Course: Economics of Industry

Lecture 14: Vertical and horizontal externalities

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Externalities

- What is an Externality?
- Graphical Analysis of Externalities
- Private Responses to Externalities
- Public Responses to Externalities
- Implications for Income Distribution
- Positive Externalities

Theory - What is an Externality?

An EXTERNALITY occurs when:

1) The activity of one agent directly affects the welfare of another agent

And

2) This affect is not transmitted by market prices

Externality Examples

Externalities:

-A firm pollutes the air through production

-A dorm student uses up all the bandwidth downloading *So You Think You Can Dance*

-neighborhood dogs make your house safer

Not Externalities:

-A store with noisy country music must reduce price to keep customers

-Subway has a sale, forcing Mr. Sub to have a sale also

Theory - Externality Features

Externalities carry a variety of rarely considered features:

1) EXTERNALITIES CAN BE PRODUCED BY CONSUMERS AS WELL AS FIRMS
2) EXTERNALITIES ARE RECIPROCAL IN NATURE
3) EXTERNALITIES CAN BE POSITIVE OR NEGATIVE
4) PUBLIC GOODS AND EXERNALITIES CAN BE SIMILAR

EXTERNALITIES CAN BE PRODUCED BY CONSUMERS AS WELL AS FIRMS

Examples:

-a student using bandwidth

-a smoker

-a neighborhood watch patrol

-a cell phone “loud-talker”

EXTERNALITIES ARE RECIPROCAL IN NATURE

-all parties using an unmarketted good affect each other

  -the roommate downloading movies and the roommate downloading papers

  -person using a cell phone beside 2 people talking

-which is “worse” is a biased value judgement

EXTERNALITIES CAN BE POSITIVE OR NEGATIVE

-As previously stated, externalities can also be positive

-but people rarely do an activity to the extent where the positive is sufficient

-ie: shoveling your snow makes winter easier on your neighbours, but they still need to shovel their snow

PUBLIC GOODS AND EXERNALITIES CAN BE SIMILAR

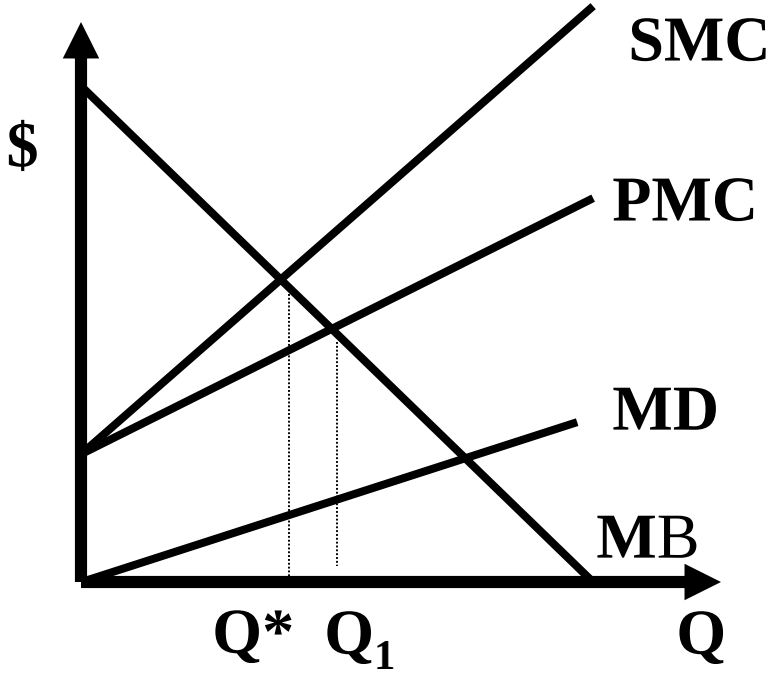
-Externalities are *unintended* costs or benefits to the community, whereas public goods have *intended* benefits to the community (Mishan 1971)

-ie: If you hire security, it has externalities. If your block hires security, it is a public good

-It is still useful to examine them independently in practice

Math - Graphical Analysis of Externalities:

When an agent consumes a good with a negative externality, he only equates marginal benefit (MB) and his Private Marginal Cost (PMC) and consumes at Q_1.



Society, however, experiences Marginal Damage (MD), and therefore Social Marginal Cost (SMC) is higher than PMC.

Efficient consumption therefore occurs where SMC=MB, at point Q*. There is ***overconsumption***.

Graphical Notes

-The marginal benefit curve slopes down:

1) due to diminishing marginal benefit

or

2) As a reflection of the demand curve and market price decreasing with quantity

-Costs tend to increase with output, therefore PMC is upward sloping

Graphical Notes

-Typically as output increases, the negative externality also increases, causing the MD curve to be upward sloping

-(2 barking dogs is more annoying than one)

-The distance between the SMC and the PMC is always the MD.

Graphical Implications

-Private markets will ***overproduce*** when negative externalities exist

-without a market for externalities, this is a RATIONAL action

-Note that optimal amount of the externality IS NOT ZERO (ie: pollution is a cost, but some level is acceptable for the benefit)

-To analyze the effect of externalities, we will look at a numerical example:

Graphical Example

Assume a city starts buying dogs that bark at night. Let:

MD=Q

MB=350-Q

PMC=50+Q

Therefore:

SMC=PMC+MD

SMC=50+Q+Q

SMC=50+2Q

Graphical Example

MD=Q

PMC=50+Q

Individual:

MB=PMC

350-Q=50+Q

300=2Q

150=Q_1

P_1=350-Q

P_1=350-150

P_1=200

MB=350-Q

SMC=50+2Q

Society:

MB=SMC

350-Q=50+2Q

300=3Q

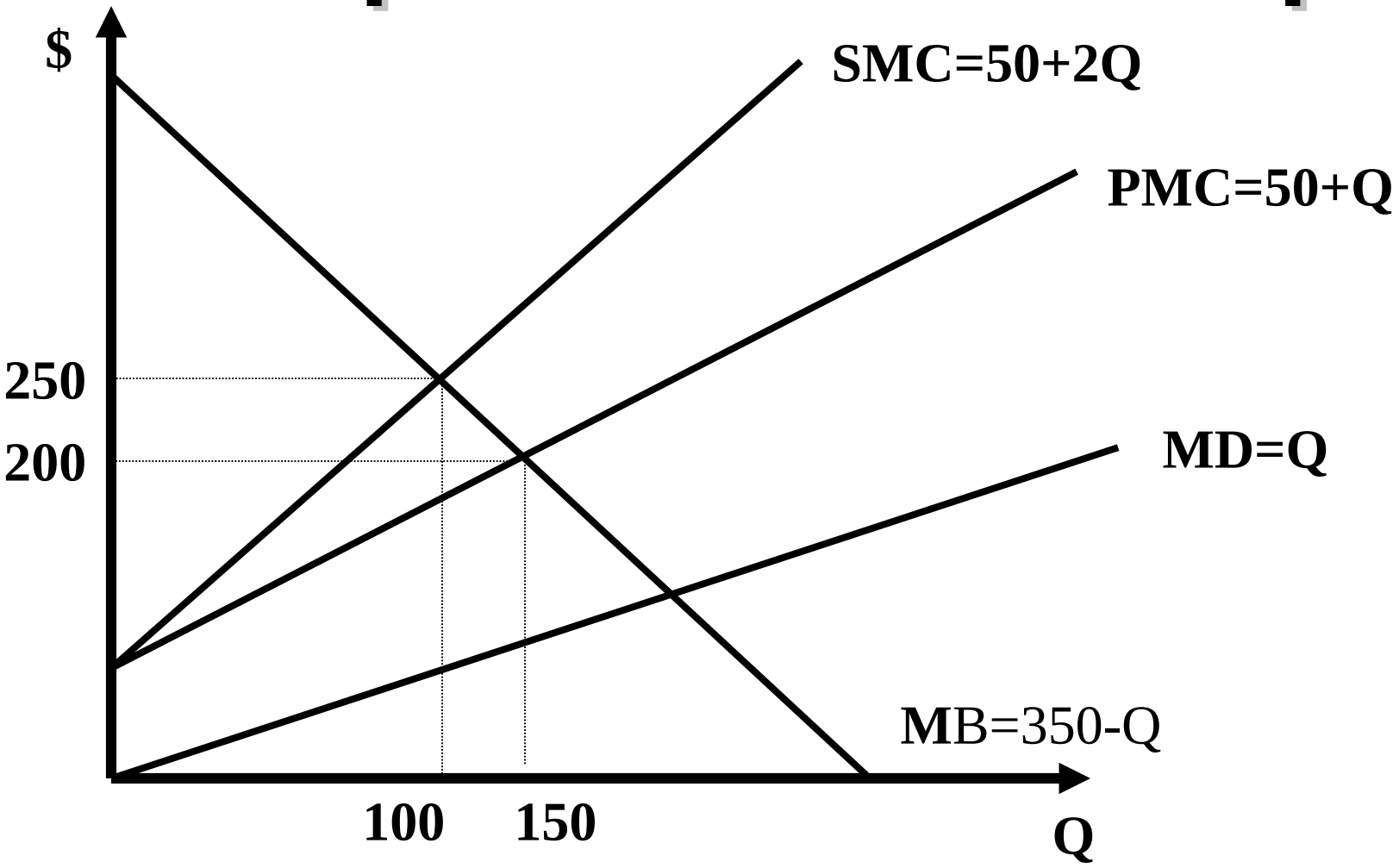
100=Q*

P*=350-Q

P*=350-100

P*=250

Graphical Example:



Benefit of reducing output

To analyze, the benefit of reducing output, we need 2 more points in the graph:

$SMC=50+2Q_1$

$SMC=50+2(150)$

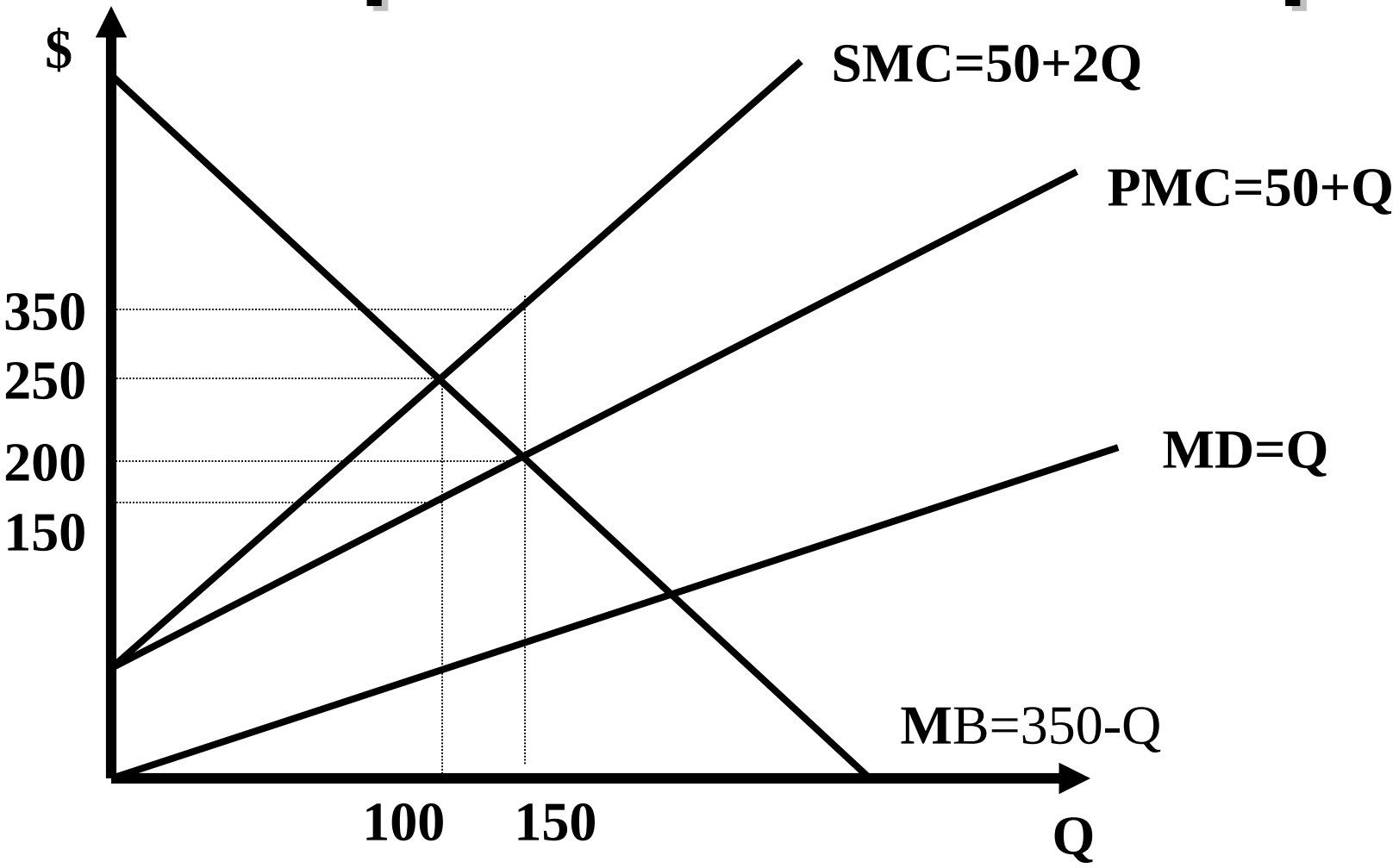
$SMC=350$

$PMC=50+Q^*$

$PMC=50+100$

$PMC=150$

Graphical Example:



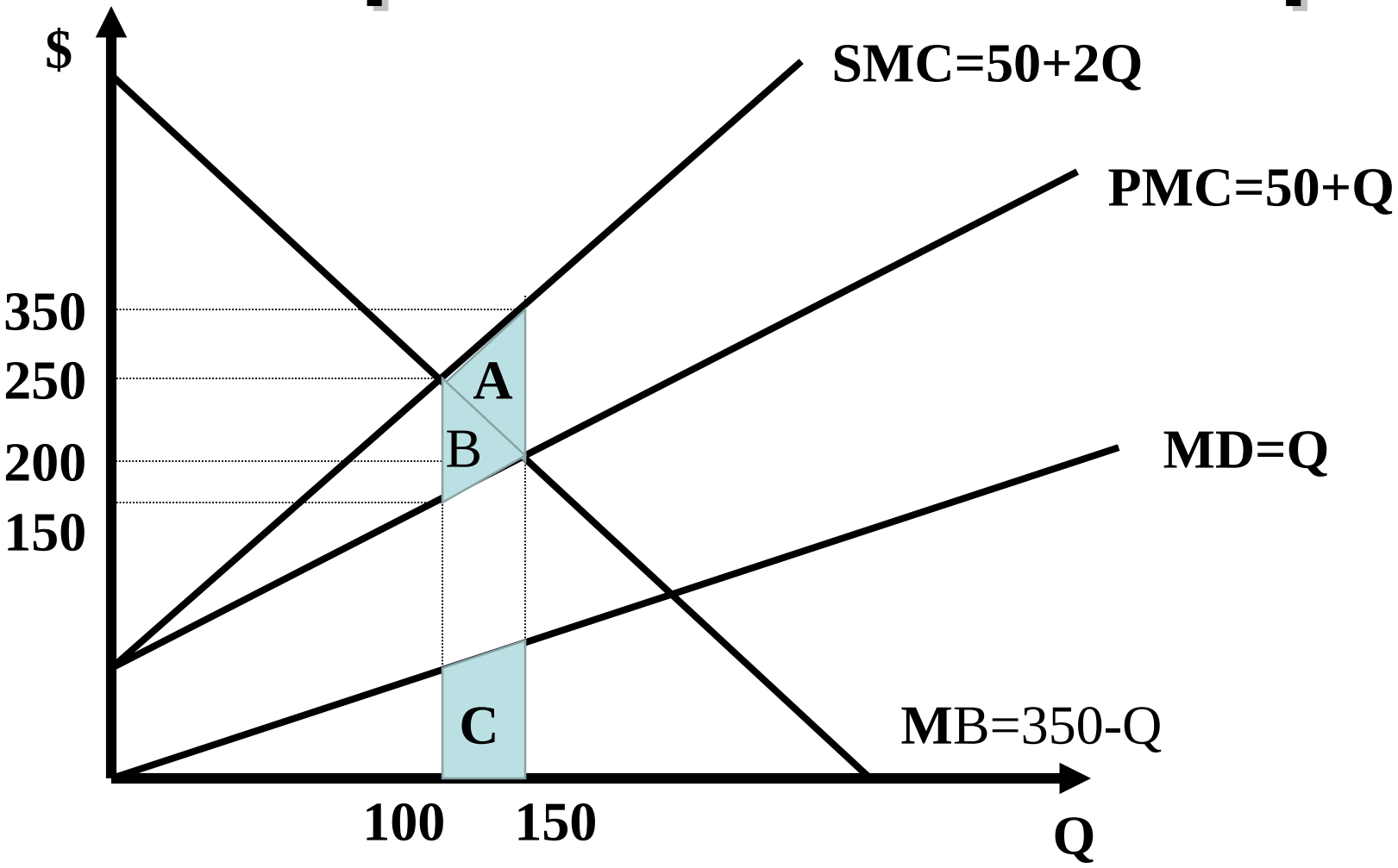
Obviously, this graph is not to scale.

