The COVID Baby Bust

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It is always difficult to predict the future, but to make an economic forecast, one could do worse than try to read the demographic tea leaves. Demographic trends can hint at what a society will look like several decades into the future. Low birth rates spell trouble down the road because it means a shrinking workforce and a smaller tax base. And that is one reason researchers are concerned that the pandemic has triggered a "baby bust."

In the West, lockdowns started in March 2020, meaning that any impact on birth rates wouldn't be seen until November or December 2020 at the earliest. Most states and countries have not yet reported birth rates for such recent months, and so it is difficult to measure any changes with certainty yet. But back in October 2020, a team at the IZA Institute of Labor Economics in Bonn, Germany devised a clever way to predict the impact of the pandemic on birth rates using Google.

First, the researchers showed that, in the United States, the search volume for Google keywords related to conception and pregnancy have historically been associated with higher numbers of births a few months later, whereas excess searches for unemployment keywords are associated with a decline in births in the following months. Using statistical learning methods, the researchers identified keywords that were most strongly associated with birth rates, which they separate into the "early indicators" category (that includes words like Clearblue, morning sickness, ovulation, pregnancy test, etc.) and an "unemployment" category (including words like unemployment and layoff).

Next, they used data on Google searches during the COVID-19 pandemic to forecast fertility rates in the United States. They estimated, based on surging 2020 unemployment keyword searches, that the number of births in February 2021 would be just 84.3 percent of what they would have been. That 15 percent drop in births, if it materializes, would be on par with the decline in birth rates during the 1918 influenza pandemic and during the Great Depression. Emerging data – like that from the state of California – showed a 19 percent drop in December 2020 births compared to December 2019. In Florida, there was about a 7 percent drop in December 2020 births compared to the same month in 2019; the drop was 10 percent in January 2021 and 6 percent in February 2021 compared to the same months in 2020. Uncertainty remains; the jury is still out on most birth rates for February and March of this year, and it is unclear how many births have been simply delayed, rather than forgone altogether.

The striking association between birth rates and google searches for unemployment raises the question of whether this association is an American phenomenon or whether it exists in other countries, too. In the United States, unemployment may make it significantly more difficult to raise a child, because unemployment benefits are relatively stingy and the loss of a job is often accompanied by loss of health insurance. Perhaps women are more likely to plan to avoid childbearing in this situation; the stress of job loss could also result in higher risk of miscarriage. In countries with more social spending and social support for families, unemployment may not be so directly linked to births.

To investigate this question, I expanded the IZA Institute's researchers' study to examine the relationship between google searches for unemployment and births in twenty-eight countries: Australia, Austria, Belgium, Canada, Chile, Costa Rica, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, South Korea, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. I collected births data in these countries from 2004 to 2020

from the United Nations' website and used Google Translate and Google Trends to download the monthly search volume for 'unemployment' (or the equivalent term in the appropriate language).

One of the challenges with the data is that, while I obtained the total number of births per month for each country, I could not get a standardized measure (births per 1000 people). I could only find data about the total population by year, not by month, which made it impossible to accurately calculate a standardized monthly birth rate. For that reason, I did not analyze the data using a single regression with all countries together; instead I did 28 separate regressions, and ran Lasso variable selection procedures for each country to see whether lagged google searches for unemployment were significantly correlated with births a few months down the line.

I then binned the countries into two different groups: those where there was a significant negative association between births and google searches for unemployment, and those where there wasn't. I hypothesized that social spending (as a percentage of GDP) might predict which group each country belonged to. To investigate that hypothesis, I ran a logistic regression and found that social spending was not significant at a 0.05 significance level (although it was significant at 0.1 level). At this stage, then, it is difficult to know exactly why this association exists in some countries but not others, though it could be worth investigating in an even greater number of countries. For now, it's a mystery even Google can't crack – yet.

```
## Parsed with column specification:
## cols(
##   year = col_double(),
##   month = col_character(),
##   total.births = col_number(),
##   unemployment = col_double()
## )

## Parsed with column specification:
## cols(
##   Week = col_character(),
##   unemployment.Florida = col_double()
## )

## Parsed with column specification:
## cols(
##   year = col_double(),
##   month = col_double(),
##   total.births = col_number(),
##   unemployment = col_double()
## )

## Parsed with column specification:
## cols(
##   Week = col_character(),
##   unemployment.california = col_double()
## )

## Parsed with column specification:
## cols(
##   year = col_double(),
##   month = col_double(),
```

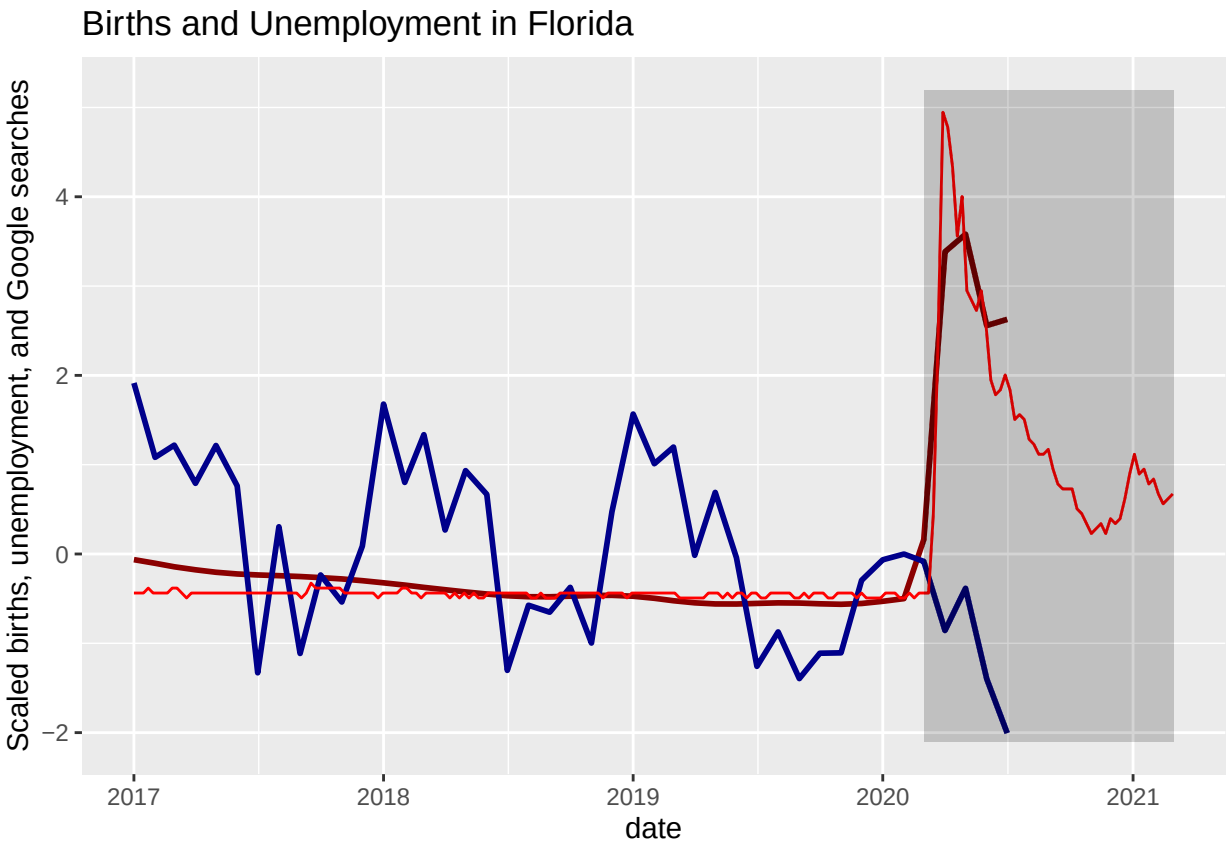
```
##   total.births = col_double(),
##   unemployment = col_double()
## )

## Parsed with column specification:
## cols(
##   Week = col_character(),
##   unemployment.Germany = col_double()
## )
```

Methods.

All data were scaled before plotting. The scaling function calculates the mean and standard deviation of each variable and then scales each data point by substracting the mean and dividing by the standard deviation. In this way, I could show the trends in all of the data on the same graph.

I chose to examine California and Florida, because those states had monthly birth data through November 2020 and February 2021 respectively.

