

Introductory Economics

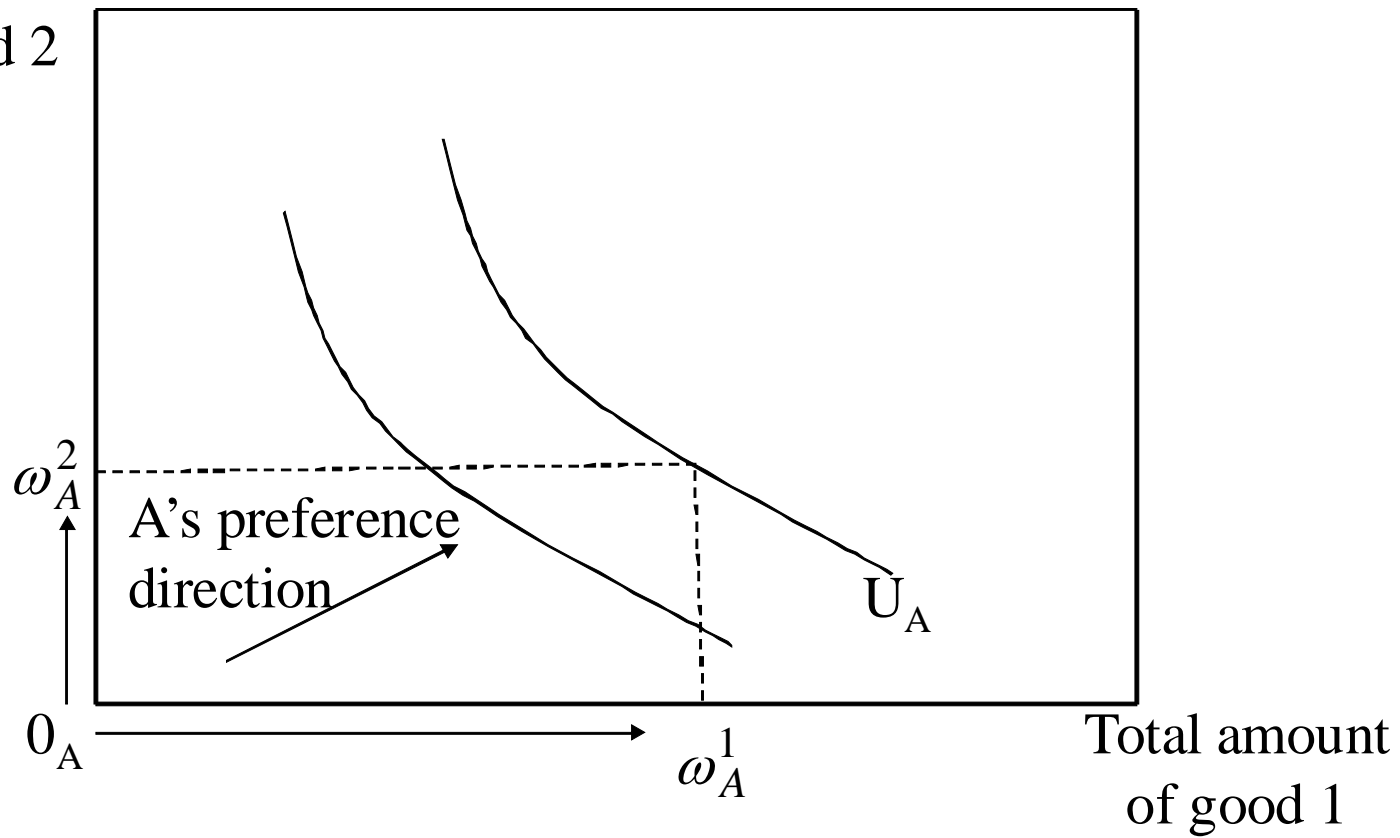
Lectures 19 & 20 - General Competitive Equilibrium and Externalities

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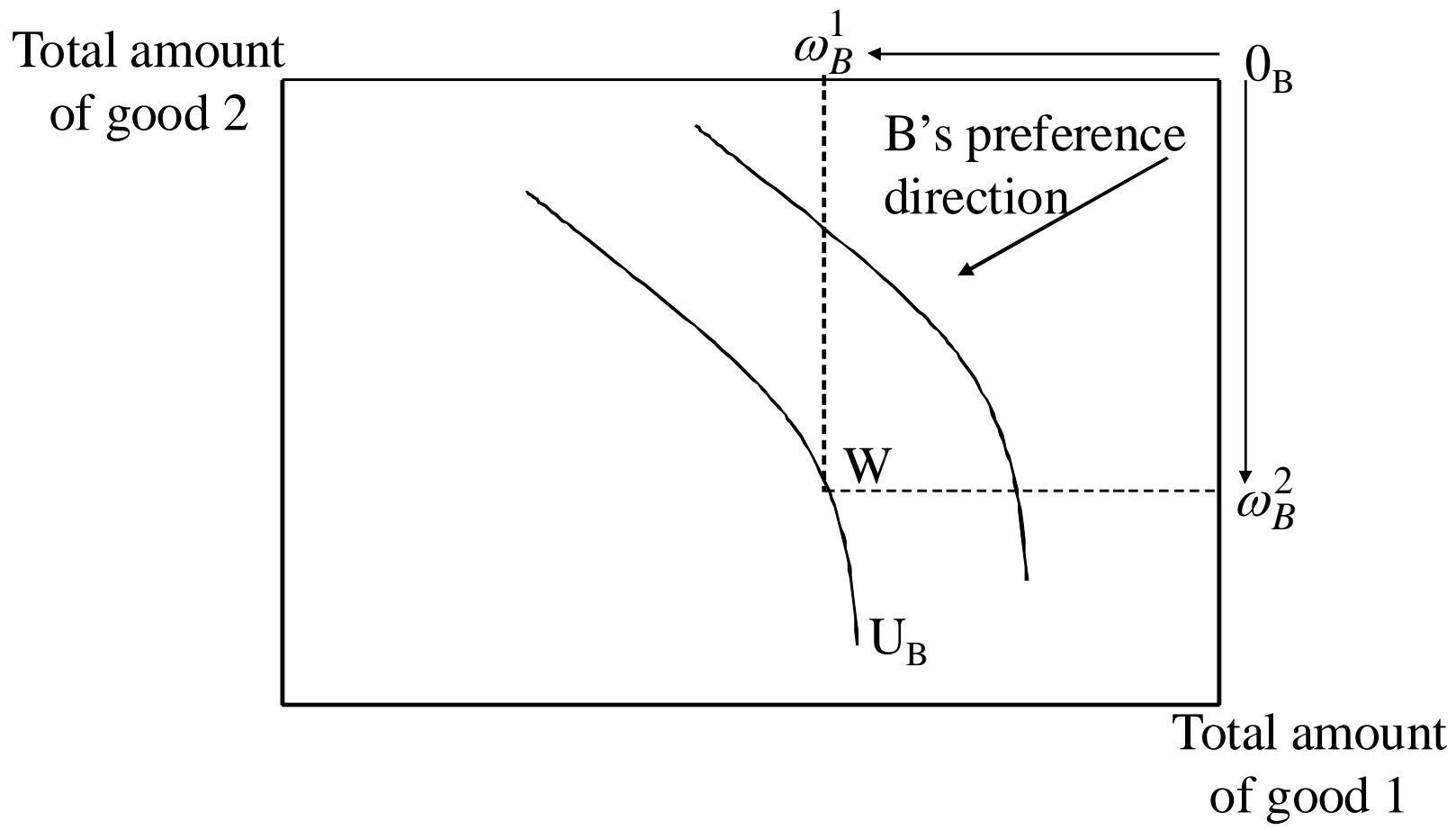
Department of Economics

