# The influence of Lent on marriages and conceptions explored through a new methodology

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**Abstract**

Herteliu et al. (2015) have elsewhere analyzed the impact of religious festivals on births in Romania. Here we broaden the analysis (i) by studying the effect of Lent on marriages as well as births (ii) by analyzing a number of other countries which allows a comparison with non-Orthodox countries. We also introduce a new methodology which treats the data in a way that frees the analysis from bias related to seasonal patterns of births and marriages.

The comparison between the effects on marriages and conceptions appears of particular interest for it permits to assess the respective weighs of social pressure on one hand and personal leanings on the other hand. Our analysis reveals a strong effect of Lent on marriages with a reduction by 80% in Orthodox countries and 40% in West European Catholic and Protestant countries. Since the influence of Lent on conceptions is independent of any form of direct social control one might expect the effect to be much smaller. In percentage terms it is roughly 10 times smaller than the effect on marriage.

The present methodology opens the way to the accurate investigation of the impact of other mobile religious periods (e.g. Ramadan) on various social phenomena (e.g. suicide).

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*Provisional. Comments are welcome.*

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# Introduction

The purpose of our investigation is to find explanations for some puzzling observations in relation with marriage and birth rates. Although we know that nowadays it is fairly uncommon to start a paper by describing intriguing facts[1], in the present case we felt that this presentation could be useful because, beyond the specific issues treated here, it will also emphasize that comparative analysis can be of great help in solving such riddles.

## Marriage rates in March

Our first intriguing observation is the strange pattern of marriage numbers during the month of March in Bulgaria. Such a more or less periodic plot looks like seasonal fluctuations except that here the curve shows *annual* variations in a given month. Why should the number of marriages in 1929 be over 10 times larger than in 1928?
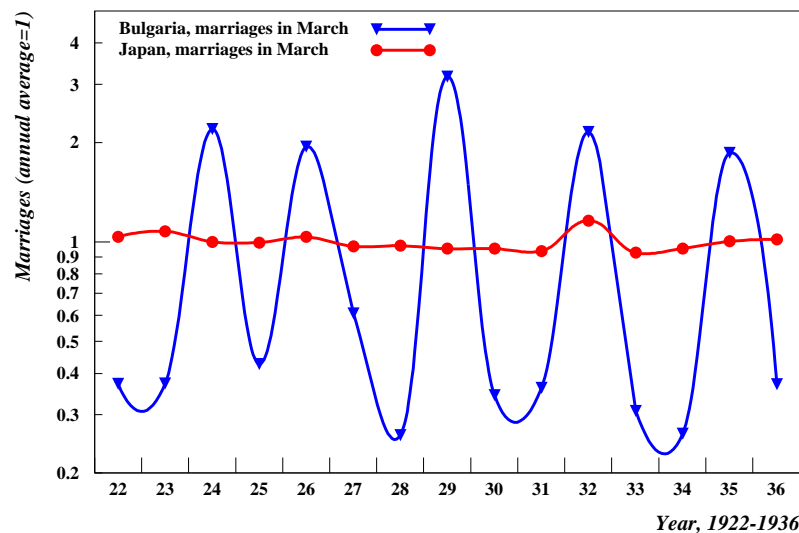


**Fig. 1a   Number of marriages during March in Bulgaria and Japan, 1922-1936.** For the purpose of comparison the two series were normalized. Note the broad range (from 1 to 10) of the Bulgarian changes. Clearly there is a factor at work in Bulgaria which does not exist in Japan. *Source: Bunle (1954, p. 249 and 258.*

Can comparisons with other countries help us to identify the origin of this mysterious pattern?

As a first test, it is natural to try a distant country which differs from Bulgaria in many respects. Fig. 1a shows that what we see in Bulgaria is not a "universal" regularity but rather one that is tied to a specific factor which, obviously, does not exist in Japan.

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[1]In the 18th and 19th centuries, it was common for Academies of Sciences to organize academic contests (rewarded by a cash prize) in which the participants had to explain some challenging facts. For instance, one of those competitions which took place in France in 1818, led to the discovery of the so-called Arago spot, a bright dot at the center of the shadow of an opaque circular object. This unexpected and astounding observation became a key argument in favor of the wave theory of light.
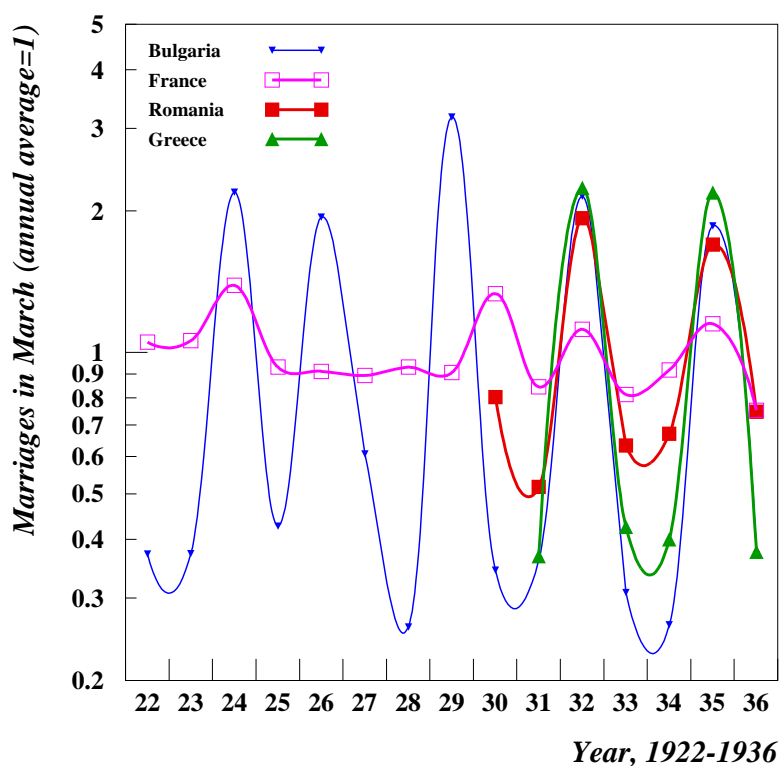
**Fig. 1b Number of marriages during March in Bulgaria, France, Romania and Greece.** For Romania and Greece the data are available only from 1930 and 1931 on. For France the fluctuations are somewhat similar to those in Bulgaria yet not as identical as those of Romania and Greece. *Source: Bunle (1954, p. 249-251 and 255.*