Benefit of reducing output

If we were to move from our individual optimum to our social optimum:

1) Society would gain area A+B, (which is equal to area C).
2) The individual would lose profits or utility equal to area B
3) Therefore, assuming everyone is equal in society the net gain is area A

Graphical Example:



Obviously, this graph is not to scale.

Benefit of reducing output

A=(1/2)bh

A=(1/2)(350-200)(150-100)

A=7500 – Net benefit to society

B=(1/2)bh

B=(1/2)(250-150)(150-100)

B=5000 – Loss to individual

A+B=12500 – Gain to society

Theory - Real World Calculation Difficulties

1) Utility and demand are hard to measure, making MB hard to define
2) The Marginal Damage (MD) can be hard to identify, quantify, and value:
   a) What activities produce pollutants?
   b) Which pollutants do harm?
   c) What is the value of the damage done?

2a) WHAT ACTIVITIES PRODUCE POLLUTANTS?

Smog has been linked to many health concerns, and depends on factors such as production causing particulates and gases, temperature, and wind.

-But these particulates and gases can travel large distances before causing smog

-This makes smog production hard to pin down

-Greenhouse gases have a greater transborder effect

2b) WHICH POLLUTANTS DO HARM?

-Scientists can't do randomized studies on pollution (take 50 people and expose them to pollution and compare them to 50 kept away from pollution)

-CORRELATION can be found, but CAUSATION is more difficult to prove

-It is also possible that an outside variable is increasing both pollution and health problems

-ie: Low income may lead to lower healthcare and lower removal of pollution

2c) WHAT IS THE VALUE OF THE DAMAGE DONE?

-Assume we have perfect scientific information, and the amount of damage can be accurately assessed

-What is the value of that damage?

-One could compare house prices in polluted and non-polluted areas to estimate value

-But what if people underestimate (or overestimate) the health impact?

-Some effects may also be long-term

MD Difficulty Conclusion:

-Although the model is simple, the application is difficult

-It requires biologists, engineers, ecologists, and doctors to work with economists

-Long-term and transborder effects make this even more difficult

-The economist's tool of ***marginal*** analysis is essential in any policy, since zero pollution is never a possibility.

MD Examples:

1) Assume a new student moves into dorms and plays loud, bad music (country rap), long into the night. The average GPA of the floor goes from a 3.1 in Fall to a 2.8 in Winter. What are the marginal damages?

2) A new Styrofoam recycling plant opens up in Podunk (Population 200,000). Cancer rates rise from 10% in 2000 to 15% in 2010. What are the marginal damages?

Theory - **Private** Responses to Externalities

Government regulation isn't the only method to deal with externalities. Externalities can be dealt with through private individuals through:

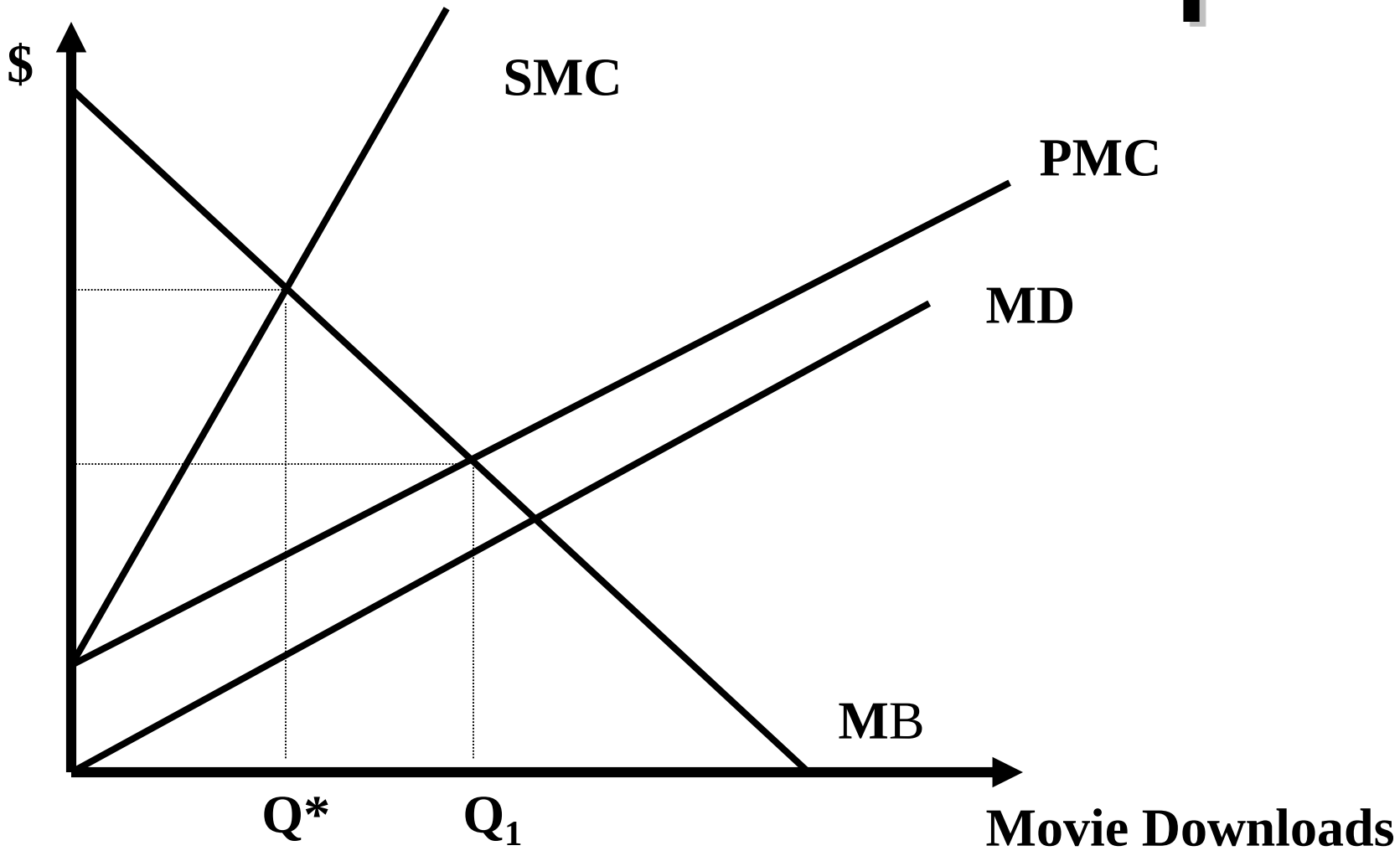
1) The Coase Theorem (assigning property rights)
2) Mergers
3) Social Conventions

1) Assigning Property Rights

One way to privately deal with externalities is for one party to be given OWNERSHIP or PROPERTY RIGHTS of the market the externality exists in.

Let's examine the case of internet bandwidth. We have 2 people sharing the internet, one for downloading movies (Mark), another for everyday use (Evan). As we see on the following graph, Mark's downloading causes Marginal Damage to Evan:

Internet Example:



OPTION 1: “Pollutor Given Rights”

Assume that Mark is given property rights over bandwidth.

