Healthcare Economics

Sol Yates

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Lecture 1: Resource allocation I : allocative efficiency

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1 Resource Allocation I: Allocative Efficiency (budgets)

1.1 Health Care Markets And Access to Health Care

Health Care Markets

- Health as an economic good
- There are efficiency and equity concerns on both sides of the arguments for and against public and private provision of health care
- But why inequalities in health exist is important

Access to Health Care

- Looking at the importance of access to health care
- Measuring inequalities in access to health care
- Policy on how we can reduce inequalities in this aspect

Access to health care is particularly important to resource allocation

1.2 Health Care as an Economic Good

Healthcare : Perfect Competition

- Healthcare is an economic good, it is scarce relative to wants
- In competitive markets, market forces match supply with demand
  - Shortages drive prices up
  - Shortages drive prices down
- Providers produce health care in an efficient way, maximising profit
- Purchasers are willing and able to pay equilibrium
- Access in a free market is based on *the ability to pay rather than need*

Market Failure

- The first fundamental theorem of welfare economics
  - Perfect competition generates a socially efficient (pareto optimal) allocation of resources
  - That is, social marginal benefit = social marginal cost

- In a perfectly competitive market the allocation of resources may be privately efficient but not necessarily socially efficient
- When the private marginal benefit $\neq$ social marginal benefit OR private marginal cost $\neq$ social marginal cost then we cannot be **pareto optimal** and market failure exists

Externalities

- Individuals consume unto the point where the individual's marginal utility of consumption (PMB) equals the individuals marginal cost of consumption
- Any external effect of consumptino or production (MEB, MEC) is typically not accounted for when individuals or firms maximise their utility/profit
- EG, smoking vaccinations altruism
- From a welfare perspective, the competitive market is not pareto optimal since with
  - Positive externalties : goods are underconsumed
    - SMB=PMB + MEB > PMB MEB>0
    - SMC = PMC + MEC < PMC MEC<0
  - Negative externalities : goods are overconsumed
    - SMB = PMB + MEB < PMB (MEB<0)
    - SMC = PMC + MEC > PMC (MAC>0)

Public Goods

- Public goods are good jointly consumed by everyone
  - Non rival : consumption by one does not prevent consumption of same good by another individual
  - Non-excludable : cannot exclude other from consuming same good (free rider problem)
- Healthcare can be rival (hospital beds) and excludable (ability to pay)
- Some types of health care are public goods (vaccinations, altruism)

Consumer Sovereignty

- Individuals may not demand health care rationally (over or under - valuing healthcare)
- This could be due to :
  - Imperfect information - not knowing what treatment is needed/necessary
  - The ability to communicate needs - how can we signal our preferences (if unconscious)
  - Exploitation when health shocks arise (irrationally choosing healthcare with highest cost and lowest risk - does having say headache make a painkiller worth more?
  - Excessive discounting (age dependent) : long term effects of activities?

Imperfect Information

Three main causes of imperfect information

- Lack of opportunity for sampling : no prior experience to value quality since most health care is "one off event"
- Unclear cause-effect relationship :
  - Quality is rarely learnt
  - It is difficult to distinguish the cause and effect of treatment impacts, is it the effect of drugs or the natural healing process
- Asymmetric information : education is costly, giving suppliers a degree of power, this may incentivise supplier induced demand

1.3 Arguments For And Against Public And Private Provision of Healthcare

Public or Private Provision?

- The existence of market failure in health care does not necessarily mean public provision is warranted :
  - Insurance markets can work to account for unpredictable nature of health
  - Nominated guardians and insurers can offset such concerns about under or over - estimating value of health and health care
  - Limited public intervention could work alongside health insurance :
    - Information campaigns, quality guidelines, regulation
    - Taxes and subsidies

Public provision problems :

- Removes competitive market forces which can potentially open up inefficiencies in the provision of healthcare, possibly government failure
- Moral hazards - can be insured regardless of health investment
- Free riding - no 'price' to health care, over utilisation may occur
- Financing - equitable - use it or lose it?

Private provision problems

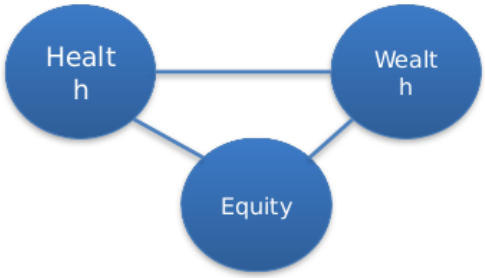
- Free rider problem - compulsory insurance can resolve this
- Adverse selection and asymmetric information - the wrong people buy insurance
- Moral hazard - individuals may alter their probability of ill-health
- Uninsured populations are certainly those most in need of health care, no provision

There is currently an A&E crisis in England, is this indicative of government failure, would this be resolved in the private sector?

Health Policy Trilemma

We can think of health policy as being three pronged

1. Health - health of the population
2. Wealth 0 spending on other goods
3. Equity - fairness



Moving towards either poses an opportunity cost, reducing the ability to meet the other. Though it must be noted that different countries may have different preferences.

3 National Health Policies Beveridge model

- Universal, single-payer insurance
- Public provision
- Free at point of service
- Aim : equity
- UK, Canada, Australia
- Issues
  - Price rationing doesn't exist resulting in queuing (but reduces moral hazard and potentially equitable)
  - Services delivered (resulting in health technology assessment which incorporates cost effectiveness, equity and public health)
  - Efficiency (resulting in policy aimed at competition and financial incentives)

Bismarck model

- Universal insurance (via private insurance)
- Private provision of health care
- Heavily regulated with price controls
- Aim: patient choice and provider competition
- Founded in Germany

- Japan, Germany, France and Switzerland
- Issues
  - Adverse selection (no-one can opt out but can choose insurer, community ratings of risk rather than an individual offsetting this)
  - Risk selection (insurers insuring low risk but risk adjustment policies can equate risk via compensation payments)
  - Cost containment (Regulation a key factor in containing prices)

American model (free market for patients and provision)

- Private markets (insurance and provision)
- No requirement for universal insurance
- Partial universal coverage (medicare - over 65s, medicaid - poor)
- Aim: free markets
- Founder: employers using health insurance as a benefit with wages frozen
- America
- Issues
  - Non-insurance
  - Job-lock (cost of switching job high if health is observable but policies permitting maintain insurance after exiting a job may help)

Comparisons are difficult since each country may

- Place different preferences on different aims (allocative efficiency)
- Have different heath productive frontiers (technical efficiency)

Say, the US may be on a different productive frontier, and Switzerland may be allocatively inefficient if marginal benefits to other expenditure are greater

Equity Even if the market for health care is perfectly competitive, the distribution of h health and/or health care may be unequal If society values equity then Pareto optimality does not hold. Thus, *equity* is a key argument for some degree of public intervention in the provision of health care.

There are two areas where inequities may arise:

1. Financing / provision of health care
2. Distribution of health

1.4 Why Might Inequalities Exist in Health Care?

There are NICE, WHO and NHS guidelines / indicators for health inequalities(GPs per head, quality primary care, waiting times, hospitalisation, dying in hospital, overall mortality - NHS equity indicators)

However, **inequality** gave birth to the NHS with the reprot by Beveridge in 1942 highlighting poor access to health care as a driver for socioeconomic inequity in health.

The NHS was born in 1948 with the aim of universal coverage to a single (public) provider, free at the point of service.

Evidence on Health Inequalities in The UK Several key reports have highlighted inequalities in health

- Black (1980) : inequalities had widened rather than narrowed following the introduction of the NHS
- Acheson(1998) : reiterated findings of the black report
  - Which led to a sustained assault on reducing inequity
  - Widenning inequalities followed as whilst health improved, this was the greatest for the wealthiest
- Marmot (2010) : also confirmed inequalities remain

It appears that the upstream structural population wide strategies rather than downstream strategies (targeting behavioural change) are thus likely to reduce health inequality - Asaria (2017) ; This and White (2021).

There is a focus on socio-economic status (ethnicity and gender too), but there is relatively sparse evidence on sexual orientation and disability

However, not all inequalities in health can be removed, but *inequity* is where differences are avoidable and unjust

The NHS has to abide by the equality act 2010, meaning There are

- Public sector equality duty : must advance the equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it
- Protected characteristics : age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex, sexual orientation
- There is an NHS constitution that adheres to the Equality act (2010) but it also aims to provide access to health care - on the basis of the need for health care and not the *ability to pay*

1.5 Access to Healthcare

Our focus so far has been with regards to access to health care

So why do we assess access and not health?

- As a provider of health care and as part of its constitution; the NHS is responsible for equitable delivery of health care. In other words - *equitable access to health care*
- In addition, health outcomes are a function of:
  - Natural healing process and heterogeneity in treatment effects
  - Individual behaviours / adherence
  - Access to health care

Access to health care depends on:

- A-vailability (geographic, queuing, opening times)

- A-cceptability (patient's willingness to accept treatment and provider's willingness to provide treatment
- A-wareness (knowledge of service availability and effects of treatment)
- A-ffordability (cost of using services : time off work transport etc)

Access is much more than that, (Mcintyre paper), some is availability (number of appointments), opening times, appointment times - what you can access, But it also *depends on awareness*, for instance weekend appointments, would that constitute good access to GP appointments, 7 days a week.

Gender, sex, age, ethnicity, sexual orientation can all influence threshold to access GPs. This is also the case for the flip side. GPs may not offer services based upon these.

Affordability - prescription costs, NHS dental costs, **opportunity cost** - what could you have been doing instead of visiting dentist/hospital. Possibly not prepared to since value extra hour in bed etc, affordability in that sense.

Equitable access to healthcare is not just about access :

Good access : empowerment of the patient to seek and obtain care when needed

Extended access policy - **access 7 days a week**

Prolific work in this area, motivation being :

Take pressure off of A&E services

Issues

- Moral hazard - people already accessing them may overuse them upon further opportunity to use services
- 7 day access doesn't necessarily improve access for the population, no improvement in access in terms of opportunity cost
- Cultural changes take time (such as sunday shop opening hours), maybe culturally it is strange to access GP on Sundays
- *Awareness* - reflecting poor access

Finding that it does take pressure off of A&E services, specifically for younger people it has improved access. However, uptake of this was very low, 40% of appointments weren't taken up. Due to practices not advertising this.

Issues around service itself such as not being the 'local' centre etc.

Given the NHS and public sector interventions are mainly around improving access

How Can we Define Access Inequality?

- Horizontal Equity - Equal treatment of equals - individuals with equal need for health care have equal access. Essentially, that access depends on need. The GP has final say in this.
- Vertical Equity - Unequal treatment of unequal needs - different access for individuals with different needs

Vertical different health different access. People who are different have different access

Horizontal - same need same health. Everyone cancer free has same access. Everyone in cancer group has same access. People who are identical in that sense

Example.

Horizontal equity - people with MA in economic get the same wage

- vertical equity - people with different degrees get different wages

Access Inequities - Empirics

How to define unequal in health?

- One way to measure inequalities in access is to assess use: Here we can regress use on **health** (need / (un)equals), age, gender, income (need / (un)equals) , social class, supply (adjusting for confounding)
- Need to record protected characteristics and need (health)
- This allows us to make positive statements about equity
- Supply can also bias the protected characteristics

ID	Use	Age	Gender	Postcode	Practice	Health
1	3	55	Male	SK14 4PP	Y89637	55545
2	6	40	Male	M3 5EW	P76823	03344
3	4	70	Male	M13 9PL	B86988	22232
4	0	72	Female	M13 9PL	B86988	33422

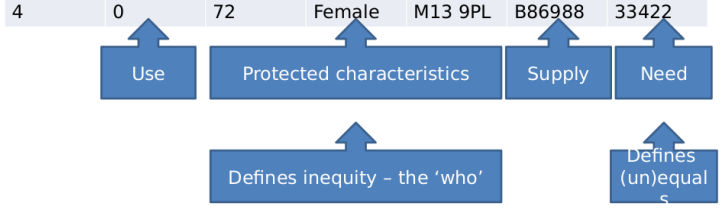


Figure 1: Minimum Dataset

Which we can infer, who is using the service, whether the service use differs by a protected characteristic (over and above need - health / EQ5D) : horizontal inequity. And whether service use in proportion to need : vertical equity (but there is a need for subjectiveness here)

Example (OVB).

