Deseasonalizing Macroeconomic Data: A Caveat to Applied Researchers in Turkey

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Abstract

This paper analyzes the effects of regular seasonal fluctuations of macroeconomic variables in Turkey due to the religious events according to the Hegirian calendar in monthly frequency. Conventional deterministic deseasonalization techniques are applied to the detrended and linearized major macroeconomic series. Investigation of the seasonally filtered series reveals residual seasonal regularities vis-à-vis the Islamic religious events for some of the series. Consequences of ignoring this type of seasonality are also scrutinized.

Keywords: Deterministic seasonality, Holiday effects, Hegirian calendar, Dummy Variables

JEL Classification: C22, E32

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1. Introduction

Many economic time series exhibit regular seasonal fluctuations. Weather is one reason for such fluctuations in sectors such as tourism, agriculture, and construction. The existence of a fiscal year also causes regular seasonal variation in such variables as government expenditures, car and real estate purchases[1] and the interest rates. The New Year, Mothers' Day, Fathers' Day and the school calendar also have pronounced influence on the retail trade. All these factors, which cause seasonality in economic time series, have fixed dates according to the Gregorian calendar and their effects on these series can be identified without any difficulty using conventional deseasonalization techniques.

While doing time series econometric analyses, identifying and eliminating regular seasonal fluctuations from each variable entering the estimation would increase the precision of the coefficient estimates. This is due to two reasons, first, seasonal regularities impose additional variation on variables used in the estimations and second, such fluctuations, in general, are not identical across the dependent and the independent variables.

The method that should be used to eliminate these seasonal fluctuations and the consequences of using different deseasonalization methods on the time series properties of a variable have been studied extensively in the literature (See for example, Lovell (1963), Jorgenson (1964), Grether and Nerlove (1970), Gersovitz and MacKinnon (1978), Barsky and Miron (1989), Jaeger and Kunst (1990), and a more recent survey by Hylleberg (1992a)). The purpose of this study is to address the deterministic seasonality issue due to religious holidays in a predominantly Muslim country, Turkey[2]. Conventional methods of deseasonalization that are suitable for the Gregorian calendar will not detect seasonality of the religious events that have fixed dates

[1] Transaction fees are determined once a year, and are put into effect at the beginning of each year. In a high inflation environment, this discrete increase in fees is substantial and causes an increase in purchases of cars and real estate towards the end of the year and a decrease of sales, once the increase in fees actually takes place.

[2] Turkey has been following the Gregorian calendar according to law #698 passed in December 26, 1925.

according to the Lunar or the Hegirian calendar[3], since these events move approximately 11 days earlier every Gregorian year

Three significant Islamic events take place according to the Hegirian calendar system: The holy month of Ramadan[4], the Feast of Ramadan, and the Feast of Sacrifice. The feast of Ramadan, also referred to as Eid ul-Fitr, lasts for 3.5 days following the end of the month of Ramadan and the feast of Sacrifice, also referred to as Eid ul-Adha, lasts for 4.5 days [5]. Frequently, when the feast of Ramadan or Sacrifice happens in the middle of the week, the Turkish government decrees the remaining days of the week as a holiday and all civil servants enjoy a 9-day holiday. These religious events will clearly affect retail trade, production, and financial markets. For example, when people refuse to use credit cards for transactions for the Feast of Sacrifice due to religious reasons, liquidity demand increases. Similarly, stock market transactions may also be affected. On the one hand, the probability of a crisis during the holiday may deter risk averse investors from holding stocks for the duration, while on the other hand, since transactions clear two days later, the return for purchasing stocks in the last two days before the holidays is high[6].

There are basically two questions that will be addressed in the paper. What may be evident in the weekly data may average out in the monthly frequency[7]. Hence, first, whether these aforementioned holidays cause regular, seasonal, deterministic fluctuations in the main macroeconomic indicators in Turkey is probed for. The monthly data set is first linearized, seasonally adjusted and detrended using conventional methods. After using the Box-Jenkins (1976) approach for identifying the series, dummy variables for each of the holidays are used to detect the existence of any

[3] The Islamic lunar calendar is called the Hegirian, dating from the migration of the prophet Mohammed to Medina in 622. It is based on cycles of the moon around the earth while the Gregorian calendar is based on the cycles of the earth around the sun.

[4] Ramadan is a month of ritual fasting during which believers do not partake of food, drink or pleasures of the senses between daybreak and sunset. Ramadan occurs during the ninth month of the Hegirian calendar.

