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Measuring and Interpreting core inflation: evidence from Italy

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Structure of the paper

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1. Introduction

The aim of this paper

To suggest appropriate measures for estimating and analysing core inflation to be used by the Bank of Italy and the Italian National Statistical Institute (Istat)
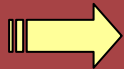
➡ **To identify reliable measures of core inflation for a specific country**

⬇

analyse the specific economic situation and the distribution of the price changes

the choice of method should be tailor-made to the needs of the country

⬇

We carried out a very detailed analysis based on more than 500 monthly price indices for representative products from 1996 to 2008

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2. A brief review of the definitions and methods for measuring core inflation

various definitions ⟹ more suitably linked to the methods

Two broad concepts:
❑ the *persistent component* of measured inflation
❑ the *generalised component* of measured inflation

Keeping in mind
• These concepts
• The characteristics of the data necessary for carrying out the estimations

The methods can be classified

Group 1

➢ **time series** to distinguish trend from temporary shocks

smoothing techniques, moving average, exponential smoothing, Arima,Multivariate methods, etc.

Group 2

➢ **cross-section data on the distribution of price changes for each month,** to obtain adequate and robust estimations of core inflation for each month separately

2.1 Exclusion-Based Methods

2.2 Limited influence estimators *median, trimmed means, etc.*

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3. Data set description and organisation of the analyses on Italian data (a)

⟹ **Very detailed data set**

DATA DESCRIPTION:
- Monthly CPIs for the whole nation concerning representative elementary items
- Revision of the basket and the weighting system annually
- Number of elementary indices differ from year to year (never below 530)

CALCULATIONS:
- ❑ <u>Period</u>: January 1996-December 2008
- ❑<u>Computation of price changes</u>:
  - ✓ Elementary indices and the general CPI
  - ✓ Horizon k=1 and k=12
- ❑ **Month-on-previous month**   and   **year on previous year** changes

✓Elementary index $\pi_{it}^1 = \dfrac{P_i^{0,t}}{P_i^{0,t-1}} - 1$ $\pi_{it}^{12} = \dfrac{P_i^{0,t}}{P_i^{0,t-12}} - 1$

✓Overall CPI $\Pi_t^1 = \dfrac{I^{0;t}}{I^{0;t-1}} - 1$ $\Pi_t^{12} = \dfrac{I^{0;t}}{I^{0;t-12}} - 1$

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3. Data set description and organisation of analyses on Italian data (b)

We computed the following **measures of underlying or core inflation**:

❑ **Time series approach,** using ARIMA model;
❑ **Exclusion Based approach**, excluding products on the basis of some measure of volatility of their prices;
❑ **Stochastic approach**, using Median and Weighted median, Mean Percentile and Asymmetric Trimmed means
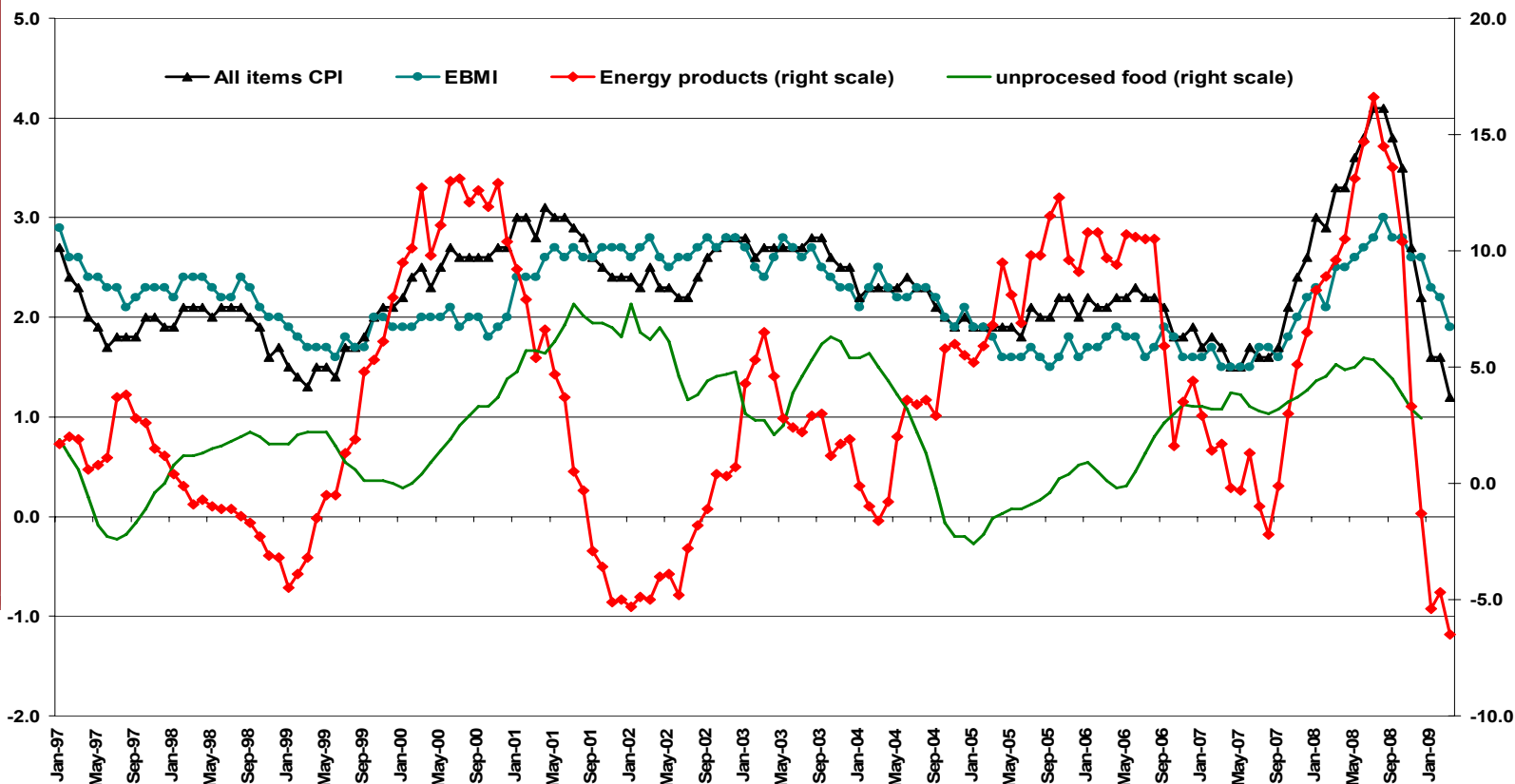
Assessing the performance of the estimators

❑ **Tracking trend inflation**
  • *Benchmark*: 12 month centred moving average
  • *Indicators*: **a)** Root Mean Square Error (RMSE) **b)** Mean Absolute Deviation (MAD)

❑ **Efficient, robust and unbiased**
  ➢**the reduction in volatility**
    •standard deviation
    •a short term volatility measure
  ➢**Unbiasedness**
    •Comparing averages
    •Specific statistical tests

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4. The current measures of core inflation in Italy - ISTAT

In order to analyse the inflation process ISTAT calculates **decomposition measures** concerning *sub-component* indices, such as for processed and unprocessed foods, energy products, tobaccos, services, durable and non durable goods etc.

