Undergraduate Public Finance: 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

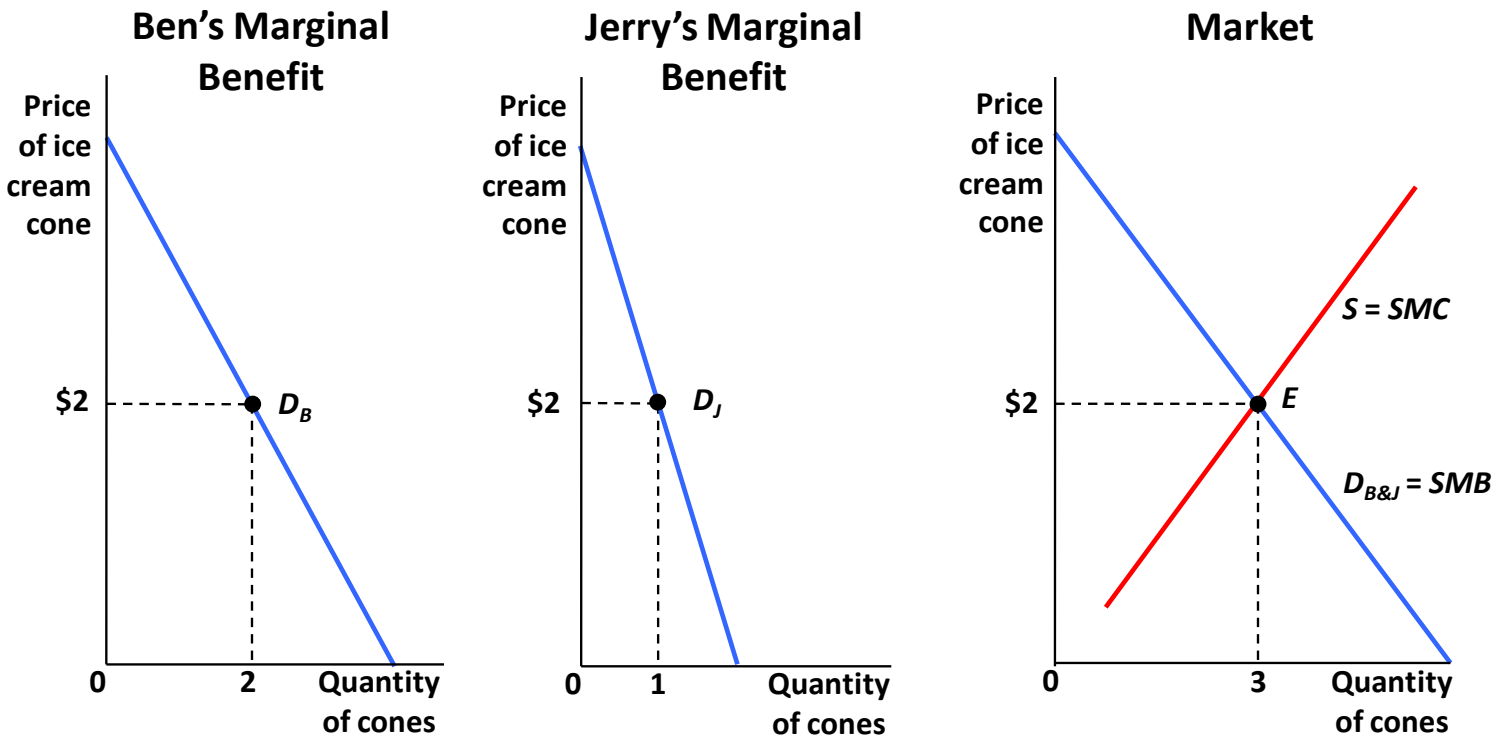
The optimality condition for the consumption of private goods is written as: $MRS^B_{ic,c} = MRS^J_{ic,c} = P_{ic}/P_c = P_{ic}$

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

In equilibrium, therefore: $MRS^B_{ic,c} = MRS^J_{ic,c} = MC_{ic}$

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

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

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

In net, society is willing to give up $MRS^B_{m,c} + MRS^J_{m,c}$ cookies for 1 missile

