Central Bank Review
Vol. 13 (January 2013), pp.51-82

ISSN 1303-0701 print 1305-8800 online

https://www3.tcmb.gov.tr/cbr/

TREATMENT OF SEASONAL PRODUCTS AND CPI VOLATILITY

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ABSTRACT In this study, we first discuss the issues of treatment of seasonal items in consumer price indices (CPI), strong seasonality and unpredictable volatility. Later we examine the effect of selected seasonal treatment methods on the volatility of Laspeyres-type CPI for the first time using a unique data set of fresh fruits and vegetables prices from 2007 to 2011. Based on combination of treatment methods we calculate 720 different fresh fruits and vegetables price indices. Results suggest that using 2 or 3 month price averages reduces the monthly volatility of strongly seasonal products by 15 and 23 percent, respectively, in comparison to using one month averages. Also, using fixed weights yields 18 percent lower volatility than using variable weights. The other categories of base price selection, imputation of missing prices and treatment of extreme prices/trimming have mixed yet minor effects on volatility.
JEL C23, E31
Keywords Consumer price index, Inflation, Strong seasonality, Volatility

ÖZ Bu çalışmada öncelikle tüketici fiyat endekslerinde mevsimlik ürünlerin ele alınışı, güçlü mevsimsellik ve öngörülemeyen oynaklık kavramları tartışılmaktadır. Daha sonra mevsimlik ürünlerin endekse dahil edilmesine ilişkin seçilmiş yöntemlerin Laspeyres tarzı tüketici fiyat endeksinin oynaklığı üzerindeki etkileri incelenmektedir. Bunun için 2007-2011 dönemini kapsayan taze meyve ve sebze fiyatlarını içeren özgün bir veri seti kullanılmaktadır. Farklı metotların tüm kombinasyonlarını içeren 720 farklı taze meyve ve sebze fiyat endeksi hesaplanmıştır. Sonuçlar bir aylık ortalama fiyat kullanımına kıyasla, iki veya üç aylık ortalama fiyat kullanımının mevsimlik ürünler fiyatlarındaki aylık oynaklığı sırasıyla yüzde 15 ve yüzde 23 oranında azalttığına işaret etmektedir. Ayrıca sabit ağırlık kullanımı değişken ağırlık kullanımına kıyasla yüzde 18 oranında daha düşük oynaklığa yol açmaktadır. Diğer yöntem kategorilerini oluşturan baz fiyat seçimi, var olmayan fiyatların tahmin edilmesi ve uç fiyatların düzeltilmesinin ise oynaklık üzerindeki etkileri karışık olmakla birlikte küçük boyutlardadır.
MEVSİMLİK ÜRÜNLER VE TÜFE OYNAKLIĞI
JEL C23, E31
Anahtar Kelimeler Tüketici fiyat endeksi, Enflasyon, Güçlü mevsimsellik, Oynaklık

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1. Introduction

Treatment of seasonal products in consumer price index calculations is a difficult task since it requires more assumptions compared to the treatment of non-seasonal products. Since these products are not continuously available on the market, issues like which representative items to include at each month and how to assign relative weights to these items demand special attention. All these technical choices made are directly linked to how volatile the seasonal good prices will be –a concern not to be underestimated since seasonality is a major source of volatility in the consumer price index.

As long as the calendar months of the predetermined items' entry and exit coincide each year and relative weights are correctly assigned, the volatility in the seasonal goods inflation will be predictable and of reasonable magnitude. However, the presence of irregular moving seasonality might yield the predetermined methodological choices highly inefficient in terms of keeping volatility low. In other words, the predictable volatility stemming from seasonality is not a big concern, whereas the unpredictable volatility due to irregular seasonal fluctuations is. Dealing with this type of volatility is of great importance not only from the technical perspective, but also from the policy side. The reflection of high volatility is visible in the form of sharp and mostly not economically justifiable jumps in headline inflation. This, while challenging the communication and expectation management strategies of policy makers, might also introduce significant welfare implications to the society as well.

Nature of seasonal item prices in a consumer basket is highly sensitive to the supply chain and the market structure of seasonal items. As a result, the proper approach of treatment for those items depends crucially on country-specific structure of production. Therefore it is essential to make the choice among alternative methods using actual data provided that the methods satisfy the objective of seasonal treatment. Given the objective of removing volatility driven by irregular seasonality, this study introduces a novel way of method combination selection procedure by quantifying the contributions of different methods to different volatility measures. The candidate set of methods employed in this study is selected according to their applicability, reasonability of their underlying assumptions and integrity with the methodology of non-seasonal items.

In order to raise attention to the macro level implications of unpredictable volatility stemming from seasonal products and to contribute to the

methodological discussion, this study first discusses the treatment of seasonal products and related challenges from the perspective of policy makers. Next, the study critically reviews the methodological choices available for the treatment of seasonal products. Following that, using the fresh fruits and vegetables prices –most volatile seasonal products in Turkey case– as the framework and making use of a unique and rich dataset, the study provides an empirical analysis by exploiting alternative treatment options. A large number of different fresh fruits and vegetables price indices calculated are then assessed with the sole aim of achieving lowest volatility. Finally, the contribution of each approach to overall volatility of fresh fruits and vegetables prices is analyzed along with a concluding discussion of their implications to the volatility of the headline inflation.

2. Strong Seasonality and Treatment of Seasonal Products: An Overview

2.1. Strong Seasonality and Treatment of Seasonal Products

The well-known fact about seasonal products in a consumer price index is that they have a significant impact on the volatility of the aggregate index. On the other hand, what is not that well-known is the characteristics of this volatility. In the following sections firstly the nature of seasonal product price volatility will be centered on the concept of strong seasonality and it will be characterized by the size of unpredictable price changes. Accordingly, Section 2.1.1 describes the problem associated with seasonal products. Then there are two subsections discussing the implications of seasonal volatility of prices on the quality of a consumer price index and on the communication of an inflation targeting central bank's policy actions. First three subsections provide the basis to the need of special treatment of seasonal items in the Consumer Price Index (CPI). Lastly, Section 2.2 introduces an overview of the seasonal product treatment in the literature. Moreover, the last section discusses potential problems associated with seasonal treatment methods that are frequently cited.

2.1.1. Strong Seasonality and the Size of Unpredictable Volatility

Seasonality brings important challenges both in the calculation and in the interpretation of a price index. Because most price changes do not exhibit a seasonal pattern and they are only subject to marginal cost shocks; they do not possess a chronic type of volatility such as some systematically volatile seasonal products have. Depending on the strength of common or sector specific shocks, prices of the majority of items in a consumption basket might fluctuate relatively more for periods when cost shocks are intense.

Consequently, in a general perspective the main characterization about such volatility is that its contribution to the total volatility of the index becomes large only for certain periods of time. On the other hand, for some items impact of seasonality on volatility is strong and persistent. These so called strongly seasonal products such as many fruits, vegetables and clothing products can only be found in the markets for certain periods of the year.

It is essential to distinguish between the volatility of strongly seasonal items and that of remaining items in the price index. The difference is mainly structural in the sense that prices of strongly seasonal items, if not treated properly in CPI calculations, may generate volatility that is external to the pricing dynamics of other items. This is not to say that price changes of strongly seasonal products are not driven by the states of supply or demand conditions. On the contrary, the exogenous volatility is imposed by the flawed treatment, which does not take into account demand-supply equilibrium in the market. Changes that account for the volatility stem from unadjusted inclusion of seasonal price fluctuations in the basket, which are rapidly corrected by the choices of the consumers. Accordingly, unexpected seasonal variations in sectors associated with strongly seasonal products should be treated with special care.

