LECTURE 3

I. DEFINITION OF PUBLIC GOODS

Property 1 - non-excludable
Property 2 - non-rival
examples

II. EFFICIENCY CONDITIONS FOR PUBLIC GOODS

A. How much of a public good should be provided?
- Add up MRS across people

Example 1, public goods
Example 2, public goods

B. Why is government intervention needed?
1. Free rider problem
2. No "invisible hand"
3. Since the good is non-rival, should allocate costs to ANYONE who benefits from it

Readings: Rosen, chapter 4

You may want to review the following problems for this section:

Midterms
Spring 1995, Question 1
Fall 1995, Question 2
Winter 1996, Question 4
Spring 1996, Question 2
Winter 1998, Question 2
Spring 1999-1, Question 1
Spring 1999-2, Question 1
Fall 1999-1, Question 1
Fall 1999-2, Question 1

Finals
Fall 1995, Question 1
Winter 1996, Question 1
Spring 1996, Question 1

Fall 1997, Question 3
Winter 1998, Question 2
Fall 1999-1, Question 2
Fall 1999-2, Question 2b

I. PUBLIC GOODS

Public goods have two important properties that differ them from private goods.

Property 1: public goods are non-excludable. If someone wants to consume the good, he or she may.

**Non-excludability means private provision may not reach a pareto efficient allocation. Why?*

1. People may hide their true valuation for the good, since they receive the benefit whether or not they contribute. This is known as the "free rider" problem -- there is little incentive to pay for the good voluntarily.

2. Example: Some people may want to rent a movie to watch on the dorm's VCR, but it is hard to exclude people, and no one volunteers to pay for the movie.

3. How can the government do better? The government can use coercion. It can make people pay for a good.

Property 2: public goods are non-rival in consumption. Once the good is provided, the marginal cost of another person consuming it is zero.

Non-rivalness:

1. Undesirable to exclude anyone: an individual's consumption does not reduce the amount available for others.

2. MC of an additional person versus MC of another unit.

   $MC_{\text{another person}} = 0$
   $MC_{\text{another unit}} > 0$ ... i.e. another police officer costs money.

3. Private good, such as clothing:

$MC_{\text{another person}} > 0$ ... i.e. to clothe two people costs more than one person.

4. Since public goods are non-rival, everyone consumes same Q. But consumption not valued equally by all (i.e. national defense). For private goods in competitive markets, everyone pays the same P, but consumes different Q.

Examples of public goods:
National defense for a nation, police protection for a community, a fireworks display, or house cleaning for a group of roommates.

II. EFFICIENCY CONDITIONS

A. How much of a public good should be provided?

For public goods, the sum of the MRS equal the marginal rate of transformation. The MRS is the slope of the indifference curves, and the MRT is the slope of the production possibilities curve (PPF). That is:

$$\sum_i MRS_i = \frac{P_{PUBLIC}}{P_{PRIVATE}} = MRT$$ for public goods.

The MRS of private goods for public goods tells us how much of the private good each individual is willing to give up to get one more unit of the public good. The sum tells us how much ALL members would be willing to give up to get another unit of the public good. This sum is relevant because public goods are non-rival.

Example
Jerry and George have identical utility functions. They derive utility from the <u>total</u> number of lava lamps in the house, V, and the amount of food that they eat alone, F. Lava lamps, V, are a local public good:

$$U_i(V, F_i) = V^{\frac{1}{3}} F_i^{\frac{2}{3}}$$ for i=Jerry or George

Note: We have changed to using lava lamps instead of clothing because lava lamps are non-rival and non-excludable. Therefore, this is a public goods example.

Note 2: Notice that the utility of each person depends on the total number of lava lamps and on the amount of food consumed individually.

Each has income of \$300, P_V=100, P_F=0.20. Given these prices, 500 units of food can implicitly be converted into 1 lava lamp. We shall therefore assume that the MRT is constant and equal to 500.

