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Does Ramadan Have Any Effect on Food Prices: A Dual-Calendar Perspective on the Turkish Data

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Does Ramadan Have Any Effect on Food Prices: A Dual-Calendar Perspective on the Turkish Data

Abstract

The effects of a specific religious tradition on the food prices establish the central theme of this paper. In specific, I investigate whether the month Ramadan has any effect on food prices. I perform the analysis under two alternative calendar conventions, namely the Gregorian and Hijri calendars. Under both conventions, the paper reveals the effects of Ramadan, yet these effects are better captured when the latter is used. This highlights the importance of the calendar choice on econometric analysis, on the basis of a simple-yet-genuine socio-economic exercise. Possible benefits from this exercise in pedagogical terms as well as in inflation forecasting are also addressed.

JEL Classification: C22 and C51.

Key Words: Seasonality, Ramadan, Food prices, Calendar effects.

1. Introduction

The effects of a specific religious tradition on the food prices establish the central theme of this paper. The Muslim people fast for a month every year in Ramadan, which is the 9th month of the Hijri calendar.[1] Using food price data from Turkey, I investigate whether this has any effect on food prices under the conventions of both Gregorian and Hijri calendars. Under both, the paper reveals the effects of Ramadan (henceforth *Ramadan Effect*), yet these effects are captured better when the Hijri calendar is employed. This finding highlights the importance of the calendar choice on econometric analysis, on the basis of a simple but genuine socio-economic exercise.

Earlier literature suggests several solutions to handle real-world data with plain seasonal behavior, namely the seasonality over the Gregorian (i.e. nearly solar) calendar. These solutions cover a wide spectrum of approaches ranging from the implementation of usual time series techniques where seasonal dummy variables are used as regressors to more sophisticated approaches that include spectral tools; as in the rich practices of X11 and X12-ARIMA (see US Census Bureau, 2001; Findley et al., 1998; Ladiray and Quenneville, 1999). The framework suggested by the US Census Bureau is already capable of accounting for the mismatch between different calendars to some extent; that is, the lunar effects can be partially filtered from time

[1] The Islamic Calendar (Hijri Calendar) based purely on lunar cycles and was first introduced in 638. The reference point for the Islamic calendar was the migration of earlier Muslim society from Makkah to Medina (the two religiously highlighted towns located in the Arabian Peninsula). Islamic events are traditionally scheduled against the Hijri calendar. Within the modern-secular structure of Turkey, the Hijri Calendar possesses no legal significance at all; yet, it still guides the timing of religious events for people's personal religious practices.

series.[2] However, to my best knowledge, no specific sub-routines were developed for the case of the Islamic calendar (see Riazuddin and Khan, 2002).

Nevertheless, the literature is not poor in terms of resolutions to cases of shifting seasonality based on lunar calendar; see for instance Lin and Liu (2002) and Riazuddin and Khan (2002). The latter study places special emphasis on the Islamic calendar effects, which is nothing but the temporal structure of Muslim holly days or periods which are scheduled over the Hijri (i.e. lunar) calendar.[3]

The treatment of lunar calendar effects in this paper is different from the above-cited literature. The difference is mainly due to the selection of calendar convention of the data series. The techniques based on Gregorian-calendar do not handle lunar-calendar effects explicitly. Riazuddin and Khan (2002) account for lunar effects explicitly, yet they operate within the Gregorian calendar. In this paper, the data series of concern, itself, has been subject to a calendar-conversion; that is, the lunar representation of the *originally-Gregorian* time series is employed in the estimation stage.

Specifically, the piece of research work presented in the paper was motivated by the question of whether the month Ramadan had any effects on food prices in Turkey. Indeed, there have been some priors with regard to certain effects of Ramadan on food prices but the evidence has been mostly anecdotal. Correct measurement of such effects could not either be done.

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[2] The lunar effects can only be partially filtered owing to the fact that the lunar seasonal patterns are mixed with the solar patterns in economic time series. Hence, the mentioned techniques based on the Gregorian-calendar may distort the actual size of the lunar-calendar effects.

[3] The term "shifting seasonality" is often used to identify the lunar calendar effects. This is mainly due to simple arithmetic of different calendars. A Gregorian calendar year lasts for 365 or 366 days, whereas a Hijri year lasts for 354 or 355 days. Therefore the latter should shift back by 11 days every Gregorian year.