Besides, ISTAT computes a measure of core inflation for the general CPI excluding energy and unprocessed food products -EBM1- (42 products excluded)

12 month rates of change of CPIs, EBM1, Energy products and unprocessed food prices indices. *Year 1997 – 2009.*

Legend: All items CPI — EBMI — Energy products (right scale) — unprocesed food (right scale)

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4. The current measures of core inflation in Italy - Istat

12 month rates of change of CPIs, BM1, Energy products and unprocessed food prices indices. *Year 2007 – 2009.* *12- month percentage rates of change, differences*
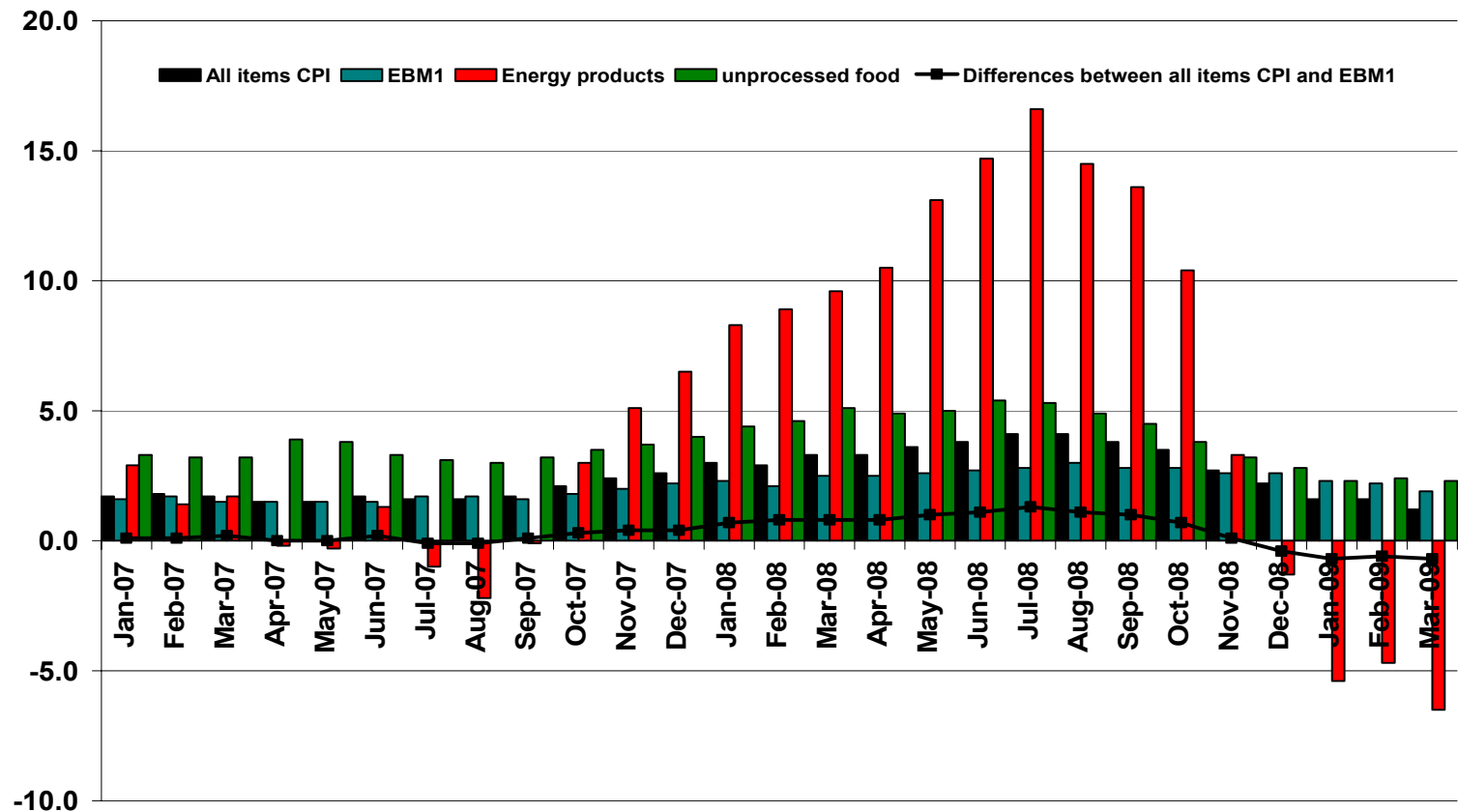
EBM1 reduces volatility and provides a useful tool for understanding underlying inflation

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5.1 Time series approach (a)

➤By using TRAMO SEATS, we identified the SARIMA model (2,1,0)(0,1,1):

