A NOTE ON THE USE OF CALENDAR REGRESSORS

Autor: *Leandro Navarro Pablo*(*)

P. T. N.º 17/08

Dirección de contacto: Instituto Nacional de Estadística. Paseo de la Castellana, 183. 28046 Madrid. e-mail: lenapa@ine.es

(*) I appreciate the help of Juan Bógalo Román, with whom I am indebted for his computations and for most of the series herein analysed, as well as Ángel Cuevas, Enrique M. Quilis and Luis Julián Álvarez for their comments and advice. Any views expressed herein are those of the author and not necessarily those of the Instituto Nacional de Estadística (INE).”

Edita: Instituto de Estudios Fiscales
N.I.P.O.: 602-08-004-3
I.S.S.N.: 1578-0252
Depósito Legal: M-23772-2001

INDEX

1. INTRODUCTION
2. CALENDAR RELATED ISSUES AND SOME MODELLING CONSIDERATIONS
3. THE SPECTRA OF CALENDAR PHENOMENA
    3.1. The spectral analysis of the leap year
    3.2. The spectral analysis of the Easter
4. THE TRADING DAY
    4.1. The computation of the spectra of the respective trading-day regressors
    4.2. The correction of yearly economic data using calendar regressors
5. SOME CONCLUDING REMARKS
REFERENCES
Síntesis. Principales implicaciones de política económica

ABSTRACT

In this paper I analyse the implications of using three different variables aiming at capturing the "trading day" effect. Specifically, the proposal outlined in Bógalo and Quilis (2006), which is consistent with Eurostat's (2007 and 2002), Cleveland and Devlin (1982), and the one used in the programs Tramo/Seats. It is found that Eurostat's (2002 and 2007) proposal presents some drawbacks with respect to the standard regressors used in Tramo/Seats and when compared with the variables brought forward by Cleveland and Devlin (1982). Moreover, although these variables might show some downsides, they offer the best results of all the methods considered.

Keywords: seasonal adjustment, frequency domain analysis, calendar effects.
JEL Classification: C22, C49.

1. INTRODUCTION

Calendar effects have an impact on an important number of economic time series, such as manufacturing production, retail sales or energy consumption. For this reason, numerous authors and institutions[1] have considered the possibility of capturing such effects by using national calendar variables or specific regressors.

This paper concentrates on the implications of using three different variables aiming at capturing the "trading day"[2] effect. Specifically, the proposal outlined in Bógalo and Quilis (2006), which is consistent with Eurostat's (2002 and 2007), Cleveland and Devlin's (1982), and the one employed in the programs Tramo/Seats. It is found that the proposal by Eurostat (2002 and 2007) presents some drawbacks with respect to the standard regressors used in Tramo/Seats or the variables proposed by Cleveland and Devlin (1982). Moreover, although these variables present some drawbacks, they offer the best results of all the methods considered.

Further, in order to analyse the implications of employing diverse trading day variables, it is mandatory to first understand the features of other calendar-related effects, i.e., the Easter and the leap year. Thus, following a similar exposition as in Bógalo and Quilis (2006), I analyse not only the fundamental characteristics of these calendar effects, but also the degree of interaction between them.

The paper is structured as follows. In the second section I revise the exact definitions of the diverse calendar related issues implicitly analysed when performing calendar adjustment. In the third section I describe and perform a frequency domain analysis of the Easter and leap year effects. After doing so, in the fourth section the above-mentioned proposals concerning the trading day are discussed and applied by computing the diverse calendar variables according to the three methods and their respective spectra using the Autonomous Region of Madrid as an example[3]. Moreover, the fifth section also includes an analysis of the implications of using such trading day regressors when correcting yearly economic series from calendar effects. Finally, in the last section some conclusions are drawn.

---

[1] Bógalo and Quilis (2006), Cleveland and Devlin (1982), EUROSTAT (2002 and 2007).

[2] Considering as such the non-seasonal part of the trading day effects not included in the Easter effect or leap year effect.

[3] Although this note uses the Autonomous Region of Madrid as an example, the conclusions are perfectly extensible to other countries or states.

2. CALENDAR RELATED ISSUES AND SOME MODELLING CONSIDERATIONS

For understanding the diverse calendar phenomena it is of uttermost importance to know their exact definition. In this sense the *tropical year* –or solar year– is defined as the interval between two successive passages of the mean Sun through the mean vernal equinox and lasted in the year 2000 (AD), in mean, approximately 365.2421896698 days[4].

In contrast, the *civil year* is a conventional period, composed of a whole number of days, which must coincide, as much as possible, with the tropical year. A calendar is precisely the attempt to make both kinds of years coincide.

Three main calendars have been devised for this purpose, i.e., the Egyptian Calendar, the Julian Calendar and the Gregorian Calendar. The first one consisted of exactly 365 days, thus with a mean error of 0.24218967 days[5] –which can be written, approximately, as (1/4)-(3/400)-(3/10,000)-(1/100,000)-(3/10,000,000) ≈876/3617–. This motivated, among other issues, its reform by Jules Cesar, which gave rise to the Julian Calendar, that in origin introduced a day between the 23rd and 24th of February, the sixth day before march ("bis sextus dies ante calendas Martii"), and duplicated the 23rd of this month every four calendar years, inserting thus a correction term of 1/4 days. Nonetheless, this correction term resulted to be excessive by 3/400 days. This problem caused the Gregorian Reform, which took into account this correction term for the Calendar, i.e., 3 years out of every 400 were to be non-leap years.

This set of rules gave rise to the so-called leap year. According to them, all the years divisible by 4 are leap years. In addition, if the modulus after division of the year by 100 is zero then such years are not to be considered as leap years. The exceptions to this rule are the years for which the modulus after division by 400 is zero that are to be reconsidered as leap years. Thus, in 400 calendar years there should be 97 leap years, in order to keep the Gregorian Calendar close to the tropical year.

Moreover, according to the Gregorian Calendar, the year lasts 365.2425 days, thus it excesses the actual mean tropical year by approximately

---

[4] Nonetheless, it must be taken into account that the Earth's rotation is not constant and varies across the centuries. As a matter of fact, 85 millions of years ago, during the upper Cretaceous period, the Earth revolved much faster and the year comprised in mean 370,3 days. During the Cambrian period it reached 425 days. Nowadays, the speed of the Earth's rotation is eventually slowing down, so that in the future the number of days will be lower.

[5] The reasons behind the mathematical problem of the calendar and a thorough exposition on the possible solutions can be found in N.M. Beskin (1980). This author employs a for his computations a year, which consists of 365 days, 5 hours, 48 minutes and 46 seconds for his exposition, differing only by 1 second from the mean tropical year in the year 2000 (AD), and approximates it by way of a continued fraction.

0.00031033 days, implying, that if the mean year were constant through time, the Gregorian Calendar also would need, a correction-term of, approximately, -[(3/10,000)+(1/100,000)] in order to keep up, as much as possible, with the tropical year. Therefore, it could be convened to transform in non-leap years three out of every 10,000 years. Further, one out of every 100,000 years should also be non-leap years.

So far, I have concentrated on Solar years. As they have the disadvantage of not being easily observable, through history many attempts have been made to establish lunar calendars. Nonetheless, as in the case of solar calendars, Lunar ones have to insert one leap day about every third year to keep in step with the moon phases. Despite of that they are asynchronous with the seasons. Alternatively to both conventions, other types of calendars, which aim at overcoming these drawbacks, have been used though history. One of the most influential ones is that of *Meton* (432 BC).

The so-called *Metonic Calendar* covers, nowadays, 6,940 days (whereas 19 tropical years cover, in mean, 6,939.60178 days). This is an especially relevant feature for the computation of another especial date of the calendar, the Easter.

Closely linked to the Easter is the so-called *Epact*, which is a measure of the age of the moon, i.e., the number of days that have passed since an "official" new moon on a particular date. In the Gregorian calendar, the Epact is the age of the moon at the start of the year. Therefore, the sequence of Easter dates in the Gregorian calendar repeats itself according to the product of the following numbers:

- 19 (the year-cycle of the phases of moon or Metonic cycle).
- 400 (the Gregorian equivalent of the Solar cycle).
- 25 (the cycle of the so-called “Lunar Equation”).
- 30 (the number of different Epact values).

This implies that the exact date of the Easter, i.e., the number of the day in a month and the day of the week and its temporal sequence, repeats every 5,700,000 years.

Another special characteristic of civil calendars is that they are periodic, i.e., every Sunday is followed by a Monday, every Monday by a Tuesday and so forth. Two phenomena related to this feature are what in economic time-series analysis are usually called trading-day and working day effects. While the trading-day stands for the different behaviour an economic time-series can show, due to the different behaviour economic agents show on different days of the week, the working day effect is related to the different composition of trading days in each month. As the exact sequence of the number of the day and the day of the week are periodic in a calendar, both can be understood as a phase-shift of the weekly cycle, and, in so far, they can be easily modelled[6].

---

[6] One example might be found in Cleveland and Devlin (1982).

3. THE SPECTRA OF CALENDAR PHENOMENA

In this section, the main spectral features of the leap year and of the Easter are analysed resorting to frequency domain analysis.

3.1. The spectral analysis of the leap year

For the analysis of the leap-year, an artificial time series, LY, can be set up, which is defined as follows,

$$\mathrm{LY}_t^* = \begin{cases} 0{,}75 \text{ Februaries if the modulus after division of the year by 4 and 400 is zero} \\ -0{,}25 \text{ Februaries if the modulus after division of the year by 100 is not zero} \\ -0{,}25 \text{ otherwise} \end{cases} \quad (1)$$

In order to eliminate any seasonal behaviour from this variable, the monthly-specific mean of all Februaries of this variable across 400 years was subtracted from it. Despite the fact that the mean year and the mean leap year variable evolve through time, this procedure could be regarded as a second best solution. The evolution across diverse time spans of the mean and the standard deviation of LY_t^* is as represented on table 1 and figure 1. In case the analysis of this effect is performed through a time-span shorter than 400 years, this procedure leaves a “residual” seasonality in the leap year variable. Nonetheless, in case that the monthly specific sample averages were used, and taking into consideration the results presented in table 1, this might induce a distortion in the estimation of the seasonal component of economic time series.

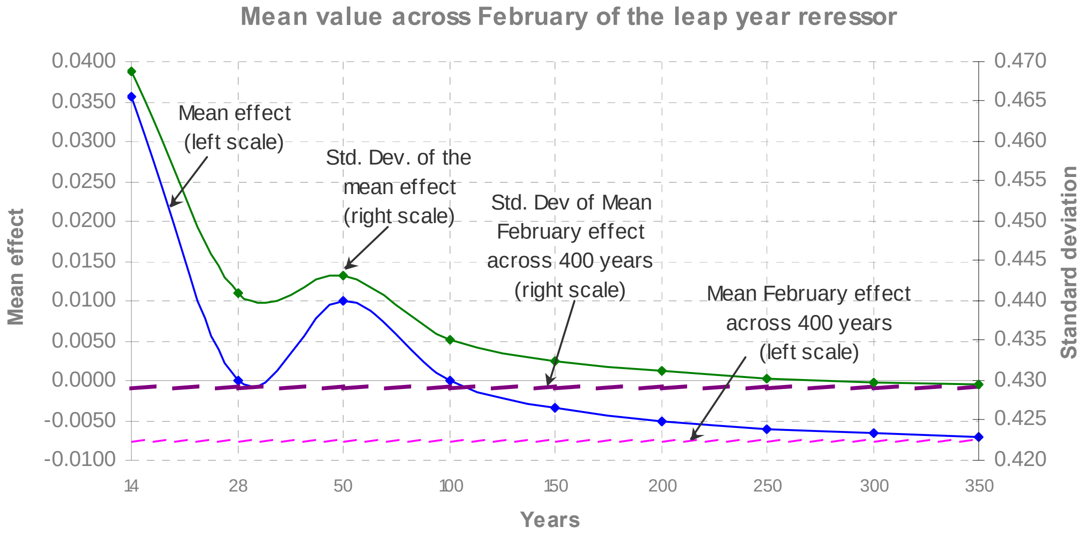
Table 1

MEAN EFFECT AND STANDARD DEVIATION OF THE MEAN EFFECT OF THE LEAP YEAR VARIABLE, LY_t^*

Years	Mean value	Std. Dev.
14	0,035714	0,468807
28	0,000000	0,440959
50	0,010000	0,443087
100	0,000000	0,435194
150	-0,003333	0,432515
200	-0,005000	0,431166
250	-0,006000	0,430354
300	-0,006667	0,429812
350	-0,007143	0,429423
400	-0,007500	0,429132

Figure 1

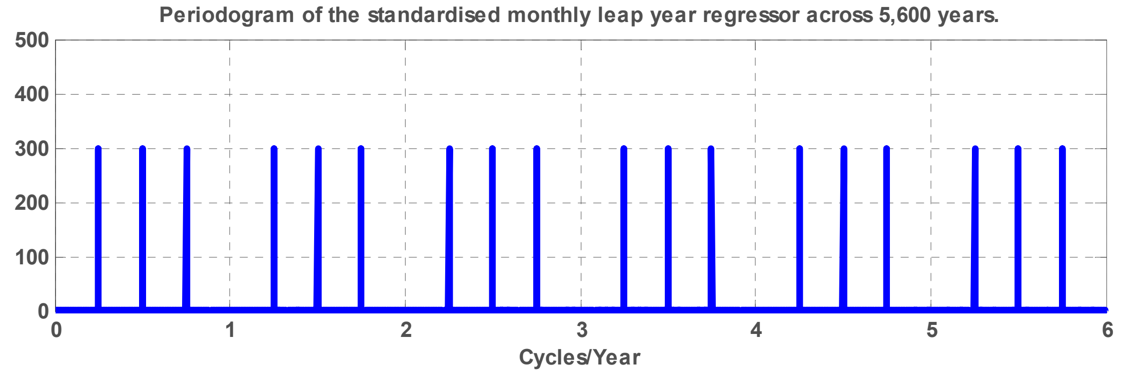
MEAN EFFECT AND STANDARD DEVIATION OF THE MEAN EFFECT OF THE LEAP YEAR



Finally, in order to be able to establish a comparison between the magnitude of the effect of the leap year and the other calendar effects herein analysed, and, in order to isolate the non-seasonal part of the leap year, the monthly specific averages across 400 years were subtracted form LY_t^* and the resulting time series was divided by its standard deviation.