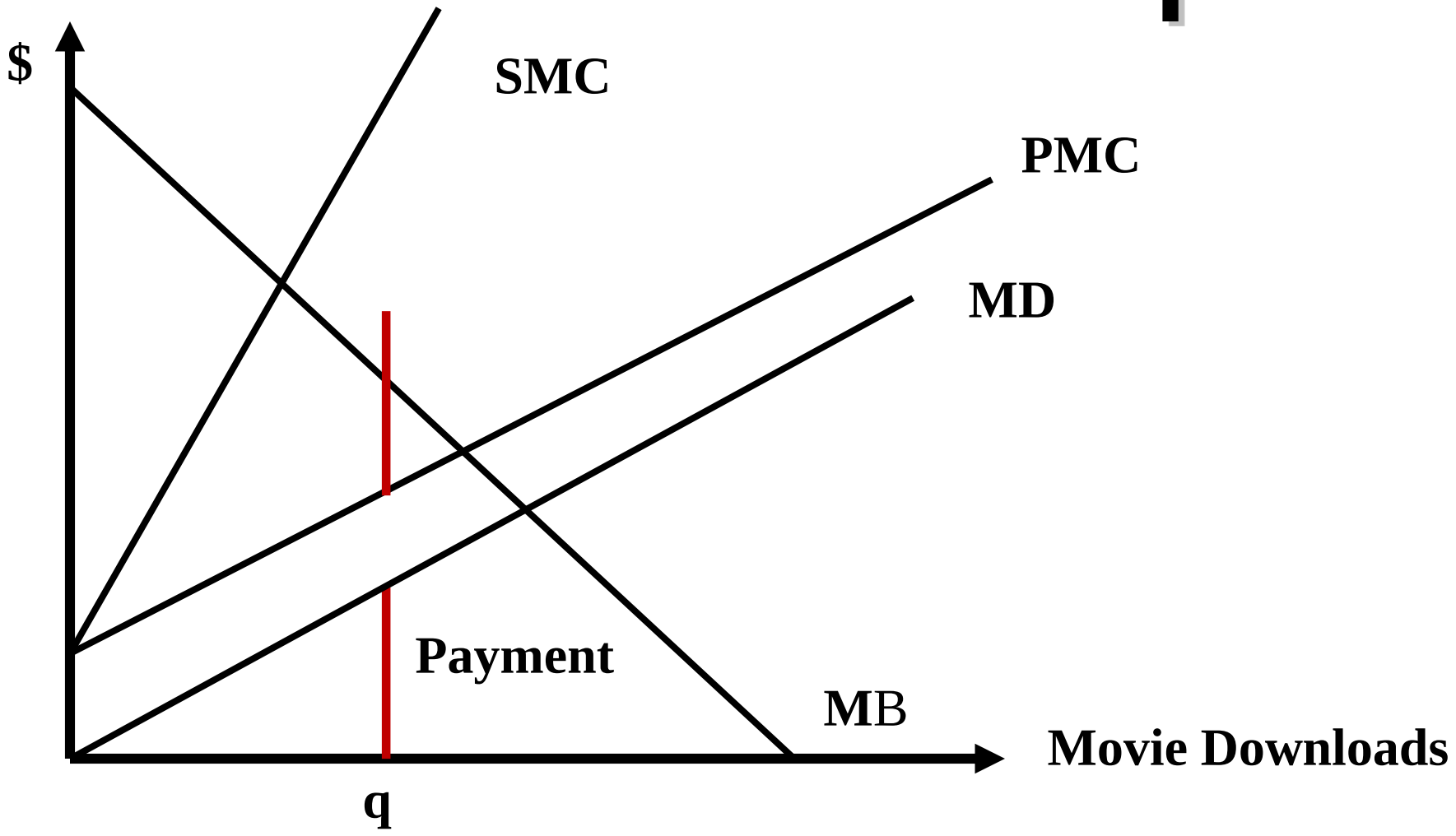
-Mark consumes up to Q_1 because his MB>PMC up to that point

-He’d be willing to give up marginal consumption if Payment>(MB-PMC)

-Evan is willing to pay up to his MD

-Since between Q_1 and Q*, MD>MB-PMC, room for negotiating exists:

Internet Example:



The maximum payment Evan is willing to give Mark to give up consumption point q is greater than MB-PMC

Option 2 – "Non-Polluter" Given Rights

Assume that Evan is given property rights over bandwidth:

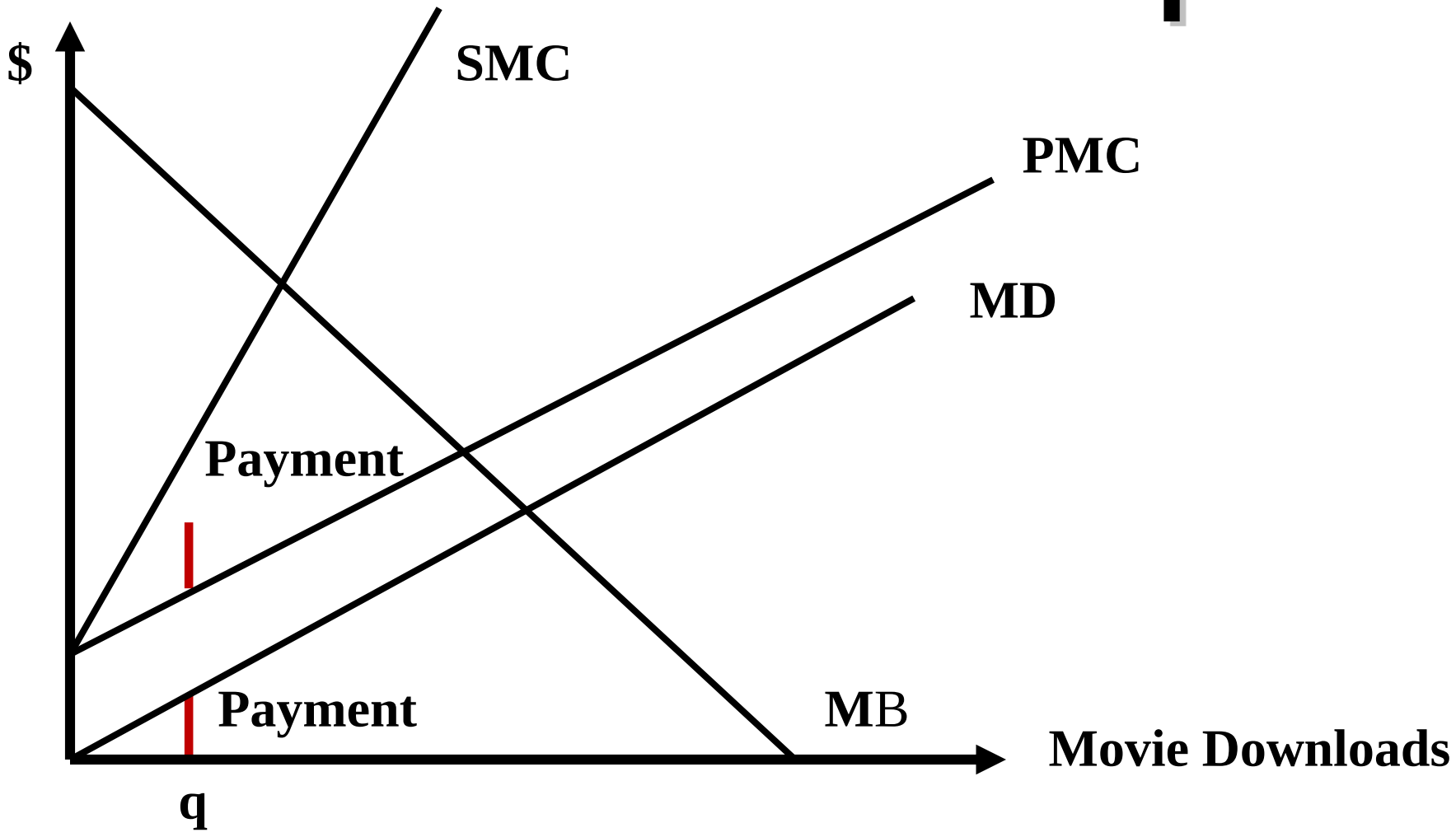
-Consumption starts at zero

-Evan is willing to allow downloading if the payment he receives is greater than MD (which starts at zero)

-Mark is willing to pay to download if the payment is less than his MB-PMC

-To the left of Q_1, this is the case:

Internet Example:



The minimum payment Evan is willing to accept to allow consumption point q is less than MB-PMC

Private Responses to Externalities

For the above analysis to work:

1) Bargaining costs must be low
2) Resource owners must be able to identify damages to their property and legally prevent them (ie: Evan cutting off Mark's internet)

Note that since for most production points the willingness to pay > willingness to accept, the actual payments are a function of bargaining ability.