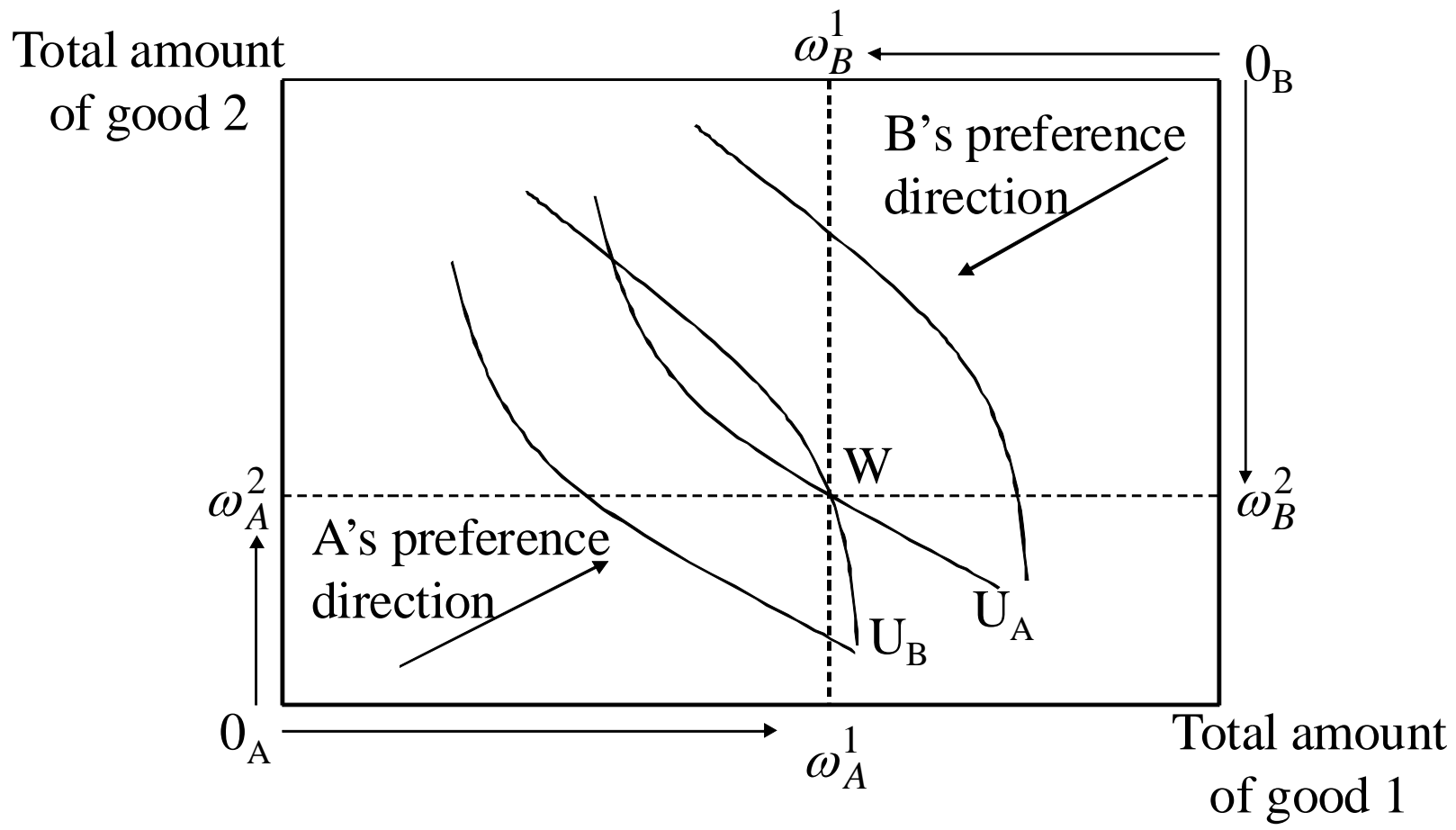
- Suppose we have two people A and B .
- They have endowments of two goods (ω_A^1, ω_A^2) and (ω_B^1, ω_B^2)
- Their consumption bundles are (x_A^1, x_A^2) and (x_B^1, x_B^2)
- A pair of consumption bundles is called a **feasible allocation** if total consumption equals total endowment (total demand equals the total supply) of each good.

