

The impact of encouraging blood donations: An experimental study

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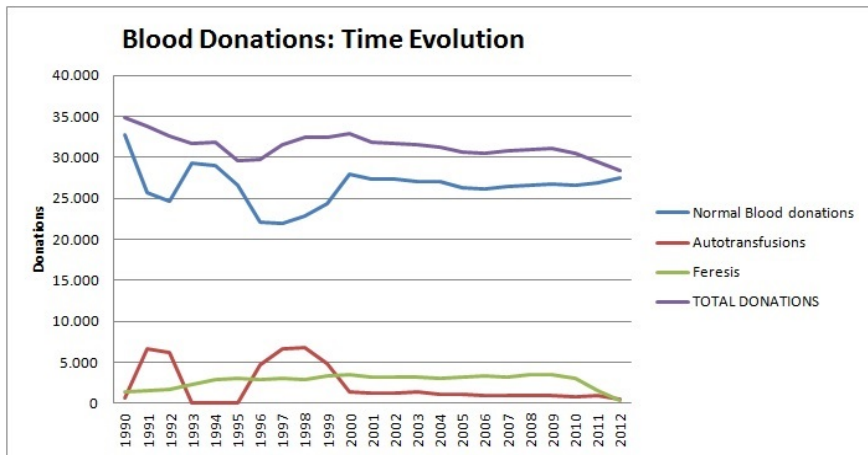




Motivation (I)

- Blood cannot be artificially created and only voluntary donors are the only providers for blood
- Need for blood in risk of not being covered: only a small percentage of the world population donates blood
- Specific need for the blood donors associations to analyze the impact of "costly-thought" pro-donation campaigns

Motivation (II)



Objective

To analyze the impact (increase in the frequency of donation) of a of pro-donation campaigns that took place between 1990 and 2012

List of Pro-donation events in the last two years

18/01/2010: 1st phase blood donations' campaign "Y TU, ¿QUÉ ERES?"

01/02/2010: 2nd phase blood donations' campaign "Y TU, ¿QUÉ ERES?"

11/06/2011: One day street campaign. ADONA goes to the street

23/08/2011: Summer campaign Red Cross + ADONA

23/09/2011: Blood donations' campaign "YO DOY LA CARA, ¿Y TU?"

June 2012: Osasuna dedicates the month to blood donors

21/09/2012: Extraction Mobile Unit to the University of Navarra

Methods (I)

- We treat Pro-Donation Campaigns as a Natural experiment (Meyer, 1995): we want to analyze how individuals behave when there is a campaign versus when there is not a campaign, and evaluate (if possible) these differences
- We use individual data from several years: *Before* (control group) and *After* (treatment group) design for the estimation of the **regularity of donations**, the **number of blood donations**, and the **number of new blood donors**, before, during and after each campaign
- We will do evaluation of multiple campaigns, which are implemented not simultaneously, but in different moments of time

Methods (II)

Estimation of Differences in the outcomes of interest

We want to estimate the impact of each campaign. The simplest model is:

$$Y_t = \beta_0 + \beta_1 \cdot t + u_t, \quad \forall t = \{1, 2\} \quad (1)$$

$Y_t = Y_1 - Y_0$ is the outcome of interest (the difference in the number of donations, the difference in the number of new donors, the number of days between consecutive donations, etc) and t is 1 if the campaign is active and 0 before the campaign

The estimated effect of the campaign is the difference of the outcome of interest in $t = 1$ and $t = 0$:

$$\hat{\beta}_1 = E[Y_1] - E[Y_0] \quad (2)$$

Methods (II)

Estimation of Differences in the outcomes of interest

- The term u_t recruits all the information that we have not included in the model and has an influence over the variations in the number of donations.
- We need to know as much as possible concerning other factors that could bias our estimation and control for them

Examples: Other variables that could influence donors' regularity

- Being near 50, 100, 150 donations may increase regularity (social recognition: medals)
- Gender: men can donate more regularly than women
- Blood group O (universal) may be more regular
- Age: younger (elder) individuals may wait less (more) time between two consecutive donations

- Data: We have 74,499 donors registered since 1990, and a total of 730,779 donations
 - 47% are women (36,024) and 52.29% men (39,475)
 - The most frequent groups are O and A with the 49.01% (33,884) and 42.43% (29,334) of donors respectively. The other groups AB and B are less frequent (with the 2.52% and 6.05%)
 - Normal blood donation is the most frequent (96,69% of donors make a normal donation). The rest are autotransfusions (3.27%), Feresis with RBCs (0.01%) and Feresis without RBCs (0.03%)

Data Analysis

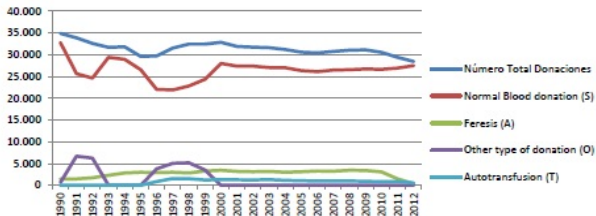
- 1 Variation in the total number of donations: Could we say that pro-donation campaigns/events increase (total) blood supply?
- 2 How do we measure the **success** of a pro-donation campaign?
 - Increase in the frequency of donation, especially for those individuals who were not regular donors before the campaign
 - Number of new donors
 - New donors that become frequent donors
- 3 Comparison between campaigns:
 - Is there a difference in terms of success between campaigns?
 - Could it be a matter of time, so that the first campaign has stronger impact than those later in time?