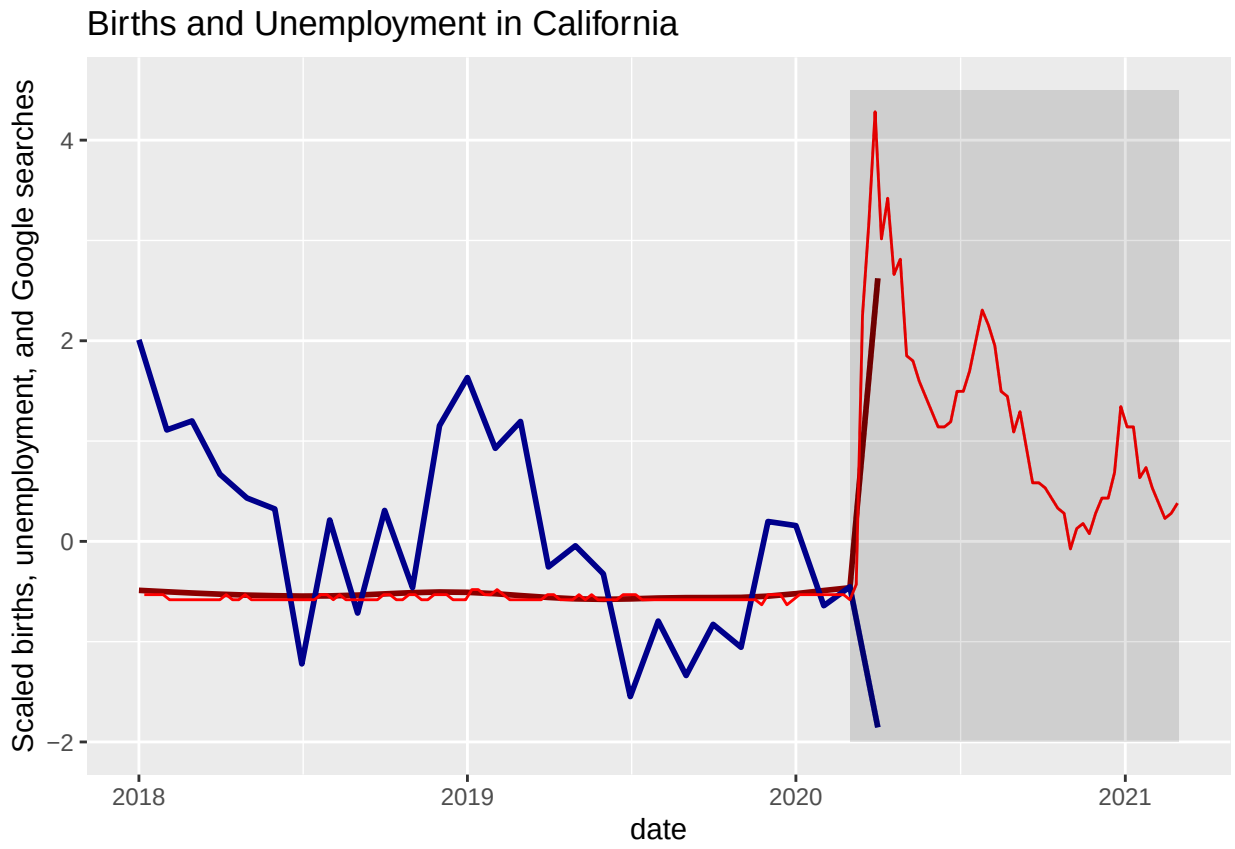
Graphics.



In dark blue: the number of births per month in Florida, scaled. The births were plotted by month of conception. (Florida Department of Health data)
In dark red: the number of unemployed people in Florida per month, scaled. (Bureau of Labor statistics data)

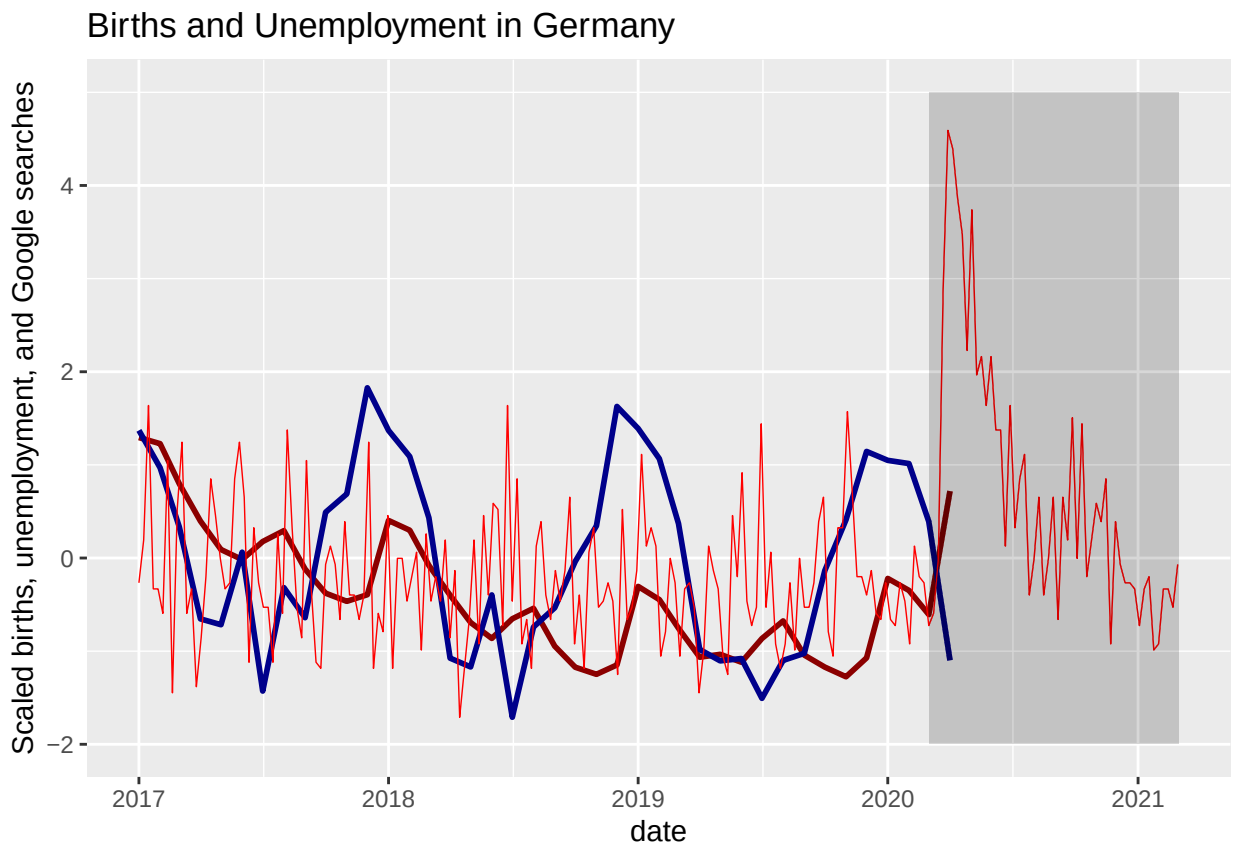
In red: the number of Google searches for unemployment in Florida each week, scaled. (Google Trends data)

The period from March 2020 to March 2021 is shaded in gray.
The number of births, plotted by month of conception, drop off at the beginning of the pandemic when the unemployment rate and Google searches for "unemployment" peak. If is unclear how far the births will drop, but they are noticeably breaking from the cyclical pattern in prior years.



In dark blue: the number of births per month in California, scaled. (California Department of Health data)
In dark red: the number of unemployed people in California per month, scaled. (Bureau of Labor Statistics data)
In red: the number of Google searches for unemployment in California each week, scaled. (Google Trends data)

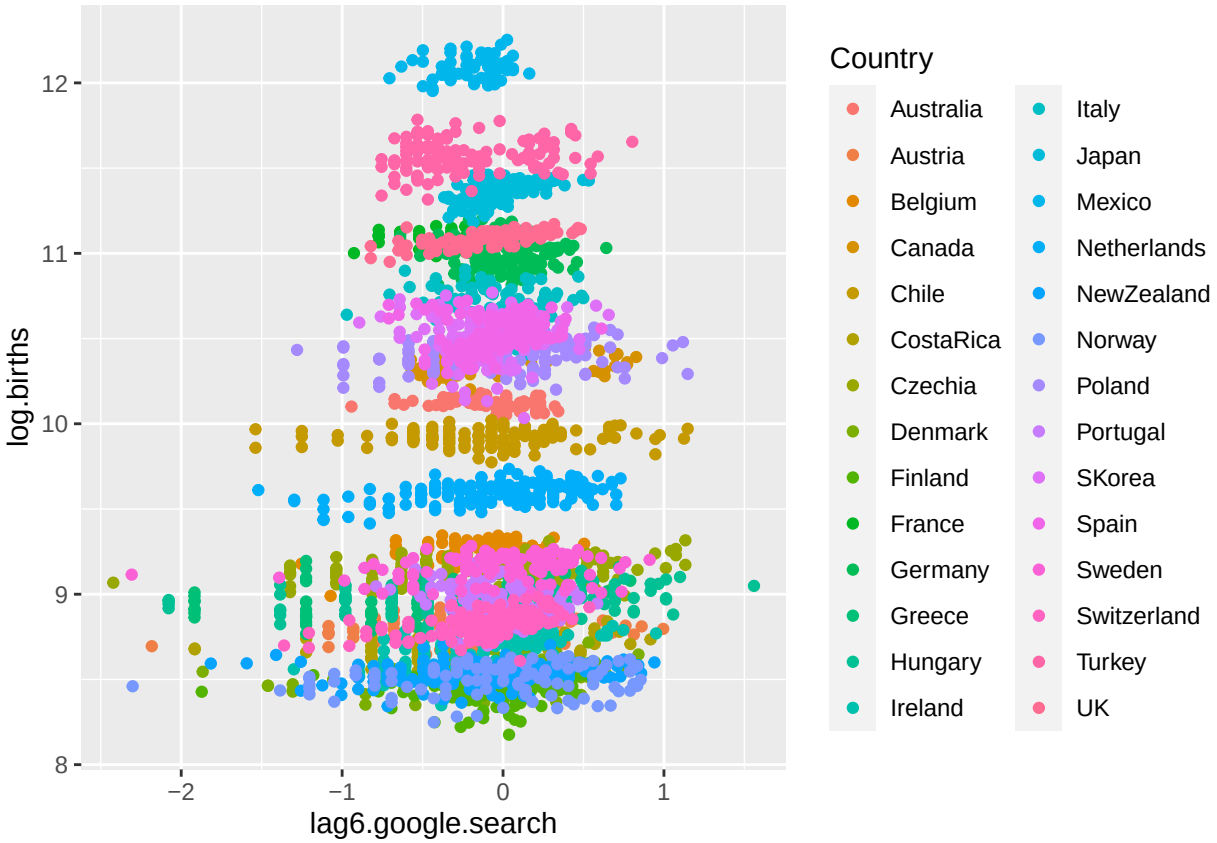
The number of births, plotted by month of conception, drop off at the beginning of the pandemic when the unemployment rate and Google searches for "unemployment" peak. If is unclear how far the births will drop, but they are noticeably breaking from the cyclical pattern in prior years. It is interesting that the Google searches for "unemployment" in California match the three big waves of COVID in the United States.



