Public Economics

Level 2

2020-2021

Conférence de méthode

Session 5

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SciencesPo

Semester's plan

Session 1 : **introduction & maths recaps**

Session 2 : **research in economics & a look at taxation**

Session 3: **concentrated markets & informational problems**

Send an email with your group's composition

MARKET FAILURES

Session 4: **collusion & externalities**

Send an email with your topic

Session 5: **public goods**

handing of written report (November 23)

Session 6: **group projects presentations** (December 2 / 9)

Content of the 5th session

1. **Numerical exercises**
   1. Exercise 1: asymmetry of information
   2. Exercise 2: positive externalities
   3. Exercise 3: negative externalities (additional video)

2. **Research article discussion: public good**

   Budish, Roin & Williams (2015) about investment in long-term research

1. Numerical exercises

1. **asymmetry of information**
2. positive externalities
3. negative externalities

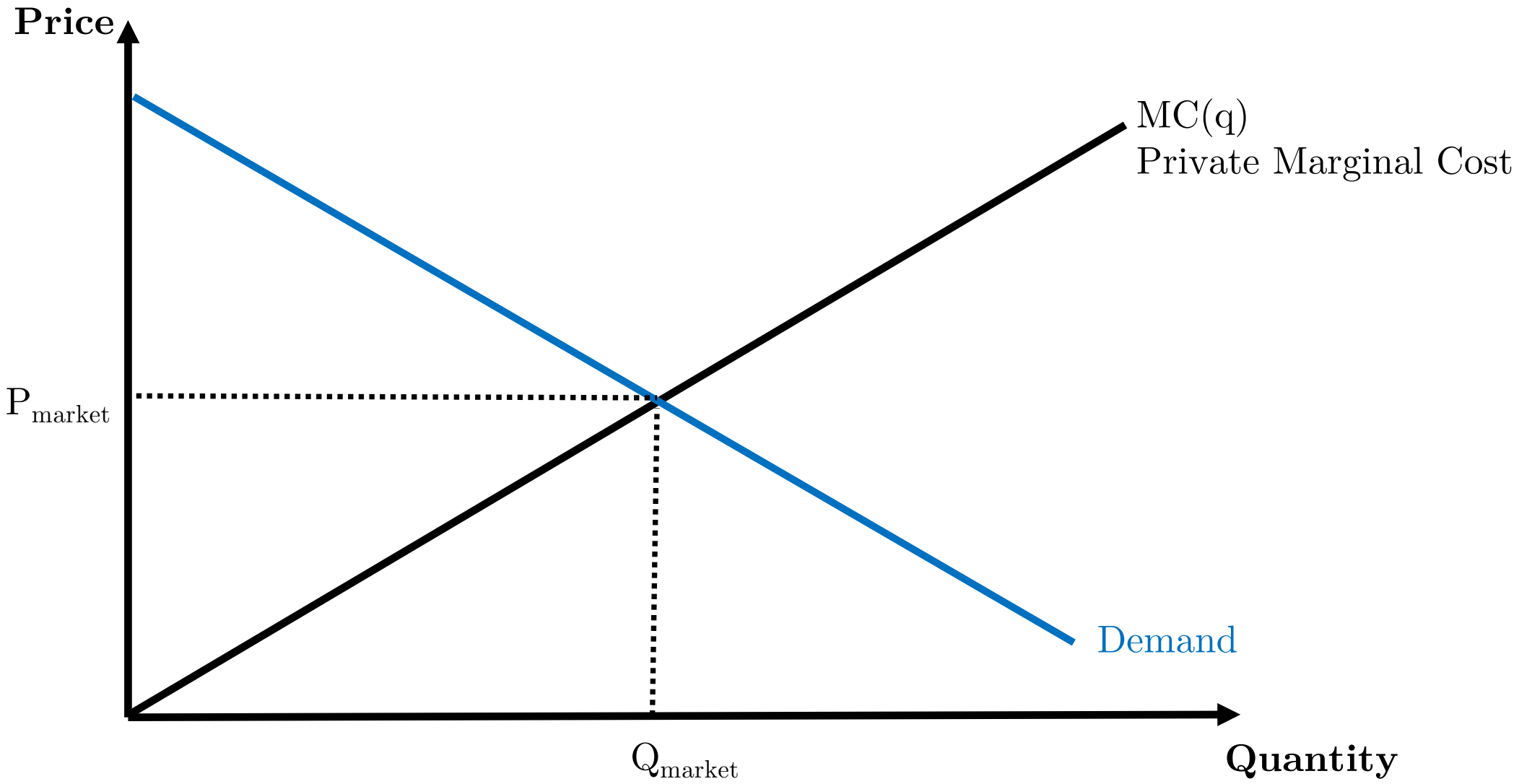
1. Numerical exercises

1. asymmetry of information
2. **positive externalities**
3. negative externalities