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

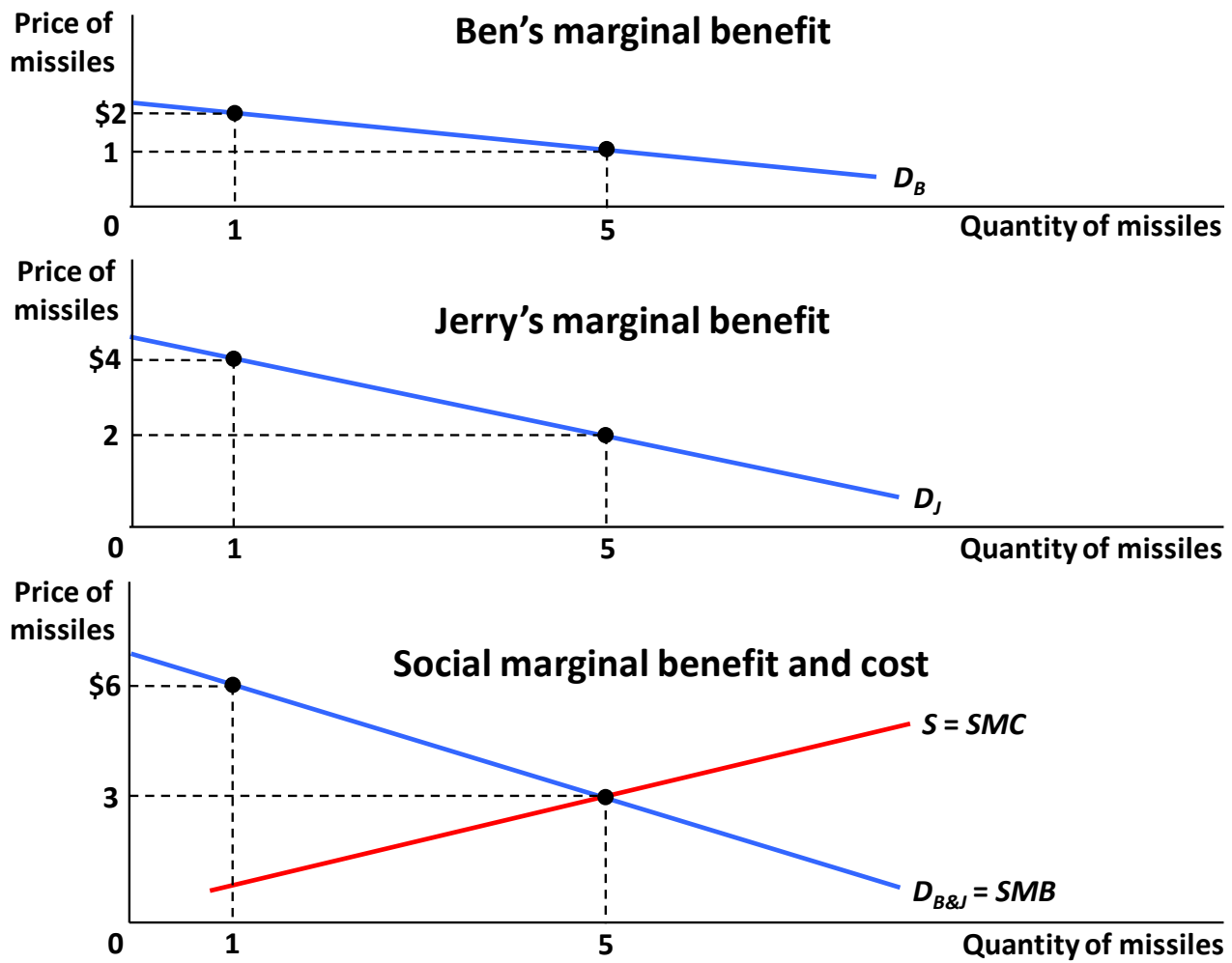
$$MRS^B_{m,c} + MRS^J_{m,c} = MC_m \tag{1}$$

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



A Simple Exercise

Suppose 20 people each have the demand $Q = 20 - P$ for streetlights and 5 people have the demand $Q = 18 - 2P$ for streetlights. The cost of building each streetlight is \$10. If it is impossible to purchase a fractional number of streetlights, how many streetlights are socially optimal?

Private Sector Underprovision

Private sector provision such that $MRS^i_{mc} = MC_m$ for each individual i so that $\sum_i MRS^i_{mc} > MC_m$

$\Rightarrow$ 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 undersupplies public goods

Conceptually, private provision of a public good creates a positive externality (as everybody else benefits), and we know that goods with positive externalities are under-supplied by the market

Case Study: Wikipedia

Online information sharing is typically subject to free riding:

- Over 500 million unique visitors consult Wikipedia.
- The content is exclusively written by volunteers.
- About 6% of readers have ever made an edit!
- About 3% of non-editing readers donated to the nonprofit so others could make edits!

Let's discuss the free-rider problem formally...

