

# Public Goods

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## **PUBLIC GOODS: DEFINITIONS**

**Pure public goods:** Goods that are perfectly **non-rival in consumption** and are **non-excludable**

**Non-rival in consumption:** One individual's consumption of a good does not affect another's opportunity to consume the good.

**Non-excludable:** Individuals cannot deny each other the opportunity to consume a good.

**Impure public goods:** Goods that satisfy the two public good conditions (non-rival in consumption and non-excludable) to some extent, but not fully.

## 7.1

## Defining Pure and Impure Public Goods

		Is the good rival in consumption?	
		Yes	No
Is the good excludable?	Yes	Private good (ice cream)	Impure public good (Cable TV)
	No	Impure public good (crowded sidewalk)	Public good (defense)

## OPTIMAL PROVISION OF PRIVATE GOODS

Two goods:  $ic$  (ice-cream) and  $c$  (cookies) with prices  $P_{ic}, P_c$

$P_c = 1$  is normalized to one (numéraire good):

Two individuals  $B$  and  $J$  demand different quantities of the good at the same market price.

$MRS_{ic,c} = MU_{ic}/MU_c = \#$  cookies the consumer is willing to give up for 1 ice-cream

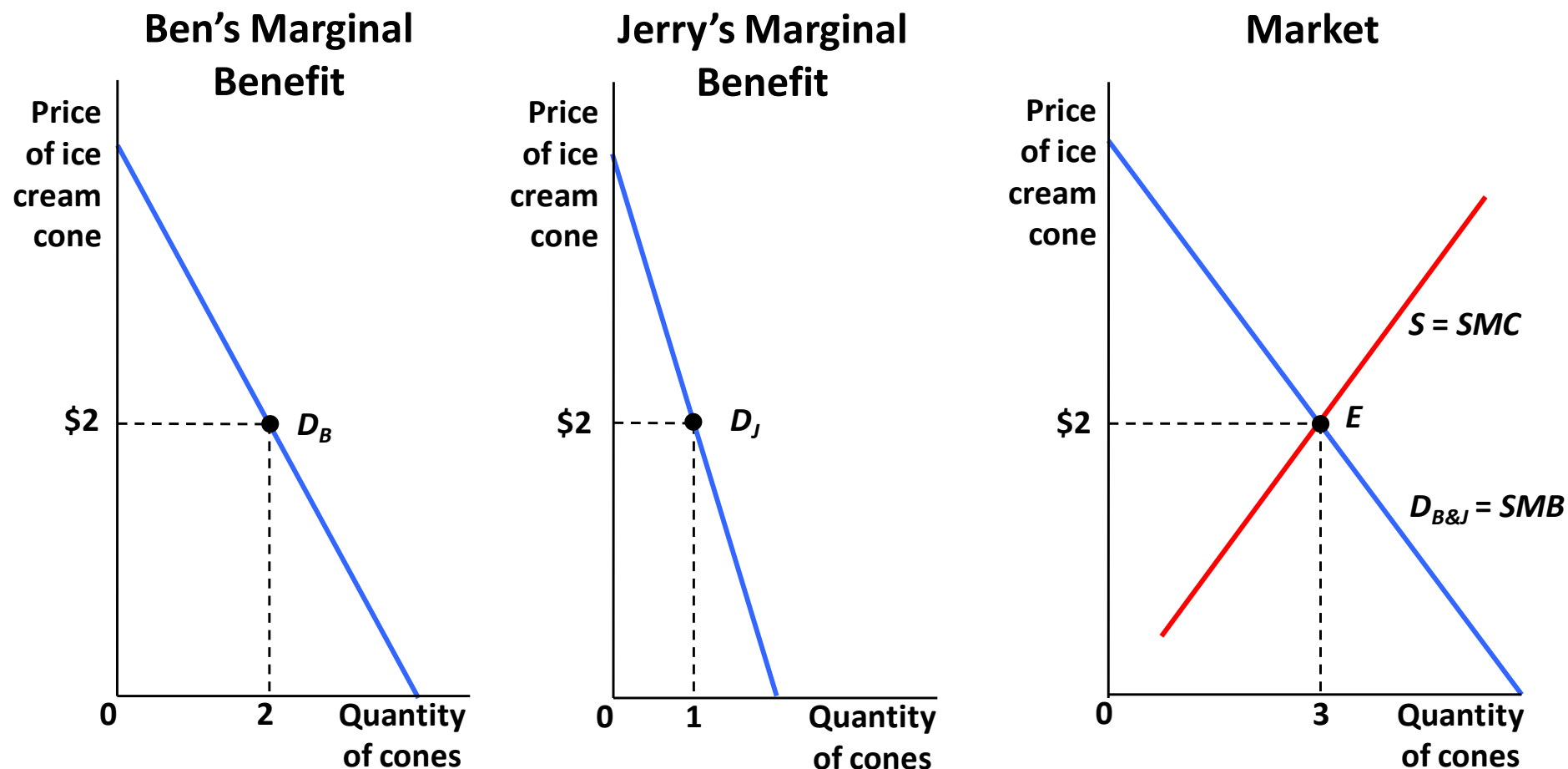
The optimality condition for the consumption of private goods is written as:  $MRS_{ic,c}^B = MRS_{ic,c}^J = P_{ic}/P_c = P_{ic}$

Equilibrium on the supply side requires:  $MC_{ic} = P_{ic}$

In equilibrium, therefore:  $MRS_{ic,c}^B = MRS_{ic,c}^J = MC_{ic}$

## 7.1

## Horizontal Summation in the Private Goods Market



- To find social demand curve, add quantity at each price—sum horizontally.

