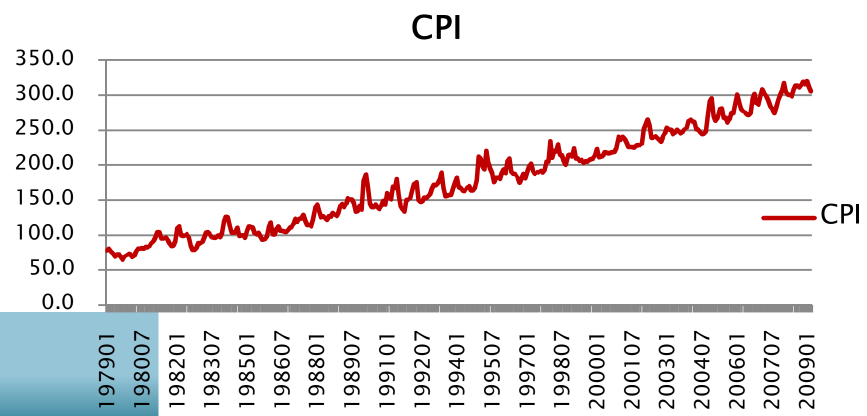
Results

PPI=Fresh Vegetables

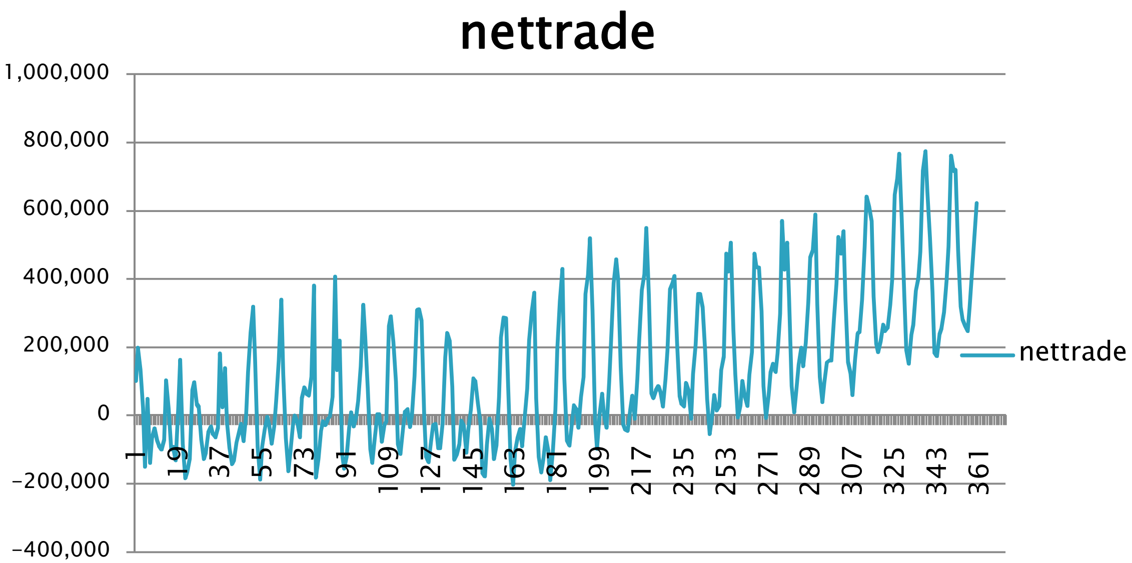


PPIall=Fresh+Canned+Frozen





Net Trade (Imports-Exports)



Imports are increasing over the years and very much seasonal

PPI-Fresh Vegetables

Dependent Variable: DPPI

Method: ML - ARCH (Marquardt) - Normal distribution

Presample variance: backcast (parameter = 0.7)

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.048231	1.272433	-0.037905	0.9698
	Variance Equation			
C	300.8382	84.85331	3.545392	0.0004
RESID(-1)^2	0.227658	0.060473	3.764604	0.0002
GARCH(-1)	0.339358	0.160205	2.118275	0.0342

R-squared	-0.000077	Mean dependent var	0.180110
Adjusted R-squared	-0.008458	S.D. dependent var	25.99708
S.E. of regression	26.10679	Akaike info criterion	9.312526
Sum squared resid	244000.1	Schwarz criterion	9.355528
Log likelihood	-1681.567	Hannan-Quinn criter.	9.329621
Durbin-Watson stat	2.302191		

PPI-All types of vegetables

Dependent Variable: DPPIALL
Method: ML - ARCH (Marquardt) - Normal distribution
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.145287	0.428690	0.338910	0.7347
		Variance Equation		
C	33.38692	9.882943	3.378237	0.0007
RESID(-1)^2	0.220117	0.060203	3.656229	0.0003
GARCH(-1)	0.352146	0.166277	2.117822	0.0342