Measures of impact of campaigns

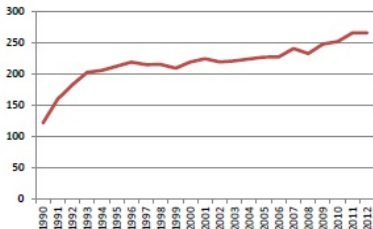
- 1 Days between donations
- 2 Number of donations
- 3 Number of New donors

Measures of impact of campaigns

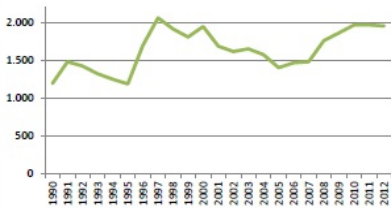
Total Donations: Time Evolution



Days between donations (individual mean)

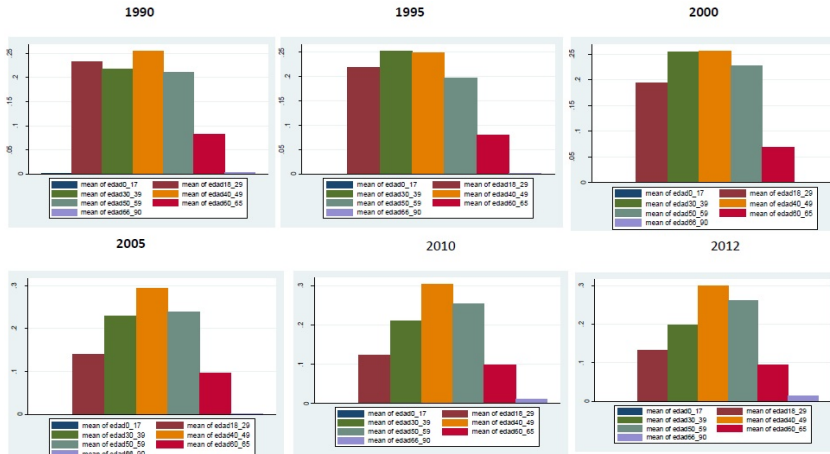


Number of New donors, by year



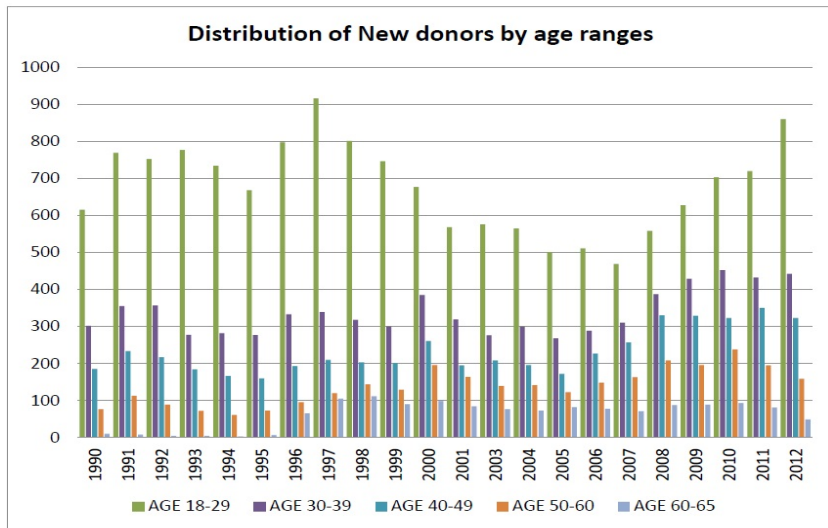
Results

Age: variation of distribution of individuals by age ranges since 1990



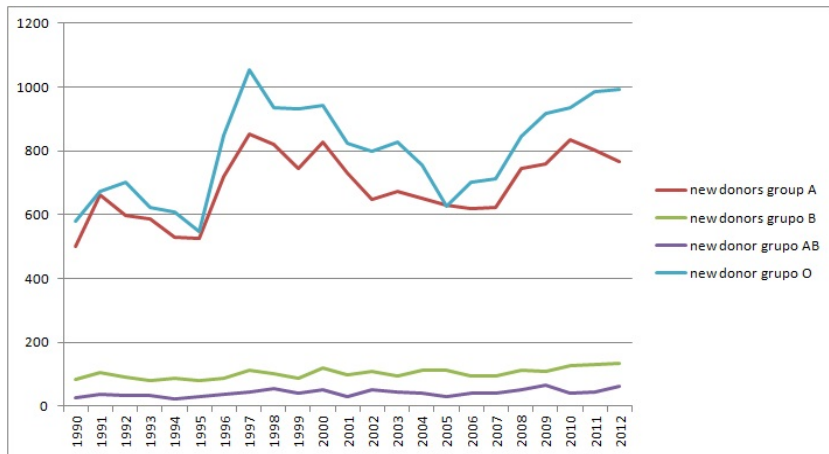
Results

Age: variation of distribution of new donors by age ranges since 1990



Results

Descriptive Analysis



Results

Measures of Impact of Pro-donation campaigns

| Campaign | Dates | Period of Campaign | New Donors | Repeat in next 3-6 months | Repeat in next 1 year | Repeat in next 2 years | >= 5 donations after 2 years |
|------------------------------|-------------------------|-------------------------|-----------------|---------------------------|-----------------------|------------------------|------------------------------|
| Y tú, ¿qué eres? (1st phase) | 2010/01/18 - 2010/02/01 | 2010/01/18 - 2010/02/01 | 91 | 10 | 39 | 58 | 21 |
| Y tú, ¿qué eres? (2nd phase) | 2010/02/01 - 2010/02/14 | 2010/02/01 - 2010/02/14 | 121 | 19 | 52 | 60 | 32 |
| ADONA one day in the street | 11/06/2011 | 2011/06/11 - 2011/06/25 | 104 (1) | 3 | 7 | 8 | 57 |
| Summer campaign 2011 | 2011/08/23 - 2011/09/07 | 2011/08/23 - 2011/09/07 | 81 | 17 | 45 | 54 | 7 |
| Da la cara | 2011/09/23 - 2011/10/07 | 2011/09/23 - 2011/10/07 | 83 | 24 | 49 | 51 | 12 |
| Osasuna (Month) | 2012/06/01 - 2012/07/01 | 2012/06/01 - 2012/07/01 | 171 | 55 | 95 | NA | NA |
| One day at University | 21/09/2012 | 2012/09/21 - 2012/10/05 | 108 (29) | 16 | 26 | NA | NA |