Very short recaps & complements on externalities

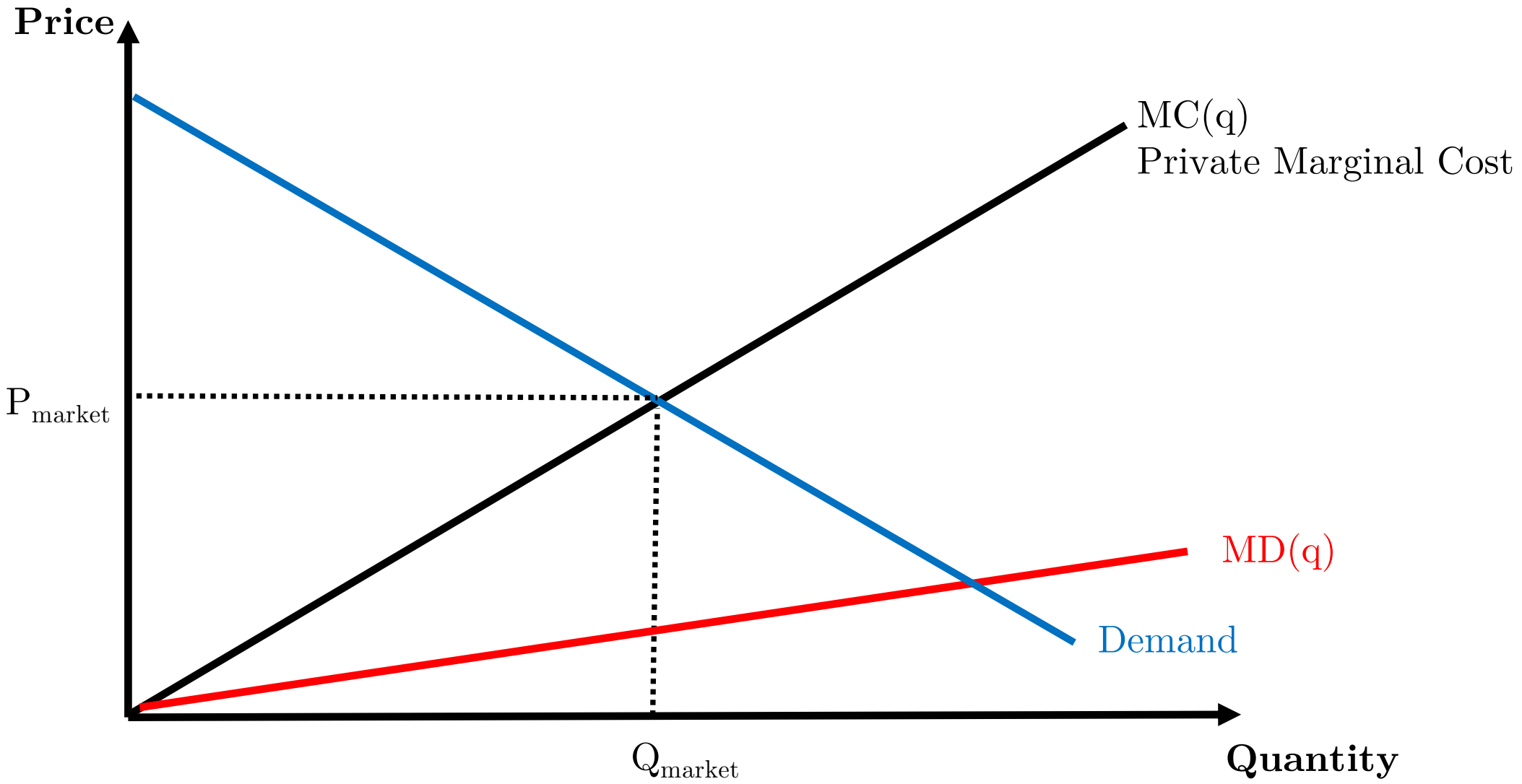
Optimal outcome vs market outcome

Negative externality (production)



Optimal outcome vs market outcome

Negative externality (production)



Optimal outcome vs market outcome

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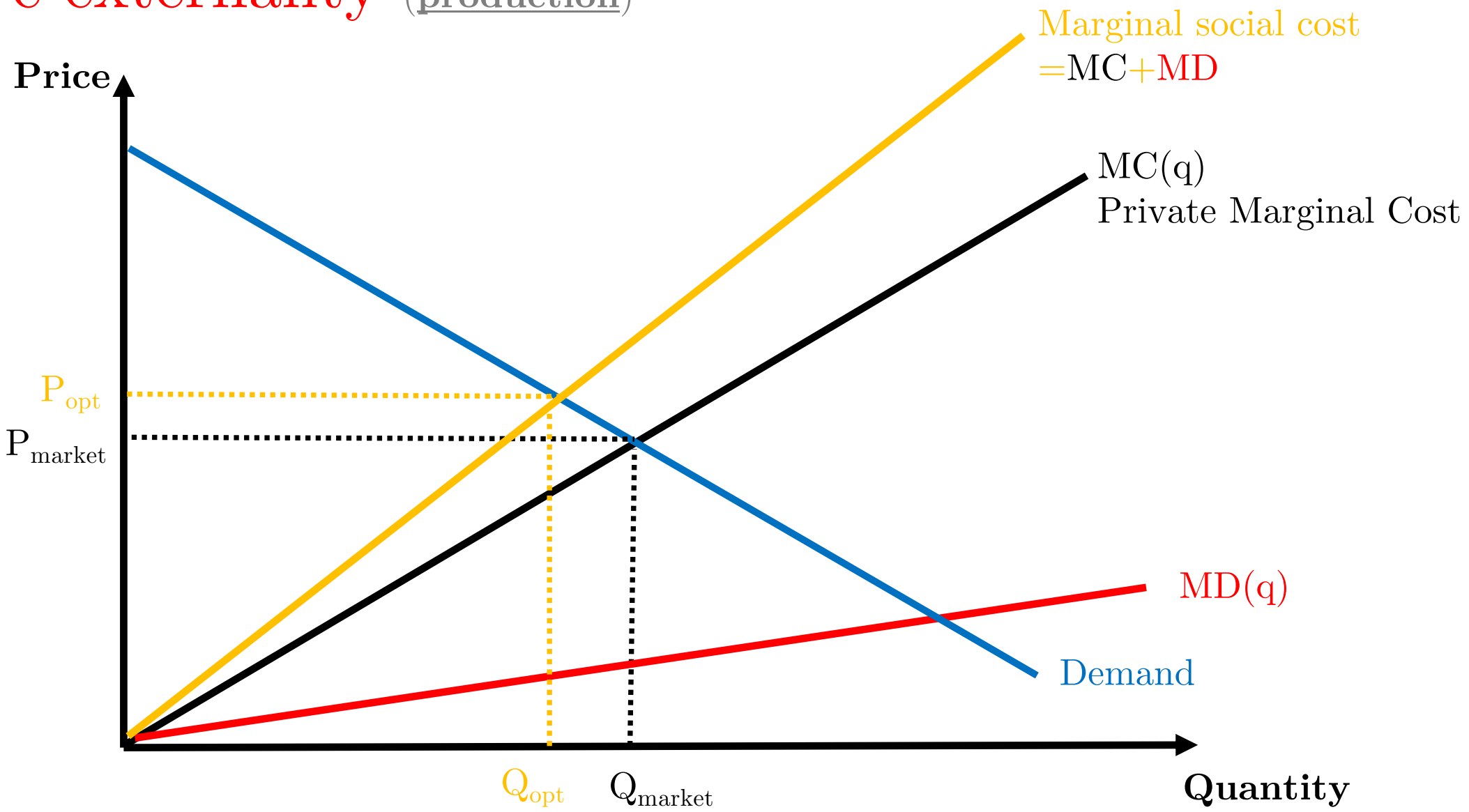
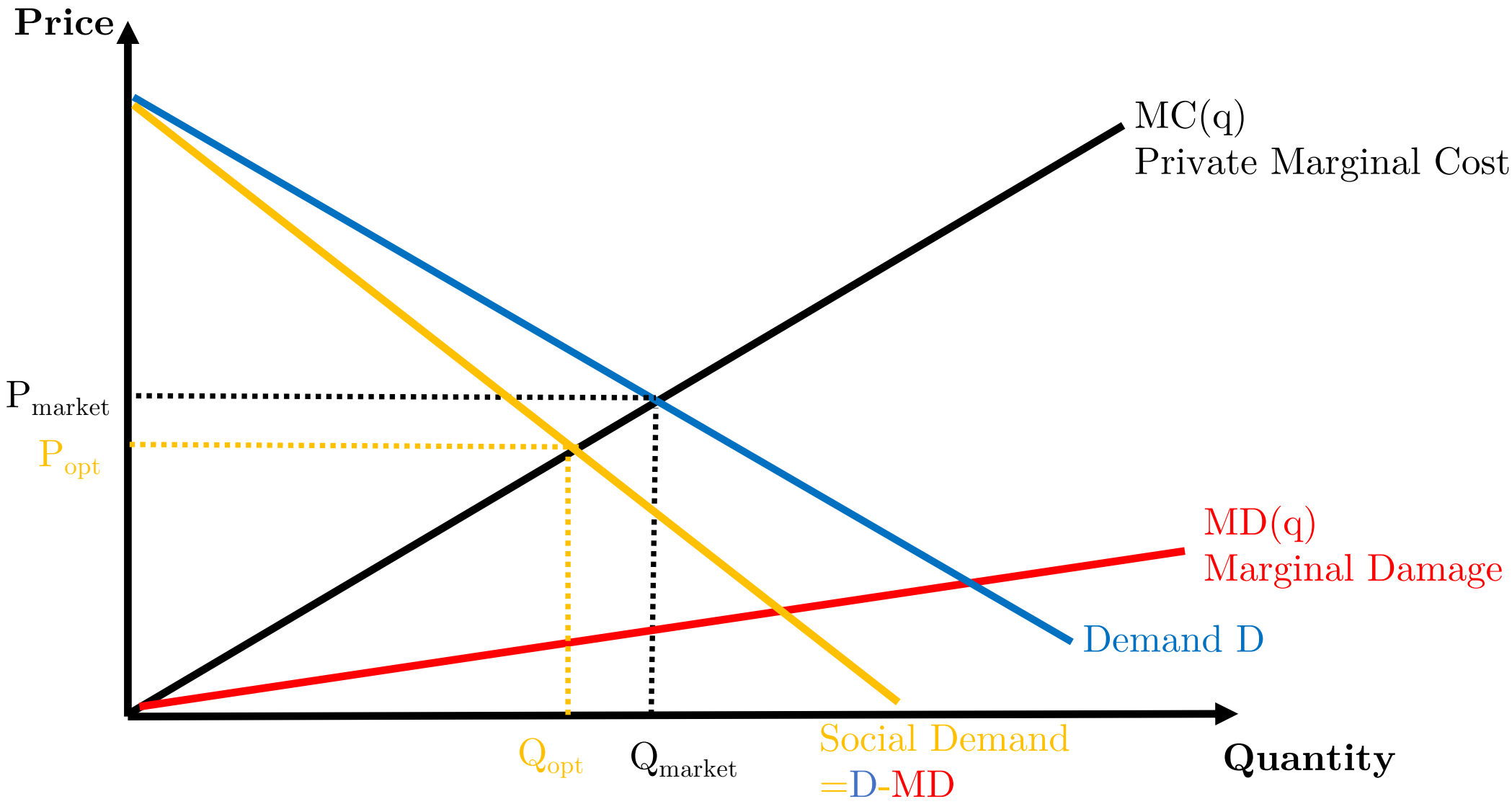