Figure 2.1

PERIODOGRAM OF THE LEAP YEAR



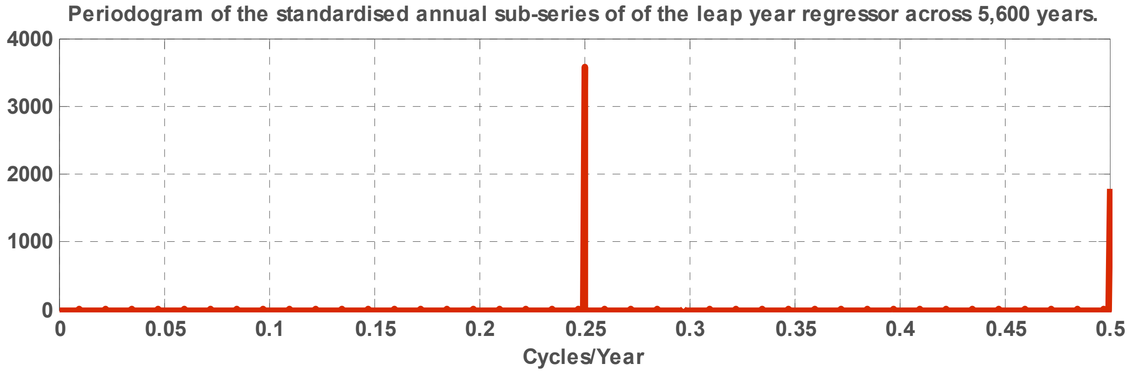
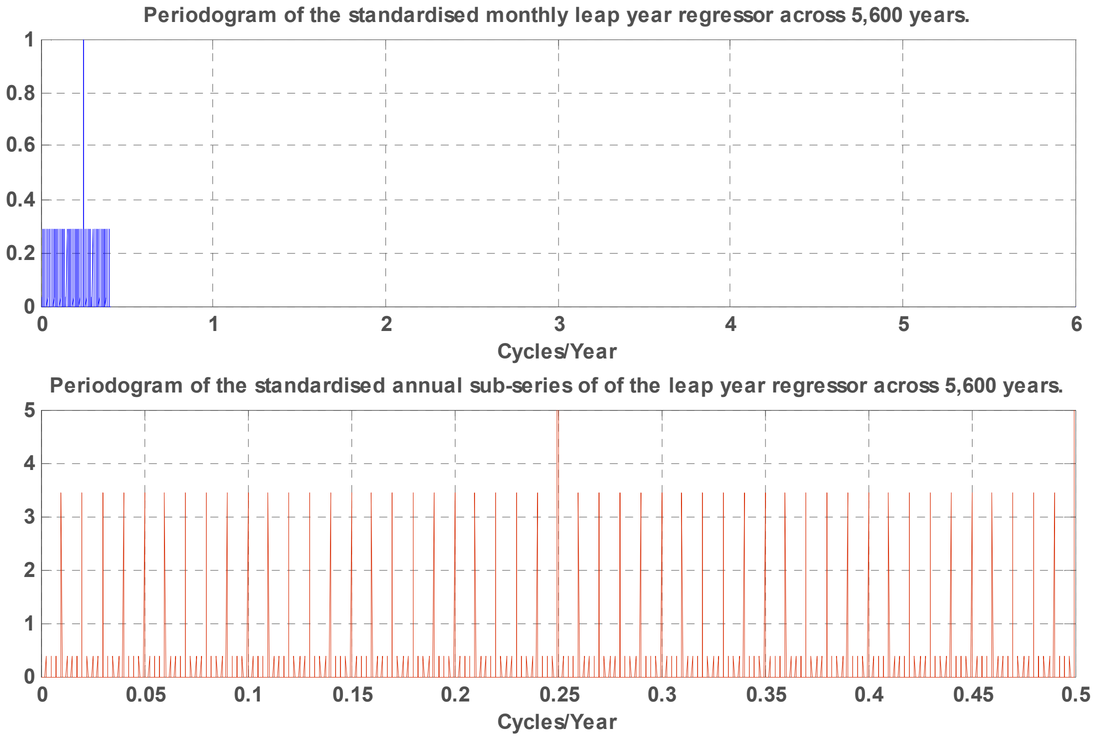


Figure 2.2

PERIODOGRAM OF THE LEAP YEAR. (ZOOM)



The spectrum of the monthly leap year variable is mainly reflected on frequencies that are multiples of 0.25 cycles/year (See figure 2.1.). Moreover, a close inspection of the periodogram shows that a residual term remains in the spectrum, which is explained by other frequencies (See figure 2.2.). In the case the annual sub-series a similar pattern arises. Its periodogram concentrates on 0.25 and 0.5 cycles/year, but other frequencies (multiples of 0.0025 cycles/year) also contain relevant information about this calendar effect.

3.2. The spectral analysis of the Easter

As in Bógalo and Quilis (2006), an initial set of artificial time series, $P(\tau)$, has been generated in order to estimate the main characteristics features of the Easter in the frequency-domain.

This artificial time series can be constructed according to the following algorithm; if the Easter falls entirely in march (april), then the value for march (april) is set to 1 and a 0 is assigned to april (march). In contrast, when the Easter falls between both months, then an intermediate value is assigned to both months. This value also depends on a parameter, τ, which measures the number of days preceding the Easter Sunday[7].

---

[7] For simplicity reasons the values of τ have been set at 3, 6 and 9. The exact regressor and the Matlab program devised for computing it can be sent on request. The algorithm employed in it can be found in Jean Meeus (1998).

For being able to isolate the non-seasonal component of the Easter, the monthly-specific means have been computed across a whole cycle of the Easter, i.e., 5,700,000 years. Despite the fact that any possible astronomical or ecclesiastical revisions might alter the outcomes of this analysis in the far future, it is also important to simulate this variable across a time span long enough as to allowing the determination of the “true” monthly specific mean and its “true” standard deviation of the Easter effect as it is established nowadays. In case that the sample average monthly-specific values were employed for this purpose, then the effect of the Easter would be delusive, in as far, as it would over- or undercorrect the seasonal behaviour of the Easter phenomenon, thus, leading to a distortion in the frequency domain[8]. The evolution across time of the monthly-specific means and standard deviations are presented in the following table.

Table 2

MEAN EFFECT AND STANDARD DEVIATION OF THE MEAN EFFECT OF THE EASTER

Time span (Years)	Mean value of march	Std. Dev. of the values march and april	Mean value of march	Std. Dev. of the values march and april	Mean value of march	Std. Dev. of the values march and april
	$\tau = 3$		$\tau = 6$		$\tau = 9$	
28	0,285714	0,460044	0,345238	0,446589	0,392857	0,442880
1.400	0,289524	0,440018	0,341667	0,437829	0,390873	0,434785
2.800	0,292262	0,439527	0,344821	0,438755	0,393889	0,435311
5.600	0,298810	0,441266	0,348780	0,441363	0,398849	0,436316
14.000	0,300143	0,442135	0,350440	0,441702	0,400254	0,436756
28.000	0,299643	0,441587	0,349726	0,441546	0,399690	0,436524
56.000	0,300024	0,441904	0,349994	0,441702	0,399952	0,436632
112.000	0,300080	0,441849	0,350024	0,441718	0,400035	0,436608
224.000	0,300134	0,441911	0,350045	0,441745	0,400038	0,436634
448.000	0,300122	0,441889	0,350009	0,441744	0,400018	0,436620
896.000	0,300118	0,441895	0,350005	0,441743	0,400007	0,436624
1.344.000	0,300133	0,441901	0,350012	0,441749	0,400016	0,436627
5.700.000	0,300139	0,441902	0,350014	0,441753	0,400019	0,436628

---

[8] The same applies to all other calendar-related effects.

Hence, after computing $P(\tau)$, the resulting times series were "standardised" by subtracting from them the respective monthly-specific means across 5,700,000 years, and not the sample-mean as is commonly done, and by dividing the resulting figures by the standard deviation across this time span. This new variable is what is taken into account as the Easter regressor. The resulting variable has been named, $P'(\tau)$. Taking into consideration these results, the spectra of the monthly Easter regressor, as well as the ones of the corresponding annual sub-series, have been calculated and plotted across 5,600 years. Moreover, the so-called annual sub-series have been computed by forming a new variable, which, after subtracting the corresponding "true" monthly-specific mean value and after dividing the resulting figure by the "true" standard deviation, takes into account the effect of each march/april across the analysed span.

Further, this procedure still doesn't eliminate all the residual seasonal behaviour of the Easter regressor if the time-span of the analysis is lower than the one of a full cycle of the Easter. In this respect, another way of standardising the Easter regressor would be that of computing it as the result of subtracting the mean across the span for march and april. While this practice eliminates any possible residual seasonality, it would lead to a distortion in the regressor each time it were to be computed as well as to an over- or under-estimation of the seasonal component of an economic time series.

As depicted in figure 3 and table 3, the higher τ is set, the more the signal is concentrated along the main twelve frequencies of the Easter[9]. A closer inspection of the spectra yields another special feature, i.e., the lower τ is chosen, the stronger is the effect of other frequencies, which, for simplicity, have been called "Tau3 companions". In contrast, the higher τ, the more weight in the variance is assumed by other frequencies, which, correspondingly, have been called "Tau9 companions". The main frequencies arising in the periodogram are represented in the following table.

---

[9] See Bógalo and Quilis (2006).

Figure 3

PERIODOGRAMS OF THE EASTER REGRESSOR ACROSS 5,600 YEARS

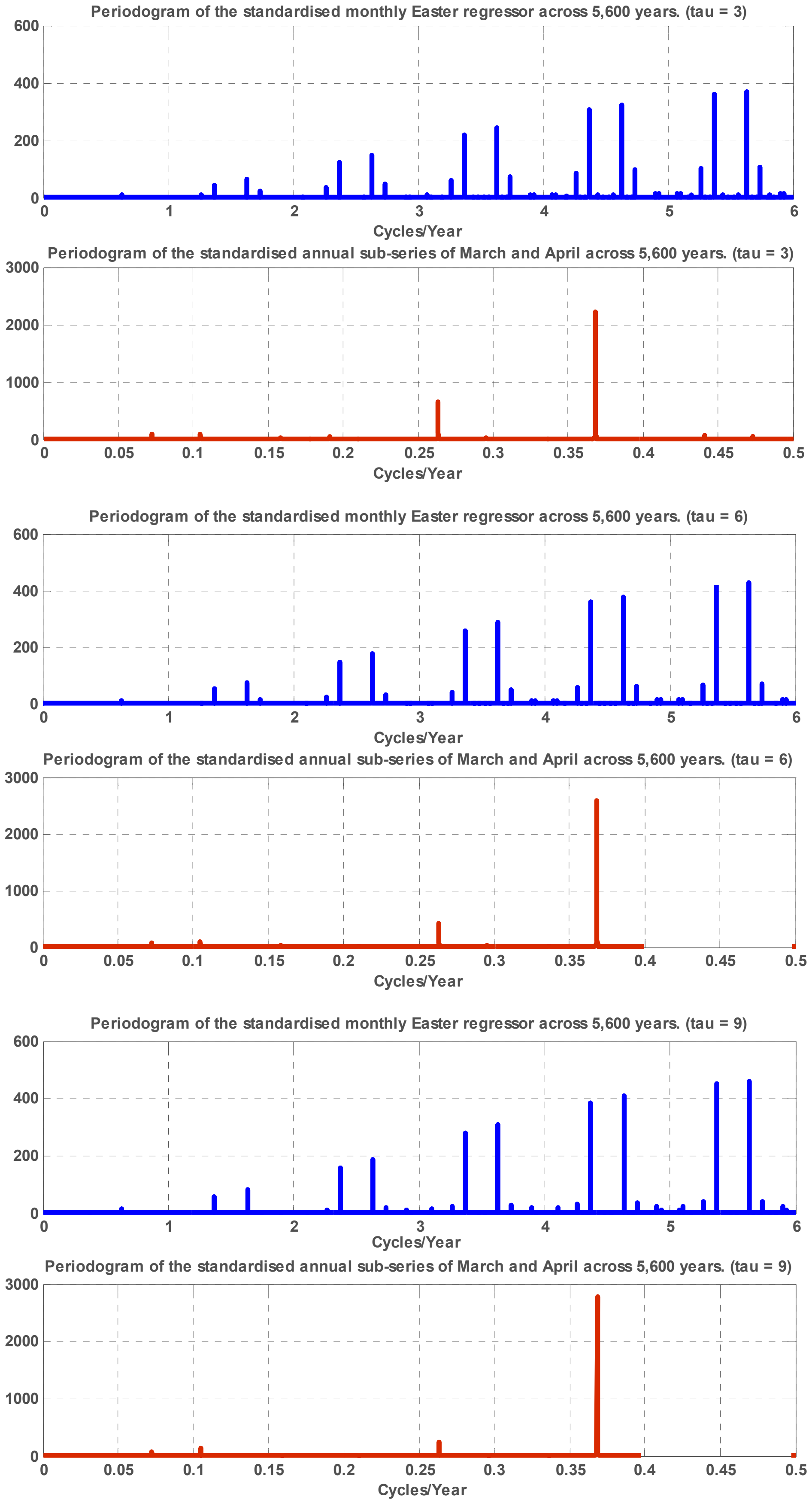


Table 3

MAIN FREQUENCIES OF THE MONTHLY EASTER REGRESSOR ACROSS 5,600 YEARS

Cycles/Year	**Spectrum**		
	Tau=3	**Tau=6**	**Tau=9**
0,368	5,10	5,89	6,37
0,632	14,91	17,24	18,62
1,368	67,60	78,17	84,45
1,632	94,40	109,17	117,94
2,368	185,67	214,71	231,95
2,632	222,28	257,05	277,70
3,368	327,66	378,92	409,35
3,632	364,28	421,26	455,10
4,368	455,54	526,80	569,11
4,632	482,35	557,80	602,60
5,368	535,04	618,73	668,43
5,632	544,85	630,07	680,68
% in total	**58,9%**	**68,1%**	**73,6%**

"TAU3 COMPANIONS"			
Cycles/Year	**Spectrum**		
	Tau=3	**Tau=6**	**Tau=9**
0,263	0,67	0,44	0,25
0,737	5,20	3,37	1,95
1,263	14,93	9,68	5,60
1,737	27,30	17,71	10,24
2,263	44,16	28,64	16,56
2,737	61,06	39,60	22,90
3,263	80,53	52,22	30,20
3,737	97,43	63,18	36,54
4,263	114,28	74,12	42,87
4,737	126,65	82,14	47,51
5,263	136,39	88,45	51,16
5,737	140,92	91,39	52,86
% in total	**15,2%**	**9,8%**	**5,7%**

"TAU9 COMPANIONS"			
Cycles/Year	**Spectrum**		
	Tau=3	**Tau=6**	**Tau=9**
0,105	0,01	0,01	0,02
0,895	0,79	0,91	1,36
1,105	1,20	1,37	2,05
1,895	3,34	3,81	5,71
2,105	4,04	4,61	6,91
2,895	6,96	7,94	11,91
3,105	7,77	8,87	13,29
3,895	10,70	12,20	18,29
4,105	11,40	13,00	19,48
4,895	13,54	15,44	23,14
5,105	13,94	15,90	23,84
5,895	14,72	16,80	25,18
% in total	**1,6%**	**1,8%**	**2,7%**

On the one hand, the so-called "Tau3 companions" account for almost 15.2% of the total variance of the Easter regressor when τ equals 3, while this percentage does not even reach 6% when τ is set to 9. On the other hand, the weight in the total variance of the regressor contained in the "Tau9 companions" is very reduced, oscillating between 2.7% $(\tau = 9)$ and 1.6% $(\tau = 3)$.

