F. SUPPLY OF HEALTH CARE

F.1 Physicians

F.2 Hospitals

F.3 Pharmaceutical Drugs

F.4 Long-Term Care (Bonus)

Bhattacharya, Hyde and Tu
Chapter 5: The Labor Market for Physicians
Chapter 6: The Hospital Industry
Chapter 12: Pharmaceuticals and the Economics of Innovation

F.1 PHYSICIANS: SUMMARY

F.1.1 Physician income

– higher income to provide return to training

F1.2 Physician licensing (to improve quality by training)

– restricts physician supply

– can restrict substitutes, e.g. physician assistants

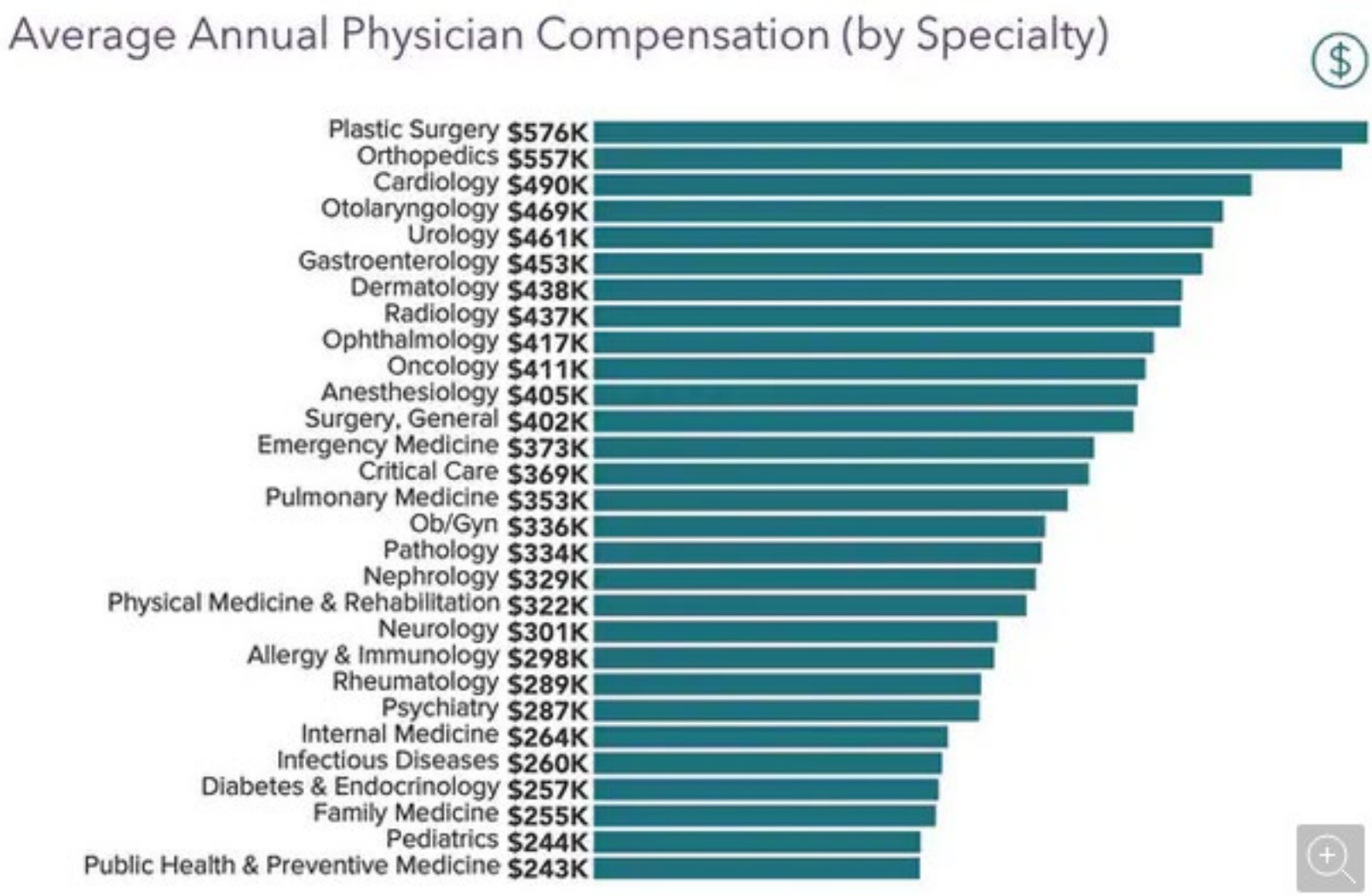
F.1.3 Physician-induced demand

- physician-induced demand can shift out demand curve.