(a) *Calculate the optimal quantities if the person lived alone.*

From Cobb-Douglas preferences, this implies that $V = \frac{1}{3}\frac{300}{100} = 1$, $F = \frac{2}{3}\frac{300}{0.20} = 1000$.

(b) *Suppose that Jerry assumed that George would buy no lava lamps, and this turns out to be true. Calculate the quantities and utilities for each person.*

Jerry then acts as if he is the sole provider, and chooses the same allocation as in part (a). U_J=100. George spends all his money on food, $U_G = 1^{\frac{1}{3}}1500^{\frac{2}{3}} = 131$. George has gained from his free rider position.

(c) *Is the allocation in (b) pareto efficient? What is the efficient amount of public goods?*

$$MRS_i = \left(\frac{\partial U_i}{\partial V} \Big/ \frac{\partial U_i}{\partial F_i} \right) = \frac{F_i}{2V}$$

where i=Jerry or George

For the allocation described in (b), MRS_J=500, MRS_G=750. Therefore, Jerry and George combined would sacrifice 1,250 units of food for another lava lamp, but from the prices given, it would only cost them 500 units of food ($500*0.20=F*P_F=100=P_V$). Therefore relying on the decentralized system is inefficient. Efficiency requires:

$$MRS_J + MRS_G = \frac{F_J}{2V} + \frac{F_G}{2V} = \frac{F_J + F_G}{2V} = \frac{P_V}{P_F} = \frac{100}{0.20}.$$

Therefore $F_J+F_G=1000V$

Substitute this into a combined budget constraint for the household: $.20(F_J+F_G)+100V=600$

Which gives $V=2$, $F_J+F_G=2000$. Note that efficiency requires 2 lava lamps, but does not say how much food each would consume.

B. Demand curves for public goods

Efficient provision of a public good requires that the sum of each person's marginal valuation on the last unit just equal the marginal cost. To find the market demand curve for a public good, we add up individual demand curves vertically. This is in contrast to private goods, where we add up demand curves horizontally. Why? <u>Because a public good must be consumed in equal amounts</u>.

Example 2

Two people have the following individual demand curves for defense:

$$Q_1 = 30 - P$$

$$Q_2 = 50 - 2P$$

Rewrite with Q as independent variable:

$P_1 = 30 - Q_1$, thus P_1 is the "willingness to pay" of person 1 for defense

$$P_2 = 25 - \frac{1}{2}Q_2$$

Then, $P = P_1 + P_2$ is society's willingness to pay for defense.

$$P_1 + P_2 = 30 - Q_1 + 25 - \frac{1}{2}Q_2$$

Remember that $Q_1 = Q_2$ because both people consume equal amounts of the public good.

$$P = 55 - \frac{3}{2}Q \qquad \text{for } Q \leq 30$$

$$P = P_2 = 25 - \frac{1}{2}Q \qquad \text{for } Q > 30$$

For example, suppose we want to provide 2 units of defense. Person 1 is willing to pay $28 for the last unit, and person 2 is willing to pay $24, so society is willing to pay $52 for the last unit.

Notice at 30 units, person 1's willingness to pay for additional units is zero. Society's demand is person 2's demand after that quantity.

After finding the demand curve, simply draw in the supply curve to find the equilibrium quantity.

***** SEE FIGURE 3-1, 3-2, 3-3, 3-4 *****

Figure 3-1 (Private Good example)

If this were a private good, how would you get aggregate demand?

Figure 3-3

Find DWL if person 2 provided the good.