Population of 1000 where split population under and above 50

50+ have 3 emergency department visits, those under have 1

Regression

$$Use_{it} = \beta_0 + \beta_1(age_{50} + u) + e_{it} \tag{1}$$

To get estimated use of poeple under 50

$$\hat{\beta}_0 + \hat{\beta}_1(age_{50} + u) = 1.0 + 2.0(age_{50} + u) = 1.0 + 2.0 \cdot 0 = 1 \tag{2}$$

Predicted use of those aged 50+

$$\hat{\beta}_0 + \hat{\beta}_1(age_{50} + u) = 1.0 + 2.0(age_{50} + u) = 1.0 + 2.0 \cdot 1 = 3 \tag{3}$$

This regression basically gives us the averages

$\hat{\beta}_1$ tells us by how much more (or less) the population aged 50+ use

But need for healthcare likely depends on more than age, and specifically characteristics correlated with age, the variable before is likely biased, hence OTB, not picking up the true effect, picking up other things.

$\beta_2 < 0$ then ...

If $\hat{\beta}_1$ is significant, looking at equation 2 there will be horizontal inequity in need, their use and treatment is different subject to which sides of 50 they are on. Thus horizontal inequity in need. In 3 ...

Protected characteristics allow us to identify horizontal inequality, health measure vertical inequity

Example.

Under the NHS constitute, there should be equal use of services for those with equal need (capacity to benefit)

***Erwin and Whittaker (2016)** aimed to analyse whether access to primary care (GP services) was equitable across sexual orientation (regressing GP visits on : sexual orientation, job status, religious belief, ethnicity (protected, age, health () and GP characteristics ()*

Findings suggest in NW, there may be inequality in access for lesbian women, bisexual using more (OR > 1)

Adjusted model does not include age - since this can be a big issue here (we don't want to pick up other things when advising policy - we can have unintended effects)

Adjusted regression takes into account supply measures, need, so on.

For the adjusted, we still find less use for lesbian women, but maybe we are concerned there is access issues for bisexual women

Gay men use GP services 20% more. From which side is this?

Looking at inequalities, it is so important to make sure regression is specified correctly

Under the NHS constitution, where we want equal want for equal need, not depending on sexual orientation, it should be equitable.

Barriers to access - differences due to acceptability? Concerns on sex of GP? Availability is still there but there is something in the patients mind creating a barrier, but this is the

***Health System's problem** to make right*

If we believe heterosexual women should use GPs more (say pregnancy), this may be a reason why heterosexual women are using more than bisexual

***Vertical Equity** :*

- *Recall normative judgements are needed on whether unequal use is justified for unequal need for health care*
- *A standard test is that those in rose health have higher use*

Summary

Market for health care

- Health care is an economic good - scarce relative to our wants
- Left to a competitive market, the market for health care would not be **pareto optimal** - market failure likely
- The existence of market failure does not necessarily prove the need for public provision
- Public provision or intervention usually driven by equity concerns

Health and access to health care inequalities

- These exist and are a key policy target
- Sustained inequality in health by social class
- With the aim of equitable access for equitable need, the NHS can be assessed on the basis of access
- Access to health care is a useful way to evaluate potential policy impacts on health inequalities (it is a key determinant of health)
  - Equal use or access to health care is typically modelled when assessing equity in distribution of health care
  - Regression models of use can identify horizontal inequity
  - Normative statements are needed for vertical equity measurements
  - Access should not depend on a range of protected characteristics

The next topic provides an example of how equity concerns impact on policy and can move us away from maximising health

- Local health care budgets / resource distributions
- How economists determine resource allocation for health care
- How economists deal with health inequalities in resource allocation
- Impacts of equity aims on how allocatively efficient allocated resources are

1.6 Tutorial 1 - Access And Fundamentals in Resource Allocation Formulae

Domains of Access

1. *A 7 day NHS is one of the Conservative government's policy initiatives. This includes extending family practitioner opening hours to include evenings and weekends. a. Consider the domains of access to health care, why might the government have decided 7 day family practitioner services is needed?*

Access depends on availability, acceptability, and affordability:

- Availability
  - At present, patients who need to see a GP may not be able to do so due to rationing where no appointments in core hours may be available
  - Patients may not be able to see their GP because the service is closed and hence unavailable when they need to see the GP

  - Patients may feel access is limited and utilise alternative options such as hospital services (A&E) based on past experience in making an appointment

- Acceptability
  - Patients may feel their quality of treatment will be better at hospitals due to expectations of the quality of GP appointments
- Affordability
  - Patients may find it expensive to make an appointment during core hours if they are employed (and need to take time off work)

Thus, each of these *domains of access* may be impacted by extended opening hours, by increasing availability of appointments (and the potential impacts on core and extended appointment availability); by altering patients perception of GP services and improving the quality of services; by reducing the opportunity costs of attending an appointment. Each imply there will be *unmet need* in primary care and or inefficient use of alternative care

b. What factors might affect how successful 7 day services are?

Again we consider the *domains of access*, factors may include

- Availability
  - Whether appointments are provided when needed - i.e. Whether extended hours are at time when patients need to aces their practice
  - Whether access includes access to accompanying services such as pharmacists and diagnostic tests
- Acceptability:
  - Whether patients are accepting of 7-day services, especially given the culture / tradition of working day core hours
  - Whether patients are accepting of seeing an alternative practitioner on their own
  - Whether patients are prepare to attend a difference practice (if service are at hubs)
- Affordability:
  - Whether patients opportunity cost of leisure is greater than the cost of working
- Awareness:
  - How aware patients are of the service

Other factors may include: whether core hour patients shift to extended hours and if the resulting gap is left unfilled. Whether patients attending extended appointments 'need' to

c. How might you test whether 7 day family practitioner opening hours have been successful at improving access?

You could compare the use of appointments before the intervention against patient characteristics and the use of appointments after the intervention against patient characteristics to see whether different types of patients are using services after 7 day services are introduced.

Alternatively, we could assess extended hour appointments and compare patients against core hour patients prior to the intervention to see whether a different population is using the extended hour service.

Weighted Capitation

Imagine you are a decision maker and are responsible for distributing the budget for sexual health services in England to 150 Local Authorities. You generate the shares of the sexual health budget by weighted capitation using utilisation data.

a. Why might the decision maker have chosen to distribute budgets using utilisation data?

As a policy maker we would like to redistribute budgets (resources) to areas of greatest need, but utilisation data doesn't directly translate a greater use to a greater need. We don't directly observe the need for healthcare, though use is a good proxy.

Consider the possible alternative and limitations of these:

- Epidemiological data is difficult to obtain, requiring detailed data on every individual's sexual health state
- Age and gender are likely to be a poor proxy for need as the need for sexual health services will likely depend on other factors such as ethnicity, deprivation, sexual orientation.

Thus, we can argue *why utilisation may be a better approach* since utilisation may be a better proxy for need as it can incorporate several needs measures, and potentially reduce bias causes by unmet need and/or supply side factors.

b. Describe the steps you would take to generate the weighted capitation formula. In particular: i. The data required ii. How weights are determined iii. How unmet need and/or supply side bias is accounted for

We could propose the following steps: To begin with we require data on utilisation, this should be all sexual health services provided. Ideally this should be at the lowest possible level (person-based) to better identify relative need. And it should also be as upto data as possible because old data may not defect the need for services today.

Then, we need to cost the utilisation data to enable us to measure all sexual health services in *one model*. And, to determine weights, we need to identify potential measures of need. These may include: deprivation, age, gender, ethnicity, sexual orientation,education etc. And we may also want to include supply side measures such as the presence of a sexual health clinic as these may be associated with your needs measures and not including them may lead to bias on the needs estimates.

Then, regress costed utilisation against these factors - and then use the estates on the needs measures as weights for the budget allocation.

Any perverse signed estimates may reflect unmet need and should be excluded from the model

Critiquing a Proposed Model *A decision maker allocates a budget for dentistry to Local Authorities in England for 2016-17. Her model uses data on the average number of missing teeth a person has within each Local Authority for the period 1998-99.*

a. What issues might you have with the resource allocation formula? Here, it is important to look at models with a *critical* eye - state the issue but also explain why this is an issue

There are a number of potential issues (this is not an exhaustive list)

- Measure of use

  - There is no measure of use here, we have missing teeth as a proxy for need. Missing teeth may be a poor measure of need for dental services and favour the elderly, hence being a poor needs proxy for the young
  - The services required for missing teeth are less expensive than other oral treatments, utilisation data on service use could better capture differences in budget requirements
  - *Thus*, a better approach could consider services such as general dental service use, orthodontic services and prevention services
- Timing of the data - the time of the needs measure may be a poor reflection of need in 2016-17
- Level of granularity
  - The data is at local authority level and more granular data could better identify relative need between local authorities (England been broken down into 150 areas in question)
- Potential for supply-side bias - missing teeth may be influenced by supply side factors, for example, are teeth missing because of poor access to dental services?

Lecture 2: Allocation of healthcare resources (budgets)

Wed 07 Feb 14:53

[**Lecture 2**]

1.7 Allocation of Healthcare Resources (Budgets)

Topics in The Supply, Regulation And Financing of Health Care

1.8 Health Care Budgets

- Publicly funded health care systems require some form of resource allocation funding principles to enable the payer to distribute budgets across a population
- Health care provision is usually by geographically specified boundaries (primary care trusts, local authorities (public health), clinical commissioning groups (NHS Budget)
- These geographically specified population groups are likely to differ in terms of the need for healthcare (recall NHS aims of equal access for equal need)

Capitation

- Capitation - population size
- Populations can be identical, though they can vary Population of 4 will always get the same share, though a much older population is likely to need a greater need for healthcare, furthermore looking at gender, ethnicity etc. This may influence the make-up of our budget required
- Rarely done, when we don't have good data to find above characteristics

Differences in health care likely due to

- Population size, age and gender distribution, health and socio economic deprivation

Weighted Capitation

Say elderly have twice the need as young, we can take this into account by multiplying need factor by population size

$$Weight = 2:1 \quad \text{(A young, B elderly)}$$
$$\text{Weighted population} = 1000 * 1$$
$$\text{weighted population} = 500 * 2$$

1.9 Utilisation Measures

How can we capture 'need'? **Use as a proxy for need** - how much use a population has of healthcare, last year say, compared to another population

Though there are issues with use, we may underestimate need due to under access

- Access is a product of demand and supply (nearby to a hospital - induced demand?)
- Access depends on list of access - why is the use a problem (**fundamental problem in this course**)
- Say if dentists earn more money, the more they treat, is use reflecting need? Or rather over treatment?

We have measures of use, this may reflect differences in supply (more hospitals / appointments due to differences in supply), we don't want to allocate resources based upon this (we want to adjust/predict supply), we want to predict use.

However, use might be related to protected characteristics

Thus, can we identify *'need'* from use?

We predict **use**, however use is mad up of supply, inequality and need. We want to isolate several valid estimations of need into our predicted value of use.

- Use was a product of need, inequalities and supply factors
- Use can act as a proxy for need (adjusting for inequalities and supply factors). Where in general, higher use is indicative of higher need
- Model factors that explain differences in use
- That may also be correlated with supply factors
- Thus, factors conditional on supply factors become weights

Thus,

- Develop a measure that aggregates all factors of use (e.g., appointments) and converts this into cost.
- Measure supply and perform OLS (Ordinary Least Squares) regression based on these measures.
- Logical to translate 1 injection + 1 A&E visit into cost.