## OPTIMAL PROVISION OF PUBLIC GOODS

Replace private good ice-cream  $ic$  by a public good missiles  $m$

$MRS_{m,c}^B = \#$  cookies B is willing to give up for 1 missile

$MRS_{m,c}^J = \#$  cookies J is willing to give up for 1 missile

In net, society is willing to give up  $MRS_{m,c}^B + MRS_{m,c}^J$  cookies for 1 missile

Social-efficiency-maximizing condition for the public good is:

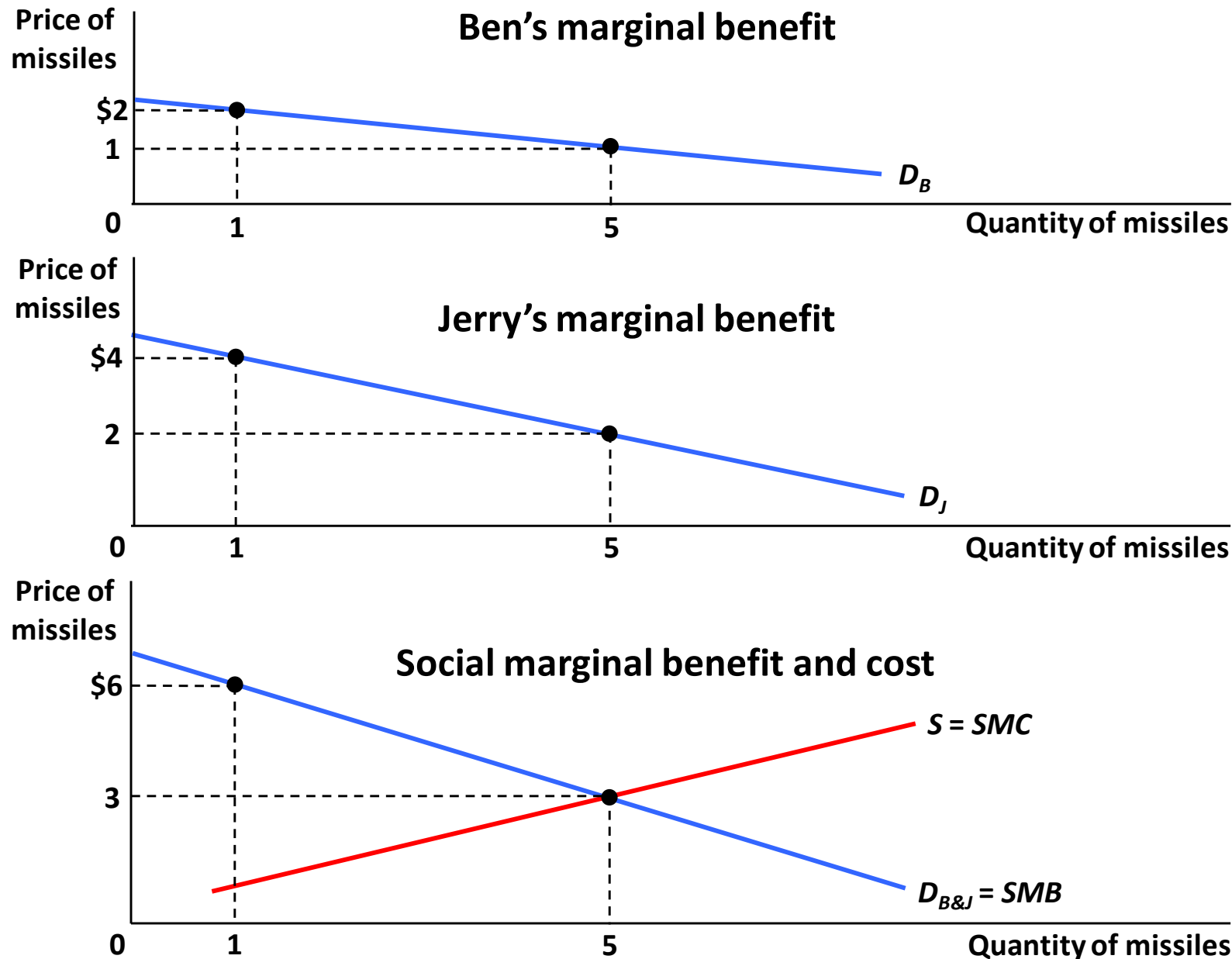
$$MRS_{m,c}^B + MRS_{m,c}^J = MC_m$$

Social efficiency is maximized when the marginal cost is set equal to the *sum of the MRSs, rather than being set equal to each individual MRS*.