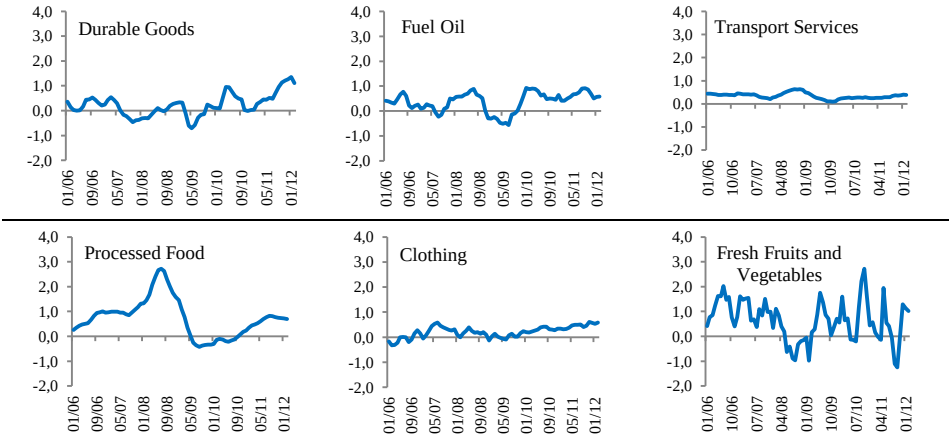
Volatility of strongly seasonal products is a distinct phenomenon compared to that of other products. Still, distinguishing the volatility of strongly seasonal products does not imply that an ordering of different products along the levels of price volatility is irrelevant. For example, energy prices are more volatile than durable consumption goods. The superiority of energy price volatility in this example is perfectly transformable into the level of stochastic marginal cost shocks. Hence, this volatility has predictable economic roots and no special treatment of energy prices is implied. The same applies even for many products with seasonal characteristics. For example, prices of items such as education services and hotels show seasonal fluctuations, yet the source of associated price changes- seasonality in regulator periods for the first and seasonality of demand for the second- remain relatively weak in generating a sizeable and unpredictable volatility.

In order to clarify the effect of unpredictable volatility on inflation, using contributions of selected item groups' on annual headline inflation is appropriate for several reasons. First, it has been recognized for a long time that looking at annual changes provides a linear seasonal adjustment. Noting that our intention is not to remove all stochastic seasonality in the series, contribution to annual inflation is capable of reflecting accumulated month-specific price changes on annual inflation. Second, calculating contributions

allows for adjusting the price changes according to their consumption weights in the basket.

Contributions for each month from January 2006 to February 2012 are illustrated in Figure 1. In addition, the descriptive statistics are given in Table 1. Group selection is done on the basis of reflecting the volatility of different types of items. Figures point that transport services display the smoothest contribution to the annual inflation, whereas other selected item groups have their own courses of contributions with varying volatility.

Figure 1. Contributions of Selected Groups to Annual CPI Inflation (Percentage Points)



Note: Processed food contains bread, cereals and oils. Source: TURKSTAT, CBRT.

A brief description of the sectors associated with the selected items provides the insight on the evolution of contributions and information about the representativeness of the selection. Durable goods, fuel oil, transport services and processed food items do not display strong seasonality, i.e. all items are available throughout the year. Durable goods and fuel oil are characterized by a high degree of import dependency. Also, processed food items used in this study, bread, cereals and oils, are highly vulnerable to marginal cost shocks in import prices (Başkaya, Gürgür and Öğünç, 2008). While durable goods and fuel oil fluctuate between positive and negative levels of contribution depending mostly on international prices and exchange rate developments, the contribution of the processed food group remaining at positive levels reflects the effects of factors such as international food prices. Adversely affected by fuel oil price developments, transport services group have a smooth contribution path partly due to the share of input prices in the final price being low. On the strong seasonality front the prices of fresh fruits and vegetables group being significantly more

volatile than those of the clothing group suggests that strong seasonality nature of product groups is not the only decisive factor of high volatility.

The main determinant of the divergence in the levels of volatility across strongly seasonal items is the different market structure of the sectors. The following example clearly illustrates the reason of such divergence. Assume that the climate conditions are very favorable and the summer season starts earlier than regular. Therefore, consumers demand t-shirts and similar items suitable for warmer weather before the start of the regular summer season. In addition to this general favorable condition, at the same time suppose that a flood affects a region where most of the season's fruit production takes place and thus hits the fresh fruit supply. Consequently, t-shirts and fruit prices are expected to jump contrary to the regular seasonal pattern. In other words, there is potential that these events generate unpredictable volatility in both item groups. However, sectoral differences result in a substantial change in terms of the realized volatility for both groups. The vast number of clothing products manufacturers and timing of the production (taking place in advance of the beginning of season) allows for stock-building. That assures meeting the demand shock to some extent. On the other hand, for fresh fruits and vegetables majority of the production area is affected by the irregular seasonal climate effect so that the supply shock yields a temporary decline in the aggregate supply.

Table 1. Descriptive Statistics of Contribution to Annual Inflation

A. Contribution of Selected Items to the Annual Headline Inflation (Percentage Point)

	Processed Food	Fuel Oil	Clothing	Durable Goods	Transport Services	Fr. Fruit & Veg.
Mean	0.73	0.38	0.21	0.23	0.34	0.65
Max.	2.72	0.93	0.61	1.36	0.64	2.73
Min.	-0.42	-0.56	-0.32	-0.71	0.09	-1.25
Standard Dev.	0.77	0.39	0.22	0.45	0.12	0.82

B. First Difference of the Contributions

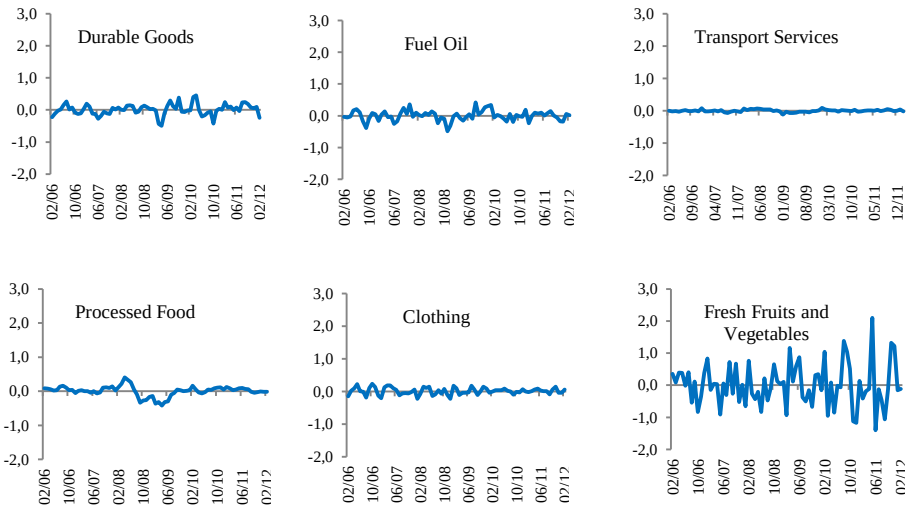
	Processed Food	Fuel Oil	Clothing	Durable Goods	Transport Services	Fr. Fruit & Veg.
Mean	0.01	0.00	0.01	0.01	-0.001	0.01
Max.	0.40	0.42	0.24	0.46	0.09	2.09
Min.	-0.42	-0.49	-0.23	-0.50	-0.12	-1.40
Standard Dev.	0.15	0.16	0.11	0.17	0.04	0.67
Variance Test Prob.*	0.00	0.00	0.00	0.00	0.00	0.08

Notes: Data ranges from January 2006 to February 2012. Processed food group contains bread, cereals and oils. (*) Variance Test Prob. refers to the variance ratio test of the series in Panel A and B under the null of unit variance ratios of contributions of item groups and their first difference.

Panel A in Table 1 presents descriptive statistics for the contribution to annual headline inflation of selected item groups. The highest average contribution to the annual inflation comes from processed food group in our selected item list. It is followed by fresh fruits and vegetables, while clothing provides the smallest contribution on average. The contribution of fresh fruits and vegetables is the most volatile series with the biggest range. It is closely followed by the contribution of processed food, which suggests that volatility stemming from non-seasonal products can be as large as volatility stemming from the products of strongly seasonal nature in this respect. However, the type of volatilities differs when first difference of the contribution series are examined.

Figure 2 shows the first differenced contributions. First difference corresponds to the monthly net contribution of the item group to the annual inflation. From the figure it is evident that monthly net contributions of the items other than fresh fruits and vegetables group vary at small rates. The contribution of the fresh fruits and vegetables groups to headline inflation on the other hand can vary by 2 percentage points one month to another and is totally unpredictable.

Figure 2. Monthly Net Contributions to Annual CPI Inflation (Percentage Points)



Note: Source: TURKSTAT, CBRT.