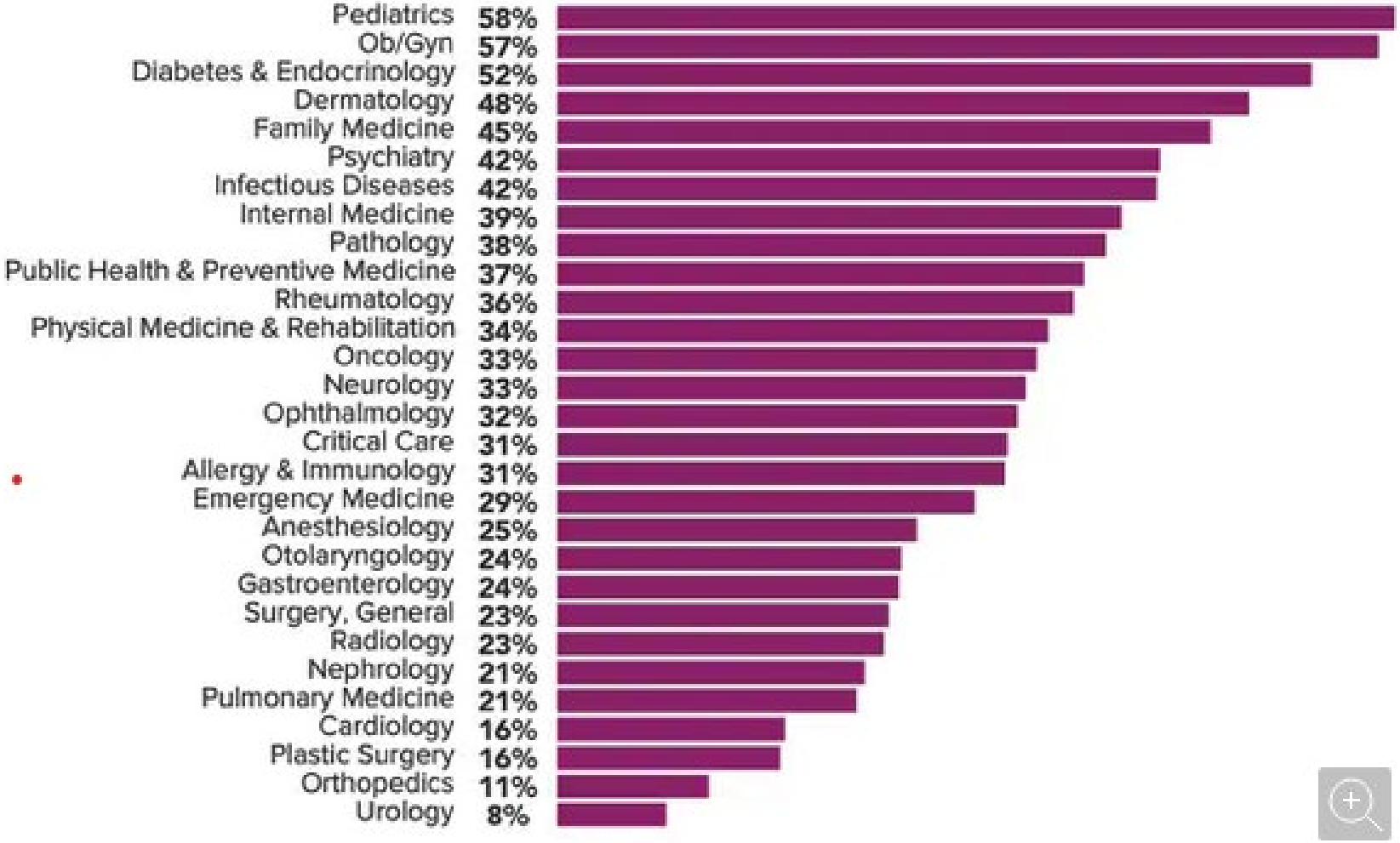
F.1.1 Physician Income: Amount

- Physician income is very high.
  - Figures vary by source.
- From Medscape Compensation Report 2022 (May 2022)
  - Primary care $260,000 is ave. annual full-time compensation
  - Specialist $368,000 is ave. annual full-time compensation
  - And varies within specialty
    (Often lower where copays/coinsurance more important).
- Other details
  - less than one-third in private practice (rest on salary)
  - self-employed earn 20% more
  - 57% have performance bonus which is 10-20% of salary
  - hours are long (average 50 hours per week)
  - across specialties 42-72% feel fairly compensated and 63%-99% would choose the same specialty again.

Medscape Physician Compensation Report 2021
Average Annual Compensation



Percentage of Women in Specialties



- **Training:** 4 years med school
  + 3-4 years residency
  + more years if specialist

- Doctors income high as
  - Highly skilled
  - High direct cost of training
  - Large foregone earnings during training
  - Unpleasant training
  - Demanding job (long hours)

- We consider how to allow for the high cost of training.

