Negative Spillover Effects of Opt-out Defaults: Evidence from Organ Donation Policies

Negative Spillover Effects of Opt-out Defaults: Evidence from Organ Donation Policies[1]

Abstract

Many of today's pressing societal challenges, such as the shortage of organs for transplantation, low vaccination rates, or the progression of climate change, require significant changes in individual behavior. One promising intervention to encourage such behavioral change is the opt-out default, which presumes consent to a desirable behavior rather than relying on people to actively opt in. However, past research mainly studied how opt-out defaults affect the targeted behavior but largely omitted the possibility of negative spillover effects on related behaviors. Here, we study the possibility of such negative spillover effects on living organ donation (the related behavior) when countries switch to opt-out organ donation targeted at deceased donation. Analyzing epidemiological panel data from countries that switched to an opt-out default between 2000 and 2019, we show that switching to an opt-out default policy, on average, increased *deceased* organ donors by 2.79 per million population (pmp)—i.e., a relative uplift of +18% in the targeted behavior—but also decreased *living* organ donors by -3.56 pmp—i.e., a relative drop of -62% in a related behavior—resulting in an overall net-zero effect. Using a comparative country survey and experiment, we demonstrate that this reduced willingness for living altruistic (vs. familial) donations is attributable to people being less willing to become a living donor because they hold stronger beliefs that the organ supply is sufficiently met under opt-out (vs. opt-in). Our research advances insights into the unintended consequences of default nudges and offers initial suggestions on how to overcome negative spillover effects.

Keywords: Behavioral interventions, default nudges, public health policy, organ donation, spillover effects.

Authors' notes: EMM's contribution has been funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (Grant agreement No. [802227]). JT gratefully acknowledges the financial support from Nanyang Technological University under the Start-Up Grant, and the Ministry of Education Singapore under the AcRF Tier 1 Grant (RG126/20). EF gratefully acknowledges the financial support from NIHR Blood and Transplant Research Unit in Donor Health and Behaviour (NIHR203337). The authors declare no conflict of interest.

Corresponding author: Pascal Güntürkün (pascal.guentuerkuen@wu.ac.at)

[1] Pascal Güntürkün, WU Vienna University of Economics and Business; Sinika Studte, HSBA Hamburg School of Business Administration; Daniel Winkler, WU Vienna University of Economics and Business; Michel Clement, University of Hamburg; Jonathan H. W. Tan, Nanyang Technical University; Eva-Maria Merz, Vrije Universiteit Amsterdam, Sanquin Research; Elisabeth Huis in 't Veld, Tilburg University; Eamonn Ferguson, University of Nottingham, University of Cambridge.

Introduction

Many of today's pressing societal challenges such as the shortage of organs for transplantation, low vaccination rates, or the progression of climate change, call for significant changes in individual's behavior (Benartzi et al., 2017; Mertens et al., 2022; Thaler & Sunstein, 2008). One of the most promising interventions to promote such behavioral change is the opt-out default nudge, where a socially desirable behavior is set as the default option that applies if one does not actively opt-out (Michaelsen & Sunstein, 2023; Thaler & Sunstein, 2008). Introducing such an opt-out default has a strong influence on behavior because the default conveys a recommended action, establishes a reference point for evaluation, and makes it easy to accept the behavior (Dinner et al., 2011; Jachimowicz et al., 2019). For policymakers, the inherent appeal of adopting an opt-out policy also stems from its non-coercive nature, as it does not restrict individual choice or change economic incentives (Thaler & Sunstein, 2008). Not surprisingly, opt-out default policies have been widely adopted and shown to be highly effective and cost-efficient in promoting socially desirable behaviors across various domains (Benartzi et al., 2017; Hummel & Maedche, 2019; Jachimowicz et al., 2019; Mertens et al., 2022).

One of the most prominent examples of the success of the opt-out default policy concerns organ donations. Securing a sufficient supply of organ donations is important to save lives. In the US, for example, the waiting time for a kidney is 3-5 years, and every day, 17 people die while waiting for an organ transplant (Administration, 2023). In their seminal article, Johnson and Goldstein (2003) suggested that simply switching from an opt-in default (where nobody is a donor unless they opt-in) to an opt-out default for deceased organs (where everybody is a donor unless they opt-out) can save many of these

lives, as countries using an opt-out default policy have, on average, 6-times higher registration rates for deceased organ donation. Many other studies have since confirmed a positive effect of the opt-out default on deceased donor registration rates and actual deceased donations (for a review see Steffel et al., 2019). Given these promising projections and the organ shortages worldwide, many countries have decided to adopt an opt-out default policy (e.g., most recently England and the Netherlands (Jansen et al., 2022)) or are currently considering a switch (e.g., Germany (Bundesrat, 2024)).

However, there is yet little evidence on the total welfare gains of such a policy switch regarding total organ donors gained and lives saved. One key reason is that prior work on opt-out policy default has primarily focused on the direct effects of the intervention on the target behavior (i.e., deceased organ donations), while the possibility of negative spillover effects on related behaviors, not targeted by the policy intervention (i.e., living organ donations) has been largely neglected (Golsteyn & Verhagen, 2021; Shepherd et al., 2014). Approximately 61% of kidney transplants worldwide come from deceased, and 39% come from living organ donors (GODT, 2022), therefore, a more holistic perspective is essential to assess the actual welfare gains of the opt-out default policy in terms of its effects on the total supply of organs for transplant from both living and deceased donors.

In this paper, we examine whether adopting an opt-out default policy leads to negative spillover effects on related behaviors (i.e., living donation) not targeted by the intervention. The context of organ donations is especially well-suited to test this idea as there is only one behavioral alternative to becoming a deceased organ donor, that is, becoming an organ donor while alive. Any potential spillover effects of the opt-out

default policy targeted at increasing the rate of deceased organ donors should thus be fully captured in the rate of living organ donors. To obtain causal estimates for the effects of the policy adoption on deceased and living organ donor rates, we use a difference-in-difference approach (Callaway & Sant'Anna, 2021) to analyze epidemiological panel data from 33 countries that either switched to an opt-out default or remained with an opt-in default policy between 2000-2019. The results show that moving to an opt-out default policy increases the number of deceased organ donors, on average, by 2.79 per million population (pmp) but decreases the number of living organ donors, on average, by -3.56 pmp, resulting in an overall net-zero effect on the number of donors.

We hypothesize that a perceptional bias of the supply implications of the policy adoption can explain this negative spillover effect. Specifically, we predict that people will be less willing to become a living organ donor under an opt-out compared to an opt-in default policy due to stronger beliefs that organ supply is sufficient to meet demand under opt-out. This inflated perception of organ supply is likely to be triggered by the anticipation of higher registration rates under opt-out and may be reinforced by the rhetoric from politicians advocating a move to an opt-out default policy (BBC, 2017). Thus, people might perceive more organs are available under the opt-out default policy and as a result feel less inclined to donate as a living donor.

We also expect this negative spillover effect to be stronger for decisions about altruistic (e.g., to a friend or stranger) versus kinship living donations (e.g., to a family member). The decision to donate to a close family member should be less susceptible to being influenced by the default policy, because people are generally more willing to incur higher costs to help family members due to direct personal and genetic benefits

(Dawkins, 1976; Ferguson, 2022; Hamilton, 1964), while the default policy more likely influences the assessment of altruistic acts (Davidai et al., 2012). This distinction not only promotes a deeper understanding of the limits of conditional cooperation but is also important from a clinical perspective, as altruistic donations accounted for 10% of living kidney donations in the UK in 2019-2020 (NHSBT, 2020) and 7% in the US in 2021 (Administration, 2023) – a trend that is likely to increase (Lewis et al., 2021).