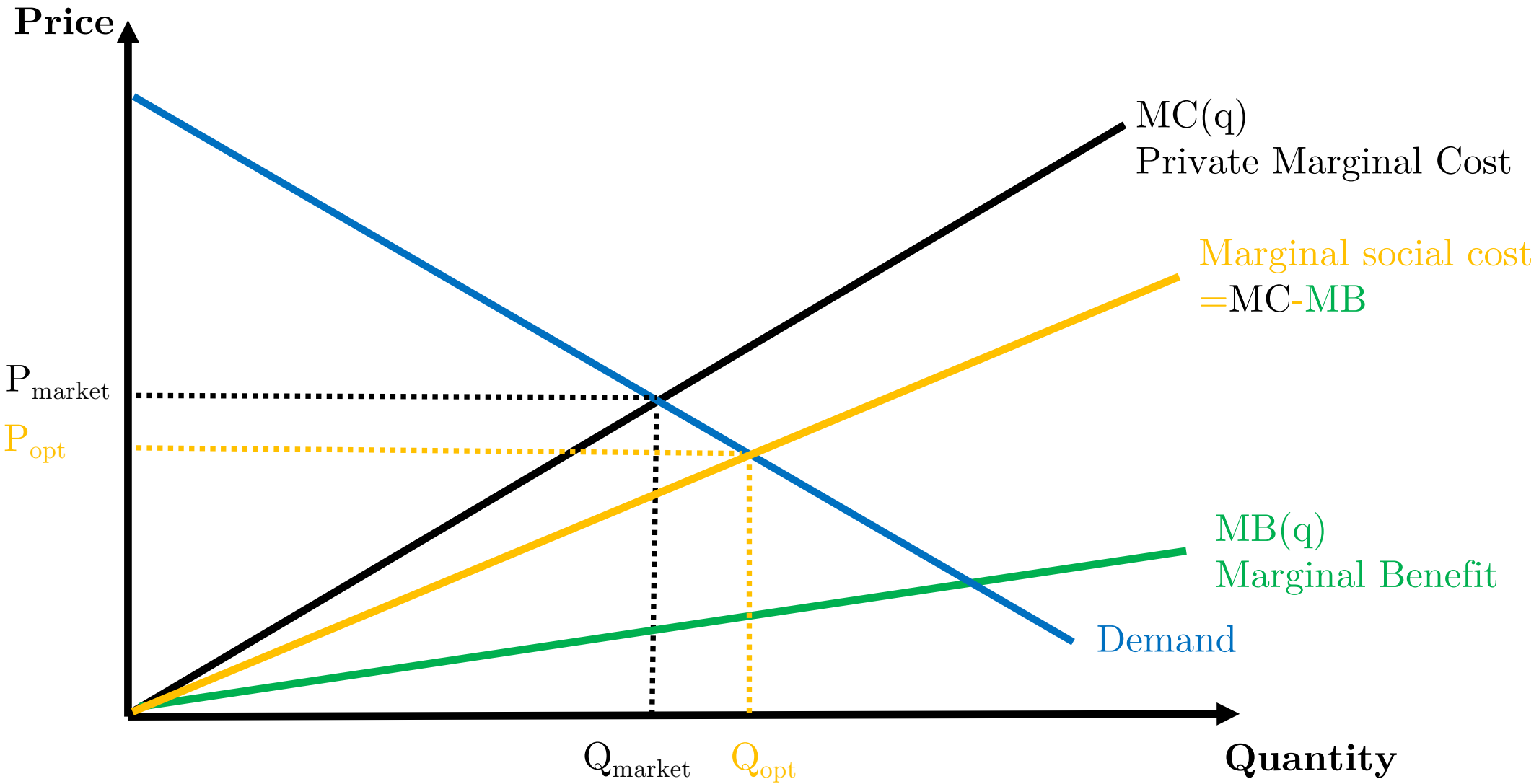
Optimal outcome vs market outcome

Negative externality (consumption)