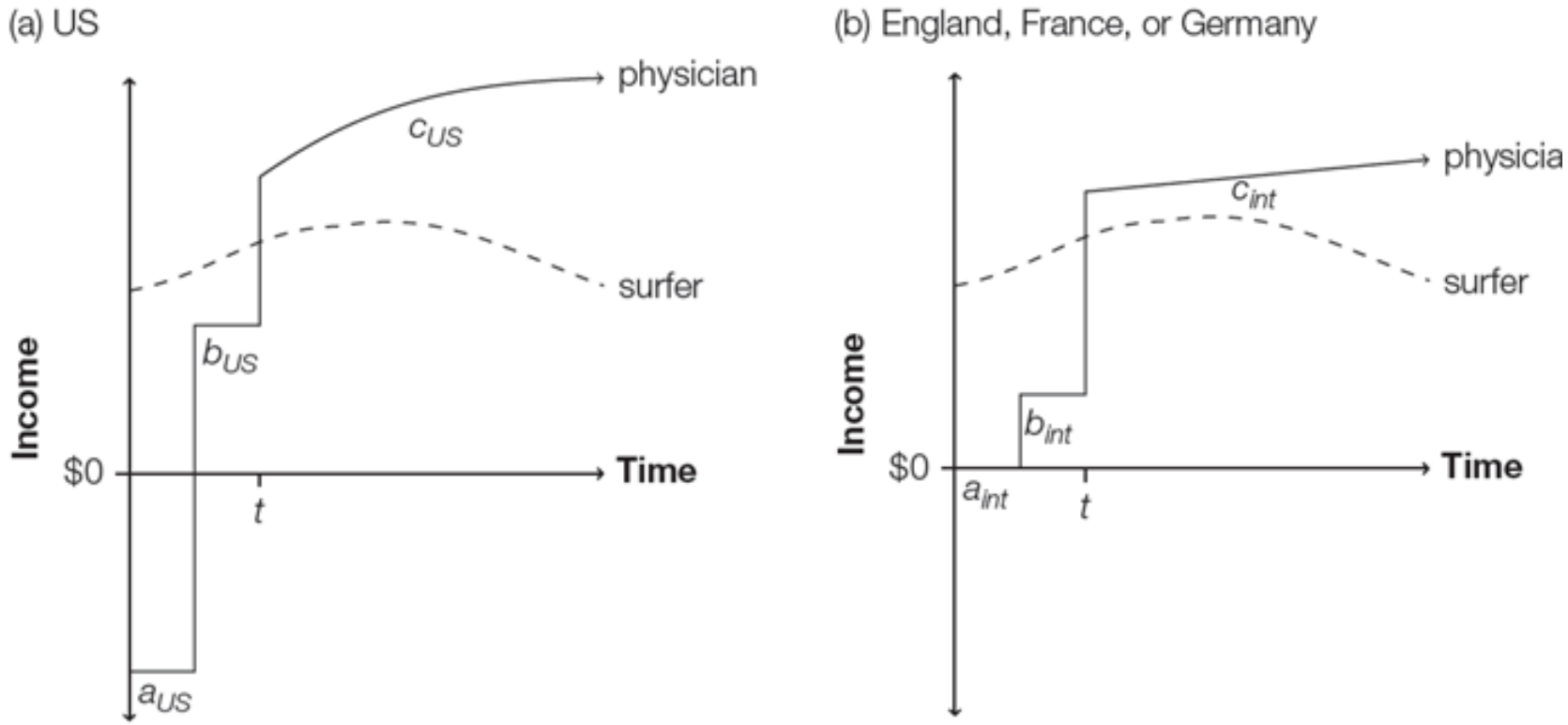


Figure 5.2. *The surfer earns a moderate income over his entire career. (a) In the US, an aspiring physician earns negative income while in medical school (interval a_{US}) and then relatively low income during residency (interval b_{US}). After that though, he makes a very high income (interval c_{US}). (b) In countries where medical school is entirely or heavily subsidized, physicians-in-training sacrifice less income early on (interval a_{int}) but also tend to earn less after graduation.*

F.1.1 Physician Income: Human Capital Theory (cont.)

- Net present value is the discounted value of future returns
  - $NPV = \Sigma_{t=0}^{T} \delta^t \times I(t)$ where δ is the discount factor
  - $= \Sigma_{t=0}^{T} I(t)/(1+r)^t$ where r is the discount rate
- **Internal rate of return** r* is where PDV of costs and benefits equated across investments (here training and no training)

  $\Sigma_{t=0}^{T} I_A(t)/(1+r^*)^t = \Sigma_{t=0}^{T} I_B(t)/(1+r^*)^t$
- IRR for doctors is high compared to e.g. market interest rates.
- Example: A 1985 study found for 1980 that IRR is
  - 12% for all physicians versus just 4-year college degree
  - 14% for GPS versus just 4-year college degree
  - 7% for lawyers versus just 4-year college degree

F.1.1 Physician Income: Human Capital Theory (cont.)

- Compare college graduate with biology degree to omeone who trains as a pharmacist (four more years of training).

  - Manuel Carvajal and Iona Popoovici (2021), "The Rate of Return to a Pharmacy Education Investment in the U.S.,"Research in Social and Admininstrative Pharmacy, Vol.17, pages 904-910.

- All figures in real (inflaction-adjusted) dollars.

  - Pharmacy training costs $40,920 and in financed by a large 24 year loan at 6.67% real rate

  - Biologist begins at $44,500 & grows 1% annually in real terms.

  - Pharmacist begins at $126,120 & grows 1% annually in real terms (in first year work only six months).

- Figure on next page

F.1.1 Physician Income: Human Capital Theory (cont.)

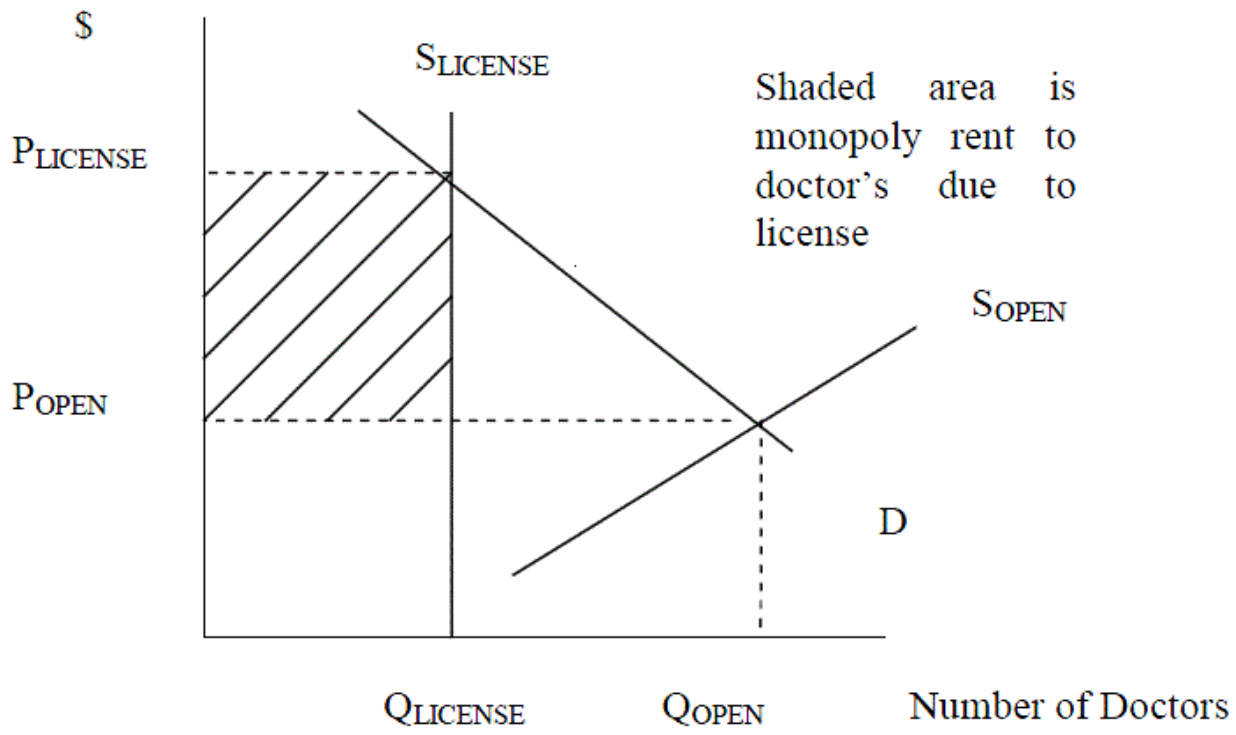
Age	Estimated Costs (U.S. dollars at 2019 prices)			Estimated Benefits (U.S. dollars at 2019 prices)		
	Tuition	Books and Fees	Financing (interest)	Salary as a Biologist	Salary as a Pharmacist	Net Income (benefits)
22	35,920	5000	4160	44,500	0	−44,500
23	35,920	5000	8320	44,945	0	−44,945
24	35,920	5000	12,480	45,394	0	−45,394
25	35,920	5000	16,640	45,848	0	−45,848
26			16,640	46,307	63,060	16,753
27			15,808	46,770	127,381	80,611
28			14,976	47,238	128,655	81,417
29			14,144	47,710	129,942	82,232
30			13,312	48,187	131,241	83,054
31			12,480	48,669	132,553	83,884
32			11,648	49,156	133,879	84,723
33			10,816	49,647	135,218	85,570
34			9984	50,144	136,570	86,426
35			9152	50,645	137,936	87,290
:			:	:	:	:
72				73,186	199,327	126,141
73				73,918	201,321	127,403
74				74,657	203,334	128,677
75						
Total	143,680	20,000	216,320	3,090,373	7,861,669	4,771,296