We provide empirical evidence for these predictions in two pre-registered studies: a cross-country survey (n = 435) that compares people's perceptions about the supply of organs for transplantation and their willingness to become a living organ donor across two culturally similar countries using different default policies (i.e., Germany opt-in and Austria opt-out) and a randomized experiment (n = 1,721) in which we manipulate the default policy (opt-in vs. opt-out) and registration rate (low vs. high) as a behavioral proxy of the supply for deceased organs for transplantation.

Our research makes two important contributions to the recently emerging literature on unintended consequences of default nudges (e.g., Beshears et al., 2024; Hagmann et al., 2023). First, we show that adopting an opt-out default policy to increase individual altruistic giving behavior (i.e., becoming an organ donor after death) can lead to substantial negative spillover effects for related altruistic acts untargeted by the intervention (i.e., becoming an organ donor while alive). Analyzing the effects of country-level policy switches between 2000-2019 reveals that this negative spillover effect may entirely offset the intended welfare effects of the policy. Second, we identify a novel mechanism related to the default nudge that, in part, explains this negative spillover effect. Specifically, we show that higher beliefs in the effectiveness of the default nudge

create an inflated perception of the supply for the public good, which in turn, decreases people's willingness to engage in related altruistic behavior.

Overall, our findings emphasize the importance of looking beyond the target behavior and considering potential negative spillover effects on related behaviors to understand the full welfare implications of opt-out defaults. The mechanism we identify points to a dilemma for policymakers who want to advocate for implementing an opt-out default regulation, as the stronger people believe in the effectiveness of a default nudge, the stronger the identified negative spillover effects are. These findings have important implications for behavioral scientists and (health) policymakers seeking to improve the effectiveness of opt-out defaults.

Study 1: Epidemiological Study Using a Quasi-Experimental Design

In Study 1, we examine how adopting an opt-out default policy has affected deceased and living organ donor rates in countries that have switched from opt-in to opt-out in the last decades. To examine behavioral consequences over time, we collected epidemiological data on the annual number of living and deceased organ donors per million population (pmp) per country from the international registry for organ donation and transplantation (IRODaT, 2024) between 2000-2019. The study period was determined by data availability considerations (i.e., there is only limited data before 2000) and the decision to exclude the Covid-19 pandemic as an external shock with diverse effects on national public health systems. Following prior research on organ donations, we further added annual statistics on gross domestic product (GDP) and road traffic fatalities (RTF) from the World Bank database to serve as covariates in the model (e.g., Shepherd et al., 2014). Information on organ default regulations and policy

adoption timings were added based on prior studies (Etheredge, 2021; Saab et al., 2019; Shepherd et al., 2014) and additional desktop research. In sum, 33 countries met our inclusion criteria and could be included in the data analysis. The final sample consists of 26 countries that used an opt-in policy throughout the study period and seven countries that switched to an opt-out policy between 2000-2019 (Figure 1).

We use a quasi-experimental approach that compares the relative development of donor rates between countries that switched to an opt-out default and those that continued to use an opt-in default during the study period. We employ the difference-in-differences estimator proposed by Callaway and Sant'Anna (2021) for inferring causality from quasi-experimental data settings with staggered adoption. Figure 2 shows the average effects of adopting an opt-out default policy on deceased donors (Panel A) and living donors (Panel B) for a year relative to the switch. Panel C shows the aggregated effects across the post-adoption period. Any deviation from zero in the post-adoption effects can be attributed to the switch. It is interpreted as the relative difference to the counterfactual, i.e., the development of the donor rates if the country would not have switched its default policy.

The results show that the adoption of an opt-out default policy significantly increased the number of deceased organ donors, on average, by 2.79 pmp (95% CI: 1.09, 4.48; $P = 0.0013$), which reflects a relative uplift in deceased organ donors of +18% (Figure 2, Panel C). This finding corroborates prior studies (Steffel et al., 2019) and shows that the opt-out policy produced the intended effects on deceased donor rates, i.e., the targeted behavior. However, as hypothesized, the results also reveal a substantial negative spillover effect caused by the policy adoption, as the number of living organ donors significantly decreased, on average, by -3.56 pmp (95% CI: -7.07, -0.06; $P =$

0.0462), which translates to a relative drop in living donors of -62% (Figure 2, Panel C). Notably, the effects of the policy adoption remain relatively stable over time, at least for the 15 years of the post-adoption period we observe in these data (see Figure 2, Panel A and B). Taken together, the total effects of the policy adoption result in an aggregated but non-significant negative effect on total donors, on average, by -0.78 pmp (95% CI: -4.53, 2.98; $P = 0.69$).

Note that most people waiting for an organ transplant wait for a kidney (Administration, 2023). Potential two kidneys (vs. one) can be extracted from a deceased (vs. living) donor. Although the actual number of possible transplants is lower (e.g., on average 1.5 kidneys per deceased donor in the US (OPTN/SRTR, 2023). Adjusting for this factor would, for the US example, lead to an increase of 0.63 transplantable kidney donations pmp due to the policy adoption. Besides quantity, however, one would also need to adjust for the quality of donated organs, as a kidney from a living (vs. deceased) donor yields significantly higher quality of life (De Groot et al., 2013) and patient survival rates (Medin et al., 2000; System, 2013). Thus, the total welfare effects of the policy adoption are not as clear-cut as the reported statistics.

In sum, Study 1 provides causal evidence for the hypothesized negative spillover effect of the opt-out default policy on living donor rates that largely offsets the positive effects of the policy adaption on deceased donor rates. In Studies 1 and 2, we further examine the underlying mechanism and explore potential boundary conditions for this spillover effect.