As a second test let us consider another European country, for instance France. The French marriage numbers display fluctuations which are somewhat similar to those in Bulgaria although of much smaller amplitude and not exactly in sync (Fig. 1b). This observation makes us suspect that in France there is a factor similar, yet not identical, to the one at work in Bulgaria.

Greece and Romania have a common border with Bulgaria in the south and north respectively. Although their curves cover only the last years of the interval, the fact that they are highly parallel strongly suggests the existence of the same factor as in Bulgaria. The three countries belong to the Orthodox world. Is this the factor which can explain the observed fluctuations?

A possible mechanism comes to mind.

> In the Christian religion the time preceding the Easter Sunday is called Lent. In the Orthodox religion Lent lasts 7 weeks (i.e. 49 days). As Lent is a time of fasting and penance it is understandable that people will avoid celebrating their marriage during Lent. Can this mechanism account for the fluctuations observed in the number of marriages?

In order to get a quick answer let us observe two extreme cases, namely 1928 (613 marriages) and 1929 (7,462 marriages). In 1928, Orthodox Lent started on 27 February and ended on 14 April which means that the whole month of March was included in the Lent period. On the contrary, in 1929, Lent started on 18 March which means that only 13 days were included in Lent. Actually, in the whole series of years from 1922 to 1936 this is the latest date which explains that 1929 has the largest number of marriages.

By repeating this procedure (which is summarized in Fig, 2) for all the years we get the curves shown in Fig. 3.
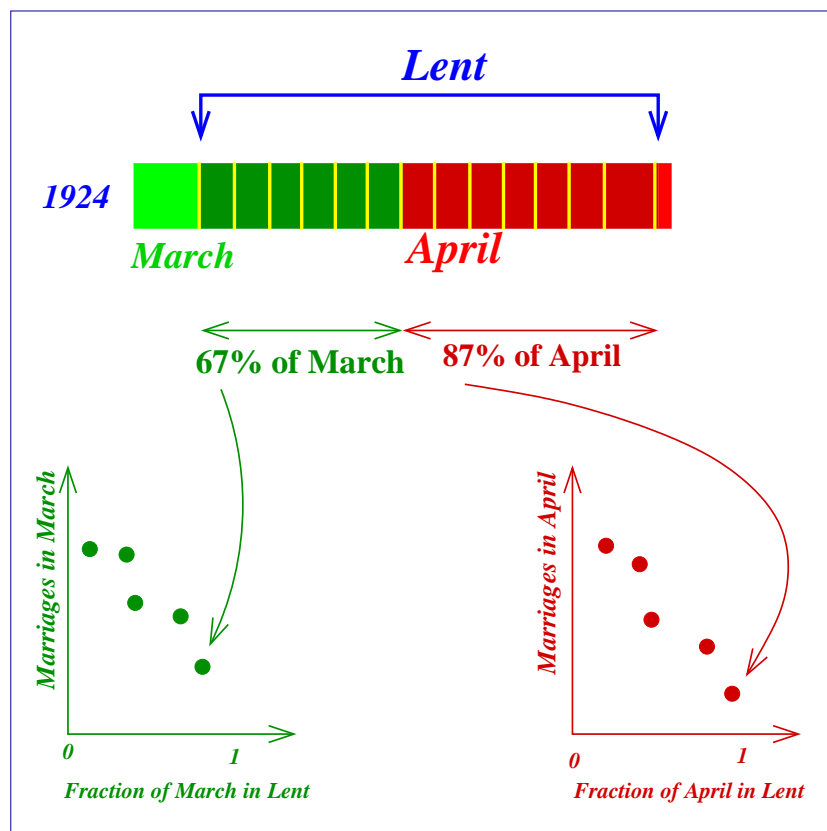


**Fig. 2  Procedure for determining the correlation between Lent-month overlap and the number of marriages in that month.** In 1924 the Orthodox Lent lasted from 10 March to 26 April. The figure shows only March and April. In a few years Lent may start in February which means that there will be a third graph. It is important to keep the graphs of the different months apart in order to avoid any interference caused by the seasonal profile of marriages.