Calculations lead to internal real rate of return of 4.89%.

F.1.2 Physician Licensing

- Motivation for licensure is to **improve quality**.
- But can **increase physician income** (profits) by
  - Restricting supply
  - Restricting ability to substitute to other inputs
    (nurse practitioners, competing types of doctors, …)
- Supply was especially restricted from
  1910 (Flexner Report upgraded standards to be a doctor)
  to 1965 (fed govt. increased physicians trained).

DEMAND AND SUPPLY OF DOCTORS UNDER LICENSURE



In practice higher quality doctors will push the Demand curve out, leading to even higher prices.

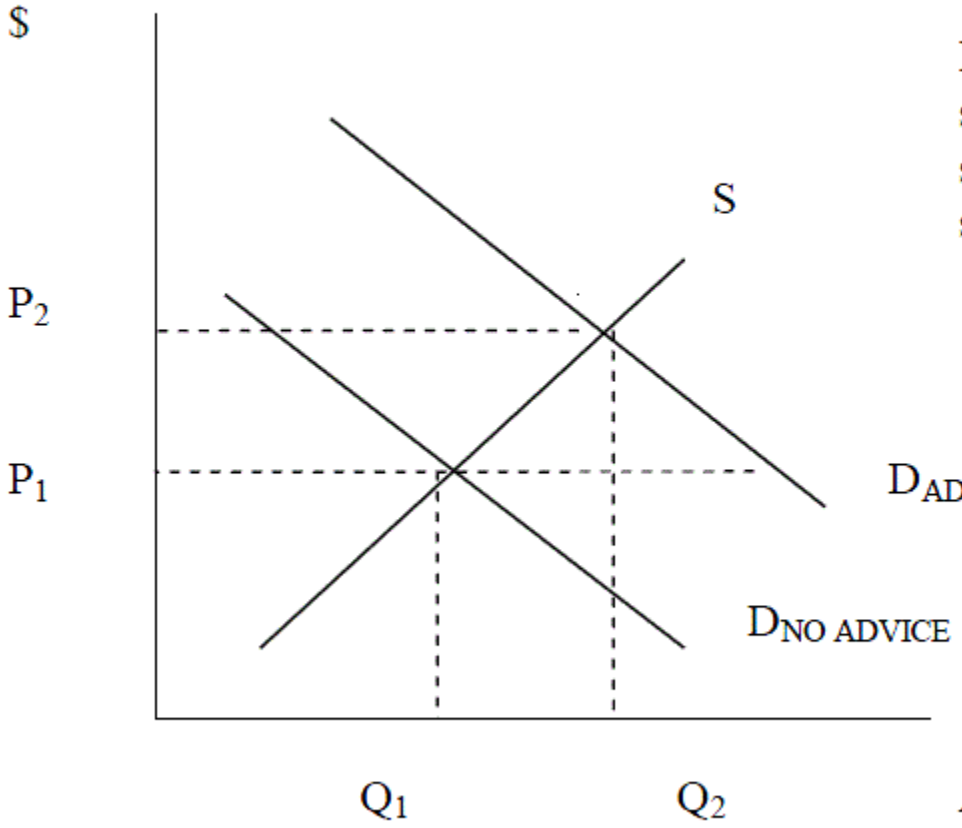
F.1.2 Physician Licensing (continued)

- Fuller history:
  - Pre- 1900 licensure resisted by govt as doctors had little to offer in return (little science)
  - 1910 Flexner Report advocated higher standards for medical schools (improve quality)
  - 1930-60 AMA restricted growth to 1% per year (pop. growth)
  - 1963 legislation built more medical schools, bribed existing schools and allowed more foreign physicians.
    Physician supply ↑ but also income continued ↑
- Foreign medical graduates provide flexibility as can more quickly increase or decrease than train doctors in U.S.
- 50% of new medical school graduates are women.
- Cycles of predictions of too many doctors and too few doctors.
- And always too few nurses (economist skeptical: raise wage).