Panel B in Table 1 provides the descriptive statistics of monthly net contributions. As suggested by Figure 2, differenced contributions of fresh fruits and vegetables, as in regular contributions display the largest volatility, almost 4 times larger (in terms of standard deviation) than that of durable goods. Bottom row of the table represents probabilities associated with the

test statistic where null hypothesis is the equality of variance of cumulative contributions to monthly net contributions. Except for fresh fruits and vegetables the null is rejected with significance even at 1 percent level. On the contrary, the volatility of the cumulative contribution of the fresh fruits and vegetables group is found to be not statistically (at 5 percent level) different than that of the monthly contributions.

This basic analysis sheds light on the nature of the volatility of consumer prices. Composing of strongly seasonal products, fruits and vegetables group is by far the greatest source of volatility in terms of marginal monthly contributions to the headline inflation. On the other hand, clothing items indicate that strong seasonality does not necessitate the existence of considerable unpredictable volatility, which points to the importance of the structure of sectoral production.

Focusing on the level of volatility generated by fresh fruits and vegetables, treatment of seasonal products turns out to be one of the most crucial issues in calculating the CPI. The challenge not only comes from reflecting true consumption weights given price levels but also from maintaining a smooth index as an economic indicator to be used for policy formulation and communication. These two aspects are briefly discussed below.

2.1.2. True consumption Weights and the Cost of Living

The unavailability of strongly seasonal items for purchase throughout the year might be addressed to different aspects of price formation. Demand is the governing source of strong seasonality for clothing products, while environmental and climatic conditions determining the supply account for seasonality in fresh fruits and vegetables. Whether the seasonality comes from supply or demand, such prices are characterized by discontinuity of product availability. This naturally imposes a seasonal pattern of prices where prices enter the market at relatively higher levels due to the scarcity of supply (as in fresh fruits and vegetables) or strength of consumer demand (as in clothing items) followed by a gradual decline as supply increases or demand subsides. The general pattern in many strongly seasonal products is predictable even though it potentially imposes serious volatility. Predictability is a desired property and in terms of assessing the inflation and its volatility, one might think that comparing prices to that of the same month in previous year would be adequate. However as shown by the previous analysis, price changes, especially month-to-month are not easily predictable for strongly seasonal items.

The sign of price changes are confidently predictable according to the season and for a given strongly seasonal product. However, most of the time

it is not the sign but the size of price changes that account for the volatility of inflation. Hence, it turns out that the seasonal pattern itself is volatile. The factor that constitutes the basis for the volatility of the seasonal fluctuations is basically the concept of moving seasonality. Although it is plausible to assume a general pattern of climate conditions, stochastic shocks on these conditions affect the availability or desirability of the seasonal products especially in the time of introduction of these products in the markets. The resulting price jumps, when compared with the levels of the previous year, impose unpredictable volatility on the index.

The effect of the seasonal volatility on aggregate index depends mainly on the portion of such seasonal products in the items list and their corresponding consumption shares. If number and consumption weights of seasonal products are high, then volatility is inevitably transmitted to the aggregate price index.

In the presence of scanner data which enables obtaining quantity and price information simultaneously, calculating true consumption weights is not a problem since the required information is embedded in the data set. If consumers follow consumption smoothing behavior, the expected volatility in their consumption should not be as excessive as that of the price series. When prices jump following the entry of the items into the market, consumers rule out the effect of the price through adjusting quantities purchased, so that the aggregate effect of prices in CPI is smoother. This is an automatic stabilizer ensured by the consumer behavior. On the other hand when simultaneous quantity information is not available, using index weights based on average consumption patterns may result in promoting excess volatility to the price index. This becomes a more serious problem when the deviation of the price of the item from its seasonally expected levels is huge. As a result by ignoring the quantity adjustment of the households the volatile series at hand diverges from the true cost of living, based on the actual consumption levels.

2.1.3. Seasonal Volatility and the Inflation Targeting Regime

Inflation not only measures the cost of living but also it is the most important economic indicator of the aggregate price level in the economy. Moreover, it is of utmost importance in an inflation targeting framework, since monetary policy decisions are taken based on the movements as well as the level of inflation. A continuous type of volatility stemming from strong seasonality as shown above in fresh fruits and vegetables directly affects the information content of price index. It becomes more difficult to extract the monetary policy relevant part of inflation from the headline figures due to the dominance of seasonal volatility. Moreover since volatility

is of unpredictable nature, this has two important implications from the viewpoint of monetary policy. First, monetary authority puts a pronounced emphasis on the core measures of inflation to justify its policy actions. Second, the inability to forecast stochastic seasonal shocks becomes a burden for the inflation targeting monetary authority. As core measures might deviate from headline inflation under persistent seasonal volatility shocks while forecasting the headline inflation in such a setting requires a wider uncertainty sphere, communication of monetary policy actions becomes noisier.[1] Indeed the noise is insensitive and external to the monetary policy; however the monetary authority should devote constant effort on reducing it. Given the limited attention of economic agents to detailed communication efforts of monetary authority, there are reasons to argue the inefficiency of such efforts. As a result, letting unpredictable seasonal volatility dominating the course of inflation constitutes a potential and continuous threat on the soundness of monetary policy communication.

Economic contracts and inflation expectations are also distorted by the effect of seasonal volatility on the consumer price index. The change generated by fresh fruits and vegetables in annual headline inflation for a given month could range from approximately -1.5 to 2 percentage points. Given that housing rents are adjusted once a year indexed on annual inflation in the contract month, rental adjustments for household even in consecutive months might differ substantially. Such indexation in economic contracts imposes a further volatility in inflation dynamics. Furthermore if firms set their prices according to the anticipated inflation for the following months and there exists substantial heterogeneity in their own inflation perceptions, then it is reasonable to assume that some firms will choose to set higher levels of inflation along the wide uncertainty band. The firms that undershoot inflation at the end of price setting process will relatively suffer the losses for predicting a lower rate of inflation. Consequently, in this setting the tendency to anticipate a higher short-term inflation will increase. Therefore, volatility imposed by the unpredictable seasonality not only harms monetary authority's communication effectiveness of policy actions but also is a major obstacle for disinflation process.

2.2. Seasonal Product Treatment in the Literature

There are various methods to deal with strongly seasonal commodities, i.e. commodities that are not available in the market-place during certain periods

[1] The effect of exogenous seasonal volatility on the policy communication may be reflected in the wider uncertainty bands. Since the unpredictable part of volatility is amplified by prices of strong seasonal products, Turkey has on average around 1.5 percentage point wider uncertainty band on target inflation compared to other inflation targeting countries in 2011.

of the year, in CPI calculations. The differing composition of basket each month due to these strongly seasonal commodities requires a special treatment in index calculations. Although no best or satisfactory approach exists, there are several methods to deal with this issue. The most common approaches are using the month-to-month indices with differing weighting schemes and using year-over-year indices.

2.2.1. Month-to-month Approaches

There are two main approaches enabling a month-to-month comparison of a price index in the presence of strongly seasonal commodities. The first is the fixed weights approach, where seasonal products are treated as regular products by allocating fixed annual weights. The second approach is variable weights approach, in which weight for the seasonal product is assumed to be zero when the item is not supplied in the market. The basket and its share composition in this approach vary each month. A derivative of variable weight approach is the class-confined approach where the year is divided into different seasons and the weight of each item is held constant within, but variable between seasons.

Fixed Weights Approach: In this approach the weights of all items are constant at all months. For months where the product is unavailable a price value is imputed for index calculations. The choice of the imputation method is crucial in this approach. For a certain period where no price data is available, a common way to impute a price is to take the last available observed price and to multiply with the inflation of the most similar group of products. A specific single "similar" product or a smaller group of products can be selected as benchmark in this case. The rate of change of aggregated groups at higher levels, which are likely to be influenced by different factors, might lead to misleading results. Thus, the use of products from the same COICOP[2] class or group as benchmark would enhance comparability with the variable weight approach. However, if the COICOP class used as benchmark is extremely volatile, use of less volatile higher-level aggregated groups can be preferred.

The major assumption of this approach is that all of the products are on sale throughout the year with annual fixed weights. Thus, this assumption may impose the theoretical monthly consumption pattern to deviate from the actual. Nevertheless, fixed weight approach is easy to implement and treats the price-imputed seasonal items as regular commodities of the index.