Whereas for Bulgaria one gets a high correlation, we can now also understand why the curve of the marriages in France was out of sink. This is because, except in a few years, the western Lent (i.e. Catholic or Protestant) does not coincide with the Orthodox Lent. The former starts earlier and is somewhat shorter. It lasts 46 days instead of 49[2].

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[2]The western Lent lasts from "Ashes Wednesday" to the Saturday before Easter. Actually the time for fasting lasts only 40 days because the 6 Sundays are excluded. Because, nonetheless all 46 days are a time of penance, we treated
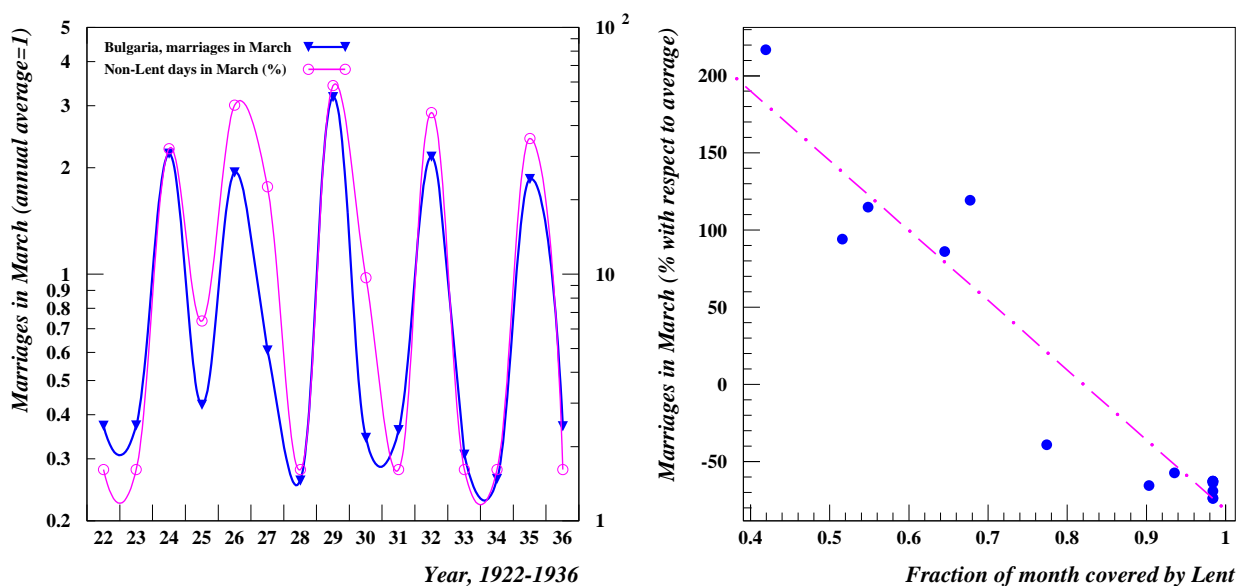
**Fig. 3a,b  Number of marriages during March in Bulgaria versus Lent in March. (a)** Marriages versus non-Lent days. The scale for the non-Lent days is on the right-hand side. **(b)** Scatter-plot for the same data: $x$=Lent days, $y$=marriages. The correlation of the two series is 0.96. *Source: Bunle (1954, p. 249.*

The same procedure can be repeated for all months with which Lent overlaps, that is to say February, March and April. The fact that we get separate estimates for each month is a distinct benefit of this procedure for it permits to completely bypass the nagging difficulty of how to get rid of the seasonal fluctuations of vital rates[3].

## Reduction in marriage numbers during Lent in Orthodox countries

In Orthodox countries the clergy is very reluctant to celebrate marriages during Lent. Thus, if all marriages were celebrated in a religious way the number of marriages during Lent would fall almost to zero. As shown in Fig. 3 and Table 1a, a sizeable number of marriages nonetheless take place during Lent; this gives an estimate of the number of purely civilian marriages

Table 1a gives the correlation and regression results for Bulgaria, Romania and Greece. Lent has a drastic effect on the number of marriages: on average they are nearly divided by 4 and by 10 in the most extreme cases such as March 1928, 1929 considered previously.

## Marriage reduction during Apostles' fast in Orthodox countries

In Orthodox countries, apart from Lent and Advent there is also the Apostles' Fast (also called "Peter and Paul Fast"). In a sense this is an ideal case for applying the overlap methodology explained in Fig. 2 for this fast falls always in June and is of

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them in a uniform way. The same remark applies to the three days before Easter which in some sources are not included in Lent.

[3] Ad hoc corrections can be tentatively defined in various ways but lack clear theoretical justification; moreover there is always the suspicion that the observed effect has in some way been created (or at least modified) by such corrections.