F.1.3 Physician-Induced Demand

- **Physician-induced demand** occurs when doctor moves out demand curve by telling (poorly-informed) patient to consume more (e.g. more visits).
- Then quantity ↑ and price ↑ so revenue up.
- Many health economists downplay this, but hard to test.
  - Some evidence of target income for physicians.
    If fees down then # services up (and vice-versa).
  - If doctors own an MRI machine it is used more by them.
- Physician-induced demand is most likely when
  - doctors are paid under FFS and are not salaried
  - patients have FFS insurance with low copays and deductibles.
- This was the case up to the 1980's, but now we have managed care, more salaried doctors, higher deductibles, …

PHYSICIAN INDUCED DEMAND



Physician may suggest additional services e.g. MRI scan if owns MRI

F.2 HOSPITALS: SUMMARY

F.2.1 Hospital history

- Came of age in the 20th century.

F.2.2 Hospital Characteristics

- Big and funded by third party.

F.2.3 Physicians within Hospitals

- Not traditional firm.

F.2.3 Hospital Competition

F.2.5 Hospital reimbursement

- change from retrospective to prospective payment
- and to negotiated fees with much discounting off posted prices.

F.2.1 Hospitals History

- Originally care for those without potential home care
- Word "hospital" originated in 12th century.
- First U.S. hospital in Pennsylvania in 1751
- Technological advances beginning in late 1800's
  - anesthesia for surgery
  - asceptic techniques to reduce germs
  - x-rays to diagnose.
- Funded in U.S. by philanthropy until 1929.
  - then insurance initially through Blue Cross
    and now MCOs and Medicare/Medicaid.
- 1946 Hill-Burton Act
  - increased # hospitals by paying for construction
  - in return hospitals provide free or low-cost care for the poor.

F.2.2 Hospital Characteristics

- 6,100 hospitals, 920 million beds, 7.4 million workers in 2019. Mostly community hospital; 20% are for profit.
- Average characteristics of a hospital in 2010
  https://www.statista.com/study/11733/hospitals-in-the-us-statista-dossier/
  - $220 million revenue (41% for outpatient care)
  - 150 beds (there are economies of scale)
  - Revenue sources mostly third party (and much from govt.)
    - 35% Private insurance
    - 57% Government (28% Medicare, 20% Medicaid
    - 3% Patient self-pay (often copay)
    - 5% Philanthropy and other private
  - Uses of Funds
    - 56% Wages and benefits
    - 12% Professional Fees
    - 32% Supplies, other

- Hospitals are much more labor and capital intensive and treat serious case, so utilization is down but is more intensive.

- Utilization
  - 2018 6.7% of popn per year have one or more hospital stays
  - 1980-2018 Ave length of stay down from 7.6 to 5.4 days
  - 66% of beds are occupied (excess capacity)
  - Increased use of substitute outpatient surgery.

- Great change in real cost per patient bed day (2010 $)
  [due mostly to increased labor per bed day]

1950	1960	1970	1980	1990	2000	2010	2019
$100	$170	$330	$560	$1000	$1400	$1800	$3,100

- Kaiser Family Foundation: hospital expenses per inpatient day $2,900 in 2021 in current 2021 $
  - ranged from $1,300 in Misissippi to $4,200 in California.

F.2.3 Physicians within Hospitals

- In the U.S. physicians are usually not directly employed by the hospital.
- Instead the physician has access to the hospital
  - called "physician's workbench"
  - patient pays both hospital for use of its facilities & physician
  - this may provide little incentive to keep costs down.
- This also raises issues of who controls the hospital
  - Administration / Managers ?
  - Doctors ?
  - Community ? Since hospital is not-for-profit.
- Volume-outcome relationship
  - outcomes for a service (e.g. coronary bypass) are better the more the hospital does the service.

F.2.4 Hospital Competition

- Hospitals do compete
  - most are non-profit which is tax-favored
  - but non-profits behave a lot like profits.

- Herfindahl-Hirschman Index (HHI) measures concentration
  - HHI = $\sum_i s_i^2$ where s_i = market share
    = 0 if little concentration to 1 if monopoly
  - HHI = 0.33 on average for hospitals in each market
    This is e.g. 3 hospitals each with a one-third market share
    > 0.25 is highly concentrated according to Justice & FTC

- Hospitals compete as oligopolies with a differentiated product.
  - price competition is muted by insurance
  - competition is more on quality
    e.g. get the best doctors by having the best equipment
    (medical arms race)
    e.g. nice hospital amenities for patients.

F.2.5 Hospital Reimbursement

- Historically paid by **retrospective payment**
  - payment for each service provided to the patient.

- Increasingly **prospective payment** where paid for providing a particular treatment regardless treatment intesity
  - e.g. payment by diagnosis related group (DRG)
  - e.g. per diem hospital accommodation per bed day
  and capitation with Casemix adjustment for severity of case.

- Hospitals prices in the U.S. are negotiated with payers.

- The starting point is a menu of prices for different services called the **chargemaster**.

- Bhattacharya et al. Figure 6.3 gives posted prices for seven different California hospitals for several procedures
  e.g. A chest x-ray is listed as $120, $120, $410, $410, $450, $800 and $1,500 at the 7 hospitals!

- There is then much discounting (75% discount is not unusual)
  - Medicare and Medicaid pay the least
  - private insurers pay the next least
  - uninsured pay the most (if they can pay)
  - about 6-7% of hospital care is uncompensated.

Other Methods of Funding Hospitals

- **Philanthropy**
  - The initial funding source for hospitals and still happens.
- **Global Budget** = grant for all costs.
  Military, VA, State mental and also other countries.
- **Cost shifting**
  - revenues from one group of patients subsidizes others
  - pays for uninsured, research, education, autopsies, complex cases, Medicaid (if under-reimburse)
  - possible if profits made elsewhere.

F.3. PHARMACEUTICAL DRUGS

F.3.1 Pharmaceutical history

- Really established in 1940's.

F.3.2 Pharmaceutical industry characteristics

- Now mostly funded by third party
- High prices under patent encourages R&D and new drugs.

F.3.3 Pharmaceutical reimbursement

- When patent in effect monopoly pricing
- Generics possible once off patent and formularies are used.