Private Underprovision 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

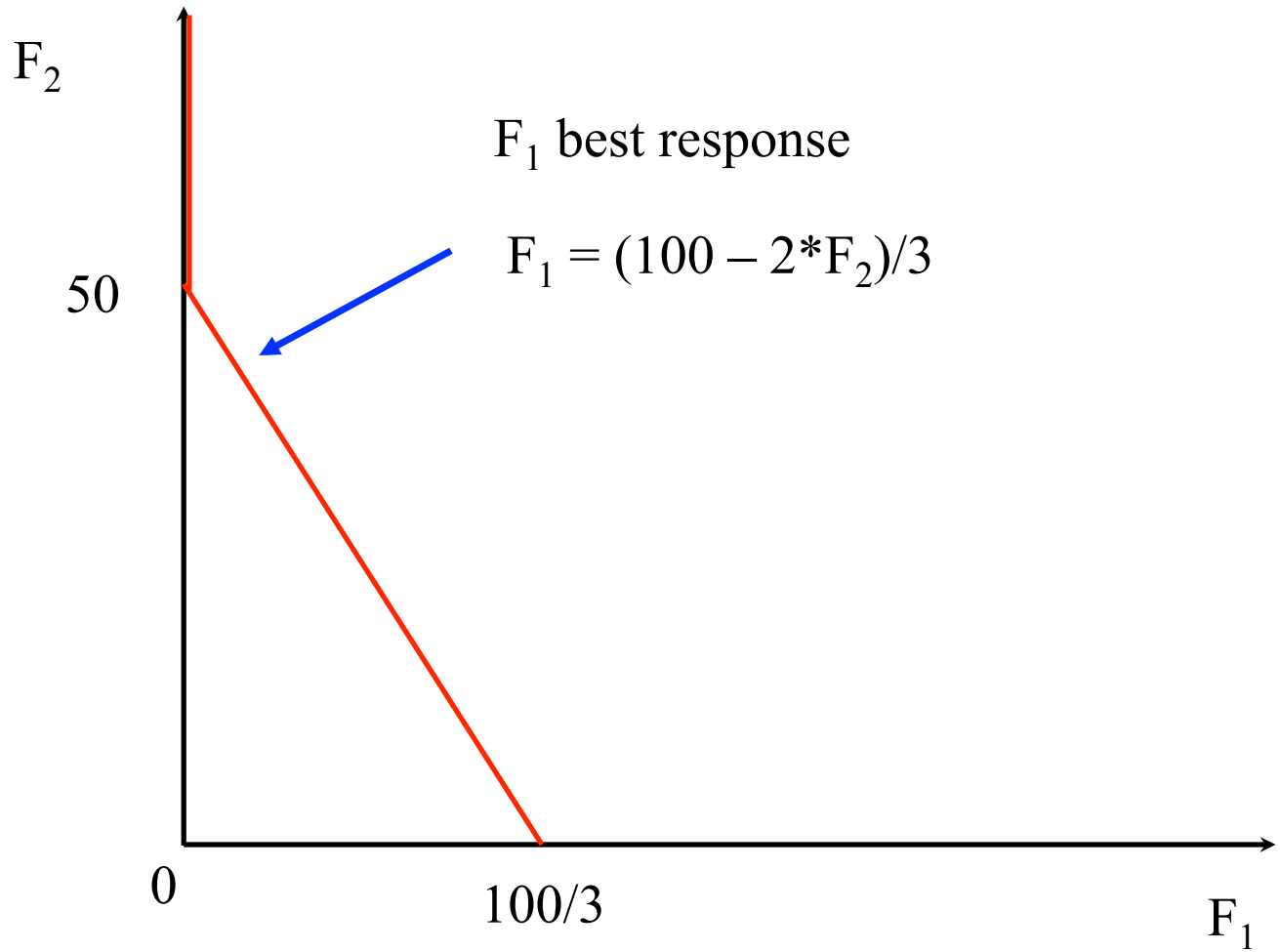
Utility of individual i is $U_i = 2\log(X_i) + \log(F_1 + F_2)$ with budget $X_i + F_i = 100$

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

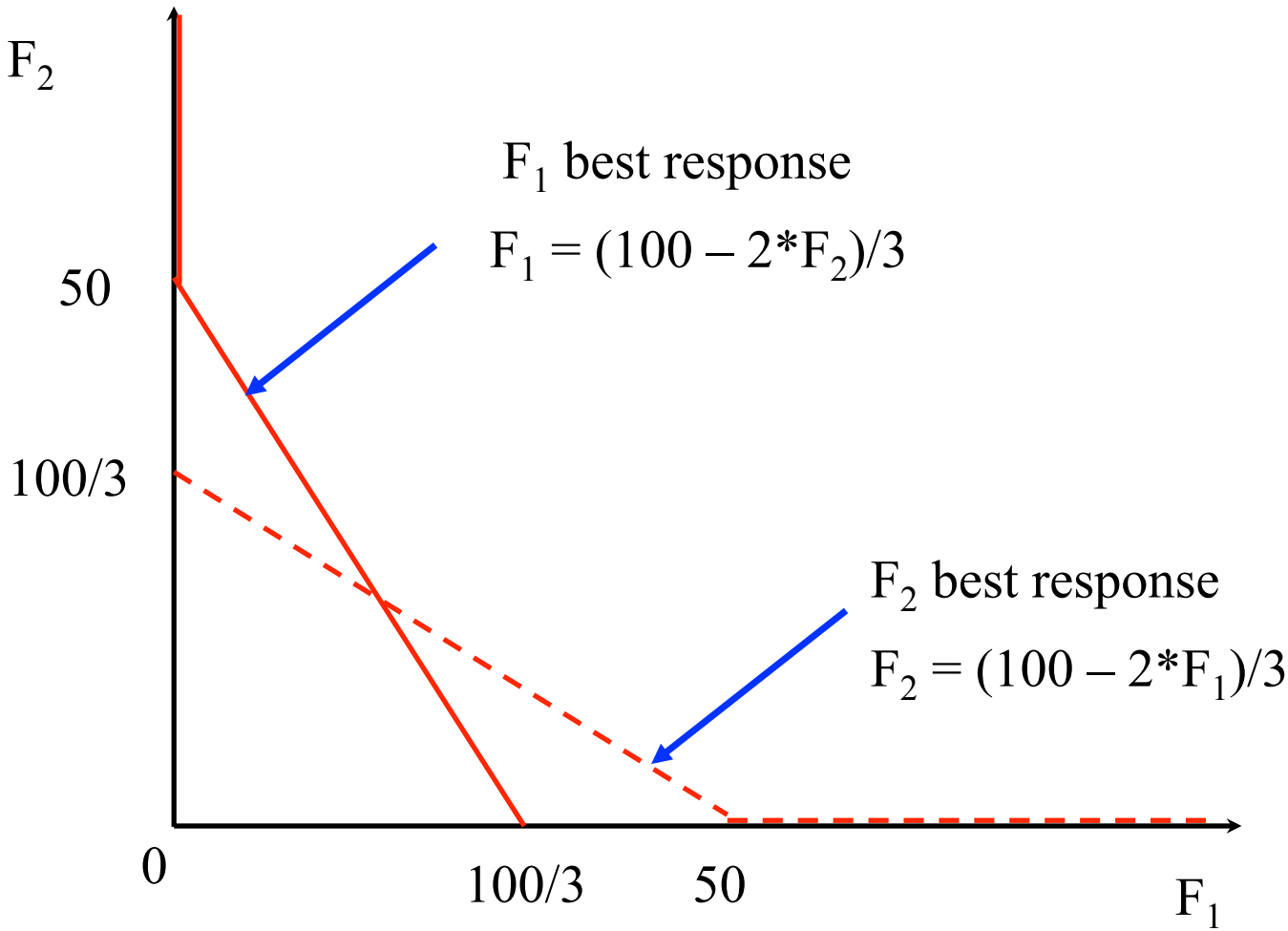
First order condition:
$-2/(100 - F_1) + 1/(F_1 + F_2) = 0 \Rightarrow F_1 = (100 - 2F_2)/3$