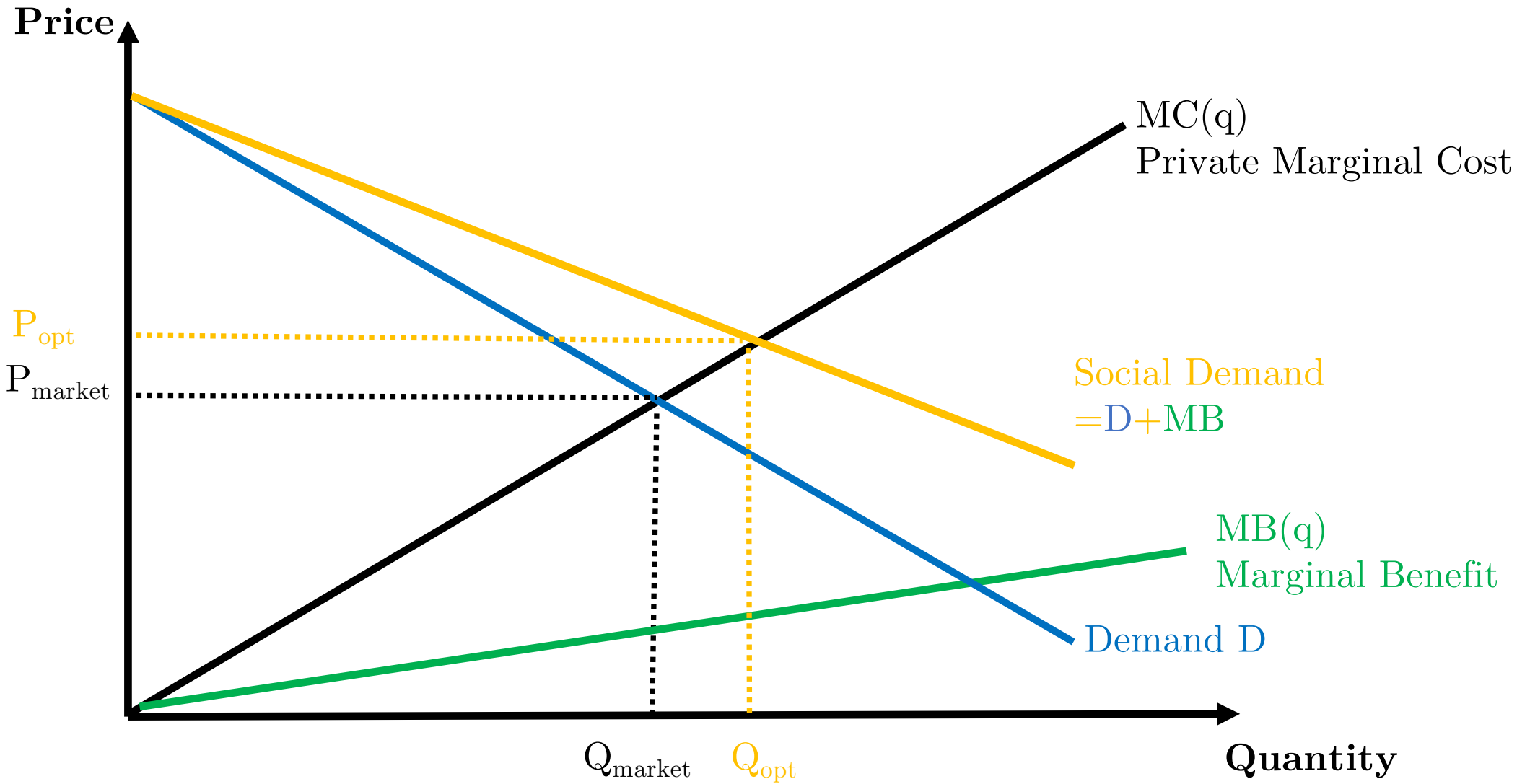
Optimal outcome vs market outcome

Positive externality (production)



Optimal outcome vs market outcome

Positive externality (consumption)



What correction to choose?

- **Norms & permits** if the production level is crucial
  Certainty on quantities, uncertainty on prices

  Example : nuclear wastes

- **Pigouvian taxes** if abatement costs vary among producers
  Uncertainty on quantities, certainty on prices

  Exemple : polluting chemical companies

  TGAP (*Taxe générale sur les activités polluantes*)

  Specific case of **Pigouvian subsidy**
  (pay the producter to produce less)
  Not recommended due to wrong incentives
  + ethically doubtful

Composantes TGAP	**Unité de perception**	**Taux en euros** (applicables au 1er janvier 2019 et seulement pour 2019)
Hydrocarbures non méthaniques, solvants et autres composés organiques volatils	Tonne	141,81
Poussières totales en suspension (PTS)	Tonne	270,94
Arsenic	Kilogramme	521,31
Sélénium	Kilogramme	521,31
Mercure	Kilogramme	1042,61
Benzène	Kilogramme	5,22
Hydrocarbures aromatiques polycycliques (HAP)	Kilogramme	52,14
Plomb	Kilogramme	10,23
Zinc	Kilogramme	5,12
Chrome	Kilogramme	20,46
Cuivre	Kilogramme	5,12

1. Numerical exercises

1. asymmetry of information
2. **positive externalities**
3. negative externalities

1. Numerical exercises

1. asymmetry of information
2. positive externalities
3. **negative externalities (additionally on Moodle)**

2. Research article: public good provision

Public good provision

Budish, Roin & Williams (2015)

"Do Firms Underinvest in Long-Term Research? Evidence from Cancer Clinical Trials"

American Economic Review

Motivation

- Cancer is the 2nd cause of death in the US (~25%) — 1st is heart disease

- 2010-2015:
  - 8 new drugs for lung cancer
    All for most advanced forms of the disease
    With very incremental improvement of survival (e.g. Genentech's Avastin 10.3 to 12.3 months)
  - Contrast: 0 approved to **prevent** lung cancer

- Why this ≠?
  - Are scientific challenges different?
  - Is there differences in demand from patients?
  - Are there private incentives?
  - Is it a distortion from optimal R&D levels (market failure)?

Motivation (ii) – 2 examples of clinical trials

- Clinical trials require:
  - Recruiting patients
  - Proving statistically significant survival improvement

- de Bono et al: metastatic patients (5 years survival ~20%)
  - Median follow-up time for measuring patient survival: 12.8 months
  - Trial length: 3 years

Privately funded

- Jones et al: localized cancer patients (5 years survival ~80%)
  - Median follow-up time for measuring patient survival: 9.1 years
  - Trial length: 18 years

Publicly funded

US National Cancer Institute

Motivation (iii) – Patents structure

- Patents awarded for 20 years when the innovation is registered

  Pharma firms are very likely to register early in the process at the stage of discovery

  and they face ≠ commercialization lengths

Trial length: 3 years => **17** remaining years of patent protection

Trial length: 18 years => **2** remaining years of patent protection

- Incentives provided by society are **unequally rewarding** inventions
  - Seems in favor of financing research on advanced stages of cancer

Data

- **Cancer Registry**
  SEER (Surveillance, Epidemiology and End Results) from National Cancer Institute
  - Patient survival time (diagnosis and death dates)
  - Basic demographics (age, gender, etc.)
  - Cancer stage (3): localized, regional, metastatic
  - Cancer type/organ (80): lung, breast, prostate, stomach, etc.