**Table 1: Reduction in the number of marriages during Lent in Orthodox countries**

|  | March | April | Mar-Apr average |
|---|---|---|---|
| Bulgaria, 1922–1936 |  |  |  |
| Correlation $(l, m)$ | $-0.96$ | $-0.88$ | $-0.92$ |
| Reduction, %$(h)$ | $-452 \pm 74$ | $-177 \pm 51$ | $-314 \pm 44$ |
| Romania, 1930–1936 |  |  |  |
| Correlation $(l, m)$ | $-0.98$ | $-0.91$ | $-0.95$ |
| Reduction, %$(h)$ | $-291 \pm 38$ | $-70 \pm 28$ | $-180 \pm 23$ |
| Greece, 1931–1936 |  |  |  |
| Correlation $(l, m)$ | $-0.99$ | $-0.99$ | $-0.99$ |
| Reduction, %$(h)$ | $-443 \pm 57$ | $-184 \pm 19$ | $-313 \pm 27$ |
| Average |  |  |  |
| Correlation $(l, m)$ |  |  | $-0.95$ |
| Reduction, %$(h)$ |  |  | $-269 \pm 22$ |

Notes: In the correlation $m$ denotes the number of marriages whereas $l$ designates the overlap fraction between Lent and the month under consideration. The reduction $h$ is the decrease in marriage number for a month completely included in Lent, i.e. when the overlap fraction increases from 0 to 1. The error bars are confidence intervals for a confidence probability of 0.95. On average, during Lent the reduction is -269% which means that the number of marriages is divided by 3.7. The results for February were omitted because the rare overlaps produce too few data points.
Source: Bunle (1954, p. 248-251).

variable length. It starts on a date which can move from early to late June and ends always on 29 June.

If one applies the overlap procedure for Bulgaria in 1921-1936 one obtains for the correlation between fraction of June covered by fast and marriage rate a value of $-0.39$ (instead of $-0.96$ for Lent) which shows that this fast is enforced with much more flexibility both by the Orthodox Church and by the population. As a matter of fact, in some denominations there has been a secular tendency to reduce this fast to a few days instead of its traditional length.

The same observation probably also applies to Advent. However, in this case, since it is not a mobile time interval one cannot apply the overlap methodology.

### Reduction (or increase) in marriage number in Catholic and Protestant countries.

Table 1b documents the effect of Lent on marriages in two Catholic countries namely France and Spain, one mixed Catholic-Protestant country, namely the Netherlands and two Protestant countries, namely Finland and Sweden.
Two main observations emerge.

- The impact of Lent on marriages is much smaller than in Orthodox countries; in term of percentage it is seven times smaller: 38% as compared to 269%.

**Table 1b: Reduction in the number of marriages during Lent in Catholic and Protestant countries**

|  | February | March | April | Feb-Apr average |
|---|---|---|---|---|
| France, 1922–1936 |  |  |  |  |
| Correlation $(l, m)$ | −0.92 | −0.63 | −0.85 | −0.80 |
| Reduction, % $(h)$ | −46 ± 15 | −90 ± 59 | −25 ± 8 | −53 ± 16 |
| Netherlands, 1922–1936 |  |  |  |  |
| Correlation $(l, m)$ | −0.88 | −0.083 | −0.70 | −0.55 |
| Reduction, % $(h)$ | 39 ± 15 | 6 ± 41 | −22 ± 12 | −22 ± 13 |
| Spain, 1922–1936 |  |  |  |  |
| Correlation $(l, m)$ | −0.45 | −0.57 | −0.77 | −0.60 |
| Reduction, % $(h)$ | 28 ± 41 | −62 ± 49 | −31 ± 13 | 40 ± 20 |
| Average |  |  |  |  |
| Correlation $(l, m)$ |  |  |  | −0.65 |
| Reduction, % $(h)$ |  |  |  | −38 ± 9 |
| Finland, 1922–1936 |  |  |  |  |
| Correlation $(l, m)$ | −0.83 | −0.55 | +0.43 |  |
| Reduction, % $(h)$ | −34 ± 17 | −44 ± 37 | +15 ± 18 |  |
| Sweden, 1922–1936 |  |  |  |  |
| Correlation $(l, m)$ | −0.76 | −0.25 | +0.77 |  |
| Reduction, % $(h)$ | −29 ± 18 | −27 ± 58 | +40 ± 18 |  |

Notes: The meanings of $l, m, h$ are the same as in Table 1a. In France, the Netherlands and Spain, on average, the reduction due to Lent is: -38%. In Finland and Sweden during the month of April instead of a reduction one observes an increase in the number of marriages together with Lent overlap. The reason of this effect remains an open question. For the sake of clarity only averages which had a clear meaning were given in the table. Source: Same as for Table 1a.

- Whereas in the great majority of cases Lent reduces marriage numbers there are two cases where greater Lent overlap results in *higher* marriage numbers. This happened during the month of April in Finland and Sweden[4]. The reason remains an open question.

# Effect of Lent on conceptions

## Effect of new marriages on birth rates

Apart from new marriages does Lent also affect births? Newly married couples may conceive a child shortly after being married; in that way, fluctuations in the number of marriages might induce similar fluctuations 9 months later in birth numbers. Although this argument sounds plausible, a closer examination will tell us that this effect is fairly small.

The argument goes as follows.

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[4]For Denmark there are no data available for 1931-1936. Other Protestant countries which could be tested (and for which data are available) are Australia, Norway, Scotland and the State of Massachusetts in the United States. This will be left for a subsequent study.

First we will describe three observations after which an explanation will be proposed.

For the observations we consider the series of monthly marriages, $M(t)$, and births, $B(t)$, between the years $t_1$ and $t_2$. Then, we translate $B(t)$ to the left by 9 months which gives $B'(t)$. As this operation brings births into coincidence with conceptions it should result in a substantial correlation. This test will be carried out for three countries: Bulgaria, Sweden and France.

*Bulgaria*   Here we take $t_1 = 1930, t_2 = 1936$ which gives 84 monthly data points. The correlation between $M(t)$ and $B'(t)$ is found equal to $0.023$ which means no correlation.