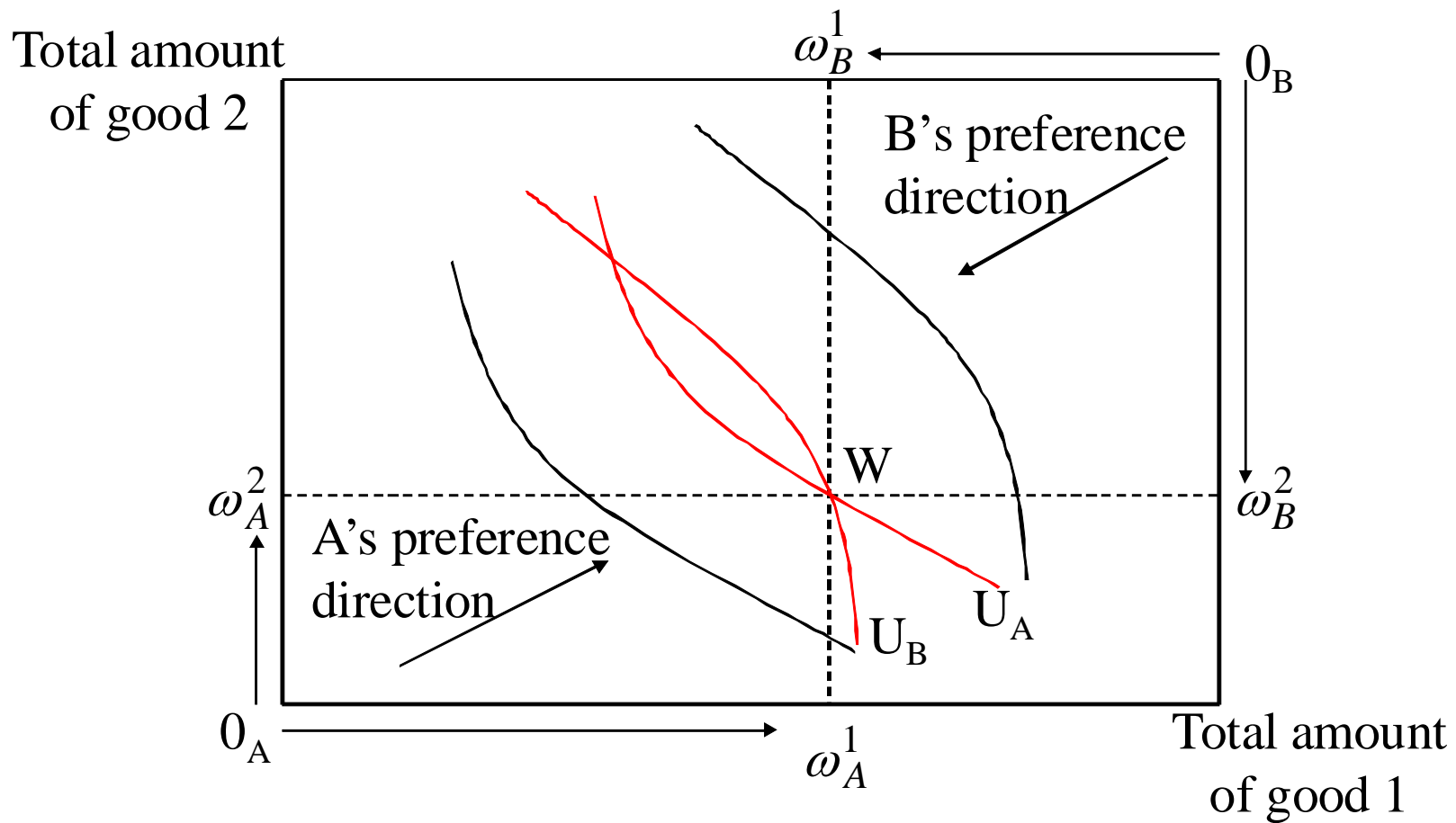
Total amount
of good 2

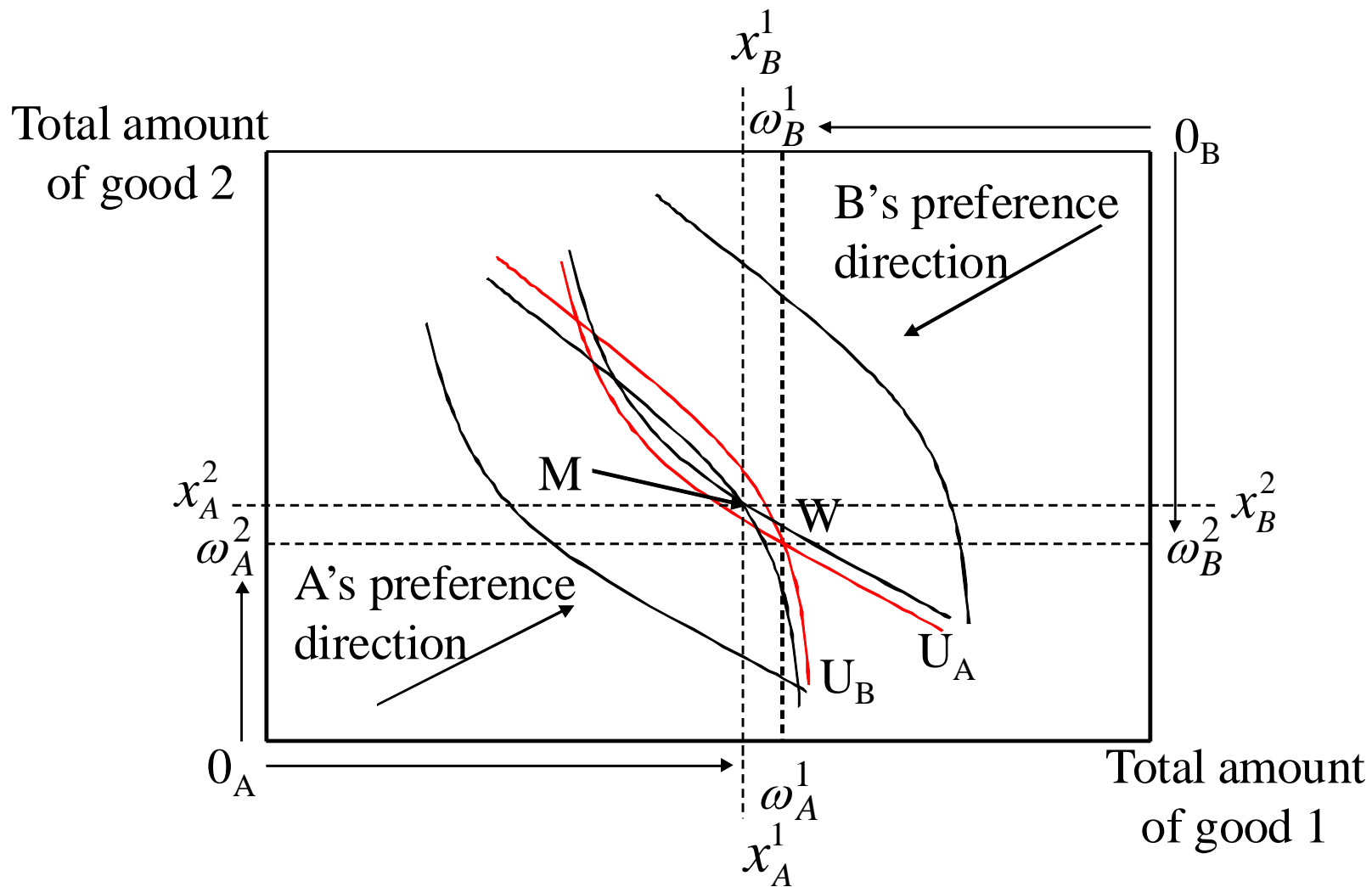


Total amount
of good 1

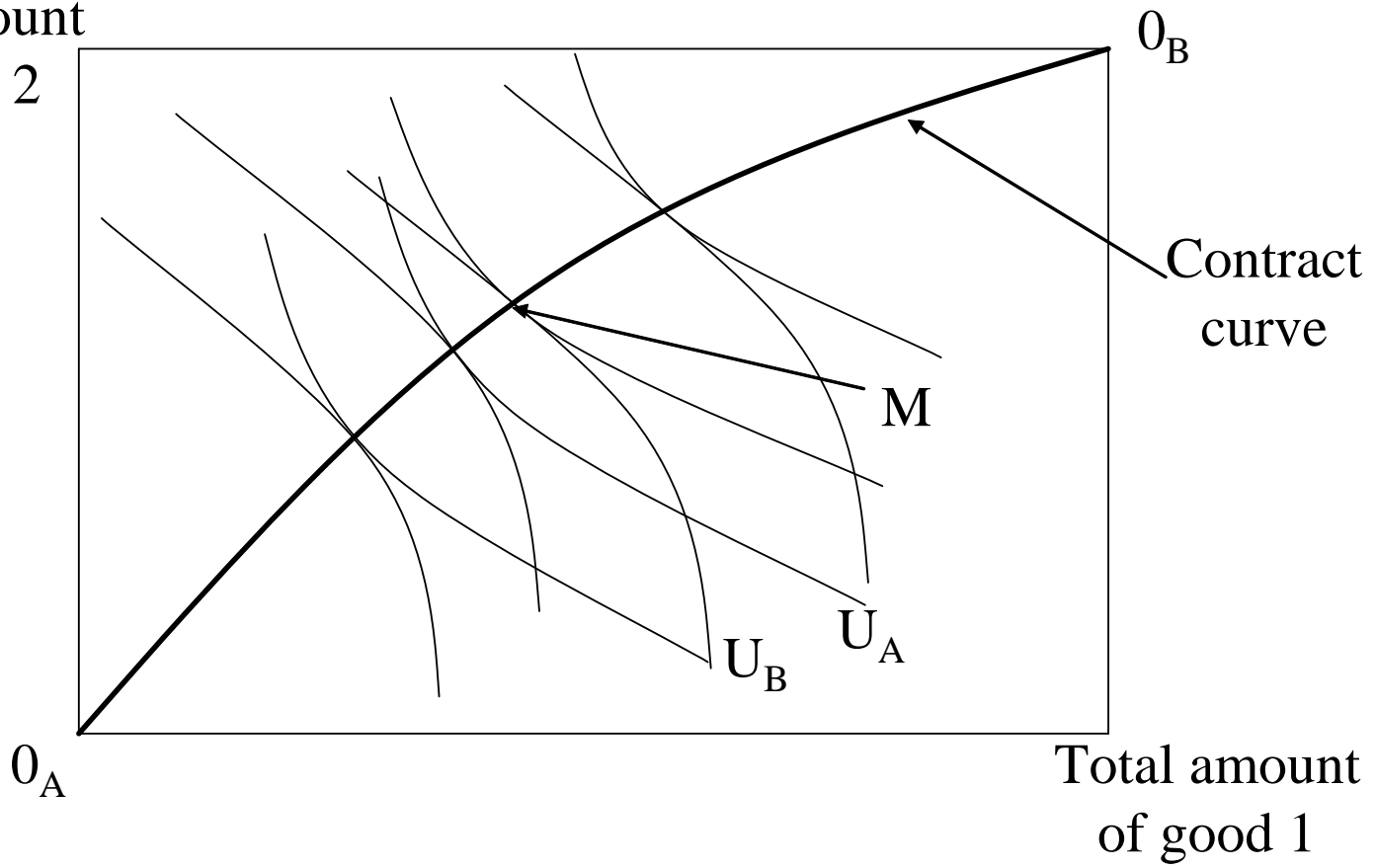








Total amount
of good 2



Contract
curve

M

U_B

U_A

Total amount
of good 1

- Points on the contract curve/Pareto set are characterised by the following conditions

1. They are feasible allocations

$$\begin{aligned}x_A^1 + x_B^1 &= \omega_A^1 + \omega_B^1 \\x_A^2 + x_B^2 &= \omega_A^2 + \omega_B^2\end{aligned}$$

2. The two parties's MRS's are equalised

$$MRS_{2,1}^A = MRS_{2,1}^B$$

- Imagine $MRS_{2,1}^A = -\frac{1}{4}$ and $MRS_{2,1}^B = -\frac{1}{2}$
- We could take 1 unit of good 2 off B and give it to A .
 - A would be better off and B would be worse off.
- We could then take away 4 units of good 1 from A
 - that would put him back at his original welfare level.
- But we only need to transfer across 2 of those units to B to compensate her.

If consumers start with an allocation off the contract curve

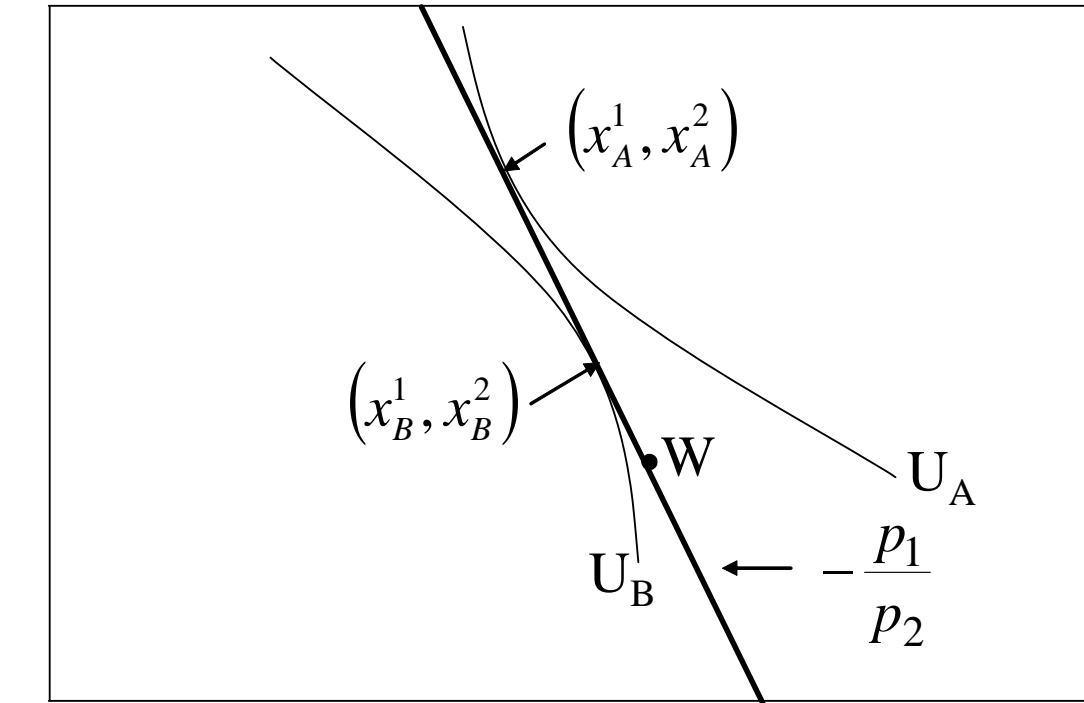
1. there is a clear incentive to trade

2. they will trade and move into the lens shaped area where gains are possible and locate somewhere on the contract curve within the lens-shaped area defined by
 - (a) their initial endowments and
 - (b) their indifference curves which pass through their initial endowments.

But more than that we cannot say - unless we introduce prices.