Further, the same feature, as described in the case of the periodogram of the monthly Easter regressor, arises in the case of the annual sub-series (see table 4). The variance of the annual sub-series concentrates mainly on two frequencies, 0.3611 cycles/year and 0.2634 cycles/year. Moreover, the lower τ is set, the lower the proportion in the total variance is captured by the main eight frequencies.

Table 4

MAIN FREQUENCIES OF THE ANNUAL SUB-SERIES OF THE MONTHLY EASTER REGRESSOR ACROSS 5,600 YEARS

Cycles/Year	**Spectrum**					
	Tau=3		**Tau=6**		**Tau=9**	
0,0727	98,45	1,76%	84,29	1,51%	64,66	1,16%
0,1048	86,37	1,55%	99,34	1,78%	149,70	2,68%
0,2634	841,38	15,07%	546,07	9,77%	315,98	5,65%
0,2955	69,74	1,25%	71,69	1,28%	71,16	1,27%

(Sigue)

(Continuación)

Cycles/Year	Spectrum					
	Tau=3		Tau=6		Tau=9	
0,3361	47,02	0,84%	44,31	0,79%	40,47	0,72%
0,3611	3289,66	58,92%	3808,48	68,14%	4115,76	73,61%
0,4409	94,98	1,70%	54,71	0,98%	17,82	0,32%
0,4730	75,68	1,36%	76,28	1,36%	72,62	1,30%
% in total		**82,45%**		**85,61%**		**86,71%**

4. THE TRADING DAY

After going through some of the features of the calendar, in this section, I revise the three proposals outlined in the introduction for estimating trading days, starting with Bógalo and Quilis (2006), for later continuing with Cleveland and Devlin (1982), and finally the one used in the programs Tramo/Seats. Although other specifications are possible, only these three have been considered for modeling purposes as some of them possess more drawbacks than benefits or because their in-depth analysis escapes the possibilities and the scope of this paper.

Bógalo and Quilis (2006)

Bógalo and Quilis (2006) analyse, among other, two indicator variables. The first variable, F_t, counts the number of non-working days, and can be defined as follows,

$$F_t = \alpha_1 D_{6,t} + D_{7,t} + FF_t + FS_t \qquad 0 \le \alpha_1 \le 1 \tag{2}$$

where $D_{6,t}$ and $D_{7,t}$ are the number of Saturdays and Sundays, respectively[10]. The coefficient α_1 allows Saturdays to be considered as complete non-working days $(\alpha_1 = 1)$, partial $(0 < \alpha_1 < 1)$ or full working days $\alpha_1 = 0$. Although the parameter α_1 may take any real value in the [0,1] interval, it must be noted, that for simplicity reasons, just three cases have been considered, i.e., $\alpha_1 = 1$, $\alpha_1 = 0.5$ and $\alpha_1 = 0$. Furthermore, FF_t and FS_t are, respectively, non-working days with and without a fixed calendar date.

Thus, the number of working days in a month has been computed as follows:

$$L_t(\alpha_1) = D_t - F_t. \tag{3}$$

where D_t is the duration of the month.

---

[10] Bógalo and Quilis (2006) also include a term, which takes into account the effect of bridging days, but these have not been taken into account in this article for simplicity reasons.

This sort of variable is consistent with the methodology proposed by Eurostat, amongst other institutions. Moreover, for taking into account the non-seasonal part of the trading-day effect, it is advisable to subtract from it the monthly long-term averages. At this point, the analyst should be aware of the fact that it would be preferable if the monthly-specific average values were those calculated across a complete cycle of the "weekly-cycle", i.e., 28 years.

Cleveland and Devlin (1982)[11]

Cleveland and Devlin (1982) assume that a daily time series can be decomposed into three main components: Let this daily time series be generically named as $Z(t)$. The main components of this series are; i) an oscillatory component $O(t)$, which possesses an exact weekly periodicity, ii) a fixed effect $k \geq 0$ and a residual factor $r(t)$ which comprises all the other effects not accounted for by the other two variables, resulting in,

$$Z(t) = O(t) + k + r(t) = \sum_{j=0}^{\infty} \delta_j \cos\left(2\pi \frac{jt}{7}\right) + r(t) \qquad (4)$$

where δ is the wave amplitude linked to the frequency of $j/7$ cycles per week.

The weekly variables can be aggregated in order to obtain the corresponding monthly ones, by simply calculating their respective integrals. Moreover, Cleveland and Devlin propose taking into account only amplitudes for low values of j, i.e., k = 1 and 2 as the effect of other amplitudes results almost negligible.

Further, Cleveland and Devlin's specification goes further in the definition of the trading day. Behind it lies what has been called in Bógalo and Quilis (2006) as "weekly cycle" which can be regarded as an alternative means of capturing the different economic effects of the weekdays. For more information, please, refer to Bógalo and Quilis (2006).

Tramo/Seats

As a trading-day regressor one might argue when using Tramo/Seats[12] whether or not to choose the one-regressor case or the six-regressor specification. Because of the fact that the use of a six-regressor-specification might present some serious drawbacks, only the one-regressor case has been taken into consideration. Let this regressor be named TR_t. It can be defined and computed as,

$TR_t =$ (Number of Mondays, Tuesdays, Wednesdays, Thursdays and Fridays in month t) – (number of Saturdays and Sundays in month t $* \frac{5}{2}$) (5)

---

[11] A more in-depth description can be found in Bógalo and Quilis (2006).

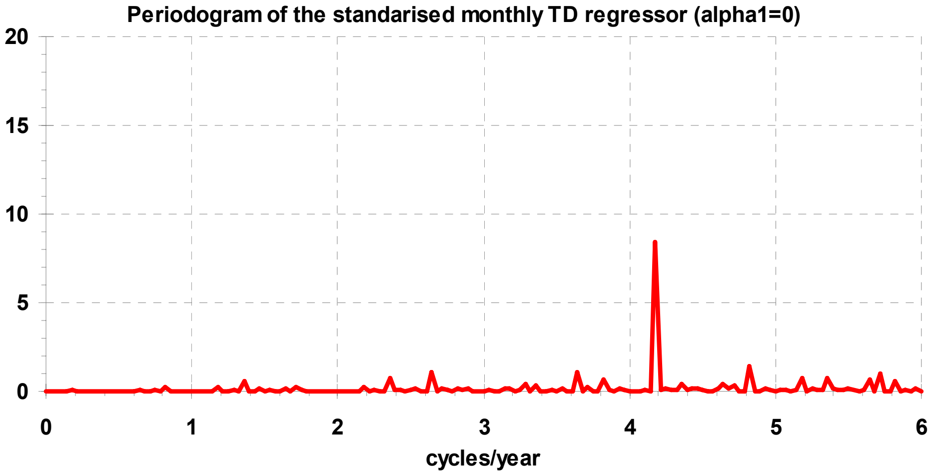
[12] For further details, please, see Víctor Gómez and Agustín Maravall (1998).

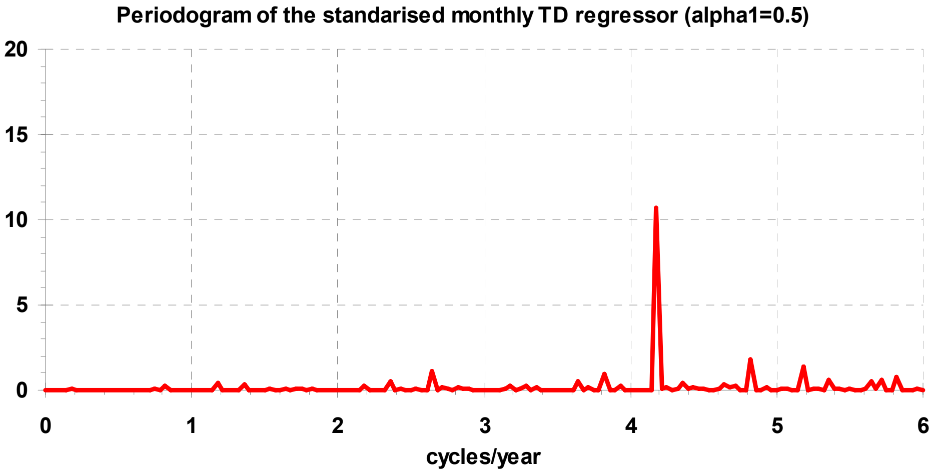
4.1. The computation of the spectra of the respective trading-day regressors

A set of three regressors has been calculated using equation (1) with different values of α_1[13]. Firstly, a variable containing the working days over 28 years for the Autonomous Region of Madrid has been computed. In a second step, the monthly-specific averages have been subtracted from these series in order to isolate the "trading day" effect. After doing so, these differences have been standarised as to being able to establish a comparison between all the considered variables and the spectra of these series have been plotted[14].

Figure 4

PERIODOGRAMS OF THE STANDARDISED MONTHLY TRADING DAY REGRESSOR

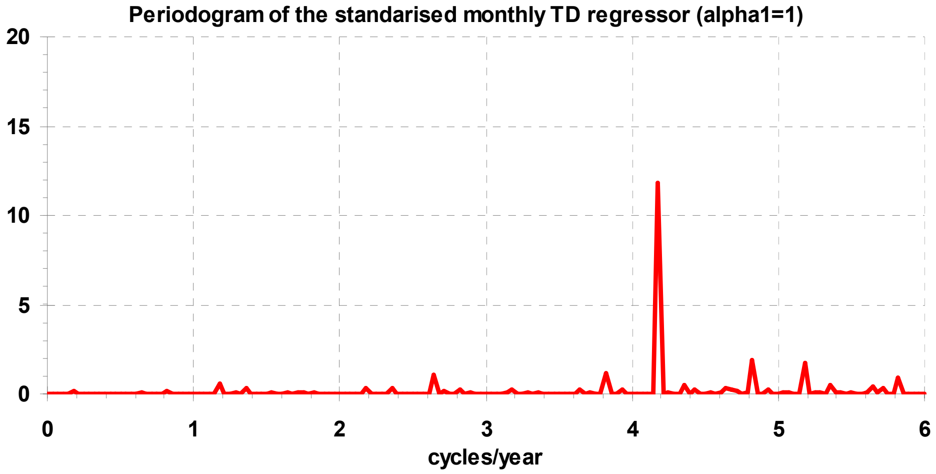

Periodogram of the standarised monthly TD regressor (alpha1=0)


Periodogram of the standarised monthly TD regressor (alpha1=0.5)

---

[13] In concordance with the methodology proposed by the Joint EUROSTAT-ECB Steering Group on Seasonal Adjustment.

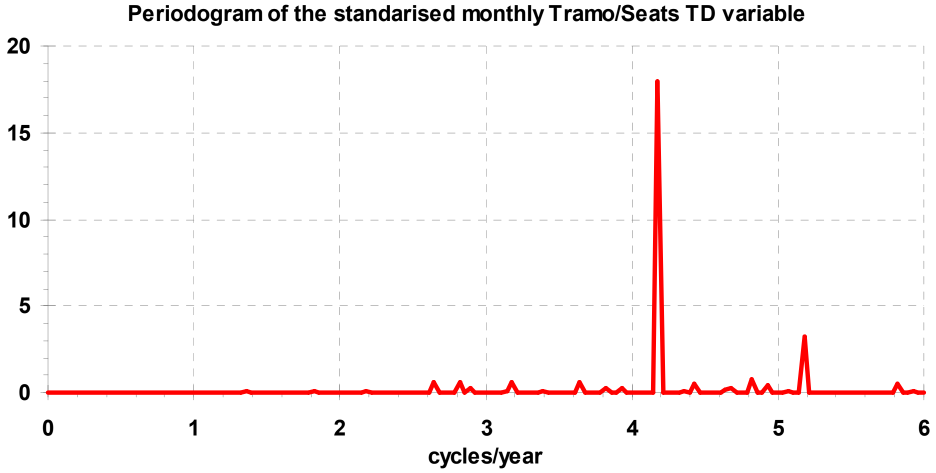
[14] The first regressor considers Saturdays as a full working day $(\alpha_1 = 0)$, the second one as a half working day $(\alpha_1 = 0.5)$ and the third as a non-working day $(\alpha_1 = 1)$.



It can be noted, that the less Saturdays are considered as a working days ($\alpha_1 = 1$), the more part of the "working day" effect, in terms of variance, is being captured. Moreover, these spectra have been compared with the ones implied by the series as used in Tramo/Seats with one regressor and the ones published by Cleveland and Devlin[15] (henceforth, CLD) (1982).