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

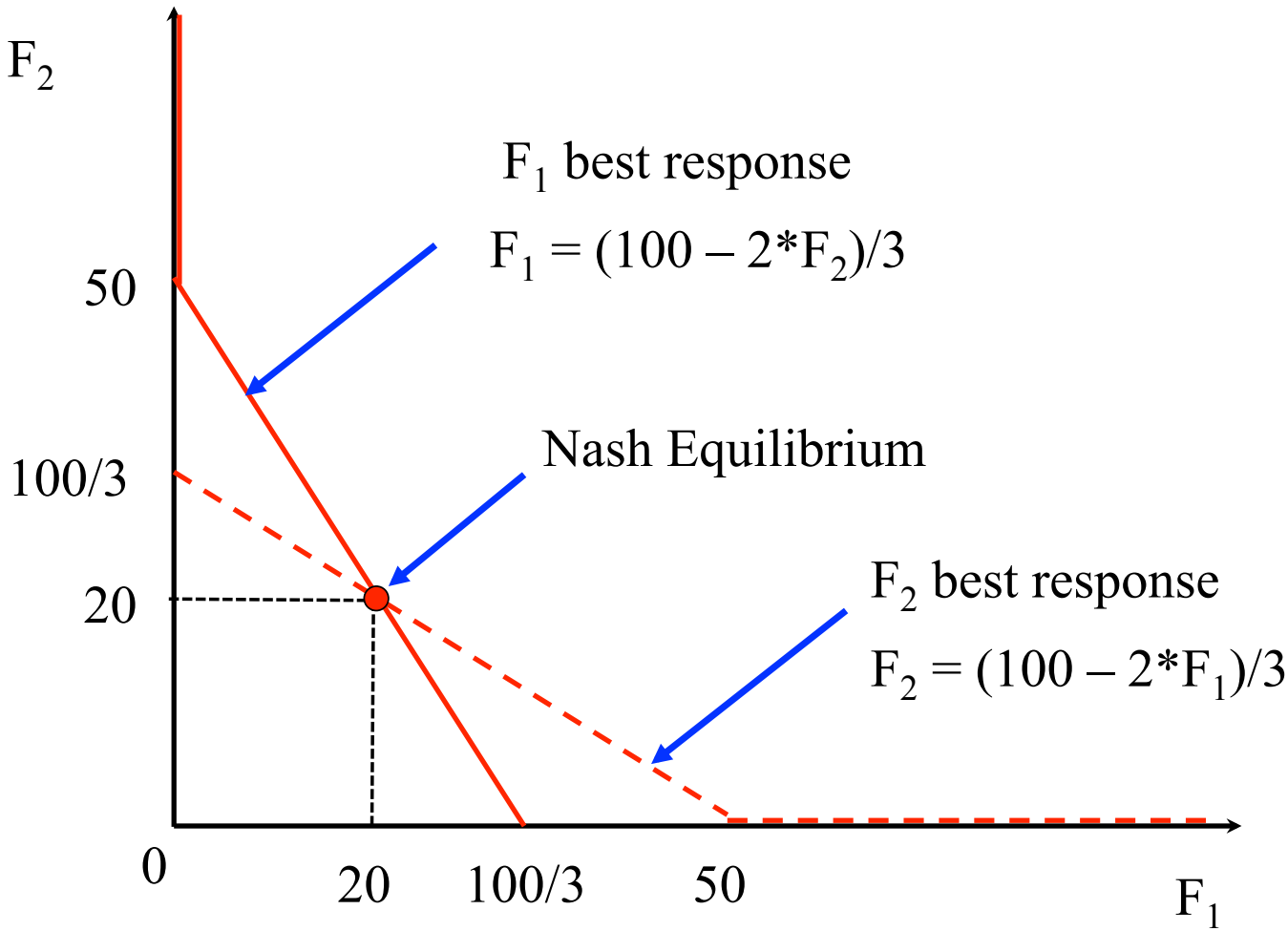
Private Provision of Public Good



Private Provision of Public Good



Private Provision of Public Good



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:

$F_1 = (100 - 2F_2)/3$ 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? $\sum_i MRS^i = MC = 1$

$MRS^i_{FX} = MU^i_F / MU^i_X = (1/(F_1 + F_2))/(2/X_i) = X_i/(2F)$

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

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

Conclusion: Public good is under-provided by the market

Can private providers overcome the free rider problem?

Generally, the free rider problem does not lead to the complete absence of private provision of public goods.

When private suppliers are given the ability to **overcome the problem of non-excludability**, they can produce the efficient quantity of the good.

The private sector can in some cases combat the free rider problem to provide public goods by **charging user fees that are proportional to their valuation of the public good**.

Case Study: Business Improvement Districts (BIDs)

Clean and safe sidewalks are public goods.

Cities attempt to provide them through street repair and police work, financed with tax revenue.

But New York City's Time Square in the 1980s was a failure: *"Dirty, dangerous, decrepit, and increasingly derelict"*

In 1992, a group of private firms formed a "Business Improvement District" to improve the area themselves

Case Study: Business Improvement Districts (BIDs)

How did the BID work?

A (BID) is a legal entity that privately provides local services and funds these services with fees charged to local businesses.

How do BIDs overcome free rider problem?

NYC law allows BIDs to levy fees on nonpaying members, as long as 60% of members contribute.

In the Times Square case, 84% of local businesses agreed to pay fees to fund the BID's services.

Case Study: Business Improvement Districts (BIDs)

Resounding success!

- Crime has dropped significantly.
- The area is cleaner and more attractive.
- Business and tourism are booming.

Success of BIDs depends on the legal underpinnings: Can members charge fees to encourage payment?

The BID entity overcame the public goods problem by overcoming the non-excludable assumption. They received government permission to (potentially) charge, via a tax, all consumers.

Differential Valuations of the Public Good

Markets can (mostly) overcome the free rider problem when some individuals care more than others.

Suppose Ben cares much more about fireworks than Jerry.

Then, Ben will want to buy a lot of fireworks for himself.

And the efficiency loss is not too great.

Experimental Evidence on Free-riding

Many public good lab experiments. e.g., Marwell and Ames 1981:

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. So why do we observe that they do?

Altruism: Individuals value the benefits and costs to others in making their consumption choices

Social Capital: The value of altruistic and communal behavior in society (largely related to how much you can trust others)

Warm Glow:: Individuals care about both the total amount of the public good and their particular contributions as well

$\Rightarrow$ Suggests private markets will also provide public goods for these reasons (to some extent)

Public Provision of Public Goods

Despite private provision, there is a role for government provision of public goods.

Under private provision, not everyone contributes to the good, even though everyone benefits.

Government provision potentially solves the problem of noncontributors.

Nonetheless, there are several challenges to government provision.

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 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