- **Clinical trials**:
  - 1973-2011
  - Informs on eligible patient groups (stage-organ)
  - Partial info on publicly or privately funded

- FDA **drugs approval**:
  - 1990-2002

No need to go through

TABLE 1—SUMMARY STATISTICS: CANCER-STAGE DATA

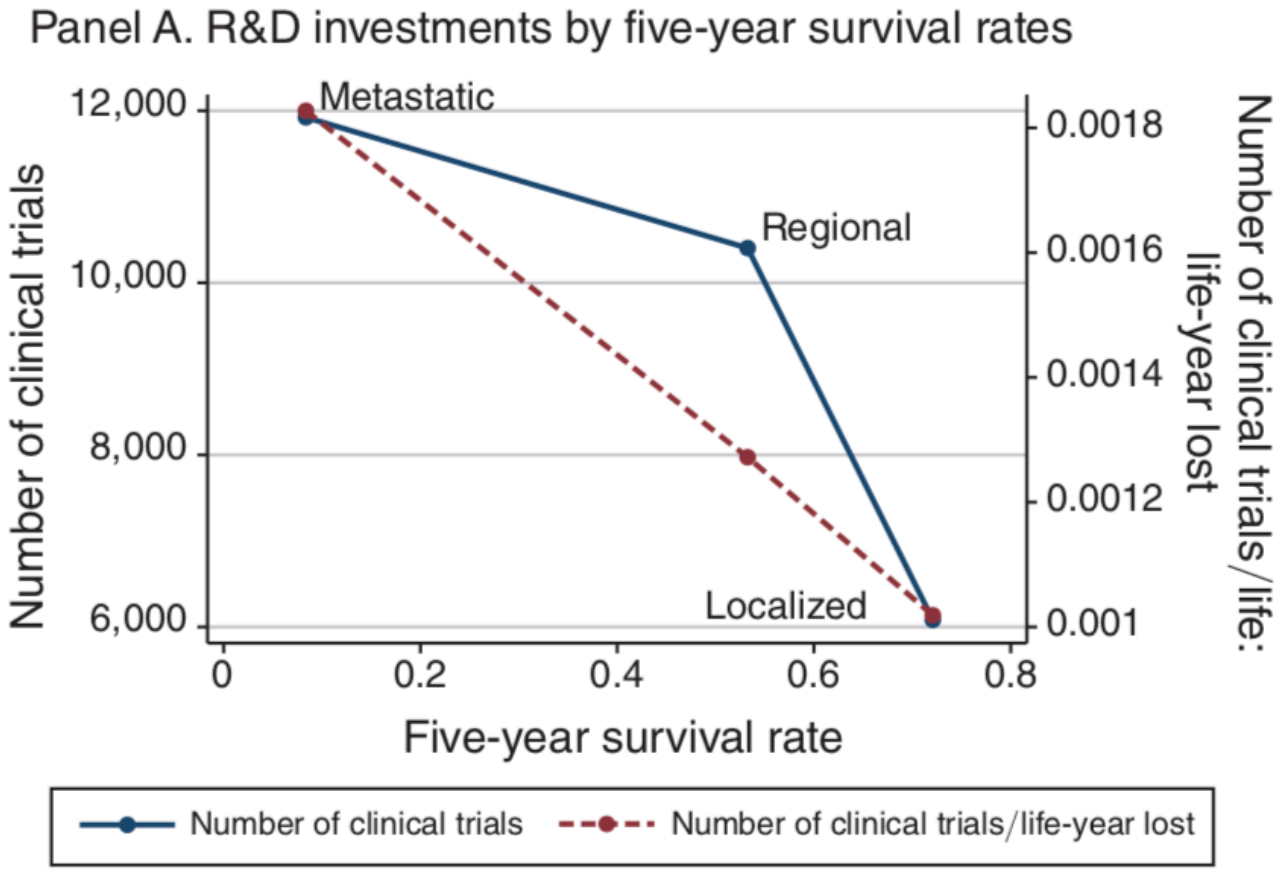
	Mean	Median	Standard deviation	Minimum	Maximum
Number of clinical trials, 1973–2011	945	556	1,015	221	7,385
Number of drug approvals, 1990–2002	0.507	0	1.221	0	7
Five-year survival rate, cases diagnosed 1973–2004	0.377	0.383	0.249	0.006	0.945
Number of diagnoses (1,000s), 1973–2009	12.423	3.159	29.429	0.010	252.593
Estimated years of life lost (1,000s), 1973–1983	114.433	35.663	233.576	0.583	1,658.804
Share of trials privately financed	0.258	0.265	0.062	0.122	0.507

Notes: This table shows summary statistics for our cancer-stage level data. The level of observation is the cancer-stage. The clinical trials data is available from 1973–2011. The drug approvals data is available from 1990–2002. The SEER data starts in 1973 and ends in 2009, which is why the number of diagnoses variable is measured over that time period. The five-year survival rate is calculated over patients diagnosed between 1973–2004, the cohorts for which five-year survival is uncensored as of 2009. The life years lost measure is calculated on cohorts diagnosed from 1973–1983 to minimize censoring, as explained in the text. As explained in the text, we suspect that sponsorship data is more likely to be reported for publicly funded trials relative to privately financed trials. All variables have 201 observations except for the life lost measure which has 192, because 9 cancer-stages had no patients diagnosed between 1973–1983. For details on the sample, see the text and online Data Appendix.