[5] The official durations of the holidays are decreed by law number 2429, article 1B. With respect to the duration, the feasts of Ramadan and Sacrifice are referred to as the lesser and the greater feasts, respectively.

[6] For the day of the week effects at the İstanbul Stock Exchange, see Metin et al (1997) and Bildik (1998).

[7] Preliminary analyses, using weekly data, reveal that the effects of these religious events are significant. However, with quarterly data this effect is not evident.

regular seasonal, deterministic patterns. The second question that the paper addresses regards the consequences, if any, of ignoring this type of deterministic seasonality.

Section 2 gives a brief description of the methodology. Section 3 presents the data and the estimation results. Section 4 concludes.

2. Methodology

Traditional univariate methods of analyzing economic time series are mainly concerned with decomposing the variation in a particular series into trend, seasonal, cyclical and irregular components. The decomposition method for a series is not unique and certain systematic assumptions about the nature of and the interaction among the trend, seasonal, cyclical and irregular components are needed to identify the series. For example, the seasonal component may be deterministic/stochastic or multiplicative/additive in nature. Since there are no guidelines from the microeconomic theory about the functional forms of the aggregate series, we follow the standard practice of the real business cycle literature and assume separable trend and seasonality once the series is linearized. We start out by taking the natural logarithm of the series and then detrend and deseasonalize the series in succession for further analysis. Our ultimate aim is to analyze the cyclical and irregular components of the series for the existence of any residual deterministic seasonality. The claim is that standard methods of deseasonalization are unable to remove certain deterministic seasonality that evolves through time across the Hegirian calendar.

Let Y_t be a series of interest. We wish to remove the trend and then the deterministic seasonal component of the series.[8] We employ the spline function proposed by Hodrick and Prescott (1997) that extracts the long-run component of the $\ln Y_t$ series, τ_t, leaving $\ln Y_t$ stationary up to the fourth order. The trend component is chosen to minimize the following quadratic expression:

[8] Stochastic seasonality is not the focal point of this paper. For stochastic seasonality, see for example, Barsky and Miron (1989) and Hylleberg et al. (1990)

$$\sum_{t=1}^{T}(\ln Y_t - \tau_t)^2 + 14{,}400\sum_{t=2}^{T}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

and the detrended variable is equal to the difference between $\ln Y_t$ and τ_t. The filter proposed by Hodrick and Prescott allows the trend component to change slowly across time.[9] The multiplicative and the additive versions of the Census X-11 method is the standard method employed by the U.S. Bureau of Census to seasonally adjust the released data. [10] The linearized and detrended variable is adjusted by the additive Census X-11 method.

Let ysa_t denote the detrended and "conventionally" deseasonalized (or seasonally adjusted) series produced by the procedures described above. In order to analyze any remaining deterministic seasonal variation, that is, the regular seasonal peaks and troughs, in ysa_t (which we assume still exists due to the "implicit" existence of the Hegirian calendar effects), we estimate the equation

$$ysa_t = \sum_{s=1}^{3}\delta_s d_t^s + \eta_t$$

where η_t is the stochastic component, d_t^s is a monthly seasonal dummy variable that takes the value 1 if one of the three religious events takes place that particular month, zero otherwise. The stochastic component, η_t, by construction has zero mean or trend and is a stationary autoregressive process of *a priori* unknown order. We first identify the order of the autoregressive process and choose the order such that the error terms are white noise. We then estimate the autoregressive process including the religious intercept dummy variables and check for the significance of the dummy variables. Significant coefficient(s) of the dummy variables is an indication of "leftover" or "residual" deterministic seasonality.

[9] The Hodrick Prescott filter has been subject to criticisms, see for example, King and Rebelo (1993), and Cogley and Nason (1995). However, previous research on the Turkish data by Alper (1998) reveals insignificant differences in results when an alternative filter is considered.
[10] See Hylleberg (1992b).

We next analyze the consequences of ignoring this "residual" seasonality. As mentioned previously, improperly identifying and eliminating regular seasonal fluctuations from variables used in time series analyses reduce the precision of the coefficient estimates since seasonal regularities impose additional variation on variables used in the estimations. For a number of macroeconomic monthly time series, we calculate the autocorrelation functions and check whether or not persistence increases since there exists less noise in the data once the deterministic "Hegirian Seasonality" is eliminated. We also check to see whether the volatility of each series reduces once the leftover seasonality is removed. Finally, we calculate monthly cross-correlations and look for any emerging patterns after the residual deterministic seasonality is eliminated.

