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Redesigning the Market for Volunteers: A Donor Registry

This is the final peer-reviewed author's accepted manuscript (postprint) of the following publication:

Published Version:
Stephanie Heger, Robert Slonim, E.G. (2020). Redesigning the Market for Volunteers: A Donor Registry. MANAGEMENT SCIENCE, 66(8), 3528-3541 [10.1287/mnsc.2019.3371].

Availability:
This version is available at: https://hdl.handle.net/11585/847618 since: 2022-01-25

Published:
DOI: http://doi.org/10.1287/mnsc.2019.3371

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(Article begins on next page)

12 October 2024

This is the final peer-reviewed accepted manuscript of:

Heger, S. A., Slonim, R., Garbarino, E., Wang, C., & Waller, D. (2020). Redesigning the market for volunteers: A donor registry. *Management Science*, *66*(8), 3528-3541.

The final published version is available online at:

https://doi.org/10.1287/mnsc.2019.3371

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Redesigning the Market for Volunteers: A Donor Registry*

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Abstract: This paper addresses volunteer labor markets where the lack of price signals, non-pecuniary motivations to supply labor, and limited fungibility of supply lead to market failure. To address the causes of the market failure, we conduct a field experiment with volunteer whole blood donors where we introduce a market-clearing mechanism (henceforth: the Registry). Our *intention-to-treat* estimates suggest that subjects invited to the Registry, regardless of joining, are 66% more responsive to critical shortage appeals than control subjects. While the registry increases supply during a critical shortage episode, it does not increase supply when there is no shortage; thus the Registry significantly improves coordination between volunteer donors and collection centers, thereby improving market outcomes. We find evidence that the Registry's effectiveness stems from crowding-in volunteers with purely altruistic motives and volunteers with a preference for commitment.

Keywords: Voluntary labor, coordination, market failure, altruism, commitment, ask avoidance, market design.

*We greatly appreciate the generous financial support of the Australian Research Council, #1095222, and #150101307 and the Australian Red Cross Blood Service (Blood Service) for their continuous support. We appreciate the support from many Blood Service personnel including Perfecto Diaz, Bianca Folber, David Irving and Geoff Smith. We would like to acknowledge the Australian Red Cross Blood Service and Australian governments that fully fund the Blood Service for the provision of blood products and services to the Australian community. We received helpful suggestions from Daniel Gottlieb, Ignacio Esponda, Glenn MacDonald, Filippo Massari, Robert Pollak, Kevin Schnepel and seminar participants at the University of Sydney and Washington University in Saint Louis.

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1 Introduction

Markets are the primary institution in which economies organize and allocate goods and services among individuals. The power and appeal of market institutions are that under certain assumptions, market equilibria are also socially optimal. However, in markets that lack a price signal, it can be difficult to achieve equilibrium. This difficulty is exacerbated in markets that rely on volunteers to supply goods and services when the volunteers are primarily motivated by unobservable preferences that are difficult for markets to react to, such as altruism, warm glow and status-seeking. In such cases, these markets may not only result in shortages but can also experience excess supply. For example, Bertina Ceccarelli of United Way in New York remarked "that sometimes its almost more work to find something for a volunteer to do than to just turn them away."[1]

In this paper, we consider the market for whole blood, which relies on altruistically motivated volunteers and is characterized by both periods of excess demand and excess supply, resulting in a direct loss of nearly $1.1 billion USD annually. The lack of price signals and the altruistic motivations of blood donors makes it difficult for collection centers and donors to coordinate to meet demand.[2] The challenges in the whole blood market are more similar to the challenges facing other volunteer labor markets, rather than those found in charitable giving or organ markets, since blood, unlike money, is not fungible and blood markets, unlike organ markets, are "thick" and the supply is generic (i.e., it is only differentiated by a small number of blood types).[3]

The main problem in the whole blood market is one of coordination of supply to meet demand. Demand for whole blood is temporally stable with the vast majority of donated blood used for treating cancer and blood diseases, while only 2% is used for trauma, which may fluctuate over time. However, supply fluctuates, resulting in periods of excess supply and periods of excess demand. The fluctuation in supply is best illustrated through the pattern of solicitations issued by the Australian Red Cross Blood Service (henceforth: Blood Service) throughout the year. In August and September (winter months in Australia), the Blood Service increases the number of blood donation solicitations by 200-300% relative to

[1] See http://www.nytimes.com/2009/03/16/nyregion/16volunteers.html.

[2] Exceptions include the use of "blood barometers" in many Scandinavian countries, where blood collection agencies post the current level of supply for each blood type on agency web sites to communicate the current need to interested donors.

[3] Clearinghouse mechanisms have proven to effectively increase thickness in many "thin" markets, such as the market for kidneys or bone marrow (**??**) by bringing together a larger number of "buyers" and "sellers" to facilitate a transaction. **?** provides a thorough outline and examples of providing thickness and overcoming congestion in various markets. Registries (or clearinghouses) have also been used to reduce congestion as markets become thick, for example, in entry-level labor markets (**??**) and school choice (**???**).

other months (see Figure S1). This costly surge in solicitations is due to a lower supply, rather than an increase in demand. Moreover, due to the short shelf-life of whole blood, approximately 21-42 days, blood collected during periods of excess supply cannot be cost-effectively stored to cover periods of excess demand.[4] To address the coordination problem, we designed the Registry. The Registry collects information on individual preferences for making a blood donation (henceforth, donation always refers to a blood donation) so that a central organizer is able to coordinate potential donors' actions based on information on their preferences, instead of donors acting on their own. In this way, we create a more responsive supply to address the temporal imbalances.[5]

In partnership with the Blood Service, we conduct a field experiment that implements a mechanism, the Registry, to improve market coordination.[6] We randomly assigned 15,388 long-lapsed donors (donors who have donated before, but have not made a donation in at least the past 24 months) to a treatment within the experiment, which unfolded over 14 months and two rounds (described in Section **??**). In Round 1, we randomly assigned some subjects to be invited to join the Registry (henceforth: the Registry Conditions). Subjects assigned to the Registry Conditions were truthfully told that the Blood Service was creating a donor Registry where Registry members would only be asked to donate when there was a need for their blood type and that the Blood Service would only contact Registry members once or twice per year.[7] By contrast, subjects in the Donation Solicitation Only and Control conditions (henceforth: Donation Only and Control, respectively) were never informed of the existence of the Registry. Round 2 calls began three to five months later (when anticipated winter shortages occurred) and subjects were randomly assigned to receive a Standard Shortage Appeal or a Critical Shortage Appeal, which occurs when there are less than a few weeks of blood supply remaining. The two rounds allow us to answer the following set of four questions:

(1) Does inviting individuals to join the registry crowd-out contemporaneous donations? And

[4]Additionally, blood donors are required to wait 8-12 weeks between whole blood donations to allow the body to regenerate red blood cells and can only give a fixed amount during a donation. Thus, collection centers cannot continually cultivate the most willing donors during shortages.