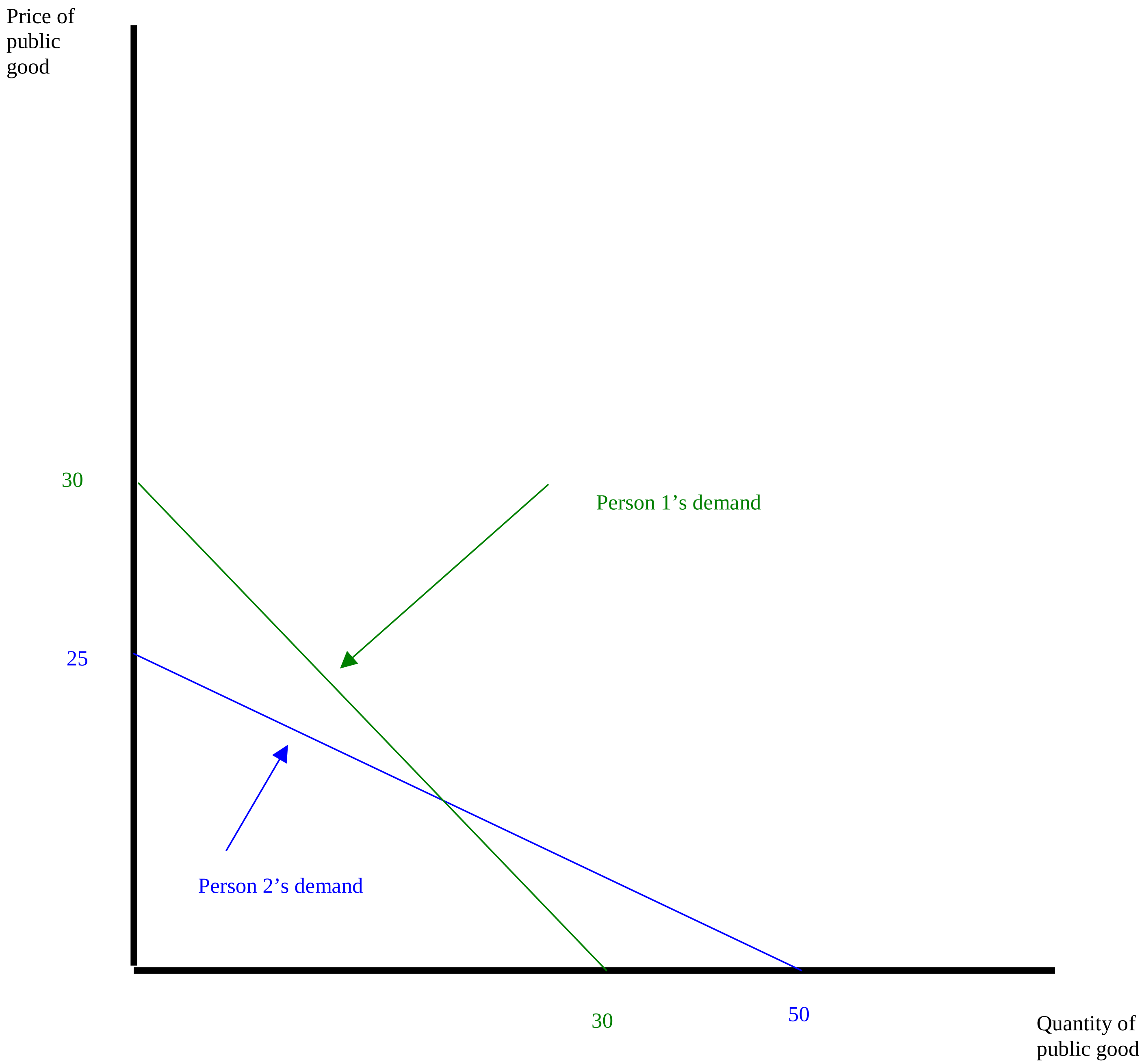
Figure 3-4

Find DWL if person 1 provided the good.