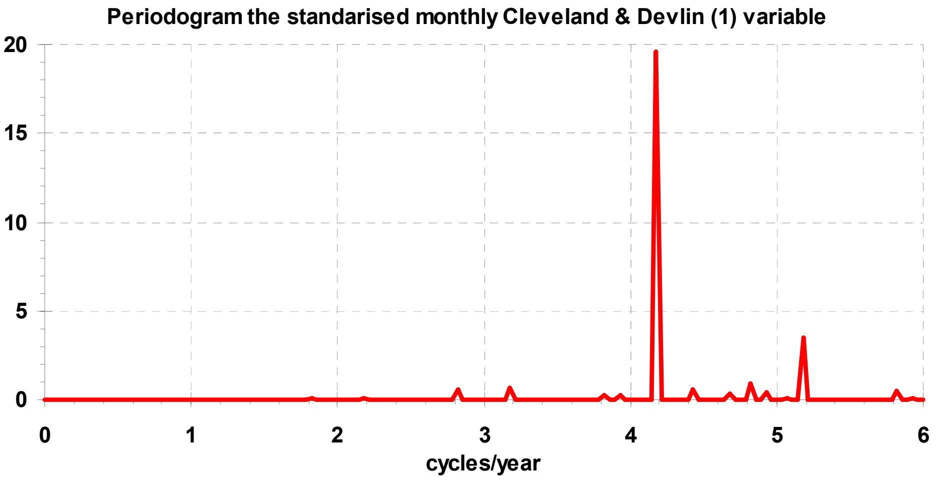
Figure 5

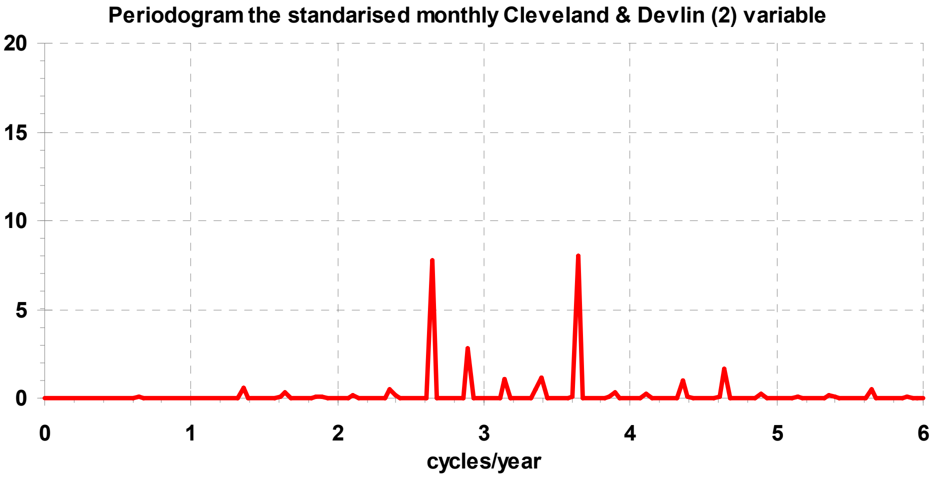
PERIODOGRAMS OF THE STANDARDISED MONTHLY TRAMO/SEATS AND OF THE CLEVELAND AND DEVLIN'S REGRESSORS

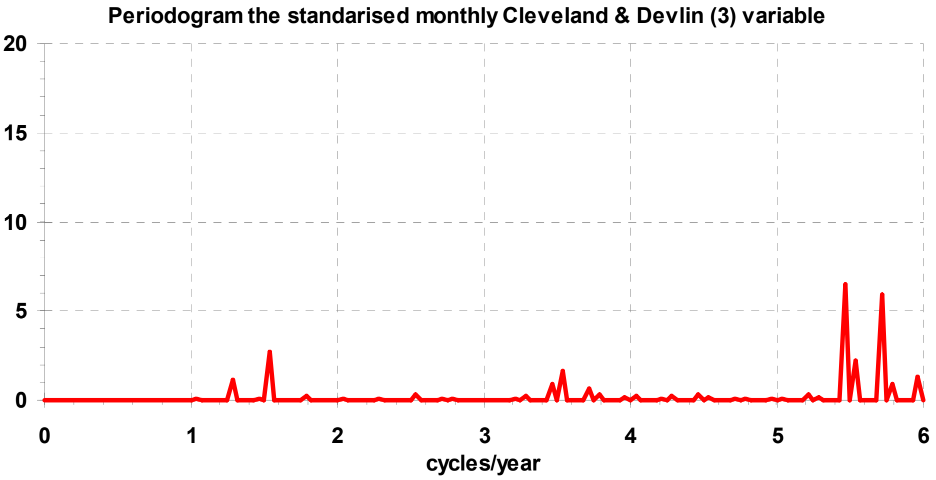


---

[15] Cleveland and Devlin propose the use of three regressors. The total trading day effect would be a linear combination of the three variables, which correspond to 1 cycle/week, 2 cycles/week and 3 cycles/week.


Periodogram the standarised monthly Cleveland & Devlin (1) variable


Periodogram the standarised monthly Cleveland & Devlin (2) variable


Periodogram the standarised monthly Cleveland & Devlin (3) variable

In the figures, it can be noted that the spectra of both, the Tramo/Seats and the CLD variables, are by far more informative about the "trading day" effect than the calendar regressor of equation (1). In this respect, the CLD variables (1 cycle per week –short, 1 c/w-, 2 cycles per week –short, 2 c/w- and 3 cycles per week –alias, 3 c/w-) capture most of the variance of the "trading day" effect;

slightly more than the Tramo/Seats regressor and by far more than any of the versions of equation (1).

It follows, that building such "trading day" regressor variables, like the ones resulting from equation (1), doesn't add any useful information when compared with Tramo/Seats's variable or with the CLD and, therefore, the CLD and Tramo/Seats's variable are more suitable for the correction of this effect.

By construction, calendar regressors as those in equation (1) do not just contain information about the "trading day", but also on other calendar effects like the Easter. While it still remains unclear which role the parameter α_l plays in the proportion of variance captured by this regressor concerning the Easter frequencies. It is much more than the desired one. The fact that not all of the Easter frequencies are accounted for has it origin in the way these regressor variables are constructed; they take into account the non-working days during march or april, but they do not take into consideration the duration of Easter. As depicted on table 5, the periodograms of all the analysed trading day regressors resulting from equation (1) show a high degree of correlation with the ones of the Easter, i.e., to some extent they explain the same features.

Table 5

CORRELATION MATRIX OF THE PERIODOGRAMS OF THE MONTHLY VARIABLES ANALYSED ACROSS 28 YEARS

		Trading day							**Easter**			**LY**
		$\alpha_{Ŧ}$ 0	$\alpha_{Ŧ}$ 0.5	$\alpha_{Ŧ}$ 1	T/S	**CLD I c/w**	**CLD 2 c/w**	**CLD 3 c/w**	τ= 3	τ= 6	τ= 9	
Trading day	$\alpha_{Ŧ}$ 0	1,00										
	$\alpha_{Ŧ}$ 0.5	0,99	1,00									
	$\alpha_{Ŧ}$ 1	0,98	1,00	1,00								
	T/S	0,96	0,98	0,98	1,00							
	CLD 1 c/w	0,95	0,97	0,98	1,00	1,00						
	CLD 2 c/w	0,16	0,08	0,06	0,03	-0,02	1,00					
	CLD 3 c/w	0,05	0,00	-0,02	-0,02	-0,02	-0,04	1,00				
Easter	τ = 3	0,28	0,21	0,17	0,10	0,08	0,40	0,02	1,00			
	τ= 6	0,19	0,11	0,07	0,01	-0,01	0,43	0,02	0,97	1,00		
	τ= 9	0,18	0,11	0,07	0,01	-0,01	0,44	0,01	0,96	1,00	1,00	
	LY	-0,05	-0,05	-0,05	-0,04	-0,04	-0,06	-0,08	-0,09	-0,10	-0,11	1,00

In this context, a problem of duplicity may arise. At a first glance, one might be tempted to argue that the most unfavourable case would be that of the second variable of Cleveland and Devlin, followed by the trading day regressor using $\alpha_1 = 0$ and $\tau = 3$, where both variables possess a degree of correlation of almost 0.30, a percentage that goes down to less than 10% in the case of $\alpha_1 = 1$ and $\tau = 9$. Further, the Tramo/Seats and the Cleveland & Devlin's regressors with one and three cycles per week show a better performance, as their periodograms show a degree of correlation of almost 0.

Nonetheless, more informative than the correlation is the spectral coherence, which takes into account, not the degree of co-movement in the spectra, but also the conformity of two spectra across each frequency. It can be defined as,

$$SC = \frac{\left|f_{xy}\right|^2}{f_{xx} \cdot f_{yy}} \tag{6}$$

where f_{xy} stands for the cross-spectrum between two variables and f_{xx} and f_{yy} are the respective spectra of the analysed variables.

The spectral coherence between the Easter regressor and the diverse trading day variables and the leap year regressor is as depicted on the following tables (tables 6 to 8).

Table 6

SPECTRAL COHERENCE BETWEEN THE MONTHLY EASTER REGRESSOR $(\tau = 3)$ AND THE TRADING DAY AND LEAP YEAR VARIABLES ACROSS 28 YEARS

Cycles/Year	Spectral coherence								Value of the periodogram for 28 years
	Easter using $\tau = 3$ versus								
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	T/S	CLD 1 c/w	CLD 2 c/w	CLD 3 c/w	Leap year	
0.105	0.12	0.12	0.14	0.04	0.06	0.02	0.06	0.36	0.000
0.263	0.00	0.04	0.07	0.20	0.01	0.46	0.02	0.15	0.005
0.368	0.08	0.10	0.15	0.22	0.03	0.27	0.01	0.06	0.021
0.632	0.26	0.25	0.17	0.42	0.01	0.53	0.05	0.09	0.064
0.737	0.25	0.25	0.20	0.27	0.07	0.31	0.16	0.24	0.033
0.895	0.13	0.16	0.16	0.36	0.31	0.16	0.32	0.06	0.005
1.105	0.51	0.41	0.36	0.36	0.30	0.14	0.21	0.15	0.007
1.263	0.10	0.05	0.04	0.27	0.05	0.42	0.16	0.20	0.101
1.368	0.39	0.33	0.22	0.31	0.01	0.48	0.02	0.07	0.286
1.632	0.60	0.51	0.37	0.21	0.00	0.41	0.01	0.08	0.404

(Sigue)

(Continuación)

Cycles/Year	Spectral coherence								Value of the periodogram for 28 years
	Easter using $\tau = 3$ versus								
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**T/S**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**	**Leap year**	
1.737	0.66	0.58	0.42	0.17	0.08	0.31	0.08	0.23	0.179
1.895	0.42	0.41	0.39	0.21	0.35	0.13	0.26	0.09	0.020
2.105	0.20	0.19	0.17	0.09	0.31	0.16	0.03	0.13	0.025
2.263	0.43	0.49	0.51	0.09	0.05	0.26	0.04	0.21	0.297
2.368	0.72	0.79	0.81	0.38	0.06	0.38	0.03	0.08	0.788
2.632	0.73	0.79	0.76	0.40	0.01	0.55	0.02	0.08	0.949
2.737	0.56	0.52	0.41	0.10	0.06	0.33	0.10	0.22	0.403
2.895	0.61	0.42	0.28	0.44	0.36	0.17	0.12	0.10	0.043
3.105	0.74	0.79	0.70	0.40	0.36	0.10	0.23	0.12	0.048
3.263	0.67	0.62	0.47	0.03	0.05	0.23	0.13	0.21	0.539
3.368	0.59	0.60	0.50	0.21	0.01	0.38	0.01	0.08	1.392
3.632	0.70	0.69	0.54	0.66	0.04	0.59	0.03	0.08	1.554
3.737	0.63	0.50	0.32	0.43	0.13	0.43	0.17	0.22	0.645
3.895	0.47	0.52	0.51	0.26	0.31	0.10	0.29	0.10	0.065
4.105	0.41	0.39	0.36	0.29	0.29	0.09	0.19	0.12	0.070
4.263	0.26	0.20	0.16	0.06	0.04	0.29	0.10	0.21	0.762
4.368	0.26	0.19	0.15	0.01	0.02	0.49	0.04	0.08	1.938
4.632	0.48	0.36	0.25	0.02	0.07	0.58	0.05	0.08	2.056
4.737	0.45	0.34	0.27	0.06	0.01	0.39	0.19	0.22	0.840
4.895	0.42	0.32	0.26	0.04	0.07	0.18	0.26	0.11	0.083
5.105	0.01	0.03	0.06	0.21	0.22	0.21	0.12	0.11	0.085
5.263	0.31	0.22	0.17	0.04	0.04	0.20	0.01	0.22	0.908
5.368	0.71	0.72	0.67	0.01	0.00	0.21	0.01	0.08	2.277
5.632	0.71	0.78	0.81	0.10	0.00	0.44	0.02	0.08	2.321
5.737	0.69	0.66	0.59	0.01	0.02	0.31	0.11	0.22	0.936
5.895	0.54	0.47	0.40	0.18	0.19	0.10	0.06	0.11	0.090

Table 7

SPECTRAL COHERENCE BETWEEN THE MONTHLY EASTER REGRESSOR $(\tau = 6)$ AND THE TRADING DAY AND LEAP YEAR VARIABLES ACROSS 28 YEARS

Cycles/Year	**Spectral coherence**								**Value of the periodogram for 28 years**
	Easter using $\tau = 6$ versus								
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**T/S**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**	**Leap year**	
0.105	0.04	0.04	0.04	0.01	0.03	0.11	0.08	0.21	0.000
0.263	0.01	0.01	0.05	0.28	0.03	0.53	0.01	0.06	0.004
0.368	0.07	0.03	0.07	0.20	0.01	0.31	0.02	0.02	0.026
0.632	0.20	0.22	0.19	0.42	0.01	0.61	0.04	0.03	0.079
0.737	0.12	0.14	0.13	0.16	0.02	0.42	0.15	0.11	0.029
0.895	0.11	0.11	0.10	0.17	0.18	0.08	0.49	0.06	0.006
1.105	0.30	0.23	0.21	0.22	0.15	0.04	0.37	0.11	0.009
1.263	0.14	0.06	0.02	0.20	0.02	0.53	0.15	0.09	0.088
1.368	0.41	0.36	0.26	0.35	0.01	0.55	0.01	0.02	0.351
1.632	0.53	0.49	0.38	0.22	0.01	0.51	0.01	0.02	0.497
1.737	0.61	0.56	0.42	0.11	0.01	0.43	0.06	0.10	0.155
1.895	0.36	0.31	0.26	0.19	0.16	0.16	0.26	0.08	0.025
2.105	0.17	0.16	0.14	0.01	0.14	0.14	0.08	0.10	0.031
2.263	0.57	0.60	0.60	0.16	0.01	0.29	0.05	0.09	0.257
2.368	0.77	0.82	0.80	0.37	0.08	0.36	0.03	0.02	0.967
2.632	0.74	0.83	0.81	0.46	0.02	0.61	0.03	0.02	1.167
2.737	0.59	0.63	0.55	0.14	0.01	0.42	0.08	0.10	0.348
2.895	0.39	0.20	0.06	0.20	0.13	0.14	0.15	0.08	0.053
3.105	0.73	0.60	0.41	0.14	0.13	0.06	0.24	0.10	0.059
3.263	0.65	0.60	0.47	0.06	0.00	0.29	0.11	0.09	0.467
3.368	0.56	0.62	0.59	0.27	0.00	0.43	0.01	0.02	1.710
3.632	0.73	0.72	0.57	0.73	0.02	0.66	0.02	0.02	1.910
3.737	0.70	0.48	0.28	0.52	0.06	0.55	0.15	0.10	0.558
3.895	0.37	0.31	0.25	0.13	0.14	0.06	0.42	0.08	0.081
4.105	0.23	0.19	0.16	0.13	0.13	0.08	0.33	0.09	0.087
4.263	0.13	0.09	0.07	0.02	0.02	0.35	0.10	0.09	0.660
4.368	0.21	0.17	0.15	0.02	0.03	0.50	0.03	0.02	2.380
4.632	0.51	0.40	0.29	0.06	0.04	0.61	0.05	0.02	2.527
4.737	0.37	0.28	0.24	0.13	0.03	0.48	0.17	0.10	0.727
4.895	0.26	0.21	0.18	0.06	0.03	0.13	0.42	0.09	0.103

