Ec355, lecture 6 (5.5): Public Goods

Lecturer: David Reinstein

Notes for this Week

Reading: C&M Chapter 4-5, HM Ch. 5 (skip 5.5, 5.6, 5.9)

Media:

Tuesday, November 9, 2010 The Tuesday Podcast: Lighthouses, Autopsies And The Federal Budget **(see also "government failure" and "public interest" models)**

Friday, March 25, 2011 The Friday Podcast: Economists On Federal Funding For National Public Radio,

NPR: Planet money The Tuesday Podcast: A Big Bridge In The Wrong Place, August 9 http://www.npr.org/templates/archives/archive.php?thingId=127413729

Slightly related: **Friday, May 6, 2011** The Friday Podcast: Medieval Economics.

Practice questions:

- Note extensive set of practice questions on lectures 3-5 up on CMR! More to come on other weeks' material…

C&M Ch. 4 Q1 (give arguments), ch. 4, q3.

- Consider a case as in "an algebraic example", but let Ui = c+(G-i +gi).
- What will be the socially optimal level of the public good provided (hint: it need not be an interior solution)? What is the Nash Equilibrium outcome? Show that the latter is Pareto-inefficient.
- See also question 1 from last year's Formative Assesment

Notes …

Rescheduled classes, extra lecture (to make up for technical problems)

Module: EC355-6-AU, EC355-6-ZA - PUBLIC ECONOMICS, PUBLIC ECONOMICS

Type: Class

Day: Monday (Week 9-10)

Date: 28-11-2011,05-12-2011

Time: 13:00 to 14:00

Room: 5B.202 (30) (AV)

Type: Lecture

Day: Monday (Week 11)

Date: 12-12-2011

Time: 13:00 to 14:00

Room: 5B.202 (30) (AV)

Lecturer: Reinstein, David

Notes…

Tomorrow's class: Public goods discussion, go over exercises and computations from today's lecture

Formative assessment (online quiz) ... Don't worry, it is coming... but you also have the option of turning in a page or two of "your own answers" to practice questions and giving it to me, and I will give you hands-on feedback

Term papers: Try to talk to me about it at least once before break, and before you turn it in.

This Week

Reading: C&M Chapter 4-5, HM Ch. 5 (skip 5.5, 5.6, 5.9)

Public Goods

1. What is a public good? Definition, examples

2. Optimal provision of PG
3. Market failure
4. Private (under) provision

5. Experimental and behavioural evidence

6. Government provision of PG's
   - Finding valuations (preference revelation)
   - Practical Issues

Market Failures

Market failures occur when prices do not fully reflect either the marginal social benefits or costs

Such failures provide scope for political interaction

How does this happen?

Potential sources of market failure: Public Goods

Public Goods and Government

In market economics private suppliers provide the majority of goods and services to consumers. However, certain goods are publicly provided. These include defence, education and health.

Why does the government instead of the market provide these goods?

Which characteristics differentiate goods that are privately provided from goods that are publicly provided?

How do we define public goods?

Public Goods and Government cont.

The terminology might induce the conclusion that public goods are goods that are publicly provided as opposed to private goods.

This conclusion is simply WRONG!

The public or private nature of the goods is an intrinsic characteristic of goods that is not related to the provider of the good.

Hence, it may well be that the state provides a private good or that the market provides a public good.

Def: Public Good

Definition: A *pure public* good is a good that has two characteristics

1. **NON-EXCLUDABLE**: Once the good is provided, it is not possible (or prohibitively expensive) to prevent any individual (even individuals that eventually have not paid to access the good) from using the good.

2. **NON-RIVAL**: the fact that some people are using the good doesn't not prevent other people from using the same good. In other words, the consumption by one person doesn't reduce the quantity available for the consumption of other individuals. There is no "crowding."

Class: think of some examples.

Public Goods

There are very few cases of pure public goods. Nevertheless many goods have some public good properties that create problems to their private provision. Ex. Hampstead Heath.

If the park is not full then the marginal cost of one extra consumer is probably zero. However, if all London decides to visit the park simultaneously there will be congestion.

It is possible to charge admittance to Hyde Park by building a fence around it with a gate where admission is charged

In Betweens

If a good is *excludable* and *rival (also called depleatable),* then the good is a private good

Some goods possess just one of these properties

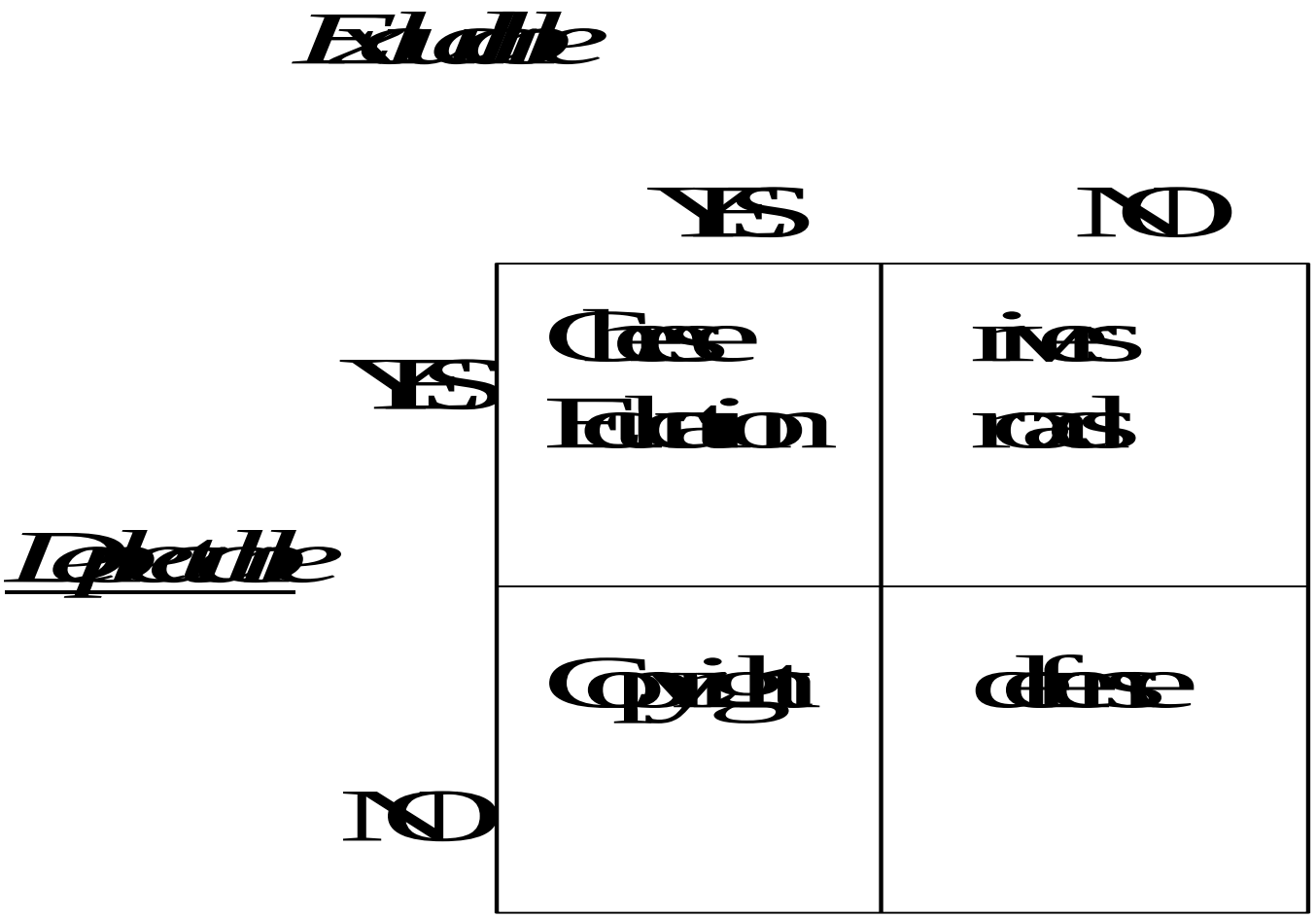
"Club Goods" are excludable but non-rivalrous (at least up to a certain congestion point)