*Sweden*   The time interval is the same and leads to a correlation of $0.30$; the confidence interval with probability 0.95 is (0.07,0.49) which means a low and barely significant correlation.

*France*   Here we take $t_1 = 1925, t_2 = 1936$. The correlation is found equal to $0.49$ with a confidence interval $(0.34, 0.60)$ which indicates a low but significant correlation.

In short, in Bulgaria we found no correlation whereas in France and Sweden we found a low correlation.

## Newly married women versus all women of child bearing age

How can one explain the previous results. Clearly they must be in relation with the share of the conceptions which occur shortly after marriage (itself a subset of first births) in the total of all births. If we assume the same conception rate for all women between the ages of 20 and 30 the number of their conceptions will be proportional to their numbers.

We take the case of Sweden and for the sake of simplicity we limit our discussion to the age interval 20-30. In the 1930s there were on average every month about 4,000 marriages which means 4,000 women joining the pool of all women able to have children. At the census of 1930 there were 520,000 women in the age group $20 - 29$ (Flora et al. 1987, p. 72,134). Thus, the $4,000$ newly married women represented only $0.8\%$ of the total number of women in the age-group $20 - 29$. This percentage will be even smaller in a country like Bulgaria where the fertility rate is higher. In 1930 in Sweden there were 56 births per 1,000 women in the age interval $15 - 49$ whereas there were 120 in Bulgaria (Bunle 1954 p. 78-79).

In other words, it is not at all surprising that we found no correlation in Bulgaria. It is rather the opposite which is surprising, namely that we found a low correlation in France and Sweden. This is probably due to the fact that the monthly fluctuations of births in the whole population are much more stable than the monthly number of marriages.

In the case of France which has the highest correlation we can compute the regression. When each series is expressed in percentage with respect to its average one gets: births=0.16×marriages.

## Expected births versus observed births

Can this coefficient of 0.16 by confirmed by a direct calculation? Fig.4 suggests an argument based on the sheer size of the fall in birth rate as observed between October and December. We focus on the case of Bulgaria. For the interval 1930–1936 the average annual reduction in the number of births was $6,180$. We wish to compare this number to the reduction expected as a consequence of the fall in marriages. For the same 1930–1936 interval there were on average 13,100 marriages in February compared with only 1,900 in March. It results that the reduction in the number of new married woman was $13,100 - 1,900 = 11,200$. As already mentioned above, there were 120 births per 1,000 women in the 15-49 age group. Thus, to the deficit of $11,200$ marriages will correspond an expected deficit of $11.2 \times 120 = 1,340$ births. How does this number compare to the births reduction actually observed? As $\rho = 1,340/6,180 = 21.7\%$, we see that this estimate of the share of the marriage effect in the total birth reduction is compatible with the proportion of $0.16$ given by the regression.

The same calculation performed for France (also over 1930–1936) leads to the following results.
Annual reduction in births between October and November[5]: $2,470$
Annual reduction in marriages between February and March: $7,860$
Number of births for 1,000 women aged 15-49: $68.2$
Expected reduction in births due to the fall in marriages: $7.86 \times 68.2 = 535$
Ratio of expected to observed reduction in births: $\rho = 535/2470 = 21.6\%$

The fact that the two values of $\rho$ are close to each other in spite of a difference in the magnitude of the effect is reassuring,

In conclusion we now know that the fall in marriages accounts for not more than 25% of the observed decrease in birth numbers. The 75% remaining are certainly due to a reduction in conceptions that is to say a change in sexual behavior. Next we present two graphs which give an intuitive idea of this effect. After that we will try to estimate the relationship between Lent and births.

## Evidence for the effect of Lent on births 9 months later

In the first section it was suggested that the origin of the fluctuations of marriage numbers in Bulgaria could be identified through comparative analysis. The same

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[5]We took the difference Oct-Nov instead of Oct-Dec as previously because from Nov to Dec there is an increase; this difference is probably related to the fact that on average western Lent starts about 2 weeks before Orthodox Lent.

message could be repeated here for indeed if considered alone the curves of Fig. 4a,b would not be easy to explain. However, a comparison with Japan and France would again suggest that this effect is related with the Orthodox religion.
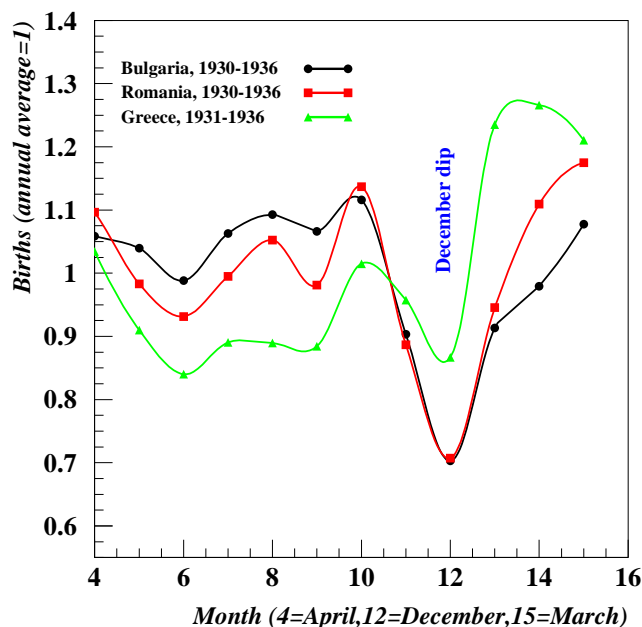


**Fig. 4a  Number of births in Bulgaria from April to March of the following year.** In the context of this paper it will be clear to readers that the dip is due to the effect of Lent 9 months earlier. However, considered alone it would appear fairly mysterious. *Source: Bunle (1954, p. 307,309,311.*

## Two difficulties

The effect of Lent on births is more difficult to study than its impact on marriages for two reasons.