[5]Alternative approaches, such as offering or increasing extrinsic incentives (**????**), informing prospective donors of shortages (**??**), reducing time costs (**?**) or providing unconditional gifts (**?**) may increase supply, but they are not designed to encourage supply-side flexibility. Conversely, the Registry is effective because it targets supply increases only when there is excess market demand conditional on the normal supply, thereby improving market efficiency.

[6]**?** provides an early and brief discussion of the Registry on pages 191-193. **?** tested three variations of registry designs against current market setups for volunteers in a controlled lab experiment and found significant improvements in market efficiency in all the Registry Conditions.

[7]Since the completion of the Registry study period, the Blood Service has continued to use the Registry.

similarly, does inviting individuals to make a contemporaneous donation crowd-out joining the registry?
(2) Does implementing a Registry improve the coordination of blood supply (i.e., the intention to treat effect)?
(3) Is the Registry cost-effective to implement during a shortage?
(4) If the Registry is effective, what type of donors are crowded-in to donation activities by the Registry?

We find that the introduction of the Registry significantly improves the coordination of supply. Based on our *intention-to-treat* analyses, subjects who received a Registry invitation, regardless of joining the Registry, are significantly more responsive to donation solicitations than subjects who do not receive an invitation. For instance, they are 66% more likely to donate within three weeks of receiving a solicitation. Further, we find that the Registry invitation serves as an effective selection or screening mechanism—Registry members are 100% more responsive to critical shortages than individuals who were not invited to the Registry as well as individuals who opted out of joining the Registry. Further, soliciting Registry members during a shortage reduces solicitation costs by 50% and results in a lower probability of both excess supply and excess demand.[8]

Beyond our main intention-to-treat analyses, we also find that the Registry additionally serves as an effective selection (i.e., screening) mechanism. In particular, we also explore the channels through which the Registry may serve as an effective screening mechanism. The invitation to join the Registry was designed to appeal to individuals who might be the most likely to be marginal donors: (1) individuals with purely altruistic motives, rather than only warm glow motives (**??**); and (2) individuals who are in need of a commitment device. We briefly discuss how the Registry might be working through each of these behavioral channels in Section **??** and provide the formal development in Supplementary Material B.[9]

2 Experimental Design, Hypotheses and Data

In partnership with the Australian Red Cross Blood Service, we introduced a Registry throughout Australia using a large-scale field experiment that unfolded over two rounds.

[8]The structure of the Registry invitation and donation solicitation follows a "foot-in-the-door" approach **?**, whereby individuals who first comply with a smaller request (e.g., join the Registry) are more likely to comply with a later, larger, request (e.g., make a donation). However, the literature in psychology is mixed as to the effectiveness of the "foot-in-the-door" technique (see **??** for reviews) and that its effectiveness is quite heterogeneous (**?**).

[9]The Supplementary Material can be found here Supplemental Materials.

We drew the sample for our experiment from the population of long-lapsed donors. Long-lapsed donors are donors who have given at least one successful whole blood donation, but have not donated in at least the past 24 months.[10] Before presenting the details, we initially provide a high-level overview of the experiment and our main hypotheses (Section **??**) and then present the more precise details and data used (Section **??**).

2.1 Overview of Design & Hypotheses

The motivation for our experimental design was to determine (1) inviting individuals to join the registry crowd-out contemporaneous donations (and vice versa); (2) implementing a Registry improves the coordination of blood supply (i.e., the intention to treat effect); (3) the Registry is cost-effective to implement during a shortage; and (4) type of donors are crowded-in to donation activities by the Registry

To answer these questions we designed a two-round experiment that consisted of call agents from the Blood Service contacting long-lapsed donors by telephone. In Round 1, which occurred between April and June 2012, our objective was to populate the Registry. To do this we conducted a 2×2 between-subjects design, where the two treatments are a randomly assigned Registry invitation and a randomly assigned Donation solicitation. This design results in four treatment groups: Registry Invitation Only, Donation Solicitation Only, Registry Invitation & Donation Solicitation and No Registry Solicitation & No Donation Invitation (henceforth: Registry Only, Donation Only, Registry + Donation, and Control, respectively). The Round 1 design allows us to understand how to populate the Registry by comparing whether individuals were more or less likely to join the Registry when the invitation was or was not coupled with a donation solicitation.

When subjects were invited to join the Registry in Round 1, they were told that if they joined the Registry they would only be called when there was a current need for their blood type and would be called only once or twice a year. If subjects joined the Registry with this invitation, they were placed into what we will refer to as the General Registry. If subjects declined this invitation, they were then asked whether they would consider joining a Critical

[10] We also restricted our sample to donors whose last donation occurred within the past 4 years in order to increase the likelihood of reaching these donors. Our concern was that donors who last donated more than 4 years ago may be more likely to have changed their contact details and thus be harder to reach. Long-lapsed donors have two major advantages as a population to study. First, they are likely to be the "marginal" donors; donors who have donated more recently are more likely to donate regardless of treatment conditions, and people who have never donated before may be more likely to be unresponsive to any manipulation. Second, once a donor has been designated as long lapsed, the Blood Service ceases to have any form of normal marketing communications with these donors; thus, we can minimize the likelihood that these donors are having any other form of (unobserved) solicitations that might interfere or add noise to the measurement of treatment effects.

Registry that would only solicit donations if the Blood Service had less than a three day supply of blood. If they declined both of these invitations, then they were not placed in either Registry.

In Round 2, we conducted a second round of calls between July and September 2012 and in March 2013 to test the Registry's effect on subsequent donation behavior as well as the motivations of donors crowded back in by Registry (that will allow us to address questions 2 and 3 above). In Round 2, we treated all subjects who answered the phone in Round 1 and a further random sample from the Control condition in Round 1 (henceforth: Control 1). The remaining sample that was not contacted in either Round 1 nor in Round 2 was thus not treated in Round 2 (henceforth: Control 2). The Round 2 treatment manipulated whether subjects received a Standard Shortage Appeal or a Critical Shortage Appeal. The key difference between the Standard and Critical Appeal is that the Critical Appeal informed donors that there was a *critical shortage* and those donations were *needed within the next few weeks*. The standard donation appeal consisted of the Blood Service's standard donation solicitation and did not inform the donors of any critical shortages or time frames. When there was not a critical shortage, only standard donation solicitation calls were made, whereas during critical shortage periods donors were randomly assigned to receive either a standard or critical appeal script.