3. Data and Empirical Results

The monthly data set consists of 23 variables and is obtained from the web site of the Central Bank of Turkey (www.tcmb.gov.tr). Table 1 gives the definitions and the ranges of each series used in the analysis.

As explained in the methodology, we first take the natural logarithm of these variables, then obtain the trend-free series using the Hodrick-Prescott filter and finally deseasonalize the series using the additive Census X-11 method. The resulting series must be the irregular component with no trend and no regular seasonal fluctuations. Next, we identify the order of the autoregressive process for each of the 23 trend-free, deseasonalized and linearized series. The order of the series is chosen based on two criteria: first the residuals from the estimation must be serially uncorrelated, and second, the principle of parsimony. After the autoregressive order of each series is identified, Islamic dummy variables are appended to the estimation; and based on Schwarz criterion (1978) and Wald tests of coefficient restrictions, the significance of these in the regression are tested.

Four dummy variables are created to represent the three religious events[11]. The first dummy variable is for the feast of Ramadan and takes on the value 1 if a month contains at least two days of it, zero otherwise. Similarly, the second dummy variable is

created to represent the feast of Sacrifice and takes on the value 1 if a month has at least 2.5 days of the feast, zero otherwise. The third dummy variable is for the 9-day holiday, and it takes on the value 1 if the government has decreed a 9-day holiday for the feast and zero otherwise. The fourth dummy variable is for the Holy month of Ramadan and takes on the value 1 if a month contains at least 5 business days of it, zero otherwise. Thus, while the first three dummy variables cannot take on the value 1 for two consecutive "Gregorian" months, this is not necessarily true for the Ramadan dummy. Table 2 presents the values of the four dummy variables.

Table 3 reports the results of the autoregressive estimations that have the dummy variables appended to them. Of the 23 variables examined, 9 variables contain significant effects of at least one of the three religious events. For variables like the industrial production index and its subgroups, the intercept dummies are significantly negative due to the loss of business days. We also observe that while the central bank money does not change significantly for the months having the two feasts, the reserve money increases significantly, implying that the open market operations by the central bank provide liquidity to the market during the holidays. These operations are carried out in response to an increase in the liquidity demand prior to the holidays. We also note that government expenditures increase significantly during the month of Ramadan.

Figure 1 reports the plots of the detrended, deseasonalized industrial production index before and after the removal of deterministic residual seasonality. [12]

After verifying the existence of residual deterministic seasonality due to the existence of the implicit Hegirian calendar, we next turn to consequences of ignoring these effects. For this purpose, we obtain cross-correlations and auto-correlation tables of the detrended and deseasonalized variables with and without the residual seasonality. Table 4 reports the autocorrelations up to six lags for measures of aggregate economic activity such as the Industrial Production Index, its 3 sub-categories and imports. The upper half of the rows report results pertaining to the linearized, detrended, and deseasonalized data containing "residual" seasonality, the lower half of the rows report

[11] The exact dates of these events for the post 1987 period are obtained from the Directorate of Religious Affairs of Turkey.

autocorrelations after the "residual" seasonality is removed. Conforming to the *a priori* expectations, the auto-correlation coefficients, giving information about the persistence[13] of the data, rise once the residual seasonality is removed[14].

Next, as is standard in the business cycle literature, cross correlations of some of the series[15] with the Industrial Production Index and their volatilities are analyzed. The results are reported in Table 5. Again, conforming to the *a priori* expectations, the volatility of most of the series[16] is reduced once the noise from the "residual seasonality" is removed. Correlation coefficients that are greater than 0.20 in absolute value are boldfaced to imply statistical significance. When the cross correlation coefficients prior to the removal of the deterministic residual seasonality are compared to those obtained after the removal, no clear trends emerge. When the variables that have significant coefficients in the upper part of the table are analyzed, [17] only the monetary variables show mixed sign changes in the lower part of the table. On the other hand, cross correlation coefficients for the CPI, over-night interest rates and the TL/USD exchange rate show consistent decreases in all significant lags whereas for credits and the USD-based İstanbul Stock Exchange Index, the opposite effect is observed. The correlation coefficients for İstanbul Stock Exchange trade volume increase on the average by 33%. This final point becomes very significant when we consider the fact that the correlation coefficients for the İstanbul Stock Exchange trade volume are insignificant in the upper part of the table.

