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Treatment of Seasonal Products in Consumer Price Index

*Empirical Evaluation of Methodological Choices
Focusing on Fresh Fruits and Vegetables Prices*

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M. Utku ÖZMEN
Economist

CENTRAL BANK OF THE REPUBLIC OF TURKEY
Research and Monetary Policy Department

- Motivation
- Data
- Methodology
- Estimation results
- Discussion
- Conclusion and policy implications

- Treatment of seasonal products in CPI is different than non-seasonal products
- Among seasonal products, strongly seasonal items are available in the market only at certain months of the year
- Thus several issues should be addressed for their treatment:
 - What representative goods to include each month
 - How to assign the relative weights
- It is almost not possible to observe the real time price-quantity and to adjust the weights dynamically
- Accordingly, some assumptions are to be made

- Based on the assumptions, different methodological choices are available
- Then, the question is:
 - Which method is the best?
 - What is the criteria to choose?
- Answer depends on the nature of seasonal products in each country
- Seasonal products are the major source of volatility in the CPI
- So, why not define the best as:
 - The calculation methodology that brings about the least volatile price index
- Securing lower volatility can also increase predictability

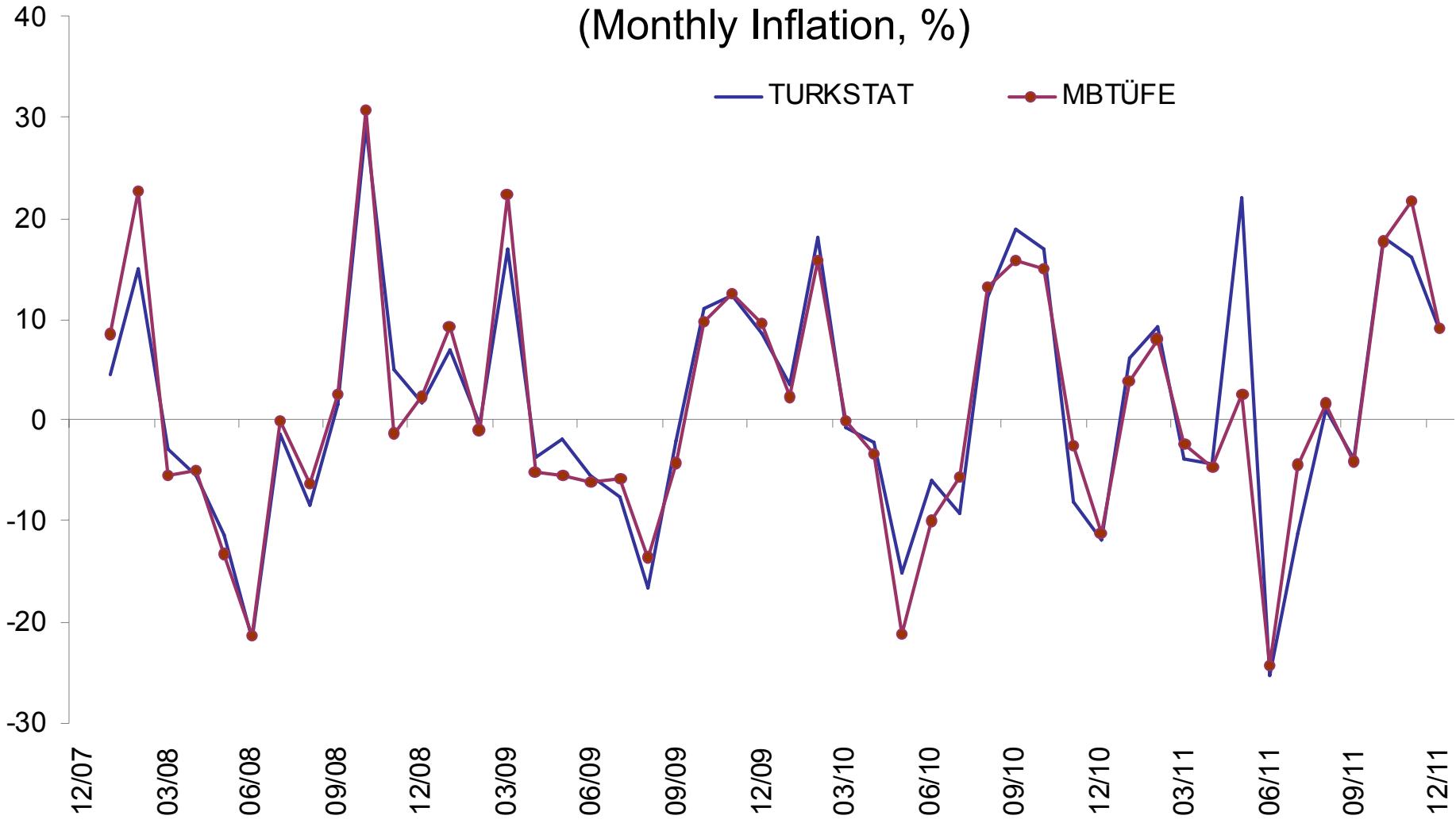
- In this study we try to understand which methodology, out of a set of generally applied techniques, produces less CPI volatility
 - For this purpose we use the fresh fruits and vegetables prices in Turkey as a case study
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- The choice of fresh fruits of vegetables is not arbitrary:
 - Although they constitute a smaller share of the basket, they account for the bulk of the overall inflation volatility
 - Such unpredictable volatility have its roots in the *irregular seasonality* of these products, the effects of which may be mitigated through a detailed treatment strategy