C. Why is government intervention needed?

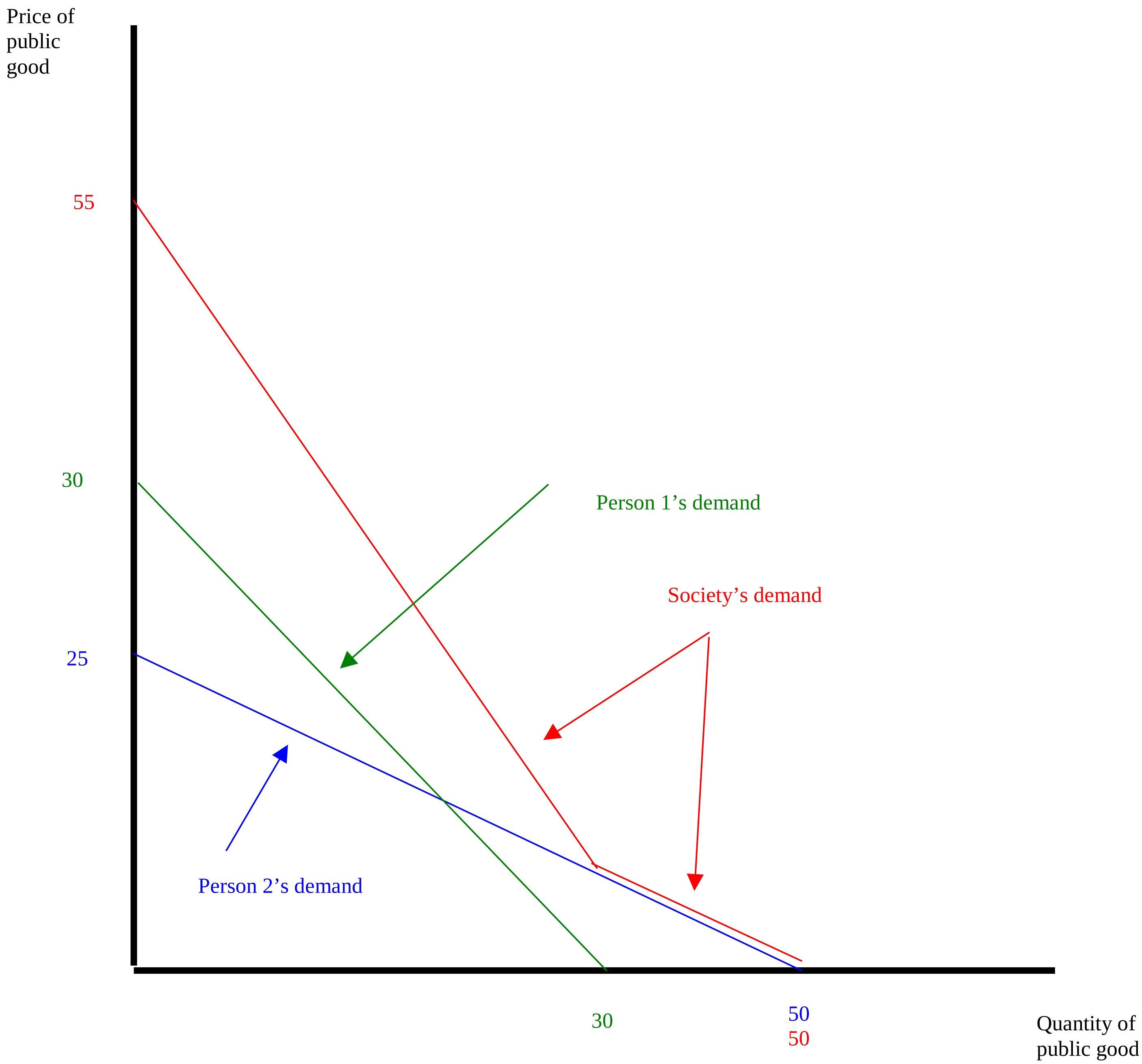
1. Free rider problem -- consumers do not want to reveal high valuations for the public good if they will have to pay according to the valuations. This arises because of non-excludability.
2. No tendency for free markets to reach parieto efficiency. No "invisible hand."
3. Even if excludable, provision still inefficient. Good is non-rival, so anyone who gets benefit from it should consume it.