Theory - The Coase Theorem

WHO receives property rights affects income distribution, but not outcome – production moves to Q*, where MB=SMC

THE COASE THEOREM implies that once property rights are established, no government intervention is required to deal with externalities. (Coase 1960)

Of Coase There's Problems

The Coase Theorem works best in cases where few parties are involved and the sources of externalities are well-defined.

-Often many people are involved (ie: air polution)

-Often the externalities are poorly defined (ie: air pollution, noise pollution, etc)

-Coasian assignment of property rights has seen fruit both in waterways of England and Scotland and elephant herds of Zimbabwe

2) Private Response: Merger

One way to "internalize" an externality is to combine involved parties. For example, if one firm's actions caused an externality to another, the two firms could merge (through buyout or a 3rd party)

-IE: Bookstore buys out the Discotheque next door (externality = noise)

-The new, superfirm would then take their externality into account and move to Q*

-Since everything happens within one firm, one could argue it is no longer an externality

3) Private Response: Social Conventions

Social conventions and moral precepts encourage people to take Marginal Damage into account:

-you should recycle, if you don't you're a horrible person

-you should respect others, and not litter or be noisy

-you shouldn't bud in line, as it is rude and affects everyone else behind you

3) Private Response: Social Conventions

The Golden Rule:

"Do unto others as you would have them do unto you"

can be turned into economic terms as:

"Always consider the external marginal benefits and marginal costs of an action"

-social conventions and moral precepts work to move PMC closer to SMC

Public Responses to Externalities

If private responses to externalities don't work or don't occur, there are a variety of ways the government can intervene, including:

1) Taxes
2) Subsidies
3) Creating a Market
4) Regulation

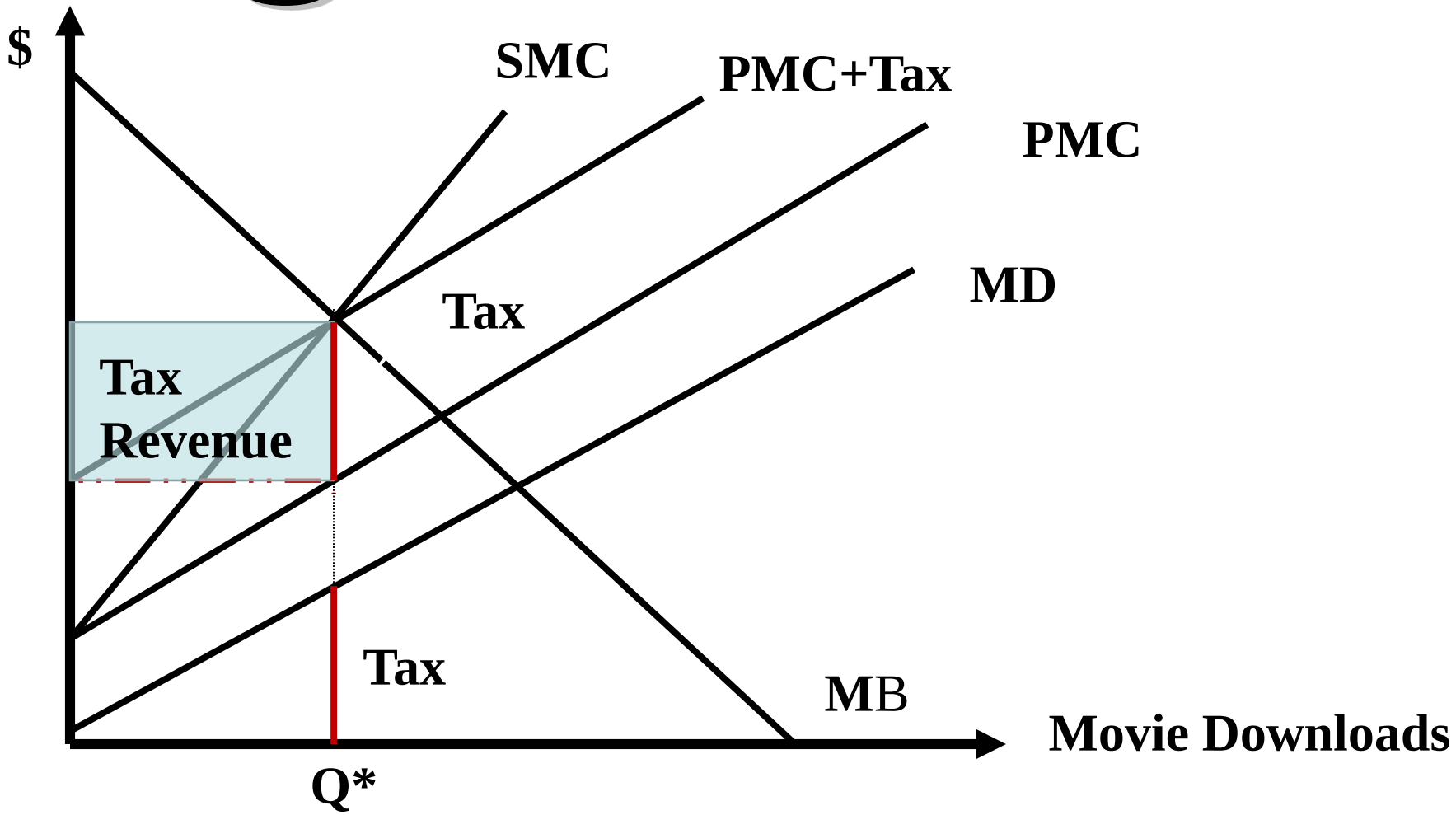
1) Public Response: Taxes

Since actions with externalities have SMC>PMC, one way to raise PMC is through taxation

-a PIGOUVIAN TAX is a per-unit tax on output equal to the marginal damage at the efficient level of output, Q*

-If administrated correctly, the can move production to the efficient level of output:

Pigouvian Tax



A per-unit tax shifts up the PMC curve by the amount of the tax.

1) Public Response: Taxes

-The Pigouvian tax also yields tax revenue

-It may be tempting to give this tax revenue to the victims of the externality, but this distorts the market, and encourages others to experience the negative externality in order to get the payment

Pigouvian Taxes have 2 concerns:

1) Estimation – one needs to know the exact MD in order to place the tax
2) Efficiency – sometimes a similar tax is more efficient (tax on cars vs. tax on kilometers)