- Data is collected by the CBRT
 - The aim is to follow the course of fresh fruits and vegetables prices which are difficult to forecast otherwise
 - high volatility and unpredictability
 - Introduction of MBTUGE (a CPI followed by central bank)
- We collect weekly prices of 17 fresh fruits and vegetables, in total of about 1000 items
- Data from major cities, and from market halls and supermarkets
- Using geometric mean and seasonal pattern of the statistical institute, month-on-month fresh fruits and vegetables inflation calculated with our data is very similar to official figures

Sources of MBTUF

| Source | Number of Items | Collection Method |
|-----------------------------------------------------------------------------|-----------------|-------------------|
| National Market Chain 1 (Ankara, İstanbul, Antalya, İzmir, Bursa, Adana) | 290 | Internet |
| National Market Chain 2 (İstanbul) | 43 | Internet |
| Ankara Market Chains (4 markets) | 180 | Field |
| Ankara Market Hall | 83 | Field |
| Antalya Market Hall | 99 | Internet |
| İstanbul Market Hall | 105 | Internet |
| İzmir Market Hall | 101 | Internet |
| Trabzon Market Hall | 85 | Internet |

Fresh Fruits and Vegetables Index in Official CPI (TURKSTAT) and MBTÜFE (Monthly Inflation, %)



- Using the data, different fresh fruits and vegetables price indices are compiled with altering specifications.
- The alternating specifications relate to following methodological choices:
 - base price selection
 - imputation of missing prices
 - weighting scheme
 - treatment of extreme observations
 - smoothing (averaging) of prices

Alternative Choices for Five Decision Category

Weighting
schemes
(W)

- Variable weights
- Fixed weights
- Class-confined weights

putation
Missing
Prices
(IP)

- Prices updated with 5-digit level inflation
- Prices updated with 4-digit level inflation
- Prices updated with 3-digit level inflation
- Prices updated with 2-digit level inflation

Averaging
Prices
(AV)

- One-month average
- Two-month average
- Three-month average

Base
Price
Selection
(BP)

- Last price updated with 5-digit level inflation
- Last price updated with 4-digit level inflation
- Last price updated with 3-digit level inflation
- Last price updated with 2-digit level inflation
- Average price in the previous year

Treating
Extreme
Prices (at
months of
entry)(TR)