This paper does not analyze the motivation of the sizable price adjustments in the month Ramadan. However, we can list the possible reasons behind these price adjustments which are spread over the food industry. One trivial explanation is the *already-settled* habits in the industry; yet this is far from being informative. Specific food consumption data is unfortunately not available; yet, the anecdotal evidence suggests that people do postpone part of their food consumption, especially some traditionally-valued food items like special meat products or more expensive desserts, to Ramadan. One may also develop judgments about food consumption during Ramadan based on human psychology: while fasting during daytime the Turkish people skip the breakfast and lunch, which are of lower calories in the typical Turkish diet. The fast is broken in the dinner, which contains much higher calories. Furthermore, a pre-dawn meal is added to people's diet during Ramadan, which is rich in energy content. All in all, it is quite possible that people increasing their total calorie intake as compared to other months (hence the average quality of their food consumption basket) during Ramadan. This makes Ramadan an opportune episode for food-retailers to adjust their sale prices facing the boosted food demand.

In Section 2, I address the statistical difficulties that I have mentioned above and present my dual-calendar approach as a remedy. Section 3 concludes the paper.

2. Empirical Analysis

In this section, I present the analysis of Ramadan effect with respect to Gregorian calendar first. This exercise hardly reveals the Ramadan effect. On the other hand, when the same analysis is carried out using the Hijri calendar, a statistically significant Ramadan effect is found.

The food price (index) data was taken from the State Institute of Statistics[4] consumer prices database. The base year of the index is 1994 and the index was disseminated between January 1994 and December 2004[5], which is also the period of my econometric analysis.

In order to guess the parameters, transfer functions[6] are estimated. That is, inflation is assumed to follow an autoregressive path which is disturbed by exogenous variables. In this context, these are the Ramadan-specific variables as well as the usual monthly dummies. The Ramadan-specific variables over the Gregorian calendar are defined using the information provided in Table 1. In Table 1, the reader can see how successive months of Ramadan spread over the Gregorian calendar. For example, the Ramadan spread over the February and March of 1994 (first two lines of Table 1). It lasted for 29 days, where 17 and 12 Ramadan days were in February and March, respectively. In fact, this is exactly the point imposing some difficulties. One should either define a Ramadan-dummy variable assigning it a value of 1 for February and March 1994, or should she define an intensity measure. I followed both ways. First, I defined the dummy variable RDUM (abbreviation for Ramadan Dummy) over the Gregorian sample and assigned it a value of 1 if the corresponding Gregorian month overlaps with Ramadan. Elsewhere it is zero. Then I created another variable labeled RINT (abbreviation for Ramadan Intensity) which is defined for each Gregorian

[4] See http://www.die.gov.tr and/or http://tcmbf40.tcmb.gov.tr/cbt.html

[5] From February 2005, the former CPI was replaced with its new version with base year 2003. As the commodity coverage of the index, even within main commodity sub-groups, has changed considerably, I preferred not to extend the older food price data by incorporating information from the new index.

[6] Transfer functions demand shorter modeling-time and provide adequate as well as fast information on the effects of exogenous variables on an autoregressive system. I specifically preferred that scheme in the paper to structural type of models in order to avoid possible complications in extracting the relevant information.

month as the ratio of Ramadan days to the number of days in that month. For instance, in the first line of Table 1 the figure of 0.607 has been obtained as 17/28.[7]

The monthly dummy variables G1 (January) to G11 (November) facilitate the Gregorian months in the analysis. The variable CR (abbreviation for crisis) has been defined as a control variable and covers both 1994 and 2001 financial crises, which have probably had impact on food price inflation. CR takes the value of 1 for crisis months and it is zero elsewhere. Inflation series against the Gregorian calendar is named GINF.

The estimation of a series of transfer functions[8] over the Gregorian calendar (presented in Table 2) reveals no Ramadan effects except for the third column, where RINT has a positive coefficient estimate significant at 10%. The sixth to tenth columns are replications of the 1st to 5th columns with seasonally-adjusted data, which have been estimated for robustness purposes. They show the disappearance of the Ramadan effect and the monthly effects except for January. The disappearing Ramadan effect (captured by the variable RINT) should have been corrected through the seasonal adjustment procedure (here Census-X11). All in all, the Gregorian treatment of food price data gives some idea regarding the Ramadan effect, yet being far from quantifying it.

Next, I replicated the above analysis over the Hijri calendar. To do that, I simply re-computed inflation for the Hijri months throughout my sample span. In that, I defined inflation for Hijri months as a weighted-moving average of Gregorian inflation figures. This can be exemplified as follows: Suppose that inflation is 3% and

[7] For a more formal notation of the variable RINT, see Riazuddin and Khan (2002).