2) Public Response: Subsidies

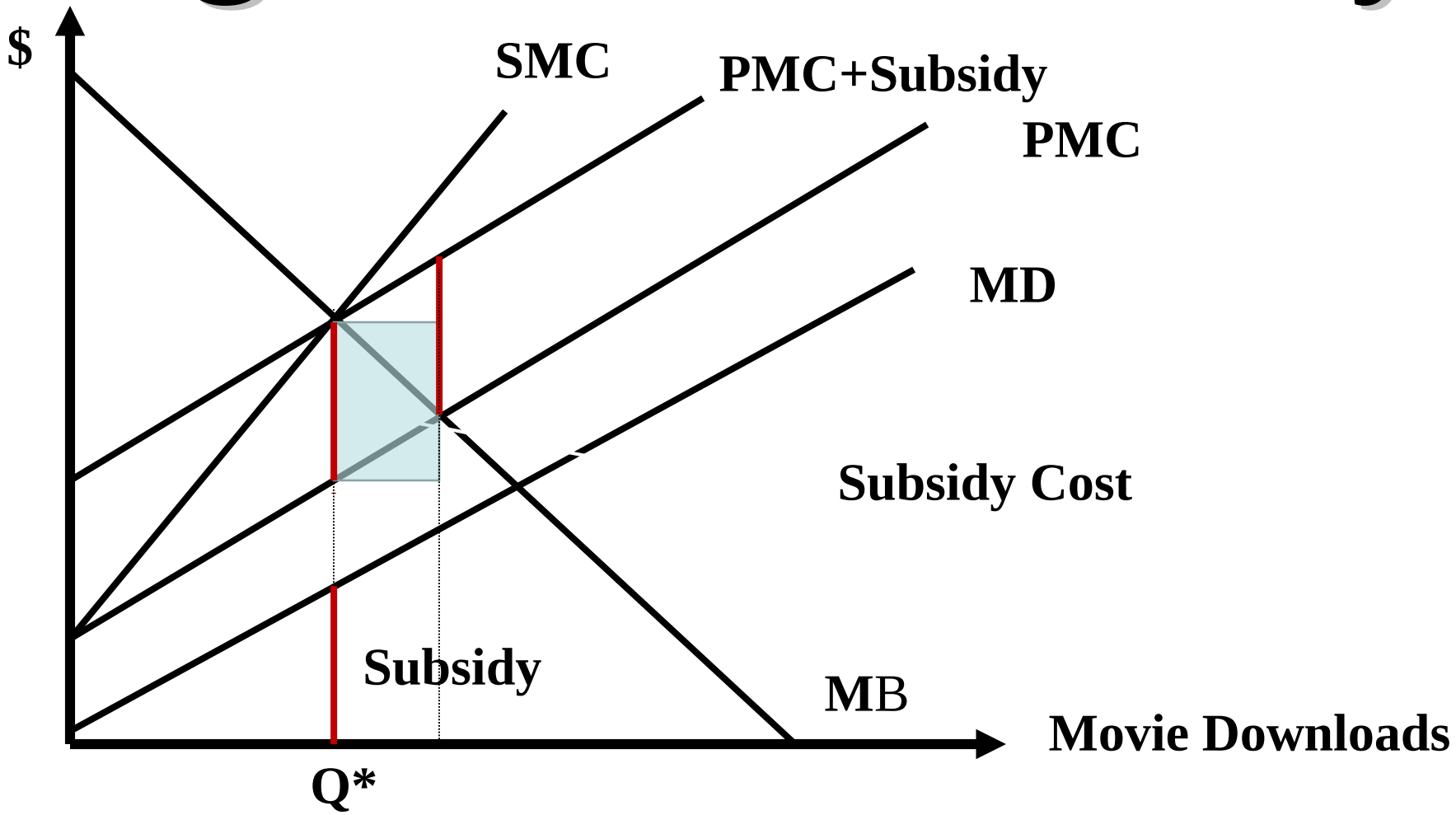
Since actions with externalities have SMC>PMC, another way to raise PMC is through subsidy

-a PIGOUVIAN SUBSIDY is a per-unit subsidy on REDUCED output equal to the marginal damage at the efficient level of output, Q*

-Therefore choosing to produce has the added PMC of giving up the subsidy

-If administrated correctly, the can move production to the efficient level of output:

Pigouvian Subsidy



Choosing to produce increases the PMC by the amount of the subsidy given up

2) Public Response: Subsidies

In addition to the the Pigouvian Tax issues, the Pigouvian Subsidy has 3 additional problems:

1) The subsidy raises profits, encouraging other firms to join the market and produce externalities
2) The financing of the subsidy cost often comes from additional distortionary taxation that further restricts the economy

   -The externality may be less costly

3) Paying a firm not to pollute is often regarded as unappealing

3) Public Response: Creating a Market

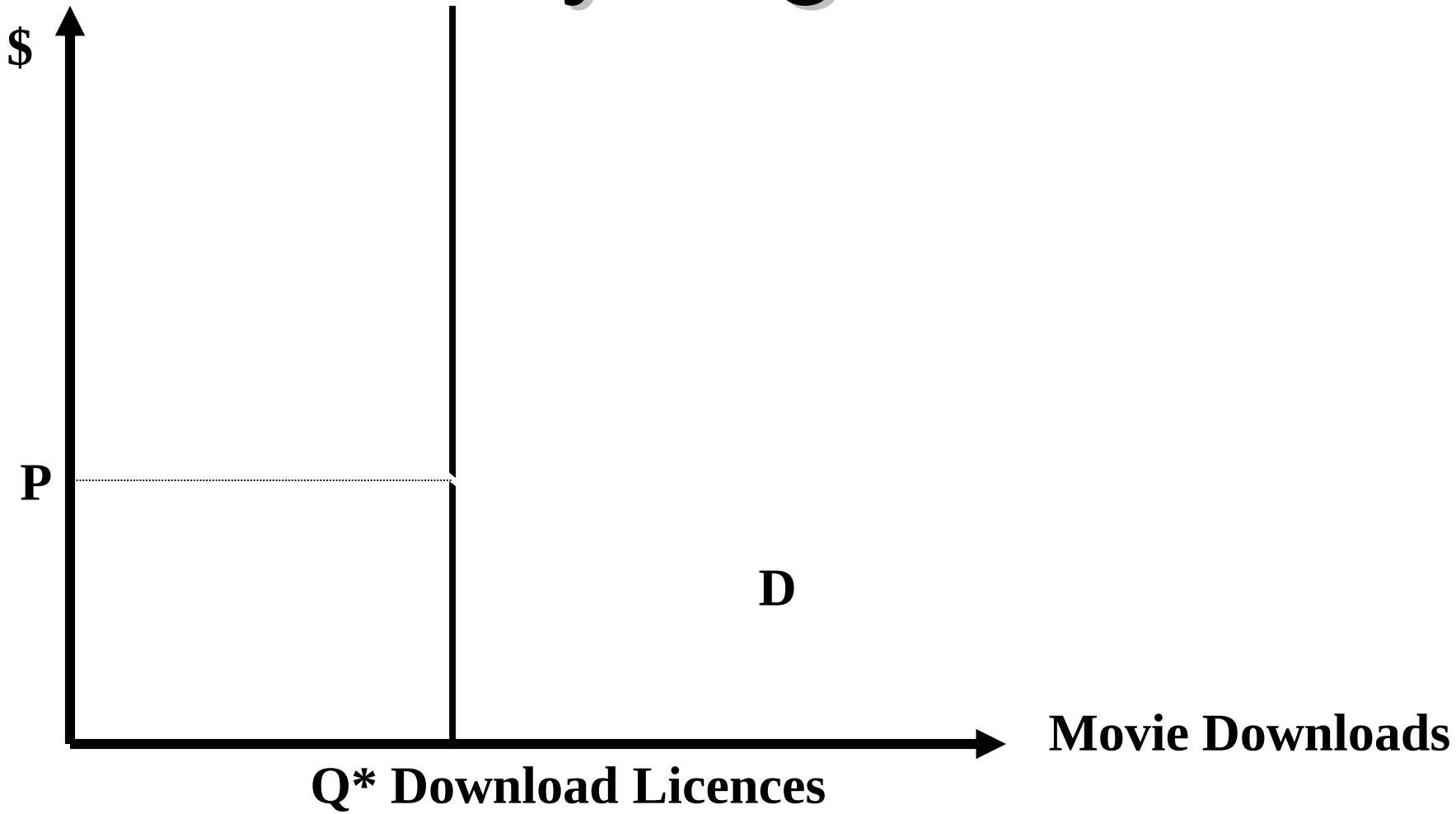
Another way for the government to control externalities (ie: pollution) is to sell a set supply of externality permits

-A competitive auction will automatically find an equilibrium price for these permits

-An EFFLUENT FEE is the price charged for the right to pollute

-Note that alternately, the government could freely distribute these permits. The equilibrium price would arise from trading among firms, only equity would be affected

Externality Rights Market



Selling the licences or distributing them for free and allowing trading causes the same equilibrium price.

3) Public Response: Creating a Market

Like Pigouvian taxes, we need information on optimal MD and pollution to accurately issue permits.