Good 2

O_B



(x_A^1, x_A^2)

(x_B^1, x_B^2)

W

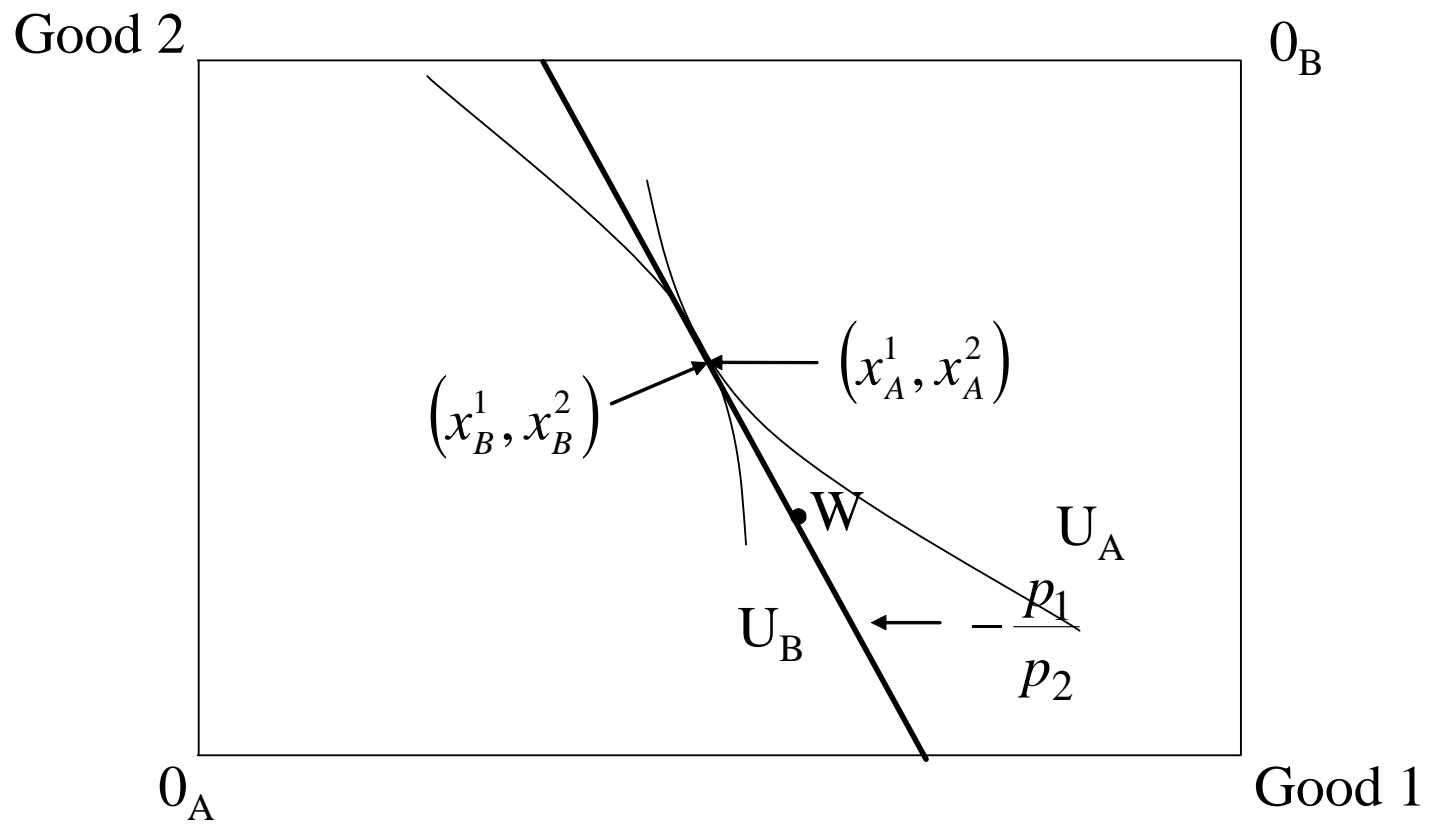
U_A

U_B

$-\frac{p_1}{p_2}$

O_A

Good 1



Some definitions

Allocation: a set of individuals' consumption bundles

Feasible Allocation: an allocation in which aggregate consumption (demand) equals aggregate endowment (supply) for each good

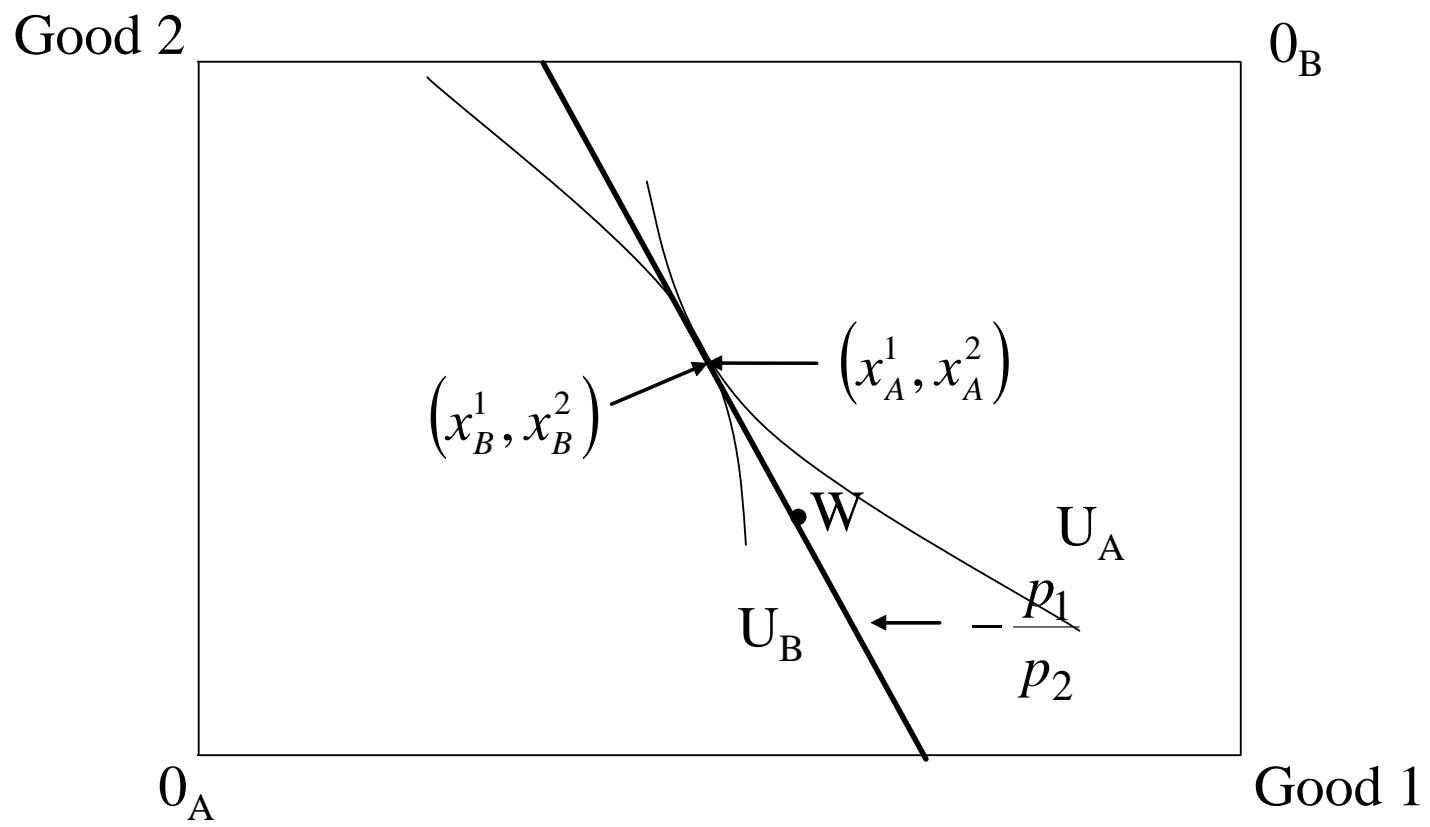
Pareto efficient allocation: a feasible allocation in which the gains to trade have been exhausted - all consumers are optimising.

Contract curve/Pareto set: the set of all Pareto efficient allocations

Walrasian/Competitive/Market Equilibrium: a set of prices and consequent feasible allocation such that all consumers are optimising.