This is called the **Samuelson rule** (Samuelson, 1954)

## 7.1

## Vertical Summation in the Public Goods Market



## PRIVATE-SECTOR UNDERPROVISION

Private sector provision such that  $MRS_{mc}^i = MC_m$  for each individual  $i$  so that  $\sum_i MRS_{mc}^i > MC_m \Rightarrow$  Outcome is not efficient, could improve the welfare of everybody by having more missiles (and less cookies)

**Free rider problem:** When an investment has a personal cost but a common benefit, selfish individuals will underinvest.

Because of the **free rider** problem, the private market under-supplies public goods

Another way to see it: private provision of a public good creates a positive externality (as everybody else benefits)  $\Rightarrow$  Goods with positive externalities are under-supplied by the market



## PRIVATE PROVISION OF PUBLIC GOOD

2 individuals with identical utility functions defined on  $X$  private good (cookies) and  $F$  public good (fireworks)

$F = F_1 + F_2$  where  $F_i$  is contribution of individual  $i$

Utility of individual  $i$  is  $U_i = 2 \log(X_i) + \log(F_1 + F_2)$  with budget  $X_i + F_i = 100$

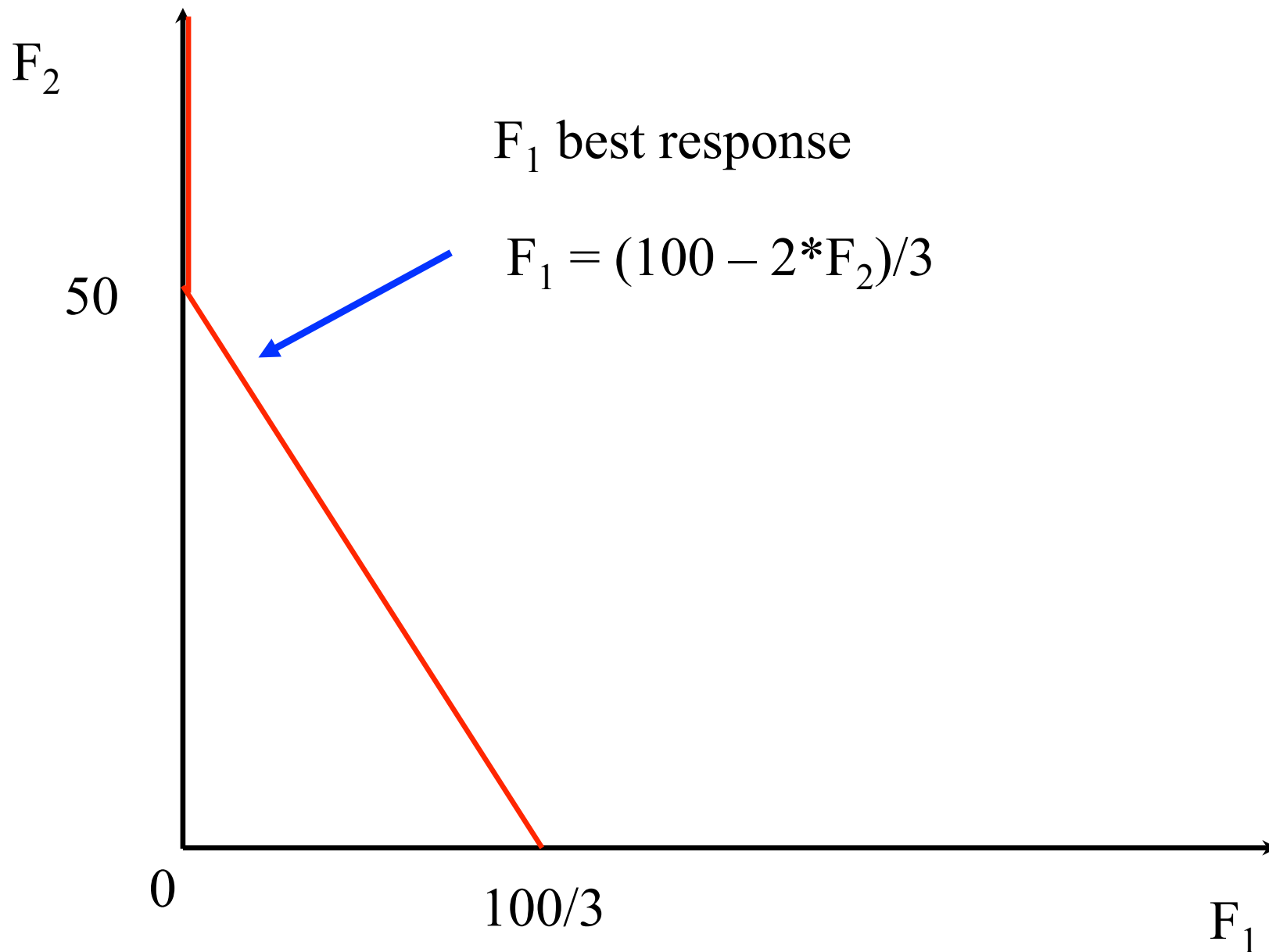
Individual 1 chooses  $F_1$  to maximize  $2 \log(100 - F_1) + \log(F_1 + F_2)$  taking  $F_2$  as given