A Panel data on deceased donors

B Panel data on living donors

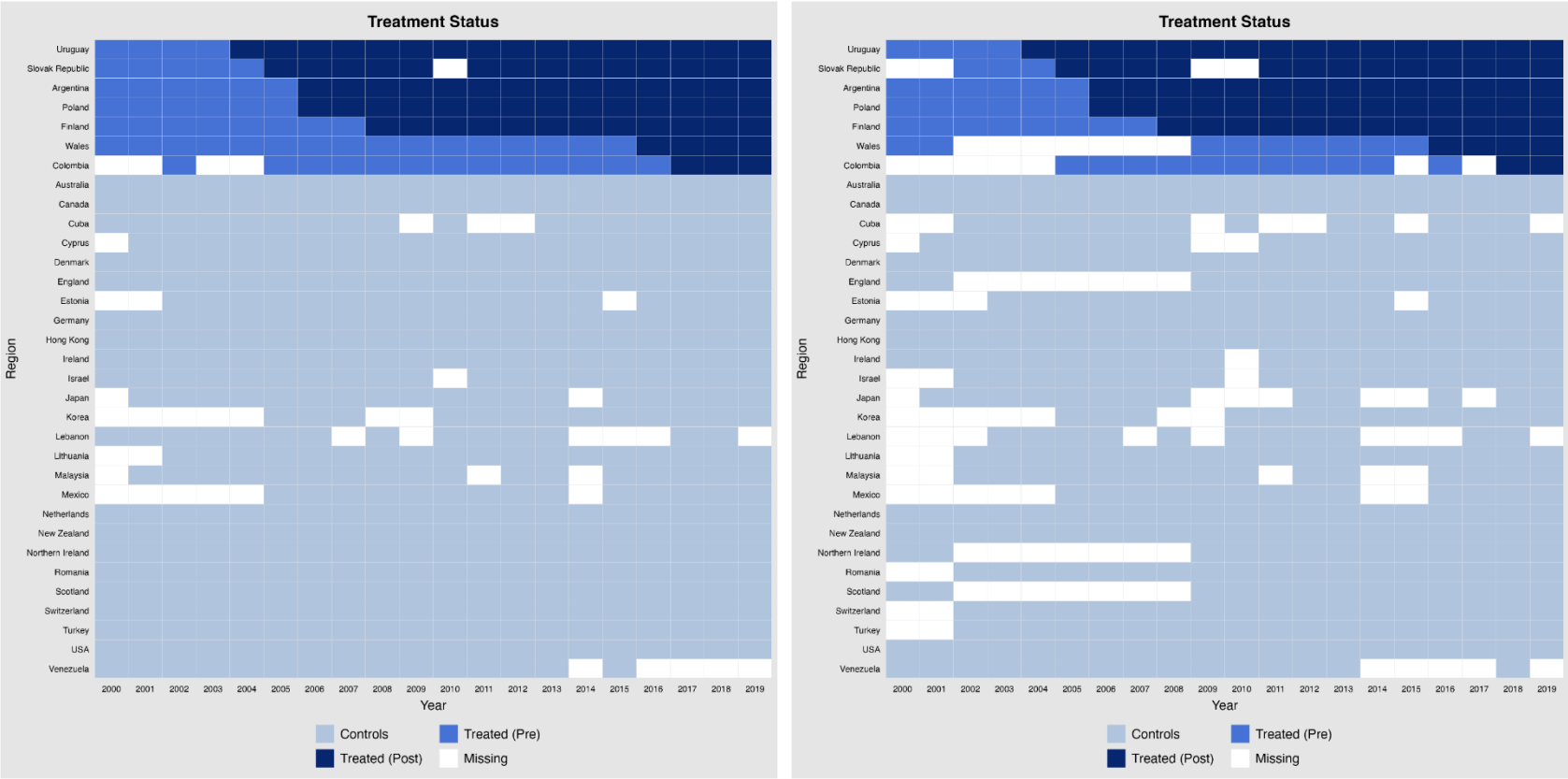

Figure 1. Overview of available panel data on deceased donors (Panel A) and living donors (Panel B) from all countries in the final sample that switched to opt-out default (treated) and maintained an opt-in default (controls) throughout the study period. Treated countries have switched to opt-out default within the study period. As policy adaptions can occur within a running year, we treat the first year in which the policy is fully in place as the first year of the treated (post) period. The panels show the available panel data before data imputation.

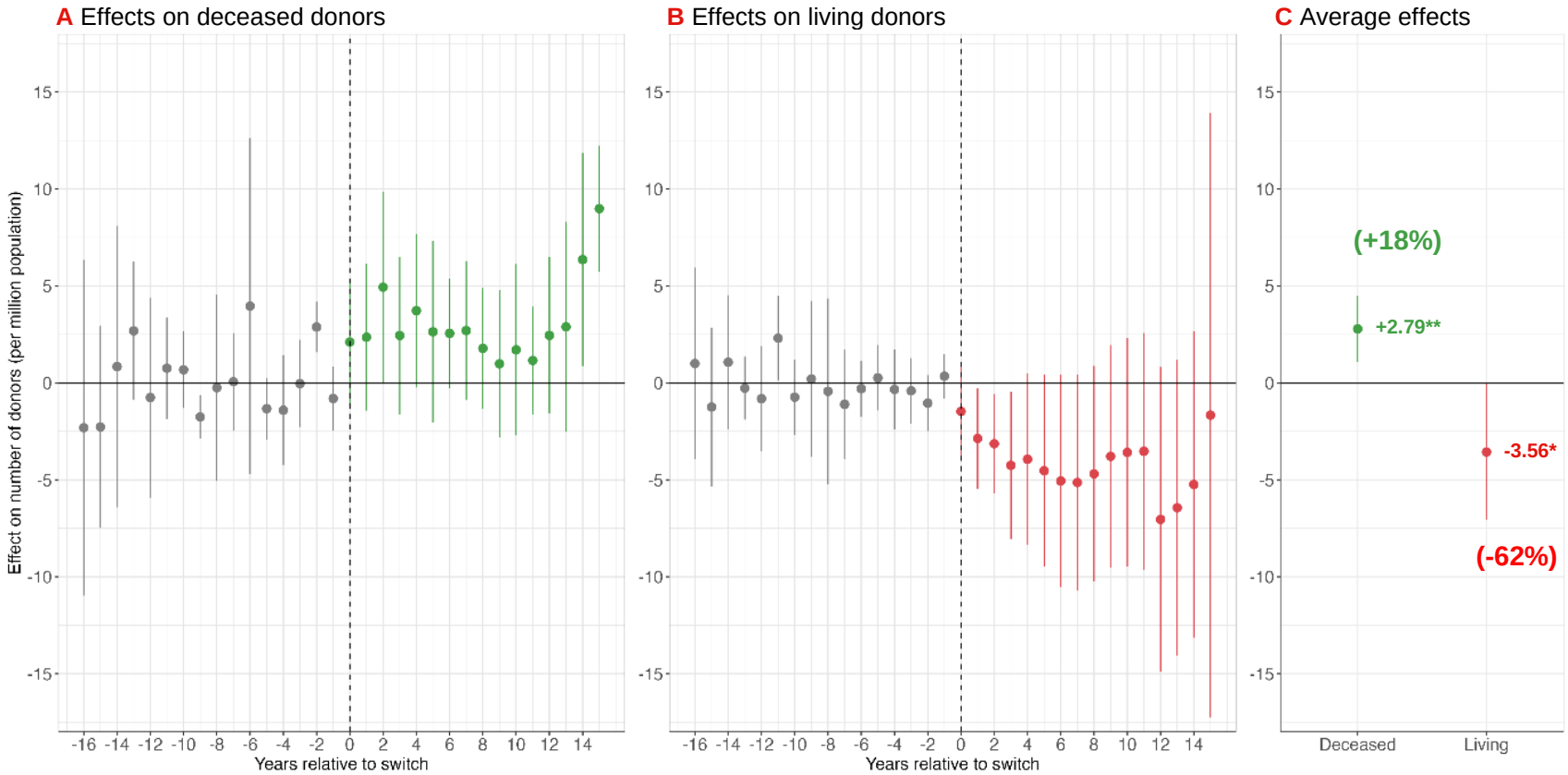

Figure 2. Effects of adopting an opt-out default policy on deceased and living organ donors. The vertical dashed lines in panel **A** and **B** reflect the timepoint of the policy switch. Panel **C** shows average post-adoption effects. Error bars represent the 95% confidence interval for each point estimate. Significance levels in panel **C**: ** $P < .01$, * $P < .05$.

Study 2: Field-based Comparison between Germany (opt-in) and Austria (opt-out)

In Study 2, we compared perceptions of supply sufficiency and likelihood to become a living organ donor between two culturally similar countries who operate different default policies: Germany (opt-in) and Austria (opt-out). We used an online survey to collect a sample of 435 participants with representative demographic profiles from both countries (N_{GER} = 210; N_{AT} = 225; 49% female; M_{age} = 44.17; SD = 15.06).

Upon entering the survey, participants were briefed about the default policy and donor registration rates in their respective countries (Germany: opt-in default, 36% registered; Austria: opt-out default, 99.5% registered) and received general information on living organ donation. Participants then indicated how likely they would be to become a living organ donor for five potential recipients (i.e., a close family member, a remote relative, a close friend, an acquaintance, and a stranger), which served as our dependent variables. To test our hypotheses regarding the underlying mechanism, we measured to what extent participants perceived the supply of organs to be sufficient to meet demand (e.g., "I think that the need for organs is already sufficiently covered by the number of existing donors" (Evans & Ferguson, 2014)) and the perceived reputation building associated with an organ donation (e.g., "Donating organs gives me social approval" (Chell & Mortimer, 2014)). Finally, participants responded to a set of covariate items, provided demographic information, and were debriefed.