To empirically answer questions (2) and (3), our main results compare the behaviors of the subjects in the Donation Only condition to subjects in the Registry + Donation condition since these subjects are treated exactly the same throughout the experiment except for the Round 1 Registry invitation. Our first hypothesis concerns the causal effects of the Registry; that is, whether the introduction of the Registry in Round 1 crowds-in donations and that subjects assigned to the Registry + Donation condition will be more likely to donate within three weeks of a solicitation than Donation Only condition, but will not be more likely to donate beyond the period of critical need (i.e., improves coordination of the supply). To test this hypothesis, we estimate an intention-to-treat effect, in which we compare the Round 2 donation rates between the subjects assigned to the Donation Only condition and those assigned to the Registry + Donation condition, regardless of Registry membership.

Hypothesis 1. *The invitation to join the Registry in Round 1 will*
(i) increase supply in Round 2; and
(ii) improve coordination in Round 2.

Next, we hypothesize that the Registry serves as a screening mechanism; that is, subjects who join the Registry are (1) more likely to donate when solicited and (2) *no more* likely to donate when not solicited than subjects in all other conditions who were not invited to join

the Registry. Thus we hypothesize that subjects who select into (select out of) the Registry in Round 1 will be more (less) likely to donate in Round 2 than subjects in the Control 2, Control 1 and Donation Only conditions.

Hypothesis 2. *The invitation to join the Registry serves as a selection or screening mechanism.*

Finally, we consider the preferences of subjects who are crowded-in by the Registry and hypothesize that the Registry will crowd-in donations from individuals who are motivated to donate by pure altruism and from individuals who need a commitment to donate.

The following hypotheses are developed in detail in **??** and Supplementary Material B. Here, we provide a brief intuitive explanation for why the Registry crowds-in donors with preferences for pure altruism and a need for commitment, and how the experiment was designed to test these hypotheses.

A subject with pure altruist preferences is motivated by the benefit that her donation provides to the recipient (Andreoni, 1989). The Registry should thus attract donors with pure altruist preferences since joining the Registry in Round 1 implies a promise to help in the future (Round 2) if there is a need. To test whether the Registry crowds-in donors with a preference for pure altruism, we should observe that Registry members will be more responsive to the critical than standard appeal solicitation in Round 2 compared to subjects in the Donation only condition since the critical appeal solicitation signals a greater need (which is the main reason for the inclusion of the Round 2 for critical and standard appeal treatment conditions).

Hypothesis 3. *The Registry crowds-in donations from long-lapsed donors with pure motives.*

We also hypothesize that the Registry crowds-in donations from subjects with a preference for a commitment mechanism. When subjects were asked to donate in Round 1 there was no prior promise or commitment to donate by any subject. Since there was no commitment to donate in Round 1, a need for commitment does not affect Round 1 donation rates and thus we expect that in Round 1 subjects in the Registry + Donation condition and subjects in the Donation Only condition will be equally likely to donate. However, during the Round 1 calls, subjects assigned to the Registry Condition were informed that there would be a future solicitation *if they joined the Registry*, thus joining the Registry gives donors an opportunity to make an implicit promise (or commitment) to donate when called later. This implicit promise is not available to subjects in the Donation Only condition because, by design, they were not invited to join the Registry. Thus, if the Registry crowds-in donations from subjects who need a commitment device, then we expect that the Round 2

donation rates among the Registry + Donation subjects will be greater than the Round 1 rates and that this increase is driven by subjects joining the Registry. By contrast, we do not expect an increase in donation rates from the subjects in the Donation Only condition. In sum, subjects from the Registry condition, driven by joining the Registry, should be more responsive in Round 2 than Round 1 to a donation solicitation than Donation only subjects.

Hypothesis 4. *The Registry crowds-in donations from long-lapsed donors who have a preference for commitment.*

2.2 Details of the Experimental Design & Description of Data

In this Section, we elaborate on the details of the experimental design outlined in Section **??**. In particular, we discuss in further detail the sample for our experiment, the details of Round 1 and the details of Round 2.

2.2.1 Sample

We identified 44,223 eligible long-lapsed donors in Australia from which we randomly drew 15,388 for the Registry project.[11] Of the 15,388 donors assigned to the Registry project, we identified 1,827 donors who were subsequently (during our study) contacted by Blood Service staff for campaigns unrelated to the Registry project and outside of the parameters of the project. Since these donors have been contacted for other purposes including to make donations, we have discarded them from the main analysis, resulting in an effective sample of 13,561 long-lapsed donors that are randomly assigned to a treatment arm.[12] We then conducted two rounds of calls. No calls were made to either control group during the Round 1 calls, but Control Group 1 receives a solicitation call in Round 2. Table **??** presents the sample sizes in each treatment condition. Table **??** shows that donor characteristics and treatment assignment are orthogonal.[13]

[11]The criteria for the population we identified required (a) donated whole blood at least once in the past four years, (b) maximum age (since some older donors may have permanently retired from donating) and (c) blood types O and A (since these are the most commonly needed during shortages) and constitute approximately 87% of the Australian population and (d) excluded donors who donated for medical reasons, since the Registry would presumably not motivate them. While the age, blood type and non-medical requirements restricted this population somewhat, the major restriction was having donated at least once in the past 4 years. The Blood Service provided us with the universe of donors meeting our criteria which is this 44,223 sample.

[12]In Figure S2 we show the proportion of subjects from each of the treatments that were dropped from our analysis due to this outside contact. In Figure S3 we compare the averages across the observable characteristics for the included sample of 13,561 versus the excluded 1,827 observations. Finally, in Table S5, we replicate our main analysis from Table **??** including the 1,827 observations.

[13]In randomly assigning subjects to conditions, we balanced on gender, age, past donation categories (1 donation, 2-3 donations, 4+ donations), telephone call dates and call agents. The benefit of a field experiment

2.2.2 Round 1 Calls

The Round 1 calls occurred from April to June 2012. The design in Round 1 was a 2×2 between-subjects design, where the two treatments were a donation solicitation and Registry invitation, resulting in four distinct treatment groups: Registry + Donation, Registry Only, Donation Only, and the Control condition where subjects were not called in Round 1. Subjects in the control group were randomly assigned into Control 1 (who received a donation solicitation in Round 2) and Control 2 (who did not receive a call in Round 2).[14] Whether a subject received treatment in Round 1 depends on whether he answered the phone call.[15] Table S1 shows that males and older donors were more likely to answer the phone in Round 1, though this was equally true across all treatments. When a subject was solicited for a donation, we used the standard Blood Service solicitation script. Subjects who were not invited to join the Registry were not aware of the existence of the Registry.

2.2.3 Round 2 Calls

The second round of calls occurred either during July and September 2012 when shortages (and, specifically, critical shortages) of whole blood usually occur every year or in March 2013 (when the next shortage occurred). During Round 2, we intended to treat all subjects who answered the phone in Round 1 plus a random subset of the Control group (i.e., Control Group 1).[16] Thus, in Round 2 we contacted subjects who were in the Registry Only and Registry + Donation conditions who answered the phone call in Round 1, regardless of whether they selected in or out of the Registry, subjects in the Donation Only condition who answered the phone call in Round 1, and Control group 1. The two treatment conditions in Round 2 were the Critical Appeal or Standard Appeal.[17] The Blood Service placed

is that participants do not select into treatment and are unaware that they are taking part in an experiment (**?**).