First order condition:  $-2/(100 - F_1) + 1/(F_1 + F_2) = 0 \Rightarrow F_1 = (100 - 2F_2)/3$

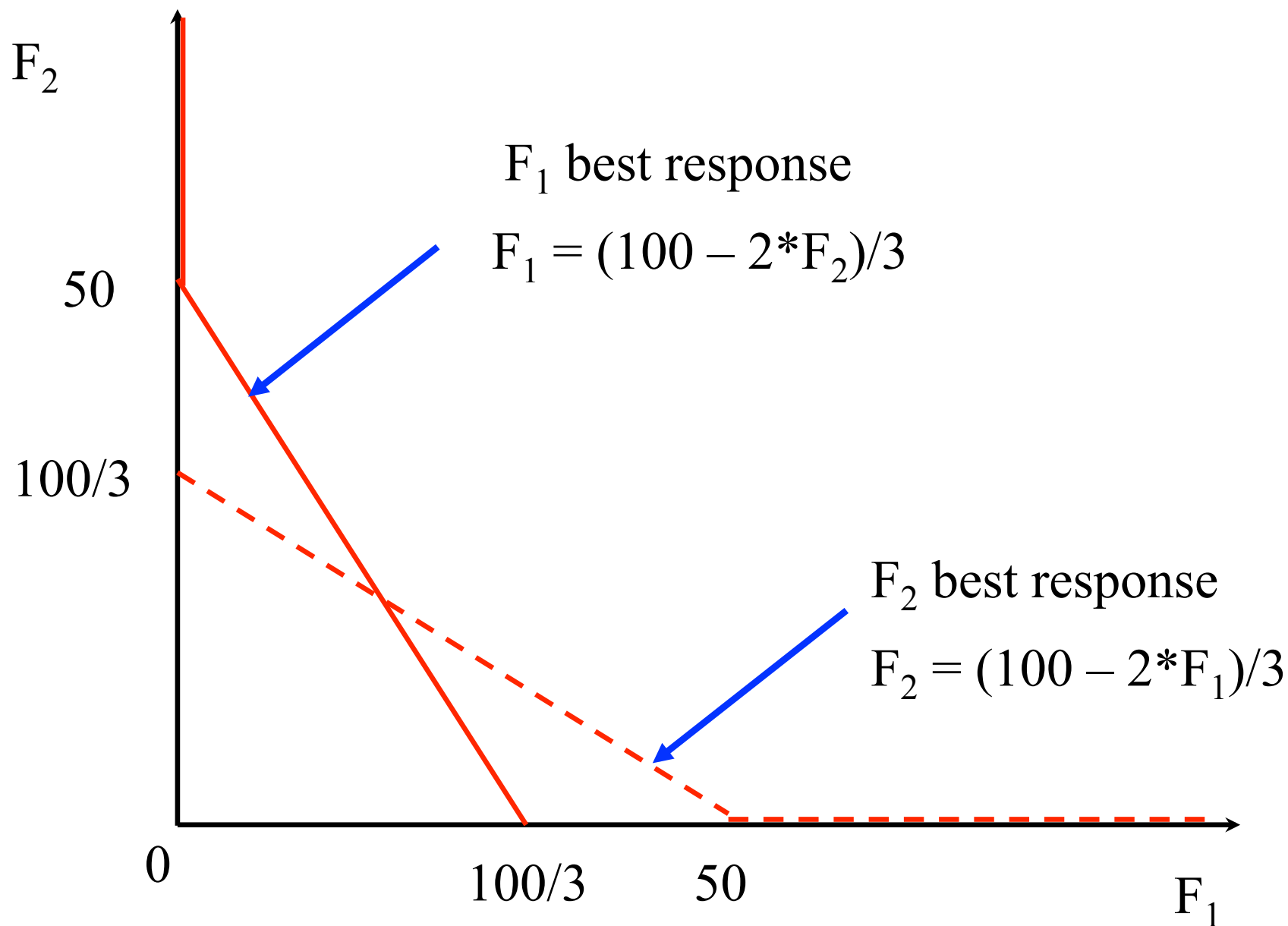
Note that  $F_1$  goes down with  $F_2$  due to the free rider problem (called the reaction curve, show graph)