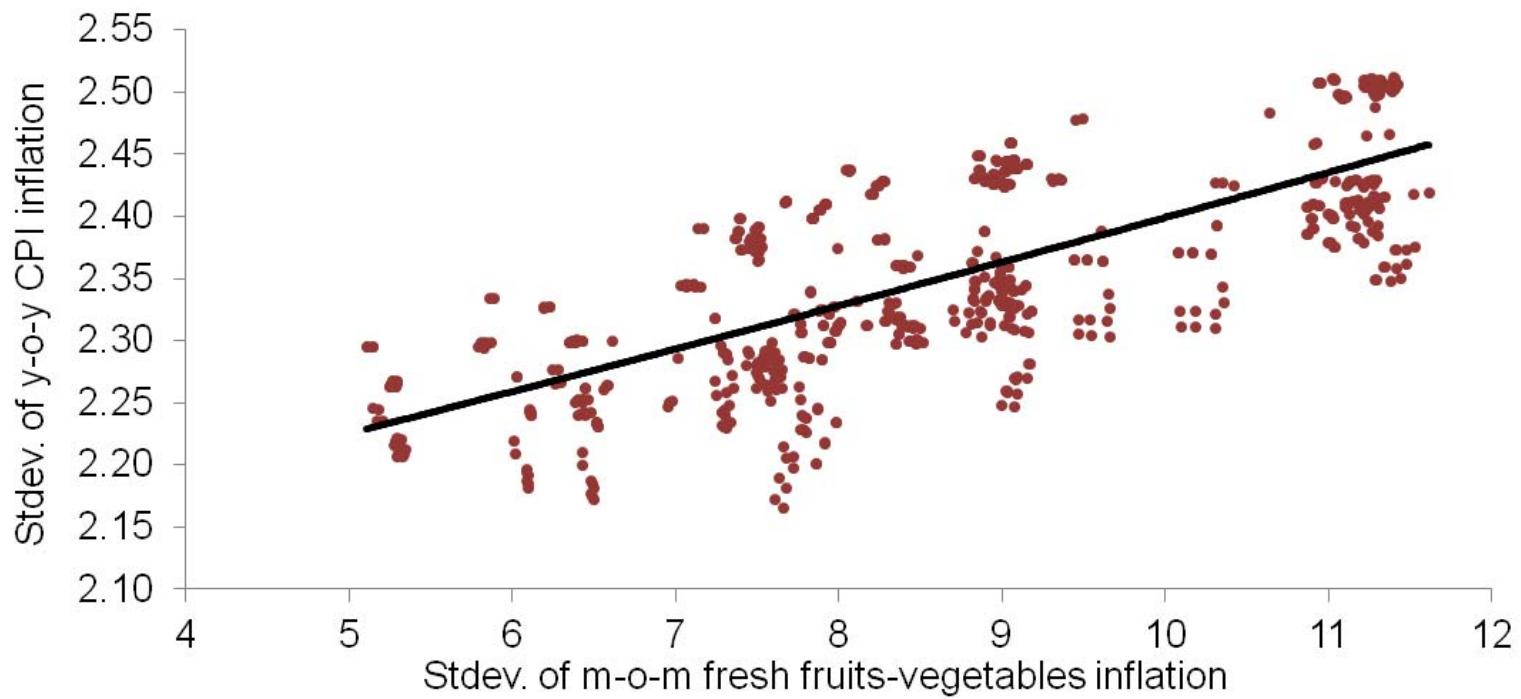
- No trimming / observed prices
- Trimming 10% from right tail of the distribution
- Trimming 20% from right tail of the distribution
- Trimming 30% from right tail of the distribution

*Note with trimming: Prices are
trimmed only at the months of entry.*

Total: $3*4*3*5*4=720$

- Based on the decision categories, we calculate 720 distinct fresh fruits and vegetables price indices
- Then, we try to see which combinations produce less volatile inflation
- *Test different dimensions of volatility*
 - Panel measure of absolute monthly rate of change of fresh fruits and vegetables indices
 - Standard deviations of annual CPI inflation caculated with different fresh fruits and vegetables price indices
- *Also, analyze the predictability of fresh fruits and vegetables prices*
 - Standard deviation of the residuals of a generic AR() model

Standard Deviations of CPI and Fresh Fruits and Vegetables



- Standard deviation of m-o-m fresh fruits and vegetables inflation is linearly correlated with CPI inflation volatility

- We estimate OLS regressions with a volatility measure as the independent variable and a set of dummy variables as dependent variables:

$$\begin{aligned} \text{Volatility } i,t = & \text{constant} + D_W_2i + D_W_3i \\ & + D_BP_2i + D_BP_3i + D_BP_4i + D_BP_5i \\ & + D_IP_2i + D_IP_3i + D_IP_4i \\ & + D_TR_2i + D_TR_3i + D_TR_4i \\ & + D_AV_2i + D_AV_3i + ei,t \end{aligned}$$