F.3.4 Drug Research and Development Process

- Very expensive and takes a long time to bring drug to market.

F.3.5 Pharmaceutical example: Claritin (Loratadine)

F.3.1 Pharmaceutical History

- Late 1800's: Help symptoms but no cure.
- Mid 1890's: Diphtheria anti-toxin.
- 1902: Biologics Control Act (federal govt. gets involved)
- 1906: Pure Food and Drug Act (labeling)
- 1931: FDA established (Food and Drug Administration)
- 1940's: Growth of modern pharmaceutical firms
  - new techniques
  - patent process, not just product
  - licensing to other firms ceased.
- 1950's-60's: Wonder drugs created e.g. aspirin.
- 2010's: Biologics (complex mixtures such as vaccines, rather than single chemical entity) being developed.

Pharmaceutical history (continued)

- 1962: Thalidomide anti-nausea drug led to birth defects
- 1962: Drug approval requirements ↑ (safe and effective).
- 1984: Can extend patent up to 5 years (beyond 20) if long delays in approval. Also much easier to approve generics.
- 1997: Speed up drug approval. Allow more advertising.
- 2007: Monitor drugs after approval (e.g. Vioxx, stents).
- Recent large increase in brand name drug prices, especially biologics (not simply a chemical).
- 2020: Rapid development and approval of Covid-19 vaccines including messenger ribonucleic acid (mRNA).
- 2022: Inflation Reduction Act includes negotiated prices for 10 Medicare Part D drugs in 2026.

F.3.2 Pharmaceutical Industry Characteristics

- $378 billion in 2021 on retail prescription drugs.
- Current detailed data is difficult to find.
- **Revenue Sources**
  - 45% Private Insurance
  - 15% Out of pocket (versus 82% in 1970)
  - 28% Medicare (versus 2% before Part D)
  - 8% Medicaid
  - 4% Other Public
- Big changes are switch from self-pay and introduction of Medicare Part D Prescription in 2006.
- Prescription drug average prices from Getzen (2010) p.249
  - All prescriptions $72
  - Brand name $138 [35% of prescriptions]
  - Generic $35 [65% of prescriptions]
  - Generics were 20% of dollars spent.

Pharmaceutical Industry Characteristics (continued)

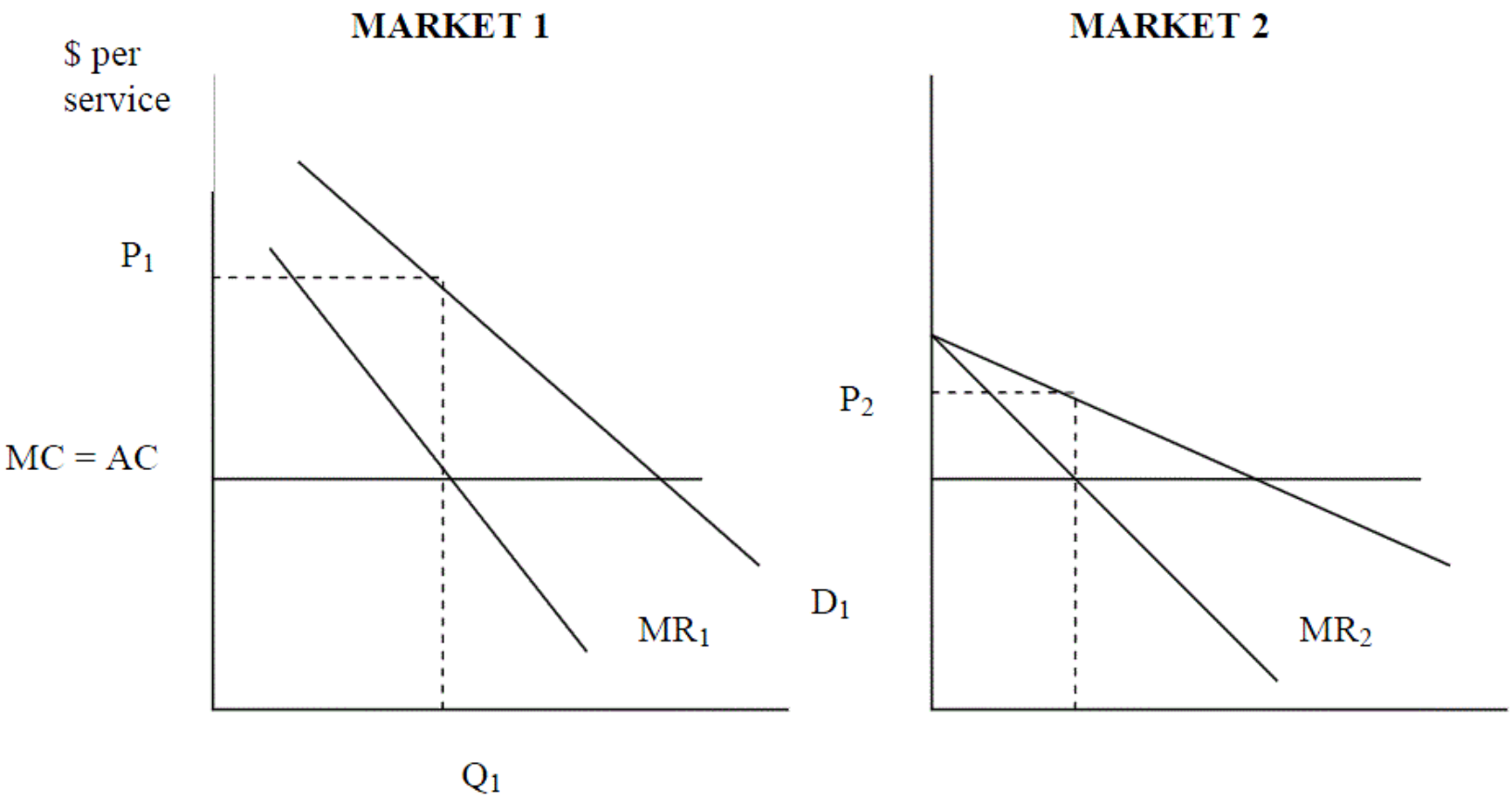
- Use of funds (old 2003 data)
  - 30% Cost of Drugs
  - 31% Sales, Marketing, Advertising, Administration
  - 13% R & D (Research and Development)
  - 6% Taxes
  - 20% Profits
- High profit rate (for non generic drugs)
- R&D is high but not as high as one might think
  - PhRMA survey says 20% of sales in 2019.
- Big risk as it is calculated that each new chemical entity costs as much as $500 million (questionable) to bring to market.
- Patent can be extended extra five years beyond 20 years if approval delay, provided <= 14 years effective patent life.