Symmetrically, we have  $F_2 = (100 - 2F_1)/3$

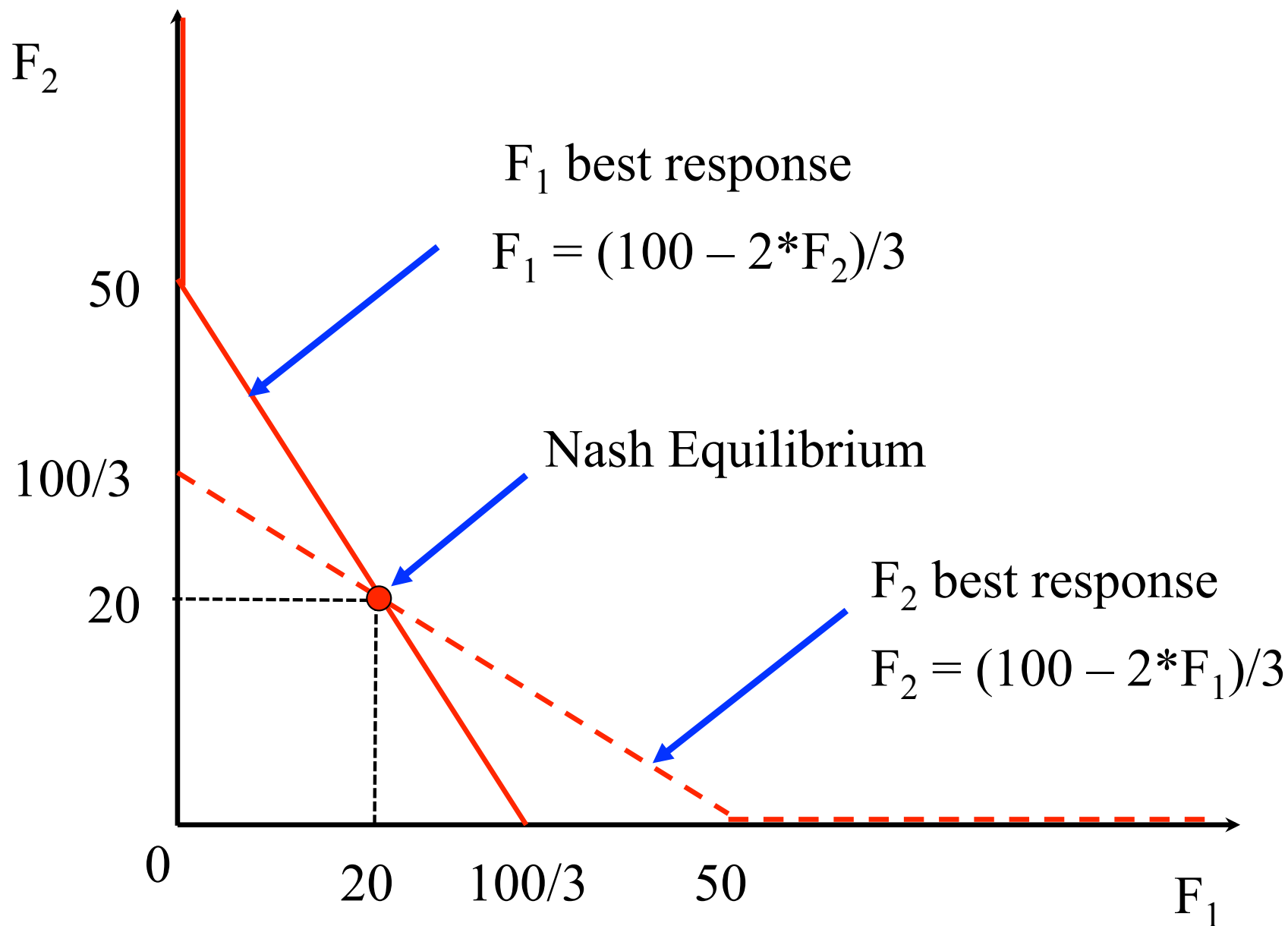
# Private Provision of Public Good



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## PRIVATE PROVISION OF PUBLIC GOOD

**Nash equilibrium definition:** Each agent maximizes his objective taking as given the actions of the other agents

At the Nash equilibrium, the two reaction curves intersect:

$$F_1 = (100 - 2F_2)/3 \text{ and } F_2 = (100 - 2F_1)/3$$

$$\Rightarrow F_1 + F_2 = (200 - 2(F_1 + F_2))/3 \Rightarrow F = F_1 + F_2 = 200/5 = 40 \Rightarrow F_1 = F_2 = 20$$

What is the Social Optimum?  $\sum_i MRS^i = MC = 1$

$$MRS_{FX}^i = MU_F^i / MU_X^i = (1/(F_1 + F_2)) / (2/X_i) = X_i / (2F)$$

$$\Rightarrow \sum_i MRS^i = (X_1 + X_2) / (2F) = (200 - F) / (2F)$$

$$\Rightarrow \sum_i MRS^i = 1 \Rightarrow 200 - F = 2F \Rightarrow F = 200/3 = 66.6 > 40$$

**Public good is under-provided by the market**

## **Can Private Provision Overcome Free Rider Problem?**

The free rider problem does not lead to a complete absence of private provision of public goods. Private provision works better when:

### **1) Some Individuals Care More than Others:**

Private provision is particularly likely to surmount the free rider problem when individuals are not identical, and when some individuals have an especially high demand for the public good.

### **2) Altruism:**

When individuals value the benefits and costs to others in making their consumption choices.

### **3) Warm Glow:**

Model of public goods provision in which individuals care about both the total amount of the public good and their particular contributions as well.

## Experimental evidence on free riding

Laboratory experiments are a great device to test economic theories

Subjects (often students) are brought to the lab where they sit through a computer team game and get paid based on the game outcomes

Many public good lab experiments. Example (Marwell and Ames 1981):

- 10 repetitions for each game
- In each game, group of 5 people, each with 10 tokens to allocate between cash and public good.
- If take token in cash, get \$1 in cash for yourself. If contribute to common good, get \$.5 to each of all five players.