[8] The appropriate lag lengths have been chosen by employing the Final Prediction Error (FPE) Criterion.

6% for – 30-day – Gregorian months (t) and (t+1), respectively. Suppose further that a 30-day Ramadan overlaps with these months where its 10 days coincide with month (t) and 20 days coincide with month (t+1). Then inflation for Ramadan is computed as (3%)(10/30)+(6%)(20/30), namely 5%.[9] In fact, the numerical information is not lost during these operations, but the time frame is appropriately shifted (Figure 1 and Figure 2 display the one-to-one correspondence between Gregorian and Hijri inflation series).[10] Despite such congruence between original and calendar-converted series, the conversion yields fruitful results in terms of the estimated parameters, as presented below.

Having re-defined inflation over the Hijri calendar, the need to define Ramadan-specific variables naturally drops out; since Ramadan and other holly months have their fixed places within the lunar temporal convention. Consequently, the monthly dummies are defined from H1 (1st month of Hijri year, Muharram) to H11 (11th month of Hijri year, Dhul Qadah). Also the Hijri version of the crisis dummy variable CR has been generated. Inflation series against the Hijri calendar is names HINF.

When the transfer functions are estimated over the Hijri calendar the results turn out to be promising. As Table 3 suggests, the variable H9 (dummy variable for

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[9] This approach may be criticized since the existing autocorrelation of (Gregorian) inflation is manually shifted over Hijri months, which is largely true. However, the problem is not fatal since the estimation approach (e.g. transfer functions) well handles the autocorrelation issue.

[10] Riazuddin and Khan (2002) assert that detection of Islamic calendar effects would be a simpler task if the existing data were also compiled according to Islamic calendar. In fact, the lunar-calendar data compilation is not essential. For instance, the monthly percentage change in price index series yields monthly inflation figures. One can fairly assume that the prices increase daily at a constant pace within every single month and employ the calendar conversion procedure suggested here. That assumption is neither completely plausible, nor is it totally wrong. Ramadan lasts for 29 or 30 days, which is almost the same as the length of an average Gregorian month. Consequently, the time series resulting from my calendar conversion shall not be distorted considerably (as Figures 1 and 2 suggest). One can also implement similar strategy to deal with data series compiled at daily frequencies, like central banks' monetary aggregates or financial market indicators. Provided that there is a meaningful daily interpretation (representation or compilation) of a data series on Gregorian grounds, the same data set should also have a Hijri representation, with similar long-run statistical properties.

R7amadan, Hijri 9th month) is positive and statistically significant (at the 5% level) in both columns 1 and 2. The reader will also observe significant positive effects in Hijri 6th and 7th months.[11] Moreover, since the estimated coefficients of H9 solely belong to Ramadan, they can be used for forecasting. That is, one can distribute the estimated Ramadan effect over the Gregorian figures through simple backward calculations. 3rd and 4th columns of Table 3 regenerate the first two columns as robustness checks. All monthly effects (including the pure Ramadan effect – H9) vanish in the 3rd and 4th regressions, except for Muharram (Hijri 1st month) in the 4th column.

To sum up, the Ramadan effect has been captured in the Hijri calendar based estimations contrary with the Gregorian treatment of the same model(s). Next section provides a short-length elaboration of issues related to this finding.

3. Discussion and Concluding Remarks

This paper first shows the benefits drawn from using the genuine (other than Gregorian) calendar while analyzing a specific event scheduled in terms of a non-Gregorian calendar. Though this practice seems strange at first sight as it requires re-defining and computing the data, it yields more tangible numerical measurement of parameters. Second, the food price inflation in the month Ramadan has been captured in a statistically significant manner; hence, the existing anecdotal evidence has been augmented. Third, the dual calendar perspective used in the paper may give pedagogical support to professionals in teaching shifting seasonality effects within a seasonal adjustment framework. Finally, the estimated coefficients are quite applicable in inflation forecasting owing to the simplicity and reversibility of data-conversion.

[11] This is, in fact, not unexpected since Hijri 7th to 9th months are together called *triple-months* in order to identify the sacred quarter of a year in Islamic tradition.