- In this specification, the omitted category is the current choice (Baseline):
 - Not trimmed, one-month average prices
 - Variable weights
 - Base prices updated with 5-digit indices

OLS with Time Fixed Effects of Monthly Volatility on Index Characteristics

| Dependent Variable: Absolute m-o-m inflation of fresh fruits and vegetables indices | | | | |
|-------------------------------------------------------------------------------------|--------------------------|-------------|----------------|---------|
| Characteristic | Explanatory Variables | Coefficient | Standard Error | P-value |
| Weighting Scheme | Fixed Weight | -1.60 | 0.05 | 0.00 |
| | Class Confined Weight | -0.27 | 0.05 | 0.00 |
| Base Price Selection | P0 4-Digit | -0.12 | 0.06 | 0.03 |
| | P0 3-Digit | -0.14 | 0.06 | 0.01 |
| | P0 2-Digit | -0.15 | 0.06 | 0.01 |
| | P0 Previous Year Average | -0.01 | 0.06 | 0.85 |
| | | | | |
| Imputation of Missing Prices | Imputation 4-Digit | -0.17 | 0.06 | 0.00 |
| | Imputation 3-Digit | -0.44 | 0.06 | 0.00 |
| | Imputation 2-Digit | -0.46 | 0.06 | 0.00 |
| Trimming | Trim 10% | 0.05 | 0.05 | 0.35 |
| Extreme Observations | Trim 20% | 0.04 | 0.05 | 0.39 |
| | Trim 30% | 0.05 | 0.05 | 0.31 |
| Averaging Prices | 2-Month Averaging | -1.36 | 0.05 | 0.00 |
| | 3-Month Averaging | -2.21 | 0.05 | 0.00 |
| | Constant* | 9.13 | 0.05 | 0.00 |
| | Number of obs. | 43200 | | |
| | R ² | 0.56 | | |

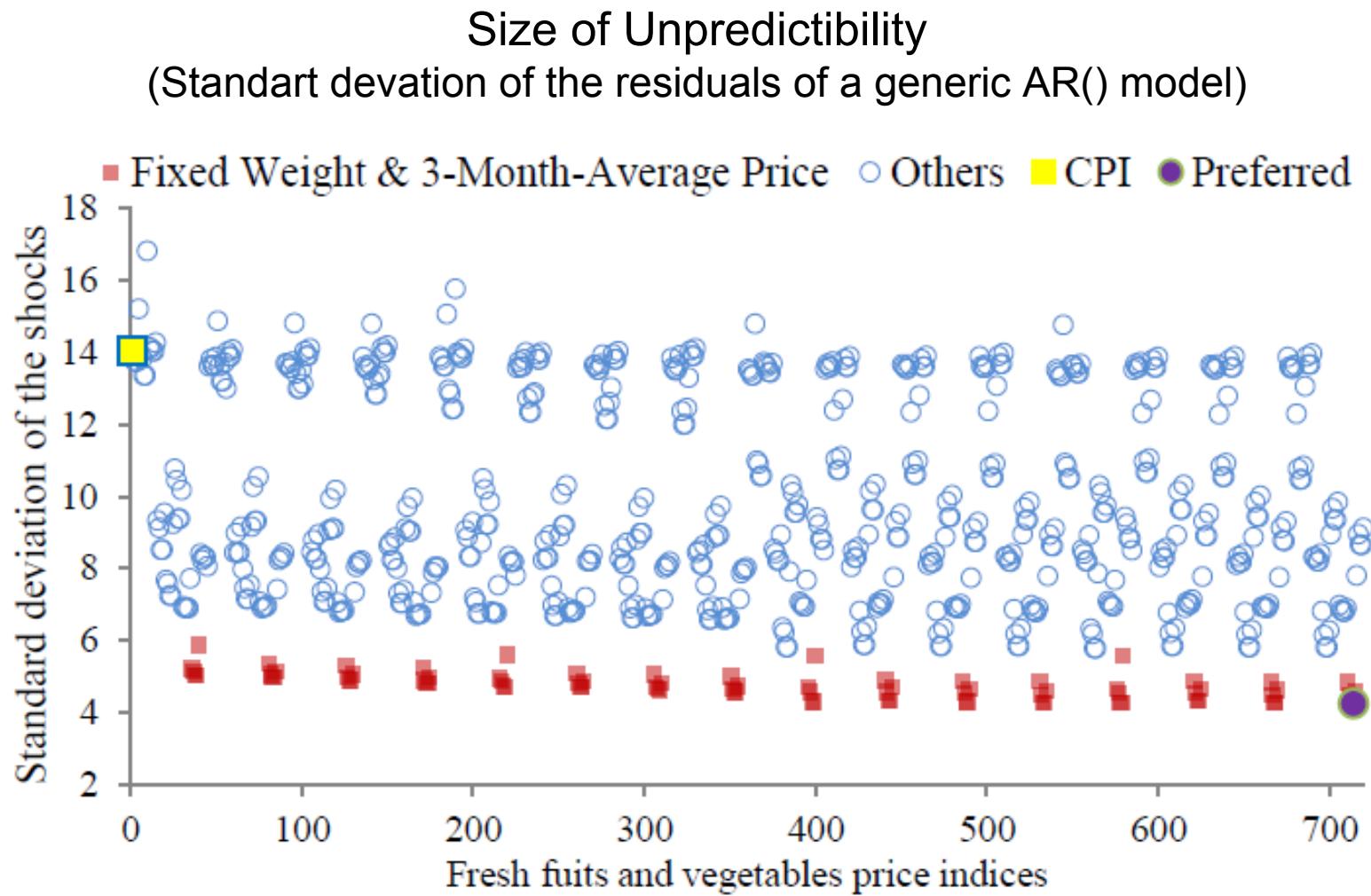
- The coefficients are interpreted in comparison to the base category