(1-0.21326B-0.28563B2)(1 –B)(1 – B12)Yt = (1-0.70919B12)αt

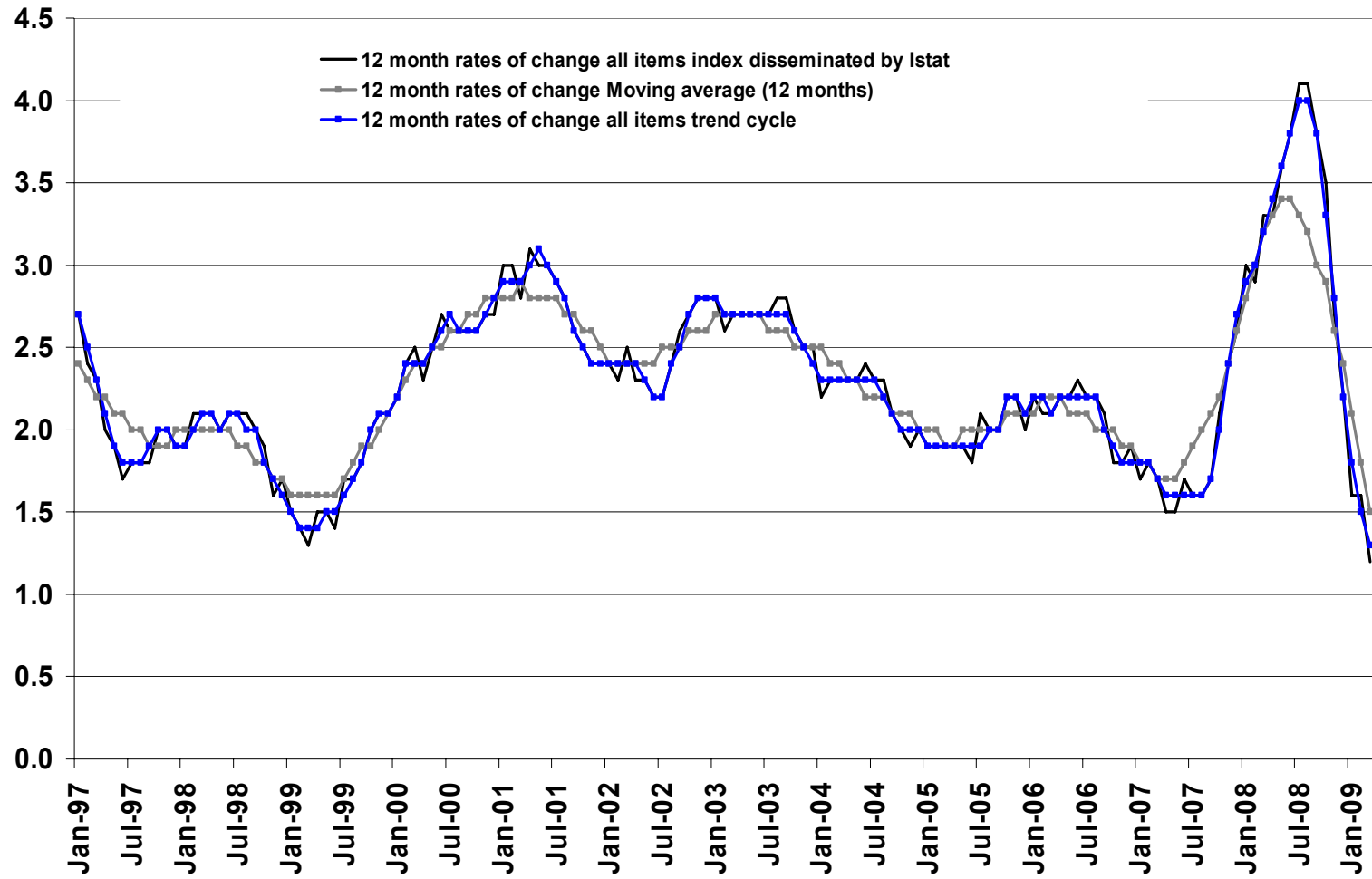➤ we extracted the trend-cycle by adopting an ARMA(3,3)

❑ CPI trend component was extremely dominant

❑ Since in the Italian CPIs the seasonal component is weak TRAMO SEATS mainly removed irregular movements

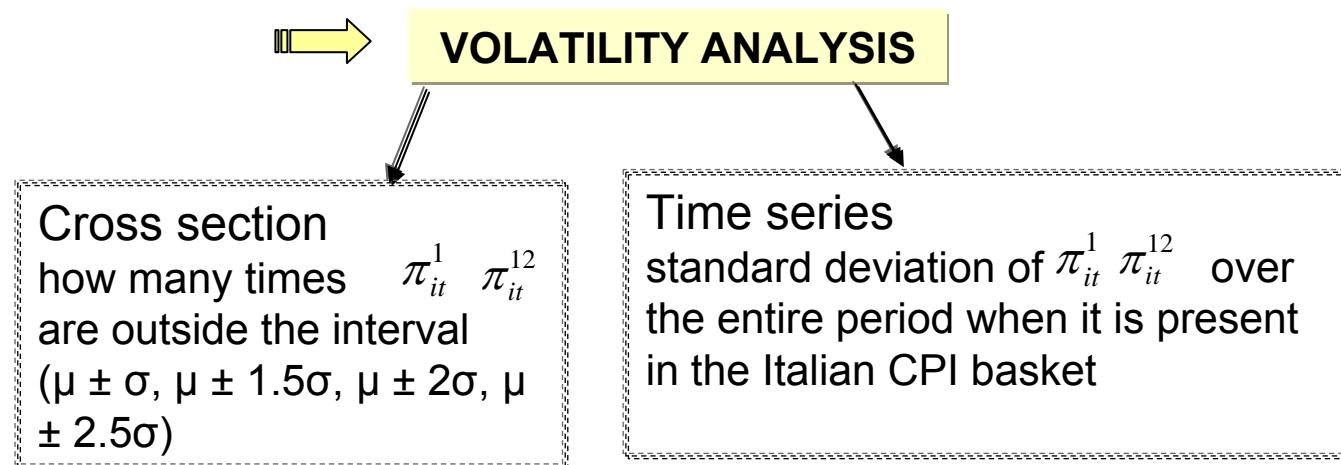❑ Trend cycle shows an evolution similar to the Italian CPIs.

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5.1 Time series approach (b)

12 month rates of change of CPIs, trend cycle and centred moving average. *Year 1997 – 2009. 12 months percentage rates of change*

Legend:
- 12 month rates of change all items index disseminated by Istat
- 12 month rates of change Moving average (12 months)
- 12 month rates of change all items trend cycle

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5.2 Exclusion based methods (a)

Exclusion Based Approach

✓Methods excluding products which are considered volatile a priori;
✓Data driven methods which exclude products on the basis of some measures of the volatility of their prices.