4. Conclusion

Proper decomposition of a macroeconomic time series into a trend, seasonal, cyclical and irregular components is essential for an econometrician to make inferences about

[12] It is clear from Figure 1 that some of the spikes (troughs and peaks) in the data disappear (e.g. 1987, 1990, 1991, 1997) once the religious events are controlled for.
[13] Informally, persistence may be defined as the long-run level effect of a 1 per cent shock on a macroeconomic time series.
[14] This increase is as large as 52% in the coefficient of the first autoregressive term in the Industrial Production Index. The average increase is 16.2%.
[15] It should be noted that the series also include variables with no deterministic residual seasonality.
[16] The volatility of all series except FXDEP (foreign exchange denominated deposits) and the CBM (central bank money), decreases significantly. Volatility increases for these series are are statistically insignificant.
[17] These are the central bank money, reserve money, CPI, credits, stock exchange trade volume, stock exchange index (USD-based), overnight interest rate and USD/TRL exchange rate.

the unknown population parameters that are of interest to economic theory. The aim of this study is to show that for Turkey, conventional deseasonalization procedures, such as X-11, may fail to remove all deterministic seasonality when certain significant events, such as religious holidays, follow a different calendar. Turkey, a predominantly Muslim country, has been following the Gregorian calendar, based on the cycles of the earth around the sun, since 1926. However, significant Islamic events follow the Hegirian calendar, based on the lunar cycles. The impact of these events on economic variables may escape the detection of conventional deseasonalization methods that search for regular monthly peaks and troughs in the series.

We analyze 23 monthly macroeconomic time series for Turkey, by first linearizing the series and then obtaining the trend-free, deterministic seasonal-free variables using conventional series. After identifying the autoregressive order of each series, dummy variables signifying the religious events according to the Hegirian calendar is appended to the estimation. Of the 23 variables examined, 9 variables contain significant effects of at least one of the three religious events. These 9 variables include measures of aggregate economic activity such as the industrial and the manufacturing production indexes.

Upon finding residual deterministic seasonality, a search has been made for the consequences of ignoring such seasonality. Estimation results indicate decreases in the volatility and increases in the persistence of the series once the residual seasonality is properly removed. No significant patterns emerge for the cross correlations of these variables with the aggregate economic activity when deterministic residual seasonality is ignored.

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Figure 1 - Industrial Production Index
Before and After the Removal of Residual Seasonality