R-squared	-0.000115	Mean dependent var	0.238674
Adjusted R-squared	-0.008496	S.D. dependent var	8.714397
S.E. of regression	8.751338	Akaike info criterion	7.130136
Sum squared resid	27417.76	Schwarz criterion	7.173138
Log likelihood	-1286.555	Hannan-Quinn criter.	7.147231
Durbin-Watson stat	2.292842		

CPI

Dependent Variable: DCPI

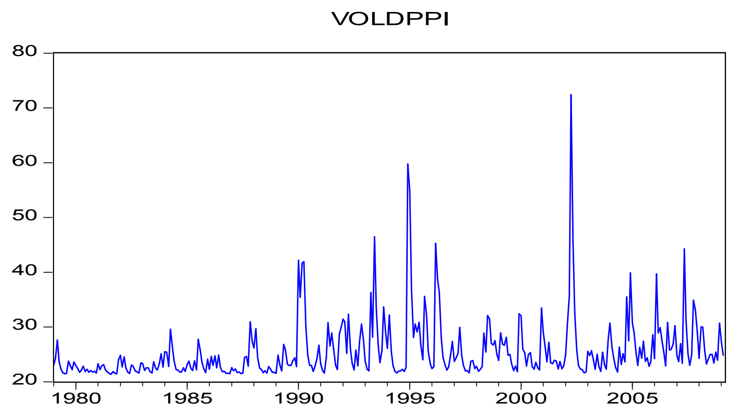
Method: ML - ARCH (Marquardt) - Normal distribution

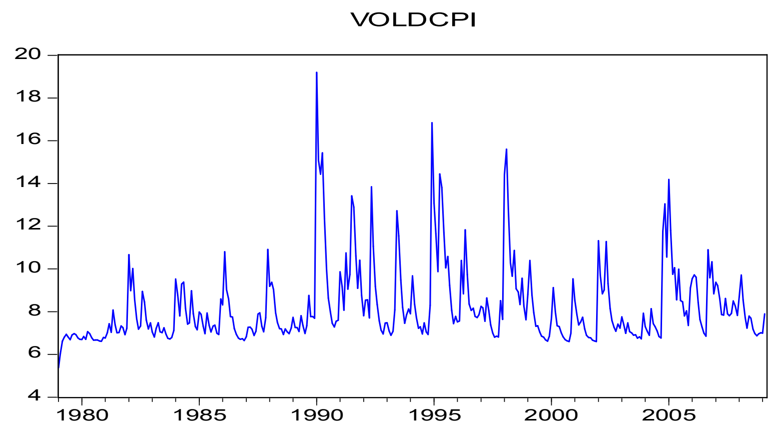
Presample variance: backcast (parameter = 0.7)

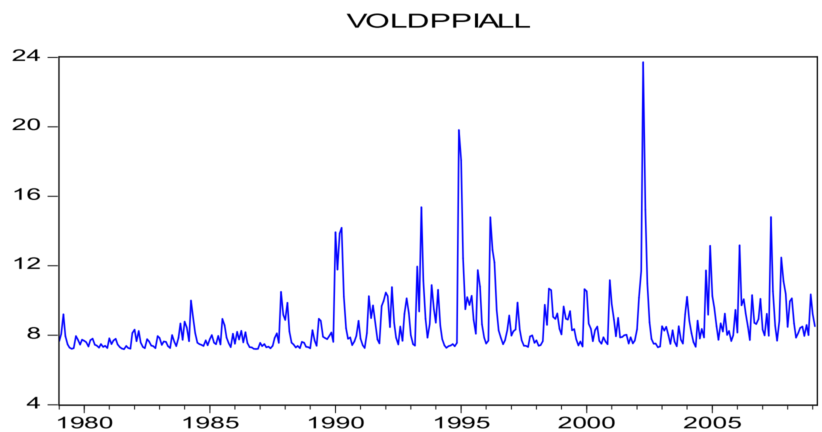
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