In dark blue: the number of births per month in Germany, scaled. (German Statistical Agency)
In dark red: the number of unemployed people in Germany per month, scaled. (Germany Statistical Agency)
In red: the number of Google searches for unemployment in Germany each week, scaled. (Google Trends data)

In Germany, the drop in births is less evident than in California and Florida. The Google searches for unemployment are also noisier, and do not match up as clearly with actual unemployment. In countries like Germany with more government/social support, the relationship between unemployment and birth rate may be less strong than it is in the United States.

Data on births and unemployment for 28 countries



To account for the periodic annual cycle, I include a third level polynomial for "month" in my linear regression model. I also include 'year' as a predictor to account for any trends over time.

The google search and lags 2, 4, 5, 6, and 8 interact with the countries; these are significant interactions based on the stepwise regression procedure. For some countries, the coefficients are negative (as expected) but for others, the coefficient is positive (which is not expected).

I wanted to investigate, for each country, which predictors are significant. So I ran individual regressions by country and tested the significant predictors:

```
## data2$Country: Australia
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.047552 -0.014887 -0.003891  0.017458  0.049631
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)        15.9144734  4.5047298   3.533  0.00092 ***
## poly(nMonth, 3)1   -0.0757871  0.0452204  -1.676  0.10025
## poly(nMonth, 3)2   -0.1221805  0.0601008  -2.033  0.04761 *
## poly(nMonth, 3)3   -0.0005051  0.0501224  -0.010  0.99200
## as.numeric(year)   -0.0028755  0.0022368  -1.286  0.20479
## google.search       0.0199413  0.0203938   0.978  0.33307
## lag1.google.search -0.0226987  0.0218342  -1.040  0.30374
## lag2.google.search  0.0488981  0.0174935   2.795  0.00743 **
## lag3.google.search -0.0406076  0.0180596  -2.249  0.02917 *
## lag4.google.search  0.0434912  0.0180085   2.415  0.01959 *
## lag5.google.search  0.0152114  0.0193254   0.787  0.43508
## lag6.google.search -0.0013085  0.0188166  -0.070  0.94485
## lag7.google.search  0.0339295  0.0188790   1.797  0.07860 .
## lag8.google.search -0.0074734  0.0181528  -0.412  0.68240
## lag9.google.search -0.0111816  0.0191611  -0.584  0.56225
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02574 on 48 degrees of freedom
## Multiple R-squared:  0.5174, Adjusted R-squared:  0.3766
## F-statistic: 3.675 on 14 and 48 DF,  p-value: 0.0003693
##
## ------------------------------------------------------------
## data2$Country: Austria
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.089965 -0.021353  0.000787  0.022419  0.082235
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        -2.020e+01  2.661e+00  -7.591 2.67e-11 ***
## poly(nMonth, 3)1    1.888e-01  5.755e-02   3.281  0.00147 **
## poly(nMonth, 3)2   -2.931e-01  5.914e-02  -4.956 3.31e-06 ***
## poly(nMonth, 3)3   -2.959e-01  5.110e-02  -5.790 9.91e-08 ***
## as.numeric(year)    1.442e-02  1.323e-03  10.899  < 2e-16 ***
## google.search      -1.487e-02  9.190e-03  -1.618  0.10909
## lag1.google.search  1.771e-02  9.988e-03   1.774  0.07949 .
## lag2.google.search  1.237e-02  9.398e-03   1.316  0.19153
## lag3.google.search  5.684e-03  9.406e-03   0.604  0.54711
## lag4.google.search  1.192e-02  9.684e-03   1.231  0.22139
## lag5.google.search -1.470e-02  9.573e-03  -1.536  0.12809
## lag6.google.search -8.776e-04  1.025e-02  -0.086  0.93192
## lag7.google.search  6.096e-03  9.789e-03   0.623  0.53503
## lag8.google.search  9.554e-03  9.921e-03   0.963  0.33809
## lag9.google.search -8.806e-03  9.461e-03  -0.931  0.35443
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04061 on 91 degrees of freedom
## Multiple R-squared:  0.7442, Adjusted R-squared:  0.7048
## F-statistic: 18.91 on 14 and 91 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Belgium
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.109098 -0.024857  0.000894  0.029823  0.080813
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        45.405450   6.307484   7.199 1.35e-10 ***
## poly(nMonth, 3)1    0.054821   0.054661   1.003  0.31842
## poly(nMonth, 3)2   -0.185904   0.055461  -3.352  0.00115 **
## poly(nMonth, 3)3   -0.161077   0.048138  -3.346  0.00117 **
## as.numeric(year)   -0.017956   0.003132  -5.733 1.14e-07 ***
## google.search       0.060723   0.022568   2.691  0.00841 **
## lag1.google.search -0.014308   0.023718  -0.603  0.54775
## lag2.google.search -0.019537   0.024078  -0.811  0.41914
## lag3.google.search  0.023230   0.024933   0.932  0.35385
## lag4.google.search  0.026759   0.024563   1.089  0.27871
## lag5.google.search -0.015279   0.025451  -0.600  0.54971
## lag6.google.search  0.035280   0.024964   1.413  0.16083
## lag7.google.search  0.056472   0.025519   2.213  0.02927 *
## lag8.google.search  0.006971   0.027119   0.257  0.79768
## lag9.google.search  0.082952   0.026848   3.090  0.00262 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04076 on 96 degrees of freedom
## Multiple R-squared:  0.5554, Adjusted R-squared:  0.4905
## F-statistic: 8.565 on 14 and 96 DF,  p-value: 1.066e-11
##
## ------------------------------------------------------------
## data2$Country: Canada
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
```

```
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.074736 -0.017389 -0.000714  0.018824  0.054953
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)         4.010115   2.593054   1.546 0.127247
## poly(nMonth, 3)1    0.079021   0.031393   2.517 0.014521 *
## poly(nMonth, 3)2   -0.378145   0.032436 -11.658  < 2e-16 ***
## poly(nMonth, 3)3   -0.126601   0.032109  -3.943 0.000213 ***
## as.numeric(year)    0.003154   0.001289   2.447 0.017370 *
## google.search       0.026957   0.020624   1.307 0.196177
## lag1.google.search -0.036970   0.025662  -1.441 0.154885
## lag2.google.search  0.053122   0.025399   2.092 0.040724 *
## lag3.google.search -0.024931   0.025481  -0.978 0.331785
## lag4.google.search  0.003250   0.025647   0.127 0.899582
## lag5.google.search -0.003921   0.025913  -0.151 0.880228
## lag6.google.search  0.030510   0.026148   1.167 0.247904
## lag7.google.search -0.048330   0.026003  -1.859 0.067986 .
## lag8.google.search  0.037782   0.026494   1.426 0.159030
## lag9.google.search -0.004147   0.021130  -0.196 0.845054
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02951 on 60 degrees of freedom
## Multiple R-squared:  0.7655, Adjusted R-squared:  0.7108
## F-statistic: 13.99 on 14 and 60 DF,  p-value: 5.3e-14
##
## ------------------------------------------------------------
## data2$Country: Chile
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.098858 -0.025600  0.006906  0.024652  0.088049
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        18.1389679  3.9726528   4.566 1.32e-05 ***
## poly(nMonth, 3)1   -0.1087815  0.0571401  -1.904  0.05960 .
## poly(nMonth, 3)2    0.0665259  0.0584600   1.138  0.25765
## poly(nMonth, 3)3   -0.0184871  0.0584641  -0.316  0.75245
## as.numeric(year)   -0.0040850  0.0019758  -2.068  0.04107 *
## google.search       0.0115226  0.0104923   1.098  0.27456
## lag1.google.search -0.0057838  0.0106658  -0.542  0.58874
## lag2.google.search  0.0057449  0.0106109   0.541  0.58934
## lag3.google.search  0.0024025  0.0110487   0.217  0.82827
## lag4.google.search  0.0032178  0.0105632   0.305  0.76124
```

```
## lag5.google.search  0.0004082  0.0106695   0.038  0.96955
## lag6.google.search -0.0025226  0.0111221  -0.227  0.82100
## lag7.google.search  0.0010052  0.0106610   0.094  0.92506
## lag8.google.search -0.0284958  0.0107892  -2.641  0.00949 **
## lag9.google.search  0.0227723  0.0101565   2.242  0.02700 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04482 on 108 degrees of freedom
## Multiple R-squared:  0.2285, Adjusted R-squared:  0.1285
## F-statistic: 2.285 on 14 and 108 DF,  p-value: 0.008883
##
## ------------------------------------------------------------
## data2$Country: CostaRica
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.094938 -0.021093 -0.003154  0.024104  0.078419
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        26.527471   3.916171   6.774 2.88e-09 ***
## poly(nMonth, 3)1    0.376431   0.039809   9.456 2.98e-14 ***
## poly(nMonth, 3)2   -0.012008   0.044061  -0.273   0.7860
## poly(nMonth, 3)3   -0.205789   0.044418  -4.633 1.56e-05 ***
## as.numeric(year)   -0.008854   0.001944  -4.554 2.09e-05 ***
## google.search      -0.008673   0.008127  -1.067   0.2894
## lag1.google.search  0.011558   0.008686   1.331   0.1875
## lag2.google.search  0.006749   0.007894   0.855   0.3955
## lag3.google.search -0.014384   0.008001  -1.798   0.0764 .
## lag4.google.search -0.003973   0.007957  -0.499   0.6190
## lag5.google.search  0.002239   0.007876   0.284   0.7770
## lag6.google.search  0.019242   0.007963   2.416   0.0182 *
## lag7.google.search  0.001272   0.007956   0.160   0.8735
## lag8.google.search -0.006733   0.007842  -0.858   0.3935
## lag9.google.search  0.010121   0.007861   1.288   0.2020
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03738 on 72 degrees of freedom
## Multiple R-squared:  0.7002, Adjusted R-squared:  0.6419
## F-statistic: 12.01 on 14 and 72 DF,  p-value: 9.77e-14
##
## ------------------------------------------------------------
## data2$Country: Czechia
##
## Call:
```

```
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.153308 -0.033621 -0.002352  0.030601  0.104054
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        22.161711   3.649710   6.072 1.26e-08 ***
## poly(nMonth, 3)1    0.074938   0.111632   0.671 0.503205
## poly(nMonth, 3)2   -0.378837   0.103354  -3.665 0.000357 ***
## poly(nMonth, 3)3   -0.188077   0.087337  -2.153 0.033100 *
## as.numeric(year)   -0.006469   0.001814  -3.566 0.000506 ***
## google.search      -0.030935   0.009794  -3.158 0.001967 **
## lag1.google.search -0.007351   0.010777  -0.682 0.496365
## lag2.google.search  0.026896   0.010249   2.624 0.009705 **
## lag3.google.search -0.002414   0.010493  -0.230 0.818397
## lag4.google.search  0.015439   0.010909   1.415 0.159349
## lag5.google.search -0.018207   0.010999  -1.655 0.100240
## lag6.google.search -0.002845   0.011389  -0.250 0.803103
## lag7.google.search  0.005005   0.011176   0.448 0.655020
## lag8.google.search -0.012758   0.011227  -1.136 0.257845
## lag9.google.search -0.007519   0.010585  -0.710 0.478737
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04614 on 132 degrees of freedom
## Multiple R-squared:  0.576,  Adjusted R-squared:  0.5311
## F-statistic: 12.81 on 14 and 132 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Denmark
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.132023 -0.032128  0.009833  0.034556  0.098117
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        25.039840   3.519162   7.115 1.28e-10 ***
## poly(nMonth, 3)1   -0.111373   0.111919  -0.995 0.321904
## poly(nMonth, 3)2   -0.341087   0.106624  -3.199 0.001810 **
## poly(nMonth, 3)3   -0.206021   0.097143  -2.121 0.036228 *
```

```
## as.numeric(year)   -0.008210   0.001749  -4.695 7.87e-06 ***
## google.search      -0.041300   0.011371  -3.632 0.000432 ***
## lag1.google.search -0.018566   0.012600  -1.474 0.143522
## lag2.google.search -0.010870   0.012593  -0.863 0.389930
## lag3.google.search -0.013286   0.012458  -1.066 0.288625
## lag4.google.search  0.007904   0.012953   0.610 0.543005
## lag5.google.search -0.034502   0.015444  -2.234 0.027539 *
## lag6.google.search  0.013067   0.016317   0.801 0.424984
## lag7.google.search  0.021918   0.013505   1.623 0.107516
## lag8.google.search -0.015012   0.013459  -1.115 0.267163
## lag9.google.search  0.005395   0.013042   0.414 0.679935
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.05058 on 108 degrees of freedom
## Multiple R-squared:  0.607,  Adjusted R-squared:  0.556
## F-statistic: 11.91 on 14 and 108 DF,  p-value: 3.388e-16
##
## ------------------------------------------------------------
## data2$Country: Finland
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.13703 -0.03168 -0.00215  0.03078  0.08755
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        47.665606   2.843010  16.766  < 2e-16 ***
## poly(nMonth, 3)1   -0.074856   0.065907  -1.136   0.2586
## poly(nMonth, 3)2   -0.438033   0.068720  -6.374 4.65e-09 ***
## poly(nMonth, 3)3   -0.221917   0.059386  -3.737   0.0003 ***
## as.numeric(year)   -0.019481   0.001413 -13.789  < 2e-16 ***
## google.search       0.028924   0.013270   2.180   0.0315 *
## lag1.google.search -0.016218   0.014511  -1.118   0.2662
## lag2.google.search  0.032777   0.014612   2.243   0.0269 *
## lag3.google.search -0.004545   0.014929  -0.304   0.7614
## lag4.google.search  0.033034   0.014895   2.218   0.0287 *
## lag5.google.search -0.010595   0.015427  -0.687   0.4937
## lag6.google.search  0.003911   0.015792   0.248   0.8049
## lag7.google.search  0.015549   0.016731   0.929   0.3548
## lag8.google.search -0.005078   0.016296  -0.312   0.7559
## lag9.google.search  0.008230   0.015815   0.520   0.6039
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04669 on 108 degrees of freedom