[14]The Registry+Donation condition consisted of two closely related sub-treatments, both of which involved donors being asked to both make a donation and to join the registry. In the Simultaneous condition, donors were first informed of the registry and then simultaneously asked to make a donation and join the registry, whereas, in the Sequential condition, donors were first asked to make a donation, and then informed and asked to join the registry. The initial purpose of including the Simultaneous and the Sequential treatments was to identify whether knowledge of the Registry crowded-out donations.

We never found any significant differences between the two conditions in any of our analyses, so we combined these two conditions for increased power and to simplify the presentation of the results.

[15]Supplementary Material C contains the script the call agents used for each call condition.

[16]The Blood Service did not want to call donors who had not answered calls in Round 1 since their view was that these donors would also be unlikely to answer in Round 2 and would thus be costly to attempt to call.

[17]For completeness, we also include Supplemental Table S3, which shows that there are no treatment differences in the propensity to answer the phone call in Round 2, except that Control Group 1 is less likely to answer. This is not surprising since donors in the Registry and Donation Only treatments have already

Table 1: Treatment Assignment

	Round 1 Treatment Assignments			
	Donation Solicitation	Registry Invitation	N	Effective N
Registry + Donation	Yes	Yes	5,999	5,249
Registry Only	No	Yes	3,000	2,610
Donation Only	Yes	No	1,799	1,556
Control 1	No	No	2,838	2,324
Control 2	No	No	1,752	1,752
Total			15,388	13,561

	Round 2 Treatment Assignments Donation Appeal Type		
	Standard	Critical	Not Assigned
Registry + Donation	817	142	814
Registry Only	516	116	238
Donation Only	276	55	165
Control 1	1,770	554	
Control 2	No	No	
Total	3,379	867	1,217

The difference between N and Effective N reflects those donors who were treated, but subsequently excluded from analysis due to receiving solicitations from other units of the Blood Service that were not part of the experimental treatments.

Table 2: Summary Statistics, by Assigned Round 1 Treatment

	All	Registry + Donation	Registry Only	Donation Only	Control
Female	.50	.50	.50	.50	.48
	(.50)	(.50)	(.50)	(.50)	(.50)
Past Donations	4.57	4.49	4.50	4.38	4.78
	(6.45)	(6.38)	(6.5)	(5.99)	(6.97)
Days Since Last Donation	1082	1088	1085	1084	1084
	(129)	(125)	(126)	(125)	(140)
Current Age	36.45	36.33	36.25	36.06	36.60
	(10.39)	(10.36)	(10.22)	(10.21)	(10.61)
State					
Australian Capital Territory	.03	.03	.02	.03	.02
New South Wales	.27	.28	.28	.25	.29
Queensland	.12	.13	.12	.13	.12
South Australia	.09	.09	.10	.09	.08
Tasmania	.04	.04	.04	.04	.04
Victoria	.33	.33	.32	.33	.33
Western Australia	.12	.11	.11	.12	.12
Urban Donor Center	.72	.71	.73	.72	.73
Observations	13,561	5,249	2,610	1,556	4,146

Standard deviations in parentheses.

some restrictions on the timing of calls. In particular, the Blood Service did not want to make calls to subjects in the Registry condition who selected out of the Registry in July and September 2012 and instead preferred to wait until March 2013 (along with a random subset of subjects from Control 1). Unlike the July and September 2012 calls, there was no critical shortage in March 2013 and therefore all calls in March used the Standard Appeal. Including those subjects who selected-out of the Registries, we are thus able to examine both the causal effects of the Registry (i.e., the intention-to-treat) and the selection effects of Registry membership. While it would have been desirable to have had some subjects who chose not to join the Registry be assigned to receive a Critical Appeal, we argue that this feature means that we are likely underestimating the causal impact of the Registry. We return to this in Section **??**.

Finally, note that treatment calls in Round 2 were restricted to subjects who were eligible to make a donation during this shortage period. This restriction was necessary because there are subjects who answered the phone in Round 1, but was ineligible to make a donation at the time of Round 2 for reasons such as medical ineligibility or having recently donated. Since this ineligibility was not random, we *include* the "Not Assigned" group in our Intention-to-Treat Analysis in Section **??**.

3 Main Results

In this section, we report our main results. Section **??** uses the Round 1 data to discuss the populating of the Registry. Section **??** uses the Round 2 data to test Hypotheses **??** and **??**. Third, we use the results from Section **??** to simulate a solicitation campaign to show the cost effectiveness of using the Registry.

3.1 Populating the Registry: Round 1 Calls

The purpose of Round 1 was to randomly assign subjects to either the Registry or non-Registry conditions (i.e., Donation only condition) in order to test our main research questions about the effectiveness of the Registry in Round 2. However, the 2×2 design in Round 1 also allows us to examine (1) if combining a donation solicitation with the Registry solicitation affects the populating of the registry compared to only having a Registry solicitation without the donation solicitation; and (2) whether combining the Registry solicitation with a donation solicitation adversely affects donations compared to only soliciting donations.

answered the phone in Round 1, thus, as a group, they are more likely to answer the phone than donors assigned to Control Group 1.

Examining subjects in the two Registry Conditions (Registry Only and Registry + Donation), Table **??** shows that (1) 22 percent of all subjects joined the General Registry (see column (1)), while conditional on answering the phone in Round 1, 66 percent joined (see column (2)); (2) subjects' characteristics are not significant predictors of joining the Registry; and (3) the likelihood of joining the General Registry is lower when paired with a donation solicitation (column (2) p-value=.103). Recall that subjects in the Registry + Donation condition were first asked to make a donation and then asked to join the Registry. One reason that Registry take-up may be lower for the Registry + Donation group is that after subjects agreed to the donation request they felt they had completed their social responsibility or fulfilled their desire for altruism and no longer felt the pressure or need to comply with an additional request.

In fact, we find that subjects assigned to the Registry + Donation condition are no more likely to make a donation in Round 1 than subjects assigned to the Donation Only condition (18.03% and 16.89% conditional on answering the phone, respectively. See Table S2). However, subjects who selected-into the General Registry from the Registry + Donation condition were significantly more likely to donate in Round 1 (24.27%) than (1) subjects who selected-out of the Registries (7.80%) and (2) subjects in the Donation only condition (16.89%). In summary, in Round 1, we find a high take-up rate for joining the General Registry, that the decision to join the Registry was not affected by being asked to concurrently make a donation, and similarly the decision to make a donation in Round 1 was not affected by being concurrently asked to join the Registry.