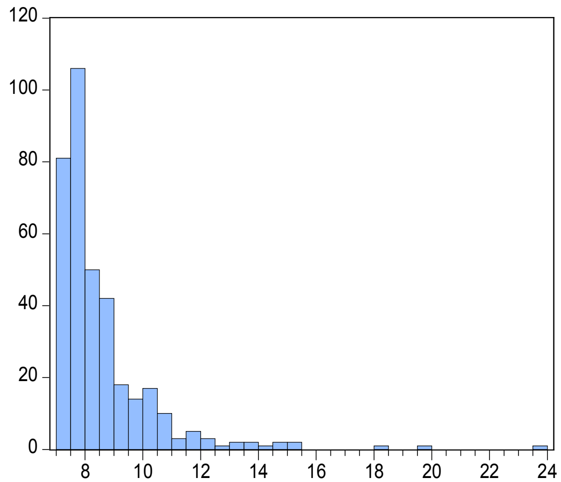
	Coefficient	Std. Error	z-Statistic	Prob.
C	0.630970	0.398377	1.583853	0.1132
		Variance Equation		
C	20.53632	6.136093	3.346808	0.0008
RESID(-1)^2	0.200491	0.068386	2.931738	0.0034
GARCH(-1)	0.520112	0.122462	4.247143	0.0000

R-squared	-0.000000	Mean dependent var	0.629558
Adjusted R-squared	-0.008380	S.D. dependent var	8.311651
S.E. of regression	8.346404	Akaike info criterion	7.037996
Sum squared resid	24939.16	Schwarz criterion	7.080998
Log likelihood	-1269.877	Hannan-Quinn criter.	7.055091
Durbin-Watson stat	1.823382		

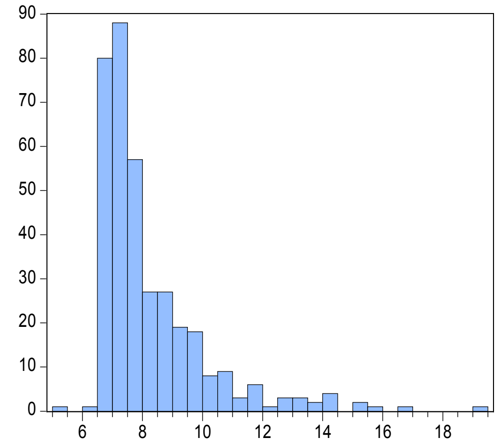

VOLDPPI
80
70
60
50
40
30
20
1980
1985
1990
1995
2000
2005


VOLDCPI
20
18
16
14
12
10
8
6
4
1980
1985
1990
1995
2000
2005

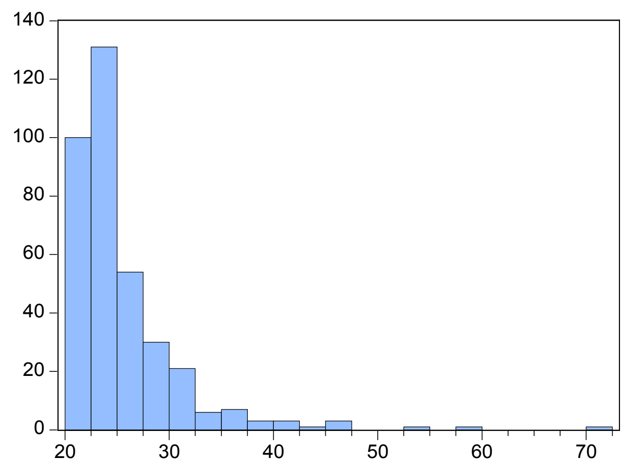

VOLDPPIALL
24
20
16
12
8
4
1980
1985
1990
1995
2000
2005



Series: VOLDPPIALL	
Sample 1979M01 2009M03	
Observations 362	
Mean	8.598539
Median	7.973255
Maximum	23.71807
Minimum	7.198167
Std. Dev.	1.827693
Skewness	3.581572
Kurtosis	22.10832
Jarque-Bera	6281.278
Probability	0.000000



Series: VOLDCPI	
Sample 1979M01 2009M03	
Observations 362	
Mean	8.243470
Median	7.631135
Maximum	19.19445
Minimum	5.376564
Std. Dev.	1.854755
Skewness	2.290048
Kurtosis	9.584709
Jarque-Bera	970.3964
Probability	0.000000



Series: VOLDPPI	
Sample 1979M01 2009M03	
Observations 362	
Mean	25.62350
Median	23.74562
Maximum	72.41370
Minimum	21.39640
Std. Dev.	5.589554
Skewness	3.631274
Kurtosis	22.71478
Jarque-Bera	6658.044
Probability	0.000000

conclusion

- Producers risks positively shifts to consumers as the volatility of CPI and PPI is serially correlated positively.
- Fresh vegetable market is more risky and fluctuative in nature unless it is stabilized by canned and frozen vegetables which has less fluctuations but high cost over the years

- More things to do……….

References:

- Bollerslev, Tim (1986). "Generalized Autoregressive Conditional Heteroskedasticity". *Journal of Econometrics* 31 (3): 307–327