  Recap

  - Deciding on budget distribution:

    - Capitation is the most obvious method, considering geography.
    - Inequitable as populations of the same size may have different healthcare needs based on age, sex, and ethnicity (e.g., Manchester vs. Salford).
  - *Weighted Capitation*:
    - Weighted population accounts for different needs (e.g., elderly population requires more resources).
    - Redistribution of resources based on population needs.

Problem

- Calculating utilisation is challenging.
- Lack of a measure for health differences between cities (e.g., Salford, Liverpool, London vs. Manchester).
- Rely on previous healthcare use, assuming higher past use indicates greater future need.
- Different access domains and supply variations affect use measures.
- More dentists in an area increase utilisation, not reflecting actual need.
- Need to remove supply influence from the measure.
- *Use as the sum of various factors* to create a 'needs-based' use measure that predicts need without reflecting supply.

Obtaining Needs Weights

$$Utilisation_{it} = \beta_x Need_{it} + \delta_x Supply_{it} + e_{it}$$

Where $\hat{\beta}_x$ allows us to determine the predicted need in a population (population weights) And, $\hat{\delta}_X$ is not used to estimate need

- $\widehat{\beta}_x$ enables us to determine predicted need in a population - population 'weights'
- $\hat{\delta}_x$ is not used to estimate need (would reinforce inequalities)
- first obtain utilisation data
- cost all activities
- identify potential needs factors
  1. socio-economic factors
  2. population change
- identify possible supply factors (say distance to neareest health care provider)
- explain differences in costed activity by needs factors - run an OLS regression of $Utilisation_{it} = \beta_x Need_{it} + \delta_x Supply_{it} + e_{it}$

Need to be proxied using deprivation, diagnosis data, proportion of population own benefits - using variables correlated with the need for healthcare.

Needs Index

An index is useful where many factors are included (need, inequalities adjustment, costs)

To calculate : With 2 populations, where one believes unemployment rate is a needs variable

	Population 1	Population 2	Total
Population	500	750	1250
Unemployment rate	0.10	0.05	

Figure 2: Step 1 : Needs Index

Under capitation, population 1 would obtain 40% budget whereas population 2 would obtain 60% of the budget, If we think unemployment is a needs variable, what does this mean?

Under weighted capitation,

1. We estimate $y =: b_0 + \beta_1 UB + e$ (where UB is indicator for unemployment benefit)
2. Predict need using the model : $\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 UB = \hat{y} = 216 + 20(UB)$
3. Normalise to actual population, we make needs equate to the total actual population ($\frac{1250}{435} = 2.87$)
4. Calculate the needs index and weighted capitation share

	Population 1	Population 2	Total
Population	500	750	1250
Unemployment rate	0.10	0.05	
Capitation	0.40	0.60	1.00
	216+2=218	216+1=217	435

Figure 3: Step 2: Predict Need

Where for population 1, $216 + 20(0.1) = 218$ and for population 2, $216 + 20(0.05) = 217$ - thus a needs based use measure.

Then using some measures of need to *predict needs-based use* and make it into our budget-share they are almost equal (in our example)

Where the total is 435, thus to bring this to the population of 1250, we multiply it by the difference between the actual population and the total use population. $\frac{1250}{435} = 2.874$

	Population 1	Population 2	Total
Population	500	750	1250
Unemployment rate	0.10	0.05	
Capitation	0.40	0.60	1.00
	216+2=218	216+1=217	435
Weighted population	218x2.874 = 626.532	217x2.874 = 623.658	1250

Figure 4: Step 3 : Normalise to Population

Thus population 1 has a similar amount of need to population 2.

	Population 1	Population 2	Total
Population	500	750	1250
Unemployment rate	0.10	0.05	
Capitation	0.40	0.60	1.00
	216+2=218	216+1=217	435
Weighted population	218x2.874 = 626.532	217x2.874 = 623.658	1250
Needs index	626.532/500=1.253	623.658/750=0.8315	
Weighted capitation	626.532/1250=0.501	623.658/1250=0.49885	1.00

Figure 5: Step 4 : Calculating Needs Index And Weighted Capitation Share

	Population 1	Population 2	Total
Population	500	750	1250
Unemployment rate	0.10	0.05	
Capitation	0.40	0.60	1.00
	216+2=218	216+1=217	435
Weig population	+25.3% → -16.85% → 626.532	217x2.874 = 623.658	1250
Needs index	626.532/500=1.253	623.658/750=0.8315	
Weighted capitation	626.532/1250=0.501	623.658/1250=0.49885	1.00

Limitations

- If used alone, utilisation measures may sustain inequalities in access to healthcare and health (δ)
- Unmet need becomes a key concern
  1. Utilisation is only observed for services being used
  2. Under-utilisation from populations with need is not controlled for
     (a) Specific unmet need - for particular groups (minority ethnic groups, liability status)
     (b) General unmet need - for the whole population
- Inappropriately met need (over-utilisation) may also occur
- Data requirements : all required detailed data, but this leads to the ecological fallacy where what is at one level is not necessarily representative of within that level. So the lowest granularity of data is preffered

Historically in England, they were stuck in regions but recently progressed to the individual level (as opposed to governmental regions)

Alternative Measures of Need

- Alternative measure of need may be
  - Demographic characteristics of the population
    - Age and gender explain need
  - Epidemiological characteristics of the population
    - Higher mortality rates explain higher need
    - Requires data on everybody in the population
- Both are imperfect measures, need is a function of more than age, gender and a specific health measure

NHS - Weighted Capitation

- weighted capitation methods are typically used for resource allocation (RA) in health care
  - since the 1970s weighted capitation has been the method used to assign budget shares in England
  - utilisation rates have formed the basis of weighted capitation
- multiplied by the health care budget, these give each population their 'fair share' of the budget
- in England, the total health care budget £180.2 In
  - Budget is split between sectors (mental health services, GP, hospital etc. - each have their own formulas - mental health to dental services - may have different use and thus stratified need
  - That is, within each sector different indices and models are estimated to better identify need and split budgets be area
- NHS England responsible for determining resource allocation formulae, *equity is the ultimate goal*

Ramp Project

Example. *Research aimed at updating the resource allocation formula for mental health budgets in England (since new data avail, was previously only using amount of time sept in hospital - there could be areas with good mental health services and thus fewer inpatient services receiving less than those with the opposite) 2008/09 - 2% of adult population using metal health services Ran regression of costing, the β from regression are used to inform costing while δ 's are not used in order to not sustain access in inequalities to services*

Table 2.12: Models for the working-age population

Model	WA1	WA2
Proportion providing informal care	-11.86309 (-7.71)	-11.78299 (-7.66)
Contains MH provider	2.74108 (4.38)	2.73913 (4.37)
Distance to CMHT base	-0.07264 (-3.32)	-0.07384 (-3.36)
IB/SDA with mental health diagnosis	**36.18262 (18.71)**	**36.02567 (18.67)**
SMR (where a mental illness excluding dementia is indicated)	**0.07360 (6.48)**	**0.07355 (6.47)**
Proportion Black Caribbean	**3.59290 (3.69)**	
Proportion Black		**2.15511 (3.87)**
Constant term	0.89021 (6.40)	0.83010 (5.64)
N	32482	32482
Adjusted R2	16.83%	16.86%
RESET	0.096	0.184

gures in parentheses are t-ratios. Models also contain PCT mean values of each of the included variables to contro for correlation between PCT effects and the included variables.

Figure 6: Ramp Results

Clinical reason for inclusion of ethnicity, analysis largely focuses on adjusted r-squared. Dine for both younger and older populations. Estimates from regression then feed into exposition book, rather than

interpreting results. They would each have their own needs index

Talking about need, how we can identify, and how we can redistribute based upon this,

Impact : (aruguably more inline with need for healthcare) :

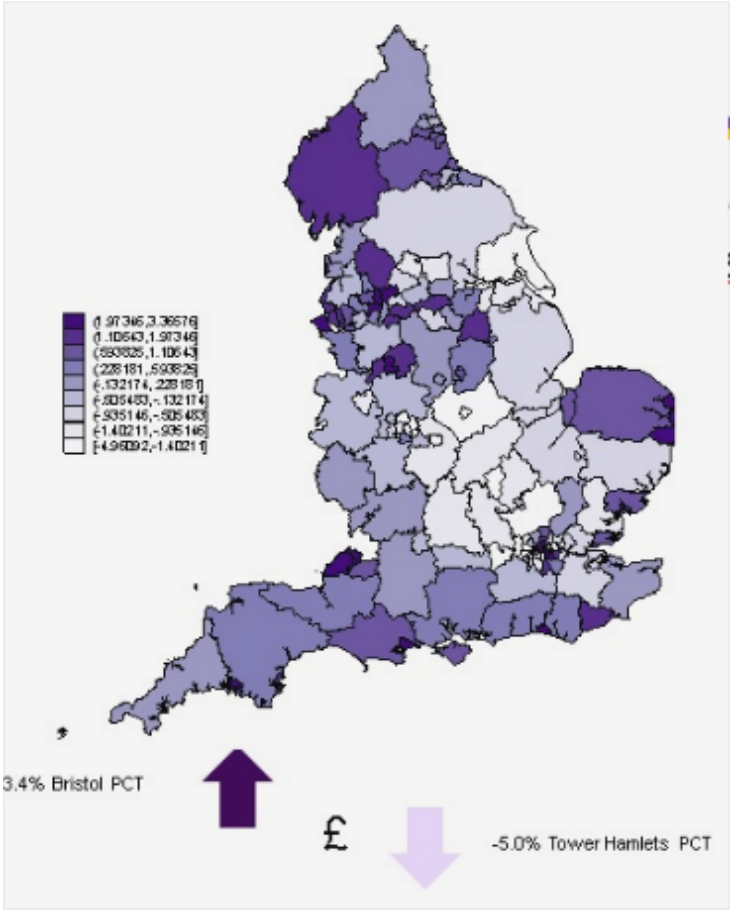


Figure 7: Spatial Effects of RAMP

Clearly, some PCTs have received larger increases in their budget due to others

Weighted Capitation : Equity

- Weighted capitation may be seen as horizontally equitable - attempting to ensure equal need has equal weight
- Weighted capitation may also be seen as vertically equitable - different needs have different weights, relative differences driven by the Odell rather than policymaker, still normative - what activity should be modelled
- Is weighted capitation efficient?
- What if the aim of the payer is equal health outcomes?

PPF Approach to Resource Allocation

When discussing efficiency and equity, it is helpful to apply a PPF approach plotting the output (gain in health) from different inputs (budget allocations). When we are looking at the *impact of different budgets* on population health that is generated over a year.

As economists, *we are largely concerned with allocative efficiency* - producing the maximum output subject to inputs such that reallocating inputs does not lead to higher output (allocating our resources in most efficient way).