Nash equilibrium: get everything in cash

Socially optimal equilibrium: contribute everything to public good

In the lab, subjects contribute about 50% to public good, but public good contributions fall as game is repeated (Isaac, McCue, and Plott, 1985)

Explanations: people are willing to cooperate at first but get upset and retaliate if others take advantage of them

## **Why Do People Cooperate?**

In standard economic model, individuals are selfish and hence play Nash and don't cooperate

Yet obvious that humans are social beings that constantly interact and cooperate at many levels (family, work, friends, community, nation, etc.)

Cooperation is innate and supported by sense of fairness and willingness to punish non-cooperators (altruistic punishment)

Likely due to evolutionary adaptation

Many lab experiments have explored “fairness” aspects of human behavior (Fair and Schmidt, 1999)

But these “social” aspects haven't integrated mainstream economics much yet, a serious limitation especially for public economics



## Crowding out of private contributions by govt provision

Suppose government forces each individual to provide 5 so that now  $F = F_1 + F_2 + 10$  where  $F_i$  is voluntary contribution of individual  $i$

Utility of individual  $i$  is  $U_i = 2 \log(X_i) + \log(F_1 + F_2 + 10)$  with budget  $X_i + F_i = 95$

You will find that the private optimum is such that  $F_1 = F_2 = 15$  so that government forced contribution crowds out one-to-one private contributions

**Why?** Rename  $F'_i = F_i + 5$ . Choosing  $F'_i$  is equivalent to choosing  $F_i$ :  $U_i = 2 \log(X_i) + \log(F'_1 + F'_2)$  with budget  $X_i + F'_i = 100$

$\Rightarrow$  Equivalent to our initial problem with no government provision hence the solution in  $F'_i$  must be the same

However, government forced contributions will have an effect as soon as private contributions fall to zero (as individuals cannot contribute negative amounts and undo government provision)

## EMPIRICAL EVIDENCE ON CROWD-OUT

Crowd-out: Reduction in private contributions to a public good due to an increase in government provision of the public good.

Two strands of empirical literature

1) Field evidence (observational studies)

2) Lab and field experiments

Lab experiments show imperfect crowd-out in public good games (where you compare situation with no forced public goods contributions and with forced public good contributions), see Andreoni (1993).

Lab experiment may not capture important motives for giving: warm glow, prestige, solicitations from fund raisers

## CHARITABLE GIVING

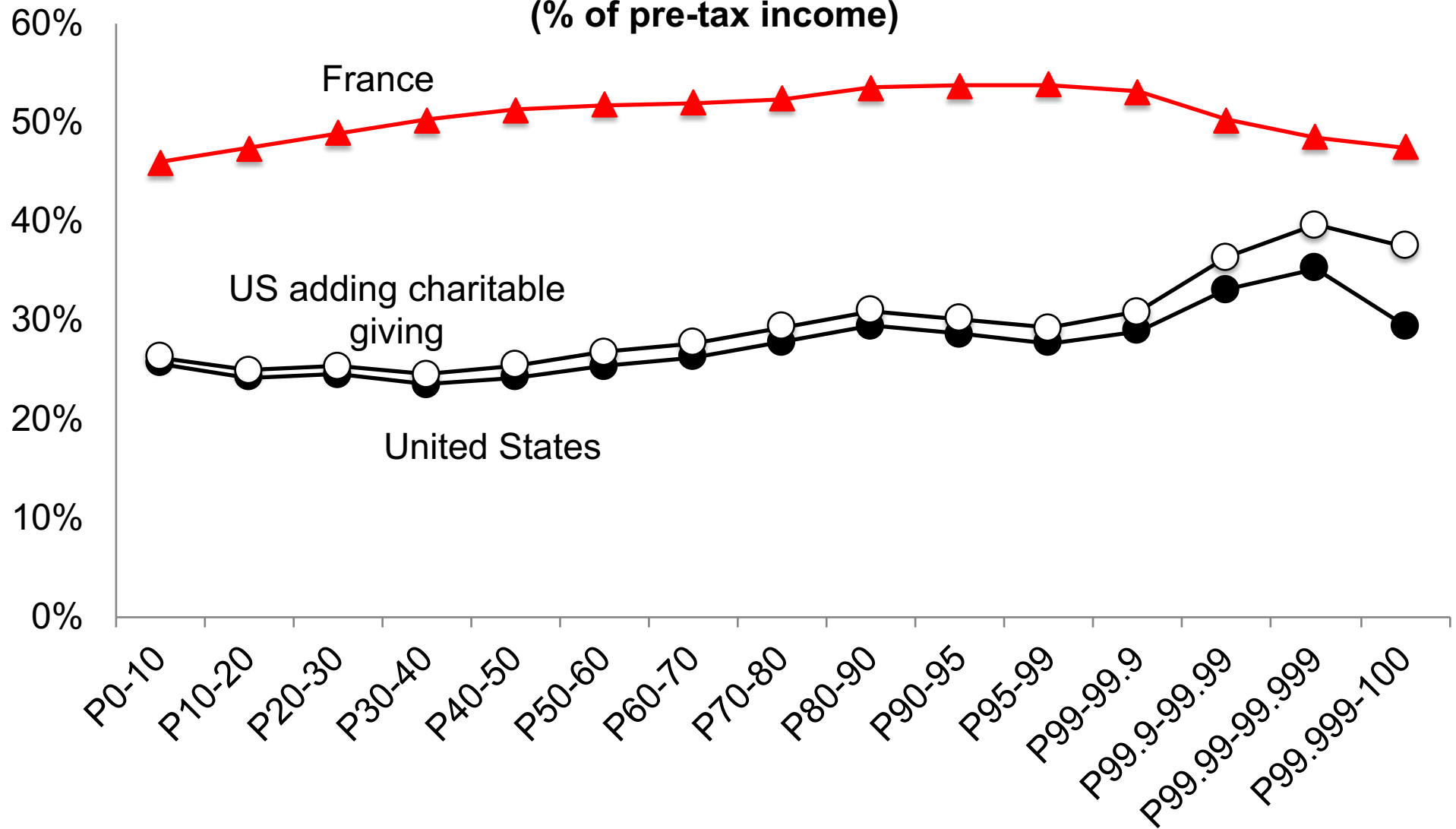
Charitable giving is one form of private public good provision