• By comparing Fig.3a and 4b one sees that for births the effect is much smaller than for marriages. This implies a greater relative incidence of background noise. Thus, one should not be surprised to see larger error bars.

• The length of time between sexual intercourse and birth is not known exactly In medical practice it is customary to define the length of pregnancy as the interval between the first day of the woman's last period and birth. Conception usually occurs two weeks later, however. If one accept the traditional figure of 40 weeks (i.e. 280 days) for pregnancy in the medical sense it results in a conception-birth interval of 266 days. Subsequently, we will use the word "pregnancy" as referring to the length time between sexual intercourse (which is zero one or at most two days before conception) and birth; it will be denoted by $G$. Fig. 4b was drawn on the assumption that this time interval was 9 months (i.e. 273 days) but this is only an approximation. The analysis presented in the next subsection will allow us to determine the length of pregnancy that is "statistically optimum".
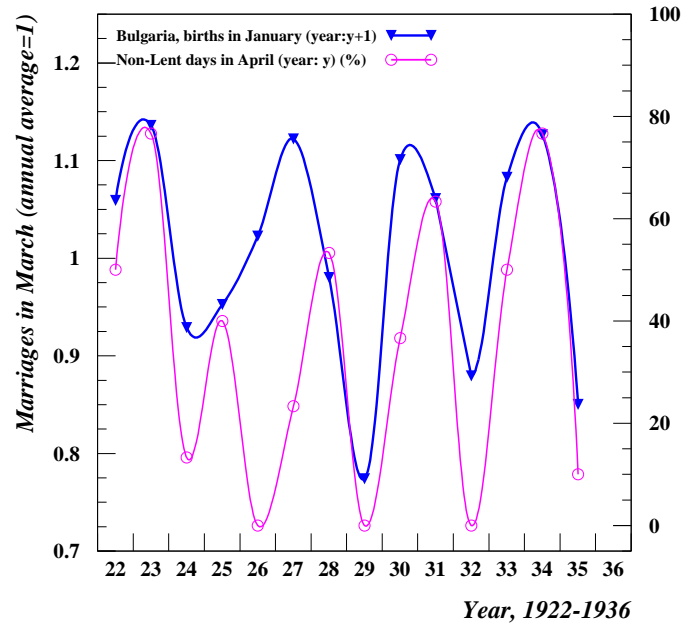
**Fig. 4b Number of births during January in Bulgaria versus number of non-Lent days in April of the previous year.** The scale for the non-Lent days is on the right-hand side. The correlation of the two series is 0.72. This figure parallels Fig.3a which showed the correlation between marriages and non-Lent days. However, in order for the conceptions of April to be mapped into births occurring in January of the following year, the pregnancy length (from conception to birth) has to be exactly equal to 9 months (i.e. 273 days). If its real average length is different (e.g. 280 days) the synchronicity between Lent and births will be affected. *Source: Bunle (1954, p.307).*

## Analysis of the relationship between Lent and births

In this study a simple but important tool was a computer macro which for any day defined by its date (year=$y$, month=$m$ and day of month=$j$) computes its position index $i$ in number of days with respect to a given origin, for instance 1 January 1920. For each of the three months November, December and January the calculation was conducted in the following way (the explanations are for November 1920).

(1) First, the Lent interval of 1920 was translated by $G$ days to the right to an interval $(i_1, i_2)$

(2) Secondly, the overlap of $(i_1, i_2)$ with November was determined. We call it $L$.

(3) The number of birth $m$ in November 1920 was taken from Bunle (1954)

(4) Once the pairs $(L, m)$ have been computed for each of the years under consideration (e.g. 1920-1936) the correlation $r$ and the regression of the $(L, m)$ scatterplot were computed. From the regression slope one derives the change of $m$ when $L$ changes from 0 to 1. Once expressed in percent, this change is denoted by $h$. As for higher $L$ it is a fall in birth numbers that is expected, $r$ and $h$ should be negative; therefore it is natural to consider as optimum the values of $G$ which give the most negative correlations.

(5) As in the procedure used for marriages the months of November, December and January are treated separately. Thus, our results are independent of the seasonal distribution of births. As already emphasized this is a crucial advantage. However, if one wishes to get synthetic indicators one can take the averages $\overline{r}$ and $\overline{h}$ of the three values $r_1, r_2, r_3$ and $h_1, h_2, h_3$. An additional benefit of averaging is to reduce the error bars by a factor $\sqrt{3}$.