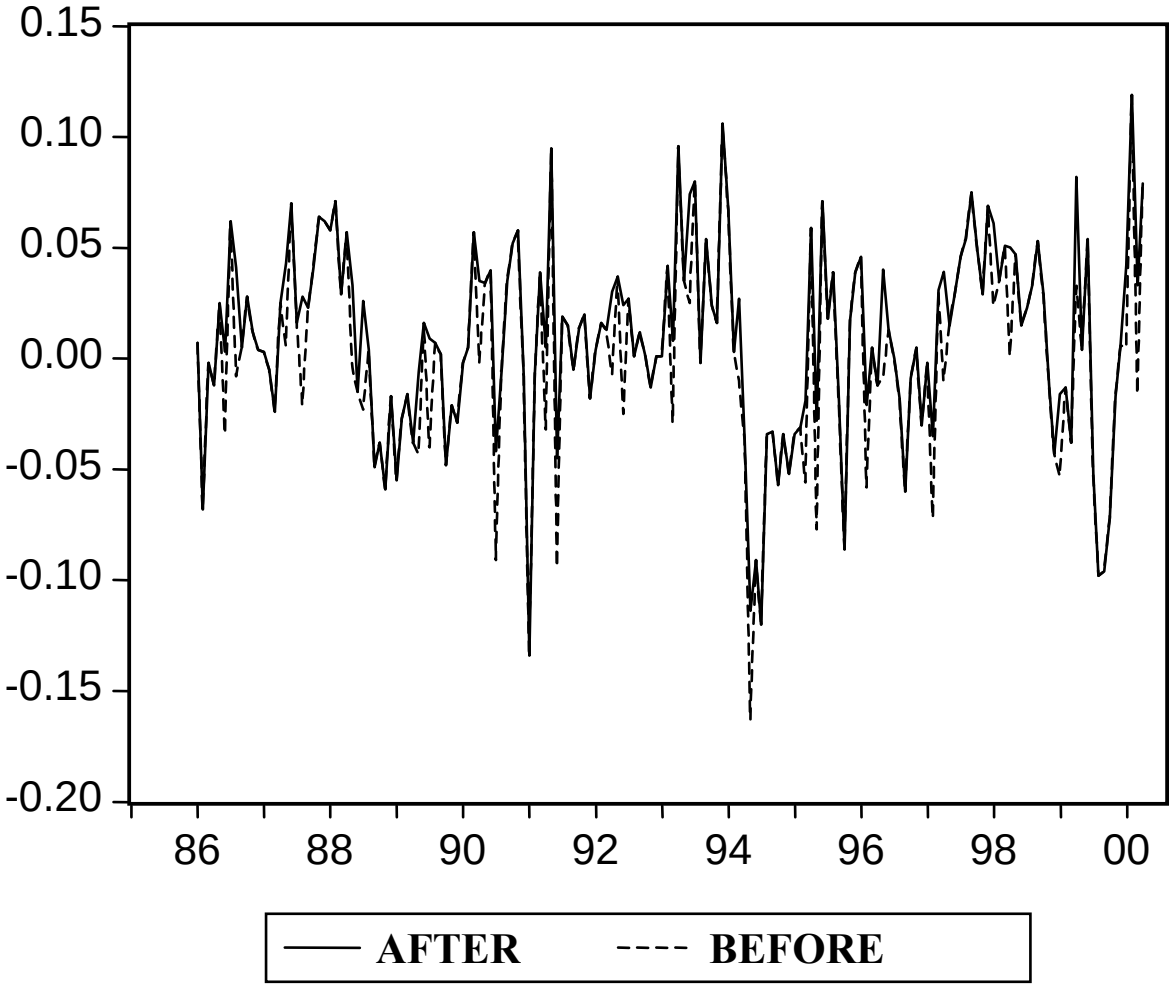

TABLE 1 - Descriptions and Ranges of Variables

Acronym	Description	Starting Date	Ending Date	Number of Observations
IPROD	SIS Industrial Production Index (1992=100)	Jan 1986	April 2000	172
IPIMQ	Mining and Quarrying (subgroup of IPROD)	Jan 1986	April 2000	172
MPROD	Manufacturing Industries (subgroup of IPROD)	Jan 1986	April 2000	172
IPEGW	Electricity Gas and Water (subgroup of IPROD)	Jan 1986	April 2000	172
IMPOR	Imports (in million USD)	Jan 1985	May 2000	185
GOVRE	Government Revenues (in million TRL)	Jan 1985	June 2000	186
GOVEX	Government Expenditures (in million TRL)	Jan 1985	June 2000	186
NDOMB	Net Domestic Borrowing (in million TRL)	Jan 1985	June 2000	186
M1	M1 (in billion TRL)	Jan 1986	April 2000	172
FXDEP	Foreign Exchange Denominated Deposit Accounts (in billion TRL)	Jan 1986	April 2000	172
CBM	Central Bank Money (in million TRL)	Sep 1989	Aug 2000	132
RM	Reserve Money (in million TRL)	Sep 1989	Aug 2000	132
WPI	SIS Whole Sale Price Index (1987=100)	Jan 1985	June 2000	186
CPI	SIS Consumer Price Index (1987=100)	Jan 1987	June 2000	162
WPIINF	WPI Inflation (year-on-year)	Jan 1986	June 2000	174
CPIINF	CPI Inflation (year-on-year)	Jan 1988	June 2000	150
CREDIT	Credits given by Deposit Banks (in billion TRL)	Jan 1986	April 2000	172
ISETL	Istanbul Stock Exchange National 100 Index (Monthly Average, TRL Based)	Jan 1986	Aug 2000	176
ISEVOL	Istanbul Stock Exchange Trade Volume (Monthly Average)	Nov 1986	Aug 2000	166
ISEUSD	Istanbul Stock Exchange National 100 Index (Monthly Average, USD Based)	Jan 1986	Aug 2000	176
ISEFIN	Istanbul Stock Exchange Financial Index (Monthly Average, USD Based)	Jan 1991	Aug 2000	116
ISEIND	Istanbul Stock Exchange Industrial Index (Monthly Average, USD Based)	Jan 1991	Aug 2000	116
ONINTR	Weighted Average of Overnight Simple Interest Rate in Interbank Market	Jan 1990	Aug 2000	128
USDTL	Exchange Rate of USD (Central Bank Buying Rate)	Jan 1985	Aug 2000	188