[2] Classification of Individual Consumption according to Purpose (COICOP) is a reference classification published by the United Nations Statistics Division to classify and analyze individual consumption expenditures incurred by households, non-profit institutions serving households and general government according to their purpose.

Variable Weights Approach: This method relies on a more realistic assumption that the consumption pattern of an average household changes each season. The changing consumption pattern concept is constrained by the assumption that the total expenditure on the product category remains constant throughout the year. That is, while the total weight of fresh fruits and vegetables remains constant, the weight of each specific product varies between different months of the year. More specifically, while the basket of fresh fruits and vegetables change each month the share of a household's expenditure on these products are fixed throughout the year.

The approach is free from the disadvantages of price imputation, as the index is computed with the available products in the market. A non-zero weight implies that the product is available for purchase. Unlike the fixed weights approach, where a fixed basket is achieved with imputed prices, the variable weights approach is required to implement a different treatment in index calculations to obtain month-to-month changes. Instead of imputing prices for all months where the price is unavailable, imputation of the base price only is adequate to achieve month-to-month comparisons. More specifically if unavailable, the price of each product at the base month, which is taken to be December of the preceding year, is required in this approach. The ratio of the available prices in the current month to those in the base period is used in index calculations.

There are two main drawbacks of variable weights approach. The first is the inconsistency of using changing consumption basket for strongly seasonal items and fixed average basket for the remaining. The second, perhaps more important, drawback is the month-to-month index changes reflecting not only the changes of price levels, but also the changes in the consumption basket. Besides these, determining the seasonal weights is of crucial importance in this approach. Atuk and Sevinc (2010) discuss this issue along with the comparison of fixed and variables weights methods for the Turkish fresh fruits and vegetables data.

Class-confined Weights Approach: A special case of variable weights is the class-confined weights approach. In this method for the months that the products are not available in the market zero weight is assigned as in the variable weights. The difference is in the weight composition of the periods where the product is available for purchase. For these months, the weights are kept constant within. Determining appropriate weights becomes more important and difficult in this case with the constraint of fixed weights of COICOP product groups throughout the year.

2.2.2. Annual Approaches

Year-over-year Monthly Indices: The changing consumption basket of the strongly seasonal products reduces the accuracy and the consistency of the index as mentioned above. Another method to treat these products and overcome this drawback is to look at the year-over-year comparisons of prices for each month of the year instead of concentrating on month-to-month changes. In this approach it is assumed that the basket of seasonal goods remain constant, that is, a product which is available in a specific month of the year is assumed to be available in the same month of the preceding year. For more than a century this approach is seen as the simplest way to deal with strongly seasonal items. Jevons (1884), Flux and Yule (1921) and Zarnowitz (1961) show that this method minimizes the effects of seasonal fluctuations in the CPI.

For this purpose year-over-year monthly Laspeyres, Paasche and Fisher indices are formed to measure average price change between the same months of successive years. Formulations and detailed examples of an artificial data set are presented in Chapter 22 of the CPI manual[3]. The unavailability of the revenue shares of the current-period necessitates developing approximated versions of these year-over-year monthly indices. This approximation is done by replacing the revenue shares of the current month by the shares of the base period. A comparative analysis of fixed base, approximate fixed based and chained Laspeyres, Paasche and Fisher indices are presented in the CPI manual. According to this study, the chained year-over-year Fisher indices are named to be the best estimates of year-over-year inflation using the specific artificial data set. Finkel, Rakhmilevich and Roshal (2007), however, working with real CPI data show that the results are highly dependent on the structure of the data and recommend a detailed separate empirical research for each country.

Rolling Year Indices: This approach enables a comparison of any 12 consecutive months of price and quantity data with those of the base year. The non-calendar month (i.e. any month of the 12 consecutive months) should be matched with the same months in the base year (e.g. Januaries are compared with Januaries). In rolling year chained Laspeyres index, 12 consecutive months can be selected as the base period. The rolling indices are therefore 12 month average indicators of inflation that are centered 6 months before the last data of month. Therefore these indices are more like trend indicators, which react slowly to recent movements (acceleration

[3] Consumer Price Index Manual: Theory and Practice (2004). For more information: http://www.ilo.org/public/english/bureau/stat/guides/cpi/index.htm

/deceleration) in inflation. Finally, these indices can be regarded as a simple form of seasonally-adjusted annual indices.

The year-over-year indices are theoretically successful in dealing with strongly-seasonal products in the CPI. However these indices cannot be used in monthly or quarterly comparisons of price developments and therefore are out of scope for this analysis.

3. Empirical Analysis

In this part of the study, an empirical evaluation of the alternative methodologies for the treatment of seasonal products within the framework of fresh fruits and vegetables will be executed with the use of a unique dataset.

Initially, the dataset is introduced along with a discussion of its representativeness. After that, different price indices for fresh fruits and vegetables are calculated with alternating specifications based on the earlier discussion. Then, the level of volatility of the price series are compared in relation to the categories they belong to. Later, the contributions of each factor to the overall volatility are assessed. Finally, the links of fresh fruit and vegetables prices to headline inflation are analyzed.

3.1. Data

The high volatility of fresh fruits and vegetables prices covered in the CPI makes short-term forecast of headline inflation difficult. Volatility distorts the general perception of the price changes and makes it difficult for the policy maker to judge and communicate what the real price change for a specific period is. For this reason, to forecast the volatile components of CPI, Central Bank of Turkey started (from 2001) to collect detailed fresh fruits and vegetables item prices regularly. The coverage of elementary prices in the index, namely MBTUFE, was significantly enhanced in 2006. Each week of month, approximately 1000 elementary fresh fruits and vegetables prices are collected from the market-places and supermarkets of Ankara as well as from internet sources. In 2011, the total number of elementary prices collected amounted 986, of which 263 are collected from field in Ankara (Table 2).

Table 2. Sources of MBTUFE

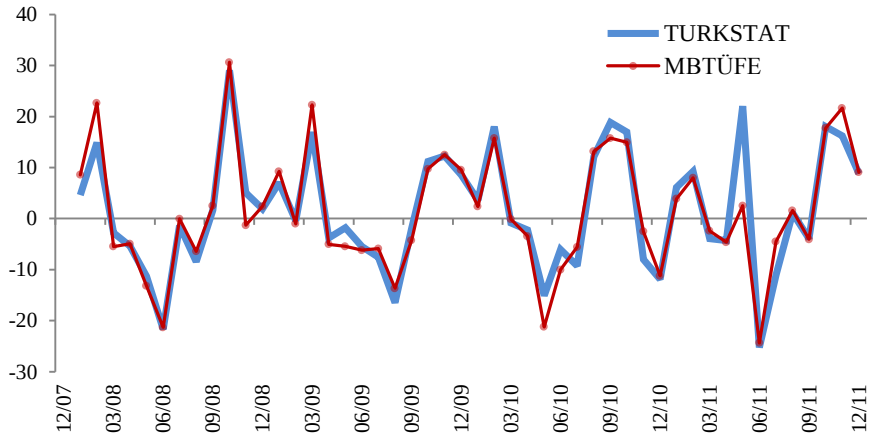
Source	Number of Items	Collection Method
National Market Chain 1 (Ankara, İstanbul, Antalya, İzmir, Bursa, Adana)	290	*Internet*
National Market Chain 2 (İstanbul)	43	*Internet*
Ankara Market Chains (4 markets)	180	*Field*
Ankara Market Hall	83	*Field*
Antalya Market Hall	99	*Internet*
İstanbul Market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

The elementary data are aggregated using CPI weights. Starting from 2012, following TURKSTAT's decision to use geometric means to derive average price of each item in the index, MBTUFE was re-calculated with the same methodology[4].

The sole purpose of the index is to mimic the movements of the prices in the CPI. For this purpose the items in the index are specifically chosen to match the price levels and movements in the official CPI.

The performance of the fresh fruits and vegetables price index with respect to that of the official CPI is given in Figure 3. As can be seen the movements of the two indices are alike.

Figure 3. Official CPI (TURKSTAT) and MBTUFE (Monthly percent change)



Source: TURKSTAT, CBRT.

[4] To compare the results of various alterations of MBTUFE developed in the study, all of the indices developed in this study use geometric means to preclude possible discrepancies stemming from data averaging methodology.