OLS Regression of Annual CPI Inflation Volatility on Index Characteristics

| Dependent Variable: Standard deviation of alternative annual CPI inflation | | | | |
|----------------------------------------------------------------------------|-----------------------|-------------|----------------|---------|
| Characteristic | Explanatory Variables | Coefficient | Standard Error | P-value |
| <i>Weighting Scheme</i> | Fixed Weight | -0.08 | 0.004 | 0.00 |
| | Class Confined Weight | 0.01 | 0.002 | 0.00 |
| <i>Base Price Selection</i> | P0 4-Digit | 0.01 | 0.005 | 0.21 |
| | P0 3-Digit | 0.08 | 0.005 | 0.00 |
| | P0 2-Digit | 0.08 | 0.005 | 0.00 |
| | P0 Previous Year | 0.01 | 0.006 | 0.63 |
| | Average | | | |
| <i>Imputation of Missing Prices</i> | Imputation 4-Digit | 0.01 | 0.004 | 0.46 |
| | Imputation 3-Digit | 0.02 | 0.004 | 0.00 |
| | Imputation 2-Digit | 0.02 | 0.004 | 0.00 |
| <i>Trimming</i> | Trim 10% | -0.02 | 0.004 | 0.00 |
| <i>Extreme Observations</i> | Trim 20% | -0.02 | 0.004 | 0.00 |
| <i>Averaging Prices</i> | Trim 30% | -0.02 | 0.004 | 0.00 |
| 2-Month Averaging | 2-Month Averaging | -0.07 | 0.003 | 0.00 |
| | 3-Month Averaging | -0.12 | 0.003 | 0.00 |
| Constant* | | 2.41 | 0.006 | 0.00 |
| Number of obs. | | 720 | | |
| R^2 | | 0.81 | | |