F.3.3 Pharmaceutical Reimbursement

- Many drugs must be provided by insurers regardless of price and cost-effectiveness!
- Medicare by law cannot directly negotiate with drug manufacturers over price for Part B (which covers physician-administered intravenous drugs) or Part D (oral cancer drugs) and cannot consider cost or cost-effectiveness in coverage decisions.
- Medicare Part D plans must cover all drugs in six protected classes (anticonvulsants, antidepressants, antineoplastic, antipsychotics, antiretrovirals and immunosuppressants) which includes anticancer drugs.
- Three-quarter of states require insurers to cover anticancer drugs for off-label uses.
- Even without these requirements insurers face great pressure from doctors and advocacy groups if they restrict access.
- Some discounting to 340B-qualified buyers and to Medicaid.

Pharmaceutical Reimbursement (continued)

- When drug is on patent have monopoly.
- Price as monopolist:
  - Q such that MR = MC and
  - Price = MC / (1 + 1/e) = MC × (e/(1+e))
    e = price elasticity of demand = (dP/dQ)×(Q/P)
  - e.g. e = -2 then Price = MC / (1 – 1/2) = 1.5×MC
  - Aside:
    MR = d(PQ)/dQ = (dP/dQ)×Q + P = (dP/dQ)×(Q/P)×P + P
    MR = MC implies (1/e)×P + P = MC implies MC / (1 + 1/e)
- Often face different markets
  - Different purchasers (MCO's ….)
  - Different countries
  - Consumers with access to discount coupons
  - Price differently in different markets


MARKET 1
MARKET 2
$ per service
P1
MC = AC
MR1
D1
P2
MR2
Q1

Pharmaceutical Reimbursement (continued)

- To encourage competition from substitute drugs
  - MCO's use formularies (lists of preferred drugs)
  - These attempt to discourage use of high cost drugs
  - And often tiered pricing
    e.g. $15 generic
    $35 brand name on formulary
  - Brand name drugs try to get around this by giving coupons that reduce the copay (to even below that for the generic).

- Also competition from other forms of health care
  - pharmaceutical substitute with other forms of health care
  - different countries have greatly different use of drugs.

- Recently no blockbuster drugs like e.g. aspirin
  - but that may change with biologics
  - e.g. Humira for arthritis, … $20 billion revenue in 2020

- **Drugs** are chemicals manufactured through chemical synthesis
- **Biologics** are complex mixtures of molecules manufactured in a living system (microorganism or plant or animal cells) often using recombinant DNA.
- **Generic drugs** must have the same, strength, dosage form and administration route as the reference drug and be bioequivalent
- Easy for drug but difficult for biologic
  - "generic" biologic is called a **biosimilar** and needs a drug trial.

- **Recent high prices of newly-developed drugs/biologics** and of some existing drugs bought out by other companies.
  - Epipen (Mylan) injectable adrenaline for allergic reactions was $100 in 2008 and is now $650 for a twin pack.
  - Daraprim (Turing – Martin Shkrelli) for toxoplasmosis and cystiososporiasis price rose in 2015 from $13.50 a pill to $750.
  - Kymriah (Novartis) a biologic for cancer (esp. a rare form of leukemia) for cancer will cost $475,000.
  - Insulin around for 100 years though improvements over time. In 2018 the average insulin price in the US was $98.70, compared to $6.94 Australia, $12.00 Canada, and $7.52 UK. There are many different formulations - see https://www.goodrx.com/blog/how-much-does-insulin-cost-compare-brands/
- **Price of generics fell** by approx. 50% from 2016 to 2023 due to three buyers accounting for 90% of purchases. Some shortages.

F.3.4 Drug Research and Development Process

- First step
  - Discovery
  - Synthesis
- Second step
  - patent (20 years from time of filing)
  - in vitro research (test tube cultures) and animals
  - often end-of –the-road
- Third step (has three phases)
  - Clinical trials in humans
  - Phases I to III.
- Risky process
  - < 1 in 5,000 new chemical entities make it to market.
  - it costs > $100 million to bring a drug to market
  - patents last 20 years from submission, then others may produce.

Phase I to III Trials

- Phase I:
  - A few people
  - Determine tolerable dose
- Phase II:
  - 30-300 patients studied for 2 years on average
  - safety and efficacy
- Phase III:
  - 1,000's of patients for 3 years on average
  - Double-blind trials
  - better measures efficacy and further ensures safety
- Fourth step
  - FDA approval takes another 2-3 years
  - there may be little time left on patents.

Drug Approval

- FDA requires the drug to be “safe and effective”.

- In deciding whether to approve a drug two errors may be made
  - type 1 error: approve bad drug (false positive)
  - type 2 error: not approve good drug (false negative).