As opposed to *technical efficiency* which is combining inputs to maximise outputs

Where outputs here (have a yearly time frame) are most appropriately measured as gain in health

PPF of a Population Group

PPF

1. No historic spend feedback (in play when we commence)
2. Zero expenditure can have positive outcomes
3. Decreasing returns to expenditure (marginal gain decreasing after point)
4. One input, one output
5. Individual behaviours, environment, other external factors are exogenous to the PPF
6. Time period is 1 year

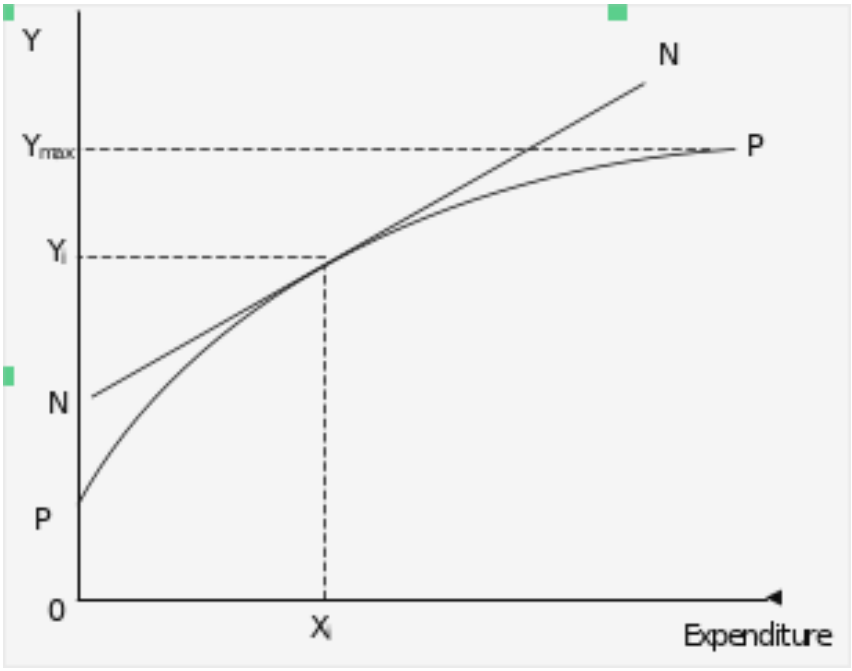


Figure 8: PPF

- Need varies at different levels of budget allocation

- Ideally give budget such that everyone is at maximum
- However healthcare is scarce resource, we are not likely to be at this point for every population
- As a decision maker - what is the most efficient point at which we can provide?
- One way is to look at marginal benefit of additional expenditure, might be prepared to say : extra days health for £1 : looking at the PPF we can figure out at which point this cutoff point meets

In reality we will likely have many different PPFs for each population. We as health economists can try to estimate the PPFs for 2 different populations. 2 populations with different needs will likely have 2 different PPFs.

Efficient Solution Recall that a payer has to identify each populations PPF (need), but different populations will have different PPFs (need)

To maximise outcomes payer needs to adjust expenditures and outcomes by risk

- From a base of capitation allocations, weight populations by risk/need
- Essentially weighted capitation - utilisation is a proxy for capacity to benefit from additional expenditure
- Risk adjustment makes the marginal social value (N) equivalent for each population
  - Expenditure has the same marginal impact on health outcomes / gain
  - Any additional increase in expenditure results in the same increase in benefit for each population
- Depends how accurate we can identify differences in need. Say we used regression, if there is problems with this we have under or overestimated need in p_1, p_2. Further, what says this is equitable, that pop 1 has more healthcare allocation than pop 2?

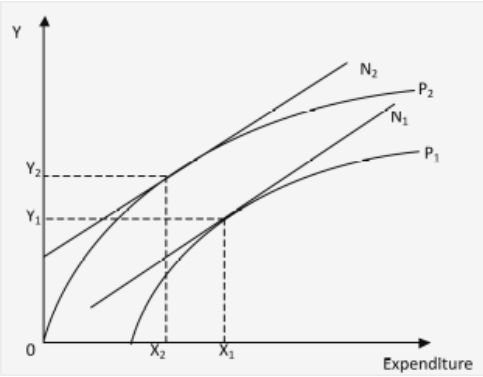


Figure 9

- $P_2(P_1)$ is the more (less) productive population
- Risk adjustment ensures the same marginal social value is applied to each population
- Outcome is higher allocations to the less productive population ($X_1 > x_2$) and different health outcomes ($Y_2 > Y_1$)

- But, this may not be seen as equitable

The efficient solution is horizontally equitable in budget allocations (health gains) if populations with the *same* PPF have the same budget allocation (health gain). Say if Liverpool has same budget as Manchester, then same healthcare is horizontally equitable (same PPF).

Whereas vertical equity different PPF

The pure efficient solution

- Social marginal value = marginal benefit from expenditure
- Maximises aggregate outcomes
- Allocatively and technically efficient

The efficient solution is horizontally equitable in budget allocations (health gain) if populations with the same PPF have the same budget allocation (health gain)

The efficient solution is **vertically equitable** if we believe the differences in budget allocations (health gain) are appropriate for differing PPFs/need.

Two reasons why the efficient solution may not be met :

- Technical efficiency across population providers may vary
- Allocations may not be at the point where the *marginal benefit from expenditure equals the marginal social value*
    1. Alternate equity objective of the payer
    2. Inaccurate needs measurement
    3. Differences in the costs of delivering healthcare - hospital in London, same hospital cheaper to run elsewhere in the country. If we don't take this into account we are deflating London's budget

Alternative Equity Aims

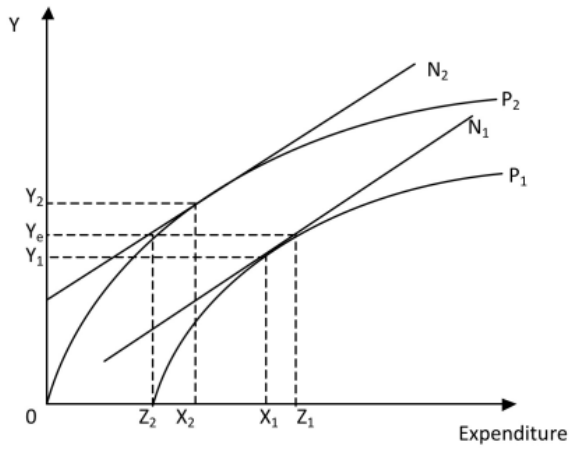
- Since populations differ in demography and epidemiology affecting how productive they are in health and hence have different PPFs
    - Differences in height do not alter efficient allocations - this doesn't alter the capacity to benefit
    - Differences in slope however could be consistent with differing health outcomes
- Even where the efficient solution is met, that is, needs are fully reflected in allocations, this may not be desirable

When bring equity in, this comes at the cost of efficiency

Equal Gain

Looking back at fig. 9

Both groups attain Y_e, an equal health gain where $Z_1 > Z_2$ The pure efficient solution is $X_1 > X_2, Y_1 < Y_2$ And an allocation less efficient would be : $Y_1 + Y_2 > 2Y_e$



Equal gain Y_e

- The solution is horizontally equitable in budget allocations (health gain) if populations with the same PPF have the same budget allocation (health gain)
- The solution is vertically equitable in budget allocation if we believe the differences in budget allocations are appropriate for the differing PPFs
- The solution is vertically *inequitable* in health gain since *differing* PPFs have the *same* health gain (no different in need reflected)

Equal Allocations

- The solution is horizontally equitable in budget allocations (health gain) if populations with the same PPF have the same budget allocation (health gain)
- The solution is vertically *inequitable* in budget allocations since differing PPFs have the same budget allocation
- The solution is vertically *equitable* in health gain if we believe the differences in health gain are appropriate in relation to *different* PPFs

PPF - middle of x_1, x_2 , tracing straight up - is this vertical equitable in budget allocations? Likely not since pops with different needs are receiving same budget allocation

Equity-efficiency Trade-off

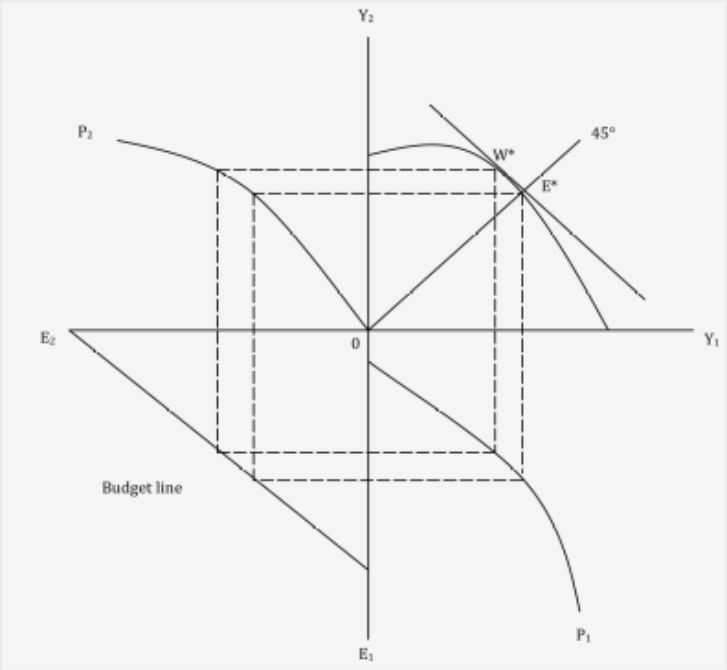


Figure 10

NW/SE represent same PPF as before,

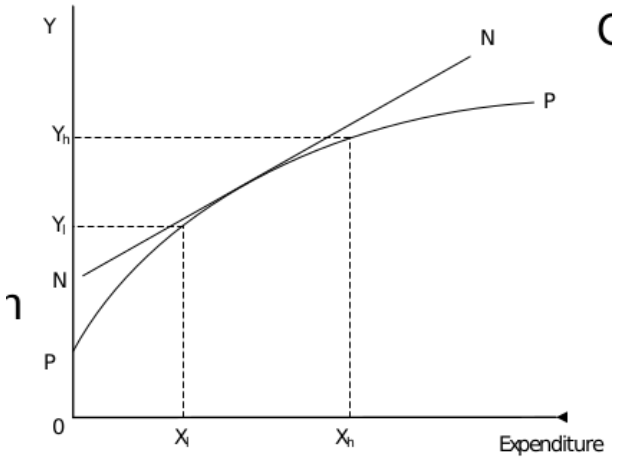
- NW and SE : PPFs
- NE : total production
- SW : budget line
- Weighted capitation dictates points on the budget line
- N: relative marginal social value of each population's outcome
- W* is the efficient solution
- Tutorial discusses avoidable inequalities in health application

In SW budget line with e_1, e_2.

45 degree line - outside of social welfare line and PPF. On N line that is the same as amount of health produced. Equal health outcomes leads to inefficient health allocations.

Inaccurate Needs Measurements

- If need is incorrectly modelled then populations of equal PPFs would receive different allocations
- Redistributing allocations would lead to a net increase in outcomes



E.g. The gain in equating payments for the low paid would be **greater than the loss** to the high paid population

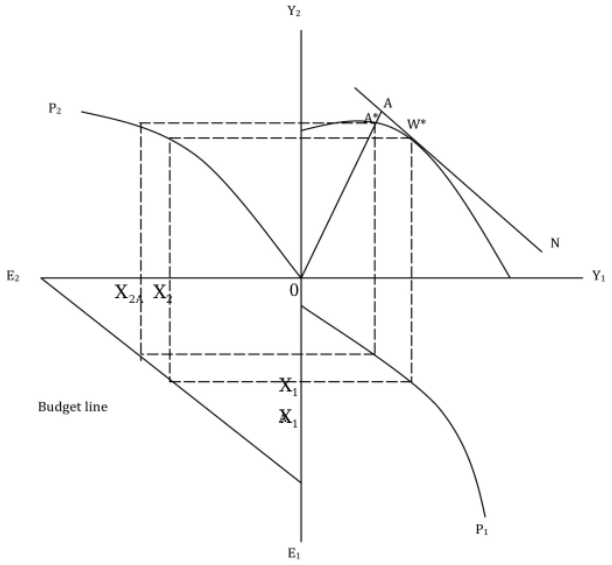
If regression is wrong, say 2 populations with same PPF, but regression is wrong say included supply variables so included supply side variables in predicted use. The gain is less than the loss generated thus inefficient allocations.