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Table 1. Distribution of Ramadan Days and Ramadan Intensity

Gregorian Months (t)	Number of Ramadan Days In Month t	Number of Days in Month t	Ramadan Intensity Of Month t (RINT)
Feb-1994	17	28	0.607
Mar-1994	12	31	0.387
Feb-1995	28	28	1.000
Mar-1995	2	31	0.065
Jan-1996	11	31	0.355
Feb-1996	19	29	0.655
Jan-1997	22	31	0.710
Feb-1997	8	28	0.286
Dec-1997	1	31	0.032
Jan-1998	28	31	0.903
Dec-1998	12	31	0.387
Jan-1999	18	31	0.581
Dec-1999	23	31	0.742
Jan-2000	7	31	0.226
Nov-2000	4	30	0.133
Dec-2000	26	31	0.839
Nov-2001	15	30	0.500
Dec-2001	15	31	0.484
Nov-2002	25	30	0.833
Dec-2002	4	31	0.129
Oct-2003	5	31	0.161
Nov-2003	24	30	0.800
Oct-2004	17	31	0.548
Nov-2004	13	30	0.433

The data on the Gregorian months coinciding with Ramadan is summarized in this table. The Ramadan portion of each Gregorian month in the sample is given in the last column as “Ramadan Intensity” (RINT). The reader may realize that RDUM takes the value of unity for the months listed in the first column.

Table 2. Estimated Equations [Gregorian Calendar]

	Original Data					Seasonally-Adjusted Data				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Constant	0.346	0.184	0.026	-0.251	-0.438	0.061	0.074	-0.062	0.190	0.059
	[0.391]	[0.188]	[0.029]	[-0.200]	[-0.363]	[0.121]	[0.130]	[-0.126]	[0.321]	[0.116]
GINF(1)	0.456***	0.457***	0.465***	0.469***	0.476***	0.509***	0.508***	0.514***	0.503***	0.508***
	[4.132]	[4.095]	[4.053]	[3.925]	[3.875]	[4.178]	[4.141]	[4.163]	[4.104]	[4.126]
GINF(2)	0.100	0.100	0.094	0.109	0.103	0.138	0.138	0.133	0.133	0.129
	[0.883]	[0.875]	[0.824]	[0.897]	[0.847]	[1.012]	[1.008]	[0.961]	[0.970]	[0.925]
GINF(3)						0.035	0.036	0.035	0.031	0.031
						[0.353]	[0.353]	[0.347]	[0.312]	[0.307]
GINF(4)						-0.176***	-0.177***	-0.173***	-0.175***	-0.172***
						[-2.957]	[-2.947]	[-2.884]	[-2.885]	[-2.828]
GINF(5)						0.167**	0.167**	0.161**	0.165**	0.159**
						[2.470]	[2.436]	[2.286]	[2.386]	[2.240]
GINF(6)						0.107*	0.107*	0.112*	0.110*	0.114*
						[1.726]	[1.696]	[1.766]	[1.733]	[1.796]
G1 January	2.551***	2.567***	2.512***	2.560**	2.508**	1.681**	1.681**	1.646**	1.686**	1.650**
	[2.843]	[2.878]	[2.965]	[2.264]	[2.222]	[2.355]	[2.348]	[2.287]	[2.427]	[2.381]
G2 February	1.928*	1.998*	1.972*	1.987	1.973	0.540	0.534	0.553	0.549	0.566
	[1.893]	[1.918]	[1.978]	[1.629]	[1.640]	[0.600]	[0.570]	[0.618]	[0.590]	[0.639]
G3 March	2.343**	2.470**	2.644**	2.804**	3.001**	0.000	-0.010	0.116	-0.080	0.042
	[2.219]	[2.230]	[2.474]	[2.276]	[2.514]	[0.000]	[-0.009]	[0.103]	[-0.069]	[0.037]
G4 April	3.485	3.640	3.789	3.630*	3.805*	1.106	1.093	1.226	1.022	1.150
	[1.451]	[1.483]	[1.564]	[1.665]	[1.762]	[1.088]	[1.019]	[1.185]	[0.947]	[1.106]
G5 May	-2.700***	-2.547**	-2.404**	-2.243**	-2.073*	0.858	0.846	0.965	0.772	0.887
	[-3.138]	[-2.655]	[-2.678]	[-2.086]	[-2.033]	[1.200]	[1.090]	[1.338]	[0.979]	[1.211]
G6 June	-3.783***	-3.621***	-3.430***	-3.263**	-3.044**	0.624	0.611	0.747	0.541	0.671
	[-4.039]	[-3.447]	[-3.472]	[-2.685]	[-2.625]	[0.930]	[0.812]	[1.082]	[0.710]	[0.964]
G7 July	0.663	0.829	1.011	1.275	1.487	1.127	1.115	1.242	1.044	1.166
	[0.598]	[0.692]	[0.881]	[0.880]	[1.052]	[1.571]	[1.428]	[1.718]	[1.324]	[1.602]
G8 August	1.284	1.445	1.589	1.896	2.069	0.036	0.024	0.138	-0.045	0.064
	[1.001]	[1.077]	[1.237]	[1.197]	[1.340]	[0.046]	[0.028]	[0.175]	[-0.052]	[0.080]
G9 September	3.609***	3.768***	3.917***	4.185***	4.362***	0.720	0.706	0.856	0.638	0.783
	[3.201]	[3.148]	[3.441]	[2.962]	[3.185]	[0.894]	[0.794]	[1.025]	[0.711]	[0.931]
G10 October	4.509***	4.612***	4.713***	4.990***	5.110***	0.574	0.566	0.647	0.488	0.565
	[4.392]	[4.267]	[4.523]	[3.956]	[4.133]	[0.816]	[0.780]	[0.926]	[0.662]	[0.801]
G11 November	2.049***	2.072***	2.014**	2.077**	2.023**	0.531	0.529	0.513	0.524	0.507
	[2.796]	[2.808]	[2.730]	[2.277]	[2.144]	[0.954]	[0.937]	[0.910]	[0.889]	[0.871]
RDUM		0.284		0.235			-0.024		-0.013	
		[0.466]		[0.330]			[-0.044]		[-0.025]	
RINT			1.314*		1.312			0.522		0.525
			[1.694]		[1.164]			[0.742]		[0.777]
CR				3.638	3.646				-0.835	-0.838
				[0.837]	[0.839]				[-1.013]	[-1.028]
R^2	0.562	0.563	0.565	0.586	0.589	0.467	0.467	0.469	0.470	0.471
$\overline{R}^2$	0.513	0.509	0.512	0.531	0.534	0.383	0.377	0.378	0.374	0.376
Sample	1994:04-2004:12	1994:04-2004:12	1994:04-2004:12	1994:04-2004:12	1994:04-2004:12	1994:08-2004:12	1994:08-2004:12	1994:08-2004:12	1994:08-2004:12	1994:08-2004:12
Sample Size	129	129	129	129	129	125	125	125	125	125