## Multiple R-squared:  0.7523, Adjusted R-squared:  0.7202
```

```
## F-statistic: 23.43 on 14 and 108 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: France
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.057911 -0.016705  0.001675  0.019838  0.054574
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)         9.9301264  8.2867695   1.198  0.23863
## poly(nMonth, 3)1    0.1106137  0.0450535   2.455  0.01904 *
## poly(nMonth, 3)2   -0.1134432  0.0409618  -2.769  0.00882 **
## poly(nMonth, 3)3   -0.1092483  0.0442511  -2.469  0.01844 *
## as.numeric(year)    0.0005836  0.0041200   0.142  0.88815
## google.search      -0.0198369  0.0294826  -0.673  0.50535
## lag1.google.search -0.0152519  0.0352968  -0.432  0.66824
## lag2.google.search  0.0310781  0.0332665   0.934  0.35642
## lag3.google.search  0.0265766  0.0333540   0.797  0.43079
## lag4.google.search  0.0199048  0.0448632   0.444  0.65993
## lag5.google.search -0.1189300  0.0345509  -3.442  0.00148 **
## lag6.google.search  0.0661909  0.0390161   1.697  0.09842 .
## lag7.google.search  0.0092311  0.0348080   0.265  0.79237
## lag8.google.search  0.0042859  0.0357342   0.120  0.90520
## lag9.google.search  0.0162502  0.0315260   0.515  0.60939
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03042 on 36 degrees of freedom
## Multiple R-squared:  0.6074, Adjusted R-squared:  0.4547
## F-statistic: 3.978 on 14 and 36 DF,  p-value: 0.0004124
##
## ------------------------------------------------------------
## data2$Country: Germany
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.102103 -0.025223 -0.001024  0.030605  0.103656
##
```

```
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          1.103e+01  8.435e+00   1.308  0.19378
## poly(nMonth, 3)1     4.852e-01  1.118e-01   4.342 3.20e-05 ***
## poly(nMonth, 3)2    -1.190e-01  1.105e-01  -1.077  0.28385
## poly(nMonth, 3)3    -5.059e-01  9.468e-02  -5.343 5.13e-07 ***
## as.numeric(year)    -2.288e-05  4.191e-03  -0.005  0.99565
## google.search       -8.801e-02  3.330e-02  -2.643  0.00944 **
## lag1.google.search  -3.268e-02  3.822e-02  -0.855  0.39449
## lag2.google.search   2.400e-02  3.344e-02   0.717  0.47462
## lag3.google.search   1.831e-02  3.329e-02   0.550  0.58339
## lag4.google.search   9.442e-02  3.477e-02   2.716  0.00770 **
## lag5.google.search  -3.124e-02  3.641e-02  -0.858  0.39277
## lag6.google.search  -2.194e-02  3.552e-02  -0.618  0.53814
## lag7.google.search  -1.150e-01  3.548e-02  -3.241  0.00158 **
## lag8.google.search  -8.852e-02  3.626e-02  -2.441  0.01627 *
## lag9.google.search  -8.933e-02  3.527e-02  -2.533  0.01274 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04667 on 108 degrees of freedom
## Multiple R-squared:  0.7617, Adjusted R-squared:  0.7308
## F-statistic: 24.66 on 14 and 108 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Greece
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.105816 -0.027989 -0.001002  0.033147  0.084108
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          60.955630   5.854602  10.412 3.24e-16 ***
## poly(nMonth, 3)1     0.131719   0.070710   1.863   0.0664 .
## poly(nMonth, 3)2    -0.198488   0.070324  -2.822   0.0061 **
## poly(nMonth, 3)3    -0.468029   0.065806  -7.112 5.72e-10 ***
## as.numeric(year)    -0.025802   0.002909  -8.869 2.64e-13 ***
## google.search       -0.004088   0.008553  -0.478   0.6341
## lag1.google.search  -0.002061   0.008916  -0.231   0.8178
## lag2.google.search  -0.005468   0.008761  -0.624   0.5344
## lag3.google.search  -0.005539   0.009152  -0.605   0.5468
## lag4.google.search   0.019749   0.008855   2.230   0.0287 *
## lag5.google.search  -0.011389   0.009286  -1.227   0.2238
## lag6.google.search   0.003069   0.008894   0.345   0.7310
## lag7.google.search   0.003553   0.009142   0.389   0.6986
## lag8.google.search   0.009149   0.008757   1.045   0.2995
```

```
## lag9.google.search  0.023108   0.009203   2.511   0.0142 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04853 on 75 degrees of freedom
## Multiple R-squared:  0.799,  Adjusted R-squared:  0.7615
## F-statistic:  21.3 on 14 and 75 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Hungary
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.139790 -0.035314  0.006215  0.039613  0.102455
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        47.770284   9.910018   4.820 4.62e-06 ***
## poly(nMonth, 3)1    0.284729   0.092561   3.076 0.002646 **
## poly(nMonth, 3)2   -0.179186   0.089003  -2.013 0.046529 *
## poly(nMonth, 3)3   -0.356777   0.080851  -4.413 2.39e-05 ***
## as.numeric(year)   -0.019298   0.004928  -3.916 0.000156 ***
## google.search      -0.035852   0.009804  -3.657 0.000394 ***
## lag1.google.search -0.014321   0.010843  -1.321 0.189322
## lag2.google.search  0.011251   0.009828   1.145 0.254795
## lag3.google.search -0.017772   0.010373  -1.713 0.089472 .
## lag4.google.search  0.009615   0.010456   0.920 0.359816
## lag5.google.search -0.017434   0.010808  -1.613 0.109583
## lag6.google.search -0.030802   0.010871  -2.833 0.005482 **
## lag7.google.search -0.005158   0.010289  -0.501 0.617161
## lag8.google.search -0.006773   0.010492  -0.646 0.519916
## lag9.google.search -0.009054   0.009991  -0.906 0.366822
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.05272 on 110 degrees of freedom
## Multiple R-squared:  0.4972, Adjusted R-squared:  0.4332
## F-statistic:  7.77 on 14 and 110 DF,  p-value: 3.538e-11
##
## ------------------------------------------------------------
## data2$Country: Ireland
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
```

```
##     lag9.google.search, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.24956 -0.03033  0.00194  0.03046  0.22692
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)         31.3077295  6.1877969   5.060 1.53e-06 ***
## poly(nMonth, 3)1     0.1440188  0.0752534   1.914 0.058030 .
## poly(nMonth, 3)2    -0.1818708  0.0723987  -2.512 0.013330 *
## poly(nMonth, 3)3    -0.1754387  0.0700206  -2.506 0.013567 *
## as.numeric(year)    -0.0112424  0.0030783  -3.652 0.000387 ***
## google.search        0.0515889  0.0179292   2.877 0.004748 **
## lag1.google.search  -0.0424849  0.0188069  -2.259 0.025688 *
## lag2.google.search   0.0514765  0.0172067   2.992 0.003369 **
## lag3.google.search   0.0025428  0.0171873   0.148 0.882632
## lag4.google.search   0.0037258  0.0174396   0.214 0.831192
## lag5.google.search  -0.0002417  0.0172450  -0.014 0.988842
## lag6.google.search   0.0375435  0.0171588   2.188 0.030608 *
## lag7.google.search  -0.0154166  0.0172754  -0.892 0.373966
## lag8.google.search   0.0270752  0.0174355   1.553 0.123087
## lag9.google.search   0.0107815  0.0183356   0.588 0.557629
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0563 on 120 degrees of freedom
## Multiple R-squared:  0.6494, Adjusted R-squared:  0.6085
## F-statistic: 15.88 on 14 and 120 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Italy
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.103000 -0.027533  0.001288  0.031094  0.093134
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          6.806e+01  3.664e+00  18.575  < 2e-16 ***
## poly(nMonth, 3)1     4.002e-01  6.242e-02   6.411 5.41e-09 ***
## poly(nMonth, 3)2    -6.754e-02  5.536e-02  -1.220  0.22540
## poly(nMonth, 3)3    -3.157e-01  6.500e-02  -4.857 4.63e-06 ***
## as.numeric(year)    -2.852e-02  1.821e-03 -15.663  < 2e-16 ***
## google.search        6.183e-02  3.116e-02   1.985  0.05004 .
## lag1.google.search  -2.510e-02  3.044e-02  -0.825  0.41163
## lag2.google.search  -3.155e-03  2.924e-02  -0.108  0.91432
```

```
## lag3.google.search -2.176e-03  2.933e-02  -0.074  0.94102
## lag4.google.search  4.193e-02  3.094e-02   1.355  0.17844
## lag5.google.search -6.066e-02  2.891e-02  -2.098  0.03853 *
## lag6.google.search  9.433e-02  2.846e-02   3.315  0.00129 **
## lag7.google.search  6.489e-03  2.971e-02   0.218  0.82757
## lag8.google.search -5.183e-06  3.082e-02   0.000  0.99987
## lag9.google.search -4.876e-03  3.033e-02  -0.161  0.87262
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04539 on 96 degrees of freedom
## Multiple R-squared:  0.8477, Adjusted R-squared:  0.8255
## F-statistic: 38.17 on 14 and 96 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Japan
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.09469 -0.01742  0.00358  0.02069  0.05068
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        39.554455   1.961090  20.170  < 2e-16 ***
## poly(nMonth, 3)1    0.167608   0.036319   4.615 9.93e-06 ***
## poly(nMonth, 3)2   -0.118399   0.036698  -3.226  0.00162 **
## poly(nMonth, 3)3   -0.223833   0.036745  -6.092 1.39e-08 ***
## as.numeric(year)   -0.014013   0.000975 -14.372  < 2e-16 ***
## google.search      -0.016754   0.023058  -0.727  0.46891
## lag1.google.search -0.049023   0.025237  -1.943  0.05442 .
## lag2.google.search  0.053788   0.023736   2.266  0.02524 *
## lag3.google.search  0.016729   0.023400   0.715  0.47606
## lag4.google.search -0.023087   0.024427  -0.945  0.34648
## lag5.google.search -0.011866   0.024160  -0.491  0.62423
## lag6.google.search  0.107264   0.023640   4.537 1.36e-05 ***
## lag7.google.search -0.063622   0.024121  -2.638  0.00946 **
## lag8.google.search -0.026437   0.023956  -1.104  0.27200
## lag9.google.search  0.015629   0.021916   0.713  0.47716
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02983 on 120 degrees of freedom
## Multiple R-squared:  0.798,  Adjusted R-squared:  0.7745
## F-statistic: 33.87 on 14 and 120 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Mexico
```

```
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.072041 -0.014692 -0.000646  0.015776  0.056537
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        59.776352   5.230950  11.427 6.77e-15 ***
## poly(nMonth, 3)1    0.283276   0.041563   6.816 1.91e-08 ***
## poly(nMonth, 3)2   -0.056945   0.032879  -1.732   0.0901 .
## poly(nMonth, 3)3   -0.239568   0.043056  -5.564 1.38e-06 ***
## as.numeric(year)   -0.023695   0.002603  -9.105 9.02e-12 ***
## google.search      -0.035090   0.026930  -1.303   0.1992
## lag1.google.search -0.053279   0.031448  -1.694   0.0971 .
## lag2.google.search -0.001662   0.026962  -0.062   0.9511
## lag3.google.search -0.032669   0.027066  -1.207   0.2337
## lag4.google.search  0.049034   0.027413   1.789   0.0804 .
## lag5.google.search -0.003456   0.028008  -0.123   0.9024
## lag6.google.search -0.003415   0.029056  -0.118   0.9070
## lag7.google.search  0.013336   0.027316   0.488   0.6278
## lag8.google.search -0.039732   0.025402  -1.564   0.1248
## lag9.google.search -0.059903   0.025687  -2.332   0.0242 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03074 on 45 degrees of freedom
## Multiple R-squared:  0.8511, Adjusted R-squared:  0.8048
## F-statistic: 18.37 on 14 and 45 DF,  p-value: 4.14e-14
##
## ------------------------------------------------------------
## data2$Country: Netherlands
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.079120 -0.015942  0.001442  0.016628  0.093608
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        28.5795222  1.7153353  16.661  < 2e-16 ***
## poly(nMonth, 3)1    0.1366902  0.0482022   2.836  0.00529 **
```

```
## poly(nMonth, 3)2   -0.3453360  0.0497610  -6.940 1.60e-10 ***
## poly(nMonth, 3)3   -0.3156133  0.0421487  -7.488 8.89e-12 ***
## as.numeric(year)   -0.0094337  0.0008525 -11.065  < 2e-16 ***
## google.search      -0.0140603  0.0067546  -2.082  0.03931 *
## lag1.google.search -0.0202013  0.0073455  -2.750  0.00679 **
## lag2.google.search  0.0189718  0.0071658   2.648  0.00910 **
## lag3.google.search  0.0007126  0.0071009   0.100  0.92021
## lag4.google.search  0.0150421  0.0082648   1.820  0.07102 .
## lag5.google.search -0.0373666  0.0079535  -4.698 6.50e-06 ***
## lag6.google.search  0.0221891  0.0091873   2.415  0.01710 *
## lag7.google.search  0.0050752  0.0077489   0.655  0.51364
## lag8.google.search -0.0111429  0.0077653  -1.435  0.15366
## lag9.google.search  0.0067819  0.0074286   0.913  0.36294
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02815 on 132 degrees of freedom
## Multiple R-squared:  0.8111, Adjusted R-squared:  0.7911
## F-statistic: 40.49 on 14 and 132 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: NewZealand
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.135059 -0.030120 -0.002056  0.022578  0.201550
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        27.245479   3.098532   8.793 6.86e-15 ***