Big in the US, 1.5% of National Income given to charities, but still much less than gap in govt spending between US = 30% of national income vs. EU = 45% of national income).

Funds (1) religious activities, (2) education, (3) human services, (4) health, (5) arts, (6) various causes (environment, animal protection, etc.)

Encouraged by government: giving can be deducted from income for income tax purposes

**Average tax rates by income group in 2018: US vs. France**  
(% of pre-tax income)



## CHARITABLE GIVING

People give out of :

(1) warm-glow (name on building)

(2) reciprocity (alumni)

(3) social pressure (churches)

(4) altruism (poverty relief)

Those effects are not captured in basic economic model

Charities have big fund-raising operations to induce people to give based on those social/psychological effects

## Empirical Evidence on Crowd-Out: Andreoni-Payne '03

Government spending crowds out private donations through two channels: willingness to donate + fundraising

Use tax return data on arts and social service organizations

Panel study: follows the same organizations overtime

**Results:** \$1000 increase in government grant leads to \$250 reduction in private fundraising

Suggests that crowdoout could be non-trivial if fundraising is a powerful source of generating private contributions

Subsequent study by Andreoni and Payne confirms this

Find that \$1 more of government grant to a charity leads to 56 cents less private contributions

70 percent (\$0.40) due to the fundraising channel

Suggests that individuals are relatively passive actors

## **Randomized field experiment to test reciprocity**

Falk (2007) conducted a field experiment to investigate the relevance of reciprocity in charitable giving

In collaboration with a charitable organization, sent 10,000 Christmas solicitation letters for funding schools for street children in Bangladesh to potential donors (in Switzerland) randomized into 3 groups

- 1) 1/3 of letters contained no gift (control group)
- 2) 1/3 contained a small gift: one post-card (children drawings)+one-envelope (treatment 1)
- 3) 1/3 contained a larger gift: 4 post-cards (children drawings)+4-envelopes (treatment 2)

Likelihood of giving: 12% in control, 14% in treatment 1, 21% in treatment 2

“large gift” was very effective (even relative to cost)

## Empirical Evidence on Social Pressure

Dellavigna-List-Malmendier '12 design a door-to-door fundraiser randomized experiment:

Control: no advance warning of fund-raiser visit

Treatment group 1: flyer at doorknob informs about the exact time of solicitation (hence can seek/avoid fund-raiser)

Treatment group 2: same as treatment 1 but flyer has a check box "Do not disturb"

Results (relative to control):

Treatment group 1: 9-25% less likely to open door for fund-raiser, same (unconditional) giving

Treatment group 2: a number of people opt out and (unconditional) giving is 28-42% lower

⇒ Social pressure is an important determinant of door-to-door giving and door-to-door fund-raising campaigns lower utility of potential donors



## **Social Prices as a Policy Instrument**

Traditional focus in economics is on changing prices of economic goods

Different set of policy instruments: “social prices”

Suppose people care about social norms and policy maker can manipulate social norms

Should make status good one that generates positive externalities.

E.g. large SUVs are frowned upon as gas guzzlers contributing to global warming while electric cars are admired

Creates another set of policy instruments to explore (Butera et al. 2019)

Recent examples from psychology and political science suggest that social price elasticities can be large

Example: Gerber, Green, Larimer '08: randomized experiment using social pressure via letters to increase voter turnout or Allcott '11 on energy conservation

## **Civic duty mailing**

Dear Registered Voter:

**DO YOUR CIVIC DUTY AND VOTE!**

Why do so many people fail to vote? We've been talking about this problem for years, but it only seems to get worse.

The whole point of democracy is that citizens are active participants in government; that we have a voice in government. Your voice starts with your vote. On August 8, remember your rights and responsibilities as a citizen. Remember to vote.