The results of a regression analysis confirm our findings from Study 1 by showing that people are significantly less likely to become a living organ donor when residing in a country that uses an opt-out default (Austria) as compared to an opt-in default (Germany) (B = -0.312; SE = 0.129; P = 0.015). Separate analyses for each potential recipient are

visualized in Figure 3 and reveal that this main effect is driven by a reduced willingness for making an altruistic donation to a friend (B = -0.317; SE = 0.160; *P* = 0.047), distant relative (B = -0.466; SE = 0.162; *P* = 0.004), acquaintance (B = -0.470; SE = 0.159; *P* = 0.003), and stranger (B = -0.347; SE = 0.158; *P* = 0.028), while the willingness for a kinship donation to a close family member is unaffected by the default policy (*B* = 0.038; *SE* = 0.140; *P* = 0.786). These results indicate that the negative spillover effect of the opt-out default policy on living organ donations mainly undermines more altruistic donation decisions, while donations to close kin are not affected.

With regards to the underlying mechanism, we find that perceived sufficiency of organ supply is significantly higher among participants from a country using an opt-out (Austria) vs. an opt-in default policy (Germany) (*B* = 0.655, SE = 0.119, *P* < .001). A mediation analysis further shows that this increase in perceptions of supply sufficiency partly explains the negative spillover effect (*B* = -0.064, *SE* = 0.035; *P* = 0.066 two-tailed; *P* = 0.033 one-tailed). This finding supports our prediction that perceptions of the sufficiency of organ supply are elevated under an opt-out default policy and offers some support for the notion that this perception explains the negative spillover effect.

We also test an alternative mechanism based on the notion that the default policy might also shape social norms and prosocial reputation building. There is evidence that being a deceased organ donor is seen as more mundane act of altruism under an opt-out (vs. opt-in) default as it shifts the norm towards being a donor (10). In turn, this weakens the reputational incentives (or “kudos”) of being a living donor. We test whether this reduction in perceived reputation building generalizes to diminish people’s willingness to

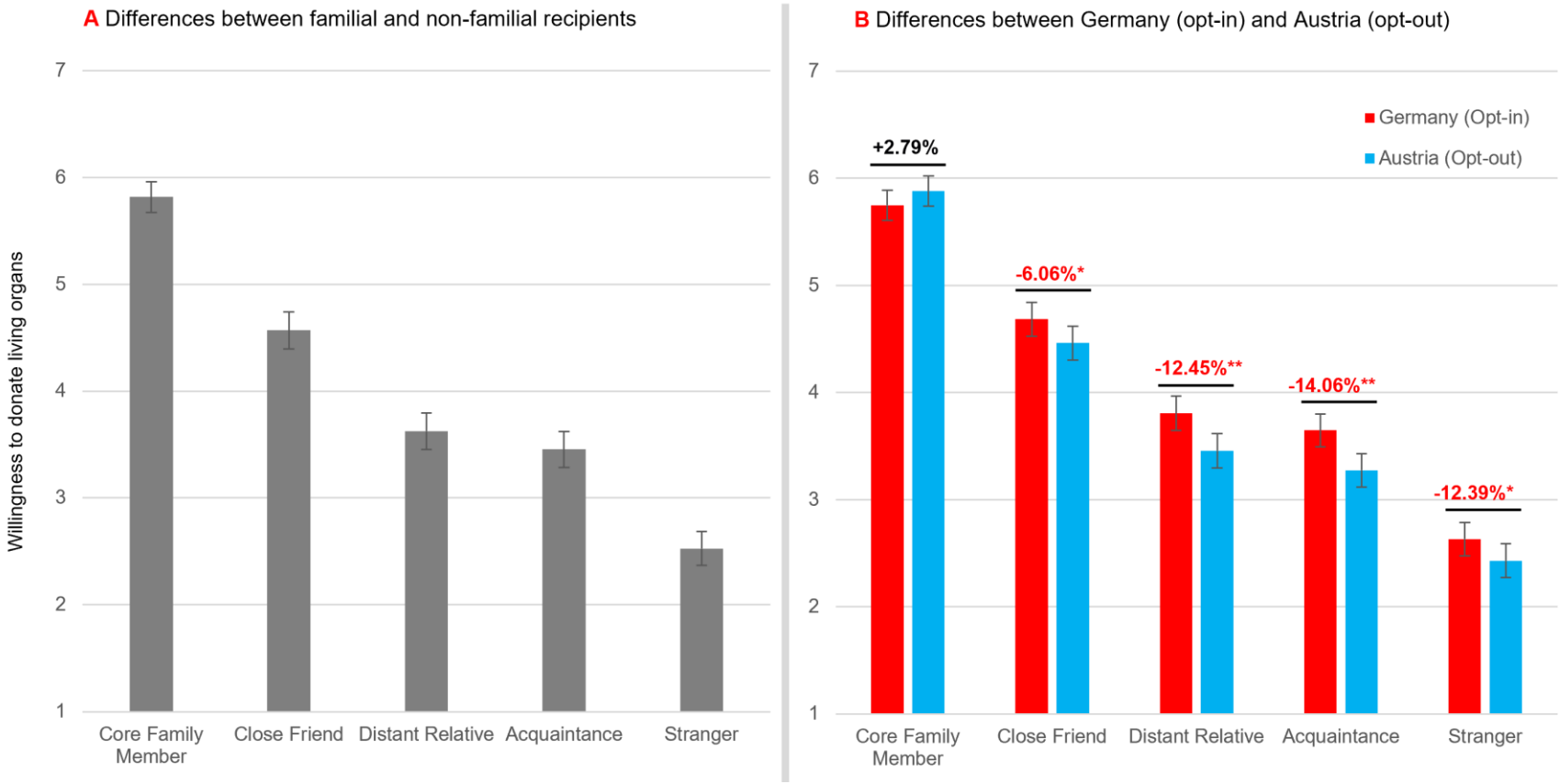

Figure 3: **Differences in the willingness to donate living organs for familial and non-familial recipients between Germany (opt-in) and Austria (opt-out).** Panel **A** shows participants' willingness to donate to familial and non-familial recipients for the total sample (n_{Total} = 435) and panel **B** shows the differences in willingness to donate between Germany (n_{GER} = 210) and Austria (n_{AT} = 225). In panel **A**, bar plots illustrate the adjusted means of participants' willingness to donate for each recipient and error bars represent 95% confidence intervals. In panel **B**, bar plots show the adjusted point estimates for mean differences and error bars represent 95% confidence intervals.

become a living organ donor. Indeed, we find that perceived reputation building is lower for participants from an opt-out (Austria) as compared to an opt-in country (Germany) (B = -0.338, SE = 0.146, P = 0.021) and that the indirect effect via reputation building also partly explains the negative spillover effect (B = -0.050, SE = 0.027; P = 0.064 two-tailed; P = 0.032 one-tailed). Thus, a second reason why people might be less willing to donate a living organ under opt-out might be linked to lower reputation building.

Taken together, these findings indicate that the negative spillover effect of the opt-out default policy is driven by a reduced willingness to make altruistic (vs. familial) donations and that higher perceptions of supply sufficiency and lower perceptions of reputation building might partly offer a mechanistic explanation for these findings.

Study 3: Experimental Manipulation of Default Policy and Registration Rates

In Study 3, we use an experiment to establish causality for the relationships tested in Study 2 and gain deeper insights into the supply sufficiency mechanism by examining whether this process is driven by the default policy per se or higher registration rates for deceased organ donations associated with this policy. To disentangle these effects, we employed a 2 × 2 between-subjects design in which we crossed the manipulation of the default policy (opt-in vs. opt-out) with information on the registration rate for deceased organ donations (low = 15% vs. high = 85%), which might serve as a proxy for the supply of deceased organs for transplant. To test these ideas, we set up a survey-based experiment and collected data from 1,721 participants from Austria and Germany with representative demographic profiles (49% female; M_{age} = 44.28, SD = 14.85).

Our manipulation was embedded in a scenario, which asked participants to imagine living in a country with an (opt-in, opt-out) policy for deceased organ donation in which (15%, 85%) of the population were registered. Participants then responded to the same measures as in Study 2. We included country as a covariate in the modeling.