VOLATILITY ANALYSIS

Cross section
how many times π_{it}^{1} π_{it}^{12} are outside the interval ($\mu \pm \sigma$, $\mu \pm 1.5\sigma$, $\mu \pm 2\sigma$, $\mu \pm 2.5\sigma$)

Time series
standard deviation of π_{it}^{1} π_{it}^{12} over the entire period when it is present in the Italian CPI basket

Two reasons:

1. verify the volatility of the unprocessed food and energy products which are currently eliminated from the EBM1 calculation

2. calculate different indicators of core inflation excluding different groups of products (in terms of their volatility)

5.2 Exclusion based methods (b)

1. verify volatility of the products excluded in EBM1

➢ **only 14 out of 42 products excluded by EBM1 are truly volatile because their price changes did not fall into the interval μ ± 1.5σ in at least 25% of the months examined.**

2. calculate different indicators of core inflation

> ➢**We calculated five experimental EBM core inflation indicators**

1) **EBM2** (exclusion of products whose 12 months rates of change fell outside interval μ ± σ)
2) **EBM3** (exclusion of products whose 12 months rates of change fell outside interval μ ± 1.5σ)
3) **EBM4** (exclusion of products whose 12 months rates of change fell outside interval μ ± 2σ)
4) **EBM5** (exclusion of products whose fell 12 months rates of change outside interval μ ± 2.5σ)
5) **EBM6** (exclusion of products whose 12 months rates of change have fallen at least 25% times out of interval defined by μ±1.5σ)

EBM6 SHOWED THE BEST PERFORMANCE IN TERMS OF MAD, RMSE AND REDUCTION OF VOLATILITY

42 PRODUCT OF THE 2008 BASKET WERE EXCLUDED FROM EBM6: ONLY 15 ARE ALSO PRESENT IN THE LIST OF PRODUCTS EXCLUDED FROM EBM1

In short volatility analysis does not completely support Istat's current method (EMB1)

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5.2 Exclusion based methods (c)

12 month rates of change of CPIs, EBM6 and EBM1 *Year 1997 – 2008.*
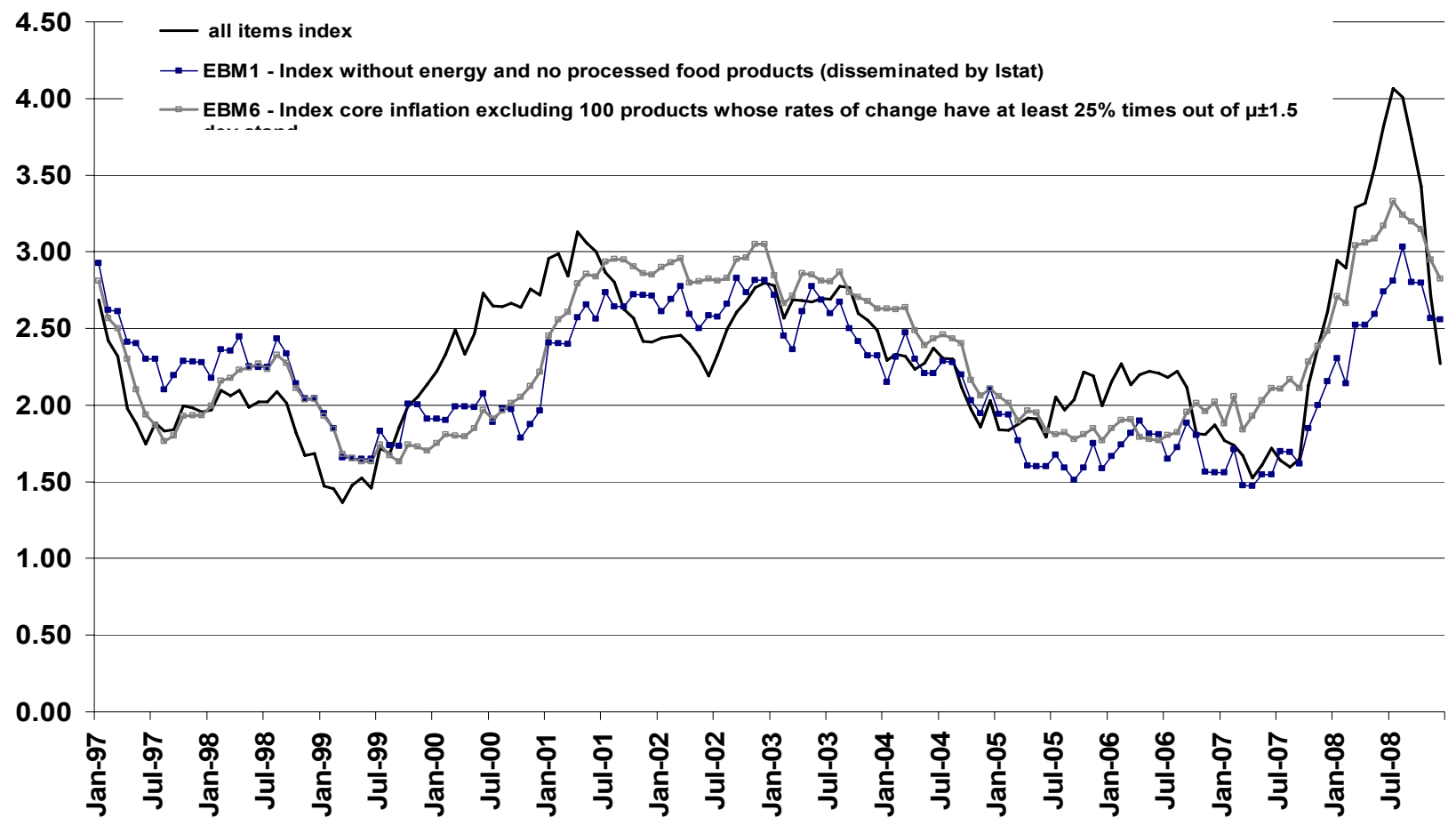
5.3 Stochastic approach: the analysis of price change distributions (a)