Table 2 – The Values of the Religious Dummy Variables

Month	Feast of Ramadan	Feast of Sacrifice	Nine Days	Ramadan	Month	Feast of Ramadan	Feast of Sacrifice	Nine Days	Ramadan
Jan-85	0	0	0	0	Dec-88	0	0	0	0
Feb-85	0	0	0	0	Jan-89	0	0	0	0
Mar-85	0	0	0	0	Feb-89	0	0	0	0
Apr-85	0	0	0	0	Mar-89	0	0	0	0
May-85	0	0	0	1	Apr-89	0	0	0	1
Jun-85	1	0	0	1	May-89	1	0	0	1
Jul-85	0	0	0	0	Jun-89	0	0	0	0
Aug-85	0	1	1	0	Jul-89	0	1	0	0
Sep-85	0	0	0	0	Aug-89	0	0	0	0
Oct-85	0	0	0	0	Sep-89	0	0	0	0
Nov-85	0	0	0	0	Oct-89	0	0	0	0
Dec-85	0	0	0	0	Nov-89	0	0	0	0
Jan-86	0	0	0	0	Dec-89	0	0	0	0
Feb-86	0	0	0	0	Jan-90	0	0	0	0
Mar-86	0	0	0	0	Feb-90	0	0	0	0
Apr-86	0	0	0	0	Mar-90	0	0	0	0
May-86	0	0	0	1	Apr-90	1	0	0	1
Jun-86	1	0	0	1	May-90	0	0	0	0
Jul-86	0	0	0	0	Jun-90	0	0	0	0
Aug-86	0	1	0	0	Jul-90	0	1	1	0
Sep-86	0	0	0	0	Aug-90	0	0	0	0
Oct-86	0	0	0	0	Sep-90	0	0	0	0
Nov-86	0	0	0	0	Oct-90	0	0	0	0
Dec-86	0	0	0	0	Nov-90	0	0	0	0
Jan-87	0	0	0	0	Dec-90	0	0	0	0
Feb-87	0	0	0	0	Jan-91	0	0	0	0
Mar-87	0	0	0	0	Feb-91	0	0	0	0
Apr-87	0	0	0	0	Mar-91	0	0	0	1
May-87	1	0	0	1	Apr-91	1	0	1	1
Jun-87	0	0	0	0	May-91	0	0	0	0
Jul-87	0	0	0	0	Jun-91	0	1	0	0
Aug-87	0	1	1	0	Jul-91	0	0	0	0
Sep-87	0	0	0	0	Aug-91	0	0	0	0
Oct-87	0	0	0	0	Sep-91	0	0	0	0
Nov-87	0	0	0	0	Oct-91	0	0	0	0
Dec-87	0	0	0	0	Nov-91	0	0	0	0
Jan-88	0	0	0	0	Dec-91	0	0	0	0
Feb-88	0	0	0	0	Jan-92	0	0	0	0
Mar-88	0	0	0	0	Feb-92	0	0	0	0
Apr-88	0	0	0	1	Mar-92	0	0	0	1
May-88	1	0	1	1	Apr-92	1	0	0	1
Jun-88	0	0	0	0	May-92	0	0	0	0
Jul-88	0	1	0	0	Jun-92	0	1	0	0
Aug-88	0	0	0	0	Jul-92	0	0	0	0
Sep-88	0	0	0	0	Aug-92	0	0	0	0
Oct-88	0	0	0	0	Sep-92	0	0	0	0
Nov-88	0	0	0	0	Oct-92	0	0	0	0

Table 2 (cont'd)