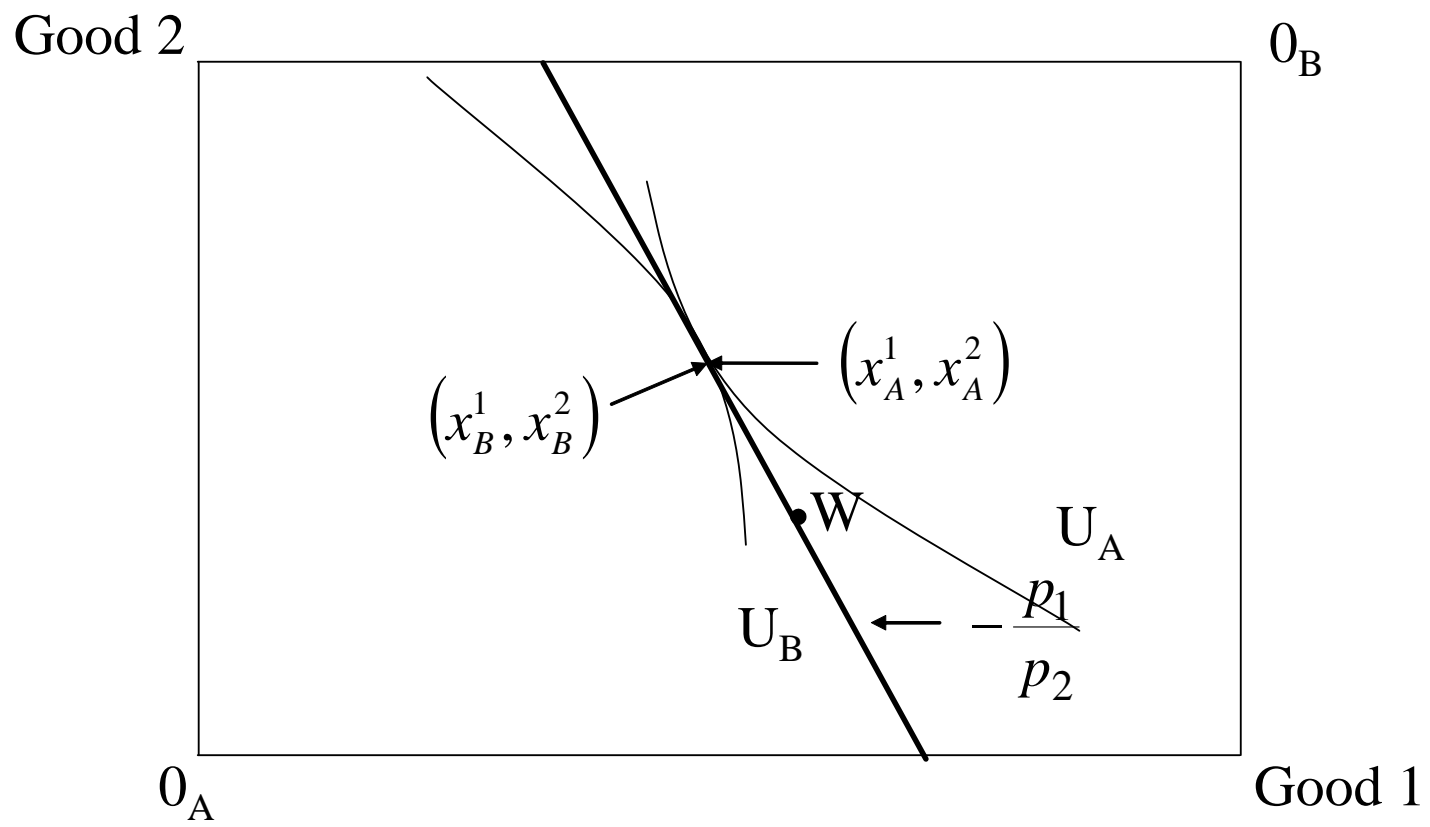
First Theorem of Welfare Economics
All competitive equilibria are Pareto efficient

“Every individual [...] intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention.” Adam Smith, *The Wealth of Nations*, Book IV Chapter II



Second Theorem of Welfare Economics

Given well-behaved preferences, there always exist a set of prices such that each Pareto efficient allocation can be achieved as a competitive equilibrium.



The Welfare Theorems - A Guide to Policy?

- Some people take the Welfare Theorems as policy prescriptions emphasizing the 1st or 2nd Theorem according to taste.
- Others view them simply as more-or-less interesting benchmarks.
- Others view their message as essentially cautionary.

Assumptions Required for the 1st Theorem

1. Self interest - agents don't care about what others consume
2. Complete set of markets - No missing markets, for present or future goods
3. Agents actually behave competitively - No monopoly power
4. Full information - No asymmetries.

What's So Great About Pareto Efficiency Anyway?

- Pareto Efficiency means that nothing is left on the table - all gains are exploited.
- It implies that you can't make anyone better off without making someone else worse off.
- But at best it's a necessary (but not sufficient) condition for a decent society

“The Impossibility of a Paretian Liberal” Amartya Sen

- We’re going to look a situation where there are two people, and three alternatives. The issue at stake is who gets to read *Lady Chatterly’s Lover**
- Consider the two people: a “Prude” and a “Lewd”

P— the Prude reads it.

L— the Lewd reads it

0— no one reads it

*By D. H. Lawrence, first published (in Italy) in 1928. It could not be published openly in the United Kingdom until 1960. When it was the publishers were prosecuted under the Obscene Publications Act of 1959. The act (introduced by Roy Jenkins former Chancellor of Oxford University) had made it possible for publishers to escape conviction if they could show that a work was of literary merit.

“The Impossibility of a Paretian Liberal” Amartya Sen

- The Prude ranks the alternatives[†]

$$0 \succ P \succ L$$

- The Lewd ranks the alternatives[‡]

$$P \succ L \succ 0$$

- Therefore $P \succ L$ is the Paretian ranking of $\{P, L\}$: moving from L to P would make them both better off

[†]Prudes prefer to be censors rather than the censored. Chief prosecutor, Mervyn Griffith-Jones, famously asked at the trial if it were the kind of book "you would wish your wife or servants to read".

[‡]This guy needs to loosen up. It will do him good.

“The Impossibility of a Paretian Liberal” Amartya Sen

- Consider the choice between $\{P, 0\}$: someone with liberal values should say that the Prude’s views should count (he thinks that $0 \succ P$ he should not be forced to read it).
- Consider the choice between $\{L, 0\}$: someone with liberal values should say that the Lewd’s views should count (he thinks $L \succ 0$ then he should be able to read it if he wants).
- So a liberal society should rank the alternatives

$$L \succ 0 \succ P$$

The Lewd \succ No one \succ the Prude

“The Impossibility of a Paretian Liberal” Amartya Sen

- But the liberal ranking $L \succ 0 \succ P$ has $L \succ P$ and the Lewd reading the book
- This is Pareto inefficient (the Pareto ranking was $P \succ L$).
- Hence the Pareto principle can conflict with very weak liberal principles. So is the Pareto principle really so compelling?

Summary

- Given the necessary conditions on agents' preferences and the economic environment we have the two *Welfare Theorems*:

1st : All Competitive Equilibria are Pareto Efficient

2nd: All Pareto Efficient allocations can be achieved as Competitive Equilibria

- But ...the assumptions underlying these Theorems are incredible and the notion of Pareto Efficiency is not a sufficient condition for a good society (it is blind to distribution) and is not, in any case, unassailable (it conflicts with weak liberalism for example).

Social Welfare - picking a point on the contract curve

- Suppose we are on the contract curve. How should we decide where we should locate?
- What if "society" has well-behaved preferences over the distribution of resources then, as economists, we're on home turf.
- We give society a utility function and call it a *social welfare function*.

Social Welfare - picking a point on the contract curve

- Suppose we have 2 goods $\{1, 2\}$ and 2 people $\{A, B\}$
 - initial endowments given by $\{\omega_1^A, \omega_2^A, \omega_1^B, \omega_2^B\}$
 - a final allocation given by $\{x_1^A, x_2^A, x_1^B, x_2^B\}$
 - preferences given by $u^A(x_1^A, x_2^A)$ and $u^B(x_1^B, x_2^B)$

Social Welfare - picking a point on the contract curve

- The social welfare function is just like a utility function but it depends on the (cardinal) welfare of individuals.
- In our two person society social welfare is represented by:

$$W(u^A, u^B)$$

- This reflects a *consequentialist* moral view (the precise functional form of W embodies ethical special cases).

Social Welfare - picking a point on the contract curve

- Take a *utilitarian* social welfare function

$$W = u^A + u^B$$

- The problem is to find an allocation $\{x_1^A, x_2^A, x_1^B, x_2^B\}$ is feasible and maximises social welfare (this will ensure a Pareto Efficient allocation too).

Social Welfare - picking a point on the contract curve

$$\max_{x_1^A, x_2^A, x_1^B, x_2^B} u^A(x_1^A, x_2^A) + u^B(x_1^B, x_2^B)$$

subject to

$$x_1^A + x_1^B = \omega_1^A + \omega_1^B \quad \text{and} \quad x_2^A + x_2^B = \omega_2^A + \omega_2^B$$

Social Welfare - picking a point on the contract curve

1. Form the Lagrangian

$$\mathcal{L} = u^A(x_1^A, x_2^A) + u^B(x_1^B, x_2^B) - \lambda_1 [x_1^A + x_1^B - \omega_1^A - \omega_1^B] - \lambda_2 [x_2^A + x_2^B - \omega_2^A - \omega_2^B]$$

Social Welfare - picking a point on the contract curve

2. FOC's

$$\mathcal{L}_{x_1^A} = u_1^A - \lambda_1 = 0$$

$$\mathcal{L}_{x_2^A} = u_2^A - \lambda_2 = 0$$

$$\mathcal{L}_{x_1^B} = u_1^B - \lambda_1 = 0$$

$$\mathcal{L}_{x_2^B} = u_2^B - \lambda_2 = 0$$

Social Welfare - picking a point on the contract curve

3. Work out the implications:

$$\begin{aligned}u_1^A &= u_1^B = \lambda_1 \\u_2^A &= u_2^B = \lambda_2\end{aligned}$$