It is noted that the distribution of price changes of MBTUFE and TURKSTAT's index may differ. Nevertheless, the high representative power of MBTUFE signals that a detailed analysis using the micro prices collected may well serve as guidance to the treatment of seasonal products in the official series.

3.2. Calculating Alternative Indices

This section of the empirical analysis deals with the calculation of alternative fresh fruits and vegetables price indices. For this purpose, several issues and the choices made regarding index calculation should be addressed. First, the average prices of individual items and their respective weights in the basket are indexed by Laspeyres methodology which is extensively used by statistical institutes for this purpose. Second, the large number of prices collected for a single item for a given period (week/month) is averaged via taking the geometric mean of the available prices.

Apart from the indexation methodology and price averaging, several issues need to be dealt with including *base price selection, imputation of missing prices, type of weighting scheme, treatment of extreme observations and the* smoothing *option of the raw prices*. In what follows, each of these issues will be discussed along with the possible options to choose from.

3.2.1.Base price selection

When compiling a price index containing various items, it is necessary to scale the individual item prices in order to eliminate the distortions coming from level effects. That is, for each item a base price should be determined so that at each period the current prices are transformed into same scale, an index with a basis of 100. For instance, the price index for an item in January 2007 is calculated as the ratio of the January 2007 price to December 2006 price multiplied by 100.

Determining the base price is a one shot task if the price index is compiled using a fixed basket and fixed item weights. However, once a chained price index is considered, a new base price should be determined at the beginning of each calendar year (as of December of the previous year) to be used in that period. Hence, an approximation to the base price should be made for seasonal products which are not available in the market as of December. Several methods are offered for this problem including using the last observed price of the item; using the average price of the item in the previous year; and updating the last observed price with the monthly inflation figures at different aggregation levels.

The last observed price of a fresh fruit or vegetable item is generally lower than the price it first appears in the market. Therefore, comparing a high entry price with a low exit price will result in unnecessarily high inflation rates in the months where the seasonal products are included in the basket. With this perspective, the option of using the last observed price is disregarded. In this study the average price in the previous year and updated last price with inflation at different aggregation levels are the options considered for base price selection.[5] The updating (referring to carrying the last observed prices forward) is made as follows: If the price of a fresh fruit item is only available between May and August, then, the last observed price in August is carried forward with 4-month-cumulative inflation (September–December) at relevant aggregation levels.

The scheme of different approximations to base prices (P0) considered in this study is as follows:

P0_1	Last price updated with 5-digit level inflation
P0_2	Last price updated with 4-digit level inflation
P0_3	Last price updated with 3-digit level inflation
P0_4	Last price updated with 2-digit level inflation
P0_5	Average price in the previous year

3.2.2. Weighting Schemes

Each individual price index contributes to the aggregated price index as a proportion of its relative weight in the available consumption basket. This relative weight is calculated as the share of the entire consumer budget spent on that item over the course of the year. When calculating the consumer price index, for most of the items, the general practice is to use this relative weight fixed for each month. However, for items which are subject to seasonal availability, there is no consensus on how to determine the monthly weights. The generally proposed options are using variable, fixed or class-confined weights as discussed in Section 2.2.1. One thing to note is that since the variable weights approach assigns positive weights to seasonal products only in the months in which they are found on the market, no action is needed when the items are not available in the market. However, for other options, missing prices should be imputed.

The different weighting schemes considered in this study are as follows:

W_1	Variable weights
W_2	Fixed weights
W_3	Class confined weights

[5] Speaking of fresh fruits and vegetables, the aggregation levels are as follows: Fresh fruits/fresh vegetables inflation at 5-digit level; fruits/vegetables inflation at 4-digit level; food inflation at 3-digit level and food and non-alcoholic beverages inflation at 2-digit level.

3.2.3. Imputation of Missing Prices

As discussed above, several approaches require item level prices to be available throughout the year. Since seasonal items are available only at specific periods of the year, approximations should be made for the prices at non-available months; in other words, the "missing" prices should be imputed. Imputation of unavailable prices is done by carrying forward the last available price by relevant monthly inflation figures at different aggregation levels, as done for base price calculation.

The scheme of different approximations to price imputation considered in this study is as follows:

I_1	Prices updated with 5-digit level inflation
I_2	Prices updated with 4-digit level inflation
I_3	Prices updated with 3-digit level inflation
I_4	Prices updated with 2-digit level inflation

3.2.4. Treatment of Extreme Prices / Trimming

In each period a large number of prices for a single item are monitored. It is likely the case that some of these prices lying on the right tail of the price distribution may well be considered as extreme observations. Hence, trimming these observations might bring in gains both in terms of statistical properties and in terms of economic interpretation of the prices. From statistical perspective, trimming the extreme observations may help keeping the average price closer to the central tendency. From economics point of view, these extreme prices may easily be disregarded by the consumers so that they do not buy the items from those prices. Then, trimming such prices also makes sense regarding the fact that these extreme prices are redundant. With all these in mind, trimming the extreme observations may reduce the volatility of the inflation without distorting the economic value of the price index.

In this study, a specific way of trimming is introduced. The extreme prices are mostly observed at the months of entry, where the price of that item is collected and included in the calculation for the first time during the year. In periods other than the month of entry, distribution of prices tend to be more condensed, whereas in the month of entry that distribution is much more skewed to the right. Hence, the analysis in this study focuses on such periods by proposing trimming the right tail of the distribution. Trimming is done by removing the observations which are out of the predetermined upper bound of the price distribution for each item at their respective months of entry. In this study, four different options are considered. First one is keeping the raw prices as they are. The other options are trimming 10, 20 and 30% of the

weekly observations from the upper side of the distribution in the months of entry and keeping the raw prices in other months.

The different trimming schemes considered in this study are as follows:

T_1	No trimming / observed prices
T_2	Trimming 10% from right tail of the distribution
T_3	Trimming 20% from right tail of the distribution
T_4	Trimming 30% from right tail of the distribution

3.2.5. Smoothing the Prices / Averaging

While compiling consumer price indices, as a general practice, the prices of fresh fruits and vegetables are collected weekly, thus, the average price for a given month is in fact the average of all weeks in a month. It is also common knowledge that prices of fresh fruits and vegetables are highly sensitive to supply shocks. Temporary price hikes and cuts are frequent at rather short intervals. Hence, taking the average for periods longer than a month can be effective in reducing the impact of the temporary price movements by smoothing out the prices. Taking this concern into consideration, in the study two additional options of price averaging (two-month average; three-month average) in addition to one-month averaging are considered.

The different price smoothing / averaging schemes considered in this study are as follows:

A_1	One-month average
A_2	Two-month average
A_3	Three-month average

3.2.6. Alternative Index Calculation Chart

Once the choices are made among the available options for each issue mentioned above, it is possible to calculate alternative price indices for fresh fruits and vegetables. The baseline index, which is currently being calculated in Turkey, is the combination of first options for each category: W_1; T_1; A_1; P0_1; I_1. That is, variable weights; not trimmed one-month average prices; baseline price updated at the nearest aggregation level (5-digit); and prices when the item is not available are imputed at nearest aggregation level (5-digit).

As mentioned in Section 3.1, the data used in this study, with the baseline specification, captures the dynamics of the official fresh fruits and vegetables price index very well. Building on this, using all the available combinations of 3 weighting schemes, 5 baseline price updating strategy, 4 missing price imputation method, 4 trimming options and 3 price averaging choices, 720 different price indices are calculated.