(Sigue)

(Continuación)

Cycles/Year	Spectral coherence								Value of the periodogram for 28 years
	Easter using $\tau = 6$ versus								
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**T/S**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**	**Leap year**	
5.105	0.05	0.08	0.10	0.11	0.10	0.17	0.12	0.09	0.106
5.263	0.40	0.35	0.29	0.03	0.02	0.24	0.01	0.09	0.786
5.368	0.65	0.68	0.66	0.02	0.00	0.21	0.01	0.02	2.798
5.632	0.69	0.77	0.79	0.13	0.00	0.47	0.02	0.02	2.852
5.737	0.71	0.68	0.61	0.07	0.01	0.38	0.11	0.09	0.811
5.895	0.77	0.64	0.51	0.06	0.06	0.01	0.10	0.09	0.112

Table 8

SPECTRAL COHERENCE BETWEEN THE MONTHLY EASTER REGRESSOR $(\tau = 9)$ AND THE TRADING DAY AND LEAP YEAR VARIABLES ACROSS 28 YEARS

Cycles/Year	Spectral coherence								Value of the periodogram for 28 years
	Easter using $\tau = 9$ versus								
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**T/S**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**	**Leap year**	
0.105	0.04	0.05	0.05	0.02	0.05	0.12	0.04	0.10	0.000
0.263	0.03	0.01	0.04	0.36	0.05	0.58	0.02	0.02	0.003
0.368	0.07	0.03	0.06	0.22	0.02	0.37	0.02	0.00	0.028
0.632	0.18	0.21	0.20	0.48	0.00	0.65	0.04	0.01	0.085
0.737	0.09	0.13	0.14	0.19	0.02	0.46	0.17	0.05	0.022
0.895	0.10	0.09	0.09	0.13	0.15	0.09	0.49	0.04	0.008
1.105	0.28	0.19	0.16	0.14	0.12	0.03	0.41	0.06	0.012
1.263	0.17	0.09	0.04	0.21	0.01	0.57	0.13	0.04	0.069
1.368	0.43	0.38	0.29	0.41	0.00	0.60	0.01	0.01	0.377
1.632	0.44	0.40	0.31	0.25	0.00	0.58	0.02	0.01	0.534
1.737	0.48	0.43	0.32	0.13	0.01	0.47	0.06	0.04	0.120
1.895	0.25	0.21	0.19	0.13	0.12	0.19	0.24	0.05	0.032
2.105	0.11	0.09	0.08	0.01	0.09	0.18	0.13	0.06	0.039
2.263	0.54	0.56	0.54	0.13	0.01	0.30	0.06	0.04	0.201
2.368	0.74	0.77	0.73	0.32	0.05	0.35	0.03	0.01	1.039

(Sigue)

(Continuación)

Cycles/Year	Spectral coherence								Value of the periodogram for 28 years
	Easter using $\tau = 9$ versus								
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**T/S**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**	**Leap year**	
2.632	0.72	0.82	0.80	0.50	0.01	0.65	0.02	0.01	1.254
2.737	0.58	0.63	0.56	0.17	0.01	0.45	0.06	0.04	0.271
2.895	0.37	0.21	0.08	0.20	0.08	0.18	0.12	0.05	0.068
3.105	0.69	0.55	0.37	0.11	0.09	0.07	0.21	0.06	0.076
3.263	0.58	0.53	0.41	0.07	0.00	0.31	0.10	0.04	0.364
3.368	0.50	0.58	0.58	0.31	0.00	0.47	0.01	0.01	1.837
3.632	0.71	0.69	0.54	0.75	0.01	0.71	0.03	0.01	2.052
3.737	0.69	0.46	0.24	0.50	0.07	0.59	0.15	0.04	0.434
3.895	0.30	0.23	0.18	0.09	0.11	0.04	0.44	0.05	0.104
4.105	0.19	0.16	0.13	0.10	0.10	0.13	0.40	0.06	0.111
4.263	0.10	0.08	0.06	0.01	0.01	0.37	0.12	0.04	0.515
4.368	0.20	0.16	0.14	0.02	0.02	0.51	0.04	0.01	2.557
4.632	0.52	0.42	0.31	0.09	0.02	0.64	0.05	0.01	2.714
4.737	0.36	0.28	0.24	0.15	0.04	0.50	0.15	0.04	0.566
4.895	0.27	0.24	0.21	0.09	0.07	0.14	0.42	0.05	0.132
5.105	0.03	0.06	0.07	0.10	0.09	0.19	0.18	0.06	0.136
5.263	0.38	0.32	0.27	0.02	0.01	0.26	0.01	0.04	0.613
5.368	0.63	0.65	0.62	0.02	0.00	0.22	0.02	0.01	3.005
5.632	0.67	0.73	0.74	0.13	0.00	0.50	0.02	0.01	3.063
5.737	0.68	0.64	0.56	0.07	0.01	0.42	0.09	0.04	0.632
5.895	0.75	0.60	0.47	0.05	0.07	0.01	0.09	0.05	0.143

From these tables it can be noted that, for all values of the parameters τ and α_1, in general terms, there exists a high conformity between the calendar regressor resulting from equation (1) and the Easter regressor. In comparison with this feature, the spectral coherence between the Easter regressor and Tramo/Seats variable and the CLD 1 c/w is lower, more in the latter case than in the first one. Another interesting aspects are that the lower τ is set, the higher is the mean spectral coherence and that the higher the value of the parameter τ the higher is the spectral coherence between the CLD 2 c/w and the CLD 3 c/w with respect to the Easter regressor.

Additionally, it should be borne in mind that, although the final effect of the CLD variables would be that of a linear combination of all three variables, the most predominant feature in economic time series is that of one cycle per week. Considering this aspect, Cleveland and Devlin's variable might be regarded as the first-best option in what concerns the low spectral coherence and its low correlation with respect to the Easter regressor. The second-best option would be that of the one-parameter-specification used by Tramo/Seats.

In addition, the spectral coherence between the leap year regressor and the diverse trading day variables, the Tramo/Seats variable shows a better behaviour than any of the other trading day variables. The CLD variable possesses a high spectral coherence at frequencies that are multiples of 0.5 cycles/year with the leap year regressor, reaching a maximum of almost 0.57 points (see table 9).

Table 9

SPECTRAL COHERENCE (SC) BETWEEN THE MONTHLY LEAP YEAR REGRESSOR AND THE TRADING DAY VARIABLES ACROSS 28 YEARS

	Leap year regressor vs						
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**Tramo/ Seats**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**
Mean SC	0,1170	0,1078	0,0876	0,0426	0,1034	0,0236	0,0133
Min SC	0,0062	0,0139	0,0045	0,0013	0,0000	0,0007	0,0005
Max SC	0,3807	0,3046	0,2694	0,1966	0,5704	0,2987	0,1082
Standard deviation of SC	0,1012	0,0942	0,0777	0,0406	0,1139	0,0577	0,0213

This is a sign that the CLD would also be capturing, at some frequencies, the leap year effect. Nonetheless, the mean spectral coherence between both effects remains very low, indicating that the CLD does not fully capture all the characteristics of the leap year effect. Thus, if a time series had no Easter effects, but yes leap year and trading day effects, the best alternative would be that of employing the Tramo/Seats variable instead of the CLD variable.

4.2. The correction of yearly economic data using calendar regressors

As in the monthly case, the yearly deviations have been computed in order to form a variable, which could be used for correcting a yearly figure from "trading day" effects[16].

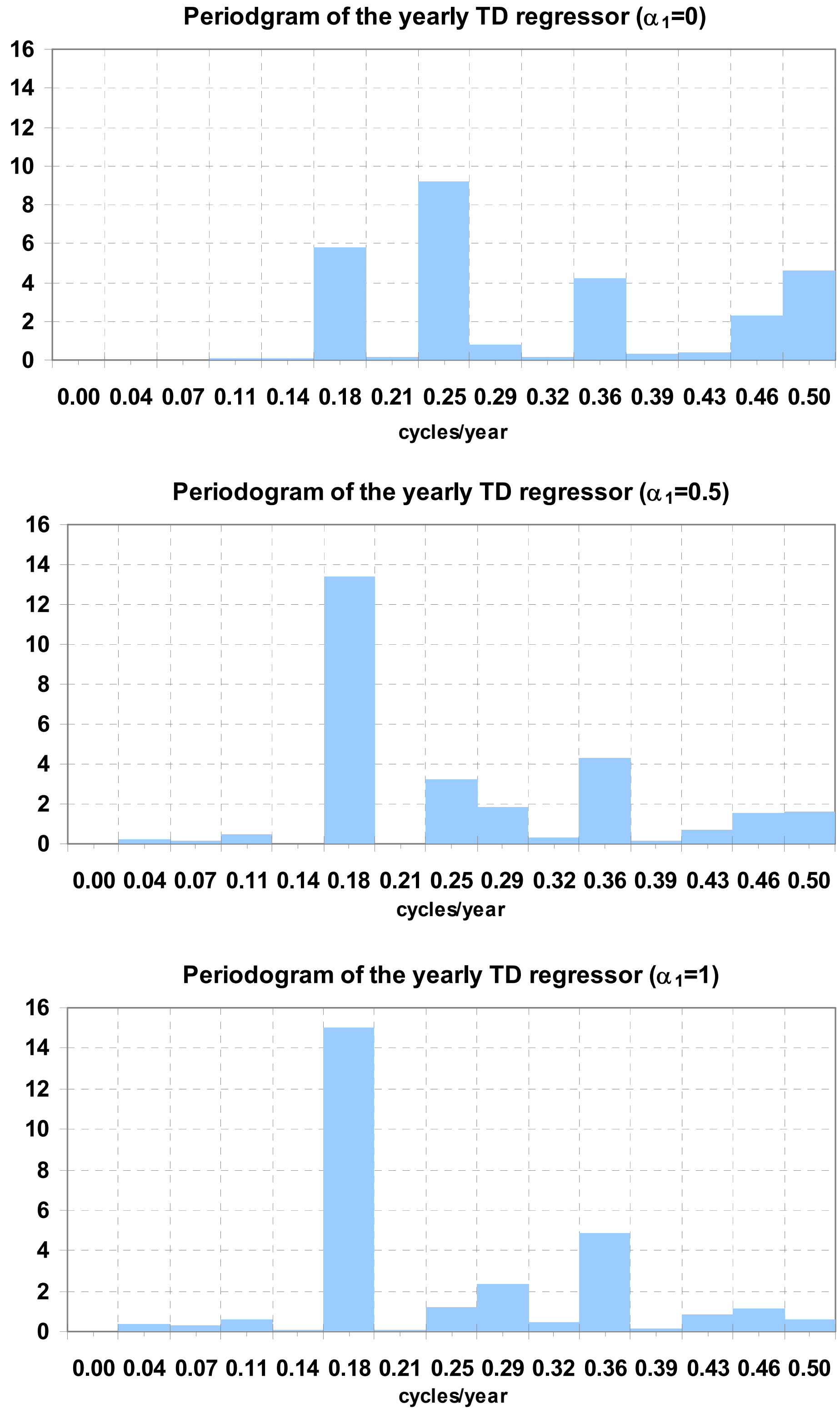
The monthly differences from the average monthly-specific averages across 28 years were added across the corresponding years. Further, these variables were standarised in order to be able to establish a comparison between them, yielding the following results.

---

[16] Following an analogous methodology as the one proposed at the joint ECB-EUROSTAT Steering Group on Seasonal Adjustment.

Figure 6

PERIODOGRAM OF THE YEARLY TRADING DAY REGRESSOR ACROSS 28 YEARS



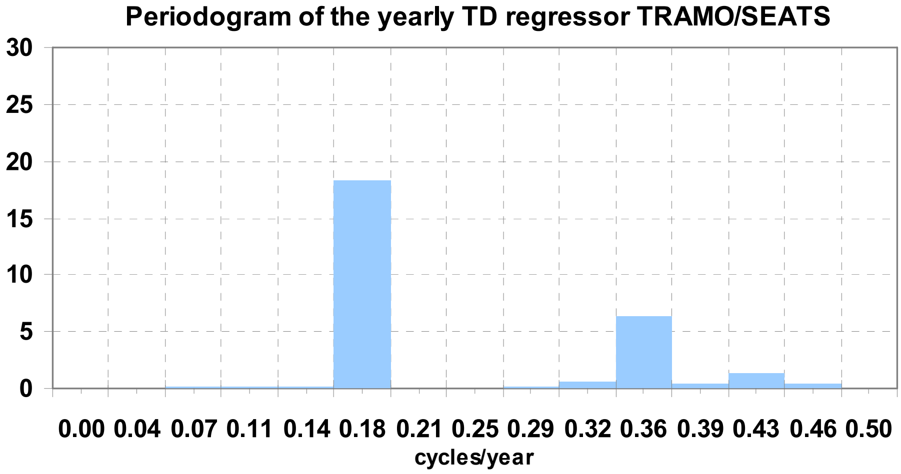
The aggregation of these variables to yearly figures is reflected on three main frequencies. The first one, 0.1786 cycles/year (the first trading-day frequency on yearly data), is stronger the less Saturdays are accounted for as working days. Also, it can be noted that the more Saturdays are taken into consideration as working days, the higher is the spike on 0.25 cycles/year, which corresponds to a cycle every four years, thus, correcting for the leap year and eliminating part of the trend-cycle if employed for correcting yearly series. Furthermore, the second frequency, 0.3571 cycles/year, which could be associated to the second trading day frequency, is more or less stable across all three variables.