## poly(nMonth, 3)1    0.112569   0.059130   1.904   0.0591 .
## poly(nMonth, 3)2   -0.015261   0.060542  -0.252   0.8014
## poly(nMonth, 3)3   -0.131289   0.059986  -2.189   0.0304 *
## as.numeric(year)   -0.009299   0.001540  -6.038 1.49e-08 ***
## google.search      -0.002540   0.010539  -0.241   0.8099
## lag1.google.search -0.003413   0.010738  -0.318   0.7511
## lag2.google.search  0.007582   0.010737   0.706   0.4813
## lag3.google.search -0.009397   0.010781  -0.872   0.3850
## lag4.google.search -0.008339   0.010394  -0.802   0.4238
## lag5.google.search  0.015809   0.011063   1.429   0.1554
## lag6.google.search -0.004279   0.011281  -0.379   0.7051
## lag7.google.search  0.015145   0.011324   1.337   0.1834
## lag8.google.search -0.012886   0.011178  -1.153   0.2511
## lag9.google.search -0.001052   0.011421  -0.092   0.9268
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 0.05528 on 132 degrees of freedom
## Multiple R-squared:  0.3355, Adjusted R-squared:  0.265
## F-statistic: 4.761 on 14 and 132 DF,  p-value: 5.173e-07
##
## ------------------------------------------------------------
## data2$Country: Norway
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.065524 -0.021734 -0.000083  0.019560  0.063691
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        28.121179   2.553555  11.013  < 2e-16 ***
## poly(nMonth, 3)1   -0.253758   0.069339  -3.660 0.000423 ***
## poly(nMonth, 3)2   -0.697794   0.076704  -9.097 1.98e-14 ***
## poly(nMonth, 3)3   -0.177750   0.056187  -3.164 0.002119 **
## as.numeric(year)   -0.009745   0.001268  -7.684 1.72e-11 ***
## google.search      -0.006325   0.007338  -0.862 0.390993
## lag1.google.search -0.003973   0.007921  -0.502 0.617157
## lag2.google.search  0.029183   0.007240   4.031 0.000115 ***
## lag3.google.search  0.006655   0.007116   0.935 0.352129
## lag4.google.search  0.007751   0.007272   1.066 0.289303
## lag5.google.search -0.011299   0.008001  -1.412 0.161321
## lag6.google.search -0.017776   0.008221  -2.162 0.033224 *
## lag7.google.search  0.018651   0.008135   2.293 0.024173 *
## lag8.google.search  0.014266   0.008317   1.715 0.089679 .
## lag9.google.search  0.001082   0.008059   0.134 0.893494
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03267 on 91 degrees of freedom
## Multiple R-squared:  0.8799, Adjusted R-squared:  0.8614
## F-statistic: 47.62 on 14 and 91 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Poland
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
```

```
## -0.123139 -0.031593  0.002966  0.033059  0.107962
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)        77.6410658  9.1827594   8.455 7.80e-14 ***
## poly(nMonth, 3)1   -0.0288627  0.1234347  -0.234 0.815515
## poly(nMonth, 3)2   -0.5094587  0.1298755  -3.923 0.000146 ***
## poly(nMonth, 3)3   -0.3529648  0.0947082  -3.727 0.000297 ***
## as.numeric(year)   -0.0334302  0.0045648  -7.323 3.03e-11 ***
## google.search      -0.0556264  0.0197383  -2.818 0.005650 **
## lag1.google.search -0.0556136  0.0208183  -2.671 0.008603 **
## lag2.google.search  0.0498355  0.0190306   2.619 0.009964 **
## lag3.google.search -0.0639302  0.0199269  -3.208 0.001713 **
## lag4.google.search -0.0004851  0.0191055  -0.025 0.979787
## lag5.google.search -0.0630074  0.0202954  -3.105 0.002378 **
## lag6.google.search -0.0191727  0.0212579  -0.902 0.368911
## lag7.google.search -0.0134708  0.0201482  -0.669 0.505043
## lag8.google.search  0.0012228  0.0219388   0.056 0.955643
## lag9.google.search -0.0614270  0.0195737  -3.138 0.002139 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04721 on 120 degrees of freedom
## Multiple R-squared:  0.6688, Adjusted R-squared:  0.6301
## F-statistic: 17.31 on 14 and 120 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Portugal
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.140348 -0.032350  0.005666  0.034937  0.116834
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)        49.1773354  3.2494324  15.134  < 2e-16 ***
## poly(nMonth, 3)1    0.2931988  0.0674018   4.350 2.87e-05 ***
## poly(nMonth, 3)2   -0.1509417  0.0649004  -2.326 0.021711 *
## poly(nMonth, 3)3   -0.2320230  0.0654513  -3.545 0.000561 ***
## as.numeric(year)   -0.0199978  0.0016145 -12.386  < 2e-16 ***
## google.search      -0.0187614  0.0257608  -0.728 0.467853
## lag1.google.search -0.0744507  0.0260280  -2.860 0.004992 **
## lag2.google.search -0.0082099  0.0254378  -0.323 0.747450
## lag3.google.search  0.0027598  0.0261252   0.106 0.916046
## lag4.google.search  0.0236126  0.0282012   0.837 0.404093
## lag5.google.search -0.1122405  0.0284304  -3.948 0.000133 ***
## lag6.google.search  0.0715889  0.0287026   2.494 0.013986 *
```

```
## lag7.google.search  0.0091261  0.0281453   0.324 0.746314
## lag8.google.search  0.0188751  0.0280695   0.672 0.502595
## lag9.google.search -0.0008181  0.0274642  -0.030 0.976286
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0547 on 120 degrees of freedom
## Multiple R-squared:  0.7545, Adjusted R-squared:  0.7259
## F-statistic: 26.35 on 14 and 120 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: SKorea
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.195420 -0.036849  0.008379  0.049575  0.146403
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)        59.6826013  4.1393426  14.418  < 2e-16 ***
## poly(nMonth, 3)1   -0.5387868  0.0911275  -5.912 3.35e-08 ***
## poly(nMonth, 3)2   -0.1405642  0.0955555  -1.471   0.1439
## poly(nMonth, 3)3   -0.4918300  0.0851335  -5.777 6.30e-08 ***
## as.numeric(year)   -0.0244330  0.0020570 -11.878  < 2e-16 ***
## google.search       0.0533738  0.0259279   2.059   0.0417 *
## lag1.google.search  0.0563240  0.0264602   2.129   0.0354 *
## lag2.google.search  0.0372524  0.0277002   1.345   0.1813
## lag3.google.search -0.0006767  0.0279870  -0.024   0.9808
## lag4.google.search -0.0396228  0.0286469  -1.383   0.1692
## lag5.google.search -0.0225629  0.0301828  -0.748   0.4562
## lag6.google.search  0.0035834  0.0301225   0.119   0.9055
## lag7.google.search  0.0185460  0.0308014   0.602   0.5483
## lag8.google.search -0.0172796  0.0294001  -0.588   0.5578
## lag9.google.search  0.0133392  0.0297883   0.448   0.6551
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07549 on 118 degrees of freedom
## Multiple R-squared:  0.6976, Adjusted R-squared:  0.6617
## F-statistic: 19.44 on 14 and 118 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Spain
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
```

```
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.085984 -0.022637  0.000372  0.027881  0.102399
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        64.542173   2.127482  30.337  < 2e-16 ***
## poly(nMonth, 3)1    0.208374   0.040248   5.177 9.18e-07 ***
## poly(nMonth, 3)2   -0.111929   0.038731  -2.890  0.00457 **
## poly(nMonth, 3)3   -0.187995   0.042230  -4.452 1.92e-05 ***
## as.numeric(year)   -0.026843   0.001057 -25.387  < 2e-16 ***
## google.search       0.021147   0.022723   0.931  0.35391
## lag1.google.search -0.020548   0.024963  -0.823  0.41207
## lag2.google.search  0.026912   0.023264   1.157  0.24964
## lag3.google.search -0.017418   0.023295  -0.748  0.45611
## lag4.google.search -0.002661   0.024508  -0.109  0.91372
## lag5.google.search -0.049956   0.023737  -2.105  0.03741 *
## lag6.google.search  0.076456   0.023662   3.231  0.00159 **
## lag7.google.search -0.040404   0.023551  -1.716  0.08882 .
## lag8.google.search  0.054509   0.024405   2.234  0.02736 *
## lag9.google.search -0.015458   0.022887  -0.675  0.50072
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03754 on 120 degrees of freedom
## Multiple R-squared:  0.8744, Adjusted R-squared:  0.8597
## F-statistic: 59.65 on 14 and 120 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Sweden
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.083675 -0.019099  0.000914  0.019367  0.092038
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        -0.952047   2.062041  -0.462  0.64525
## poly(nMonth, 3)1   -0.329644   0.047986  -6.870 4.71e-10 ***
## poly(nMonth, 3)2   -0.650219   0.045380 -14.328  < 2e-16 ***
## poly(nMonth, 3)3   -0.135937   0.043412  -3.131  0.00225 **
## as.numeric(year)    0.005022   0.001024   4.902 3.47e-06 ***
## google.search       0.002453   0.007111   0.345  0.73080
```

```
## lag1.google.search -0.006013   0.007595  -0.792  0.43036
## lag2.google.search  0.009216   0.008010   1.151  0.25249
## lag3.google.search  0.011324   0.008045   1.408  0.16222
## lag4.google.search  0.006858   0.008421   0.814  0.41726
## lag5.google.search -0.010502   0.008481  -1.238  0.21837
## lag6.google.search -0.005391   0.008264  -0.652  0.51563
## lag7.google.search  0.009882   0.008371   1.181  0.24046
## lag8.google.search  0.001195   0.007930   0.151  0.88055
## lag9.google.search -0.016584   0.007553  -2.196  0.03031 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03193 on 105 degrees of freedom
## Multiple R-squared:  0.839,  Adjusted R-squared:  0.8176
## F-statistic:  39.1 on 14 and 105 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: Switzerland
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.086122 -0.022065  0.002691  0.023680  0.065580
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)        -1.427e+01  4.282e+00  -3.333 0.001142 **
## poly(nMonth, 3)1    1.393e-01  3.641e-02   3.826 0.000208 ***
## poly(nMonth, 3)2   -3.333e-01  3.591e-02  -9.282 8.83e-16 ***
## poly(nMonth, 3)3   -2.083e-01  3.505e-02  -5.942 2.82e-08 ***
## as.numeric(year)    1.148e-02  2.127e-03   5.400 3.41e-07 ***
## google.search       1.859e-04  1.294e-02   0.014 0.988557
## lag1.google.search  1.893e-02  1.380e-02   1.372 0.172718
## lag2.google.search -1.596e-02  1.371e-02  -1.164 0.246629
## lag3.google.search -5.947e-03  1.390e-02  -0.428 0.669493
## lag4.google.search  1.811e-02  1.434e-02   1.263 0.208933
## lag5.google.search -1.049e-02  1.430e-02  -0.734 0.464577
## lag6.google.search  2.158e-02  1.460e-02   1.479 0.141889
## lag7.google.search -4.030e-03  1.466e-02  -0.275 0.783907
## lag8.google.search  1.842e-02  1.526e-02   1.207 0.229850
## lag9.google.search  1.743e-02  1.488e-02   1.172 0.243691
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0343 on 120 degrees of freedom
## Multiple R-squared:  0.7905, Adjusted R-squared:  0.766
## F-statistic: 32.34 on 14 and 120 DF,  p-value: < 2.2e-16
##
```

```
## ------------------------------------------------------------
## data2$Country: Turkey
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.120717 -0.036259  0.002328  0.034817  0.156956
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)         9.9813209  4.8001189   2.079   0.0399 *
## poly(nMonth, 3)1   -0.1869019  0.0650575  -2.873   0.0049 **
## poly(nMonth, 3)2   -0.3670756  0.0644331  -5.697 1.07e-07 ***
## poly(nMonth, 3)3   -0.7192730  0.0600800 -11.972  < 2e-16 ***
## as.numeric(year)    0.0007939  0.0023839   0.333   0.7398
## google.search      -0.0075060  0.0319819  -0.235   0.8149
## lag1.google.search -0.0104132  0.0374220  -0.278   0.7813
## lag2.google.search -0.0189784  0.0385813  -0.492   0.6238
## lag3.google.search  0.0211801  0.0388375   0.545   0.5866
## lag4.google.search -0.0253034  0.0385534  -0.656   0.5130
## lag5.google.search  0.0123661  0.0387369   0.319   0.7502
## lag6.google.search  0.0269959  0.0393605   0.686   0.4943
## lag7.google.search -0.0119183  0.0406091  -0.293   0.7697
## lag8.google.search  0.0007591  0.0420705   0.018   0.9856
## lag9.google.search  0.0410759  0.0349130   1.177   0.2420
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.05618 on 108 degrees of freedom
## Multiple R-squared:  0.6925, Adjusted R-squared:  0.6526
## F-statistic: 17.37 on 14 and 108 DF,  p-value: < 2.2e-16
##
## ------------------------------------------------------------
## data2$Country: UK
##
## Call:
## lm(formula = log.births ~ poly(nMonth, 3) + as.numeric(year) +
##     google.search + lag1.google.search + lag2.google.search +
##     lag3.google.search + lag4.google.search + lag5.google.search +
##     lag6.google.search + lag7.google.search + lag8.google.search +
##     lag9.google.search, data = df)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.050899 -0.009585  0.001623  0.012388  0.066189
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)        10.4093748  3.4008583   3.061 0.003101 **
## poly(nMonth, 3)1    0.1212195  0.0498187   2.433 0.017450 *
## poly(nMonth, 3)2   -0.0988845  0.0530131  -1.865 0.066216 .
## poly(nMonth, 3)3   -0.1740605  0.0431928  -4.030 0.000137 ***
## as.numeric(year)    0.0003435  0.0016903   0.203 0.839540
## google.search       0.0243739  0.0155054   1.572 0.120343
## lag1.google.search -0.0043962  0.0188791  -0.233 0.816530
## lag2.google.search  0.0549152  0.0141527   3.880 0.000229 ***
## lag3.google.search -0.0052571  0.0157729  -0.333 0.739876
## lag4.google.search  0.0662175  0.0170371   3.887 0.000224 ***
## lag5.google.search -0.0372424  0.0180905  -2.059 0.043145 *
## lag6.google.search  0.0365249  0.0171541   2.129 0.036656 *
## lag7.google.search  0.0288477  0.0153668   1.877 0.064532 .
## lag8.google.search -0.0153270  0.0161502  -0.949 0.345780
## lag9.google.search  0.0154754  0.0164580   0.940 0.350211
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02299 on 72 degrees of freedom
## Multiple R-squared:  0.7861, Adjusted R-squared:  0.7445
## F-statistic:  18.9 on 14 and 72 DF,  p-value: < 2.2e-16
```