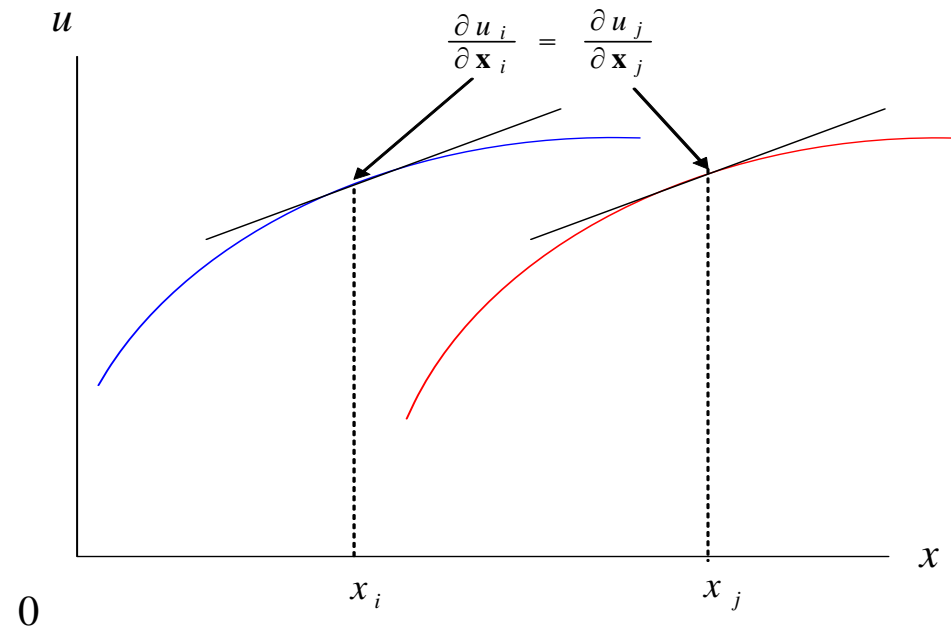
$$MRS_{2,1}^A = MRS_{2,1}^B = \frac{\lambda_1}{\lambda_2}$$

or, in other words you should allocate resources such that each agents' marginal utilities and hence their MRS's are equalised.

Social Welfare - picking a point on the contract curve

- Maximising a Benthamite utilitarian notion of social welfare only gives you an equal distribution of *stuff* iff people have the same preferences.
- We've seen that the general rule for maximising utilitarian social welfare is "equalise marginal utility".
- If people's preferences/utility functions are different (for which there is ample evidence) then this must entail an unequal distribution of "stuff".

Social Welfare - picking a point on the contract curve



In fact, given concave utility it implies you need to give more resources to inefficient utility-producers compared to efficient utility-producers. This is known as the *Champagne Tastes problem*.

Externalities

- One of the principal assumptions is that of *self interest* - a person's utility/welfare is independent of other people's consumption.
- In the partial and general equilibrium models we have looked at consumers and firms interact through their effects on prices.
- When the actions of one economic agent affect another other than through the price mechanism we say that there is an *externality*.

Externalities

- In the consumer context if another individual's consumption of a good (or goods) affects that consumer's utility then we say that there is a *consumption externality*.
- If (x_1, y_1) and (x_2, y_2) are the consumption bundles of person 1 and 2 respectively and if person 1's utility function look like this

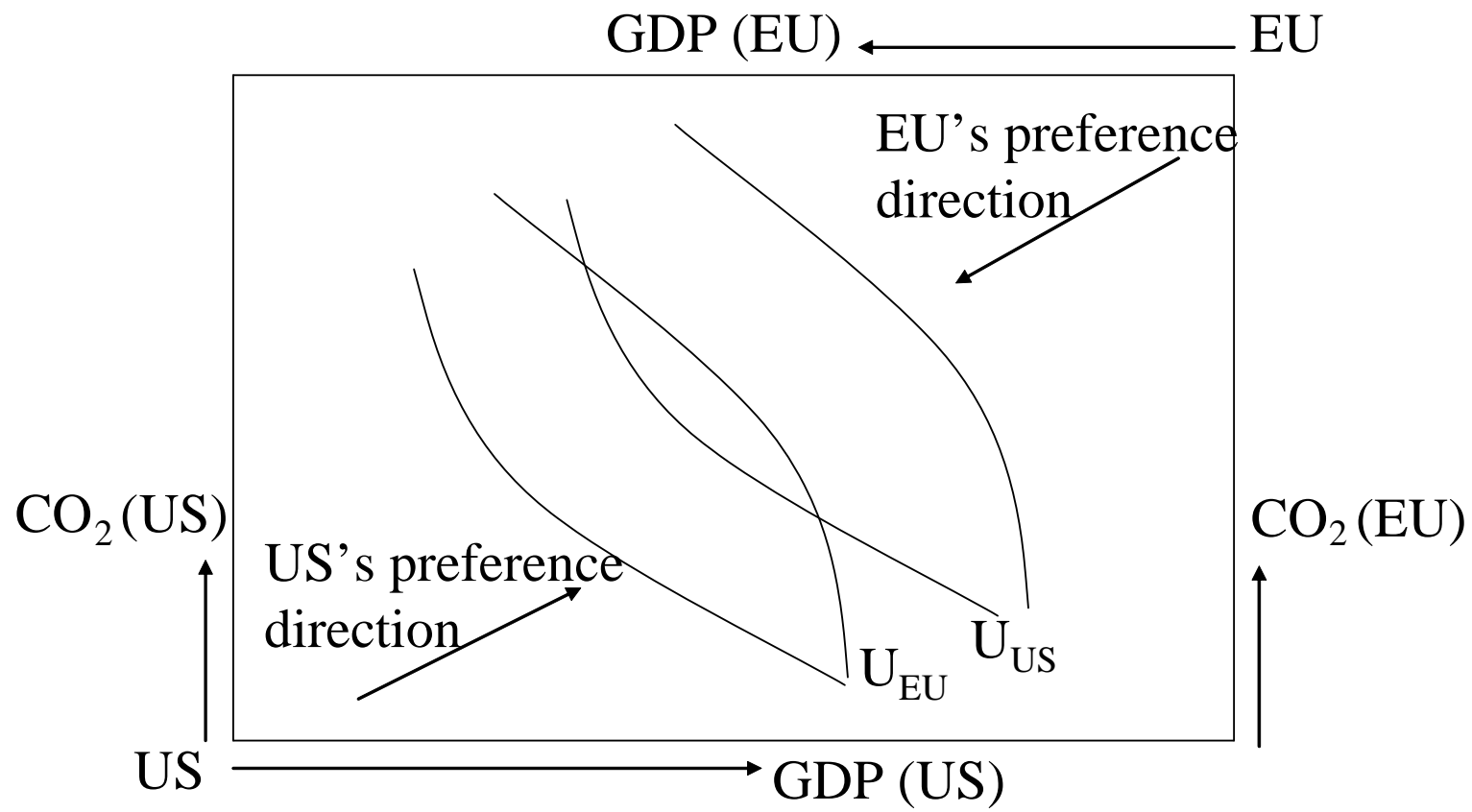
$$u_1(x_1, y_1, x_2)$$

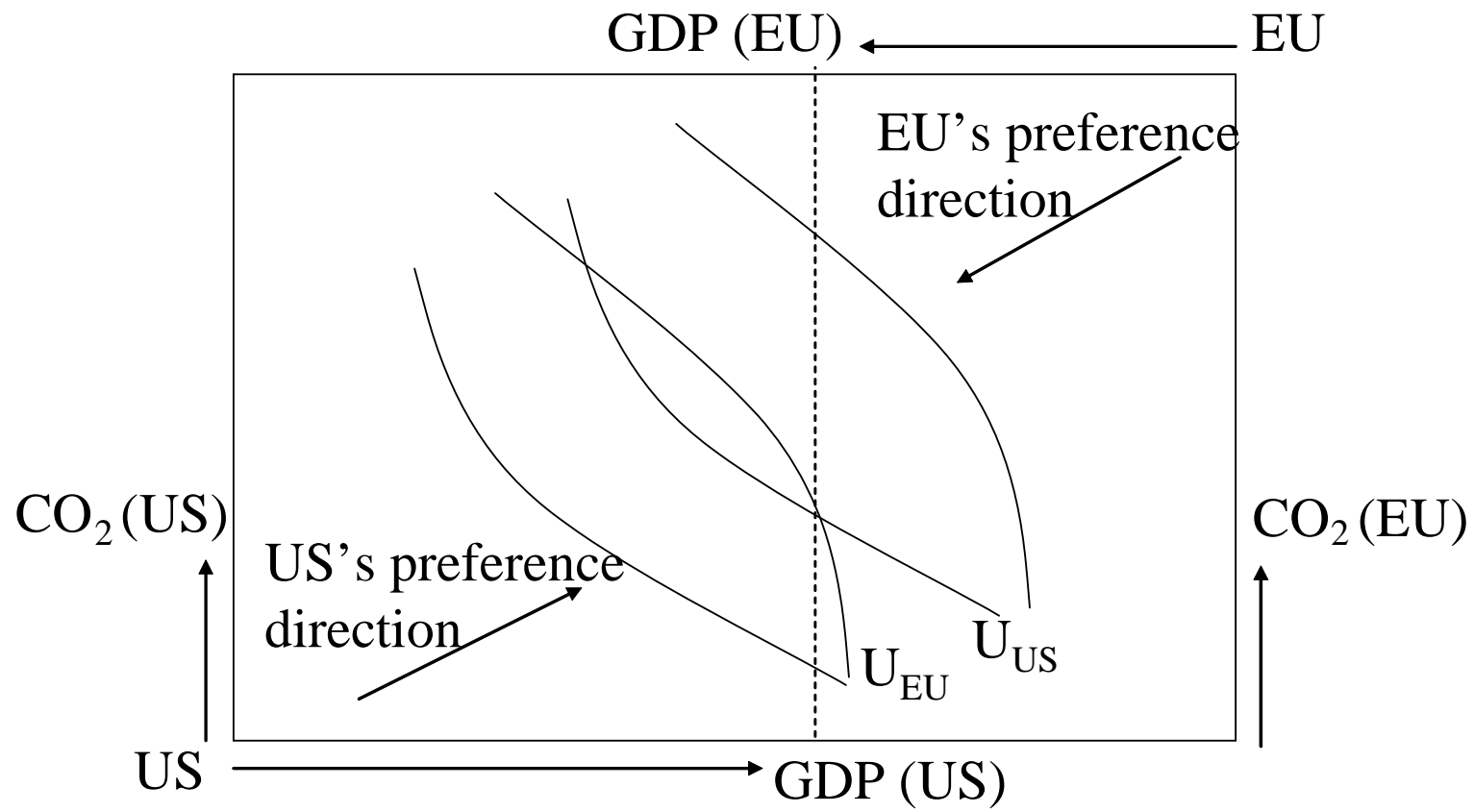
then this is just such a situation (person 2's consumption of x affects person 1's utility).