3.2 Registry Calls: Round 2

In this section, our outcome of interest is the Round 2 donation behavior of subjects *assigned* to the various treatments. Throughout our analysis, we control for gender, age, yearly blood donation rate prior to becoming long-lapsed and days since the last donation. We also include state fixed effects and a dummy for whether the donor donated at a metropolitan site. Additionally, where appropriate, we also use day-of-week fixed effects and call agent fixed effects in order to control for any differences in solicitation styles across agents.[18]

We begin by examining the donation -behavior in Round 2 when the Blood Service conducted its shortage calls. In Round 2, a subject received either a "Standard Appeal" or a "Critical Appeal" for a donation. The Standard Appeal is the Blood Service's standard donation solicitation that reminds donors of the importance of blood donations and asks the

[18]Agents were instructed to read the scripts, but if donors need additional information or clarification, then individual differences across call agents can emerge.

Table 3: Registry Take-Up

	Join General Registry	Join General Registry Answered R1	Join Critical Registry	Join Critical Registry Answered R1	Join Either Registry	Join Either Registry Answered R1
Reg + Don	-0.008	-0.03	-0.003	-0.02*	-0.01	-0.05***
	(0.01)	(0.02)	(0.003)	(0.009)	(0.01)	(0.02)
Female	0.005	0.02	-0.008***	-0.02***	-0.007	-0.01
	(0.009)	(0.02)	(0.003)	(0.008)	(0.01)	(0.02)
Age	0.0008**	0.0001	-9.64e-06	-0.0003	0.0009*	-0.0002
	(0.0004)	(0.0009)	(0.0001)	(0.0004)	(0.0005)	(0.0009)
Yearly Donation Rate	0.17	1.02	0.003	0.05	0.18	1.08
	(0.19)	(0.8)	(0.04)	(0.23)	(0.21)	(0.82)
Days Since Last Donation	2367.35	4656.41	-569.42	-2448.43	1844.28	2751.38
	(3623.72)	(7501.78)	(930.70)	(3171.76)	(3888.74)	(7183.36)
Observations	7858	2697	7858	2697	7858	2697
Pseudo R^2	0.32	0.02	0.11	0.06	0.34	0.03
State and Site FE	Y	Y	Y	Y	Y	Y
Call Day FE	Y	Y	Y	Y	Y	Y
Call Agent FE	N	Y	N	Y	N	Y
Omitted Group	Reg Only	Reg Only	Reg Only	Reg Only	Reg Only	Reg Only
Mean Probability of Omitted Group	.22	.66	.03	.20	.24	.73

Marginal coefficients from a probit regression reported. Columns (3) and (4) are conditional on not joining the General Registry. Robust Standard Errors in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

donor to make a donation, while the Critical Appeal is the typical solicitation used when there is a critical shortage, which tells the donor that the Blood Service is experiencing a critical shortage and that there is less than a few weeks of blood supply remaining.[19]

In Panel A of Table **??** we present our intention to treat analysis, where we compare the behavior of all subjects assigned to treatment in Round 2 from the Registry + Donation condition (regardless of whether they *joined* one of the Registries) with those assigned to the Donation Only condition in Round 1.[20] In columns (1) & (2), we report marginal effects from a probit regression where the outcome variable takes a value of 1 if the subject donated before the Blood Service contacted them again, on average 9 months later, and 0 otherwise. Columns (1) and (2) show that the subjects in the Registry + Donation condition are more likely to donate, but not significantly than subjects in Donation Only.

However, in columns (3) & (4), we consider a different outcome variable that examines whether the Registry improves coordination. Recall, the invitation to join the Registry informed individuals that they would only be invited to donate "when the community has a critical need for blood," so, if the Registry improves coordination, subjects in the Registry Conditions should be more likely to donate in a shorter time frame than subjects who are not

[19]The call scripts for these calls are presented in Supplementary Material C.

[20]As explained in Section **??**, our intention-to-treat analysis only uses data from these two conditions because they are treated identically except for the Registry invitation in Round 1.

in the Registry Conditions. We find, in support of Hypothesis **??**, that subjects assigned to the Registry + Donation condition are more responsive to a solicitation; they are 2 percentage points more likely to donate within 3 weeks than individuals in the Donation Only condition, representing a 66 percent relative increase. Moreover, and in further support of Hypothesis **??**, this greater responsiveness only occurs during the time of greater need. Columns (5) & (6) show that subjects assigned to the Registry + Donation condition do not donate significantly more (p-value=.85) than Donation Only subjects during the following nine weeks after the critical need has passed. The greater immediate responsiveness of Registry members (when shortages occur), but not later (when the shortages have passed) provides the first evidence of the effectiveness of the Registry to improve market efficiency. We discuss efficiency in much greater detail in Section **??**. We also find that the Critical Appeal treatment further improves coordination; Column (3) shows that individuals who receive the Critical Appeal are 10 percentage points more likely to donate within 3 weeks, while Column (5) shows that the critical appeal has a significantly weaker and no longer significant effect after the first three weeks.

Result 1 *Consistent with Hypothesis* **??**, *subjects assigned to Registry + Donation condition are more responsive to the solicitation than subjects in the Donation Only condition; specifically, subjects assigned to the Registry + Donation condition are 2 percentage points more likely to donate within 3 weeks of solicitation (a 66 percent increase), but no more likely to donate in weeks 4-12 than subjects assigned to the Donation Only condition.*

The results presented in Panel A of Table **??** show that the introduction of the Registry improves coordination of supply to meet demand. However, from a practical perspective, once the Registry is implemented it provides a population of potential donors that the Blood Service can continually return to during periods of excess demand. Thus, it is also important to consider the effect of calling Registry members relative to the subjects in the Donation Only and Control conditions. We now examine this selection effect.

In Panel B of Table **??** we replicate Panel A, but separately estimate the likelihood of donating for subjects assigned to the Registry + Donation condition based on their Round 1 decision about joining the Registry. We consider three distinct groups: subjects who selected-into the General Registry, subjects who selected-out of the General Registry but into the Critical Registry and subjects who selected out of both Registries. As we hypothesize in Hypothesis **??**, the Registry invitation serves as an effective screening mechanism: those who select-into the General Registry are significantly more likely to donate than subjects who select-out of the General Registry into either the Critical Registry or into no Registry, as well as compared to those who were in the Donation Only condition. Moreover, subjects

Table 4: Introduction of Registry: Causal & Selection Effects on Donation Behavior