Only a few individuals who start donating in the period of campaigns repeat in the short-term (in the next 3-6 months). It is more common however to make a second donation after 1 year, or even after 2 years from the first donation. Regularity seems to be a matter of time and complementarity of campaigns, more than to be the result of a specific campaign

Results

Regression Models for Before-After Analysis

- The mean days between donations have increased, but is after the 2011 campaigns that it starts to decrease. However, it is due to a specific campaign, to the time effect, or to complementarity of 2011 campaigns with previous campaigns?

| REFERENCE YEAR | Period (days of campaign) | Campaign | Days between Donations | | | |
|----------------|---------------------------|------------------------------------|----------------------------|--------------------------------|---|-----------------------|
| | | | Before ($\hat{\beta}_0$) | difference ($\hat{\beta}_1$) | After ($\hat{\beta}_0 + \hat{\beta}_1$) | p-value of difference |
| 2009 | 2010/01/18 – 2010/02/01 | Y tú, ¿qué eres? (1st phase) | 246,32 2.548 | 5,833 3.695 | 252,153 | 0.114 |
| 2009 | 2010/02/01 – 2010/02/14 | Y tú, ¿qué eres? (2nd phase) | 246,56 2.492 | 5,613 3.707 | 252,173 | 0.130 |
| 2010 | 2011/06/11 – 2011/06/25 | ADONA one day in the street | 254,429 2.260 | 12,705 4.383 | 267,134 | 0.004 |
| 2010 | 2011/08/23 – 2011/09/07 | Summer campaign 2011 | 255,915 2.134 | 10,717 5.077 | 266,632 | 0.035 |
| 2010 | 2011/09/23 – 2011/10/07 | Da la cara | 256,712 2.078 | 8,331 5.726 | 265,043 | 0.146 |
| 2011 | 2012/06/01 -2012/07/01 | Osasuna (Month of the blood donor) | 267,81 4.457 | -10,751 2.356 | 257,059 | 0.016 |
| 2011 | 2012/09/21 – 2012/10/05 | One day at University | 267,546 2.145 | -20,956 5.93 | 246,59 | 0.000 |