After running these 28 regressions, I wanted to do a variable selection procedure for each country. So I ran a Lasso regression (with cross validation) to select the significant predictors for each country.

```
## [1] 1
##   (Intercept)   I(nMonth^3)
##  1.012075e+01 -1.979186e-06
## [1] 2
##        (Intercept)   as.numeric(year)             nMonth      google.search
##      -1.360543e+01       1.113710e-02       6.684036e-04      -1.825312e-02
## lag4.google.search lag6.google.search lag7.google.search
##       6.886399e-03       5.408951e-03       9.257934e-03
## [1] 3
##        (Intercept) lag2.google.search lag7.google.search
##         9.24330609        -0.03782249         0.02023852
## [1] 4
## (Intercept)
##    10.35449
## [1] 5
##      (Intercept) as.numeric(year)
##     12.694699241     -0.001379083
## [1] 6
##        (Intercept)   as.numeric(year)             nMonth lag6.google.search
##       16.747367715       -0.004029738        0.008992442        0.004039685
## [1] 7
##        (Intercept)      google.search lag2.google.search lag3.google.search
##        9.148738586       -0.025248038        0.001089551        0.001101686
## lag4.google.search lag5.google.search
##        0.035240264        0.003431916
## [1] 8
##        (Intercept)   as.numeric(year)      google.search lag1.google.search
##       16.672930053       -0.004052145       -0.039766028       -0.027395042
## lag2.google.search lag4.google.search lag5.google.search lag6.google.search
```

```
##       -0.003400948        0.010638408        0.004999786        0.003012327
## lag7.google.search
##        0.013434054
## [1] 9
##        (Intercept)   as.numeric(year)        I(nMonth^3) lag1.google.search
##       3.824508e+01      -1.479326e-02      -2.685312e-05      -9.248721e-03
## lag5.google.search lag6.google.search lag7.google.search
##       1.018567e-02       9.292458e-03       1.645669e-02
## [1] 11
##        (Intercept)      google.search lag1.google.search lag4.google.search
##        10.98989844        -0.14207259        -0.11664854         0.04553822
## [1] 12
##        (Intercept)   as.numeric(year) lag1.google.search lag3.google.search
##      49.9825314252      -0.0203512262      -0.0141709570      -0.0060048234
## lag4.google.search lag5.google.search lag6.google.search lag7.google.search
##       0.0019693107       0.0007557102       0.0109105038       0.0270503239
## lag8.google.search
##       0.0140517468
## [1] 13
##        (Intercept)      google.search lag1.google.search lag4.google.search
##        8.961293248       -0.012949201       -0.009082873        0.011792210
## lag7.google.search lag8.google.search
##        0.002476223        0.012190035
## [1] 14
##        (Intercept)   as.numeric(year)      google.search lag2.google.search
##       28.891537905       -0.010044049        0.005564141        0.013405019
## lag4.google.search lag5.google.search lag6.google.search lag8.google.search
##        0.007119100        0.011045271        0.035928610        0.020272383
## [1] 15
##        (Intercept)   as.numeric(year)             nMonth lag1.google.search
##       53.677319084       -0.021387809        0.005274259       -0.023116306
## lag2.google.search lag6.google.search lag7.google.search lag8.google.search
##       -0.001400002        0.031346487        0.011937948        0.004323943
## [1] 16
##        (Intercept)   as.numeric(year)             nMonth lag6.google.search
##      30.8918297601      -0.0097090192       0.0009167946       0.0609517258
## [1] 17
##        (Intercept)   as.numeric(year)             nMonth lag1.google.search
##       43.608511257       -0.015677855        0.007493980       -0.042616400
## lag4.google.search lag5.google.search
##        0.023970211        0.008914506
## [1] 18
##        (Intercept)   as.numeric(year)      google.search lag1.google.search
##       20.033428291       -0.005186231       -0.017296903       -0.016018239
## lag4.google.search lag6.google.search lag7.google.search
##        0.027549156        0.013498760        0.006395942
## [1] 19
##      (Intercept) as.numeric(year)
##     21.185955617     -0.006288108
## [1] 20
##        (Intercept)   as.numeric(year)        I(nMonth^3)      google.search
##       2.217402e+01      -6.777924e-03      -5.052952e-05      -1.630448e-02
## lag3.google.search lag4.google.search lag5.google.search
##       1.031716e-02       2.981916e-02       2.408249e-02
```

```
## [1] 21
##        (Intercept)        I(nMonth^3)      google.search lag1.google.search
##       1.039646e+01      -1.009899e-05      -7.162256e-03      -1.522053e-02
## lag3.google.search lag4.google.search
##       1.787199e-02       4.707888e-02
## [1] 22
##        (Intercept)   as.numeric(year)             nMonth lag1.google.search
##       42.842421845       -0.016867047        0.005312378       -0.092414460
## lag5.google.search
##       -0.005571759
## [1] 23
##      (Intercept) as.numeric(year)           nMonth      I(nMonth^3)
##     5.461291e+01    -2.188438e-02    -8.833308e-03    -2.161739e-05
##    google.search
##     1.026548e-02
## [1] 24
##        (Intercept)   as.numeric(year)             nMonth lag8.google.search
##       58.797674389       -0.023994706        0.001952160        0.007241815
## [1] 25
##        (Intercept)   as.numeric(year)        I(nMonth^3) lag1.google.search
##       7.689264e+00       7.472070e-04      -7.435815e-05      -9.350642e-03
## lag4.google.search lag5.google.search lag6.google.search lag7.google.search
##       1.609115e-03       2.502676e-03       1.470809e-02       9.372776e-03
## [1] 26
##        (Intercept)   as.numeric(year)             nMonth lag8.google.search
##      -1.109063e+01       9.900114e-03       3.843782e-04       1.551874e-02
## [1] 27
##        (Intercept)        I(nMonth^3) lag2.google.search
##      11.6014104289      -0.0000411067      -0.0106198233
## [1] 28
##        (Intercept) lag4.google.search lag6.google.search lag7.google.search
##       11.095939168        0.041077625        0.040960173        0.017254321
## lag8.google.search
##        0.001114852
```

```
##
##                                 Stepwise Selection Summary
## ----------------------------------------------------------------------------------------------
##                              Added/                   Adj.
## Step       Variable         Removed     R-Square    R-Square     C(p)        AIC         RMSE
## ----------------------------------------------------------------------------------------------
##    1    poly(nMonth, 3)    addition       0.406       0.368    7.4790    -198.1464    0.0328
## ----------------------------------------------------------------------------------------------
```