Research question

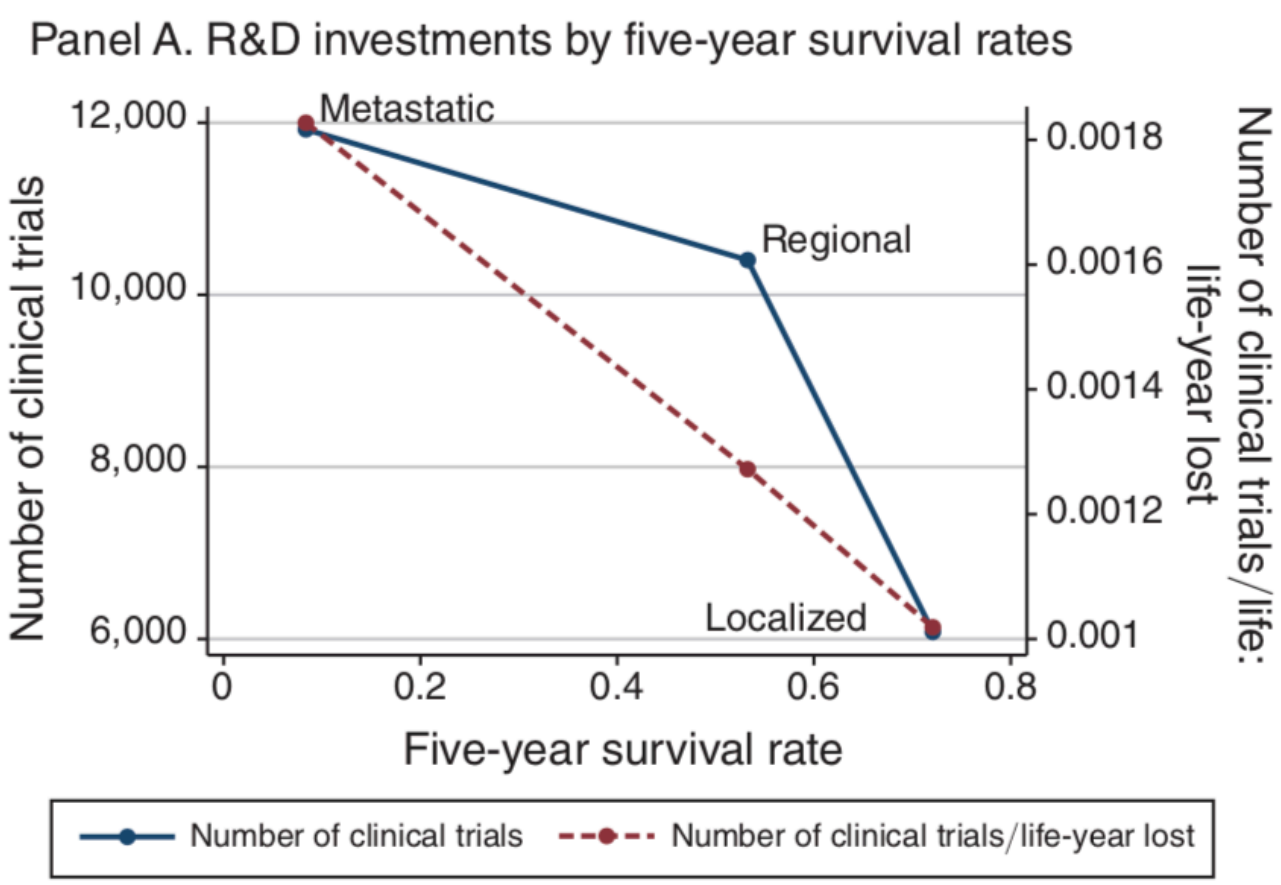
Do we indeed observe underfunded long-term R&D due to disincentivizing commercialization lags?

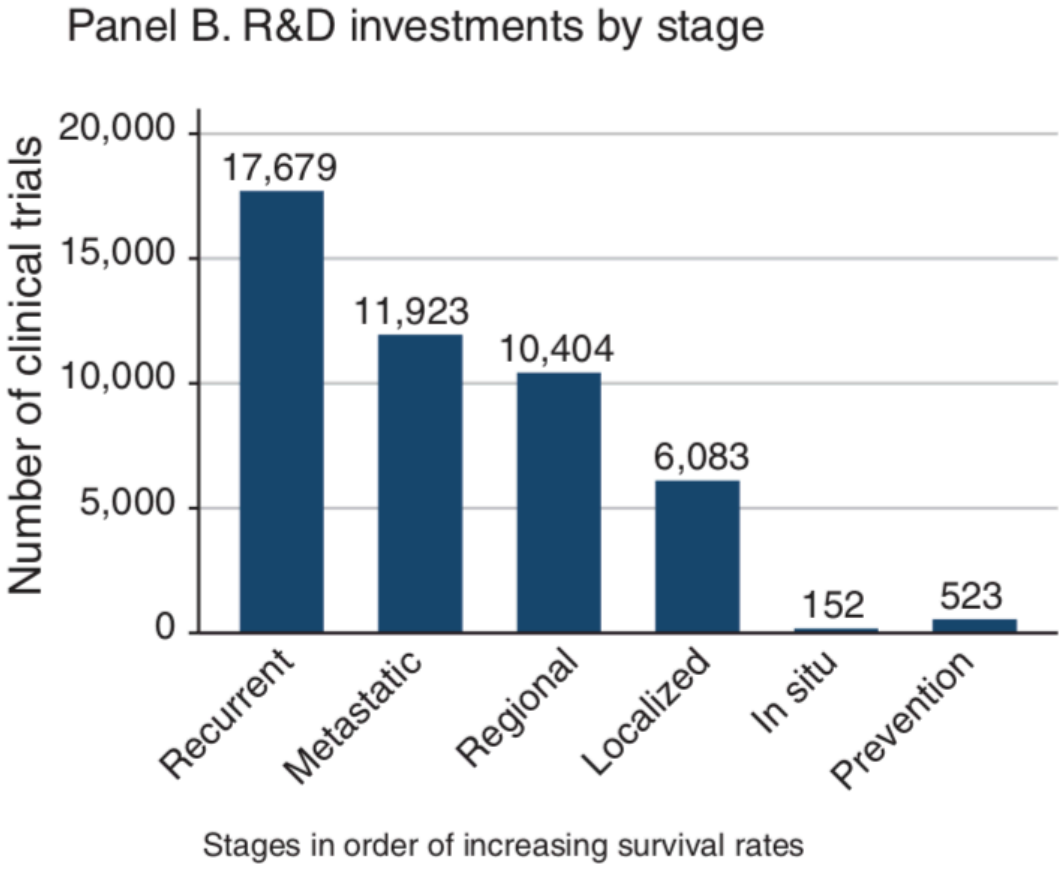
Survival and R&D Investments: Stage-Level Data



More trials for advanced stages

Survival and R&D Investments: Stage-Level Data





More trials and more money for advanced stages; almost $\emptyset$ for prevention

Cautious interpretation

It **could** be linked to the lower private incentives (patents & long-time)

but...

1. correlation need not reflect a causal relationship
   no guarantee that with lower commercialization lags, there would be ↗ R&D
   e.g. if scientifically too challenging
   or if lower demand for treatment from healthier patient less willing to enroll in clinical trials

2. The social planner may also favor faster research projects to some extent

So we need more to highlight a market failure

Drugs' approval

The Food and Drug Administration (FDA) may validate drugs which are:

1. **safe**
2. **effective**: assessed as improving survival or "disease-free survival" (i.e. time until cancer recurrence)

Sometimes an intermediate measure is used for effectiveness:

Surrogate: **intermediate markers** thought to be good **predictors** of subsequent **clinical improvement**

e.g. lower blood pressure accepted as an outcome for treating hypertension

Controversial and hard to find **valid surrogate**. **Use remains scarce**

i.e. sometimes there is a biological activity without true health improvement.
e.g. ↘ prostate specific antigene not linked to lower proba. of cancer

Hematologic cancer as a counterfactual

Leukemia, hematological cancer more allowed to get drugs approve by surrogate

because blood analysis is a good predictor of clinical improvement

FDA drugs approval data:

- 92% for hematological malignancies approved with surrogate end-points
- 53% for non-hematological malignancies

Use hematological cancer as a counterfactual:
what would be the R&D if we could have shorter commercialization length?