3.3. Estimating the Impact of Seasonal Treatment Methods on Volatility

As stated earlier, in order to have a low-level of volatility -a quality that is desired-, fresh fruits and vegetables prices should be treated with care. However volatility does not have a strict definition. Estimating the impact of treatment methods on the quality that we seek for should test different dimensions of volatility, not only for allowing comparison but also for robustness of the estimation. Therefore in the following subsections, estimations of seasonal treatment methods will be based on two different measures of volatility (or implied volatility) in line with the objectives of the treatment. First is a panel measure of absolute monthly rate of change of the calculated fresh fruits and vegetables price indices and second one is the standard deviations of annual inflations of CPI which are calculated according to 720 different fresh fruit and vegetables price series. [6]

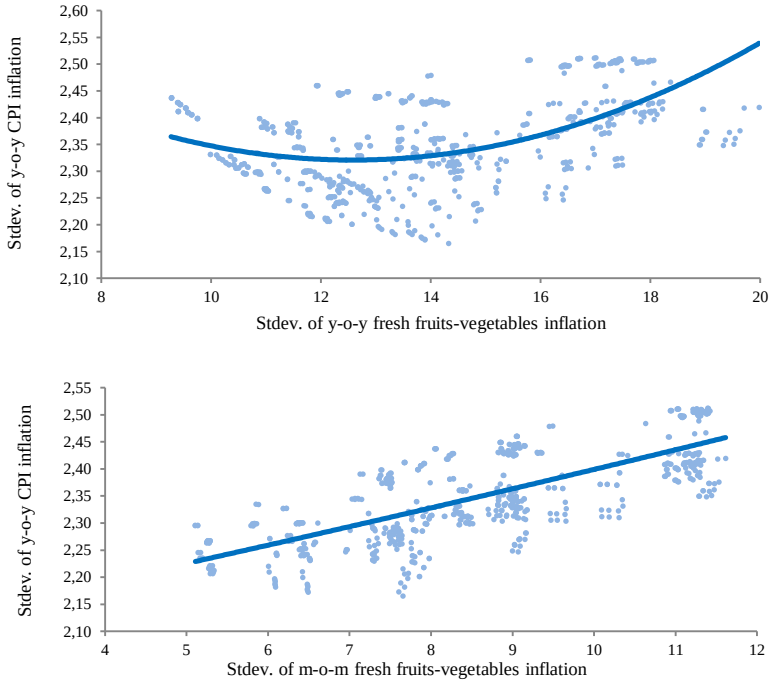
The volatility in annual headline inflation can stem from the observed irregular price movements in strongly seasonal products. Monthly jumps or falls of extreme magnitude in prices of seasonal goods are carried over to the annual inflation in seasonal product, causing a volatile inflation course. Hence, this inflation volatility is also transferred to headline inflation as well. In this sense, solving the problem backwards suggests that methodological choices that would transform the irregular and high-magnitude price changes of seasonal products into relatively smooth and of reasonable magnitude would eventually reduce the overall volatility of the headline inflation. In this perspective, the first measure of absolute monthly rate of change of the fresh fruits and vegetables prices is not a measure of volatility per se. However, as reducing the absolute size of monthly price changes would imply lower volatility of headline inflation; this is rather a measure of *implied volatility*.

In order to further motivate the use of these measures of volatility (implied volatility) Figure 4 plots the standard deviations regarding CPI and fresh fruits and vegetables inflations. The upper panel shows that standard deviations of annual CPI and fresh fruits and vegetables inflation do not exhibit a clear linear relationship. On the other hand, annual CPI and monthly sub-group inflations are positively correlated. Since our ultimate goal is to produce the sub-group indices which minimizes volatility on annual CPI inflation, comparing monthly volatilities of produced set of

[6] The correlation coefficient between sample average of absolute monthly inflation and standard deviation of monthly change computed by each series is 0.99. This, points out the fact that absolute monthly inflation for our sample is good at reflecting the overall volatility of indices in addition to its capacity to capture month-specific variations. Therefore we simply take our measure of absolute monthly inflation as *implied* volatility.

indices is more reasonable than using year-on-year changes in assessing the impact of different methods on individual indices.

Figure 4. Standard Deviations of CPI and Fresh Fruits and Vegetables



Notes: Top (bottom) panel shows the scatter plot of the standard deviations of year-on-year (month-on-month) fresh fruits and vegetables inflation with the standard deviations of the year-on-year corresponding CPI inflation. Corresponding CPI refers to the consumer price indices which are calculated by using each of the 720 alternative fresh fruits and vegetables price indices.

3.3.1. A Panel Measure: Absolute Monthly Inflation

In this section the dependent variable on which the impact of treatment is tested is defined as the absolute monthly inflation of the fresh fruits and vegetables series that are calculated according to different methodology. This *implied volatility* measure fits perfectly well to our objective of series displaying milder monthly fluctuations. This measure does not put a subjective stand on the level of inflation since inflation is considered in absolute terms. Absolute monthly inflations can be calculated for each combination every month, so that the estimation has a panel structure. As a result, the dependent variable enables to increase the number of observations while taking into account every monthly development. Explanatory variables are dummy variables associated with each method of seasonal treatment.

Table 3. 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	Update 4-Digit	-0.12	0.06	0.03
	Update 3-Digit	-0.14	0.06	0.01
	Update 2-Digit	-0.15	0.06	0.01
	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 Extreme Observations	Trim 10%	0.05	0.05	0.35
	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		

Notes: Robust standard errors are reported. Dependent variable is the absolute m-o-m inflation of fresh fruits and vegetables price indices. Index characteristics are binary explanatory variables pertaining to methodological choices. A p-value smaller than 0.05 indicates that the estimated coefficient is statistically significant at 5% significance level. The base specification is variable weights, base price selected with 5-digit level inflation, missing prices imputed with 5-digit level inflation, non-trimmed and one-month-averaged prices. (*) Constant is the sum of the constant of the regression and the average time fixed effect estimated. Coefficients of time fixed effects are not reported for the sake of simplicity. The results are also robust to inclusion of interaction terms regarding the methodological choice dummies used.

Table 3 reports the pooled OLS with time fixed effects regression result of absolute monthly inflation of the calculated price indices on various index characteristics. The constant in the regression refers to the baseline category of not trimmed one-month average prices, variable weight, and baseline prices updated at 5-digit level. Note that prices of the items that are off-season are not affected by imputation in the baseline specification since for associated prices variable weights are zero. It is possible to read the coefficients of each option within each category in comparison to the chosen baseline ones.

First thing to note is that, indices which incorporate fixed weights on average display significantly lower monthly fluctuations compared to those containing variable weights. The class confined weights also perform better compared to variable weights. On the other hand, fixed weighting cuts down monthly inflation fluctuations by 1.6 percentage points while class confined

weighting reduces the same by 0.27 percentage points on average. This is not surprising since class confined weighting stands at a midpoint between fixed and variable weighting schemes.

Second, when it comes to different base prices, indices that incorporate base prices updated at more aggregated levels are on average less volatile compared to indices incorporating base prices updated with 5-digit inflation (although at low levels of statistical significance). The levels of reduction are similar while updating base prices at 2-digit level inflation achieves the greatest impact. Updating of base prices according to the year-average price estimates a reduction level which is quite low as well as statistically insignificant. Hence, this option clearly is not a good choice in pursuit of reducing the volatility of price indices.

Third, monthly absolute inflation goes down also for price indices in which missing prices are imputed at aggregation levels different than 5-digit. Similar to the pattern observed for base price methods, the size of the impact becomes larger as imputation is made at more aggregated levels. Compared with the baseline specification of 5-digit imputation, imputing prices at 4-digit reduces absolute monthly inflation by 0.17 percentage points while the size of effect rises to 0.46 for imputation at 2-digit.

Fourth, trimming does not lead to a significant change in monthly fluctuations, though the coefficients associated with trimming indicate a positive impact on volatility. In addition to insignificance, the size is also too weak indicating that trimming in that sense does not impose a change on monthly fluctuations of fruits and vegetables series.

Finally, the most prominent index element in terms of reducing monthly volatility of the calculated indices is the averaging of prices for three months instead of one. Using a geometric average of prices over three months mitigates average monthly fluctuations by 2.21 percentage points. Averaging over two months also has a reducing effect (1.36 percentage points), which is only quite below the size of the impact estimated for fixed weights specification.

As a result, when the (implied) volatility measure is taken as absolute monthly rate of changes, the candidate set of seasonal treatment methods improve the indices according to the objective. The best treatment selected by this measure is using *fixed weights, averaging prices over 3 months and imputation and base price updated at 2-digit level*. Trimming is not found to be effective on reducing the monthly volatility of fresh fruits and vegetables index.

3.3.2. Contribution of Alternatives to CPI Volatility

The previous analysis established the determinants of the volatility of monthly changes of the fresh fruits and vegetables prices in terms of different compilation methodologies. There, it is also shown that the volatility of the monthly fresh fruits and vegetables inflation is highly correlated with the volatility of annual CPI inflation, where 720 different CPI series are calculated using alternative fresh fruits and vegetables price indices. This high correlation in fact validates the simultaneous dual objective of seeking less volatile fresh fruits and vegetables prices on one hand, and less volatile annual CPI inflation on the other.