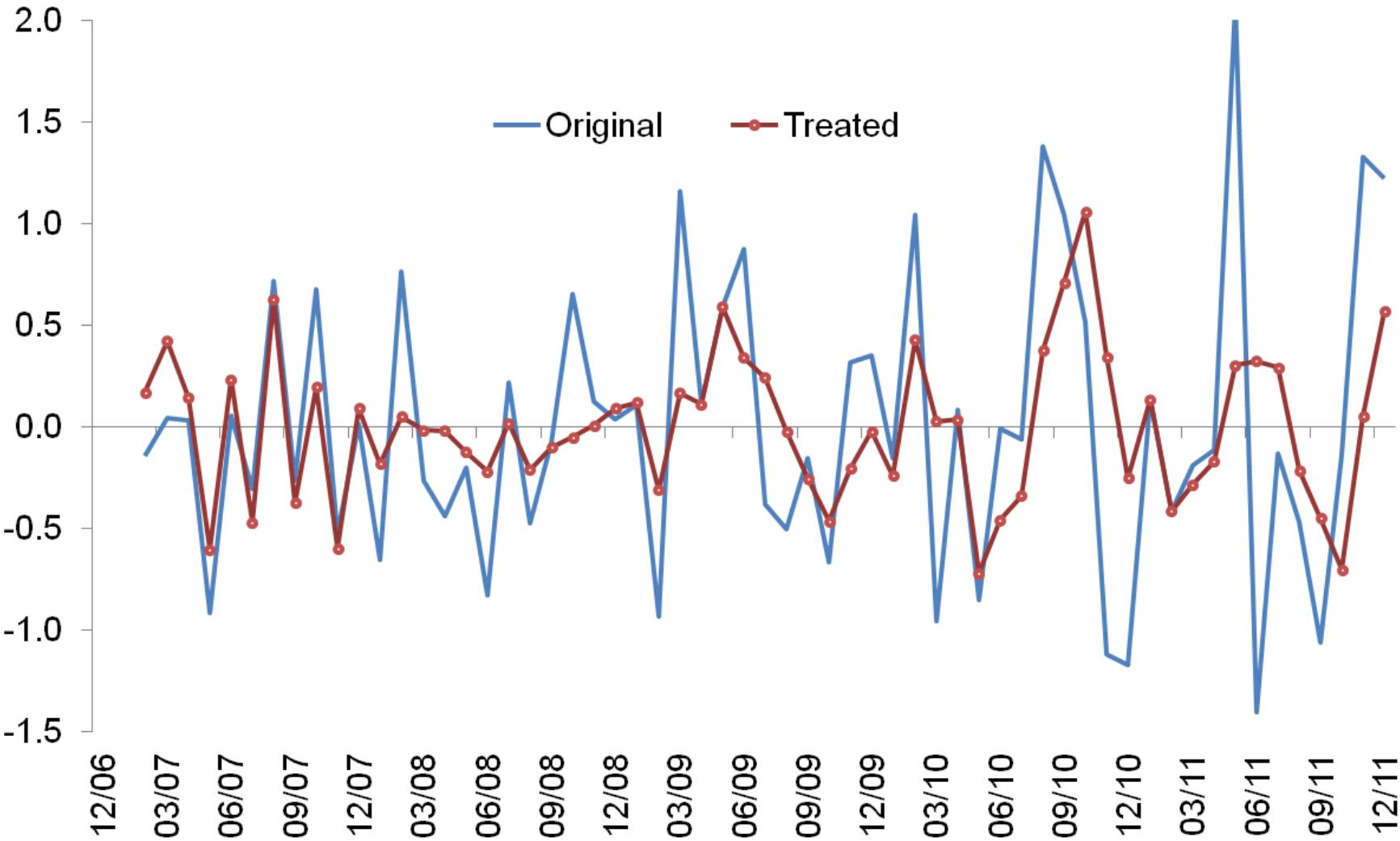
- The coefficients are interpreted in comparison to the base category

- *Choices reducing the volatility of m-o-m fresh fruits and vegetables inflation*
 - Fixed weights
 - Averaging prices longer than one month
 - Base price selection at aggregated levels
 - Imputation of missing prices at aggregated levels
- *Choices reducing the volatility of annual CPI inflation*
 - Fixed weights
 - Averaging prices longer than one month
 - Trimming extreme prices
- Thus, the proposed price index of:
 - *Fixed weights; 3-month average prices; 30% trimming of extreme prices at the months of entry; base price and missing prices are updated with 2-digit inflation produces the least volatile fresh fruits and vegetables price index given our data.*