Month	Feast of Ramadan	Feast of Sacrifice	Nine Days	Ramadan	Month	Feast of Ramadan	Feast of Sacrifice	Nine Days	Ramadan
Nov-92	0	0	0	0	Oct-96	0	0	0	0
Dec-92	0	0	0	0	Nov-96	0	0	0	0
Jan-93	0	0	0	0	Dec-96	0	0	0	0
Feb-93	0	0	0	1	Jan-97	0	0	0	1
Mar-93	1	0	1	1	Feb-97	1	0	0	1
Apr-93	0	0	0	0	Mar-97	0	0	0	0
May-93	0	0	0	0	Apr-97	0	1	0	0
Jun-93	0	1	1	0	May-97	0	0	0	0
Jul-93	0	0	0	0	Jun-97	0	0	0	0
Aug-93	0	0	0	0	Jul-97	0	0	0	0
Sep-93	0	0	0	0	Aug-97	0	0	0	0
Oct-93	0	0	0	0	Sep-97	0	0	0	0
Nov-93	0	0	0	0	Oct-97	0	0	0	0
Dec-93	0	0	0	0	Nov-97	0	0	0	0
Jan-94	0	0	0	0	Dec-97	0	0	0	0
Feb-94	0	0	0	1	Jan-98	1	0	0	1
Mar-94	1	0	0	1	Feb-98	0	0	0	0
Apr-94	0	0	0	0	Mar-98	0	0	0	0
May-94	0	1	0	0	Apr-98	0	1	1	0
Jun-94	0	0	0	0	May-98	0	0	0	0
Jul-94	0	0	0	0	Jun-98	0	0	0	0
Aug-94	0	0	0	0	Jul-98	0	0	0	0
Sep-94	0	0	0	0	Aug-98	0	0	0	0
Oct-94	0	0	0	0	Sep-98	0	0	0	0
Nov-94	0	0	0	0	Oct-98	0	0	0	0
Dec-94	0	0	0	0	Nov-98	0	0	0	0
Jan-95	0	0	0	0	Dec-98	0	0	0	1
Feb-95	0	0	0	1	Jan-99	1	0	1	1
Mar-95	1	0	0	1	Feb-99	0	0	0	0
Apr-95	0	0	0	0	Mar-99	0	0	0	0
May-95	0	1	1	0	Apr-99	0	1	1	0
Jun-95	0	0	0	0	May-99	0	0	0	0
Jul-95	0	0	0	0	Jun-99	0	0	0	0
Aug-95	0	0	0	0	Jul-99	0	0	0	0
Sep-95	0	0	0	0	Aug-99	0	0	0	0
Oct-95	0	0	0	0	Sep-99	0	0	0	0
Nov-95	0	0	0	0	Oct-99	0	0	0	0
Dec-95	0	0	0	0	Nov-99	0	0	0	0
Jan-96	0	0	0	1	Dec-99	0	0	0	1
Feb-96	1	0	1	1	Jan-00	1	0	0	1
Mar-96	0	0	0	0	Feb-00	0	0	0	0
Apr-96	0	0	0	0	Mar-00	0	1	1	0
May-96	0	1	0	0	Apr-00	0	0	0	0
Jun-96	0	0	0	0	May-00	0	0	0	0
Jul-96	0	0	0	0	Jun-00	0	0	0	0
Aug-96	0	0	0	0	Jul-00	0	0	0	0
Sep-96	0	0	0	0	Aug-00	0	0	0	0

Table 3 – Estimation Results and Significant Tests

Variable	Model	Adjusted R-squared and SC for Original Model		Feast of Ramadan	Feast of Sacrifice	Ramadan	Nine Days	Wald Test Statistic (*)	SC of the Model with Dummies
IPROD	AR(13)	0.260	-3.210	-0.037	-0.049	-	-	13.95	-3.295
IPIMQ	AR(1)	0.154	-2.732	-	-0.0450	-	-	7.83	-2.748
MPROD	AR(2)	0.177	-3.169	-0.0420	-0.0565	-	-	14.77	-3.273
IPEGW	AR(13)	0.087	-4.156	-0.0298	-0.0320	-	-	16.81	-4.304
IMPOR	AR(11)	0.509	-1.692	-0.102	-0.069	-	-	12.60	-1.779
GOVRE	AR(3)	0.748	-3.542	-0.021	-	-	-	4.34	-3.538
GOVEX	AR(13)	0.299	-2.425	-	-	-	-	-	-
NDOMB	AR(4)	0.427	0.127	-	-	-	-	-	-
M1	AR(10)	0.445	-3.061	-	-	-	-	-	-
FXDEP	AR(8)	0.738	-3.328	-	-	-	-	-	-
CBM	AR(12)	0.744	-1.763	-	-	-	0.062	4.12	-1.762
RM	AR(13)	0.526	-4.056	0.019	0.021	-	-	4.22	-4.055
WPI	AR(2)	0.858	-4.871	-	-	-	-	-	-
CPI	AR(6)	0.814	-5.142	-	-	-	-	-	-
WPIINF	AR(13)	0.878	-3.147	-	-	-	-	-	-
CPIINF	AR(10)	0.832	-3.995	-	-	-	-	-	-
CREDIT	AR(4)	0.889	-4.663	0.019	-	-0.048	-	2.81	-4.636
ISETL	AR(11)	0.878	-1.006	-	-	-	-	-	-
ISEVOL	AR(12)	0.700	1.026	-	-	-	-	-	-
ISEUSD	AR(11)	0.891	-0.933	-	-	-	-	-	-
ISEFIN	AR(11)	0.804	-0.588	-	-	-	-	-	-
ISEIND	AR(11)	0.798	-1.056	-	-	-	-	-	-
ONINTR	AR(1)	0.459	-0.423	-	-	-	-	-	-

(*) The null hyposthesis for the Wald test is the zero restriciton on the coefficients of all remaining dummy variables. The Wald test statistic follows an F distribution and the null hypothesis is rejected with 5% significance (6% for CREDIT) in all tests.