Permits do, however, have ***advantages*** over Pigouvian taxes:

1) Permits directly chose the amount of pollution, instead of indirectly (and possibly incorrectly) determining it with taxes
2) Permit prices automatically move with inflation, whereas a tax needs to be constatly re-assessed

Creating a Market=Creating Market Power?

In theory, one firm could over purchase permits in an attempt to keep other firms out of the market.

The feasibility of such a policy is difficult to predict.

If it did occur, new market power would harm efficiency.

4) Public Response: Regulation

The government can force a firm to produce at Q* or face legal sanctions.

Unfortunately, regulation is likely to be inefficient in a market with more than one firm.

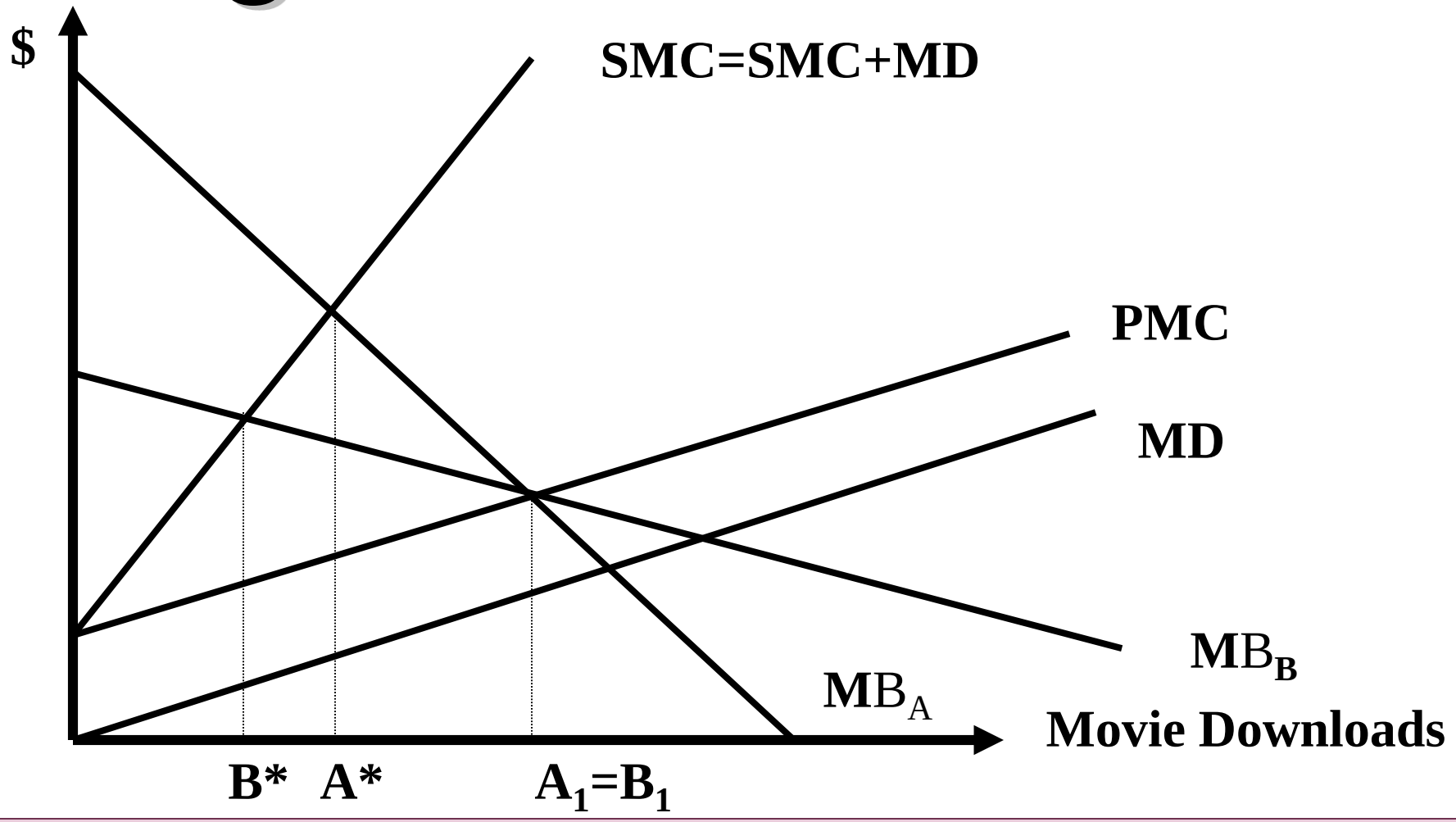
-Firms have different sizes and curves

-Can one production level satisfy all firms?

-Can one production reduction amount satisfy all firms?

-Examine the simple case where two firms (A and B) differ only in MB schedules:

Regulation Difficulties:



These two firms have different optimal production, therefore cannot be given the same production goal or reduction goal.

Public Response Issues

Externalities also differ across locations. A driver in the middle of the wilderness has less effect than an Edmontonian driver, who may have less effect than a driver in Toronto

-should Edmontonian drivers be punished according to Toronto standards?

-Differing standards increases administration costs

Public Response Conclusion

When externalities are large, there is room for government involvement

-Due to lack of information, correct involvement can be difficult

-No policy is perfect

Public Response Issues

-Typically, economic incentives (tax, subsidy, permits) to reduce pollution have the best impact, as they encourage greener practices

-Efficiency typically puts taxes and permits above subsidies and regulations

Preference order is therefore:

1) **Taxes and Permits**
2) **Subsidies**
3) **Regulation**

Theory - Income Distribution Effects

Although government is responsible to ensure efficiency in the case of externalities, it is also responsible to take into account the distribution effects of its policies

In short, when dealing with externalities the government has to ask:

1) Who benefits?
2) Who bears the cost

1) Who Benefits?

If dealing with externalities favors the rich over the poor, the policy has distribution issues.

Examples:

-If poorer areas are more polluted that rich areas, reducing pollution (an externality) has a good distributional effect

-If richer people care more about the externality than poorer people (ie: litter in national parks, noise pollution), removing the externality has a bad distributional effect

2) Who Bears the Cost?

For negative externalities, the optimal output is LOWER

Lower output => more unemployment and reduced wages, generally landing on low-income households

As seen in the previous graphs, forcing firms to realize SMC increases prices, which can be bad if the good is more used by lower-incomes

ie: Is regulating a Kraft Dinner factory good if the price of Kraft Dinner doubles?

2) Who Bears the Cost?

Some studies have shown pollution control to have bad distributional (regressive) effects:

-Hamilton and Cameron (1994) conclude that a carbon tax would reduce the lowest 20% of incomes by 3.4% and the highest 20% of incomes by only 2.7%