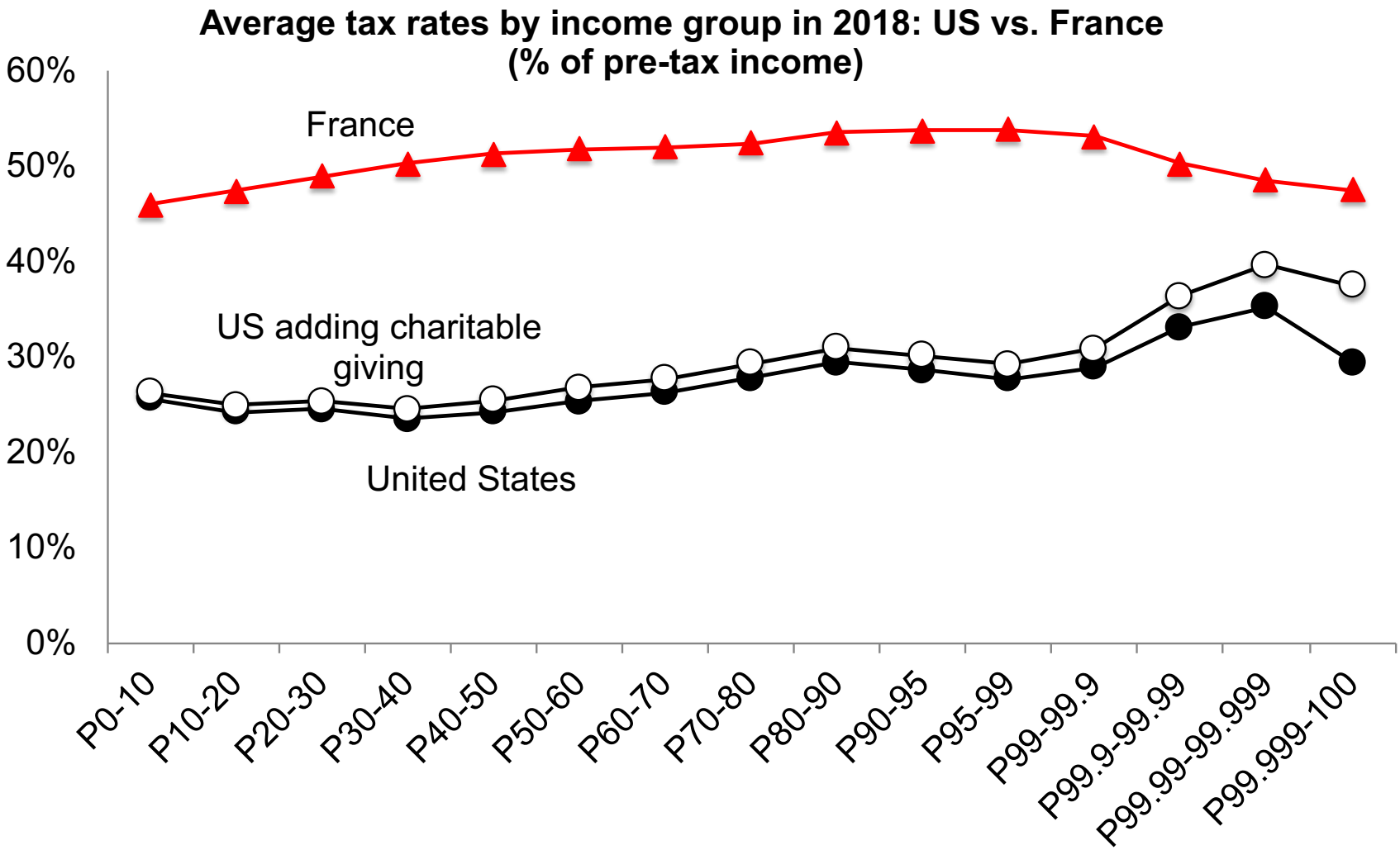
Charitable Giving

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)
60%
50%
40%
30%
20%
10%
0%
France
US adding charitable giving
United States
P0-10
P10-20
P20-30
P30-40
P40-50
P50-60
P60-70
P70-80
P80-90
P90-95
P95-99
P99-99.9
P99.9-99.99
P99.99-99.999
P99.999-100

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 crowdout could be non-trivial if fundraising is a powerful source of generating private contributions, and that donors are relatively passive actors

Generally, people give out of :

(1) warm-glow (example: name on building)

(2) reciprocity (example: alumni)

(3) social pressure (example: churches)

(4) altruism (example: 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

Testing the Warm Glow Motive

Crumpler & Grossman (2008) run the following lab experiment:

4.1. Design

Participants take part in a double-anonymous, modified dictator game paired with charities of their own choosing, selected from a list of ten (see the Appendix). All sessions were proctored by the two authors (Grossman as head proctor with Crumpler assisting with the distribution of materials) and the proctors were in the same room as the subjects throughout a session.[4] Participants were informed that the charities they selected would receive $10 from the proctor. After selecting their charities, participants were given an endowment of $10 and asked how they would like to divide the $10 between themselves and their chosen charities. Participants were informed that:

> "The amount contributed by the proctor to your selected charity WILL be reduced by however much you pass to your selected charity. *Your selected charity will receive neither more nor less than $10.*"

If you only care about how much money the charity gets (pure altruism), you shouldn't give anything... What did participants do?