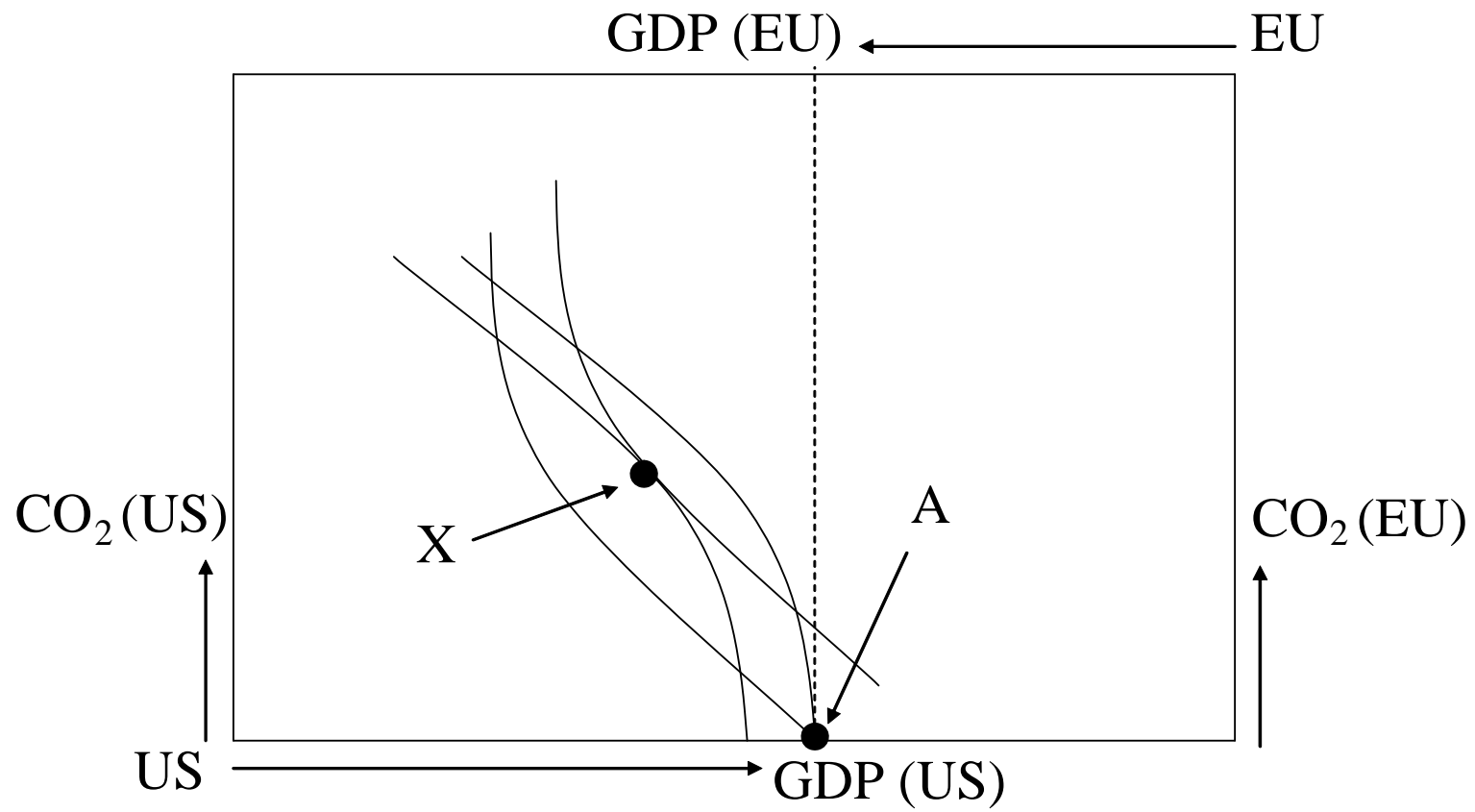
- Another way to say this is that person 1 has preferences over what person 2 consumes.