-Many energy taxes in US and Europe have regressive impacts

-One must also consider equity across locations

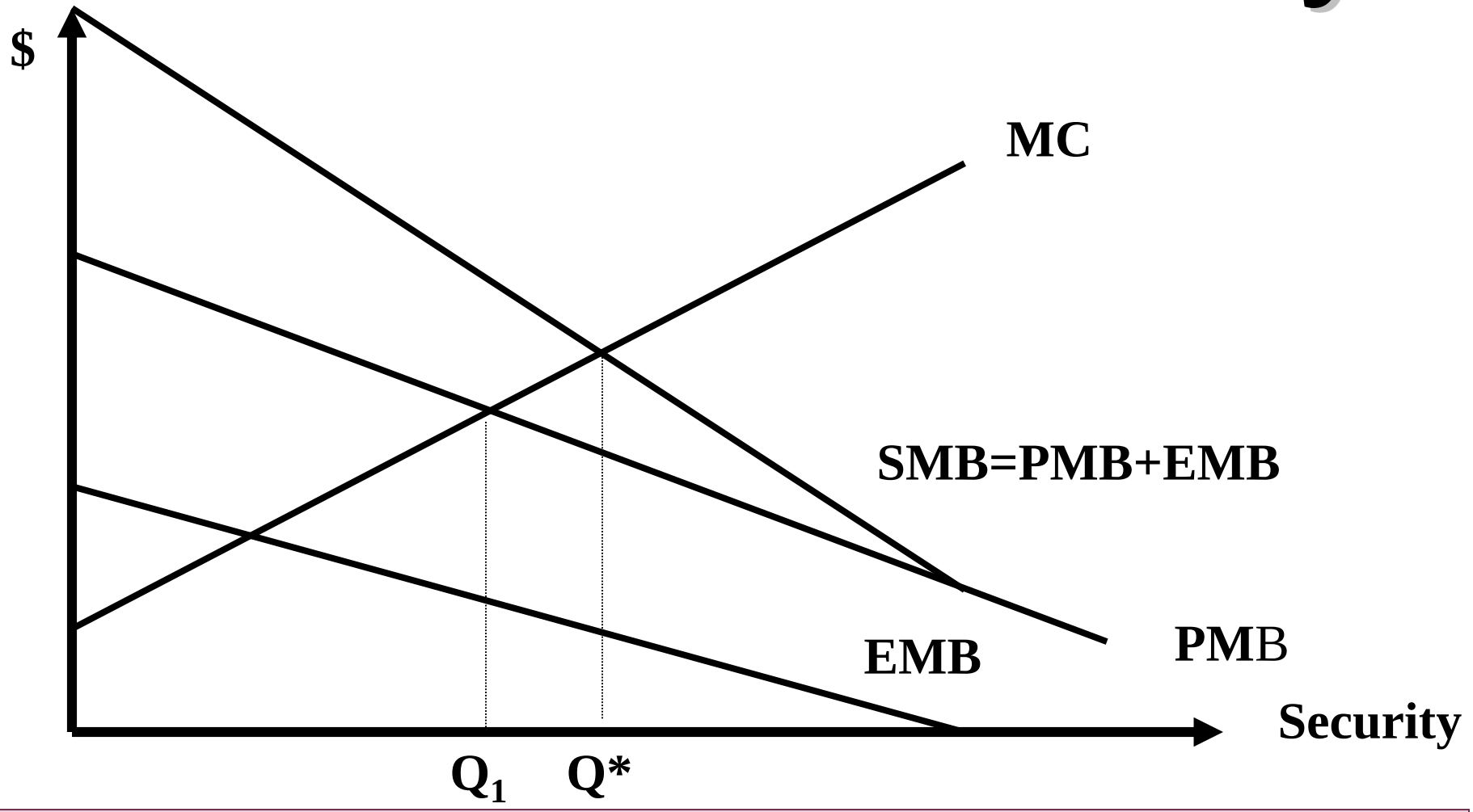
-Toronto may favor an oil tax, but Edmonton would be more in favor of a big city tax

Theory - Positive Externalities

Although negative externalities are most often discussed, positive externalities can also lead to inefficiency

-When an economic activity has an External Marginal Benefit (EMB), it causes the Social Marginal Benefit (SMB) to be greater than the Private Marginal Benefit (PMB), causing underproduction:

Positive Externality:



With a positive externality, an product is ***underconsumed***.

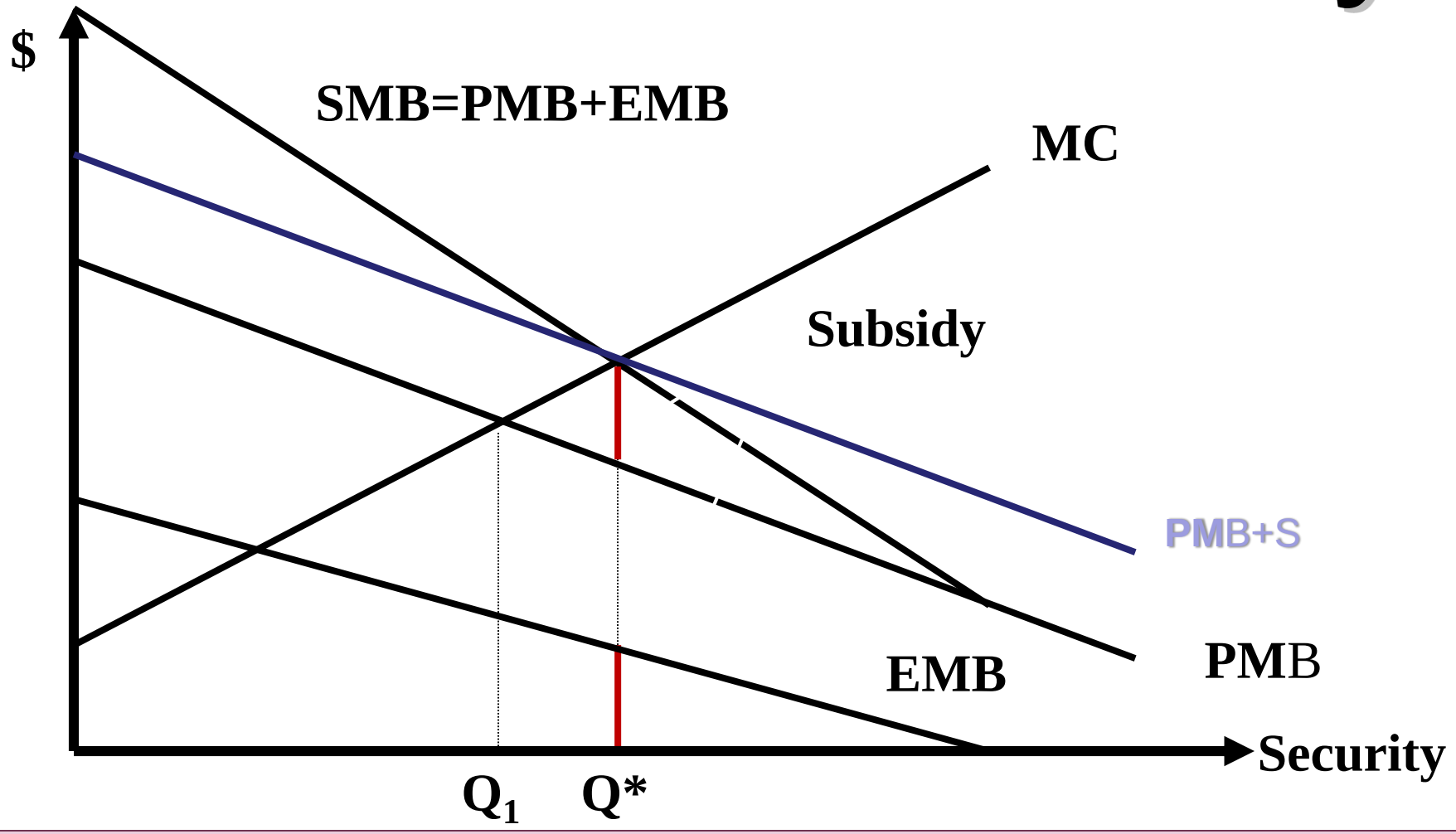
Positive Externalities

This positive externality activity can be made efficient by using a Pigouvian subsidy:

This has three issues:

1) The amount of the subsidy is difficult to measure
2) Funding the subsidy redistributes taxes from taxpayers to the recipients
3) The benefits of the externality may be regressive, (such as funding liposuction research benefiting the rich over the poor)

Positive Externality:



With a subsidy, equilibrium quantity is increased.

Positive Externalities

Finally, note that just because an activity is beneficial does not mean it has a positive externality

-Not all good activities need be subsidized

Examples:

-Many great workers (surgeons, firemen, kind insurance adjusters, emergency plumbers) are already compensated through a high wage (Econ profs aren't, so please petition your government for Econ prof subsidies)

Summary

- Externalities occur when one agents actions affect another outside market mechanisms
- Externalities cause P≠SMC, causing inefficiency
- Externalities can be dealt with privately through:

  1)Assigning property rights (Coase Theorem)

  2)Mergers

  3)Social Conventions

Summary

- The government can deal with externalities through:
  1) Pigouvian Taxes
  2) Pigouvian Subsidies
  3) Permits and a market
  4) Regulation
- Taxes and Permits are generally most efficient and effective

Summary

- All public methods to address negative externalities suffer from:
  1) the difficulty in measuring externalities
  2) possible redistribution issues
- Positive externalities can be dealt with through subsidies
  - These can be hard to measure
  - Financing subsidies can be distortionary
  - This may effect equitable distribution

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