Moreover, another side-effect is made visible on the spectra: the less Saturdays are taken into consideration as working days, the stronger is the signal on other frequencies (0.036, 0.071, 0.107, 0.25). In this sense, such a regressor variable would remove information on the trend-cycle component[17].

The spectra of these regressors point towards the fact that they are not as "clean" as they should be if they were to be used for removing the "trading day" effect from yearly economic data. Instead, by using such variables, some additional information concerning the trend and the cycle of the series would be eliminated. This can be tracked back to the problem that it would be undistinguishable if growth has been stronger/lower, because of more/less trading days in a year, or because of the behaviour of the economic trend-cycle. Moreover, the annual spectra of the Tramo/Seats variable and of the CLD were plotted in figure 7.

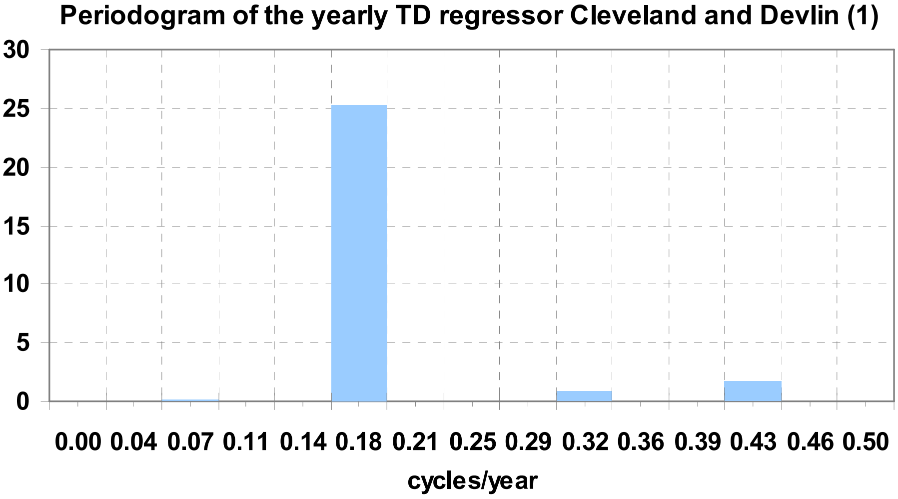
Figure 7

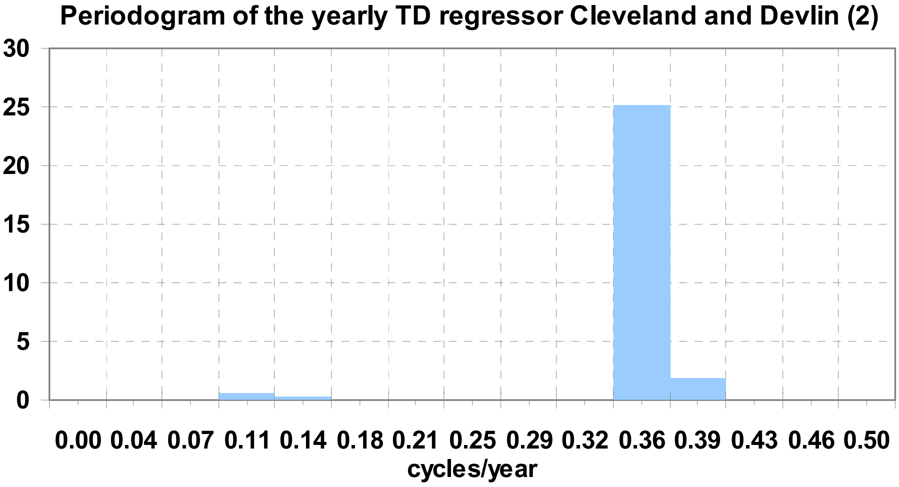
PERIODOGRAM OF THE YEARLY TRAMO/SEATS AND CLEVELAND & DEVLIN'S TRADING DAY REGRESSORS (28 years)

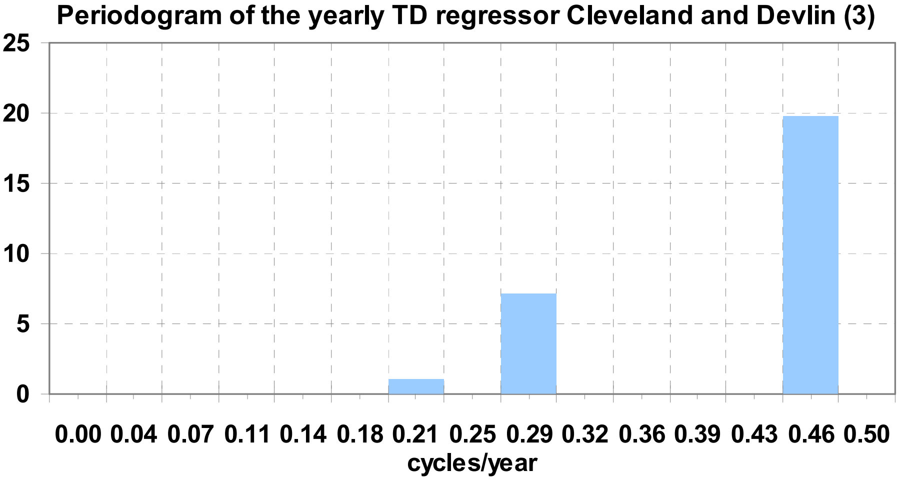


---

[17] Which should be inexistent if the regressor variable was to be used for the aforementioned purposes.







As in the monthly case, both, the Tramo/Seats variable and the CLD are superior to the yearly data resulting from the regressors from equation (1) as they capture much more of the variance due to the "trading day" effect, while inducing less noise on other frequencies. This feature can also be appreciated in the low spectral coherence between the Tramo/Seats and the CLD variables and the annual sub-series of the Easter regressor.

Moreover, concerning the spectral coherence between the diverse calendar regressors and the annual sub-series of the leap year, the lower α_1 is set the higher is its spectral coherence. In this case the CLD 1 c/w variable shows an important degree of spectral coherence with respect to the annual sub-series of the leap year, i.e., it incorporates some relevant information on the leap year effect (see, table 10).

Table 10

SPECTRAL COHERENCE (SC) BETWEEN THE ANNUAL SUB-SERIES OF THE EASTER AND THE TRADING DAY VARIABLES ACROSS 28 YEARS

$\tau = 3$	Easter annual sub-series vs						
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**Tramo/ Seats**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**
Mean SC	0,1332	0,1216	0,1676	0,1022	0,0108	0,3192	0,1669
Min SC	0,1160	0,1022	0,1614	0,0963	0,0072	0,2473	0,1599
Max SC	0,1504	0,1410	0,1737	0,1081	0,0143	0,3911	0,1739
Standard deviation of SC	0,0172	0,0194	0,0062	0,0059	0,0035	0,0719	0,0070
$\tau = 6$							
Mean SC	0,1241	0,1737	0,2211	0,1687	0,0086	0,3701	0,0721
Min SC	0,1159	0,1579	0,2089	0,1641	0,0084	0,3280	0,0677
Max SC	0,1322	0,1895	0,2332	0,1734	0,0088	0,4121	0,0766
Standard deviation of SC	0,0082	0,0158	0,0121	0,0047	0,0002	0,0421	0,0044
$\tau = 9$							
Mean SC	0,1034	0,1150	0,1498	0,1308	0,0043	0,3589	0,0473
Min SC	0,1031	0,1067	0,1412	0,1284	0,0041	0,3172	0,0431
Max SC	0,1038	0,1234	0,1584	0,1332	0,0045	0,4005	0,0515
Standard deviation of SC	0,0004	0,0084	0,0086	0,0024	0,0002	0,0417	0,0042

Table 11

SPECTRAL COHERENCE (SC) BETWEEN THE ANNUAL SUB-SERIES OF THE LEAP YEAR AND THE TRADING DAY VARIABLES ACROSS 28 YEARS

	Leap year regressor vs						
	$\alpha_1 = 0$	$\alpha_1 = 0.5$	$\alpha_1 = 1$	**Tramo/ Seats**	**CLD 1 c/w**	**CLD 2 c/w**	**CLD 3 c/w**
Mean SC	0,6589	0,3805	0,2594	0,2102	0,2679	0,0134	0,0123
Min SC	0,3956	0,0083	0,0047	0,0231	0,0142	0,0040	0,0046
Max SC	0,8625	0,7531	0,5645	0,4815	0,6475	0,0275	0,0268
Standard deviation of SC	0,1952	0,3041	0,2313	0,1964	0,2734	0,0101	0,0103

5. SOME CONCLUDING REMARKS

The first conclusion of this note is that more research is needed before applying a set of calendar regressors to economic time series in order to pre-treat them at a first stage of the seasonal adjustment. Some ad-hoc variables, like the ones presented in equation (1) and which aim at eliminating calendar effects like the trading-day, present a high degree of spectral coherence with respect to other calendar effects. This may lead to an under- or overestimation of calendar effects and could be especially harmful in the seasonal adjustment of economic time series.

Moreover, the use of calendars, as proposed by Eurostat (2007 and 2002) presents some drawbacks when compared with the standard regressors used by Tramo/Seats or the variables put forward by Cleveland and Devlin (1982). In this respect, although the interaction between them and the leap year should be closely investigated, the variables developed by Cleveland and Devlin offer the best results of all the methods considered.

Also, special attention should be paid to the construction of calendar-effect regressors. If a calendar regressor without any information on the seasonal frequencies is to be built, this should be done carefully and taking into account not the sample monthly-specific mean values, but the “real” monthly-specific values. Indeed, in doing so the periodograms may show at some stage residual seasonality in the respective periodograms, but this seasonality is spurious, as it has been induced by the time-span of the analysis. On the contrary, if the sample monthly-specific mean values are employed, these values would change from period to period, thus leading to a high instability in the computed seasonal pattern, as these monthly-specific means would over- or underestimate the seasonal “component” present in the calendar regressors.

Therefore, for avoiding an unstable and uncertain decomposition of the stochastic components of a time series, the use of ad-hoc calendar regressors like the one in equation (1) should be limited to the case where no other way of estimating calendar effects is feasible.

REFERENCES

ALLER, R.M. (1957): “Introducción a la Astronomía.”, Consejo Superior de Investigaciones Científicas (CSIC), Madrid.

BELL, W.R. and MARTIN, D.E.K. (2004): “Modeling Time-Varying Trading-Day Effects in Monthly Time Series.”. US. Census Bureau.

BESKIN, N.M. (1980): “Fascinating Fractions (Little Mathematics Library).”, Ed. Mir Moscow.

BÓGALO, J. y QUILIS, E.M. (2006): “Los efectos de calendario desde un punto de vista frecuencial.”, *Estadística Española*, vol. 48, n.° 161, pp. 135-174.

CLEVELAND, W.S. (1987): “Comments on: ‘Modeling Considerations in the Seasonal Adjustment of Economic Time Series.’”.

CLEVELAND, W.S. and DEVLIN, S.J. (1982): “Calendar Effects in Monthly Time Series: Modelling and Adjustment.”, *Journal of the American Statistical Association*, volume 77, n.° 379, september 1982.

F.G.M. (1927): “Cours de Cosmographie - Pour la Classe de Mathématiques.”, Librairie Générale, Paris.

FINDLEY, D.F. and HOOD, C.C. (2000): “X-12-ARIMA and its Application to Some Italian Indicator Series.”, Seasonal Adjustment Procedures–Experiences and Perspectives.

GÓMEZ, V. and MARAVALL, A. (1998): “Guide for Using the Programs Tramo and Seats”.

HARVEY, A.C. (1989): “Forecasting, Structural Time Series Models and the Kalman Filter.”, Cambridge. Cambridge University Press.

HILLMER, S.C. and BELL, W.R. (1983): “Modeling Time Series with Calendar Variation.”, *Journal of the American Statistical Association*, vol. 78, n.° 383, pp. 526-534, september 1983.

HILLMER, S.C.; BELL, W.R. and TIAO, G.C. (1983): “Modeling Considerations in the Seasonal Adjustment of Economic Time Series.”, In, Zellner, A. (Ed.) “*Applied Time Series Analysis of Economic Data*.”, pp. 74-100. Bureau of the Census.

LADIRAY, D. (2006): “Calendar Effects and Seasonal Adjustment: a Review.”, Conference on Seasonality, Seasonal Adjustment and Their Implications for Short-Term Analysis and Forecasting. EUROSTAT.

LIN, J.L. and LIU, TS. (2002): “Modeling Lunar Calendar Holiday Effects in Taiwan.”, *Taiwan Economic Forecast and Policy* 33 (1), pp. 1-7.

LIU, LON-MU (1980): "*Analysis of Time Series with Calendar Effects.*", Management Science, vol. 26, n.º 1, pp. 106-112, january 1980.

MEEUS, J. (1998): "Astronomical Algorithms.", second edition, Willman-Bell, 1998.

REVILLA, P. (1999): "*Calendar Effects in the Spanish Index of Industrial Production.*", Bulletin of the International Statistical Institute 52nd Session. Finland.

SALINAS, T.S. and HILLMER, S.C. (1987): "Multicollinearity Problems in Modeling Time Series with Trading-Day Variation.", *Journal of Business & Economic Statistics*, vol. 5, n.º 3, pp. 431-436, july 1987.

STATISTICAL OFFICE OF THE EUROPEAN COMMUNITIES/EUROPEAN CENTRAL BANK (2002 and 2007): "Final Report of the Joint ECB/Eurostat Task Force on Seasonal Adjustment of Quarterly National Accounts".

THURY, G. and ZHOU, M. (2006): "Calendar Effects in Monthly Time Series Models.". *Journal of Systems Science and Systems Engineering*. Systems Engineering Society of China, co-published with Springer-Verlag GmbH, pp. 218-230.

WALTER, S.D. (1994): "Calendar Effects in the Analysis of Seasonal Data.", *American Journal of Epidemiology*, vol. 140, n.º 7, pp. 649-657.

ZAVELSKI, F. (1987): "Tiempo y su medición", Ed. Mir Moscow. Colección *Física al alcance de todos*.