*Testing the procedure* In order to test the previous procedure a simulated birth series was built. We started with a constant daily series of birth numbers; then, in each year, for the days belonging to Lent plus $G$ days (with real dates for Lent) the birth numbers were reduced by $q$ percent. After that, the daily series was converted into a monthly series. Finally, a variable amount of random noise could be added to make the series look more realistic. However it is with a purely deterministic series (i.e. without noise) that the most interesting tests can be done. In this case one should get $r_1 = r_2 = r_3 = 1$ and $h_1 = h_2 = h_3 = q$ which is indeed what was verified.

Another instructive test is with respect to the value of $G$. This point is explained in the next subsection.

## Influence of pregnancy length and its significance

Fig. 5a,b shows that the value of the assumed pregnancy length $G$ used in the analysis strongly affects the results. In order to assess the significance of these results it is useful to carry out a test with a simulated series.

In this test we built the simulated series with a pregnancy length $G_1$ and we analyze it with a different value $G_2$. This test shows that even a small difference between $G_1$ and $G_2$ may lead to greatly reduced correlations. For instance, with $G_1 = 273$ days and $G_2 = 276$, the value of $r_2$ falls from 1 to about 0.5 whereas $r_1$ and $r_3$ are hardly affected. This difference between $r_2$ on the one hand and $r_1, r_3$ on the other hand is of course related to the positions of Lent+$G$. Because in most years a large part of December (or even the whole of it) is included in Lent+$G$, most of the $L$ values of this month are close to 1. This makes the scatter plot of December fairly unstable which explains that even a small perturbation may change it completely.

This test suggests that the differences documented in Fig. 5a,b are of significance and that the value of $G$ which gives the highest correlation identifies the $G$ of the real world. In order to substantiate this judgment it would be helpful to find accurate estimates of pregnancy length in different countries. An Internet search was unsuccessful and this is in fact not surprising. Accurate measurement requires exact determination of the moment of ovulation which in turn relies on daily blood tests for hormone levels. As this is a demanding procedure it is understandable that it is not done frequently. Another difficulty comes from the fact that whenever dedicated
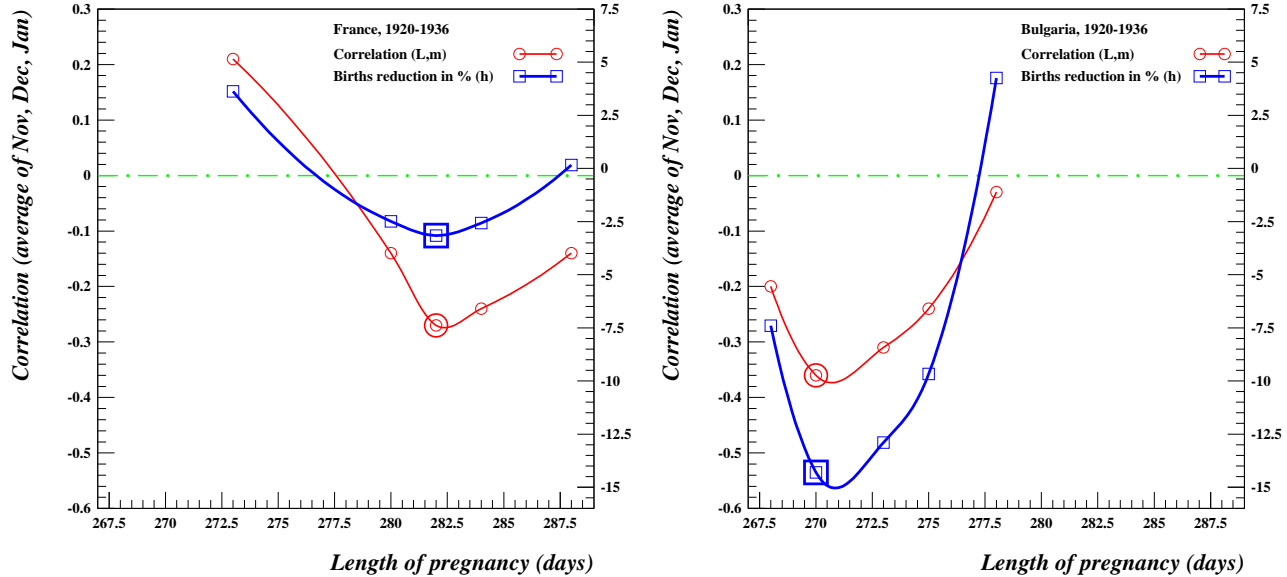
**Fig. 5a,b Relationship between Lent and number of births as a function of assumed pregnancy length** ($G$). In the correlation $(L, m)$, the variable $L$ represents the overlap of Lent+$G$ with the month under consideration; $m$ represents the number of births in the same month. The graph shows the average correlation for the three months of November, December and January (of the next year). In the reduction $h$ represents the birth reduction which occurs when the month is completely included in Lent with respect to the case when Lent does not overlap with this month. The comparison of **(a)** and **(b)** shows that whereas the correlation is approximately the same in France and Bulgaria the effect of Lent on births is about three times larger in Bulgaria. The fact that the optimum values of $G$ are not the same may be due to the fact that in some places it is the registration day which was recorded rather than the real birth day. If this reason can be excluded, the present observation can be related to the fact that the natural variation in pregnancy length is fairly large, in fact larger than thought previously (ScienceDaily 2013). It can be noted that Romania and Greece the optimum $G$ value is also around 272 days.

campaigns were set up they revealed larger standard deviations than expected (Bhat et al. 2006, ScienceDaily 2013). Within a given country the standard deviation is about 7 days but this does not tell us what is the cross-country variability.