The results of a regression analysis show a significant negative main effect of the default policy on participants likelihood to become a living organ donor (B = -0.172; SE = 0.061; P = 0.005) but no main effect for the registration rate (B = -0.048; SE = 0.061; P = 0.432) and no significant effect when adding the interaction term (B = -0.208; SE = 0.122; P = 0.088). Separate analyses for each potential recipient again showed that the negative effect of the default policy is driven by a reduced willingness for making an altruistic donation to a friend (B = -0.148; SE = 0.076; P = 0.050), distant relative (B = -0.223; SE = 0.076; P = 0.004), acquaintance (B = -0.228; SE = 0.075; P = 0.002), and stranger (B = -0.212; SE = 0.074; P = 0.004), while the likelihood for kinship donations to a close family member is not affected by the default policy (B = -0.048; SE = 0.072; P = 0.506). These findings corroborate the results from Study 2 and show that the negative spillover effect caused by the opt-out default policy mainly operates through a reduced likelihood of making an altruistic (vs. kinship) donation.

We performed a mediation analysis to analyze the underlying mechanisms. The results show that perceived supply sufficiency mediates the effect of the registration rate on people's willingness to donate (B = -0.023, SE = 0.009; P = 0.013), but not the effect of the default policy (B = -0.006, SE = 0.005; P = 0.176). This finding provides a more nuanced view on the effects of the opt-out default, as it implies that the perception that the supply of organs is sufficient to meet demand is mainly driven by higher registration

rates of deceased organ donors. This is a relevant insight as the registration rate often serves as a proxy when communicating the success of the opt-out default policy (Johnson & Goldstein, 2003).

We again test an alternative mechanism based on reputation building. The mediation analysis does not support an indirect effect of the default policy (B = -0.005, SE = 0.008; P = 0.513) or the registration rate (B = 0.005, SE = 0.008; P = 0.562) on willingness to donate via reputation building. These findings suggest that the supply sufficiency mechanism offers a more robust explanation for why opt-out defaults with high registration rates reduce living donations than the reputation-building mechanism.

As the results across studies 2 and 3 show a consistent pattern for the proposed supply sufficiency mechanism but not for the reputation-building mechanism, we pooled the data from both studies to explore a mediation model with larger statistical power. We find a significant negative indirect effect of registration rates on willingness to donate via perceived sufficiency of supply (B = -0.035, SE = 0.012; P = 0.003) but no significant indirect effect for perceived reputation building (B = -0.001, SE = 0.011; P = 0.939). Figure 4 shows the pooled model results with perceived supply sufficiency as the mediator. These findings further support the proposed mechanism based on supply sufficiency and rule out reputation concerns as an alternative explanation.

Discussion

Opt-out-default policies are effective in nudging individuals towards more socially desirable behaviors, but can they also have unintended consequences? We provide causal evidence that opt-out defaults can have negative spillover effects on

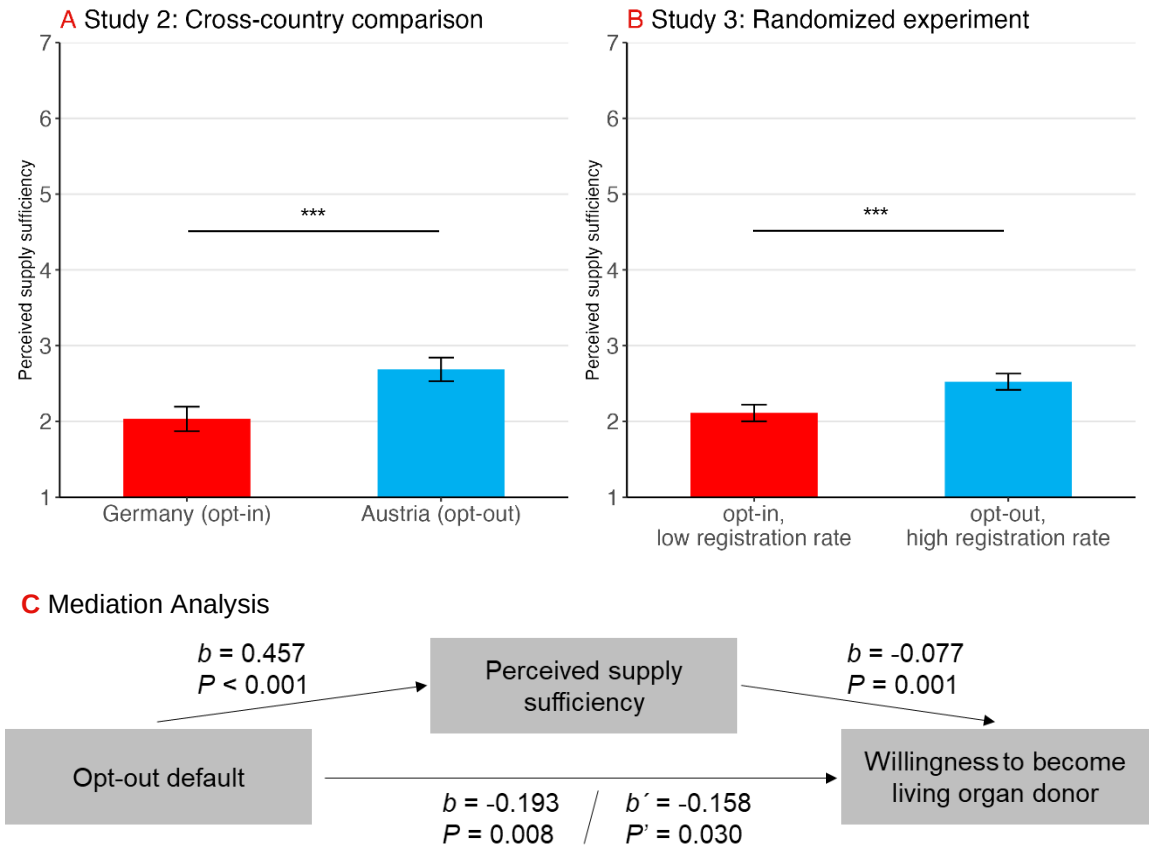

Figure 4: **Opt-out default reduces willingness to become living organ donor by increasing perceived sufficiency of organ supply.** A cross-country comparison (Panel **A**) and a randomized experiment (Panel **B**) show that perceived sufficiency of organ supply is higher under opt-out than under opt-in. Plots in **A** and **B** show conditional effects on perceived supply sufficiency when all covariates are at their mean. Error bars represent 95% CIs of these effects. Significance levels of differences: *** $P < .001$. Panel **C** illustrates that perceived sufficiency of organ supply partially mediates the effect of opt-out default policy (with a high registration rate for deceased organ donation) on general willingness to become a living organ donor.

related behaviors not targeted by the intervention, thereby substantially diminishing the intended welfare gains. Specifically, we draw on 20-years of epidemiological panel data to show that countries that switched to an opt-out default policy experienced a relative increase in the number of deceased organ donors, on average, by 2.79 pmp (+18%), but also faced a relative reduction of living organ donors, on average, by -3.56 pmp (-62%). We further show that this negative spillover effect on living organ donors is driven by a reduction in altruistic (vs. kinship) donations and is attributable, in part, to people being more likely to perceive that supply is sufficient to meet demand under an opt-out.

This shift in the perception of supply has implications for many key endeavors where individual cooperation at a societal level is necessary to enhance the public good. For example, opt-out defaults have been reported as successful to increase the uptake of vaccinations (Brewer et al., 2017; Chapman et al., 2010; Lehmann et al., 2016), thus making them a viable strategy to prevent harmful diseases. However, our findings suggest that opt-out defaults might also spillover to decrease attention to non-targeted but related risk behaviors, such as social distancing or hygiene measures. Similarly, while studies show that opt-out defaults increase the domestic use of greener energy (Ebeling & Lotz, 2015), our results suggests that this may result in people being less likely to adhere to other green behaviors, e.g., recycling or reduced air travel. While such spillover effects have been discussed as a within-person phenomenon, i.e., driven by personal adoption of a sustainable behavior (Maki et al., 2019), our research suggests that they might also be triggered by behavioral interventions, such as the introduction of an opt-out default policy. This implies that is important to look beyond the direct effects on the target behavior to understand the full welfare implications of opt-out defaults.