	Likelihood to Donate		Likelihood to Donate within 3 weeks		Likelihood to Donate within weeks 4-12	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Intention-to-Treat Effects of Registry					
Registry + Donation	0.01	0.01	0.02*	0.02**	0.0008	0.001
	(0.02)	(0.02)	(0.009)	(0.008)	(0.007)	(0.007)
Critical Appeal, Round 2	0.09***	0.09***	0.1***	0.1***	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.02)	(0.01)	(0.01)
Female	.	-0.02*	.	-0.02**	.	-0.01
		(0.01)		(0.008)		(0.006)
Age	.	0.002***	.	0.0003	.	-0.000056
		(0.0006)		(0.0004)		(0.0003)
Yearly Donation Rate	.	0.6	.	0.02	.	-0.48
		(0.58)		(0.38)		(0.54)
Days Since Last Donation	.	-3685.95	.	2262.65	.	21.04
		(5577.79)		(3222.12)		(2412.15)
Observations	2269	2269	2269	2269	2269	2269
Pseudo R^2	0.007	0.02	0.04	0.06	0.003	0.01
Omitted Group	Don Only	Don Only	Don Only	Don Only	Don Only	Don Only
Mean Probability of Omitted Group	.12	.12	.03	.03	.02	.02
	Panel B: Effects of Registry Membership					
Registry + Donation × Gen Registry Member	0.05***	0.05***	0.03***	0.03***	0.007	0.007
	(0.02)	(0.02)	(0.01)	(0.01)	(0.008)	(0.007)
Registry + Donation × Crit Registry Member	-0.08***	-0.08***	-0.02	-0.02	-0.02**	-0.02**
	(0.02)	(0.02)	(0.01)	(0.01)	(0.008)	(0.007)
Registry + Donation × Non-Registry Member	-0.05***	-0.05***	-0.02	-0.02	-0.009	-0.008
	(0.02)	(0.02)	(0.01)	(0.01)	(0.008)	(0.008)
Critical Appeal, Round 2	0.12***	0.12***	0.11***	0.11***	0.02	0.02
	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
Female	.	-0.03*	.	-0.02**	.	-0.01*
		(0.01)		(0.007)		(0.006)
Age	.	0.002***	.	0.0002	.	-0.0000432
		(0.0006)		(0.0003)		(0.0003)
Yearly Donation Rate	.	0.53	.	-0.002	.	-0.44
		(0.56)		(0.35)		(0.51)
Days Since Last Donation	.	-3611.24	.	1687.25	.	101.43
		(5423.44)		(2923.98)		(2298.12)
Observations	2269	2269	2269	2269	2269	2269
Pseudo R^2	0.04	0.04	0.08	0.09	0.02	0.03
Omitted Group	Don Only	Don Only	Don Only	Don Only	Don Only	Don Only
Mean Probability of Omitted Group	.12	.12	.03	.03	.02	.02
Controls						
Demographics	No	Yes	No	Yes	No	Yes
State & Site FE	No	Yes	No	Yes	No	Yes

Marginal effects from probit regressions reported. Robust Standard Errors in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

who select-out of both Registries are significantly less likely to donate than subjects assigned to the Donation Only conditions.

Result 2 *Consistent with Hypothesis* **??**, *subjects who selected into the General Registry are 5 percentage points more likely to donate than subjects in non-Registry Conditions (a 42 percent increase), while subjects who selected out of the Registry are 5 percentage points less likely to donate than non-Registry condition subjects. Further, General Registry members, compared to subjects in the Donation only condition, are 3 percentage points more likely to donate within 3 weeks of solicitation (a 100 percent increase), but also no more likely to donate during weeks 4-12. On the other hand, subjects who selected out of the Registry, compared to the Donation Only condition, are significantly less likely to donate both within 3 weeks of the solicitation and in the subsequent 4-12 weeks.*

3.3 Improved Efficiency in a Simulated Solicitation Campaign

In this section, we show the extent to which using the Registry as a screening mechanism can improve market outcomes. Throughout, we compare the behavior of donors who joined the General Registry from the Registry + Donation treatment (henceforth: Registry Members) to those in the Donation Only treatment, who were never invited to join nor informed of the Registry (henceforth: non-Registry members). We restrict our attention to these two treatment groups since all donors in these groups received one solicitation call in both Round 1 and Round 2, whereas donors in all other treatments did not receive a solicitation call in Round 1. To do so, we simulate a solicitation campaign to show that (1) soliciting Registry members, rather than non-Registry members, is cost effective and (2) both the expected probability of excess demand and excess supply are smaller when the campaign targets Registry members rather than non-Registry members. These results are driven by Registry members being more likely to donate and a smaller standard error on mean donation rates for Registry members than non-Registry members.

We calculate the probability distribution of donating within 3 weeks of a solicitation using estimates from a probit regression (see Table S6). We focus on donations within three weeks in order to address the timing needs during critical shortage periods when demand temporarily exceeds supply. The means of the distributions are .104 (standard error .003) and .051 (standard error .002) for Registry and non-Registry members, respectively, implying that Registry members are more responsive than non-Registry members (see Figure S4a).

Suppose the Blood Service wants to construct a solicitation campaign such that they can expect 100 donations during a critical shortage period, then they would need to solicit 958

General Registry members or 1949 non-Registry members. Calling this requisite number of non-Registry and Registry members will result in two distributions of expected donations, both with means of 100 (see Figure S4b).

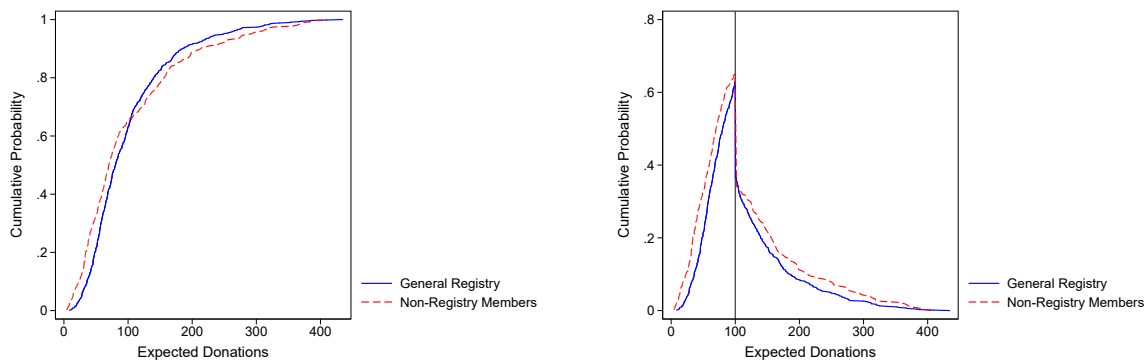
Based on making these calls, we generate the cumulative distribution of expected donations to calculate the probability that the Blood Service's campaign will result in excess supply or excess demand and how these likelihoods differ when the campaign solicits Registry versus non-Registry members. Figure **??** shows the cumulative distribution functions that represent the probability of this solicitation campaign resulting in x or fewer donations. In particular, Figure **??** shows that the probability of excess supply and the probability of excess demand is greater among non-Registry members than Registry members. This is more clearly illustrated in Figure **??**, which shows that for all expected donations that would result in excess demand (the area of Figure 1b to the left of the expected 100 donations) and excess supply (the area to the right of expected 100 donations), the probability is strictly greater from soliciting non-Registry members versus Registry members. In sum, to obtain the requisite amount of blood to address a critical temporal shortage will require 100% more calls to non-Registry members than to Registry members and the probability of both excess supply and excess demand is greater when those solicitations are made to non-Registry members than Registry members.