⇒ **the core rate of inflation is an unknown parameter**

to examine the empirical distribution

the most robust and efficient estimator depends

on the level of skewness and
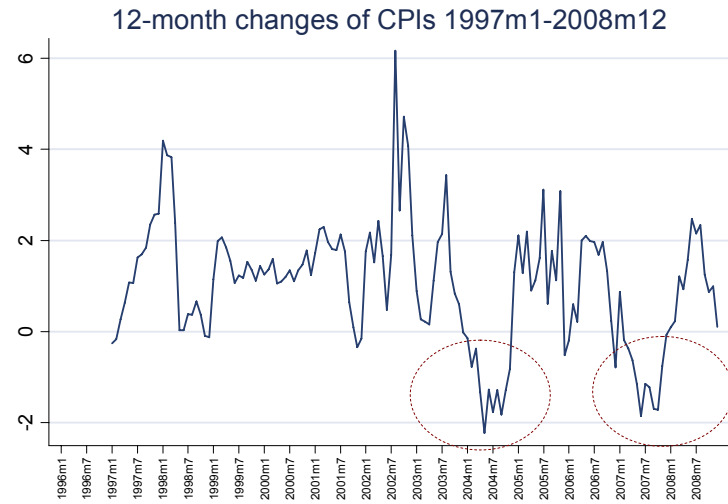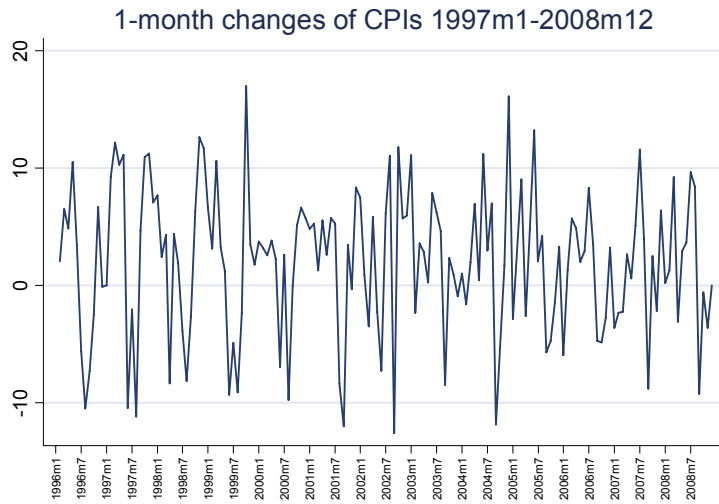
kurtosis of the distribution

Similar to the ones found for
Portugal (0.83) by Marques and Mota (2000)
Australia (0.7) by Kearns (1998)
Ireland (0.8) by Meyler (1999).

Summary statistics for Price Change Distributions

	One month ahead k=1	12 months ahead k=12
	Mean Inflation rate	
Mean	0.19	2.32
Std.dev	0.14	0.54
Min	-0.35	1.29
Max	0.53	4.16
	Std.dev of Inflation rate	
Mean	1.15	3.78
Std.dev	0.46	0.72
Min	0.42	2.63
Max	2.93	6.33
	Skewness of Inflation rate	
Mean	2.00	1.03
Std.dev	6.21	1.38
Min	-12.56	-2.23
Max	16.99	6.17
	Kurtosis Inflation rate	
Mean	96.14	18.40
Std.dev	77.25	10.52
Min	5.75	7.38
Max	386.55	87.33

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5.3 Stochastic approach: the analysis of price change distributions (b)

Skewness of Inflation rates

1-month changes of CPIs 1997m1-2008m12

12-month changes of CPIs 1997m1-2008m12

Left skewed

Kurtosis of Inflation rates

1-month changes of CPIs 1997m1-2008m12

12-month changes of CPIs 1997m1-2008m12

leptokurtic

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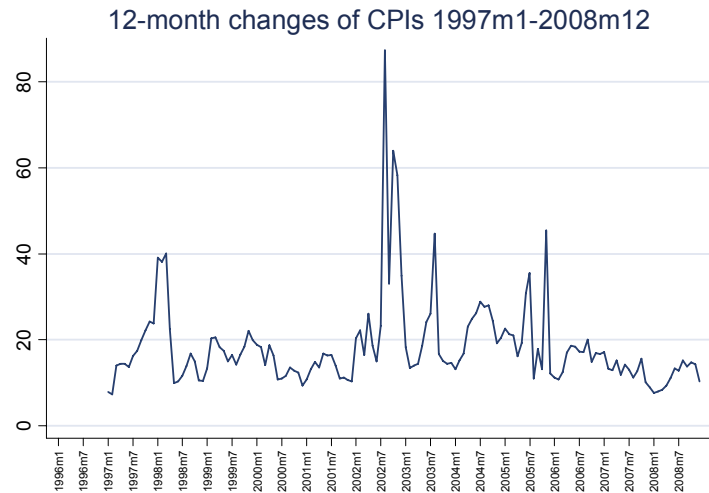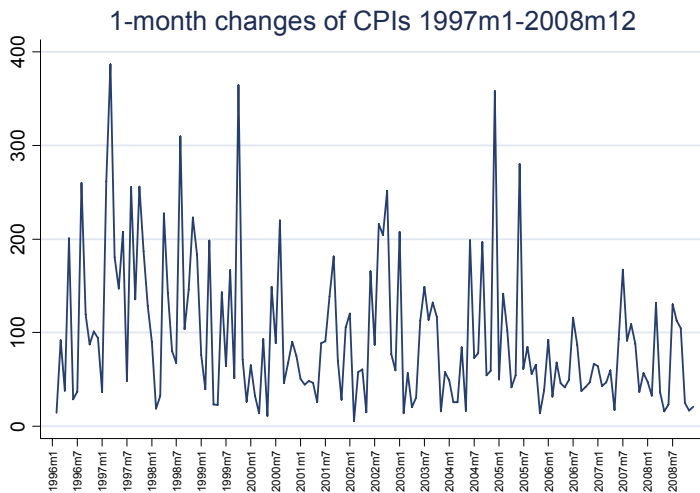
5.3 Stochastic approach: the analysis of price change distributions (c)

Correlation of moments-12month price changes

|	Mean	Standard deviation	Skewness	Kurtosis
Mean	1.000			
Standard deviation	0.394	1.000		
Skewness	0.241	-0.004	1.000	
Kurtosis	-0.021	-0.060	0.580	1.000

periods characterised by strong asymmetry are also periods in which the kurtosis is higher (and viceversa)

This figure is similar to the one found for Australian price changes by Roger (1998) where the correlation between skewness and kurtosis was 0.41 Ireland by Meyler (1999), where the correlation coefficient was 0.24.