In this part, hence, the issue is to capture how methodological choices on the treatment of fresh fruits and vegetables prices affect the overall volatility of annual consumer inflation. The extent to which the following results coincide with those of the previous analysis will strengthen the conclusions to be made. Table 4 reports the regression result of the standard deviations of the annual CPI inflation, calculated with different fresh fruits and vegetables indices, on various methodological choices employed.

The constant in the regression refers to the average volatility of the baseline categorical choices: not trimmed one-month average prices, variable weight, baseline prices updated at 5-digit level, and missing prices imputed at 5-digit level. Therefore, it is possible to read the coefficients of each option within each category in comparison to the chosen baseline index.

First thing to note is that, on average, incorporating fixed weights for the treatment of fresh fruits and vegetables prices significantly lowers the volatility by 0.08 points compared to the use of variable weights. Meanwhile, incorporating class-confined weights, on average yields slightly more volatile CPI inflation than incorporating variable weights. Thus, among three possible weighting schemes, fixed weights stand out as the first option in order to achieve less volatile headline inflation.

Table 4. 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*
Weighting Scheme	Fixed Weight	-0.08	0.004	0.00
	Class Confined Weight	0.01	0.002	0.00
Base Price Selection	Update 4-Digit	0.01	0.005	0.21
	Update 3-Digit	0.08	0.005	0.00
	Update 2-Digit	0.08	0.005	0.00
	Previous Year Average	0.01	0.006	0.63
Imputation of Missing Prices	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
Trimming Extreme Observations	Trim 10%	-0.02	0.004	0.00
	Trim 20%	-0.02	0.004	0.00
	Trim 30%	-0.02	0.004	0.00
Averaging Prices	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		

Notes: Robust standard errors are reported. Dependent variable is standard deviation of the alternative annual CPI inflations. Index characteristics are binary explanatory variables pertaining to methodological choices. A p-value smaller than 0.05 indicates that the estimated coefficient is statistically significant at 5% significance level. The base specification is variable weights, base price selected with 5-digit level inflation, missing prices imputed with 5-digit level inflation, non-trimmed and one-month-averaged prices. The results are also robust to inclusion of interaction terms regarding the methodological choice dummies used.

Second, when it comes to different base prices, indices that incorporate base prices carried forward at 2 and 3-digit level are, on average, 0.08 points more volatile than those indices incorporating base prices updated with 5-digit inflation. Whereas, carrying forward with 4-digit inflation or using average prices of the previous year as the base price provide statistically the same level of volatility as of updating with 5-digit inflation.

Third, price indices in which missing prices of fresh fruits and vegetables are imputed at more aggregated levels are on average more volatile. For instance, imputation at 2-digit level increases the volatility of headline inflation by 0.02 points in comparison to imputation at 5-digit level.

Fourth, trimming the extreme price observations at the months of first entry to the basket helps reduce the volatility of the headline consumer inflation. As seen from the results, trimming 10, 20 or 30 percent of the extreme prices in such periods, compared to not trimming, reduce the volatility by 0.02 points on average. Recalling the fact that number of price

observations considered in this study is rather limited compared to what is available to the official authority, the results suggest that there may a room for further improvement for trimming the extremely high entry prices with much larger dataset.

Finally, averaging the fresh fruits and vegetables prices over periods longer than a month significantly reduces the overall volatility of the headline inflation. For instance, averaging prices over three months brings in a reduction of 0.12 points in the volatility of CPI inflation. Given that the coefficient of averaging over three months is higher than that of averaging over two months in absolute terms indicates that longer the averaging period, lower the headline inflation's variability will be.

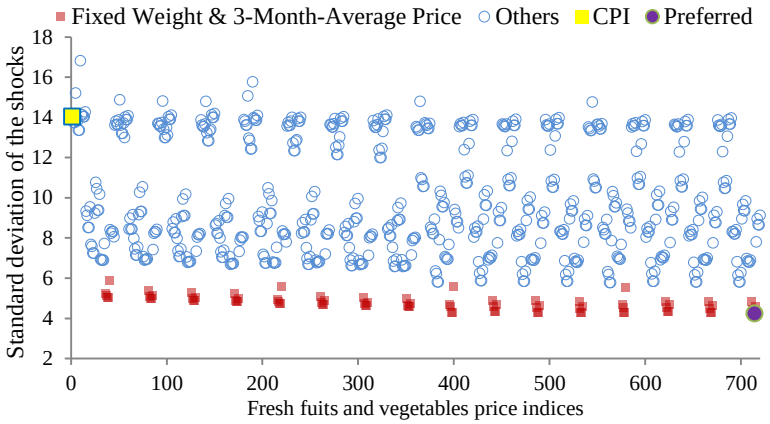
3.3.3. Optimum Combination of Alternatives / Method Selection

Previous sections described how volatility of the individual fresh fruits and vegetables price indices and CPI is affected by index characteristics. In this section, combining the findings of the two analyses, the optimum mix of alternatives is discussed.

The common results of the two analyses reveal that using fixed weights and prices averaged over longer periods decrease the monthly (implied) volatility of fresh fruits and vegetables index and the volatility of the overall annual CPI inflation significantly. Noting that these two choices are essential to achieve considerable improvement in terms of volatility, the results provide mixed evidence on the effect of other methodological choices on reducing volatility. Trimming is found to be insignificant in reducing the monthly volatility of the fresh fruits and vegetables index. This can be explained by the definition of the special trimming methodology employed, i.e. trimming in periods when the product is first introduced in the index. Since, for periods after the introduction of the product in the index it is not applied, trimming is found to be insignificant in reducing monthly volatility. On the other hand, the finding that trimming significantly reduces the volatility of the annual CPI inflation marks the importance of outlier treatment. The results put forward the usefulness of trimming, especially when working with the broader official data set. On the other hand, the use of inflation at aggregated indices which is found significant in base price selection and price updating in the panel analysis of monthly volatility is found to be insignificant on the overall year-on-year volatility of the CPI. The factors, which are influential on the monthly inflation volatility being non-significant on the year-on-year volatility of the CPI, can be attributed to the cancelling-out effect of the use of year-on-year change. That is, the impact of base year selection and the price imputation options on the monthly indices of the two consecutive years do not differ significantly.

The main lesson from this analysis is that the use of fixed weights and prices averaged over longer periods are the main contributors of reduced volatility. The other categories of base price selection, imputation of missing prices and treatment of extreme prices/trimming have minor and mixed effects on volatility. However, the fact that some of these choices help reduce volatility in certain cases justifies the need to concentrate on these choices with a larger data set as in the official index.

Figure 5. Size of Unpredictability of the Fresh Fruit and Vegetables Indices



Note: Authors' calculations. The size of unpredictibilty is measured as the standard deviation of the residuals for each price index when estimated as univariate time series models.

The results clearly show that using fixed weights and averaging prices for 3 months are the main determinants of a smoother inflation. In other words, these options are the most efficient factors for reducing the unpredictability of the fresh fruits and vegetables prices. Pursuing a simple analysis would clearly reveal this finding.[7] If the fresh fruits and vegetables price index is estimated as a univariate time series model, the standard deviation of the residuals of the model can be interpreted as the size of the unpredictable part (or the shocks) of the fresh fruits and vegetables prices. Hence, if we estimate the same univariate model for all 720 series and compare the standard deviations of the residuals, we can induce how efficient the methodological choices are for reducing the unpredicted part of the series. Figure 5 shows the size of the standard deviations of the shocks of the fresh fruits and vegetables price indices.[8] The result is that the indices incorporating fixed weights and three-month averaged prices have the

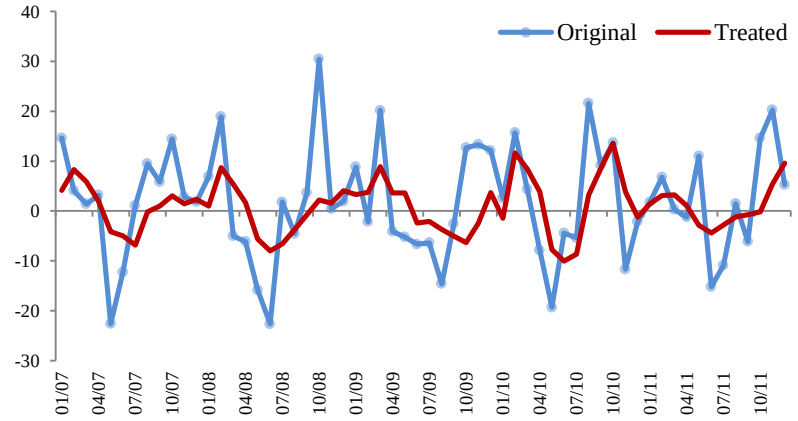
[7] We thank the anonymous referee for raising this suggestion.