To further emphasize the cost-effectiveness of the Registry, suppose the Blood Service faces a critical shortage and needs to be nearly certain of collecting the 100 donations in the next three weeks. For example, the shortage may be so critical that the Blood Service needs to be 90% confident that their collection efforts will yield the needed 100 donations. Using similar probability distributions as calculated above, we find that the Blood Service would need to solicit 212% more non-Registry members (8,321 solicitations) than Registry members (2,662 solicitations). To obtain 95% confidence, the Blood Service would need to solicit 287% more non-Registry members (13,377 solicitations) than Registry members (3,441 solicitations). In general, the Registry's value increases as the Blood Service seeks more certainty over satisfying excess demand.

4 Understanding Registry Demand: Donor Motivation

Table **??**, and particularly Panel B, shows that the Registry is effective at "crowding-in" donations from long-lapsed donors; that is, donors who had not given in at least 24 months are more willing to give after joining the Registry. In this section, we examine the preferences

Figure 1: Excess Supply and Excess Demand



(a) Cumulative Distribution Functions (b) Excess

Figure ?? shows that the CDF for non-Registry members is a mean-preserving spread of the CDF for Registry members. Figure ?? shows the same CDF, $Prob[X < x]$ as Figure ?? for $x < 100$, but shows the inverse CDF, $Prob[X > x]$, for all $x > 100$.

and motivations of donors who were crowded-in by the Registry. We consider two main motivations based on well-developed models of altruism and commitment, but we examine other motivations in Section ?? that may also be consistent with our results, including ask avoidance.

Section ?? considers the crowding-in of pure altruists; that is, the Registry provides information about the (critical) need for whole blood, which can crowd in the volunteers with pure altruism motives who get utility from this information. Similarly, in Section ??, we consider the crowding-in of donors with a preference for commitment. If a donor has self-control problems, then the Registry may provide the needed psychological commitment to crowd-in the long-lapsed volunteer.

Table ?? in Section ?? shows that conditional on answering the phone call, approximately two-thirds of individuals joined the General Registry, while the remaining one-third selected-out of the General Registry. The table shows that the available demographics do not significantly predict who selects-in and who selects-out of the Registry. However, our set of available demographics is quite limited and it is not clear that these demographics should be correlated with the preferences (pure altruism and need for commitment) that we hypothesize predict selection into the Registry. For example, ? find no relationship between demographics and purely altruistic versus warm-glow donors,[21] while ? find no relationship between age or gender and present bias. Thus, the lack of the demographic variables to

[21] While a series of studies have looked for a link between gender and altruism, the findings are mixed (?????).

predict selection into the Registry does not shed light on whether there is preference-based selection, as we hypothesize.

4.1 Pure Altruists

A pure altruist is motivated only by "need" and cares about the overall supply of the good, while in contrast, an individual motivated by warm glow cares about their private contribution and obtains utility from the "warm glow" of personal sacrifice (**??**). One of the key parts of the Registry is that it promises to call members only when their blood is needed, thus reducing any uncertainty about the overall level of need. This information is valuable to an individual motivated by pure motives, but not valuable to an individual motivated by warm glow. Further, the greater is the need, the more motivated a pure altruist will be. Thus, if the Registry's informational content drives its effectiveness then we would expect that individuals motivated by pure altruism will be more likely to select into the Registry. The testable implication in the data is that Registry members would be relatively more responsive the greater is the need than individuals not invited to join the Registry.

The Round 2 treatment conditions give us this difference in the need; recall, in Round 2, subjects were treated with either a critical call, informing them of the dire need for their donation in the next few weeks, or a standard shortage call. Following this hypothesis, we test whether the Registry crowds-in individuals with pure motives by comparing the probability of donating within 3 weeks of the solicitation in Round 2 for individuals who received a critical call and those who received a standard call. If the Registry crowds-in individuals motivated by pure altruism, then we expect the increase in donation rates between those who received a critical call versus those who received a standard call will be greater among Registry members than the control groups (i.e., those who never received an invitation).

The results are presented in Figure **??**. Figure **??** shows that approximately 25% and 9% of Registry members who were assigned to receive a critical call or standard call, respectively, donated within 3 weeks, indicating an increase of approximately 16 percentage points. We compare this to the behavior of individuals not invited to join the Registry, where there was no significant increase in donation rates between those assigned to the critical call and those assigned to receive the standard call (7% versus 4%, respectively). Supplementary Material B formally models this intuition and Table S7 shows that this result is statistically significant in a difference-in-difference regression framework.

4.2 Commitment Device

Next, we consider whether joining the Registry serves as an effective commitment and thus crowds-in individuals who have ceased donation activity due to commitment problems. During the Round 1 calls, subjects assigned to the Registry + Donation treatment and the Donation only treatment were both asked to donate and the former was also invited to join the Registry with a promise that there would be a future solicitation, in Round 2, to those who joined. Thus, in Round 1, the subjects randomly assigned to the Registry + Donation and the Donation Only treatments faced the same donation situation, and in particular, had made no commitment to donate at the time of the Round 1 donation invitation. However, during the Round 2 solicitations, subjects who *joined* the Registry have now self-selected, while there was no self-selection among subjects in the Donation Only treatment and thus, in Round 2, Registry members had made a (psychological) commitment to donate, whereas the Donation Only subjects had not made this commitment. Thus, if the Registry crowds-in donors who need a commitment and would not have donated without such a commitment, then we expect that the increase in donation rates between Round 1 and Round 2 will be greater among Registry members than among subjects in the Donation Only treatment.

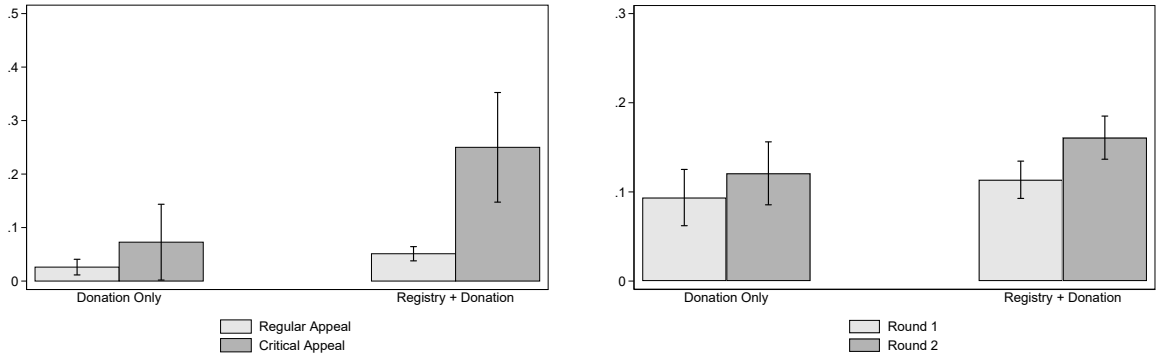
Figure **??** shows that among Registry members from the Registry + Donation treatment, there was approximately a 6 percentage point increase in donation rates between Round 1 and Round 2, while among subjects assigned to the Donation Only treatment, there was only an approximately 3 percentage point increase. Supplementary Material B models the Registry as a commitment device following the **?** model of temptation and self-control. Table S8 estimates an individual fixed effects model to show that the greater increase in donations in Round 2 over Round 1 among Registry members relative to Donation Only subjects shown in Figure **??** is statistically significant in an individual fixed effects regression framework.