We will focus on 12-month price changes

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Cumulative frequency distribution of 12-month price changes of CPI (pooled, in standard deviation from mean)
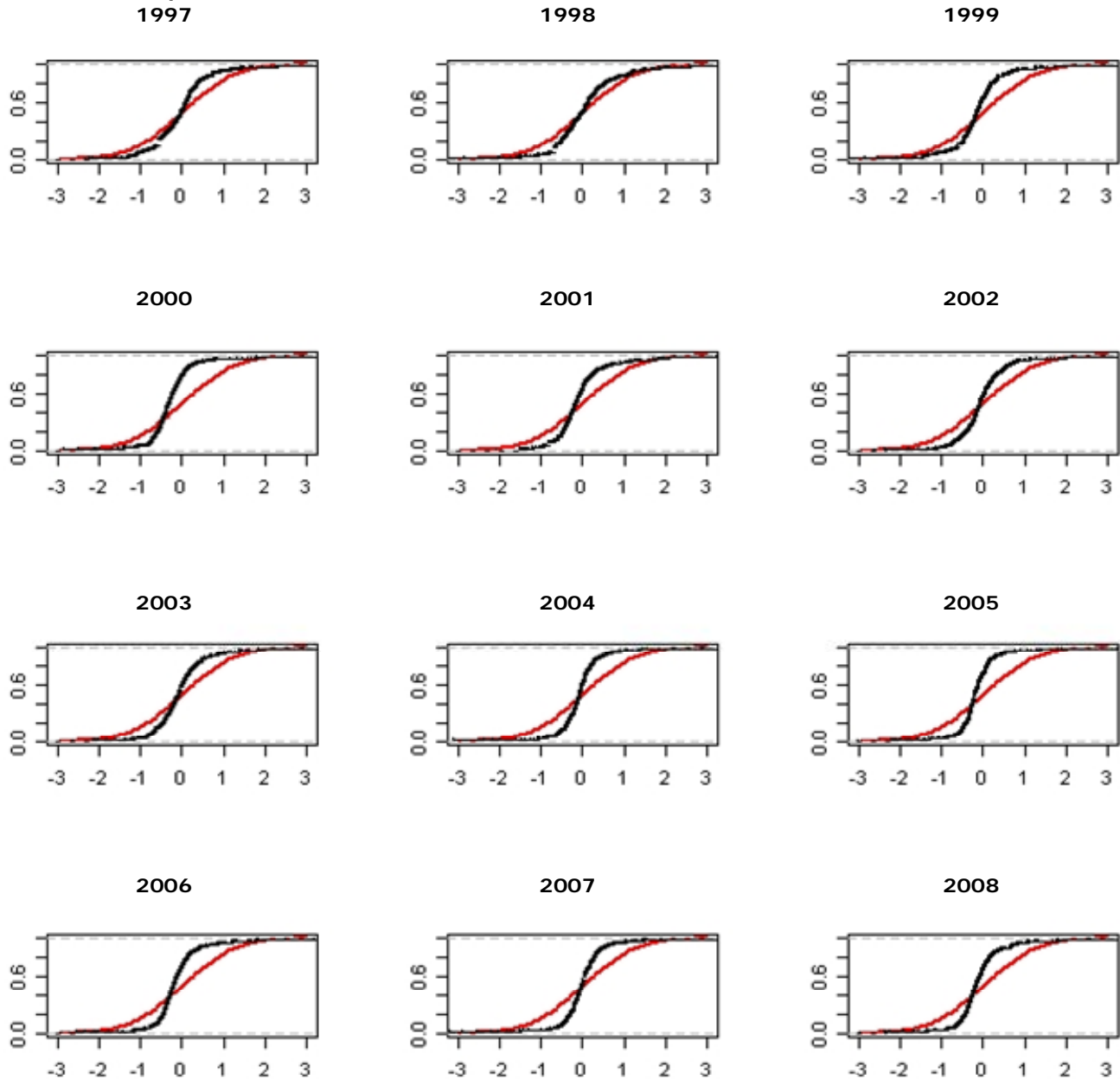
different to one another but **close to Normal** in 1997 and 1998

similar to one another but **different** from the Normal distribution

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5.4 Stochastic approach: constructing a measure of core inflation using asymmetric trimmed means (a)

an asymmetric trimmed mean whose trimming percentage varies according to the characteristics of the cross-section distribution of price changes

➢**finding an optimal asymmetric trimmed mean is a controversial methodological issue in literature.**

Trimming can be carried out in two ways ⟹ in order to find the most suitable estimator of Italian core inflation

we decided to follow both methods

1) We searched for an estimator which is not systematically biased relative to inflation *(Silver, 2006, Marques and Mota, 2000).*
maintaining the information present in the tails of the distribution

2) We looked for an estimator with minimum variance (Bakhshi and Yate, 1999, Meyler, 1999)
➢ Removing noise or temporary disturbances

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5.4 Stochastic approach: constructing a measure of core inflation using asymmetric trimmed means (b)

Our calculation strategy was:

❑ Construct a range of trimmed means with trim varying from 0 to 100
❑ Select the trimming percentage that minimises the value of the Absolute Deviation from the benchmark (12 month centred moving average)

Two indicators of core inflations where we consider the mean percentile to allow for skewness