I used the output of the lasso regression by group to determine which countries had a significant relationship between unemployment and births, and which ones did not.

Then, I binned the countries into two groups, and I ran a logistic regression to see if social spending as a percent of GDP could predict which group a country belongs to.

```
##
## Call:
## glm(formula = as.factor(unemployment.predictor) ~ social.spending,
##     family = binomial, data = OECD_social_spending_summary)
```

```
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.8272  -1.1240   0.7273   0.9173   1.6853
##
## Coefficients:
##                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)     -1.97167    1.41325  -1.395   0.1630
## social.spending  0.11072    0.06701   1.652   0.0985 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 38.243  on 27  degrees of freedom
## Residual deviance: 35.207  on 26  degrees of freedom
## AIC: 39.207
##
## Number of Fisher Scoring iterations: 4

##
## Call:
## glm(formula = as.factor(unemployment.predictor) ~ social.spending +
##     live.births.per.woman, family = binomial, data = OECD_social_spending_summary)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.8725  -1.1131   0.7114   0.9450   1.6553
##
## Coefficients:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept)           -2.48769    4.41708  -0.563    0.573
## social.spending        0.11537    0.07726   1.493    0.135
## live.births.per.woman  0.25599    2.07068   0.124    0.902
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 38.243  on 27  degrees of freedom
## Residual deviance: 35.192  on 25  degrees of freedom
## AIC: 41.192
##
## Number of Fisher Scoring iterations: 4
```