4.3 Other Motivations

While we focused on the well-developed models of altruism and commitment, we briefly examine other possible motivations behind the Registry's effectiveness, including a crowding-in of donors who (1) experience solicitation dis-utility or ask avoidance; or (2) have a preference for efficiency.

Solicitation Dis-Utility One possible explanation for the Registry increasing donations is that it crowds-in donations from volunteers who experience direct utility loss when they are solicited for a donation. Dis-utility from being asked to make a donation has been

Figure 2: Crowding-In Donations



(a) Pure Altruism (b) Commitment

observed in other contexts (**????**). To explore whether dis-utility from solicitations might have crowded-in donations from Registry members, note that a donor's status, "active" versus "long-lapsed", is determined by the time since his last donation, which, in turn, determines the number of solicitations he receives from the Blood Service. An active donor receives regular solicitations from the Blood Service, while a long-lapsed donor receives a significantly reduced number of solicitations. A donor remains long-lapsed until he makes another donation, at which point he returns to the active donor pool and receives (more) regular solicitations. In our sample, all donors are long-lapsed at the beginning of our study

When volunteers are invited to join the Registry, one principal characteristic is the promise to "contact Registry members only once or twice a year but never more than four times" in a year. Thus, joining the Registry provides substantially fewer expected solicitations than a long-lapsed donor can expect to receive if he rejoins the active donor pool without the Registry (i.e., making a donation without Registry membership). Thus, if a volunteer joins the Registry and donates, then he can expect the number of future solicitations following the donation to be fewer than if he donates and does not join the Registry. This means that the Registry may crowd-in donors who would like to make a donation, but refrain from doing so because they anticipate the dis-utility from an increased number of solicitations as an active donor. By promising to only call once or twice, the Registry provides an avenue for these ask-avoidant donors to resume donation activities. In Supplementary Material B, we derive two testable implications from the experimental design and also provides analysis that shows little empirical support for dis-utility of solicitations crowding in donations through the Registry. However, given that we do not have any direct measures on subjects expectations of future donations, we are unable to satisfactorily test this hypothesis.

Preference for Efficiency Another possible explanation for the Registry's effectiveness is that the development of a Registry may signal a commitment to efficiency on behalf of the Blood Service and that the Registry may crowd in donors who have a preference for more efficient blood collection. In other contexts, the idea that a preference for efficiency drives donations is mixed (see **?** for a review of the literature). More recently, **?** report results that are consistent with donors being driven by a preference for their donation to have an impact, rather than a preference for efficiency. Thus, a donor motivated by a preference for efficiency may be observationally similar to a donor motivated by pure motives. However, without more data and information on the changes in the Blood Service's costs and subjects' beliefs about those changes, we are unable to test hypotheses about the role of a preference for efficiency.

5 Conclusion

This paper addresses volunteer labor markets, where the lack of price signals, non-pecuniary motivations to supply labor, and limited fungibility of supply lead to market failure. We introduce a market-clearing mechanism, the Registry, that takes these market aspects into account. The Registry was designed to appeal to volunteers across two behavioral preferences: volunteers motivated by pure altruism and volunteers in need of a commitment device.

We find that the introduction of the Registry is effective at improving market outcomes. The primary result, based on the intention-to-treat analyses, indicates that the invitation to join the Registry increases the responsiveness to a solicitation by 66 percent compared to those who were not invited to join the Registry. Further, soliciting Registry members, rather than individuals never invited to join a Registry, decreases the costs associated with a critical need campaign by at least 50%. This positive effect is driven by the Registry successfully screening for donors who find the Registry appealing enough (i.e., those who select-in) that they are motivated to resume donation activities. In particular, we find evidence consistent with the Registry crowding-in volunteers with pure motives and volunteers who have a preference for commitment.

Although we introduce the Registry in the whole blood market, the Registry provides a general framework for managing voluntary labor markets. Because the supply of voluntary labor operates quite differently from traditional labor markets dictated by wages, we believe that identifying the behavioral mechanisms is an important contribution, providing useful

insights into how to design future Registries or expand existing Registries.[22]

The Registry's increased efficiency in managing voluntary blood supply suggests that Registry-like mechanisms could be a successful and powerful tool in other contexts. For instance, there now exists a product, VolunteerHub,[23] that assists not-for-profit organizations in better managing their supply of volunteers. One case study shows that Habitat for Humanity began using VolunteerHub not only to help maintain its volunteer base but also to shield against an unexpected over-supply of volunteers. VolunteerHub is becoming a popular tool among larger organizations and is also used by the Ronald McDonald House and Junior Achievement.

However, we also propose that a registry-like system can be used in other contexts. For example, Australia is now seeking ways to reduce peak-energy demand—demand surges over a limited number of hours on particularly hot days each year in many countries, including Australia. However uncommon, these spikes necessitate massive investments in infrastructure in order to be properly managed that, in turn, lead to greater costs to supply electricity. For example, during January 2018 the average spot price for electricity was $117.45 per megawatt hour, however in the late afternoon on January 29 temperatures and electricity prices spiked at a monthly high of $4631.98 per megakilowatt hour, representing a 3844% increase in price.[24] Australians are encouraged to find ways to decrease energy consumption during these peak-energy hours, such as opting not to run the dishwasher or the laundry, and to move those activities to off-peak hours. Thus, the problem is very similar to the blood market in that the problem is not to decrease overall demand, but to move demand temporally. A Registry, like the one we have implemented for the blood market, could also be implemented in the energy market. Inviting individuals to join a registry that will, at a later point in time, ask them in a coordinated manner to volunteer to refrain from high-energy activities during peak-energy hours, could reduce the need for some of the massive infrastructure needs and reduce electricity costs for all customers.

[22]The costs associated with building and maintaining a Registry are not prohibitive. In Australia, the Blood Service added the Registry invitation to already planned solicitation campaigns.

[23]See https://www.volunteerhub.com/ for more information.

[24]see Australian Energy Market Operator http://aemo.com.au/.