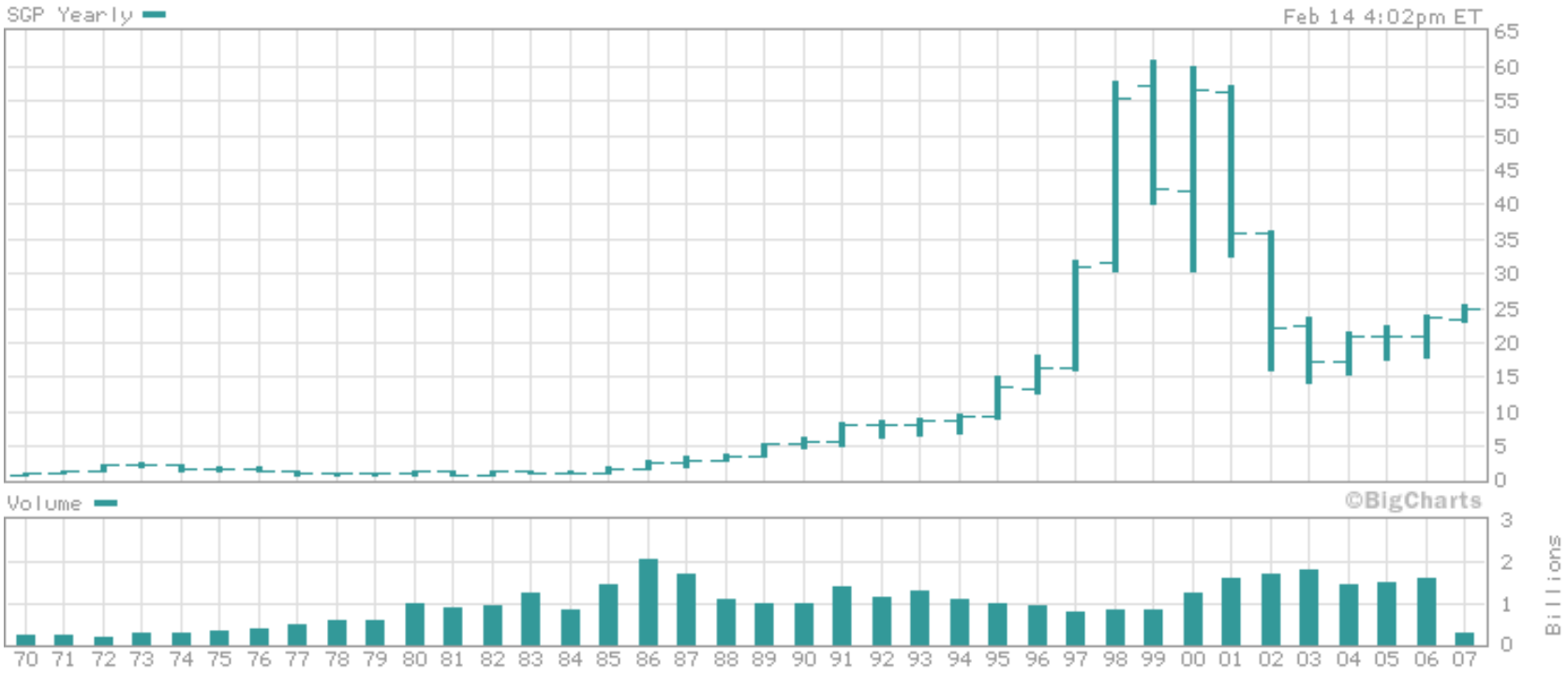
- There is a tradeoff between these
  - it is easier for public to see a type 1 error so regulators may be too conservative. So long process.

- Though effectiveness need not be great for approval
  - e.g. 30% improvement on drug versus 20% improvement on placebo is enough if statistically significant at 5%.

- Also for many drugs need physician approval to use
  - in most countries cannot do direct-to-consumer advertising.

F.3.5 Pharmaceutical example: Claritin (Loratadine)

- 1980 Schering-Plough submits patent application
- 1993 FDA approved (so 5 years left on original patent)
- 1997 Direct-to-consumer advertising $322 million
- 2000 Sales to $2.6 billion
- 2000 46% of allergy sufferers show improvement versus 35% placebo
  Chlor-trimeton just as effective.
- 2002 FDA approved for over-the-counter (OTC) sale
  (No prescription needed, so no insurance cover).



Annual data 1970 to 2007

y axis is stock price (upper) and trading volume (lower)

x axis is the year.

Peak following 1997 direct-to-conumer advertising

Fall following approved for OTC sale.

F.4. BONUS: LONG-TERM CARE (LTC)

- **Long-term care history:** Big expansion post 1965.
- **LTC revenues:** Mostly from third party.
- **LTC reimbursement mechanisms:**
  - now mostly prospective payment
- **LTC competition:**
  - two-thirds of nursing homes are for-profit
  - prospective payment can lead to low-quality care
  - cost-effective substitutes to nursing home are home health care and informal care (from family)
  - potentially large growing area

F.4.1 LTC revenues and reimbursement

- LTC is for people needing care but not in hospital
  - Skilled nursing homes include post-surgery recovery
  - Intermediate nursing homes are custodial care
  - Hospice care is for terminally ill
  - Home health care for those with acute and long-term needs (cheaper than if in nursing home)
  - Informal health care is stay at home with free family help
- Expenditures in 2021 (Source: NHE Table 1)
  - Nursing home $181 billion and Home health $125 billion.
- Funding sources for nursing home and for home health care
  - Medicaid (30% and 32%) restricted to the very poor
  - Medicare (22% and 39%) for less than 100 days
  - Private health insurance (10% and 15%)
  - Out-of-pocket (26% and 11%).
- Reimbursement - prospective with some case-mix adjustment.

F.4.2 LTC competition

- Two-thirds of nursing homes are for-profit
- Prospective payment may lead to low-quality care
  - > 66% of costs are wages and benefits (mostly aides)
  - most quality studies just use nursing home inputs
- Nursing home is most expensive so encourage
  - home health care
  - informal health care (from family)
- Potentially big area (Source: NHE Fact Sheet)
  - Average health spending on over 65 person in 2014
    = $19,000
    = 3 times that of a working-age person
    = 5 times that of a child.