Differing Costs in Delivering Health Care The costs of providers of delivering care may differ between geographic population groups

So budget allocations need to take this into account, otherwise:

- Populations with higher relative costs realise a deflated budget allocation
- Populations with lower relative costs realise inflated budget allocations
- This is because budgets are worth less or more making allocations no longer efficient

Example. *Measuring allocative efficiency*



- *Assume two populations of different PPFs are allocated* X_{1a} *and* X_{2a}
- *Poor modelling of need underestimates how low productive the less productive population is* ($X_{1A} < X_1$)
- *Allocative inefficiency is* $0A*/0A$
- *Lower output of health* $A* < W*$

Technical Efficiency

- *So far assumed budgets are spent efficiently by providers - utilising budgets to maximise outputs*
- *But technical inefficiency may arise due to*
  1. *Budget risk*
     - *Health and health care is often uncertain, variations in spend is likely*
     - *Rationing may be performed*
     - *No redistributing encourages inefficiency for under-spenders*
     - *Greater the smaller population groups and the shorter the time horizon - population of 1000 people, catastrophe has less impact on total budget. Smaller population budgets are for, the higher the risk there can be catastrophic events where we might spend more than allocated*
  2. *Within the health care system*
     - *NHS monopolistic employer and provider of health care services*
  3. *External factors*
     - *Economy pressures (COVID, Recession and its impact on NHS budgets)*

Alternative Equity Aims

- Additional health inequalities
- May detract allocations from being 'needs-based' Diverting allocation away from horizontal equity

NHS - Health Inequalities Factor

- **Unmet need and health inequities adjustment**
- Standardised mortality ratio -

NHS Final Allocations

- Allocations are not efficient
    1. Additional needs index includes an unmet need and health inequalities factor

1.10 Tutorial 2 - Equity And Efficiency in Resource Allocation Formulae

a. Graphically, show the efficient solution to resource allocation of health care budgets where 2 populations have the same PPF, stating any assumptions made

In this case the PPFs are of course identical and each population group receives the same budget and attains the same level of health gain. The efficient solution is thus where the marginal benefit of additional expenditure is the same for both populations and output is maximised.

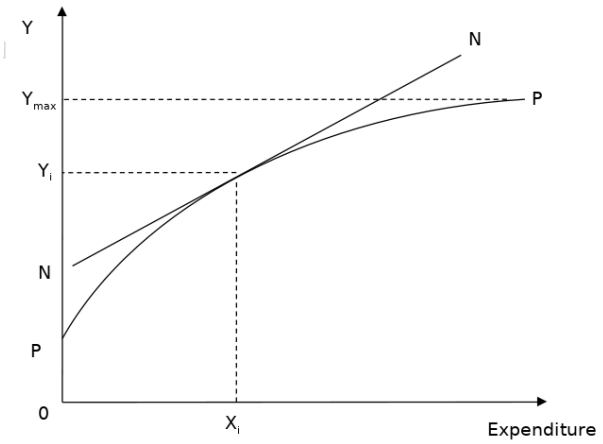


Figure 11: PPF - Equal

Where NN is the *societal*-welfare function that provides a cutoff beyond which no additional expenditure is made. PP is the production possibility frontier for each population (they are identical). Health gain is the outcomes (Y), and budget allocations are the input (X).

Hence, $PPF_1 = PPF_2$

Assuming diminishing returns - building hospital upon hospital, marginal returns decreasing. All points on frontier technically efficient, marginal value of expenditure - decreasing returns to expenditure

Assumptions:

- The PPF relates expenditure on the population group, to health outcome generated, Y

- The frontier of the PPF represents outcomes for payments where technical efficiency holds (efficient production and input purchasing of the healthcare providers serving the population group)
- There are decreasing returns to expenditure (the pp)
- Assuming only 1 input (or alternatively that all inputs can be aggregated into one measure, in this example budget allocations) and output (some measure of health)
- Other factors such as different providers, complementary services, the environment, personal characteristic, and societal influences are exogenous to the shape of the PPF
- The time period is assumed to be one year (which in reality, s typically the time frame used for allocated budgets)

b. Assuming the population groups now differ in their production possibility frontiers, how does this change your answer to part (a)?

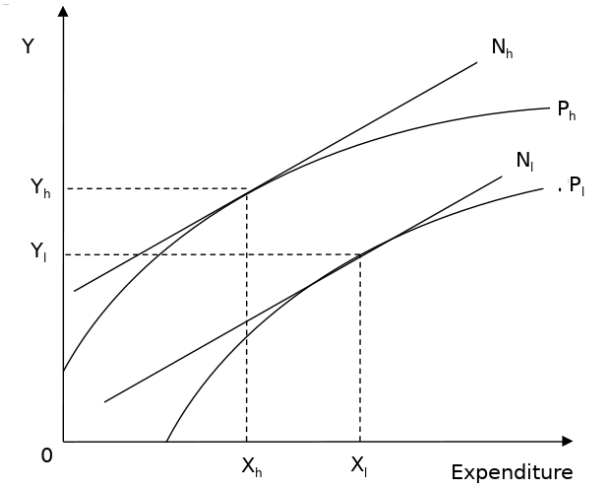


Figure 12: Different PPFs

Now the PPFs differ, there is different expenditure for different populations, specifically the gradient for population l is greater than the gradient for population h.

P_l has greater need, although population h has greater efficiency? *Differences in need is key to understanding*

Different allocations mean the marginal benefit to additional expenditure is greater

Different inputs, different health gains. Vesical equity? Different needs treated different treatment? Is this equitable? Based on need for health care

C. What tools might payer use to identify 2 different populations in need?

2nd lecture.

In addressing resource allocation for healthcare, the objective is to estimate Population Health Needs (PPNs) accurately, distinguishing between high-need and low-need populations. This estimation should leverage utilisation data but must account for and remove supply-side biases that can distort true need. Here's a structured approach to achieve this:

Step-by-Step Approach

1. **Costing Utilisation Data**:
   - Start by assigning costs to the utilisation data. This involves quantifying the services used by the population in monetary terms. This step standardizes various healthcare services into a single metric, facilitating comparisons.
2. **Identifying Need and Supply Variables**:
   - **Need Variables**: These should include proxies for healthcare needs at the geographic level, such as:
     - Proportion of the population claiming incapacity benefits.
     - Unemployment rates.
     - Chronic disease prevalence.
   - **Supply Variables**: These indicate healthcare availability and include factors like:
     - Number of hospitals or clinics in the area.
     - Availability of healthcare professionals.
   - *Note*: Supply variables should be included in the analysis to remove their influence but should not affect the final allocation.
3. **Regression Analysis**:
   - Perform regression analysis with costed utilisation as the dependent variable.
   - Independent variables should include both need and supply variables. This helps in identifying the true need by controlling for supply-side factors.
4. **Handling Supply Bias**:
   - In the regression model, include supply variables but exclude their influence in the final allocation model. This approach helps in neutralizing the distortion caused by uneven healthcare supply.
5. **Dealing with Perverse Signs**:
   - Perverse signs (e.g., negative coefficients on need variables like ethnicity or sexual orientation) can indicate underlying access issues rather than true lack of need.
   - These variables should be monitored carefully. If they indicate unmet needs or access issues, they should be frozen in allocation models to avoid reinforcing disparities.
6. **Interpreting Results**:
   - After controlling for supply, analyse the need variables. Higher utilisation (adjusted for supply) should signal higher need.
   - Use these adjusted need indicators to allocate resources more accurately, ensuring that the allocation reflects true healthcare needs rather than supply-driven utilisation patterns.

Example. *Example Scenario*

Suppose you have the following data:

- *Utilisation costs for different regions.*

- *Percentage of population on incapacity benefits.*
- *Number of hospitals per region.*

Regression Model

$$Utilisation\ Cost = \beta_0 + \beta_1(Incapacity\ Benefit) + \beta_2(Number\ of\ Hospitals) + \epsilon$$

Interpretation

- *If β_1 is significantly positive, it suggests that higher incapacity benefit claims correlate with higher healthcare costs, indicating a higher need.*
- *If β_2 is significant, it reflects the influence of supply, which should be accounted for but not affect the final allocation.*

Final Allocation

Exclude the influence of β_2 in the final allocation formula, focusing only on the adjusted need variables to ensure resources are directed based on true population health needs.

Conclusion *By carefully analysing and controlling for supply variables and being cautious of perverse signs, this method provides a robust framework for resource allocation based on true healthcare needs.*

d. Now assume the payer has accurately identified need and the providers of health care use their budgets efficiently, why might allocations be inefficient? Explain your answer graphically.

End up inflating and deflating budgets,

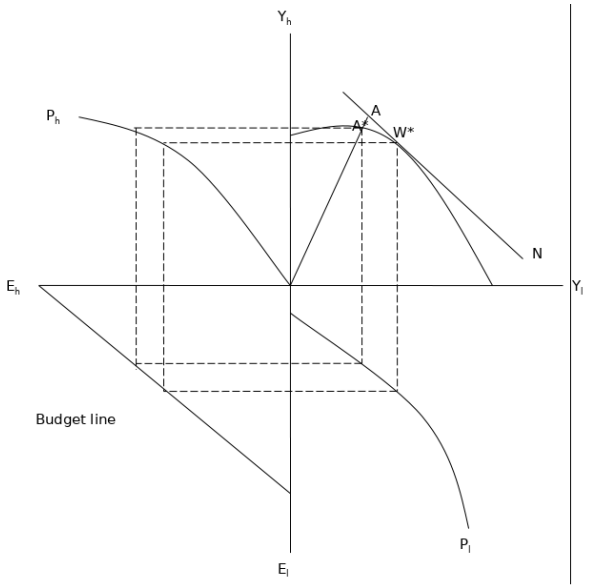


Figure 13: Quad Graph

When allocating healthcare budgets, it's crucial to recognize that costs of delivering healthcare may vary significantly between different populations. This variance can lead to inefficiencies in resource allocation.

Below is a structured approach to understanding and addressing these inefficiencies:

Inflation and Deflation of Budgets

If the need has been identified correctly, allocations may still be directed inefficiently because the costs of delivering healthcare may differ between populations. If delivering care is more expensive in one population, this will effectively deflate that population's allocation. Conversely, if delivering care is cheaper in another population, this will inflate that population's allocation.

Modelling Need and Pace of Change Factor

When creating a new allocation formula, it's essential to avoid sudden changes in budgets, as this can cause significant disruptions. Ideally, we want to move from an initial inefficient allocation (A*) towards an efficient allocation (W*). However, this transition should be gradual to prevent drastic budget changes for any area.

Graphical Representation of Allocative Inefficiency

The NE quadrant represents the total health gain and is the sum of the NW and SE quadrants, which are the production possibility frontiers for the two populations. The SW quadrant is the budget line, showing how budget changes affect allocations and output for each population. N is the relative social welfare function.

In the diagram:

- W* represents the ideal efficient allocation. - A* represents the current allocation, which deviates from W* due to the different costs of delivering care.

The goal is to gradually adjust budgets to move from A* to W*, recognizing that needs and costs will likely change over time, requiring regular updates to the model.

Explanation of the Diagram

- The NW and SE quadrants represent the production possibility frontiers (PPFs) for two populations. - The SW quadrant shows the budget line and how changes in budget allocations impact the outputs for each population. - The NE quadrant sums the health gains from both populations. - The point W* indicates the efficient allocation where resources are optimally distributed. - Point A* is the current allocation, which is inefficient due to the varying costs of healthcare delivery.

Addressing Allocative Inefficiency

To achieve efficient allocations: - Identify the true needs of each population. - Adjust allocations gradually to move towards W* without causing drastic budget changes. - Regularly update the model to reflect changing needs and costs.

To conclude, by understanding and addressing the inflation and deflation of budgets due to different costs of healthcare delivery, we can aim for more efficient and equitable resource allocation. Regular updates to the allocation model are necessary to adapt to changing conditions and maintain efficiency.