Thereby, our findings tie in with recently emerging research on unintended consequences of default nudges showing that the effects of automatic enrollment in retirement saving plans can lead to increases in household debt (Beshears et al., 2024) and that asking people about their support for, or exposing them to, an opt-out default policy for green energy usage can reduce their support for more heavy-handed system policies (Hagmann et al., 2019; Hagmann et al., 2023). We add to these emerging studies by providing initial evidence of negative spillover effects in the context of high-cost prosocial behavior. While the accumulation of wealth and sustainable behaviors elude complete capture due to their multifaceted nature, our study also stands out in that we can quantify the full extent of the spillover effect on individual behavior, as organ donations can only come from living and deceased donors.

Our work also complements prior work on organ donation defaults, which has reported differences in rates of living and deceased organ donors between countries with opt-in and opt-out default policies (Arshad et al., 2019; Golsteyn & Verhagen, 2021; Shepherd et al., 2014). We extend these descriptive insights by providing causal evidence for the link between adopting an opt-out default policy and donor rates. Moreover, we provide insights into potential boundary conditions of a negative spillover effect, such that default nudges only affect altruistic donations (e.g., to strangers) but not kinship-based donations (i.e., to close family members) and identify an underlying mechanism responsible for the negative spillover effect, which is based on the perception of the supply of a public good.

From a theoretical perspective, our findings also complement existing models of human cooperation by offering more nuanced insights into how high-cost cooperative

decision-making depends on the availability of a low-cost resource and recipient kinship (Ferguson, 2022). We extend these models by showing that perceived uptake in the availability of a low-cost resource (i.e., deceased donor organs) driven by a change in the opt-out default can crowd out more costly cooperative behaviors (i.e., becoming a living organ donor), but this only applies for altruistic but not kinship-based cooperative behavior. Interestingly, although helping a distant relative offers inclusive fitness benefits over helping a stranger (Hamilton, 1964; Thomas et al., 2018), these benefits do not ensure cooperation when the perceived supply for a high-cost cooperative act can be met through another means. This provides new insights into human cooperation and is important when policies or campaigns are designed to alter the availability of a public good.

Our study reveals a dilemma for policymakers wishing to promote organ donation by introducing an opt-out default policy, as the increase in deceased donors is roughly offset by a decrease in living donor numbers. While the substitution of living donor organs for deceased donor organs may seem like an improvement from the donor's perspective, the recipients are worse off, as a kidney from a living donor (compared to a deceased donor) has a significantly higher quality of life (De Groot et al., 2013) and patient survival rates (Medin et al., 2000; System, 2013). So, for any policy switch to an opt-out default, strategies are needed to mitigate the loss of living donors, who clinically are an increasingly important source of organs (Lewis et al., 2021).

One way forward might be to be more open about the effectiveness of opt-out to meet the demand for organs and, based on actual evidence, communicate that a 10-20% increase in organs can be expected, which is clinically significant but not to see opt-out as

a panacea to the supply problem. Also, it should be made clear that living organ donors are still needed – which is a major communication task for policymakers.

There are limitations to these studies. The experimental studies were conducted in the Global North, and generalizability to wider cultural groups and ethnicities is limited (Henrich et al., 2010). However, the change to an opt-out organ donation policy, compared to an opt-in policy, results in a reduction in living organ donors observed across the world. Thus, the behavioral phenomena do seem to generalize, and as such the proposed supply-demand mechanism should also generalize. While our experimental studies focused on the reported willingness to donate, the pattern of results observed for willingness mirrored actual behavioral data, as such we have confidence that the willingness data reflects behavior.

Materials and Methods

We pre-registered our central hypotheses and the methods for Study 2 and 3 (https://osf.io/s4zv6). Any deviations from the pre-registration are detailed in Supplementary File 8, Supplementary Table 14. Ethical approval for Study 2 and Study 3 was provided by the research ethics and data management committee at Tilburg School of Humanities and Digital Sciences under the ethics code REDC # 2019/110 (19/11/2019). All materials, data, and analysis codes are publicly available (https://osf.io/5kbha/).

Methods – Study 1

***Sampling procedure and data sources*.** To be included in the study, a country must have published its organ donor statistics on the International Registry in Organ

Donation and Transplantation (IRODaT) (IRODaT, 2024). The IRODaT is a publicly accessible database that provides annual data on organ donation. These data come from official reporters (i.e., members of national transplant organizations and ministries of health) and are reviewed by a network of experts (IRODaT, 2024). Out of the 107 countries that provide data to the IRODaT (as of 2023), we excluded all countries that had already adopted an opt-out default policy before 2000. We selected the beginning of the millennium as the starting point for our data analysis due to the limited availability of living organ donor rates on the IRODaT database before 2000 (i.e., less than 40% of countries provided living organ donor data before 2000). We only collected data until 2019, because of the multifaceted disruptions for the health sector caused by the Covid-19 pandemic from 2020 onwards. Moreover, we excluded countries for which no post-adoption data could be obtained (e.g., Iceland only switched to opt-out in 2019) and countries that switched their regulation from opt-in to opt-out and back again within the period of investigation (e.g., Greece switched to opt-out in 2013 and back to opt-in in 2018). Information on each country's organ donation legislation was obtained from prior research (Arshad et al., 2019; Shepherd et al., 2014) and was updated based on recent health ministry reports and information from national health officials (Supplementary File 1, Supplementary Table 1).

We used the IRODaT database to obtain the numbers of deceased and living organ donors per million population (pmp). In line with IRODaT, any donor score with a value of zero was regarded as missing data (IRODaT, 2024). As the analytical procedures employed require a balanced sample (i.e., no missing data), countries that did not provide data for at least 10 years and countries that did not provide data in the last five years of

the period of investigation were dropped from the analysis. In sum, 33 countries met our inclusion criteria of which 26 countries relied on an opt-in policy throughout the observation period and seven switched to an opt-out policy within the observation period (Supplementary File 1, Supplementary Figure 1).

To address the issue of missing data, we employ the multiple imputation implemented in Amelia II (Honaker et al., 2011). This algorithm specifically accounts for the panel structure of the data and jointly imputes missing values using leads and lags of both log(living donations pmp) and log(deceased donations pmp), as well as log(road traffic accident rates) and a squared time trend. Logs are utilized only for imputation as the complete data is assumed to follow a multivariate normal distribution and are transformed back to levels for the difference-in-difference estimation. Furthermore, observations are assumed to be missing at random (MAR), meaning that the probability of a datapoint being missing solely depends on the observed data.

Analytical approach. To quantify the causal impact of switching to an opt-in policy, we employ the difference-in-differences approach proposed by Callaway and Sant'Anna to consider various treatment time adoptions (Callaway & Sant'Anna, 2021). Their estimator isolates the causal treatment effect of opt-in adoption by comparing variations in adopting countries around the time of adoption with analogous countries that retain an opt-in policy. This method specifically accounts for variations in adoption times and permits heterogeneity in the adoption effect across both time and adoption cohorts. Moreover, it retains the property of the standard difference-in-differences estimator that adoption effects are identified under time-invariant differences in donation levels between switching and non-switching countries. The primary identifying assumption is

that the differences in donation levels between switching and non-switching countries would have remained constant in the post-adoption period, absent the policy change (commonly referred to as the "parallel trends assumption"). Specifically, we use a weakened form of the assumption, which requires parallel trends to hold only after accounting for covariates. In line with prior research (Shepherd et al., 2014), we use road traffic accident rates and Gross Domestic Product per capita as covariates to mitigate possible violations due to differences in road safety and income levels. Additionally, we allow for up to three years of anticipation of the policy change, as this is the typical time between the announcement and implementation of a switch. During this period, parallel trends, without the announcement, are also assumed. Finally, all standard errors are adjusted for multiple imputations as described in Honaker et. al (Honaker et al., 2011).