TRIM1
✓By cutting less from the long tail of the distribution
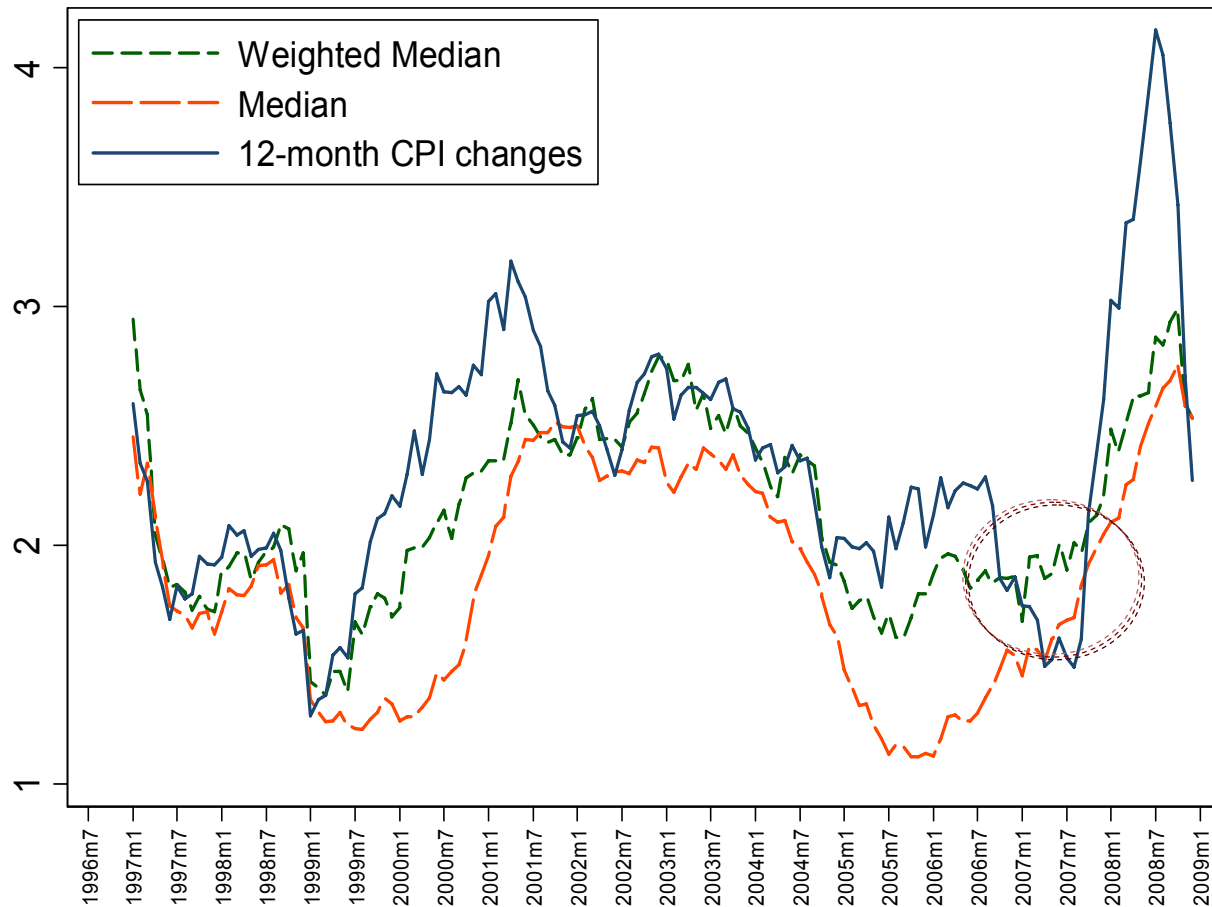
TRIM2
✓By using the following rule:

Lower half of the distribution = total percentage of trim*[1-mean percentile]
Upper half of the distribution = total percentage of trim*[mean percentile

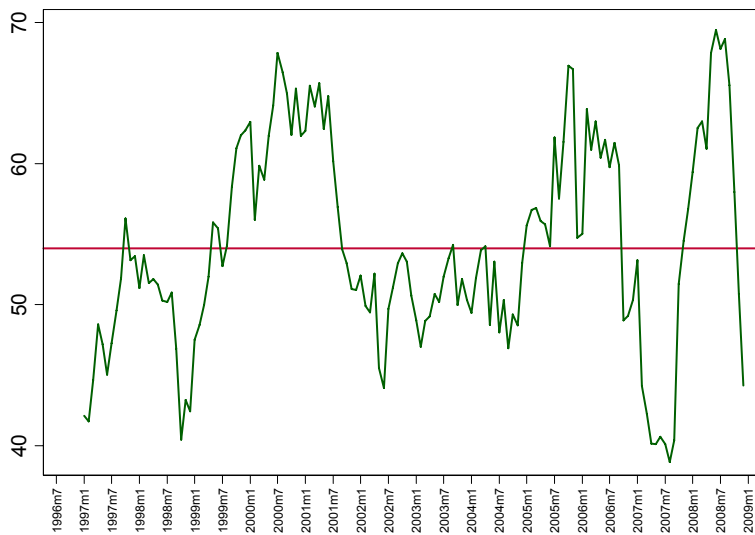# 5.5 Stochastic approach: median and weighted median (a)

We also computed the median, weighed median and mean percentile

Median and Weighted Median (12-month CPI changes)

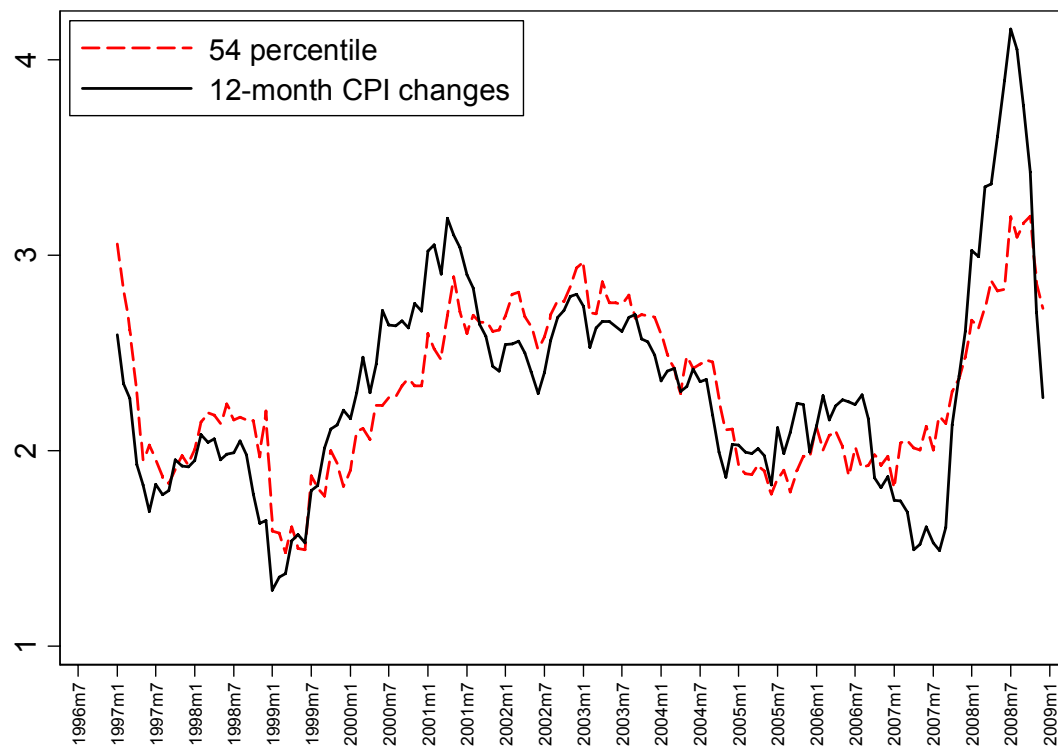The weighted median and the median are systematically lower than 12-month CPI changes, except in 2007

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5.5 Stochastic approach: Sample mean percentile (b)