Lecture 3, Figure 1 – Individual demand curves for public goods



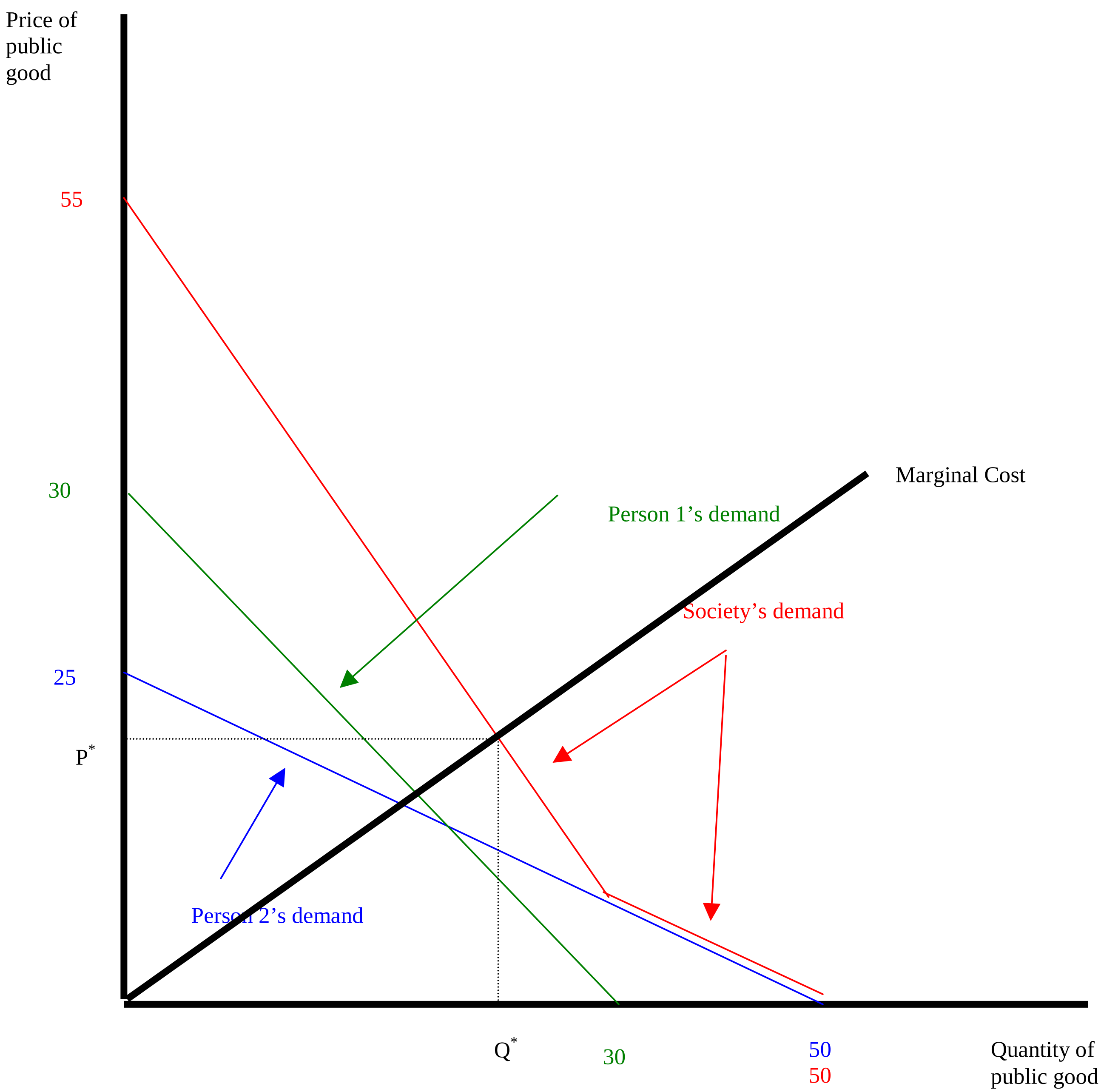
Two individual demand curves for a public good