All analyses were conducted using R V4.3.0 (Team, 2021). We used the Amelia II V1.8.1 package for imputation (Honaker et al., 2011). The difference-in-differences models were estimated using the *did* package (V2.1.2) (Callaway & Sant'Anna, 2021). The raw time series can be found in Supplementary File 2, Supplementary Figure 2.

Methods – Study 2

Sampling and participants. We programmed an online survey using Unipark's survey software (www.unipark.com) and used a professional panel provider (https://respondi.com) to collect data from respondents from Germany and Austria. Our pre-registered target sample size was 200 participants per country. The panel provider slightly oversampled this target quota, resulting in a total sample of 435 adult participants from both countries with representative demographic characteristics regarding age and gender (N_{GER} = 210; N_{AT} = 225; 49% female; M_{age} = 44.17; SD = 15.06). Participants

were paid via a redeemable points system with a single point worth one euro for 20 minutes. All participants provided informed consent.

Study design. Upon entering the survey, participants received information on the default system and donor registration rates in their respective countries (Supplementary File 3, Supplementary Table 3). Participants from Germany read that the opt-in system for organ donation applies and that approximately 36% of the population has actively registered according to official statistics at the time of the data collection, i.e., in 2019 (BzgA, 2021). Participants in Austria read that the opt-out system for organ donation applies and that approximately 99.5% of the population are on the donor list because they have not actively de-registered according to official statistics (ÖBIG-Transplant, 2021). Participants then received information on the procedure and consequences of making a living organ donation.

Dependent variables. Participants received written information about a hypothetical situation in which someone is critically ill and waiting for an organ donor (a kidney or a lobe of a liver). This included that the person needed either a deceased or a living organ for transplant and that they would be eligible as a living organ donor. Participants then indicated their willingness to make a living donation (a kidney and a lobe of their liver) for a close family member, a remote relative, a close friend, an acquaintance, and a stranger; each measured on a 7-point Likert scale ranging from "1 = not at all likely" to "7 = extremely likely" (Supplementary File 3, Supplementary Table 3). We used simple randomization on the order of the display to avoid any ordering effects. For the dependent measures, we averaged the ratings for both organs (kidney and

liver lobe) to create composite measures to capture participants' willingness to donate to each of the presented recipients.

Mediators and covariates. Following the dependent measures, participants indicated their perceptions of the *sufficient of supply to meet demand* (e.g., "I think that the need for organs is already sufficiently covered by the number of existing donors" (Evans & Ferguson, 2014)) and the potential for prosocial *reputation building* (e.g., "Donating organs gives me social approval" (Chell & Mortimer, 2014)). We used simple randomization on the order of display for these mediating measures to avoid any ordering effects. Finally, participants responded to a set of covariates, entered demographic information, and were debriefed. We used 7-point Likert scales for all core measures (Supplementary File 3, Supplementary Table 3).

Analytical approach. We assessed the reliability and validity of the multi-item measures using factor analysis. We used a path modelling approach to estimate coefficients for all relationships simultaneously (Kline, 2023). All models were estimated with a maximum likelihood estimator with robust standard errors using M*Plus* version 8.9 (Muthén, 1998-2017). All scales to be valid and reliable (Supplementary File 3, Supplementary Table 3). The complete results of the analyses for the coefficients stated in the main text can be found in Supplementary File 4, Supplementary Tables 4-7.

Power calculations. Based on Davidai et al. (2012), the effect size between the default and judgement of the default is r = .364. Using the methods developed by Schoemann et al. (2017) we ran a simulation with 1000 repetitions and 20,000 Monte Carlo draws per repetition to achieve a power of .80 with an α of .05, for a simple

mediation model. Using the estimates of r of .364 between X and M and X and Y, and a small effect of r = .25 between M and X we need 422 people to achieve power.

Study 3 - Methods

Sampling and participants. We ran an online study using Unipark's survey software (www.unipark.com) and relied on a professional panel provider (https://respondi.com) to collect data from participants from Germany and Austria. Our pre-registered target sample size was 200 participants per cell for each of the two countries. The panel provider slightly oversampled this target quota, resulting in a total sample of 1,721 adult participants from both countries with representative demographic characteristics regarding age and gender (49% female; M_{age} = 44.28, SD = 14.85). Participants were paid via a redeemable points system with a single point worth one euro for 20 minutes. All participants provided informed consent.

Experimental design. We used a 2x2 between-subjects design and relied on scenarios to manipulate the default system (opt-in vs. opt-out) and the percentage of registered deceased organ donors (low vs. high) as a proxy of organ supply. Specifically, we manipulated the default policy by asking participants to imagine living in a country that relies on an opt-in or an opt-out default consent for deceased organ donations with either 15% (low) or 85% (high) of the population registered as deceased organ donors (Supplementary Files 5, Supplementary Table 8).

Dependent variables. Following the manipulation, we used the same measures as in Study 2, in which participants were asked about their willingness to make a living donation (kidney or a lobe of their liver) for a close family member, a remote relative, a

close friend, an acquaintance, and a stranger. As in Study 2, we averaged the ratings for both organs (kidney and liver lobe) to create composite measures to capture participants' willingness to donate to each recipient.

Mediators, and covariates. We included the same measures for the mediator perceptions that supply matches demand and reputation and covariates as in Study 2 (Supplementary File 5, Supplementary Table 8). We treat country (0 = Germany; 1 = Austria) as an additional covariate in the model to adjust for country differences.

Analytical approach. We assessed the reliability and validity of the multi-item measures using factor analysis and found all variables to be valid and reliable (see Supplementary File 5, Supplementary Table 8). We used a path modelling approach to estimate coefficients for all relationships simultaneously (Kline, 2023). All models were estimated with a robust maximum likelihood estimator using M*Plus* version 8.9 (Muthén, 1998-2017). We found all scales to be valid and reliable (Supplementary File 5, Supplementary Table 8). The complete results of the analyses for the coefficients stated in the main text can be found in Supplementary File 6, Supplementary Tables 9-12. The results of the pooled mediation analysis for Study 2 and 3 can be found in Supplementary File 7, Table 13.

References

Administration, U. H. R. a. S. (2023). *US Organ Donation Statistics* US Health Resources & Services Administration. Retrieved 07/24 from https://www.organdonor.gov/learn/organ-donation-statistics

Arshad, A., Anderson, B., & Sharif, A. (2019). Comparison of organ donation and transplantation rates between opt-out and opt-in systems. *Kidney international*, *95*(6), 1453-1460.

BBC. (2017). *England to consider optout organ donation*. BBC. Retrieved 08/15 from https://www.bbc.com/news/health-41435255

Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., Tucker-Ray, W., Congdon, W. J., & Galing, S. (2017). Should governments invest more in nudging? *Psychological science*, *28*(8), 1041-1055.

Beshears, J., Blakstad, M., Choi, J. J., Firth, C., Gathergood, J., Laibson, D., Notley, R., Sheth, J. D., Sandbrook, W., & Stewart, N. (2024). *Does Pension Automatic Enrollment Increase Debt? Evidence from a Large-Scale Natural Experiment*.

Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., & Kempe, A. (2017). Increasing vaccination: putting psychological science into action. *Psychological Science in the Public Interest*, *18*(3), 149-207.