Non-excludable but rivalrous goods can be seen as "common property"

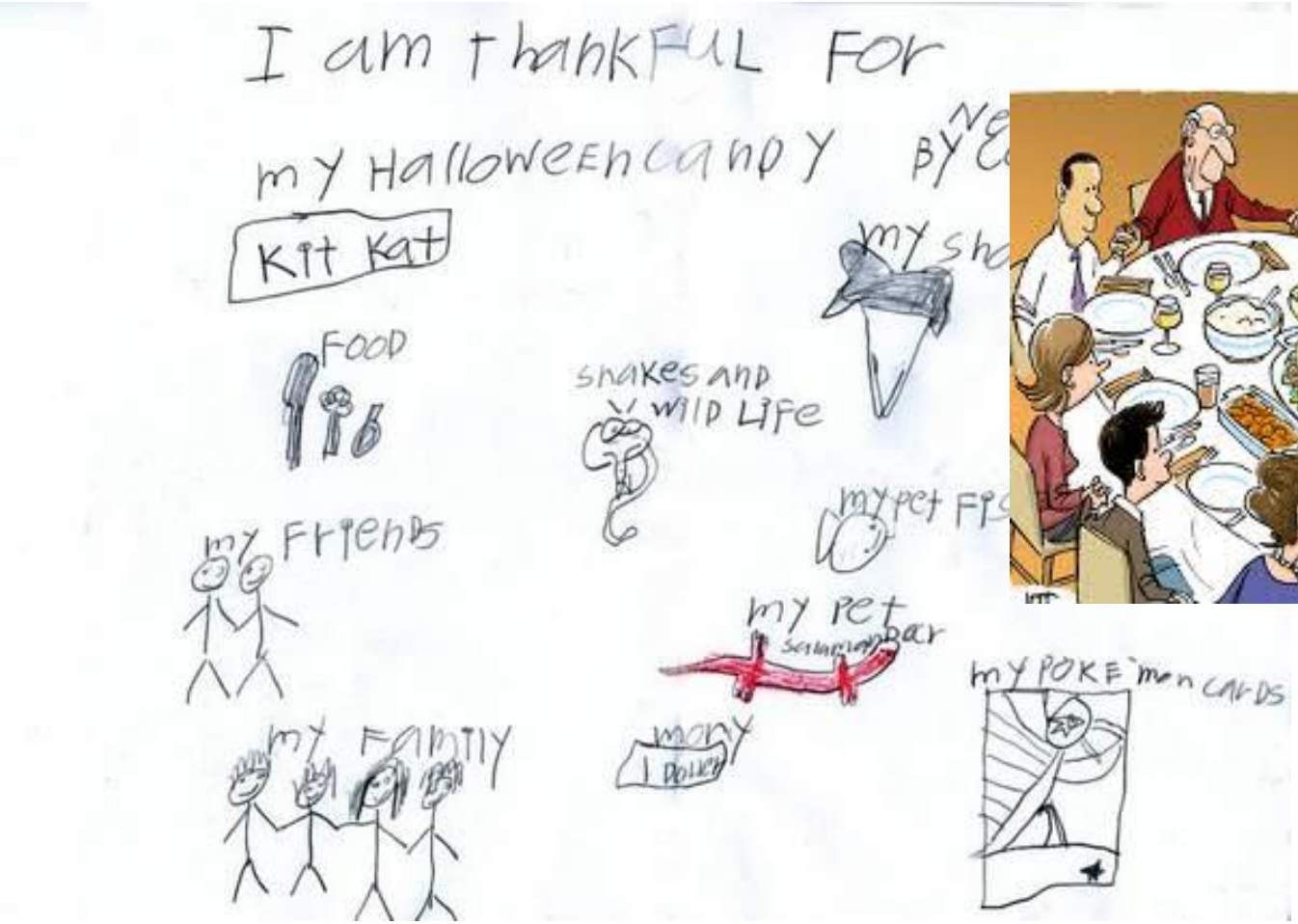
Goods that are "somewhat" non-excludable and "somewhat" non-rival are called *impure public goods*

[Class – give some examples … of club goods, of common property goods]

Some (arguable) examples



Which, if any of these, are public goods?



Connor Hart. 2nd grade. Netherwood Elementary School, Hyde Park.

What about...?

- Recorded music
- “Information” goods (e.g. software)
- A national park
- A theatre performance
- Roads
- Clean Air
- Education
- Aid to the needy
- Loud music coming from my window
- Disease control
- Economic research
- The justice system
- Fireworks in Disney World
- The 2012 olympics in London

Social Benefit of a Private Good vs. a Public Good

What is the social benefit as a function of the amount produced?