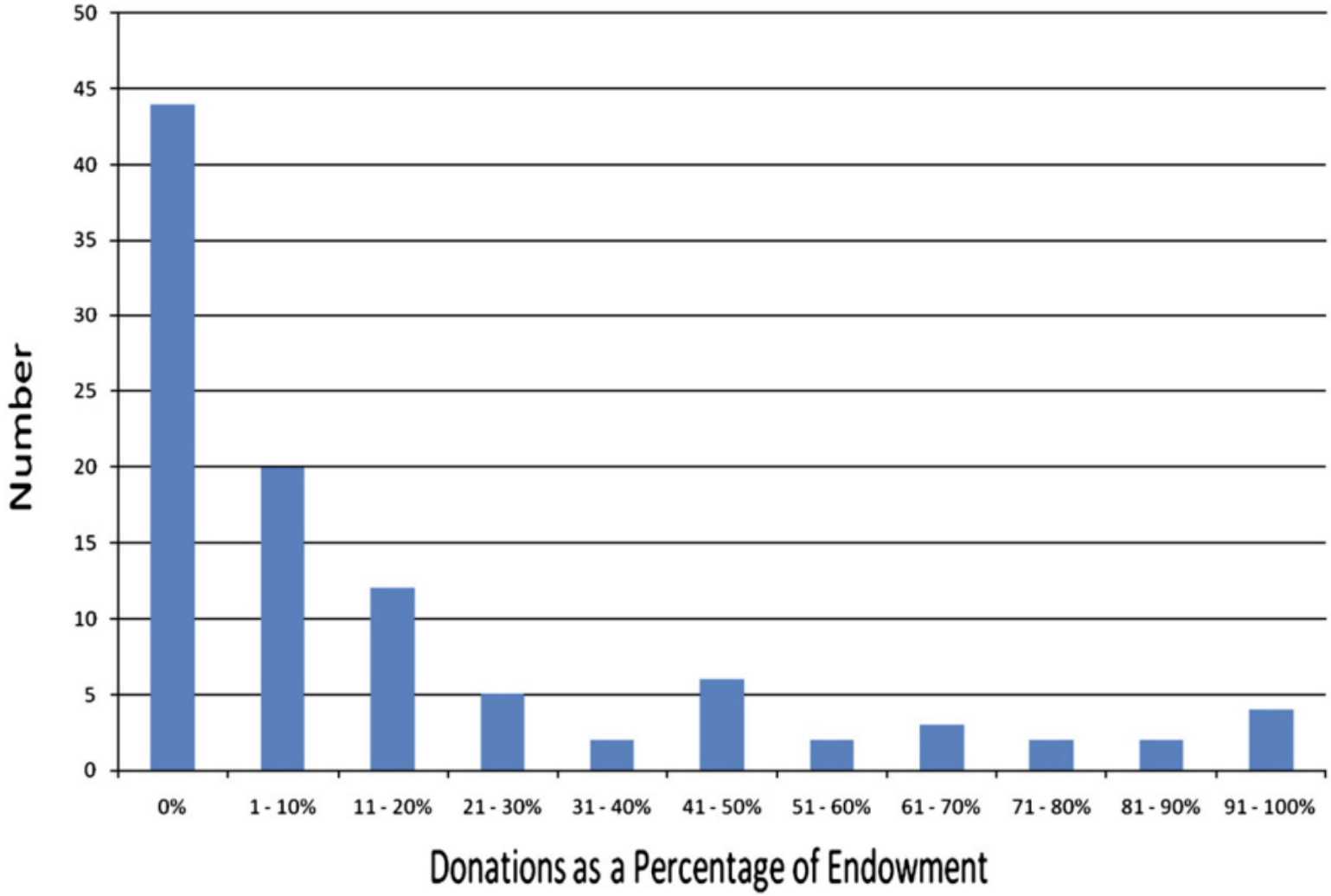


Fig. 1. Distribution of donations as a percentage of endowment.

Testing 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) Control: 1/3 of letters contained no gift

2) Treatment group 1: 1/3 contained a small gift: one post-card with children drawings

3) Treatment group 2: 1/3 contained a larger gift: 4 post-cards with children drawings

$\Rightarrow$ The large gift was very effective (even relative to cost)