Question 2

A. Assuming there are two population groups with different production possibility frontiers, graphically show how budget allocations may differ according to the following equity aims. For each state whether these comply with horizontal and/or vertical equity: i. Equal health gain ii. Equal budget allocations iii. Equal marginal benefit to additional expenditure

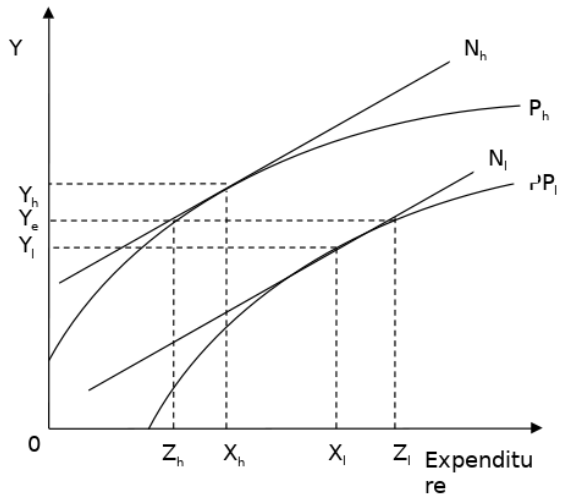


Figure 14: PPFs With Different Production Capabilities

Increases beyond the efficient solution indicate that the gradient means the low need population (H) experiences less output, as the distance between y_e and y_l decreases, leading to less output. In terms of horizontal equity, y_e suggests that if two populations are identical, they should be treated the same, reflecting the same PPFs.

However, this is not vertically equitable in terms of health gain, as vertical equity implies that different populations should be treated differently based on their specific needs. The societal welfare function, NN, provides a cut-off beyond which no additional expenditure is made. The production possibility frontier (PPF) for each population (Px) relates expenditure (X) to health outcomes (Y).

Assumptions:

- The PPF relates expenditure on the population group to the health outcome generated (Y).
- The frontier of the PPF represents outcomes where technical efficiency holds (efficient production and input purchasing of healthcare providers serving the population group).
- There are decreasing returns to expenditure (the PPF is concave).
- There is only one input (or alternatively, all inputs can be aggregated into one measure, in this example, budget allocations) and one output (some measure of health).
- Other factors such as different providers, complementary services, the environment, personal characteristics, and societal influences are exogenous to the shape of the PPF.
- The time period is assumed to be one year (typically the timeframe used for allocated budgets).
- Different PPFs relate to different needs (at any budget allocation, the marginal capacity to benefit differs).

Equal health gain – Y_e:

- Here, both populations attain the same health gain, Y_e.

- This is consistent with those of equal need having consistent outcomes/inputs (horizontal equity concerns the same need, PPF) only if need has been correctly identified.
- This is consistent with vertical equity in budget allocations if we believe the difference in allocations is appropriately proportionate to need. However, this may not be seen as vertically equitable in health gain if we believe that populations with differing needs should attain appropriately different health gains.

Equal budget allocations:

- Here, both populations attain the same budget allocation, $\bar{X}$.
- This is consistent with those of equal need having equal outcomes/inputs (horizontal equity concerns the same need, PPF) only if need is correctly identified.
- This is consistent with vertical equity where equity is defined by health gain; for unequal need, the health gain appropriately differs. It is not consistent with vertical equity concerning inputs since budget allocations do not differ in relation to need.

Equal marginal benefit to additional expenditure:

- Here, the two populations attain different allocations and different outcomes (X_l, X_h and Y_l, Y_h).
- This is consistent with horizontal equity in health gain and budget allocations since budgets are allocated so the same marginal benefit of additional expenditure is delivered for each population. This means populations with the same PPF attain the same budget allocation only if need is correctly identified.
- This is consistent with vertical equity in outcomes and input since these appropriately differ in relation to need.
- Note how only where the objective is for equal marginal benefit to additional expenditure are allocations and outcomes horizontally and vertically equitable.

B. Show, using the quad-graph approach, how these three aims may differ in efficiency.

Draw a quad diagram with three options: equal outcomes, equal inputs, and where marginal benefit is the same (W*). The first two options correspond to lower total output compared to the latter. Equal outcomes would lie on the 45-degree line in the NE quadrant. With equal budget allocations, allocations in the SW quadrant will be halfway (50% each). For equal marginal benefit, the efficient solution as described in the earlier sections holds.

The NE quadrant represents the total health gain and is the sum of the NW and SE quadrants, which are the production possibility frontiers (PPFs) for the two populations. The SW quadrant is the budget line, showing how budget changes affect allocations and output for each population. N is the relative social welfare function.

Explanations of the Quad Graph:

- **Equal Outcomes**: Both populations attain the same health gain, Y_e, lying on the 45-degree line in the NE quadrant. This is horizontally equitable if the need has been correctly identified but may not be vertically equitable if we believe that populations with differing needs should attain appropriately different health gains.
- **Equal Budget Allocations**: Both populations attain the same budget allocation, $\bar{X}$, reflected by allocations halfway (50% each) in the SW quadrant. This is horizontally equitable if the need is

correctly identified but not vertically equitable concerning inputs since budget allocations do not differ in relation to need.

- **Equal Marginal Benefit**: Different allocations and different outcomes (X_l, X_h and Y_l, Y_h), leading to the efficient solution W*. This is both horizontally and vertically equitable if the marginal benefit of additional expenditure is equalized across populations, ensuring that allocations and outcomes appropriately differ in relation to need.

3. *a. Assume that two populations have different production possibility frontiers, the payer aims to attain an equal health gain outcome. Show graphically that this may not be possible. State any assumptions made*

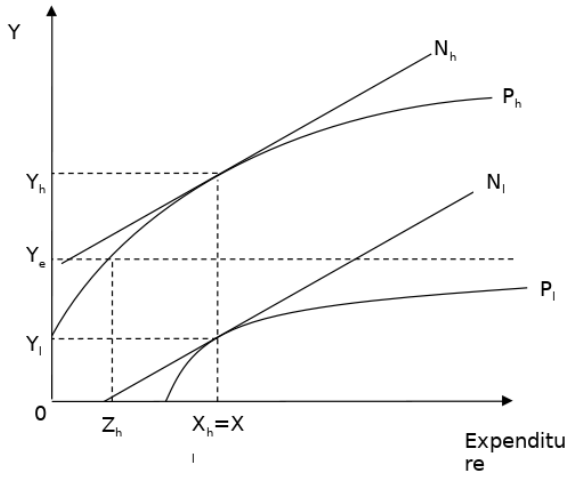


Figure 15: One Population Not Being Able to Attain an Average Level of Health

We define the following terms and assumptions for the given economic model:

- NN represents the societal welfare function, which provides a cut-off point beyond which no additional expenditure is made.
- PP is the production possibility frontier (PPF) for each population.
- Health gain is the outcome, denoted by Y, and budget allocations are the input, denoted by X.

Assumptions:

1. The PPF relates expenditure on the population group to the health outcome generated, Y.
2. The frontier of the PPF represents outcomes for payments where technical efficiency holds, meaning efficient production and input purchasing by the health care providers serving the population group.
3. There are decreasing returns to expenditure, implying that the PPF is concave.
4. There is only one input (or alternatively that all inputs can be aggregated into one measure, which in this example is budget allocations) and one output (some measure of health).
5. Other factors such as different providers, complementary services, the environment, personal characteristics, and societal influences are exogenous to the shape of the PPF.

6. The time period is assumed to be one year, which is typically the time frame used for allocated budgets.
7. In the graph, Y_e is unobtainable by population l.

Does an equity aim of equal health gains comply with vertical or horizontal equity?

Since equal health gains concern the same Y, this means populations of different need receive the same health gain, this is vertical inequity. This is also **horizontal equity** if those of equal need attain the same health gains.

Graphically show the implications that your answer to part (a) might have on the inefficiency of allocations. You may assume technical efficiency holds.

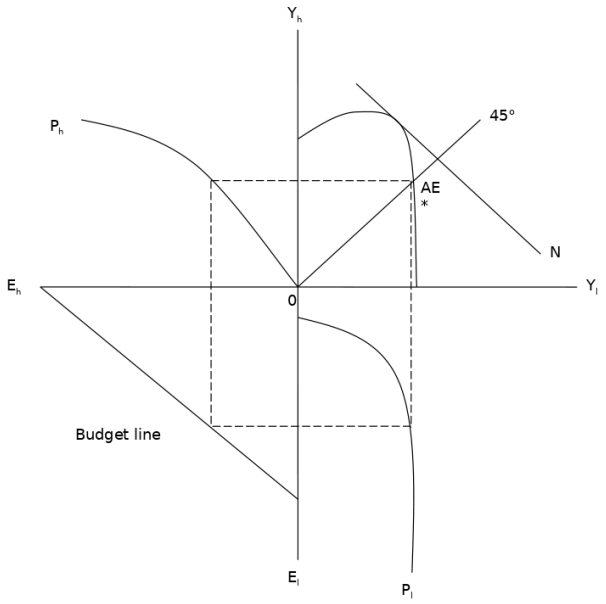


Figure 16: Quad Graph : Inefficiency of Allocations

Here we describe the different quadrants and terms used in the economic model of health gain and budget allocation:

- The NE quadrant represents the total health gain, which is the sum of the NW and SE quadrants. These quadrants are the production possibility frontiers (PPFs) for the two populations.
- The SW quadrant is the budget line, illustrating how changes relate to changes in allocations and output for each population.
- N is the relative social welfare function.
- AE^* is the equal health attained, which constitutes the maximum attainable by population l.
- The allocative inefficiency is given by $\frac{AE^*0}{A0}$.
- Total output is lower than at the efficient solution of W^*.

We note the following observation: the inability of the low productive population to significantly increase outcomes with additional expenditure leads to increasingly bigger allocative inefficiency if expenditure to the low productive population increases further.

Lecture 3: Topics in the supply, regulation and financing of health care

Wed 21 Feb 14:58

[Topic 2 Lecture 1]

2 Topics in The Supply, Regulation And Financing of Health Care

2.1 Provider reimbursement and incentives

We need systems to pay healthcare providers, but there are multiple way's of doing this, for healthcare to try to improve the healthcare provided to patients.

How do we pay hospitals? Lecture 1

Can we use incentives for the care a doctor may provide - lecture 2

How is Healthcare Different?

- Most health care is not paid for directly by the consumer
- Instead, providers are reimbursed by a third party payer (or purchaser), which is government, private insurance companies or social insurance funds depending on country
- The supply of and market *for* healthcare is therefore highly regulated

As such, price competition is typically absent, and instead provider compete for patients in non price dimensions - quality, waiting times, complementary services (visiting times)

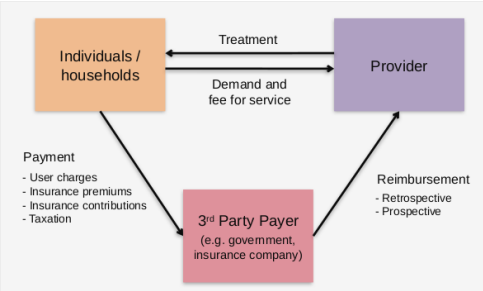


Figure 17: Simplified healthcare financing relationships

Healthcare is a fundamentally different from other types of good

- Demand for healthcare is uncertain - the onset of ill health is difficult to predict, whilst healthcare is often a need and not a want
- Healthcare is an experience good, the quality of the good cannot be known until after consumption. Thus questioning the link between quality of care and demand

- There us a moral understanding that access to health care should be universal

Furthermore, there is *information asymmetry* (Arrow, 1963)

- Between patient and provider - the patient is uncertain about the outcome of 'consuming health care'
- Between payer and provider - the quality of care is often not verifiable to the payer (without expensive monitoring)

2.2 The Role of Reimbursement in Health Care

Financial incentives are common in most industries, payers can use reimbursement system to incentive provider behaviour, providing that health care providers are concerned with profits.