The overall value of a private good is the (area under the) “horizontal sum” of individual marginal benefit curves

For public goods the aggregate value “sums vertically”

[Depict on board in “step form”; suppose first person has marginal benefit 2 and 1 for first and second unit respectively, second person has marginal benefit 1 for first unit only … what if producing unit 1 costs 2.5?]

for continuous demand see diagrams at end of slides), give graphical intuition;

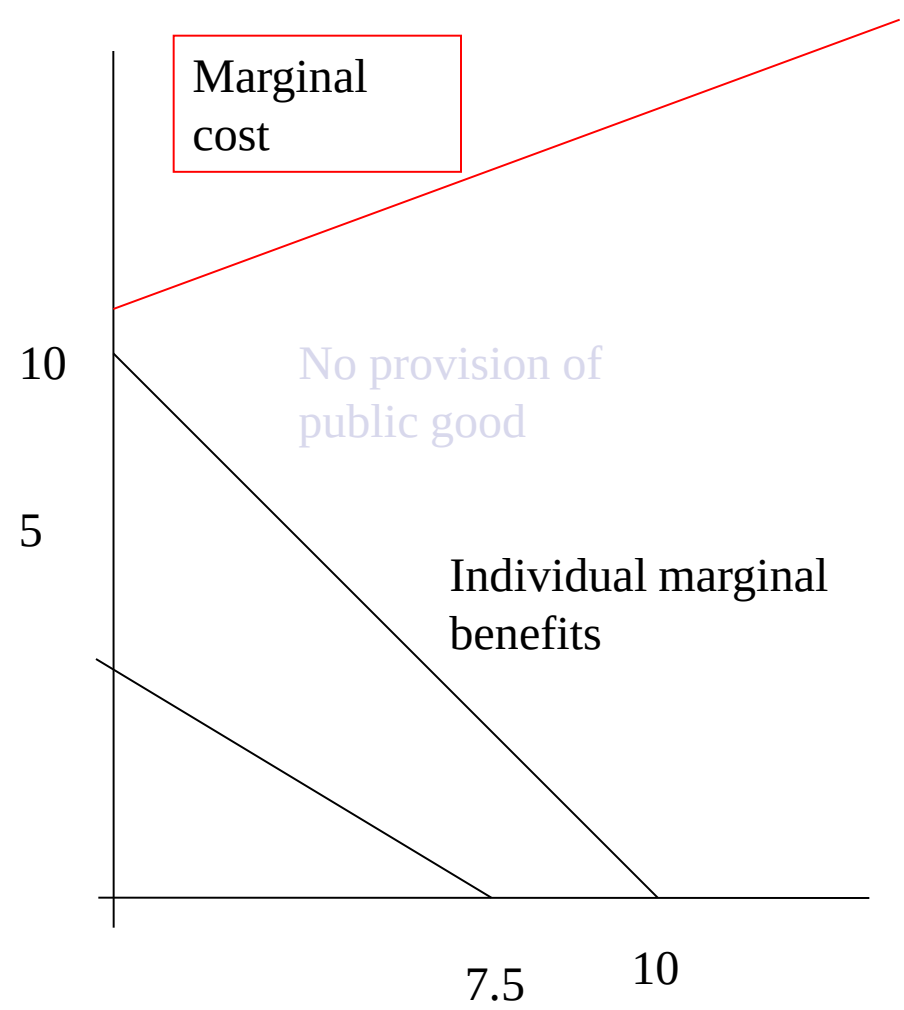
Note that with many individuals and a large-scale public good the marginal cost of providing a public good is zero, or almost zero.

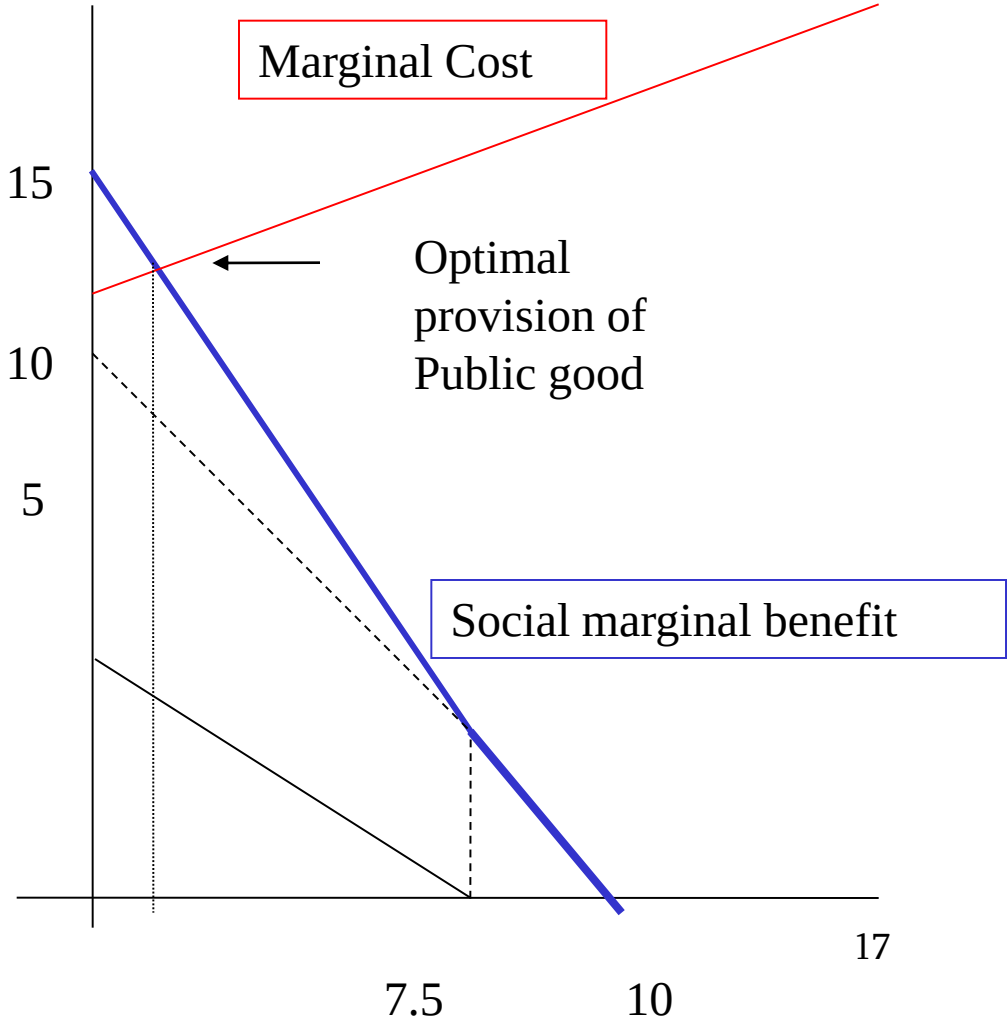
Differences between private and public

For private goods we saw, by the first welfare theorem that provision of private goods is efficient when MRT = MRS_i. For public good this does not work as:

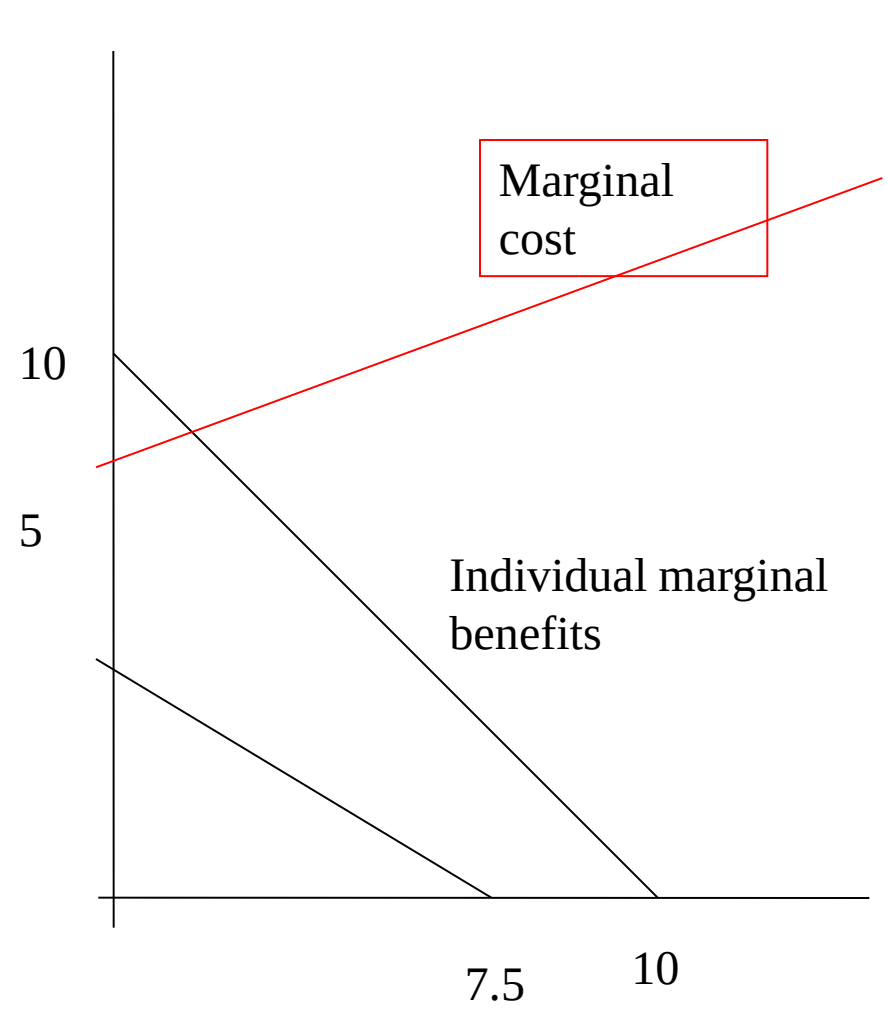
- Non-excludability implies that there is no price or not the right price (so firms don't get the right price signals for their production).
- Non-rivalry implies that everyone consumes the same amount, hence each unit provides benefit to all.

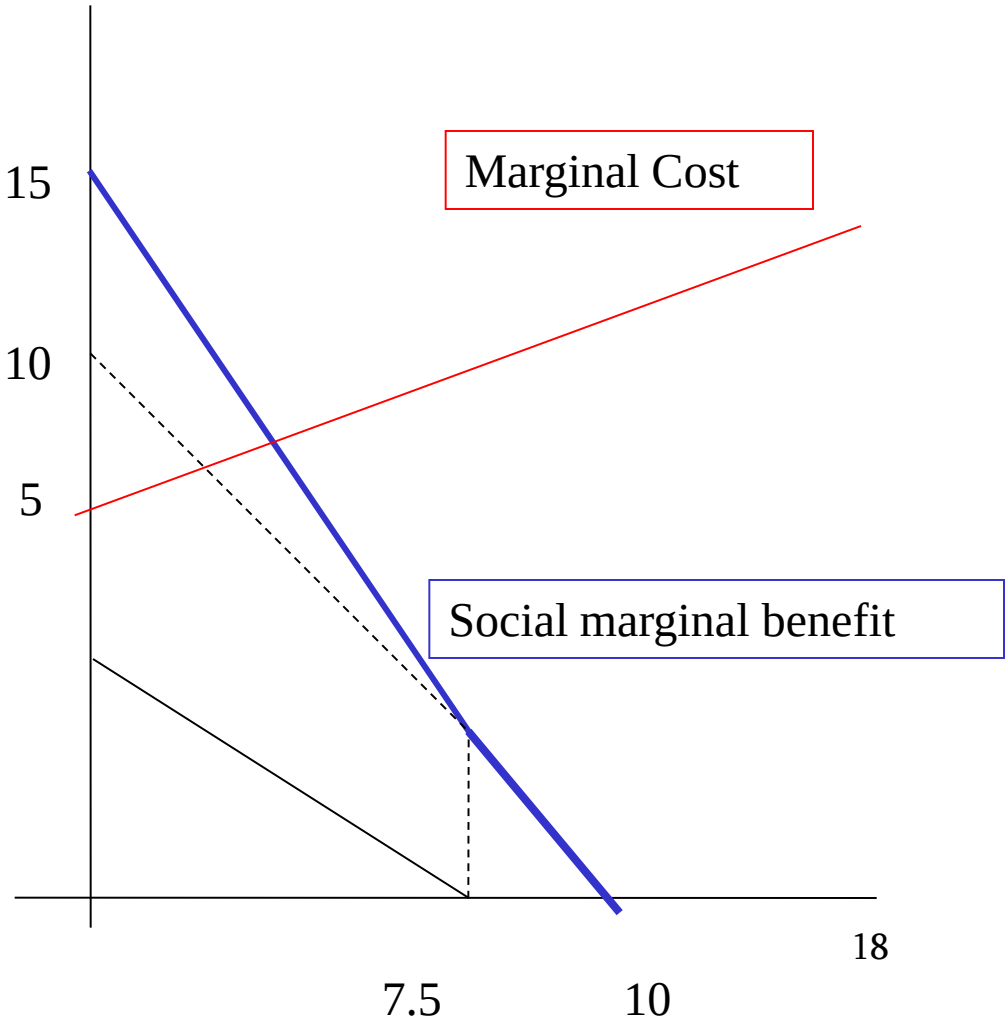
Marginal benefit and demand curve for public goods





Class question – what happens here?





The “Samuelson condition”

Pareto efficiency for Pure Public Goods implies that:

$$\sum_i MRS_i = MRT$$

The sum of the marginal rates of substitution (between the private and public good) must equal the marginal cost of providing the public good.

… see the derivation on p. 62, if you are into that sort of thing.

Market Failure

Can the market efficiently provide public goods?

Private provision through voluntary contributions

Examples: Charity, Private Security

- Cooperation between a finite number of people can be sustained as a subgame perfect Nash equilibrium in an infinitely (or indefinitely) repeated game with players who are patient enough.

- In a finite interaction, argument for this relies on “behavioral” preferences and “intrinsic” motivation” alturism, “warm glow” (in various forms), “Kantian” ethics, reputation-seeking, fairness, reciprocity. [Consider, e.g., the Wivenhoe Fireworks display]

Public goods provision as a prisoners' dilemma

(see discussion from lecture 3 in the context of altruism)

Each gains 75 from a total contribution of 100 and 125 from a total contribution of 200. We are considering contributions of 100 each.