Lecture 3, Figure 2 – Deriving demand curves for public goods



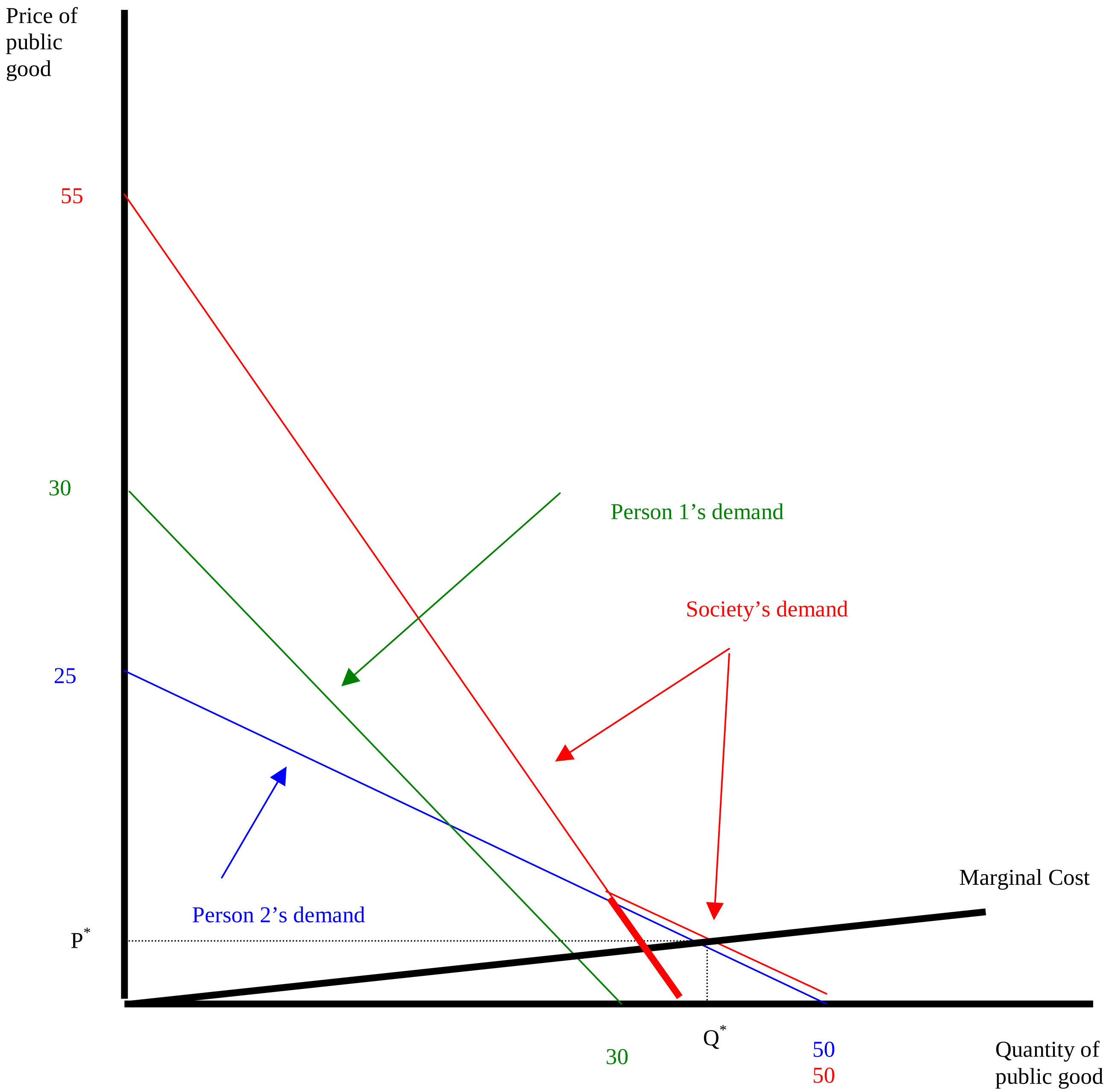
Add the individual demand curves vertically (look at the y-axis)

Lecture 3, Figure 3 – P=MC along first segment (easy case)



Make sure you set P=MC along the correct
t

Lecture 3, Figure 4 – P=MC along second segment (more difficult)



Don't set P=MC along first segment (thick red line)