There are still financial incentives we need to think about

Challenges in Health Care Reimbursement

There is a tradeoff between cost, access and quality

Where other challenges are specific to health care

1. Upcoming - relating to information asymmetry - want to measure activities hospital are doing as accurately as possible, but the doctors are the ones recording this. So the payer is relying on honesty here, but there are cases where hospital have overstated this to get more funding
2. Supply induced demand - idea being that with information asymmetry, but between patient and provider, provider can over treat patient. Dentists get payer a lot based upon how many treatments they can provide, say a filling when not necessary → unintended incentives we may face.
3. Cream-skimming and dumping patients - more profitable patients you keep, least profitable you get rid of

Role of Health Economics

One side of health economics is modelling to try to explain what will happen under certain assumptions, on the flip side there is the applied side, was switching from one thing to another the best thing in reality. Theoretical models have their limitations, assumptions may be too strict, and for applied it needs repercussions. Strike a fine line

Context in the UK

How to pay hospitals whilst maintaining efficient and quality of care, think of picture.

2.3 Types of Reimbursement Systems

Characteristics of Reimbursement Systems Fixed vs Variable

- Fixed - reimbursement doe not change as activity increases or decreases
- Variable - reimbursement increases as activity increases (dentist). Where some systems can be more variable than others, but it depends on the level at which activity is reimbursed (per item or period)

Retrospective vs Prospective

- Retrospective - payer reimburses all costs for treating patient

- Prospective - agree price before hand, any extras hospital provides is not included in the reimbursement
- Close ended - set budget, that is max revenue
- Open ended - no limit on how much hospital can spend

Prospective systems can have variable and fixed aspects, but if retrospective then .

Cost Based Reimbursement

$$R^c = \sum_{i=1}^{N} [Q_i \cdot c_i] + Z^c$$

This is a relatively easy system to implement, Z is non-activity related revenue say maintenance costs. Unit cost c either set by payer or determined by natural price in market

Features Retrospective, variable, open ended. Varies depending on activity provided

Pros

- Clear incentives to provider to increase activity - good for access
- If c_i includes some profit, for every case treated get some profit on top of that, this creates further incentives
- Incentives to improve quality
- Common in US 60s/70s → but led to medical 'arms race' - competing to provide the best health care

Better quality, but costs could spiral

Cons

- Little incentives to reduce costs
- No control over global expenditure
- Adverse incentives = supplier induced demand

Global Budgets

Lump sum amount of money, upto hospital if overspend

$$R^g = \sum_{s=1}^{S} B_S + Z^G = \sum_{s=1}^{S} [\bar{Q}_s \cdot p_s] + Z^G$$

Features Prospective, fixed, close-ended

Pros

- Incentives for provider to reduce costs and improve allocative efficiency
- Payer has control over global expenditure (closed ended)

Cons

- Potential adverse impact on quality
- Weak incentives to increase activity
- Providers may exceed target volume of activity
- Adverse incentives - 'cream skimming' - selecting which patients to treat and services to offer

This was the main way of reimbursing for a while, then moved to cost based reimbursement systems after the medical arms race

Prospective Payment Systems

Costs spiralling in US in 80s, but also wanted to increase activity, reduce waiting times. IN England, 'activity based financing'- per unit of care (item to period), tends to be per case now.

For every case treated, get this price. Grouping similar patients together based on diagnosis related groups (DRGs), and then set price pay hospital in say DRG equal to the historic how much it costs to treat that group of patients across the country

So take average costs and reimburse all hospitals this. DRG called HRH in England since the population and conditions faced very between England and America.

Normal delivery without CC - complications or co morbidities = £1496, but this may be unfair if paid all delivers one price, patient with CC would have less funding.

$$\text{Linear: } R^A = \sum_{j=1}^{J} [Q_j \cdot \hat{p}_j] \quad \text{Mixed: } R^A = \sum_{j=1}^{J} [Q_j \cdot \hat{p}_j] + \dots \tag{4}$$

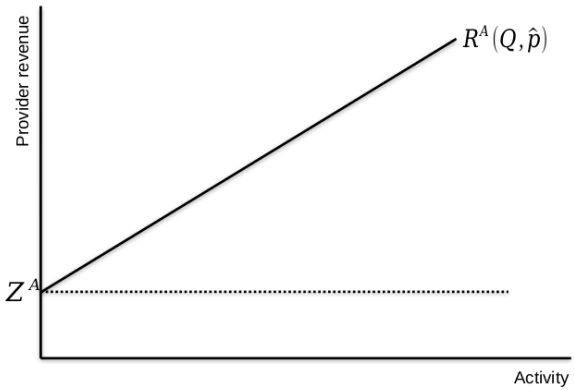


Figure 18: Mixed Prospective Payment System

Marginal, mixed - weighting

$$R^A = \sum_{j=1}^{J} [Q_j \cdot \hat{p}_j] + \sum_{j=1}^{J} \left[\left(Q_j - \bar{Q}_j \right) \cdot \alpha \hat{p}_j \right] + Z^A$$

Can set $\alpha = 0$ so that it becomes closed system

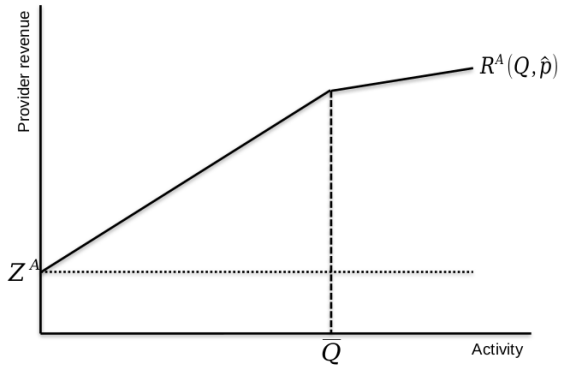


Figure 19: Mixed prospective payment system with marginal pricing

it is helpful to understand using the theory of yardstick competition, to answer "How to incentivise cost reduction in a world of regulated prices?"

2.4 Theory of Yardstick Competition

Model setup Payer (principal)

- An all knowing payer could directly contract incentives for cost reduction
- However, payers are often unable to monitor and contract cost reductions
- The payer has 2 instruments : price and a lump sum transfer

Provider (agent)

- Providers are profit maximising
- Providers have degree of monopoly power = downward-sloping demand curve
- Each provider faces a constant marginal cost
- Possible to reduce marginal cost through a costly fixed cost reduction effort

Question - But how to incentivise cost reduction and increase activity?

Retrospective payment:

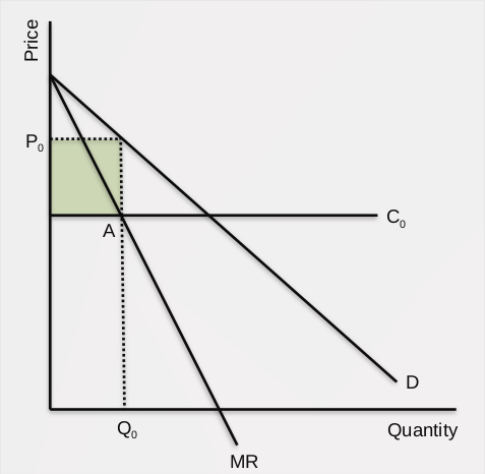


Figure 20: Retrospective Payment

- Provider produces at and chargers, where marginal cost equals marginal revenue
- Monopoly power gives incentives to reduce outputs and charge higher prices (compared to perfect competition)
- Little incentive for cost reduction

Under PPS:

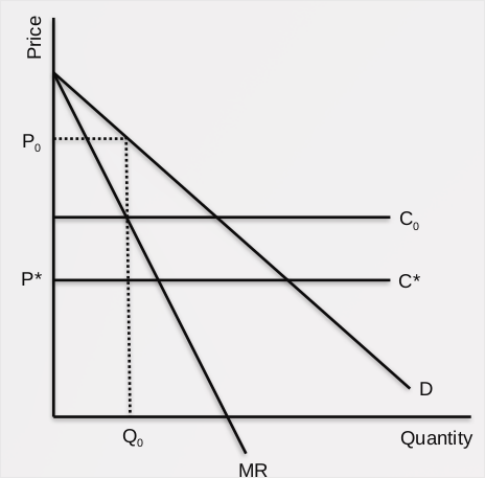


Figure 21

- Prospective payments are set equal to average MC its competitors
- Here, the provider faces a loss and the prospect of closure **unless** it reduces its marginal costs to less than by investing in cost-cutting technology at some fixed cost

Scenario 1: the provider reduces its marginal cost to $C*$ by investing in technology

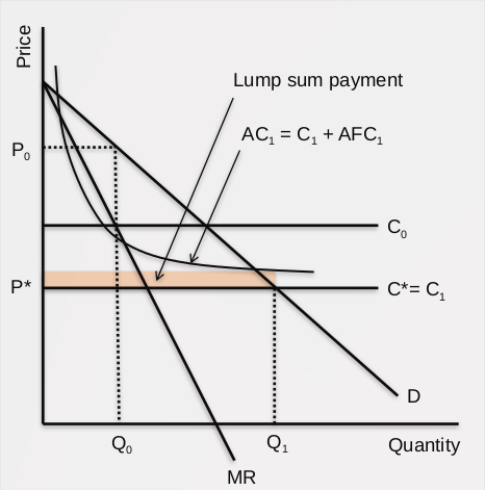


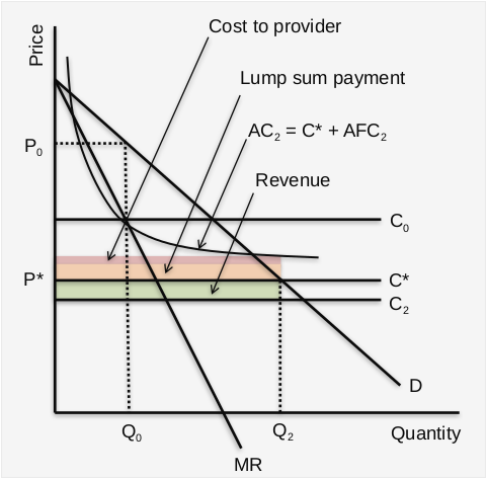
Figure 22

- The AC curve is equal to $C*+$ the ACF of the technology
- Here, the provider would produce at, and lose an amount equal to the fixed costs of reducing its marginal costs (the orange area)
- To incentivise cost reduction, the payer must cover the fixed costs using a lump sum (break even) payment

Produce at q p_1 but make loss of orange area since AC is higher than AR, but Schliefer : to incentivise reduction of MC, we can pay lump sum 'break even' payment. Make 0 profit but produce at Q_1

Reduced marginal cost to that of everybody else, if we keep investing in technology

Scenario 2: the provider reduces its marginal cost to $C_2 < C*$ by investing in more technology



- The provider has incentives to further reduce their costs if the marginal cost of efficiency effort (beyond the break even payment) is less than the marginal revenue generated from investing in

cost-cutting technology

Trading off the size of the rectangles

Would the payer stop making profit, if didn't pay orange then hospital making loss of red plus orange, then overall loss since red and orange greater than green. But key is that since setting price equal to marginal cost of all firms in market, the BE payment 'differs' based upon hospitals starting point, if producing at c* already, get no BE sum, intuitively.

Even with break even payment, still incentivised to reduce costs.