Bundesrat. (2024, accessed on 07/25/2024). *Entwurf eines ... Gesetzes zur Änderung des Transplantationsgesetzes und Einführung der Widerspruchslösung* https://www.bundesrat.de/DE/plenum/bundesrat-kompakt/24/1046/1046-pk.html

BzgA. (2021). *Wissen, Einstellung und Verhalten zur Organ- und Gewebespende* https://www.bzga.de/fileadmin/user_upload/PDF/pressemitteilungen/daten_und_fakten/Info-Blatt-27.-April-2021.pdf

Callaway, B., & Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of econometrics*, *225*(2), 200-230.

Chapman, G. B., Li, M., Colby, H., & Yoon, H. (2010). Opting in vs opting out of influenza vaccination. *Jama*, *304*(1), 43-44.

Chell, K., & Mortimer, G. (2014). Investigating online recognition for blood donor retention: an experiential donor value approach. *International Journal of Nonprofit and Voluntary Sector Marketing*, *19*(2), 143-163.

Davidai, S., Gilovich, T., & Ross, L. D. (2012). The meaning of default options for potential organ donors. *Proceedings of the National Academy of Sciences*, *109*(38), 15201-15205.

Dawkins, R. (1976). *The selfish gene*. Oxford university press.

De Groot, I. B., Veen, J. I. E., van der Boog, P. J., van Dijk, S., Stiggelbout, A. M., Marang-van de Mheen, P. J., & group, P. s. (2013). Difference in quality of life, fatigue and societal participation between living and deceased donor kidney transplant recipients. *Clinical transplantation*, *27*(4), E415-E423.

Dinner, I., Johnson, E. J., Goldstein, D. G., & Liu, K. (2011). Partitioning default effects: why people choose not to choose. *Journal of Experimental Psychology: Applied*, *17*(4), 332.

Ebeling, F., & Lotz, S. (2015). Domestic uptake of green energy promoted by opt-out tariffs. *Nature Climate Change*, *5*(9), 868-871.

Etheredge, H. R. (2021). Assessing global organ donation policies: opt-in vs opt-out. *Risk management and healthcare policy*, 1985-1998.

Evans, R., & Ferguson, E. (2014). Defining and measuring blood donor altruism: a theoretical approach from biology, economics and psychology. *Vox sanguinis*, *106*(2), 118-126.
Ferguson, E. (2022). What blood and organ donation can tell us about cooperation? *Current opinion in psychology*, *44*, 202-207.
GODT. (2022). *Kidney Transplants (%) Year 2022*. ONT-WHO Global Observatory on Donation and Transplantation. Retrieved 07/25 from https://www.transplant-observatory.org/countkidney/
Golsteyn, B. H., & Verhagen, A. M. (2021). Deceased by default: consent systems and organ-patient mortality. *Plos one*, *16*(3), e0247719.
Hagmann, D., Ho, E. H., & Loewenstein, G. (2019). Nudging out support for a carbon tax. *Nature Climate Change*, *9*(6), 484-489.
Hagmann, D., Liao, Y.-t., Chater, N., & Loewenstein, G. (2023). Costly distractions: Focusing on individual behavior undermines support for systemic reforms. *Available at SSRN 4426034*.
Hamilton, W. D. (1964). The genetical evolution of social behaviour. II. *Journal of theoretical biology*, *7*(1), 17-52.
Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2-3), 61-83.
Honaker, J., King, G., & Blackwell, M. (2011). Amelia II: A program for missing data. *Journal of statistical software*, *45*, 1-47.
Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. *Journal of Behavioral and Experimental Economics*, *80*, 47-58.
IRODaT. (2024). *International Registry of Organ Donation and Transplantation*. Donation & Transplantation Institute. Retrieved 07/25 from https://www.irodat.org/
Jachimowicz, J. M., Duncan, S., Weber, E. U., & Johnson, E. J. (2019). When and why defaults influence decisions: A meta-analysis of default effects. *Behavioural Public Policy*, *3*(2), 159-186.
Jansen, N. E., Williment, C., Haase-Kromwijk, B. J. J. M., & Gardiner, D. (2022). Changing to an Opt Out System for Organ Donation—Reflections From England and Netherlands [Original Research]. *Transplant International*, *35*. https://doi.org/10.3389/ti.2022.10466
Johnson, E. J., & Goldstein, D. (2003). Do defaults save lives? *science*, *302*(5649), 1338-1339.
Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford publications.
Lehmann, B. A., Chapman, G. B., Franssen, F. M., Kok, G., & Ruiter, R. A. (2016). Changing the default to promote influenza vaccination among health care workers. *Vaccine*, *34*(11), 1389-1392.
Lewis, A., Koukoura, A., Tsianos, G.-I., Gargavanis, A. A., Nielsen, A. A., & Vassiliadis, E. (2021). Organ donation in the US and Europe: The supply vs demand imbalance. *Transplantation Reviews*, *35*(2), 100585.

Maki, A., Carrico, A. R., Raimi, K. T., Truelove, H. B., Araujo, B., & Yeung, K. L. (2019). Meta-analysis of pro-environmental behaviour spillover. *Nature Sustainability*, *2*(4), 307-315.

Medin, C., Elinder, C. G., Hylander, B., Blom, B., & Wilczek, H. (2000). Survival of patients who have been on a waiting list for renal transplantation. *Nephrology Dialysis Transplantation*, *15*(5), 701-704.

Mertens, S., Herberz, M., Hahnel, U. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioral domains. *Proceedings of the National Academy of Sciences*, *119*(1), e2107346118.

Michaelsen, P., & Sunstein, C. R. (2023). *Default nudges: From people's experiences to policymaking implications*. Springer Nature.

Muthén, L. K. a. M., B.O. (1998-2017). *Mplus User's Guide. Eighth Edition*. Muthén & Muthén.

NHSBT. (2020). *People donating a kidney altruistically peaks at five year high*. NHS Blood and Transplant. Retrieved 08/15 from https://www.nhsbt.nhs.uk/news/people-donating-a-kidney-altruistically-peaks-at-five-year-high/

ÖBIG-Transplant. (2021). *Transplant-Jahresbericht 2020*. https://transplant.goeg.at/Jahresbericht2020

OPTN/SRTR. (2023). *2021 Annual Data Report*. H. R. a. S. A. U.S. Department of Health and Human Services. https://srtr.transplant.hrsa.gov/annual_reports/2021/Deceased%20Organ%20Donation.aspx

Saab, S., Saggi, S. S., Akbar, M., & Choi, G. (2019). Presumed consent: a potential tool for countries experiencing an organ donation crisis. *Digestive Diseases and Sciences*, *64*, 1346-1355.

Schoemann, A. M., Boulton, A. J., & Short, S. D. (2017). Determining power and sample size for simple and complex mediation models. *Social Psychological and Personality Science*, *8*(4), 379-386.

Shepherd, L., O'Carroll, R. E., & Ferguson, E. (2014). An international comparison of deceased and living organ donation/transplant rates in opt-in and opt-out systems: a panel study. *BMC medicine*, *12*(1), 1-14.

Steffel, M., Williams, E. F., & Tannenbaum, D. (2019). Does changing defaults save lives? Effects of presumed consent organ donation policies. *Behavioral Science & Policy*, *5*(1), 69-88.

System, U. R. D. (2013). USRDS 2013 annual data report: atlas of chronic kidney disease and end-stage renal disease in the United States. *National Institutes of Health, National Institute of Diabetes and Digestive and Digestive and Kidney Diseases, Vol. 2014*.

Team, R. C. (2021). *R: a language and environment for statistical computing. Vienna: R Foundation for Statistical Computing*. https://www.r-project.org/

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth and happiness*. Yale University Press.

Thomas, M. G., Ji, T., Wu, J., He, Q., Tao, Y., & Mace, R. (2018). Kinship underlies costly cooperation in Mosuo villages. *Royal Society Open Science*, *5*(2), 171535.