	Contribute	Not contribute
Contribute	(75, 75)	(-25, 125)
Not contribute	(125, -25)	(0, 0)

- Nash equilibrium?

Private (under?) Provision - An Algebraic Example

Consider an economy with **N** individuals each with income **m**

which they can use for own consumption **c** at “numeraire” price 1 (representing the cost of production),

or contribute to a public good.

Let each individual **i**’s contribution be $\mathbf{g_i}$, total contributions are $\mathbf{G=SUM(g_i)}$ and total “others’” contributions are $\mathbf{G_{-i}}$.

Private (under?) Provision - An Algebraic Example cont.

Each individual's utility is: $U_i = c + \ln(G_{-i} + g_i)$

and her budget constraint is: $c+g_i=m$

Plugging this constraint in: $U_i = m - g_i + \ln(G_{-i} + g_i)$

Sum of utilities: $NU_i = Nm - G + N\ln(G)$

Optimal provision (to maximise the sum of utilities) sets:

$$N\frac{d\ln(g)}{dG} = 1 \longrightarrow \frac{N}{G} = 1 \longrightarrow G = N \longrightarrow g_i = \frac{N}{N} = 1$$

for all i, for an equal division of this optimal provision

Private (under?) Provision - An Algebraic Example cont.

But $\mathbf{g_i}$ is not a nash equilibrium.

In an equilibrium where all are contributing something i's best (interior) response chooses $\mathbf{g_i}$ conditional on others' actions (hence in affect choosing G)

To maximise

$$U_i = m - g_i + \ln(G_{-i} + g_i)$$

Taking the FOC, the individual sets $\mathbf{g_i}$ such that

1/G=1 → G=1 → g_i=1/n for an equal (symmetric) provision

Private (under?) Provision - An Algebraic Example cont.

Suppose all individuals were contributing 1, as in Pareto optimum.

At this point my marginal benefit from G (from contributing) is **1/N** which is less than 1 (i.e. less than from own consumption) so I would reduce my contribution.

Hence all individuals setting $\mathbf{g_i=1}$ i.e. **(G=N) cannot be a Nash equilibrium**.

In fact, the only symmetric NE (check it) is for all to contribute $\mathbf{g_i=1/N}$. Observe that this is **Pareto inferior** to the optimal provision.

Homework: Check also a Nash equilibrium cannot yield G=0.

In general, private firms will not (optimally) provide a pure public good (nor a club good)

Why would a consumer pay a positive price if he could “wait” for someone else to buy it and get it for free?

Because of non-rivalry “marginal” cost doesn’t make sense here - it essentially involves a single fixed cost and zero marginal cost.

Even if exclusion was possible and the firm *did* charge a positive price, any positive price leads to underconsumption and a loss of consumer surplus (see fig 4.6 in C&M).

→ This is an argument for the government to subsidise art, music, research, software etc (but there are difficulties with this, as we will discuss later).

Experimental Evidence:
The Free Rider Problem in Public Goods Provision

What does a (typical, “modal”) public goods experiment look like?

Four male undergraduates from a sociology course are brought to a room and seated at a table. They are each giv

They are then told th $5 in a group project.

In particular each wi mount between $0 and $5 in an envelope

The experimenter w the amount and then divide this money among oods in this case is one half of the total contrib up project.

No one except the experimenter knows others contributions, but all know the total...

Consider

That experiment is an “induced values” public goods experiment. There were no *inherently* public goods in the above, but monetary payments were set up so that the incentive to contribute are “like” a public good.

Remember, each person’s contribution of $1 yielded him :

$1 × [match rate] / [number of participants] = $1×2 / 4 = $0.5.

Class question: What do you think people did? What would be Pareto optimal? What is the Nash Equilibrium?

Trying it out

Let us try it out with a “homegrown” public good.

- We each have two sweets, a private good
- Hearing a song on the cornet is a *real* public good (or bad).
- We don’t know people’s value it (we will get to this point later), but let us assume it is a good that is worth more the more notes that are played
- For every sweet contributed, I will play one note of the (modal) favourite song.
- I will try to make contributions anonymous.

What happens in the lab?

Volatility, Importance of Framing

Ledyard summarises 12 design choices in the above experiment that have been the subject of at least one experiment in the literature

The number

The gender

Education of the subjects

Whether they are face to face or acting through computer terminals or in isolated rooms

How much endowment to give to each and in what from (cash, tokens, promises,...)

Whether discussion is allowed in what form

Volatility, Importance of Framing cont.

Whether contributions are private or public

By how much to increase the total contribution.

How to divide up the larger pie (for example in proportion to contribution or to number)

Whether or when to announce the results

Whether to pay subjects publicly or privately

Whether to run the procedure once or multiple times

Volatility, Importance of Framing cont.

Ledyard notes that this gives us a set of experimental choices numbering at least 212 possible designs and that

“In fact, for most of these variables it is possible to find experimental evidence suggesting a positive effect, evidence suggesting no effect, and evidence suggesting a negative effect...”

In one-shot trials and in the initial stages of finitely repeated trials

Subjects generally provide contributions halfway between the Pareto-efficient level and the free riding level

Contributions decline with reputation

Face to face communication improves the rate of contribution

Note: More recent evidence finds that this decline seems to be related to issues of reciprocity, fairness and conditional cooperation. When conditional cooperators are separated (or can self segregate) a higher level of cooperation is maintained.

Government Provision of PG's

David's summary: Pure public goods are not provided optimally by the free market, i.e. voluntarily, except in really special and lucky cases

This is one justification for the role of government: government can enforce contributions to public goods and make everyone better off (or, allowing heterogeneous tastes, achieve a "potential Pareto improvement")

But it is difficult for the government to *determine* tastes for the public good, hence difficult to determine the optimal level

Preference Revelation ("mechanism design")

The "mechanism" is a mapping between people's stated preference and
i. The amount of public good provided
ii. Who pays for it. This is a complex issue

Case 1. No link between payment and stated valuation

Case 2. Payment is determined by stated valuation

In either case (depending on **how** a statement maps into outcomes) people may not have an incentive for truthful revelation. C&M box 4.3 gives a simple example. In general there is no "balance budget" mechanism the government can use to get it perfect.

Examples of Preference Revelation

Suppose a binary decision to provide a PG. Provided if a sum of announced valuations is at least as high as the cost.