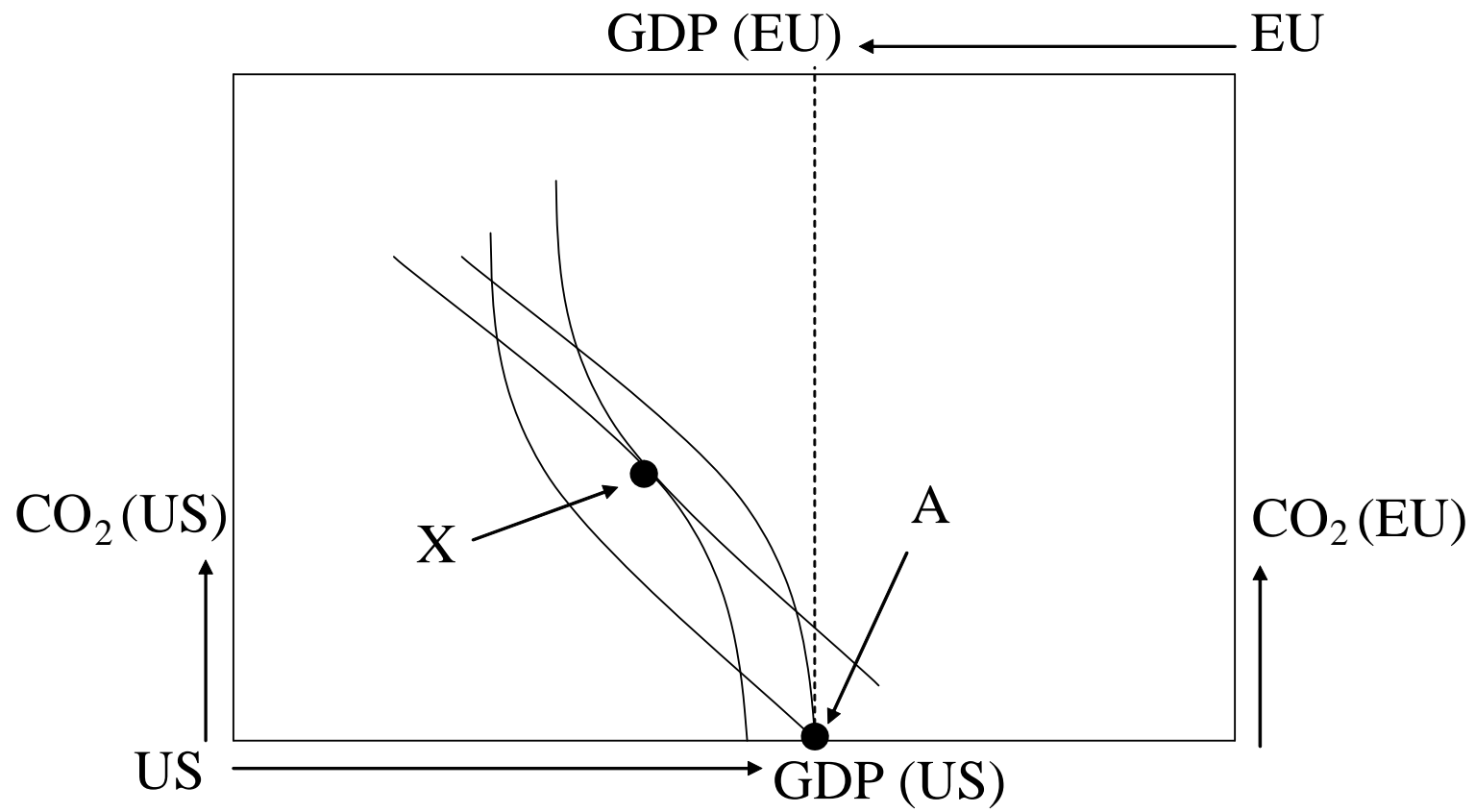
Externalities

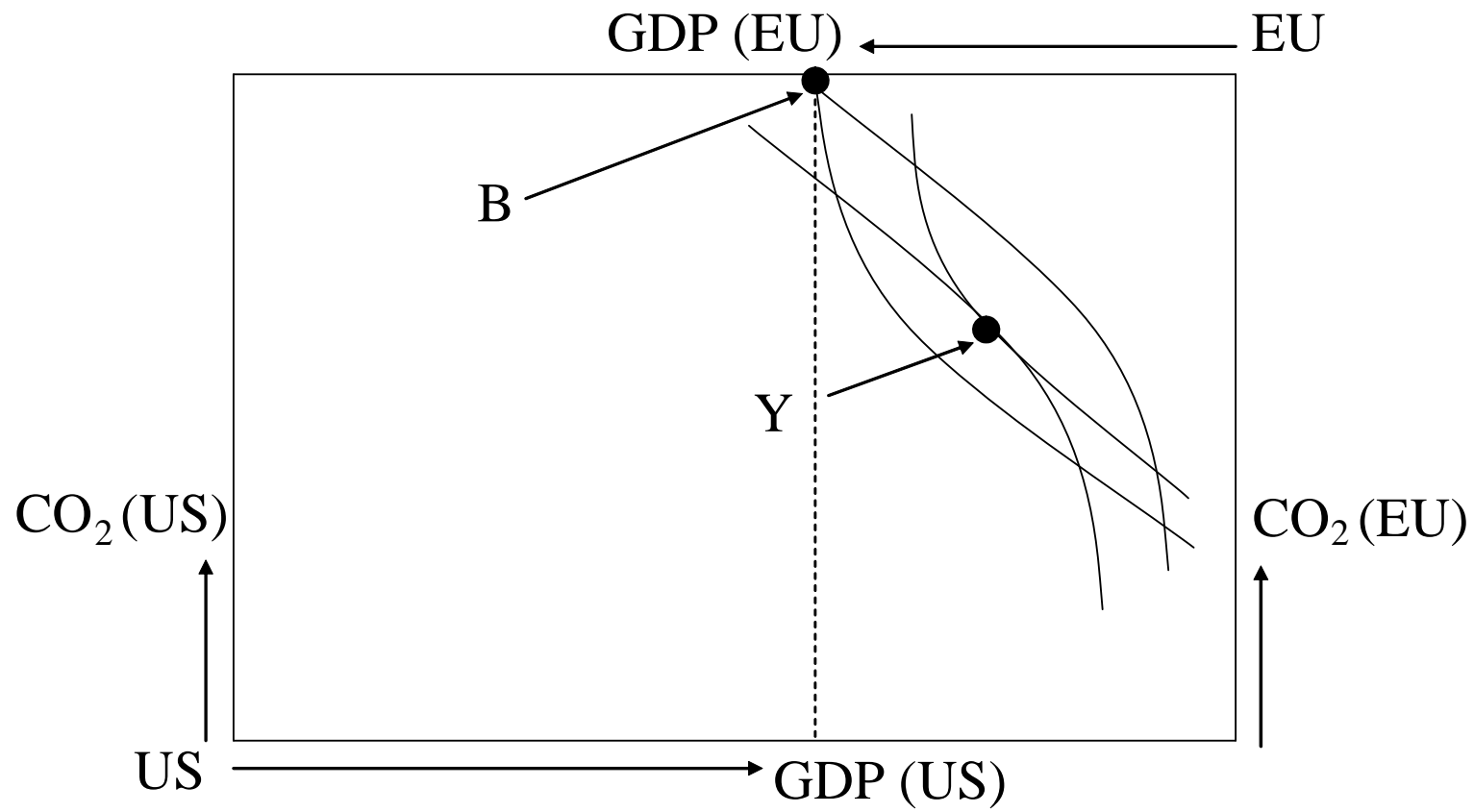
- Consider two countries: the US and the EU (apologies to Euro-sceptics) which have (social/governmental) preferences over two things wealth (GDP) and CO₂ emissions.
- We will suppose that both parties like GDP but the EU does not like CO₂ whereas the US does (apologies to Al Gore).
- Note that whilst wealth/GDP is privately consumed CO₂ as a greenhouse gas must be “consumed” by both parties in the same amount.











The Coase Theorem

The theorem states that when trade in an externality is possible and there are no transaction costs, bargaining will lead to an efficient outcome regardless of the initial allocation of property rights.

R. Coase (*Journal of Law and Economics* (1960), Nobel Prize for Economics 1991)

In practice, obstacles to bargaining, weakly enforced property rights, information asymmetries and the ability to walk away can all prevent or reduce the efficiency of Coasian bargaining.

Pigouvian Taxes and Tradeable Permits

- A production externality is a situation in which the production function of a firm is affected by the actions of another party. Consider the following example used by Varian (Chp 34).
- A steel mill produces two outputs, steel and pollution (s, x) and has cost function $c(s, x)$ with

$$c_s > 0 \text{ and } c_x < 0$$

- A fishery downstream has cost function $k(f, x)$ where f is the output of fish with

$$k_x > 0 \text{ and } k_f > 0$$

Pigouvian Taxes and Tradeable Permits

1. The firms' profit maximisation problems are

$$\max_{s,x} p_s s - c(s, x)$$

$$\max_f p_f f - k(f, x)$$

2. The first order conditions are

$$p_s - c_s = 0$$

$$-c_x = 0$$

$$p_f - k_f = 0$$

Pigouvian Taxes and Tradeable Permits

3. Interpret:

$$p_s = c_s$$

$$0 = c_x$$

$$p_f = k_f$$

- All of these conditions say (because we have assumed a perfectly competitive situation in the steel and fish markets) that price equals marginal costs. But notice *there is no market for pollution*. So the price is zero and the condition for optimal production of pollution for the steel mill is to produce it until the marginal cost is *zero*.

Pigouvian Taxes and Tradeable Permits

- To work out the Pareto efficient situation we hypothetically merge the firms.
- There is now no *externality* because the whole thing now goes on inside one entity (the merged firm)
- We say that this merger has **internalised** the externality.

Pigouvian Taxes and Tradeable Permits

1. The merged firms profit maximisation problem is

$$\max_{s,f,x} p_s s + p_f f - c(s, x) - k(f, x)$$

2. FOC's

$$p_s - c_s = 0$$

$$p_f - k_f = 0$$

$$c_x + k_x = 0$$

Pigouvian Taxes and Tradeable Permits

3. Interpret:

$$-c_x = k_x$$

- This says "equate the marginal cost of pollution abatement to the marginal benefit of a reduction in pollution to the fishery".
- Also since $k_x > 0$ it means that you will get less pollution.

Pigouvian Taxes and Tradeable Permits

Interpretation #1. The steel firm faces the wrong price for pollution (zero).

Solution. Polluter pays (the social cost of his actions).

Policy measure: Pigouvian Taxes.

Pigouvian Taxes and Tradeable Permits

Put a tax on pollution of t per unit of pollution.

1. The steel mill's problem is then

$$\max_{s,x} p_s s - c(s, x) - tx$$

2. FOC's

$$\begin{aligned} p_s - c_s &= 0 \\ -c_x - t &= 0 \end{aligned}$$

Pigouvian Taxes and Tradeable Permits

3. Interpret:

$$p_s = c_s$$

$$t = -c_x$$

If we set $t = k_x$ then we have

$$-c_x = k_x$$

Setting a tax equal to the social cost will thus make the firm behave as if it is taking the social costs of its behaviour into account

Pigouvian Taxes and Tradeable Permits

Interpretation #2. Missing property rights (no one owns the river).

Solution. Confer them (privatise the river) and allow trade

Policy measure: Tradeable permits.

Pigouvian Taxes and Tradeable Permits

Confer a property right on the fishery for a clean river but also allow the fishery to sell the right to pollute. Let q be the unit price of pollution.

1. The steel mill's problem is

$$\max_{s,x} p_s s - qx - c(s, x)$$

and the fishery's problem is

$$\max_{f,x} p_f f + qx - k(f, x)$$

Pigouvian Taxes and Tradeable Permits

2. FOC's

$$p_s = c_s$$

$$q = -c_x$$

$$p_f = k_f$$

$$q = k_x$$

3. Interpret: the price of pollution is equal to the social cost of pollution and $-c_x = k_x$ which is what we were after for the Pareto optimum

Pigouvian Taxes and Tradeable Permits

- Notice in order to come up with this solution we gave the property rights to the fishery and said they could sell them if they wanted to.
- We could have given the property rights to the steel mill and said “do what you want with the river”, and also given it the right to charge the fishery for reducing its pollution.
- It turns out that this arrangement is an identical way of getting to the Pareto optimum point (see Varian (Chp 34) for algebra)
- Of course, this is not to say that the division of profits will be identical!