Regression Models for Before-After Analysis

Other variables also affect to the days between donation, such as age, being close to the number of donations for receiving a medal. However, the inclusion of those variables does not reduce too much the estimated impact of the campaign (-10,75 vs -10,147) and therefore we could say that the impact of that specific campaign is a reduction of about 10 days between consecutive donations for each individual

| DAYS BETWEEN DONATIONS | coef | std.err | t | p-value | 95% Conf. Int | |
|-------------------------------|-------------|----------------|----------|----------------|----------------------|----------|
| Constant | 386,532 | 4,539 | 85,16 | 0,000 | 377,6357 | 395,428 |
| CAMPAIGN 2011 | -10,147 | 4,405 | -2,3 | 0,021 | -18,782 | -1,513 |
| MAN | -149,890 | 4,379 | -34,23 | 0,000 | -158,4739 | -141,306 |
| AGE 18-29 | -33,174 | 6,646 | -4,99 | 0,000 | -46,20196 | -20,146 |
| AGE 60-65 | -36,335 | 6,581 | -5,52 | 0,000 | -49,23552 | -23,435 |
| GROUP O | -2,764 | 3,954 | -0,7 | 0,484 | -10,51481 | 4,985 |
| CLOSE TO MEDAL | -77,497 | 9,099 | -8,52 | 0,000 | -95,33171 | -59,662 |

Results

Regression Models for Before-After Analysis

One of the results to emphasize is that the number of new donors is lower in those periods between campaigns. Looking at the number of donations, it seems that the first campaign (Y TU, ¿QUÉ ERES? in January 2010) had the stronger impact increasing donations. However, it takes some time, until after DA LA CARA 2011, that the number of donations does not increase between campaigns.

| | PERIOD CAMPAING 15 DAYS | | PERIOD CAMPAING 30 DAYS | | | PERIOD CAMPAING 15 DAYS | | PERIOD CAMPAING 30 DAYS | |
|--|----------------------------|---------|----------------------------|---------|---|----------------------------|---------|----------------------------|---------|
| NUMBER OF DONATIONS (PER DAY) | COEF | P-VALUE | COEF | P-VALUE | NUMBER OF NEW DONORS (PER DAY) | COEF | P-VALUE | COEF | P-VALUE |
| Constant | 115,660 | 0,000 | 114,849 | 0,000 | Constant | 6,472 | 0,000 | 7,026 | 0,000 |
| Y TU QUE ERES 1+2 | | | 15,190 | 0,044 | Y TU QUE ERES 1+2 | | | 3,413 | 0,000 |
| Y TU QUE ERES1 | 30,980 | 0,013 | | | Y TU QUE ERES1 | 0,567 | 0,091 | | |
| Y TU QUE ERES2 | -2,860 | 0,804 | | | Y TU QUE ERES2 | 2,217 | 0,033 | | |
| BETWEEN 1 | -1,469 | 0,757 | 9,763 | 0,026 | BETWEEN 1 | -1,154 | 0,826 | 1,486 | 0,003 |
| ADONA_PL CASTILLO | -7,166 | 0,647 | -12,849 | 0,024 | ADONA_PL CASTILLO | 0,390 | 0,027 | -1,070 | 0,101 |
| BETWEEN 2 | -30,131 | 0,015 | -15,810 | 0,022 | BETWEEN 2 | -3,113 | 0,450 | -0,626 | 0,427 |
| SUMMER CAMPAIGN | -11,985 | 0,434 | -3,646 | 0,628 | SUMMER CAMPAIGN | -1,314 | 0,675 | 0,795 | 0,355 |
| BETWEEN3 | 18,151 | 0,236 | | | BETWEEN3 | -0,731 | 0,909 | | |
| DALACARA | 2,327 | 0,786 | 5,927 | 0,368 | DALACARA | -0,111 | 0,000 | 1,464 | 0,052 |
| BETWEEN4 | 0,447 | 0,926 | -2,259 | 0,496 | BETWEEN4 | 2,060 | 0,040 | 0,768 | 0,043 |
| OSASUNA | 12,316 | 0,267 | -4,849 | 0,545 | OSASUNA | 2,592 | 0,000 | 0,746 | 0,414 |
| BETWEEN 5 | -5,360 | 0,094 | -13,308 | 0,007 | BETWEEN 5 | 1,302 | 0,010 | 0,121 | 0,830 |
| UNIVERSITY | -3,577 | 0,753 | -2,758 | 0,806 | UNIVERSITY | 3,345 | 0,000 | 2,791 | 0,030 |

Discussion

- No control group: the campaign is not randomly implemented to individuals. Everybody has the same probability of receiving the message
- Threats to validity of the model: omitted variables, trends in outcomes, attrition bias (loss of donors because of health reasons, age...)
- We know when a campaign starts but we don't know where it ends. So, it's one year enough to estimate its impact? Or is it too much? Taking the year seems to make sense, as regularity can only be measured by 2 or more donations, and between donations there must be a period of 3-4 months minimum.
- Individuals who went to donate and were excluded are not registered