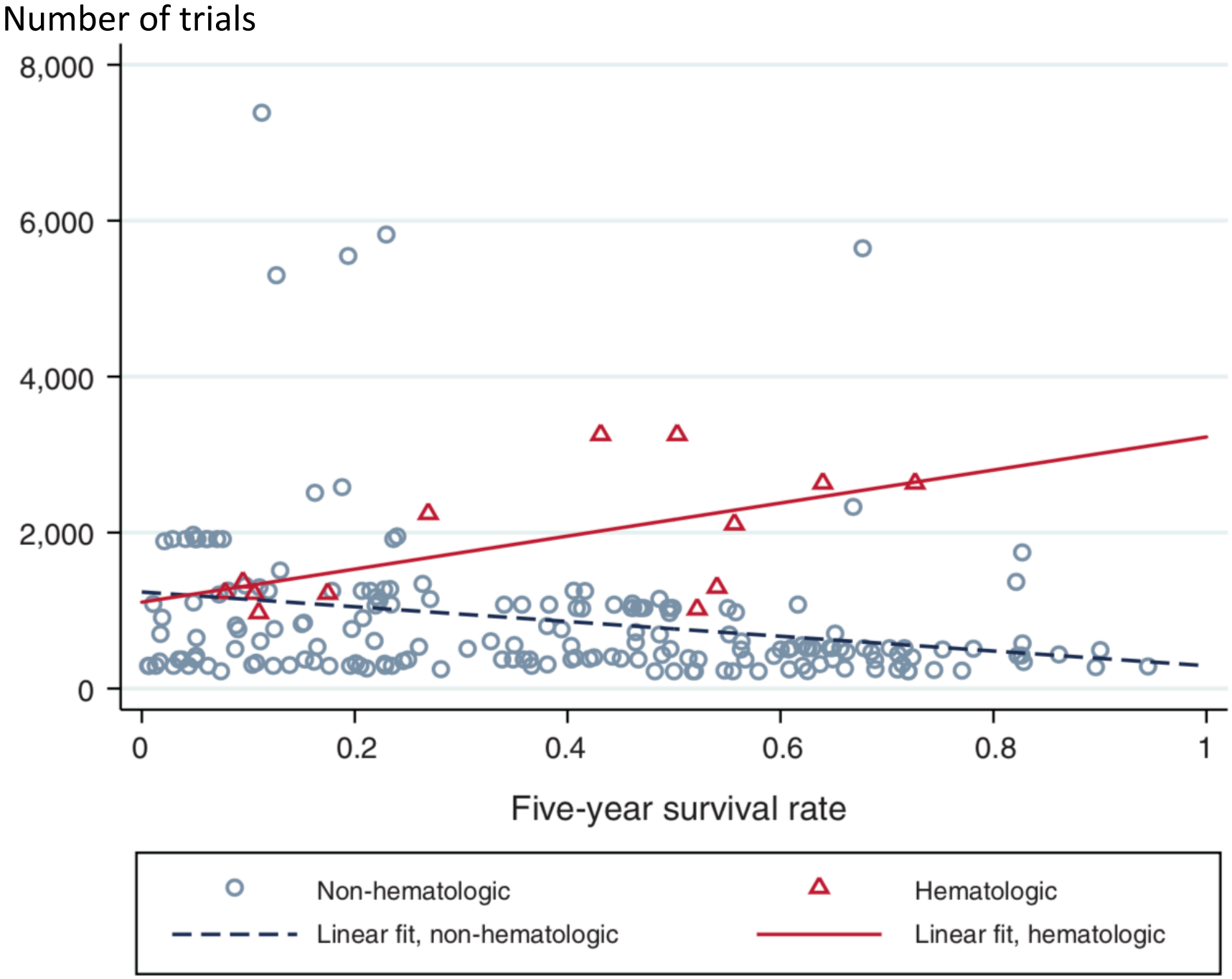
Results

Negative relationship between commercialization length and R&D in general

Positive or flat relationship for cancers with commercialization length reduced by surrogate

Here we see that for **the same 5-year survival rate**, there are **more trials** when there are **shorter** clinical trials **lengths**

(addresses the 3 points in cautious interpretation)



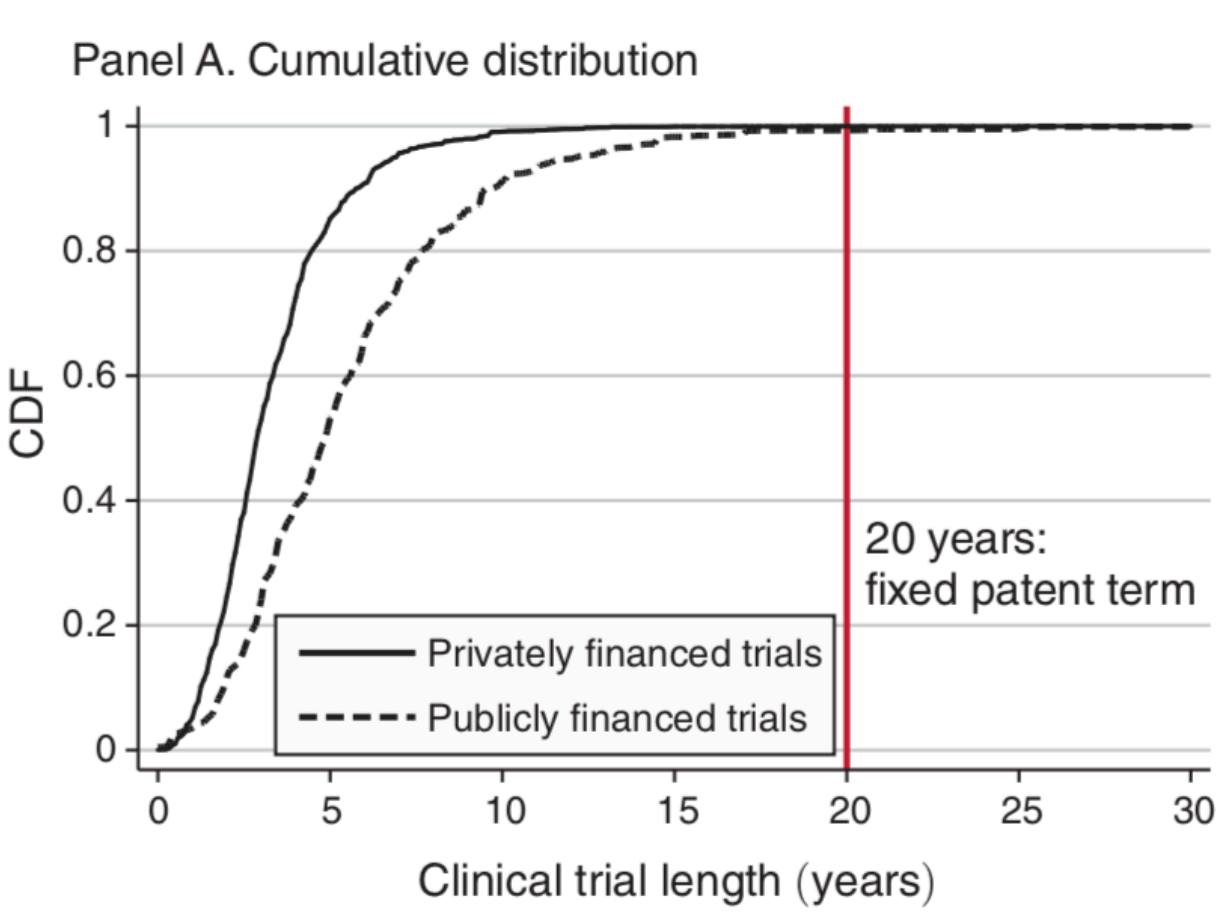
Note: each point is a cancer-stage observation (e.g. localized pancreatic cancer, regional bladder cancer, etc.)