Payments: shares proportional to announced valuations
- Can lead to false understatement
- See M&H figure 5.9 but set c=3, v1=v2=2 for a better example

Payments: shares unrelated to announcements
-Can lead to false overstatement (M&H figure 5.10)

False understatement example

(Mechanism: cost shares proportional to reported values)

(Announcements)	$r^2 = 0$	$r^2 = 2$
$r^1 = 0$	$u^1, u^2 = 0,0$	3,0
$r^1 = 2$	0,3	3/2,3/2

$G \in \{0,1\}$ binary decision to provide a public good, which costs C to provide. Player 1 (the row player) gets gross benefit v^1 if the public good is provided, player 2 gets v^2.

Let $v^1 = v^2 = 3$. C=3.

Each player h makes a report r^h, stating their valuation $v^h = 3$, or reporting a lower amount (e.g., a zero value). The good is provided if the sum of announced values meets or exceeds the cost. The cost is shared between the two players, with shares proportional to the announced values.

False overstatement example

(Mechanism: uniform charge for public good if provided)

(Announcements)	$r^2 = 3/4$	$r^2 = 1$
$r^1 = 0$	$u^1, u^2 = 0,0$	-1/2,1/4
$r^1 = 1$	-1/2,1/4	-1/2,1/4

$G \in \{0,1\}$ binary decision to provide a public good, which costs C to provide. Player 1 (the row player) gets gross benefit v^1 if the public good is provided, player 2 gets v^2.

Let $v^1=0$, $v^2=3/4$. C=1.

Each player h makes a report r^h, stating their valuation v^h , or reporting a higher amount (e.g., a value of 1). The good is provided if the sum of announced values meets or exceeds the cost. The cost is shared between the two players, with shares proportional to the announced values.

Mechanisms

Voting will not always lead to efficient provision, as “median voter’s” interest need not coincide with public interest

Lindahl mechanism (M&H 5.6) Assign shares of cost, ask how much each individual wants...adjust until these quantities agree
- Depends on lack of strategic manipulation “my scheme will only work for honest men”

Clarke Tax

(C&M pp 68-69, M&H 5.7.3)

Consider the provision of a public good with a **particular cost** and an **initial allocation of costs** among individuals (if the good is to be produced)

Each individual states a *net* value s_i good produced if sum(s_i)>=0 [FIX] "net value" is meant to indicate my personal benefit from the good minus the cost I will be asked to bear

Any **"pivotal" (deciding vote) agent pays a "Clarke tax"** equal to the absolute value of the sum of the stated net values (of the chosen outcome) of the other agents

A player is pivotal if her stated value changes the outcome (to providing or not providing); had she not been involved the decision would have been the opposite

This "sum of values" is the sum of positive values (those who gain more from the PG then their cost share) and negative values (those who gain less than their cost share)

Clark Tax

With this mechanism, truth telling is a Nash Equilibrium
(under certain conditions)

Intuition: If I am not pivotal, my statement doesn't matter to outcomes, hence I don't affect others. Hence I "might as well" be honest (I am indifferent, the only reason to misreport would be to change the outcome)

If I am pivotal I will internalise the cost I impose on others. I will only be willing to cover these real costs if my true value exceeds them
- Note that this Nash Equilibrium is not "strict" because of indifference
- Nice example on pp. 68-69 of C&M (box 4.3 & 4.4)

But...

A Clarke tax mechanism...

Is not “balanced-budget” the payments required may be that the cost of the good, but if the surplus is shared or devoted to another something else this could wreck the incentives for truth telling

The Clarke taxes must be thrown away (or given to an external party) --> wasted resources (to the group)

Is administratively costly, and asks for a lot of understanding from the participants

...doesn’t seem feasible with a large population
- (Also could be thwarted by an organised “coalition”)
- (Also requires that preferences cannot depend on income)

Clarke Tax Example

http://decisions.epfl.ch/MarketDesign/GrovesClarkExample.pdf

In this example there are 4 possible levels of provision (0-3 street lights) the individual's report their net valuations for each of these, and the one with the highest sum of net valuations is provided

Here "pivotal" means the individual changes the decision (relative to the decision without her). If she is pivotal she pays the sum of the others the net valuations of the chose decision relative

...easier to see this in a numerical example

Last weeks' questions

C&M exercises: 15.2, 15.4 (based on recent recent statistics), 17.1 (explain in context of poverty trap), 17.3 (give arguments in both directions). Also 13.5.

Q 15.2

A relative poverty measure is a particular measure of the degree of income inequality. For example, the "proportion below 50% of the mean income" will be unaffected by a doubling of everyone's income, but will rise if income is redistributed from people at (e.g.) 51% of the mean income to people at 110% of the mean income.

On the other hand, this measure is not sensitive to some changes that would effect the Gini coefficient. For example, a redistribution between two people below this poverty line will not change such a poverty measure.

- Other relative poverty measures such as Rowntree poverty line measures of the level of income necessary to participate in a society are more indirectly related to inequality. For example, if participation is based on relative expenditure (e.g., one needs to have clothing at least as nice as the average person in order to speak in public) then an increase in inequality could also increase such a measure of poverty, even if the increase in inequality came only from increased incomes at the upper end. [there is a lot more to say on this]

Q 15.4

How does the incidence of Poverty in Britain compare with other OECD countries?

The OECD statistics from 2008 (see lecture notes) suggest that the UK is in the "middle of the pack" (or better) with less poverty (based on the relative measure 'proportion with less than half-average incomes) than the US, Japan, and many other countries, but more poverty than Sweden, Denmark, France, and some other countries.

This suggests that with a measure based on proportion with below 50% of average OECD (or EU) income, the UK would be doing even better. On the other hand, there may be other measures by which the UK is lagging, perhaps in child poverty.

Q 17.1

"Outline the argument behind the paradox that whilst means-tested benefits are targeted to those most in need, universal benefits may be more effective at alleviating poverty" (explain in context of poverty trap)

Means-tested benefits are given based on present income, hence can be given towards those who are poorer. However, considering the labour-leisure tradeoff, they can lead to disincentives to work – if the benefits disappear to "sharply" as gross income increases, some people can be in a situation that the more they work, the less they take home in net – this is essentially what is called a "poverty trap." There may be some households who would choose to work more hours if they could keep (more of) their benefits, but otherwise will choose to work fewer hours. If benefits could be given on a "contingent" basis instead (e.g., to single mothers or those from poor backgrounds), this might lead to fewer such "perverse" incentives. And to take a somewhat paternalistic perspective, we could argue that it is important to encourage the poor to work to foster good habits and a connection with the professional world, which could lead to greater advancement.

Q 17.3

To what extent does a minimum wage hurt those it aims to help?

The standard argument is that it under perfect competition it creates unemployment and inefficiency, merely shutting the low-skilled out of the market. This will increase poverty and perhaps inequality as well. (A questionable side argument is that the poor often are consumers of the goods produced at low wages, so this could cause them to have less purchasing power).

But with *monopsony power* (e.g., a single employer and many independent workers) a price floor can *improve* efficiency. [depict on board] At a higher wage more people are willing to work. And even if employment is unchanged this should lead to lower inequality.