⟹ **average mean percentile (54th)**

↓

Estimator of core inflation

54th against the actual 12-month inflation rate

Legend:
- 54 percentile
- 12-month CPI changes

5.6 Stochastic approach: asymmetric trimmed mean (c)

Asymmetric Trimmed Mean- TRIM1, TRIM2 and CPI Inflation
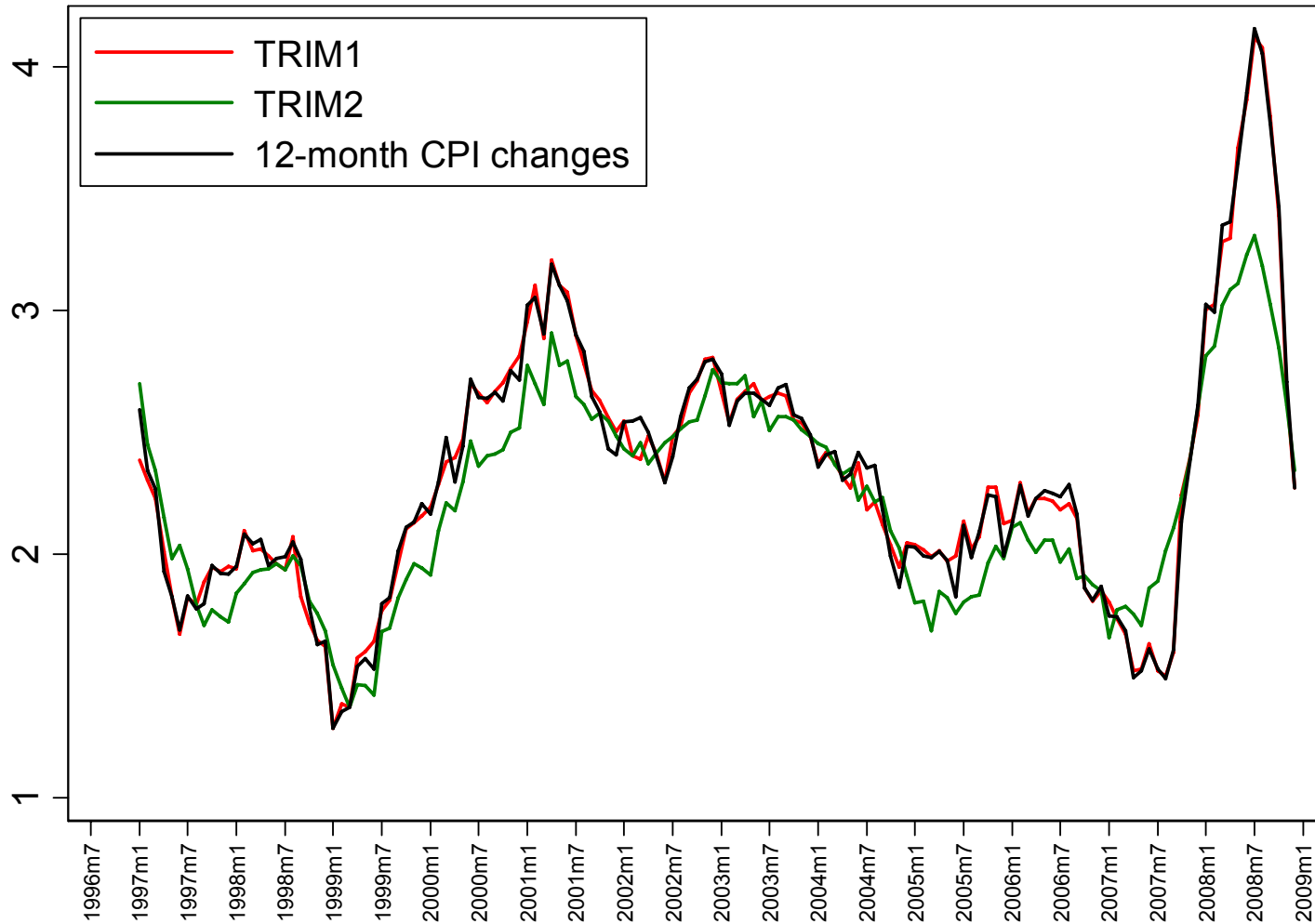
5.6 Stochastic approach: assessing the performance of the estimators (d)

Test for Unbiasedness

Estimators	F statistic	p-value
54th Percentile	1.25	0.2910
Median	99.88	0.0000
Weighted Median	22.86	0.0000
TRIM1	0.26	0.7727
TRIM2	30.40	0.0000

Volatility and tracking trend inflation

Estimators	Standard deviation	Standard deviation of the first difference	MAD	RMSE
Consumer CPI inflation	0.536	0.164		
54th Percentile	0.400	0.164	0.183	0.229
Median	0.462	0.134	0.108	0.329
Weighted Median	0.382	0.081	0.090	0.300
TRIM1	0.531	0.121	0.214	0.463
TRIM2	0.420	0.154	0.440	0.663

- ❑ two measures pass the test for unbiasedness (54th Percentile and TRIM1)
- ❑ all the measures reduce variability (except 54TH percentile)
- ❑ the 54th percentile shows the best performance in terms of RMSE
- ❑ the weighted median shows the best performance in terms of MAD

5. Concluding remarks (a)

A lot of empirical analyses were carried out in order to assess different measures of core inflation in Italy using a very detailed data set

Very interesting results

❑Time series approach

The SARIMA model only removes short term excessive variability.

❑EMB

▪ volatility analysis does not completely support the current method (EBM1)
▪ EMB6 (excluding products whose price changes fell at least 25% times outside μ±1.5σ) shows the best performance

❑ Stochastic approach

❑ The price changes distribution are very often skewed and leptocurtic
❑The weighted median and the median are systematically lower than 12-month CPI changes
❑ 54th percentile and TRIM1 pass the test for unbiasedness

No measures perform well in Italy as in other countries

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5. Concluding remarks (b)

Further research

> ➤ to examine the properties of EMB using different measures of volatility (for example using weights inversely proportional to their volatility, or other measure)

> ➤ to carry out further studies on the use and interpretation of the measures obtained with the Stochastic approach in order to interpret the fluctuation and propagation of the inflation process

Discussion Forum in Italy

> ➤ to set up a discussion forum among researchers, the Bank of Italy and Istat in order to agree on the objectives and the measures of core inflation to be computed and disseminated

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Thank you for your kind attention!

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Indice di diffusione dell'incremento dei prezzi

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