[8] All the fresh fruits and vegetables prices indices are modeled as AR(2) and the standard deviation of the errors are stored. The figure shows that standard deviation for all 720 series. The superiority of fixed weights and three month averaging is robust under other univariate specifications.

lowest unpredictable part in comparison to indices calculated with other combinations of weighting scheme and price averaging. It is evident that the majority of the improvement in reducing volatility comes from fixed weights and three-month averaged prices. Once these two options are set, other methodological choices marginally contribute to reduce volatility. Hence, the choice among those depends on the nature of the available dataset.

As a result, fixed weights and averaging prices for 3 months should be included in the preferred combination of methods. Although their effects are limited, we include 30 percent trimming, 2-digit imputation of missing prices and base price updates in order to let the reader visualize the index which is subject to most intensive treatment compared to the original one. In fact, this most intensive treatment is also the one yielding the minimum unpredictable part as depicted in Figure 5, and marked as preferred. Hence, this combination can be considered as the optimum one given the data in hand. Figure 6 shows the original and the treated (with preferred combination) indices for fresh fruits and vegetables in terms of monthly inflation.

Figure 6. Original and Treated Fresh Fruits and Vegetables Price Indices (Monthly percent change)



Source: TURKSTAT, Authors' calculations.

From this picture two features introduced by new methods set are worth noting. First, monthly fluctuations of fresh fruit and vegetables prices display a more limited pattern. Second, the treated index reveals the seasonal pattern of fresh fruit and vegetables prices. Prices start at very high levels in the beginning of the year perhaps due to harsh winter conditions then gradually pace down and decrease as temperature rises. Moving seasonality is also exposed in treated such that the months of peaks and dips of monthly

inflation change every year. On these grounds the preferred method selection shows a significant improvement in filtering out seasonal irregularities. This fact is also evident from the findings of the seasonal adjustment treatment.[9] While, for the full sample considered, no identifiable seasonality is found in the original fresh fruits and vegetables price index, indices incorporating fixed weights and 3-month averaged prices are subject to identifiable seasonality.

It should be noted once again that the purpose of the empirical section of the study is to identify the methodological options that help reduce the volatility of fresh fruits and vegetable prices. As discussed above, some options have marginal effects and their validity should be tested given an objective. Thus in this section the relevant index satisfying the condition of the lowest unpredictable part is presented in comparison with the official CPI. This study takes a purely empirical stance focusing on the relevance of available options in the literature for reducing volatility. Clearly, the feasibility of each option depends on the nature of the price index and the objectives of the data collectors.

3.3.4. Big picture: Effects on Headline Inflation

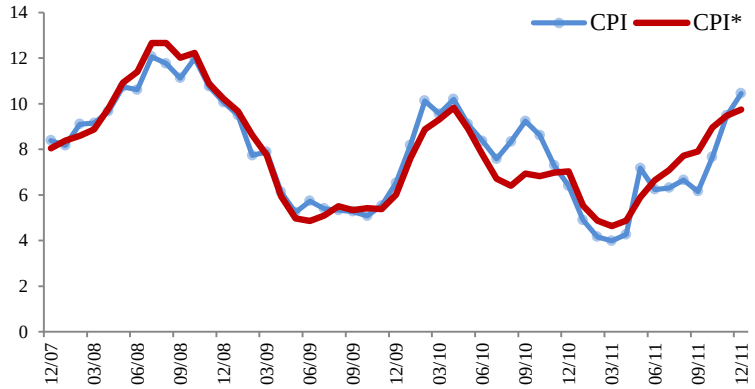
Throughout the analysis it has been emphasized that the ultimate aim of the study is to explore better methodological choices for dealing with strongly seasonal items in order to reduce the volatility, without distorting the general trend of headline inflation. As argued, the strong seasonality in fresh fruits and vegetables prices with its unpredictable nature is the main source of volatility in the CPI. Hence, it is of great relevance and importance to check whether the findings of this empirical analysis fulfill the required task.

Even though the fresh fruits and vegetables price index is the most volatile portion, it only constitutes around 5% of the CPI. With this in mind, conceptually it is expected that using fresh fruits and vegetables indices calculated with different specifications will only reduce the variability of the headline inflation, while keeping its trend almost unchanged. To check this claim, the headline (CPI) inflation is plotted with the annual inflation of the index (CPI*) in which the fresh fruit and vegetables price is calculated with the preferred specification discussed in the previous section, i.e. 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. Two year-on-year inflation series are presented in Figure 7.

[9] This seasonal adjustment analysis is run through Demetra+ package.

The very first thing to note is that the main trends of both series are quite similar. Second, as expected the CPI* follows a smoother pattern than the headline CPI. These two observations reveal that designing alternative calculation methodologies can smooth out headline inflation without distorting its main trend, hence justify the efforts spent on methodological issues.

Figure 7. Comparison of CPI and CPI* (Annual Inflation in Percentages)



Source: TURKSTAT, Authors' calculations.

Thinking on methodological issues aims not only to produce smoother inflation series, but also to search for possible welfare gains. As experienced in Turkey, annual inflation can jump in a disproportionate and economically not justifiable way at times owing to the jumps in fresh fruits and vegetables prices. For instance, in May 2011 alone, the annual inflation jumped by about 2 percentage points in this manner. A two-point jump in annual inflation at once is not an issue to be ignored at all, even though its source is known to be fresh fruits and vegetables. Before anything, such a jump might distort the expectations and the level of confidence in the economy, which may bring along significant welfare costs. The cost of this extra inflation can be quite high. Even at a micro scale, for instance, since most of the rents are adjusted in accordance with the recent annual inflation, at each period contracts are updated with an extra premium over the inflation that could have been observed with proper methodological choices.

4. Conclusion

Treatment of seasonal products becomes an issue of concern for economists when deviations of seasonally adjusted CPI disproportionately reflect the effect of seasonal variations, which mainly originate from the assumptions underlying the methodology in use. In case of Turkey, in addition to high volatility, fresh fruits and vegetables prices are capable of

contributing as much as two additional percentage points to the annual inflation in a single month. Consequently, it is economically relevant to quantify the impact of the treatment methodology for seasonal products on inflation volatility. Furthermore this issue turns into a policy concern in a country where announced monetary policy framework is inflation targeting.

It is well known that the high volatility of fresh product prices in Turkey stems from the associated market and production structure. The structural reforms require multi-dimensional micro level policies and a considerable amount of time to have an effect on minimizing price fluctuations. The relatively blur component of observed volatility is the one coming from methodological choices. This study aims to explore and quantify the extent of improvement introduced by a combination which consists of basic and widely used methods in price index literature over the current methodological choices. For this, the study draws on an extensive data set capable of representing the official CPI for fresh fruits and vegetables.

The results confirm that methodological choices are responsible for a significant fraction of the volatility in the fresh fruits and vegetables price index. The main lesson from this analysis is that the use of fixed weights and prices averaged over longer periods are the main contributors of reduced volatility. The other categories of base price selection, imputation of missing prices and treatment of extreme prices/trimming have minor and mixed effects on volatility. However, the fact that some of these choices help reduce volatility in certain cases justifies the need to concentrate on these choices with a larger data set as in the official index.

In sum, the results of the study reveal that modifying the way seasonal products are treated in CPI can significantly improve the outlook of the aggregate price indicator. This promising and yet striking result provides the motivation for exploring the room for methodological improvement in seasonal products treatment using the national statistical database, in order to test the validity of the points raised in the study.

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ACKNOWLEDGMENTS The authors thank Yoel Finkel for insights provided, the participants of the *CBRT - TURKSTAT Joint Workshop on the Treatment of Seasonal Products in CPI Calculation* for fruitful discussions, the referee of the study for valuable suggestions as well as Ayse Terkes and Duygu Halim for their assistance.