12th month of the Gregorian Calendar (December) is excluded to avoid the dummy-variable trap. (*), (**) and (***) denote significance at 10%, 5% and 1% level, respectively. Optimal lag orders were determined using the Final Prediction Error (FPE) Criterion.

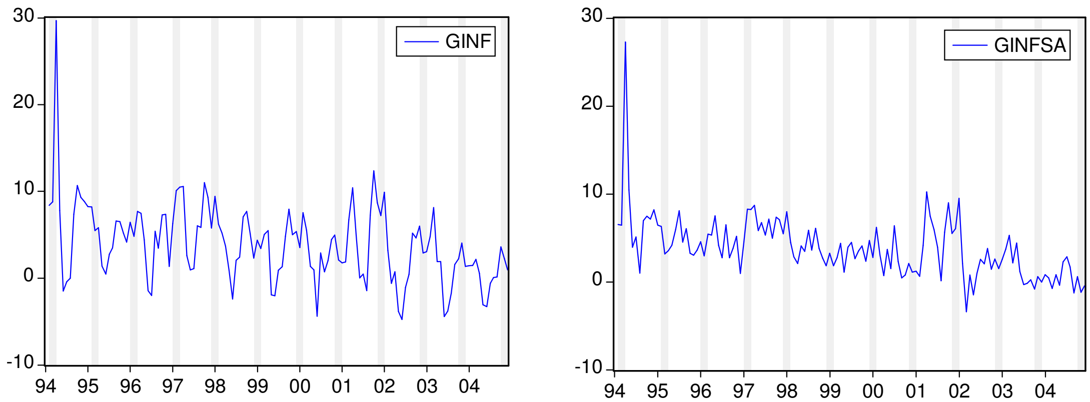
Table 3. Estimated Equations [Hijri Calendar]