SÍNTESIS

PRINCIPALES IMPLICACIONES DE POLÍTICA ECONÓMICA

Los efectos de calendario poseen un importante impacto sobre un gran número de series temporales económicas. Es por tanto que numerosas instituciones nacionales, así como internacionales, han concentrado gran parte de sus esfuerzos en definir y establecer mecanismos de análisis de los efectos de calendario, debido a que la correcta caracterización de dichos efectos permite una identificación más acurada del componente estacional y de ciclo-tendencia de las series temporales económicas.

El presente artículo aborda, desde la perspectiva del análisis en el dominio de las frecuencias, las principales características de los efectos de calendario así como las implicaciones del uso de diversos regresores de empleados en la fase de preajuste en la modelización univariante de series temporales y las posibles interacciones que pueden surgir en función de cómo se definan dichos regresores.

En concreto, siguiendo el hilo expositivo de Bógalo y Quilis (2004), y después de examinar en detalle las principales características frecuenciales del año bisiesto y de la Pascua móvil, en este artículo se analizan los regresores empleados por el software Tramo/Seats, así como los expuestos en Cleveland y Devlin (1982), para pasar a determinar las implicaciones del empleo de regresores basados en el cómputo de días laborables.

Por otra parte, el artículo aborda la cuestión de cómo debieran ser formados los regresores de efectos de calendario a fin de que dichas variables tan sólo posean información en las frecuencias no estacionales. En este sentido, en numerosos casos se recurre a la eliminación de los promedios mensuales muestrales. Esta práctica puede acarrear diversos inconvenientes como la sobreestimación o infraestimación del componente estacional de las series temporales, por lo cual resulta conveniente el empleo de los promedios verdaderos de los fenómenos de calendario.

Finalmente, la principal conclusión del presente artículo radica en que el empleo de regresores de días laborables no sólo resulta inferior al poseer un menor poder explicativo del fenómeno en cuestión, si no que además presenta serios inconvenientes en comparación con el regresor estándar de Tramo/Seats y las variables de Cleveland y Devlin (1982) al poseer un alto grado de coherencia espectral con respecto a la Pascua móvil.

NORMAS DE PUBLICACIÓN DE PAPELES DE TRABAJO DEL INSTITUTO DE ESTUDIOS FISCALES

Esta colección de *Papeles de Trabajo* tiene como objetivo ofrecer un vehículo de expresión a todas aquellas personas interasadas en los temas de Economía Pública. Las normas para la presentación y selección de originales son las siguientes:

1. Todos los originales que se presenten estarán sometidos a evaluación y podrán ser directamente aceptados para su publicación, aceptados sujetos a revisión, o rechazados.

2. Los trabajos deberán enviarse por duplicado a la Subdirección de Estudios Tributarios. Instituto de Estudios Fiscales. Avda. Cardenal Herrera Oria, 378. 28035 Madrid.

3. La extensión máxima de texto escrito, incluidos apéndices y referencias bibliográfícas será de 7000 palabras.

4. Los originales deberán presentarse mecanografiados a doble espacio. En la primera página deberá aparecer el título del trabajo, el nombre del autor(es) y la institución a la que pertenece, así como su dirección postal y electrónica. Además, en la primera página aparecerá también un abstract de no más de 125 palabras, los códigos JEL y las palabras clave.

5. Los epígrafes irán numerados secuencialmente siguiendo la numeración arábiga. Las notas al texto irán numeradas correlativamente y aparecerán al pie de la correspondiente página. Las fórmulas matemáticas se numerarán secuencialmente ajustadas al margen derecho de las mismas. La bibliografía aparecerá al final del trabajo, bajo la inscripción “Referencias” por orden alfabético de autores y, en cada una, ajustándose al siguiente orden: autor(es), año de publicación (distinguiendo a, b, c si hay varias correspondientes al mismo autor(es) y año), título del artículo o libro, título de la revista en cursiva, número de la revista y páginas.

6. En caso de que aparezcan tablas y gráficos, éstos podrán incorporarse directamente al texto o, alternativamente, presentarse todos juntos y debidamente numerados al final del trabajo, antes de la bibliografía.

7. En cualquier caso, se deberá adjuntar un disquete con el trabajo en formato word. Siempre que el documento presente tablas y/o gráficos, éstos deberán aparecer en ficheros independientes. Asimismo, en caso de que los gráficos procedan de tablas creadas en excel, estas deberán incorporarse en el disquete debidamente identificadas.

Junto al original del Papel de Trabajo se entregará también un resumen de un máximo de dos folios que contenga las principales implicaciones de política económica que se deriven de la investigación realizada.

PUBLISHING GUIDELINES OF WORKING PAPERS AT THE INSTITUTE FOR FISCAL STUDIES

This serie of *Papeles de Trabajo* (working papers) aims to provide those having an interest in Public Economics with a vehicle to publicize their ideas. The rules governing submission and selection of papers are the following:

1. The manuscripts submitted will all be assessed and may be directly accepted for publication, accepted with subjections for revision or rejected.

2. The papers shall be sent in duplicate to Subdirección General de Estudios Tributarios (The Deputy Direction of Tax Studies), Instituto de Estudios Fiscales (Institute for Fiscal Studies), Avenida del Cardenal Herrera Oria, nº 378, Madrid 28035.

3. The maximum length of the text including appendices and bibliography will be no more than 7000 words.

4. The originals should be double spaced. The first page of the manuscript should contain the following information: (1) the title; (2) the name and the institutional affiliation of the author(s); (3) an abstract of no more than 125 words; (4) JEL codes and keywords; (5) the postal and e-mail address of the corresponding author.

5. Sections will be numbered in sequence with arabic numerals. Footnotes will be numbered correlatively and will appear at the foot of the corresponding page. Mathematical formulae will be numbered on the right margin of the page in sequence. Bibliographical references will appear at the end of the paper under the heading "References" in alphabetical order of authors. Each reference will have to include in this order the following terms of references: author(s), publishing date (with an a, b or c in case there are several references to the same author(s) and year), title of the article or book, name of the journal in italics, number of the issue and pages.

6. If tables and graphs are necessary, they may be included directly in the text or alternatively presented altogether and duly numbered at the end of the paper, before the bibliography.

7. In any case, a floppy disk will be enclosed in Word format. Whenever the document provides tables and/or graphs, they must be contained in separate files. Furthermore, if graphs are drawn from tables within the Excell package, these must be included in the floppy disk and duly identified.

Together with the original copy of the working paper a brief two-page summary highlighting the main policy implications derived from the research is also requested.

ÚLTIMOS PAPELES DE TRABAJO EDITADOS POR EL INSTITUTO DE ESTUDIOS FISCALES

2004

1/04 Una propuesta para la regulación de precios en el sector del agua: el caso español.
Autores: M.ª Ángeles García Valiñas y Manuel Antonio Muñiz Pérez.

2/04 Eficiencia en educación secundaria e *inputs* no controlables: sensibilidad de los resultados ante modelos alternativos.
Autores: José Manuel Cordero Ferrera, Francisco Pedraja Chaparro y Javier Salinas Jiménez.

3/04 Los efectos de la política fiscal sobre el ahorro privado: evidencia para la OCDE.
Autores: Montserrat Ferre Carracedo, Agustín García García y Julián Ramajo Hernández.

4/04 ¿Qué ha sucedido con la estabilidad del empleo en España? Un análisis desagregado con datos de la EPA: 1987-2003.
Autores: José María Arranz y Carlos García-Serrano.

5/04 La seguridad del empleo en España: evidencia con datos de la EPA (1987-2003).
Autores: José María Arranz y Carlos García-Serrano.

6/04 La ley de Wagner: un análisis sintético.
Autor: Manuel Jaén García.

7/04 La vivienda y la reforma fiscal de 1998: un ejercicio de simulación.
Autor: Miguel Ángel López García.

8/04 Modelo dual de IRPF y equidad: un nuevo enfoque teórico y su aplicación al caso español.
Autor: Fidel Picos Sánchez.

9/04 Public expenditure dynamics in Spain: a simplified model of its determinants.
Autores: Manuel Jaén García y Luis Palma Martos.

10/04 Simulación sobre los hogares españoles de la reforma del IRPF de 2003. Efectos sobre la oferta laboral, recaudación, distribución y bienestar.
Autores: Juan Manuel Castañer Carrasco, Desiderio Romero Jordán y José Félix Sanz Sanz.

11/04 Financiación de las Haciendas regionales españolas y experiencia comparada.
Autor: David Cantarero Prieto.

12/04 Multidimensional indices of housing deprivation with application to Spain.
Autores: Luis Ayala y Carolina Navarro.

13/04 Multiple ocurrence of welfare recipiency: determinants and policy implications.
Autores: Luis Ayala y Magdalena Rodríguez.

14/04 Imposición efectiva sobre las rentas laborales en la reforma del impuesto sobre la renta personal (IRPF) de 2003 en España.
Autoras: María Pazos Morán y Teresa Pérez Barrasa.

15/04 Factores determinantes de la distribución personal de la renta: un estudio empírico a partir del PHOGUE.
Autores: Marta Pascual y José María Sarabia.

16/04 Política familiar, imposición efectiva e incentivos al trabajo en la reforma de la imposición sobre la renta personal (IRPF) de 2003 en España.
Autoras: María Pazos Morán y Teresa Pérez Barrasa.

17/04 Efectos del déficit público: evidencia empírica mediante un modelo de panel dinámico para los países de la Unión Europea.
Autor: César Pérez López.

18/04 Inequality, poverty and mobility: Choosing income or consumption as welfare indicators.
Autores: Carlos Gradín, Olga Cantó y Coral del Río.

19/04 Tendencias internacionales en la financiación del gasto sanitario.
Autora: Rosa María Urbanos Garrido.

20/04 El ejercicio de la capacidad normativa de las CCAA en los tributos cedidos: una primera evaluación a través de los tipos impositivos efectivos en el IRPF.
Autores: José María Durán y Alejandro Esteller.

21/04 Explaining. budgetary indiscipline: evidence from spanish municipalities.
Autores: Ignacio Lago-Peñas y Santiago Lago-Peñas.

22/04 Local governmets' asymmetric reactions to grants: looking for the reasons.
Autor: Santiago Lago-Peñas.

23/04 Un pacto de estabilidad para el control del endeudamiento autonómico.
Autor: Roberto Fernández Llera

24/04 Una medida de la calidad del producto de la atención primaria aplicable a los análisis DEA de eficiencia.
Autora: Mariola Pinillos García.

25/04 Distribución de la renta, crecimiento y política fiscal.
Autor: Miguel Ángel Galindo Martín.

26/04 Políticas de inspección óptimas y cumplimiento fiscal.
Autores: Inés Macho Stadler y David Pérez Castrillo.

27/04 ¿Por qué ahorra la gente en planes de pensiones individuales?
Autores: Félix Domínguez Barrero y Julio López-Laborda.

28/04 La reforma del Impuesto sobre Actividades Económicas: una valoración con microdatos de la ciudad de Zaragoza.
Autores: Julio López-Laborda, M.ª Carmen Trueba Cortés y Anabel Zárate Marco.

29/04 Is an inequality-neutral flat tax reform really neutral?
Autores: Juan Prieto-Rodríguez, Juan Gabriel Rodríguez y Rafael Salas.

30/04 El equilibrio presupuestario: las restricciones sobre el déficit.
Autora: Belén Fernández Castro.

2005

1/05 Efectividad de la política de cooperación en innovación: evidencia empírica española.
Autores:Joost Heijs, Liliana Herrera, Mikel Buesa, Javier Sáiz Briones y Patricia Valadez.

2/05 A probabilistic nonparametric estimator.
Autores: Juan Gabriel Rodríguez y Rafael Salas.

3/05 Efectos redistributivos del sistema de pensiones de la seguridad social y factores determinantes de la elección de la edad de jubilación. Un análisis por comunidades autónomas.
Autores: Alfonso Utrilla de la Hoz y Yolanda Ubago Martínez.

4/05 La relación entre los niveles de precios y los niveles de renta y productividad en los países de la zona euro: implicaciones de la convergencia real sobre los diferenciales de inflación.
Autora: Ana R. Martínez Cañete.

5/05 La Reforma de la Regulación en el contexto autonómico.
Autor: Jaime Vallés Giménez.

6/05 Desigualdad y bienestar en la distribución intraterritorial de la renta, 1973-2000.
Autores: Luis Ayala Cañón, Antonio Jurado Málaga y Francisco Pedraja Chaparro.

7/05 Precios inmobiliarios, renta y tipos de interés en España.
Autor: Miguel Ángel López García.

8/05 Un análisis con microdatos de la normativa de control del endeudamiento local.
Autores: Jaime Vallés Giménez, Pedro Pascual Arzoz y Fermín Cabasés Hita.

9/05 Macroeconomics effects of an indirect taxation reform under imperfect competition.
Autor: Ramón J. Torregrosa.

10/05 Análisis de incidencia del gasto público en educación superior: nuevas aproximaciones.
Autora: María Gil Izquierdo.

11/05 Feminización de la pobreza: un análisis dinámico.
Autora: María Martínez Izquierdo.

12/05 Efectos del impuesto sobre las ventas minoristas de determinados hidrocarburos en la economía extremeña: un análisis mediante modelos de equilibrio general aplicado.
Autores: Francisco Javier de Miguel Vélez, Manuel Alejandro Cardenete Flores y Jesús Pérez Mayo.

13/05 La tarifa lineal de Pareto en el contexto de la reforma del IRPF.
Autores: Luis José Imedio Olmedo, Encarnación Macarena Parrado Gallardo y María Dolores Sarrión Gavilán.

14/05 Modelling tax decentralisation and regional growth.
Autores: Ramiro Gil-Serrate y Julio López-Laborda.

15/05 Interactions inequality-polarization: characterization results.
Autores: Juan Prieto-Rodríguez, Juan Gabriel Rodríguez y Rafael Salas.

16/05 Políticas de competencia impositiva y crecimiento: el caso irlandés.
Autores: Santiago Díaz de Sarralde, Carlos Garcimartín y Luis Rivas.

17/05 Optimal provision of public *inputs* in a second-best scenario.
Autores: Diego Martínez López y A. Jesús Sánchez Fuentes.

18/05 Nuevas estimaciones del pleno empleo de las regiones españolas.
Autores: Javier Capó Parrilla y Francisco Gómez García.

19/05 US deficit sustainability revisited: a multiple structural change approach.
Autores: Óscar Bajo-Rubio. Carmen Díaz-Roldán y Vicente Esteve.