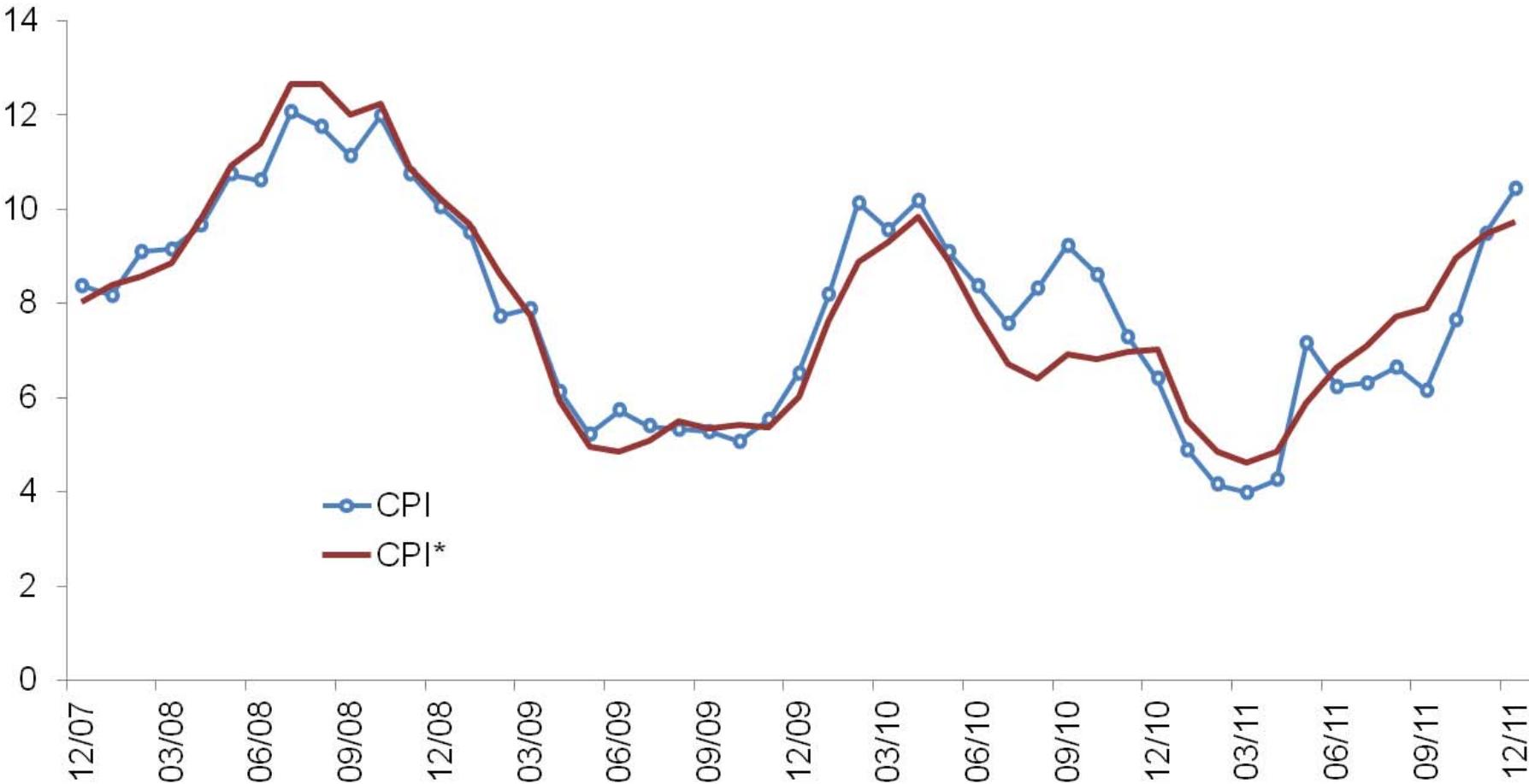
- The preferred combination also yields less unpredictability

M-o-m contribution to Annual CPI Inflation



Comparison of CPI and CPI*

(Annual Inflationn, %)



CPI*: CPI with fresh fruits and vegetables using fixed weights, 3-month averaged prices, 30% trimmed at the months of entry, base price and missing prices are carried forward with 2-digit level inflation.

- Averaging prices and using fixed weights reduce volatility significantly.
- Imputation of prices and base price updates should be based on changes of more aggregated indices -such as food inflation.
- Outlier treatment also decreases CPI volatility to some extent.
- This promising and striking result provides the motivation for exploring the room for methodological improvement in seasonal products treatment on a more detailed data set.

- Atuk, O., Özmen, M. U., Sevinç, O. (2013), Treatment of Seasonal Products and CPI Volatility, *Central Bank Review* 13/1.



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Thank you.