Table 4 – Autocorrelations of Chosen Macroeconomic Series Before and After the Removal of the Religious Effects

Raw Data	t-6	t-3	t-2	t-1	T	t+1	t+2	t+3	t+6
INDPRO	0.14	0.18	0.36	0.32	1.00	0.33	0.35	0.18	0.08
IPIMQ	0.09	0.07	0.21	0.42	1.00	0.42	0.20	0.06	0.08
MPROD	0.14	0.18	0.37	0.36	1.00	0.37	0.36	0.18	0.09
IPEGW	-0.06	0.05	0.23	0.15	1.00	0.16	0.22	0.07	-0.07
IMPOR	0.13	0.47	0.60	0.59	1.00	0.59	0.60	0.47	0.11
Religious Effects Removed									
INDPRO	0.13	0.21	0.38	0.50	1.00	0.50	0.38	0.20	0.06
IPIMQ	0.11	0.06	0.21	0.48	1.00	0.47	0.20	0.05	0.10
MPROD	0.12	0.21	0.38	0.51	1.00	0.52	0.38	0.20	0.06
IPEGW	-0.06	0.11	0.25	0.40	1.00	0.40	0.24	0.11	-0.07
IMPOR	0.15	0.52	0.64	0.68	1.00	0.68	0.63	0.51	0.12

Table 5 – Cross Correlations of Some Series with the Industrial Production Index
Before and After the Removal of the Religious Effects

Raw Data	Volatility (% s. d.)	t-6	t-3	t-2	t-1	t	t+1	t+2	t+3	t+6
INDPOR	4.62%	0.14	0.18	0.36	0.32	1.00	0.33	0.35	0.18	0.08
GOVRE	8.04%	0.02	-0.02	0.02	0.00	-0.01	0.00	0.03	-0.07	-0.17
GOVEX	9.38%	-0.05	-0.02	0.03	0.07	0.08	0.04	0.07	-0.05	0.08
FXDEP	8.00%	-0.03	-0.16	-0.22	-0.19	-0.10	-0.12	-0.15	-0.14	0.02
CBM	15.59%	0.11	0.28	0.28	0.24	0.15	0.15	0.06	0.05	-0.06
RM	3.67%	0.06	0.18	0.12	0.22	-0.19	-0.07	-0.23	-0.16	-0.12
CPI	3.96%	-0.03	-0.16	-0.20	-0.27	-0.25	-0.19	-0.16	-0.10	-0.06
CREDIT	6.66%	0.10	0.33	0.39	0.43	0.49	0.51	0.52	0.51	0.39
ISEVOL	64.22%	0.09	0.30	0.24	0.12	0.06	-0.09	-0.18	-0.19	-0.13
ISEIND	25.94%	-0.04	0.28	0.43	0.47	0.46	0.36	0.26	0.12	-0.08
ONINTR	25.94%	-0.15	-0.36	-0.42	-0.30	-0.19	0.00	0.07	0.11	0.12
USDTL	8.46%	-0.12	-0.30	-0.36	-0.44	-0.43	-0.38	-0.34	-0.27	-0.10
Religious Effects Removed										
INDPOR	4.39%	0.13	0.21	0.38	0.50	1.00	0.50	0.38	0.20	0.06
GOVRE	8.04%	0.03	0.01	0.01	0.02	-0.04	-0.01	0.00	-0.09	-0.16
GOVEX	9.37%	-0.04	-0.01	-0.01	0.08	0.09	0.03	0.05	-0.04	0.09
FXDEP	8.03%	-0.04	-0.20	-0.22	-0.18	-0.11	-0.13	-0.18	-0.16	0.01
CBM	15.60%	0.15	0.28	0.29	0.21	0.16	0.13	0.06	0.06	-0.04
RM	3.58%	0.09	0.18	0.14	0.15	-0.12	-0.14	-0.22	-0.17	-0.11
CPI	3.95%	-0.03	-0.16	-0.24	-0.27	-0.26	-0.19	-0.16	-0.11	-0.06
CREDIT	6.64%	0.11	0.33	0.42	0.45	0.51	0.55	0.54	0.53	0.40
ISEVOL	63.71%	0.01	0.31	0.39	0.39	0.38	0.29	0.20	0.13	-0.06
ISEIND	25.90%	-0.04	0.28	0.46	0.48	0.49	0.38	0.26	0.13	-0.10
ONINTR	25.79%	-0.18	-0.39	-0.44	-0.30	-0.17	-0.02	0.08	0.10	0.11
USDTL	8.47%	-0.14	-0.32	-0.40	-0.45	-0.45	-0.39	-0.36	-0.28	-0.11