The results show that a country's social spending is not significant (at level 0.05). at predicting whether there is a relationship between births and google searches for unemployment. It is significant at the level 0.1 (p = 0.0985). More data and a greater sample size would be needed to investigate this further. The constraint is that I used data from three different sources (OECD social spending data, UN birth data, and google trends data), and the countries must be present in each of the three sources in order to be analyzed.

Reference

Wilde J, Chen W, Lohmann S. 2020. COVID-19 and the future of US fertility: What can we learn from Google? IZA Institute of Labor Economics Discussion Paper
http://ftp.iza.org/dp13776.pdf

Data sources

California Department of Public Health.
California births by month.
https://www.cdph.ca.gov/Programs/CHSI/CDPH%20Document%20Library/Birth%20and%20Death%20Tables/CA_county_births_by_month.pdf

Florida Department of Public Health.
Florida births by month
http://www.flhealthcharts.com/FLQUERY_New/Birth/Count#

US Bureau of Labor Statistics.
California unemployment rate
https://data.bls.gov/timeseries/LASST060000000000005?amp%253bdata_tool=XGtable&output_view=data&include_graphs=true

Florida unemployment rate
https://www.bls.gov/eag/eag.fl.htm

German Statistical Agency
Unemployment and birth rates in Germany
https://www-genesis.destatis.de

Google Trends
https://trends.google.com/

UN Data for births in different countries: http://data.un.org/Data.aspx?d=POP&f=tableCode%3A55

UN Data for total population in different countries: http://data.un.org/Data.aspx?q=population&d=PopDiv&f=variableID%3a12

Social spending data https://data.oecd.org/socialexp/social-spending.htm