	Original Data		Seasonally-Adjusted Data	
	1	2	3	4
Constant	-0.033 [-0.035]	-0.077 [-0.088]	0.042 [0.046]	-0.206 [-0.248]
HINF(1)	0.830*** [7.926]	0.831*** [7.870]	0.678*** [4.762]	0.683*** [5.119]
HINF(2)	-0.115 [-0.793]	-0.115 [-0.786]		
HINF(3)	-0.080 [-0.565]	-0.079 [-0.556]		
HINF(4)	-0.077 [-0.775]	-0.079 [-0.797]		
HINF(5)	0.094 [1.065]	0.096 [1.059]		
HINF(6)	0.274*** [3.283]	0.274*** [3.215]		
HINF(7)	-0.167** [-2.279]	-0.167** [-2.254]		
H1 **Muharram**	-0.644 [-0.522]	-0.618 [-0.511]	2.016 [1.648]	2.248* [1.895]
H2 **Safar**	-1.248 [-1.175]	-1.223 [-1.181]	1.175 [0.937]	1.402 [1.150]
H3 **Rabi-ul-Awwal**	-0.564 [-0.489]	-0.532 [-0.476]	0.822 [0.716]	1.050 [0.946]
H4 **Rabi-ul-Akhir**	0.901 [0.710]	0.932 [0.755]	1.419 [1.147]	1.649 [1.372]
H5 **Jumaada-ul-Awwal**	0.325 [0.314]	0.360 [0.363]	0.536 [0.449]	0.765 [0.662]
H6 **Jumaada-ul-Akhir**	2.306** [2.166]	2.341** [2.300]	1.154 [1.065]	1.386 [1.334]
H7 **Rajab**	2.132** [2.123]	2.164** [2.258]	0.961 [0.841]	1.192 [1.083]
H8 **Shaaban**	1.531 [1.595]	1.545 [1.663]	0.834 [0.790]	0.841 [0.848]
H9 **Ramadan**	2.578** [2.489]	2.587** [2.518]	1.432 [1.300]	1.440 [1.293]
H10 **Shawwal**	0.952 [0.888]	0.961 [0.906]	1.330 [1.001]	1.147 [0.968]
H11 **Dhul Qadah**	1.584 [1.647]	1.589 [1.676]	1.706 [1.216]	1.483 [1.198]
CR		0.208 [0.177]		2.471 [1.496]
R^2	0.720	0.720	0.469	0.501
$\overline{R}^2$	0.673	0.670	0.416	0.447
Sample	1415:04 1425:10	1415:04 1425:10	1414:10 1425:10	1414:10 1425:10
Sample Size	127	127	133	133

12^{th} month of the Hijri Calendar (Dhul Hijjah) is excluded to avoid the dummy-variable trap. (*), (**) and (***) denote significance at 10%, 5% and 1% level, respectively. Optimal lag orders were determined using the Final Prediction Error (FPE) Criterion.

Figure 1. Evolution of Inflation (Gregorian Calendar)

a. Original Data **b. Seasonally-Adjusted Data**

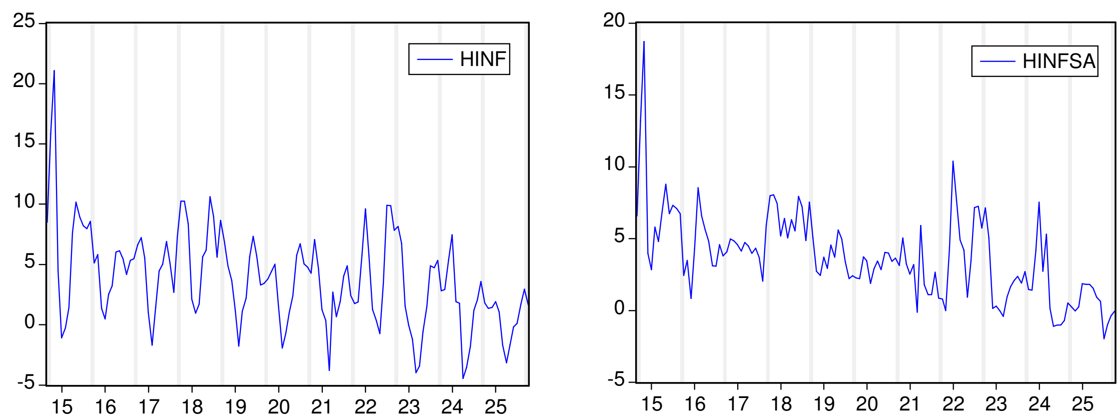


This figure displays Turkish food price inflation against the Gregorian Calendar months of the sample. The shaded regions correspond to Ramadan; however, since the Gregorian and Hijri months overlap in a partial manner, two successive Gregorian months have been shaded to indicate Ramadan.

* * *

Figure 2. Evolution of Inflation (Hijri Calendar)

a. Original Data **b. Seasonally-Adjusted Data**



This figure displays Turkish food price inflation against the Hijri Calendar months. Opposite to the case in Figure 1, the shaded regions correspond exactly to Ramadan each year.