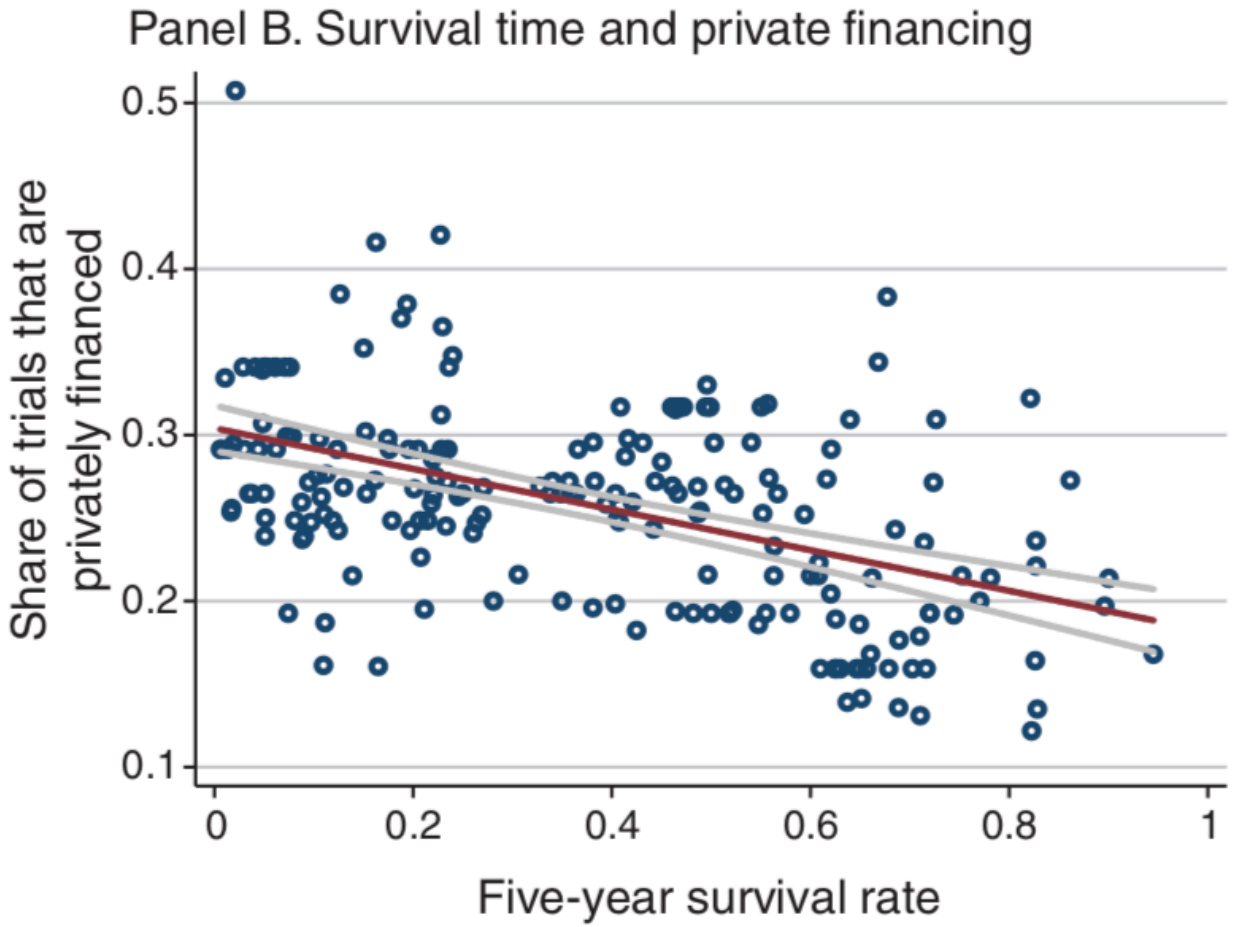
Increase in R&D when shorter trials

- This is causal & there is a market failure
- Society does favor higher investment in R&D
- Patients are willing to engage in the trial even those healthier
- They show the missing research would have positive health outcomes

  The marginal drugs (those that are not developed) would increase survival

Public/private funding of research





Both public and private R&D ↘ with longer commercialization lags, but public at lower rate

Back-of-the-envelope valuation

- Use low Value of Statistical life ($100,000/life)
- **Counterfactual**: relatively higher improvement in survival for hematological
- 890,000 life-years among people diagnosed with cancer in 2003 alone
  $\Longleftrightarrow$$89 billions
- And compute a net present value of life-years of $2.2 trillion

Policy implications

1. **Reduce commercialization lags**
   - ❖ Valid surrogates may be hard to find but it should be an objective
   - ❖ Public funding must support this effort
     "No individual private firm wants to come in and provide all of the evidence that you need to validate a surrogate endpoint, because once one is validated, that's going to be used by all of the firms on the market."

2. **Subsidize R&D** by **targeting long commercialization lag** projects
   - ❖ Prevention and early-stage cancer for which private funding is missing

3. **Adjust incentives of the length of patents**
   - ❖ Start the patent clock at commercialization (not fully addressed by the paper)
   - ❖ FDA can grant exemptions to account for the time R&D takes. 1984 Hatch-Waxman Act:
     "additional half-year of patent life for every year spent in clinical trials, max 5 years not exceeding 14 total years"
   - ❖ Broader question: **is a 'one-size-fits-all' patent policy optimal**? (20 years in most industries)

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