20/05 Aproximación a los pesos de calidad de vida de los "Años de Vida Ajustados por Calidad" mediante el estado de salud autopercibido.
Autores: Anna García-Altés, Jaime Pinilla y Salvador Peiró.

21/05 Redistribución y progresividad en el Impuesto sobre Sucesiones y Donaciones: una aplicación al caso de Aragón.
Autor: Miguel Ángel Barberán Lahuerta.

22/05 Estimación de los rendimientos y la depreciación del capital humano para las regiones del sur de España.
Autora: Inés P. Murillo.

23/05 El doble dividendo de la imposición ambiental. Una puesta al día.
Autor: Miguel Enrique Rodríguez Méndez.

24/05 Testing for long-run purchasing power parity in the post bretton woods era: evidence from old and new tests.
Autor: Julián Ramajo Hernández y Montserrat Ferré Cariacedo.

25/05 Análisis de los factores determinantes de las desigualdades internacionales en las emisiones de CO_2 *per cáp*ita aplicando el enfoque distributivo: una metodología de descomposición por factores de Kaya.
Autores: Juan Antonio Duro Moreno y Emilio Padilla Rosa.

26/05 Planificación fiscal con el impuesto dual sobre la renta.
Autores: Félix Domínguez Barrero y Julio López Laborda.

27/05 El coste recaudatorio de las reducciones por aportaciones a planes de pensiones y las deducciones por inversión en vivienda en el IRPF 2002.
Autores: Carmen Marcos García, Alfredo Moreno Sáez, Teresa Pérez Barrasa y César Pérez López.

28/05 La muestra de declarantes IEF-AEAT 2002 y la simulación de reformas fiscales: descripción y aplicación práctica.
Autores: Alfredo Moreno, Fidel Picos, Santiago Díaz de Sarralde, María Antiqueira y Lucía Torrejón.

2006

1/06 Capital gains taxation and progressivity.
Autor: Julio López Laborda.

2/06 Pigou’s dividend *versus* Ramsey’s dividend in the double dividend literature.
Autores: Eduardo L. Giménez y Miguel Rodríguez.

3/06 Assessing tax reforms. Critical comments and proposal: the level and distance effects.
Autores: Santiago Díaz de Sarralde Míguez y Jesús Ruiz-Huerta Carbonell.

4/06 Incidencia y tipos efectivos del impuesto sobre el patrimonio e impuesto sobre sucesiones y donaciones.
Autora: Laura de Pablos Escobar.

5/06 Descentralización fiscal y crecimiento económico en las regiones españolas.
Autores: Patricio Pérez González y David Cantarero Prieto.

6/06 Efectos de la corrupción sobre la productividad: un estudio empírico para los países de la OCDE.
Autores: Javier Salinas Jiménez y M.ª del Mar Salinas Jiménez.

7/06 Simulación de las implicaciones del equilibrio presupuestario sobre la política de inversión de las comunidades autónomas.
Autores: Jaime Vallés Giménez y Anabel Zárate Marco.

8/06 The composition of public spending and the nationalization of party sistems in western Europe.
Autores: Ignacio Lago-Peñas y Santiago Lago.Peñas.

9/06 Factores explicativos de la actividad reguladora de las Comunidades Autónomas (1989-2001).
Autores: Julio López Laborda y Jaime Vallés Giménez.

10/06 Disciplina credititicia de las Comunidades Autónomas.
Autor: Roberto Fernández Llera.

11/06 Are the tax mix and the fiscal pressure converging in the European Union?.
Autor: Francisco J. Delgado Rivero.

12/06 Redistribución, inequidad vertical y horizontal en el impuesto sobre la renta de las personas físicas (1982-1998).
Autora: Irene Perrote.

13/06 Análisis económico del rendimiento en la prueba de conocimientos y destrezas imprescindibles de la Comunidad de Madrid.
Autores: David Trillo del Pozo, Marta Pérez Garrido y José Marcos Crespo.

14/06 Análisis de los procesos privatizadores de empresas públicas en el ámbito internacional. Motivaciones: moda política *versus* necesidad económica.
Autores: Almudena Guarnido Rueda, Manuel Jaén García e Ignacio Amate Fortes.

15/06 Privatización y liberalización del sector telefónico español.
Autores: Almudena Guarnido Rueda, Manuel Jaén García e Ignacio Amate Fortes.

16/06 Un análisis taxonómico de las políticas para PYME en Europa: objetivos, instrumentos y empresas beneficiarias.
Autor: Antonio Fonfría Mesa.

17/06 Modelo de red de cooperación en los parques tecnológicos: un estudio comparado.
Autora: Beatriz González Vázquez.

18/06 Explorando la demanda de carburantes de los hogares españoles: un análisis de sensibilidad.
Autores: Santiago Álvarez García, Marta Jorge García-Inés y Desiderio Romero Jordán.

19/06 Cross-country income mobility comparisons under panel attrition: the relevance of weighting schemes.
Autores: Luis Ayala, Carolina Navarro y Mercedes Sastre.

20/06 Financiación Autonómica: algunos escenarios de reforma de los espacios fiscales.
Autores: Ana Herrero Alcalde, Santiago Díaz de Sarralde, Javier Loscos Fernández, María Antiqueira y José Manuel Tránchez.

21/06 Child nutrition and multiple equilibria in the human capital transition function.
Autores: Berta Rivera, Luis Currais y Paolo Rungo.

22/06 Actitudes de los españoles hacia la hacienda pública.
Autor: José Luis Sáez Lozano.

23/06 Progresividad y redistribución a través del IRPF español: un análisis de bienestar social para el periodo 1982-1998.
Autores: Jorge Onrubia Fernández, María del Carmen Rodado Ruiz, Santiago Díaz de Sarralde y César Pérez López.

24/06 Análisis descriptivo del gasto sanitario español: evolución, desglose, comparativa internacional y relación con la renta.
Autor: Manuel García Goñi.

25/06 El tratamiento de las fuentes de renta en el IRPF y su influencia en la desigualdad y la redistribución.
Autores: Luis Ayala Cañón, Jorge Onrubia Fernández y María del Carmen Rodado Ruiz.

26/06 La reforma del IRPF de 2007: una evaluación de sus efectos.
Autores: Santiago Díaz de Sarralde Míguez, Fidel Picos Sánchez, Alfredo Moreno Sáez, Lucía Torrejón Sanz y María Antiqueira Pérez.

27/06 Proyección del cuadro macroeconómico y de las cuentas de los sectores institucionales mediante un modelo de equilibrio.
Autores: Ana María Abad, Ángel Cuevas y Enrique M. Quilis.

28/06 Análisis de la propuesta del tesoro Británico “Fiscal Stabilisation and EMU” y de sus implicaciones para la política económica en la Unión Europea.
Autor: Juan E. Castañeda Fernández.

29/06 Choosing to be different (or not): personal income taxes at the subnational level in Canada and Spain.
Autores: Violeta Ruiz Almendral y François Vaillancourt.

30/06 A projection model of the contributory pension expenditure of the Spanish social security system: 2004-2050.
Autores: Joan Gil, Miguel Ángel Lopez-García, Jorge Onrubia, Concepció Patxot y Guadalupe Souto.

2007

1/07 Efectos macroeconómicos de las políticas fiscales en la UE.
Autores: Oriol Roca Sagalés y Alfredo M. Pereira.

2/07 Deficit sustainability and inflation in EMU: an analysis from the fiscal theory of the price level.
Autores: Óscar Bajo-Rubio, Carmen Díaz-Roldán y Vicente Esteve.

3/07 Contraste empírico del modelo monetario de tipos de cambio: cointegración y ajuste no lineal.
Autor: Julián Ramajo Hernández.

4/07 An empirical analysis of capital taxation: equity *vs*. tax compiance.
Autores: José M.ª Durán Cabré y Alejandro Esteller Moré.

5/07 Education and health in the OECD: a macroeconomic approach.
Autoras: Cecilia Albert y María A. Davia.

6/07 Understanding the effect of education on health across European countries.
Autoras: Cecilia Albert y María A. Davia.

7/07 Polarization, fractionalization and conflict.
Autores: Joan Esteban y Debraj Ray.

8/07 Immigration in a segmented labor market: the effects on welfare.
Autor: Javier Vázquez Grenno.

9/07 On the role of public debt in an OLG Model with endogenous labor supply.
Autor: Miguel Ángel López García.

10/07 Assessing profitability in rice cultivation using the Policy Matrix Analysis and profit-efficient data.
Autores: Andrés J. Picazo-Tadeo, Ernest Reig y Vicent Estruch.

11/07 Equidad y redistribución en el Impuesto sobre Sucesiones y Donaciones: análisis de los efectos de las reformas autonómicas.
Autores: Miguel Ángel Barberán Lahuerta y Marta Melguizo Garde.

12/07 Valoración y determinantes del *stock* de capital salud en la Comunidad Canaria y Cataluña.
Autores: Juan Oliva y Néboa Zozaya.

13/07 La nivelación en el marco de la financiación de las Comunidades Autónomas.
Autores: Ana Herrero Alcalde y Jorge Martínez-Vázquez.

14/07 El gasto en defensa en los países desarrollados: evolución y factores explicativos.
Autor: Antonio Fonfría Mesa.

15/07 Los costes del servicio de abastecimiento de agua. Un análisis necesario para la regulación de precios.
Autores: Ramón Barberán Ortí, Alicia Costa Toda y Alfonso Alegre Val.

16/07 Precios, impuestos y compras transfronterizas de carburantes.
Autores: Andrés Leal Marcos, Julio López Laborda y Fernando Rodrigo Sauco.

17/07 Análisis de la distribución de las emisiones de CO_2 a nivel internacional mediante la adaptación del concepto y las medidas de polarización.
Autores: Juan Antonio Duro Moreno y Emilio Padilla Rosa.

18/07 Foreign direct investment and regional growth: an analysis of the Spanish case.
Autores: Óscar Bajo Rubio, Carmen Díaz Mora y Carmen Díaz Roldán.

19/07 Convergence of fiscal pressure in the EU: a time series approach.
Autores: Francisco J. Delgado y María José Presno.

20/07 Impuestos y protección medioambiental: preferencias y factores.
Autores: María de los Ángeles García Valiñas y Benno Torgler.

21/07 Modelización paramétrica de la distribución personal de la renta en España. Una aproximación a partir de la distribución Beta generalizada de segunda especie.
Autores: Mercedes Prieto Alaiz y Carmelo García Pérez.

22/07 Desigualdad y delincuencia: una aplicación para España.
Autores:Rafael Muñoz de Bustillo, Fernando Martín Mayoral y Pablo de Pedraza.

23/07 Crecimiento económico, productividad y actividad normativa: el caso de las Comunidades Autónomas.
Autor: Jaime Vallés Giménez.

24/07 Descentralización fiscal y tributación ambiental. El caso del agua en España.
Autores: Anabel Zárate Marco, Jaime Vallés Giménez y Carmen Trueba Cortés.

25/07 Tributación ambiental en un contexto federal. Una aplicación empírica para los residuos industriales en España.
Autores: Anabel Zárate Marco, Jaime Vallés Giménez y Carmen Trueba Cortés.

26/07 Permisos de maternidad, paternidad y parentales en Europa: algunos elementos para el análisis de la situación actual.
Autoras: Carmen Castro García y María Pazos Morán.

27/07 ¿Quién soporta las cotizaciones sociales empresariales?. Una panorámica de la literatura empírica.
Autor: Ángel Melguizo Esteso.

28/07 Una propuesta de financiación municipal.
Autores: Manuel Esteban Cabrera y José Sánchez Maldonado.

29/07 Do R&D programs of different government levels overlap in the European Union.
Autoras: Isabel Busom y Andrea Fernández-Ribas.

30/07 Proyecciones de tablas de mortalidad dinámicas de España y sus Comunidades Autónomas.
Autores: Javier Alonso Meseguer y Simón Sosvilla Rivero.

2008

1/08 Estudio descriptivo del voto económico en España.
Autores: José Luis Sáez Lozano y Antonio M. Jaime Castillo.

2/08 The determinants of tax morale in comparative perspective: evidence from a multilevel analysis.
Autores: Ignacio Lago-Peñas y Santiago Lago-Peñas.

3/08 Fiscal decentralization and the quality of government: evidence from panel data.
Autores: Andreas P. Kyriacou y Oriol Roca-Sagalés.

4/08 The effects of multinationals on host economies: A CGE approach.
Autores: María C. Latorre, Oscar Bajo-Rubio y Antonio G. Gómez-Plana.

5/08 Measuring the effect of spell recurrence on poverty dynamics.
Autores: José María Arranz y Olga Cantó.

6/08 Aspectos distributivos de las diferencias salariales por razón de género en España: un análisis por subgrupos poblacionales.
Autores: Carlos Gradín y Coral del Río.

7/08 Evaluating the regulator: winners and losers in the regulation of Spanish electricity distribution (1988-2002).
Autores: Leticia Blázquez Gómez y Emili Grifell-Tatjé.

8/08 Interacción de la política monetaria y la política fiscal en la UEM: tipos de interés a corto plazo y déficit público.
Autores: Jesús Manuel García Iglesias y Agustín García García.

9/08 A selection model of R&D intensity and market structure in Spanish forms.
Autor: Joaquín Artés.

10/08 Outsourcing behaviour: the role of sunk costs and firm and industry characteristics.
Autoras: Carmen Díaz Mora y Angela Triguero Cano.

11/08 How can the decommodified security ratio assess social protection systems?.
Autor: Georges Menahem.

12/08 Pension policies and income security in retirement: a critical assessment of recent reforms in Portugal.
Autora: Maria Clara Murteira.

13/08 Do unemployment benefit legislative changes affect job finding? Evidence from the Spanish 1992 UI reform act.
Autores: José M. Arranz, Fernando Muñoz Bullón y Juan Muro.

14/08 Migraciones interregionales en España y su relación con algunas políticas públicas.
Autora: María Martínez Torres.

15/08 Entradas y salidas de la pobreza en la Unión Europea: factores determinantes.
Autores: Guillermina Martín Reyes, Elena Bárcena Martín, Antonio Fernández Morales y Antonio García Lizana.

16/08 Income mobility and economic inequality from a regional perspectiva.
Autores: Juan Prieto Rodríguez, Juan Gabriel Rodríguez y Rafael Salas.

17/08 A note on the use of calendar regressors.
Autor: Leandro Navarro Pablo.