(monopsony power)

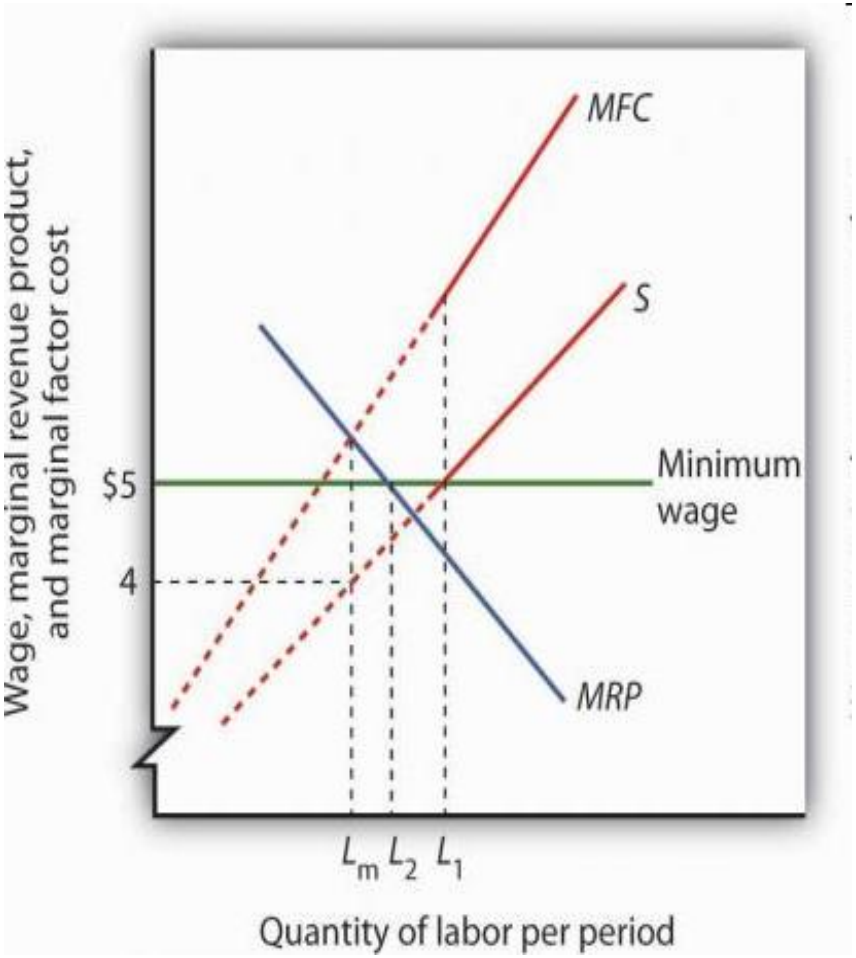
MRP is the Marginal Revenue Product.

S is the elastic supply of labour.

MFC is marginal factor cost – this includes both the wage paid and the increment to previous wages needed to hire another unit of labour.

Without a minimum wage the monopsony firm sets MFC=MRP at level Lm yielding wage =$4 (on the supply curve.

With the minimum wage the monopsony firm sets MRP=minimum wage = $5 and hires L2 in labour. The deadweight loss of monopsony is also reduced.



The evidence on the unemployment consequences of the minimum wage is mixed, and economists disagree vehemently. Perhaps the most notable recent paper is that of Card and Kreuger (1993), which ran a "difference in difference" regression of changes in 410 fast food stores in New Jersey and Pennsylvania (USA), after an increase in the minimum wage in the former. They noted no relative loss of employment in New Jersey, and in particular "stores that had to increase their wages increased their employment. But other economists have questioned these findings, and the battle goes on.

The minimum wage is a blunt tool: it may help low-wage workers in some sectors, but hurt in others, especially those that can switch to cheaper labour markets. A targeted minimum wage (by industry, experience, region, etc) may be more helpful. Furthermore a concerted international effort might be necessary to raise some types of wages.

Q 13.5

What is the poverty trap? How does this differ from an unemployment trap?

[See notes; be able to give a graph]… the main point of these traps is that as one works more, net income after benefits decreases, so no one who values leisure would choose to work "in certain regions." The difference between the two traps is that for the latter, the decrease in income occurs when one gets a job at all, i.e., for the first hour of work, while for the latter, the disincentive occurs at some low level(s) of income.

New "homework"

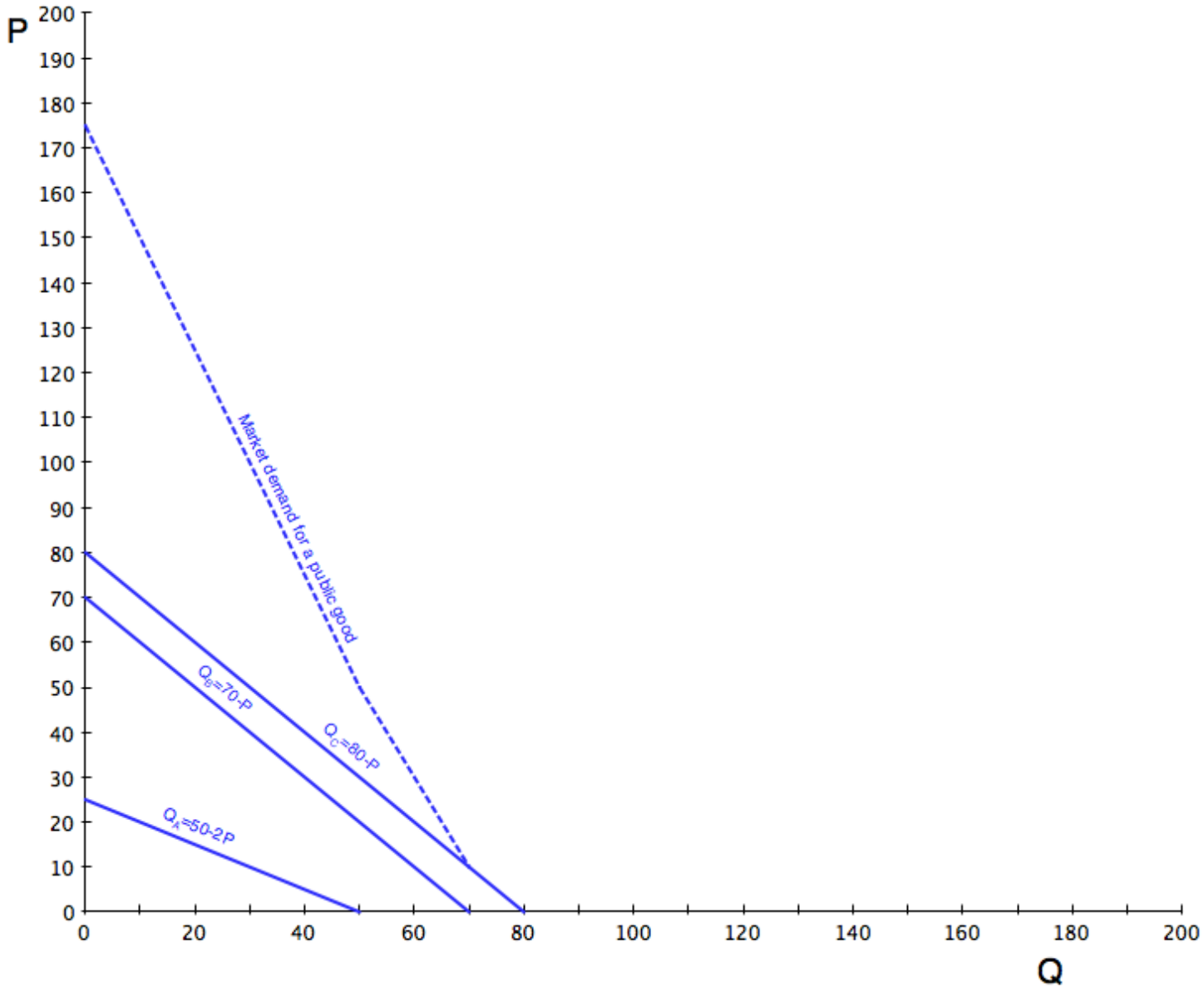
Exercises:

C&M, ch. 4 Q1 (give arguments), ch. 4, q3.

Also Consider a case as in "an algebraic example", but let $U_i = c+(G_{-i} + g_i)$.

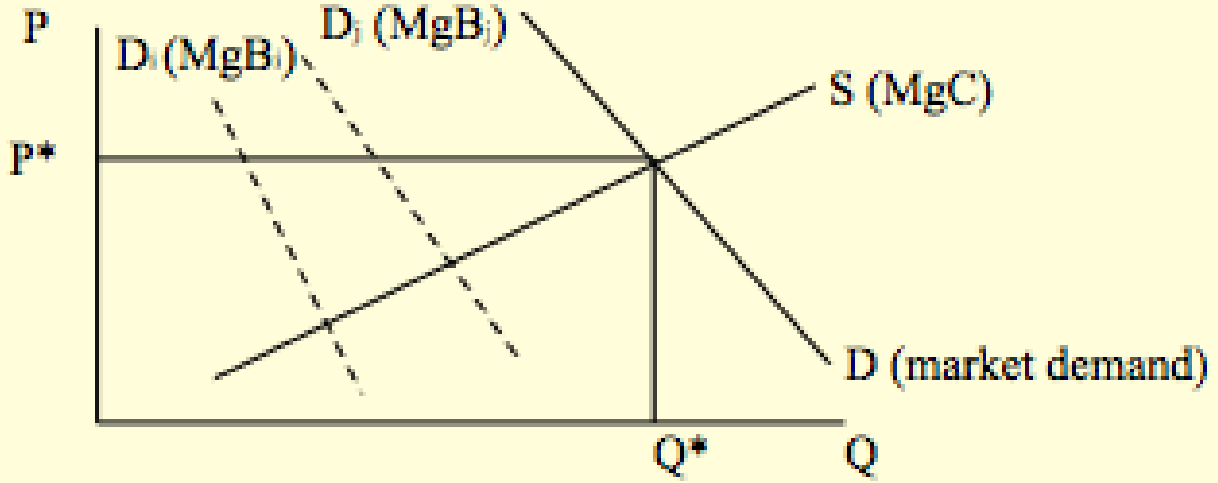
{note, this is tricky}

What will be the socially optimal level of the public good provided (hint: it need not be an interior solution)? What is the Nash Equilibrium outcome? Show that the latter is Pareto-inefficient.


P
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
160
180
200
Q
Market demand for a public good
Q_B=70-P
Q_C=80-P
Q_A=50-2P

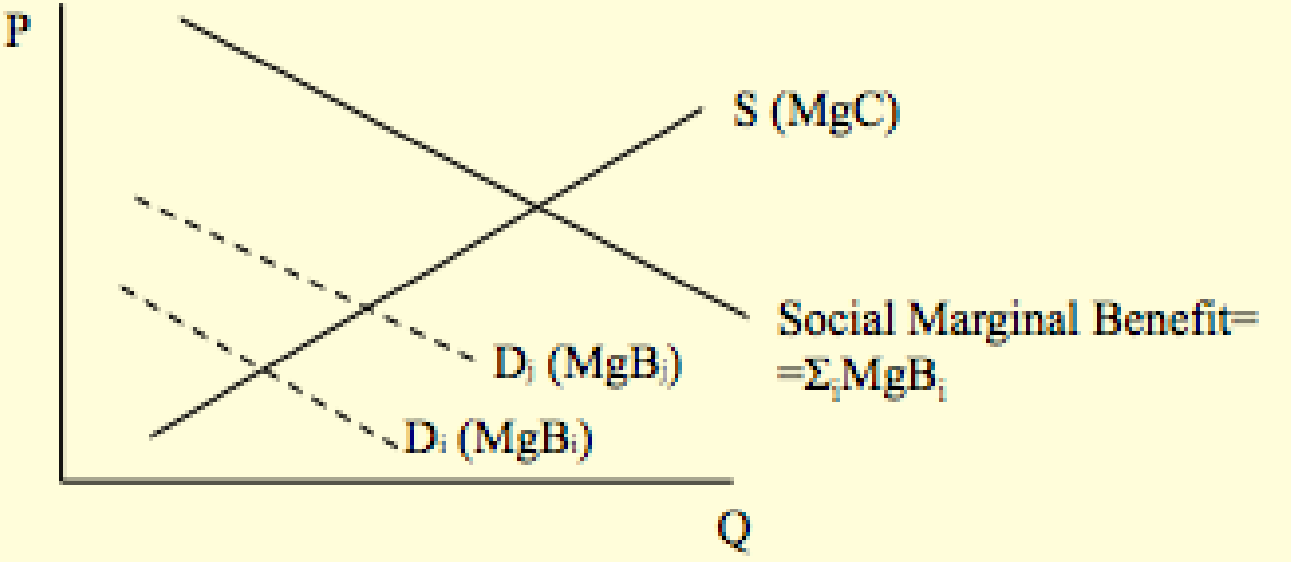
How to determine the social marginal benefit of a good?

In the case of a *private good* we just add up individual market demands *horizontally*.



At the optimum: MgBi=MgBj=Price=MgC.

For a *public good* we add individual demands *vertically* to obtain the social marginal benefit of the good (since each unit of the good can be simultaneously consumed by everyone).



At the optimum: $\Sigma_i MgB_i = MgC$