## Strength of the Lent effect in Orthodox countries

Fig. 5a,b shows the Lent effect is about three times smaller in a western country like France than in an Orthodox country like Bulgaria. The fact that the effect is smaller also means that it is more difficult to measure. That is why here we will mostly focus on Orthodox countries. to the incidence of religion on other vital rates. Table 2 summarizes the results for Bulgaria, Greece and Romania. It appears that the strength of the Lent effect is strongest in Greece.

# Conclusion

First we have studied the impact of Lent on marriage rates. This was fairly easy

**Table 2a: Reduction in the number of conceptions during Lent in Orthodox countries, 1930-1936**

|  | Bulgaria | Greece | Romania |
|---|---|---|---|
| (1) Reduction $h$ expressed in %, Nov,Jan | $-32 \pm 22$ | $-44 \pm 11$ | $-16 \pm 15$ |
| (2) Reduction $h$ expressed in %, Nov,Dec,Jan | $-13 \pm 18$ | $-27 \pm 8$ | $-9.5 \pm 11$ |

Notes: $h$ is the reduction in birth number (expressed in percent with respect to the situation without Lent) when a given month is completely included in Lent. As explained in the text the December estimates are very uncertain because most $L$ values are close to 1; here all December estimates in fact turn out to be positive. That is why we give the results in two forms: in (1) the average is restricted to Nov and Jan whereas in (2) the average includes all three months. Naturally, the estimates of (2) are lower but the ranking of the countries is not changed. Note that for Greece the time interval is 1931–1936 because the data for 1930 are not available. Finally, it should be recalled that about 1/4 of this effect is the consequence of a fall in marriages 9 months earlier whereas the remaining 3/4 results from a drop in conceptions during Lent.
Source: Bunle (1954,p.307-311)

**Table 2b: Reduction in the number of conceptions during Lent in France**

|  | $1872 - 1891$ | $1920 - 1936$ |
|---|---|---|
| (1) Reduction $h$ expressed in %, Nov,Jan | $2.6 \pm 2.5$ | $-2.0 \pm 4$ |
| (2) Reduction $h$ expressed in %, Nov,Dec,Jan | $-0.29 \pm 4.6$ | $-2.9 \pm 3$ |

Notes: The comments already made in Table 2a also apply here. As in Table 2a and for the same reason the inclusion of December whose regression slope is quite unstable (sometimes negative, sometimes positive) makes the results given in line 2 fairly uncertain. As the effect of Lent is about 5 to 10 times weaker than in Orthodox countries, the error bars are much larger in relative terms. Confidence in the fact that the estimates of $h$ are fairly correct despite the large error bars comes from the observation that similar results are obtained for different values of $G$.
Sources: The monthly birth data for 1872–1891 are from "Statistique Générale de la France" (several years). The data for 1920-1936 are from Bunle (1954,p.308),

because there is a very strong connection. It is somewhat stronger in Orthodox countries than in Western countries but is clearly visible in both cases.

The effect of Lent on conceptions was more difficult to study but it was also more interesting. Why?
Whether we consider religious or civil marriages, they will be subject to the scrutiny of the social group in which they take place. In other words, they are an indicator of social consensus and conformity. Religious consensus can be measured through other indicators. One can mention the following; the data for France are given for the purpose of illustration; they are from "Statistiques de l'Eglise catholique en France" (2017).

(1) The proportion of the population that is baptized. Being a global indicator, this proportion will change very slowly in the course of time. A more revealing indicator is the proportion of baptized person by age group. In 2015 in France 33% of newborns were baptized, down from 61% in 1990.

(2) The proportion of religious marriages. Clearly, this indicator is only meaningful in countries where the notion of purely civil marriage is recognized[6]. In 2015 in France, the percentage of Catholic marriages was 24%, down from 51% in 1990.

(3) The proportion of priests and nuns in the population. In 2012 in France priests and nuns represented 0.74 per million population, down from 1.30 in 2000.

(4) The proportion of the population who attend weekly religious service. No French data were available for this indicator.

It can be noted that the rates of decline of all French indicators are roughly the same: about 50% in 25 years, i.e. 2% per year.

With respect to the previous indicators, the incidence of religion on conceptions is of a different kind in the sense that it is independent of any form of social control. Therefore one is not surprised that in terms of percentage the reduction is about ten times smaller than the incidence on marriages.

In the future it will be possible to extend this exploration to the incidence of mobile religious time periods on other vital rates. There are mobile time intervals similar to Lent in other religions, e.g. the "Ten Days of Repentance" (from Rosh Hashanah to Yom Kippur in September-October) in the Jewish religion or Ramadan in Islam. Some preliminary tests have revealed that there is a decrease in suicide rates during the month of Ramadan. Is there a similar decrease during Lent or during the "Ten Days of Repentance"? Thanks to the methodology introduced in the present paper, such issues can be investigated by using monthly instead of daily data. In contrast to daily data which are publicly available only in a few countries, monthly data are commonly available.

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[6]According to the Wikipedia article entitled "Civil marriage" the set of countries where it exists only a religious marriage comprise the following: Bahrain, Egypt, Indonesia, Iran, Israel, Jordan, Lebanon, Libya, Qatar, Syria, Saudi Arabia, United Arab Emirates, Yemen.

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