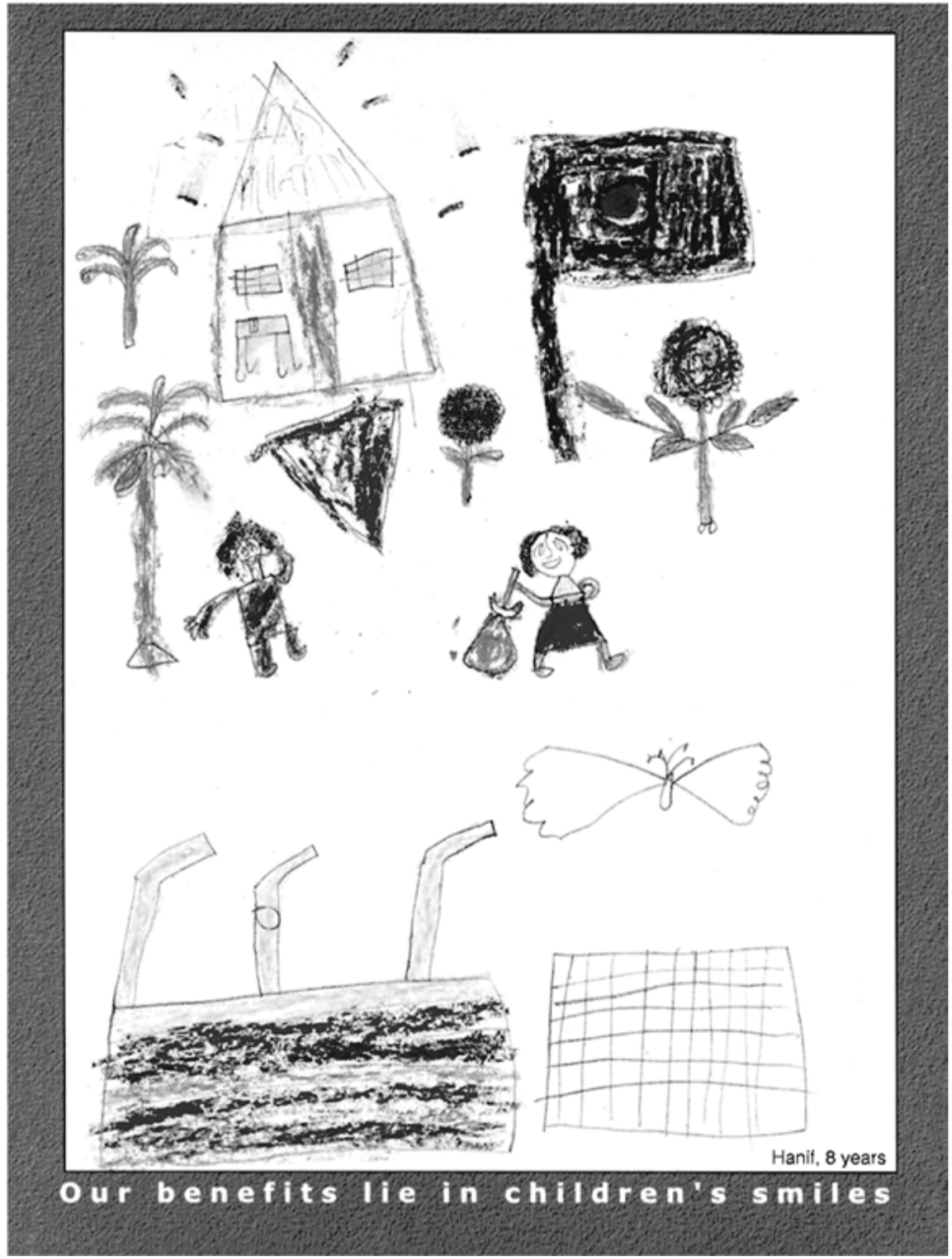


FIGURE 1.—An example of the included postcards.

Altruism or 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 or avoid fund-raiser)

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

Group 1 is 9% less likely to open door for fund-raiser and give less (but not statistically significant)

Group 2 is 23% less likely to open door for fund-raiser and gives 28-40% less

$\Rightarrow$ 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

Creates another set of policy instruments to explore (Butera et al. 2022)

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

e.g., Gerber, Green, Larimer ’08: randomized experiment using social pressure via letters to increase voter turnout

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!

Source: Gerber, Green, and Larimer (2008)

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!

Source: Gerber, Green, and Larimer (2008)

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	Aug 04	Nov 04	Aug 06
9999 ROBERT WAYNE		Voted	_____
9999 LAURA WAYNE	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!

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

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Additional Exercises

We add the demands of private goods horizontally but add the demands of public goods vertically when determining the associated marginal benefit to society.

Why do we do this, and why are the procedures different for public and private goods?

Additional Exercises

Ryan's demand for hamburgers (a private good) is Q = 21 - 6P and Madison's demand is Q = 6 - 3P.

Write down an equation for the social marginal benefit of hamburger consumption.

Now suppose that hamburgers are a public good. Write down an equation for the social marginal benefit of hamburger consumption.

Additional Exercises

Think about the rival and excludable properties of public goods.

To what degree is radio broadcasting a public good?

To what degree is a highway a public good?

Additional Exercises

Amy, Brooke, and Chelsea live in Minneapolis. Amy's demand for bike paths, a public good, is given by Q = 24 - 4P. Brooke's demand is Q = 14 - P, and Chelsea's is Q = 5 - P/3. The marginal cost of building a bike path is MC = 18.

The town government decides to usethe following procedure for deciding how many paths to build. It asks each resident how many paths she wants, and it builds the largest number asked for by any resident. To pay for these paths, it then taxes Amy, Brooke, and Chelsea the prices a, b, and c per path, respectively, where a + b + c = MC.

If the taxes are set so that each resident shares the cost evenly (a = b = c), how many paths will get built?

Show that the government can achieve the social optimum by setting the correct tax prices a, b, and c. What prices should it set?

Additional Exercises

The town of Musicville has two residents: Bach and Mozart. The town currently funds its free outdoor concert series solely from the individual contributions of these residents. Each of the two residents has a utility function over private goods (X) and total concerts (C), of the form $U = 3 \times \log(X) + 2 \times \log(C)$. The total number of concerts given, C, is the sum of the number paid for by each of the two persons: $C = CB + CM$. Bach and Mozart both have income of 60, and the price of both the private good and a concert is 1. Thus, they are limited to providing between 0 and 60 concerts.

How many concerts are given if the government does not intervene?

Suppose the government is not happy with the private equilibrium and decides to provide 8 concerts in addition to what Bach and Mozart may choose to provide on their own. It taxes Bach and Mozart equally to pay for the new concerts. What is the new total number of concerts? How does your answer compare to your answer to (a)? Have we achieved the social optimum? Why or why not?

Suppose that instead an anonymous benefactor pays for 8 concerts. What is the new total number of concerts? Is this the same level of provision as in (b)? Why or why not?

Additional Exercises

Consider an economy with three types of individuals, differing only with respect to their preferences for monuments. Individuals of the first type get a fixed benefit of 250 from the mere existence of monuments, whatever their number: $B_1 = 250$. Individuals of the second type get benefits according to $B_2 = 200 + 30M - 2M^2$. Individuals of the third type get benefits of $B_3 = 150 + 90M - 4M^2$ where M denotes the number of monuments in the city. Assume that there are 50 people of each type. Monuments cost 3,000 dollars each to build.

How many monuments should be built?