**DO YOUR CIVIC DUTY – VOTE!**

## **Hawthorne mailing**

Dear Registered Voter:

**YOU ARE BEING STUDIED!**

Why do so many people fail to vote? We've been talking about this problem for years, but it only seems to get worse.

This year, we're trying to figure out why people do or do not vote. We'll be studying voter turnout in the August 8 primary election.

Our analysis will be based on public records, so you will not be contacted again or disturbed in anyway. Anything we learn about your voting or not voting will remain confidential and will not be disclosed to anyone else.

**DO YOUR CIVIC DUTY – VOTE!**

**Self mailing**

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Dear Registered Voter:

WHO VOTES IS PUBLIC INFORMATION!

Why do so many people fail to vote? We've been talking about the problem for years, but it only seems to get worse.

This year, we're taking a different approach. We are reminding people that who votes is a matter of public record.

The chart shows your name from the list of registered voters, showing past votes, as well as an empty box which we will fill in to show whether you vote in the August 8 primary election. We intend to mail you an updated chart when we have that information.

We will leave the box blank if you do not vote.

DO YOUR CIVIC DUTY—VOTE!

-----  
OAK ST  
9999 ROBERT WAYNE  
9999 LAURA WAYNE

Aug 04	Nov 04	Aug 06
	Voted	_____
Voted	Voted	_____

## Neighbors mailing

Dear Registered Voter:

### WHAT IF YOUR NEIGHBORS KNEW WHETHER YOU VOTED?

Why do so many people fail to vote? We've been talking about this problem for years, but it only seems to get worse. This year, we're taking a new approach. We're sending this mailing to you and your neighbors to publicize who does and does not vote.

The chart shows the names of some of your neighbors, showing which have votes in the past. After the August 8 election, we intend to mail an updated chart. You and your neighbors will all know who voted and who did not

### DO YOUR CIVIC DUTY – VOTE!

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MAPLE DR	Aug 04	Nov 04	Aug 06
9995 JOSEPH JAMES SMITH	VOTED	VOTED	_____
9995 JENNIFER KAY SMITH	VOTED		_____
9997 RICHARD B JACKSON	VOTED		_____
9999 KATHY MARIE JACKSON		VOTED	_____
9987 MARIA S. JOHNSON	VOTED	VOTED	_____
9987 TOM JACK JOHNSON	VOTED	VOTED	_____

Source: Gerber, Green, and Larimer (2008)

**TABLE 2. Effects of Four Mail Treatments on Voter Turnout in the August 2006 Primary Election**

	Experimental Group				
	Control	Civic Duty	Hawthorne	Self	Neighbors
Percentage Voting	29.7%	31.5%	32.2%	34.5%	37.8%
N of Individuals	191,243	38,218	38,204	38,218	38,201

Source: Gerber, Green, and Larimer (2008)

## **Welfare Analysis of Social Pricing**

Should social pricing be used on top of standard pricing through corrective taxes (or tradable permits)?

1) Making people feel bad about driving an SUV is inefficient relative to gas tax: destroys welfare without bringing tax revenue

Could still be desirable if imposing a gas tax is impossible. Some negative actions (such as littering) are hard to enforce with fines so social norm on feeling bad about littering is desirable.

2) Making people feel good about driving an energy efficient car is efficient relative to gas tax: adds to welfare as driving an energy efficient car becomes more enjoyable

## REFERENCES

Jonathan Gruber, Public Finance and Public Policy, Fifth Edition, 2016  
Worth Publishers, Chapter 7

Allcott, Hunt. 2011. "Social norms and energy conservation" Journal of public Economics 95(9-10), 1082-1095.(web)

Andreoni, James. "An experimental test of the public-goods crowding-out hypothesis." The American Economic Review (1993): 1317-1327.(web)

Andreoni, James, and A. Abigail Payne. "Do government grants to private charities crowd out giving or fund-raising?." American Economic Review (2003): 792-812.(web)

Butera, Luigi , Robert Metcalfe, William Morrison, and Dmitry Taubinsky. "The Deadweight Loss of Social Recognition", NBER Working Paper No. 25637, March 2019. (web)

Dellavigna, Stefano, John A. List and Ulrike Malmendier, "Testing for Altruism and Social Pressure in Charitable Giving," Quarterly Journal of Economics, 2012, 127(1), 1-56. (web)

Falk, Armin. "Gift exchange in the field." Econometrica 75.5 (2007): 1501-1511.(web)



Fehr, Ernst, and Klaus M. Schmidt. "A theory of fairness, competition, and cooperation." *Quarterly journal of economics* 114, no. 3 (1999): 817-868. (web)

Gerber, Alan S., Donald P. Green, and Christopher W. Larimer. "Social pressure and vote turnout: Evidence from a large-scale field experiment." *American Political Science Review* 102.1 (2008): 33. (web)

Isaac, Mark R., Kenneth F. McCue, and Charles R. Plott. "Public goods provision in an experimental environment." *Journal of Public Economics* 26.1 (1985): 51-74.(web)

Marwell, Gerald, and Ruth E. Ames. "Economists free ride, does anyone else?: Experiments on the provision of public goods." *Journal of Public Economics* 15.3 (1981): 295-310. (web)