Optimal solution involves lump sum transfer, but if this becomes tricky to do (in paper), we can set price based upon some sort of average cost pricing - making p* higher because we also compensate for lump sum transfer in price that set

That is average cost of treating DRG group in the past,

Extensions

If lump sum transfer not possible Or, heterogeneous firms Or, in London or not (in the model)

Pros

- Stronger incentives to reduce costs and improve efficiency
- Incentives to increase activity (depending on how we define this)

Cons

- Potential adverse impact on quality (or activity) say intensity (quality) of services - may negatively impact, if not paid to keep patient. May release prenatally if not keeping in after couple days
- Open-ended - limited control over global spending
- Unintended consequences - information assymetry - hospital is one to decide whether CC

Payer is reliant on physician's judgement, this could have a knock-on effect for those not upcoding (since others have cheated the system). Patient reported CC vs hospital reported CC, comparing over time since noisy - patient reported remained flat whilst hospital reported increased over time, is there some reason for this? But really can argue due to upcoding, or that in the past patients with CC were undercoded

One hospital may be more efficient, prioritising different CC. But remember triangle between cost, access and quality

Table 7.1 Main differences across hospital payment systems

System	*Description of patients*	*Amount of activity*	*Price per unit of activity*	*Basic formulation of revenue function*
Cost-based/fee-for-service	Individual	Unrestricted	Item of service	$R^C = \sum_{i=1}^{I} [Q_i \times c_i]$
Global budget	Per hospital/ specialty	Target/ historical	Locally agreed	$R^G = \sum_{s=1}^{S} B_s = \sum_{s=1}^{S} [\bar{Q}_s \times p_s]$
'Pure' DRG-based hospital payment	DRG	Unrestricted	Fixed prospectively	$R^A = \sum_{j=1}^{J} [Q_j \times \hat{p}_j]$

Figure 23: Main Differences Across Hospital Payment Systems

Table 7.2 Incentives offered by three hospital payment models

	Objective					
	Increase activity	*Expenditure control*	*Improve quality*	*Enhance efficiency*		
				Technical	*Cost*	*Allocative*
Cost-based/ fee-for-service	Strong	Weak	Strong*	Weak	Weak	Weak
Global budget	Weak	Strong	Moderate	Weak	Moderate	Moderate
'Pure' DRG-based hospital payment	Moderate	Moderate	Moderate	Strong	Strong	Moderate

*However, quality of care could be adversely affected, as the incentive to increase activity may lead to the provision of inappropriate and potentially harmful services (see Chapter 8 of this volume).

Figure 24: Incentives Offered by Three Hospital Payment Models

Trade-offs Between Reimbursement Systems All have their advantages and disadvantages, there is so much variations since different systems require different things at different points in time

Differences between countries

There has been movement away from historical budget (global). Looking at DRG (prospective) based system, the amount of money reimbursed varies massively, comparing Austria $\sim 90\%$ with Estonia 39%.

Additional payments provide incentives

At the top we have DRG system developed in America, in England we have healthcare resource groups, highlighting PPS are different across systems.

It is common and often case that PPS aren't fully prospective, we see variations in what we see in hospitals depending on primary diagnosis, secondary diagnosis, CC, treatment intensity and lengths of stay and decisions hospitals make, that can influence revenue.

Essentially, there is a prospective component and a cost reimbursement component, finding they are much less prospective than is assumed.

Reimbursement Systems in England

2003 - Payment by results tariff system first introduced

- Prospective payment system to reimburse hospital care
- System in which autonomous provides competed to deliver care

2020 - COVID-19 led to the suspension of PbR system entirely

- The NHS reconfigured services to deal with the pandemic
- Faced significant new costs that were hard to precisely anticipate

Now, there is a movement towards blended system (fixed, variable and quality payments)

- NHS is increasingly emphasises collaboration over competition
- There is a mismatch between policy intentions and payment incentives

2.5 Evidence on Reimbursement Systems

Limitations of previous theoretical model

Theory of yardstick competition is useful to illustrate rational behind PPS, but it doesn't consider quality of care, just quantity and costs.

It suggests the solution for reducing costs and increasing cases traded ... when the payer sets the price per DRG, with / without lump sum payment and when providers are heterogeneous

But, at the end of the day it is a simplified model:

- That doesn't consider the impact on patient (e.g. Quality of care)
- Assumes providers are profit maximisers and make decisions
- Where decisions linked to cost are often made by physicians, who may
  - Have disconnect with provider's financial situation
  - Derive benefit from helping patients (benevolent)

Alternative Theoretical Model

Ellis & McGuire (1986)

- Developed a theoretical model to derive optimal reimbursement system
- When physicians also care about the benefit to the patient (benevolent)
- Using a cost-sharing perspective

With supply-side cost sharing: looking at "the extent to which payer and providers share the treatment costs of a particular patient"

Consider two scenarios:

1. Cost reimbursement: no cost sharing
2. Prospective payment system: some cost sharing - provider bears the marginal costs of care

Model Setup *1. Single Patient (principal)*

- Assume patient is fully insured (no out of pocket costs), they will accept the level of treatment prescribed.
- Essentially that there is optimal level of benefit for the patient q* Hospital (principal) - Hospital profit maximise (think of manager, profitable, don't shut down (profit function of revenue and cost))
- Physician (agent) - decision maker - decided quantity of services, derive utility from hospital profit. Compensation is independent from treatment costs

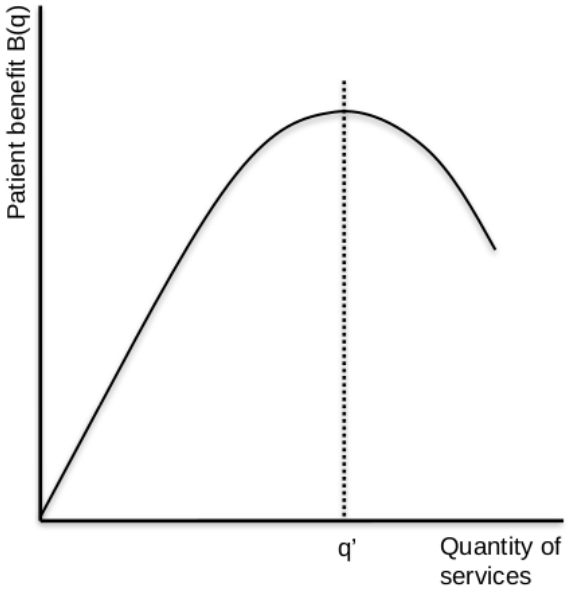


Figure 25: Patient Benefit Function

- The patient benefits from higher levels of treatment up to quantity of services = q'
- After q', higher levels of treatment become harmful to the patient reducing their benefits (i.e. Over treatment)

2. Hospital (principal)

- Cares about profit gained from treating the patient
- Profit = revenue)=(quantity of services) - costs(quantity of services)
- Revenue is a function of the payment system and quantity of services
- Assume marginal costs are constant (simple case)

3. Physician

- Decision maker: decides quantity of services (i.e. Level of treatment)
- Compensation is independent from treatment costs
- Derives utility from hospital profit and patient benefit

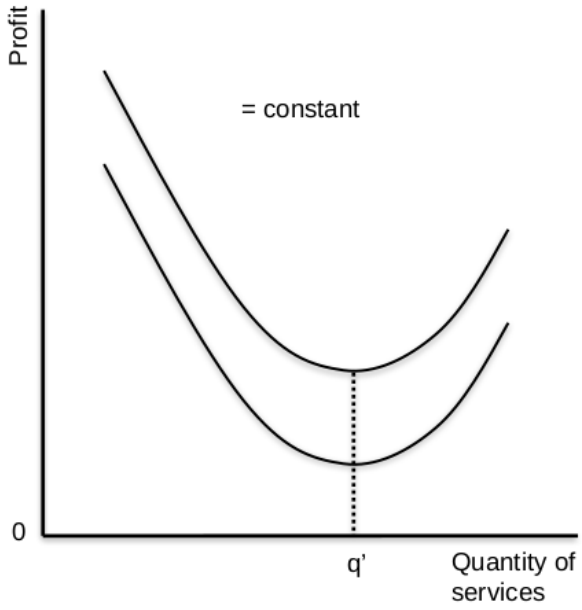


Figure 26: Physician Indifference Curves

- Shape of indifference curve depends on marginal rate of substitution (MRS) between profits and quantity of treatment
- MRS = rate at which the physician is willing to trade off one dollar of hospital profit for one dollar of patient benefit
- Assume that MRS is constant and therefore indifference curves are vertically parallel

Physician indifference curves - an inverse flip of patient benefit curve, as provide more quantity, provide more treatments but profits drop. There exists best possible care at q*

The shape of ID curve is MRS = rate at which physician willing to trade 1$ of hospital profit for 1$ of patient benefit. We assume MRS is constant, that ID curves are parallel.

2 Types of Physicians Perfect agency

- If MRS = 1: Physician weights marginal profit and marginal health gains equally
- Indifference curve is inverse shape of patients benefit function

Imperfect agency

- If MRS $<$ 1: Physician weights hospital profit above patient benefits
- Indifference curve is horizontal in extreme case when MRS = 0 (profit orientated)

Model Findings

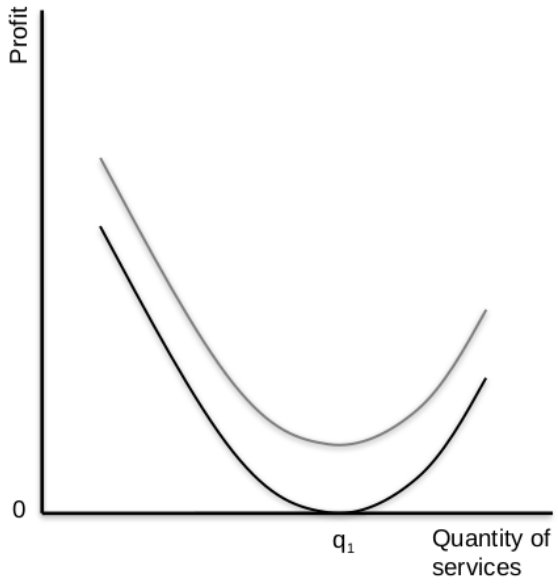
Investigates optimal solution under reimbursement systems:

- Cost-based reimbursement (pure / imperfect)

- Prospective payment system (with / without perfect agency)
- Mixed payment system

Scenario 1 : Under Pure Cost Based Reimbursement

- Hospital revenue = cost, profits always 0
- Quantity of services therefore does not affect hospital profits
- Implications for physicians behaviour
  - Physicians choose quantity of services to maximise utility
  - ... by maximising patient benefits
  - ... provided that MRS > 0



- Profits are always zero
- Quantity of services do not affect hospital profits
- Physician chooses quantity of services q_1 to maximise utility
- q_1 is level of quantity that maximises patient benefit

Scenario 2 : Under Imperfect Cost-based Reimbursement

- Not always the case that revenue = cost
  - E.g. Providers have some degree of monopoly power to influence price
  - E.g. Payer has imperfect information about true cost of services
  - E.g. Payer builds in profit margins into payments

- Reimbursed fee > cost if profits are greater than zero
- Implications for physician behaviour
  - Physicians may recommend (or tolerate) services even beyond the point at which benefits to the patient are maximised under imperfect cost-based reimbursement
  - This form of inefficiency (known as supplier-induced demand) is a common issue

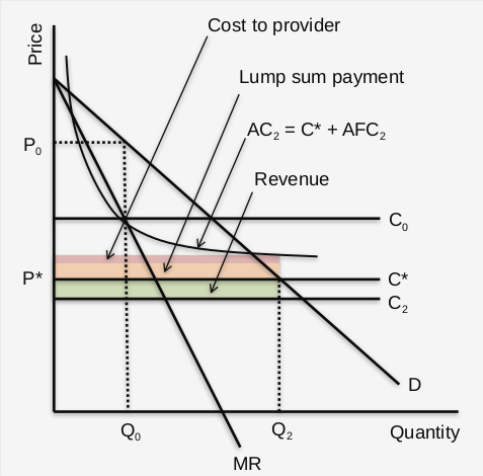


Figure 27

- Profits greater than 0
- Slope of profit line is equal to difference between marginal revenue and marginal cost
- Physician chooses quantity of services q_2 to maximise utility
- Patients benefit is less in comparison to pure cost-reimbursement due to supplier induced demand $B(q_2) < B(q_1)$

Scenario 3 : Under PPS (perfect Agency)

- Revenue per patient is constant and independent of quantity of services
- Hospital profits depend on the quantity of services provided to the patient $\text{Profit} = \text{Fixed prospective payment} - C(q)$
- The physician trade-offs increased patient benefit vs smaller profits
- Chooses the amount of treatment to supply where: marginal utility gained from patient benefit = marginal cost of increasing quality

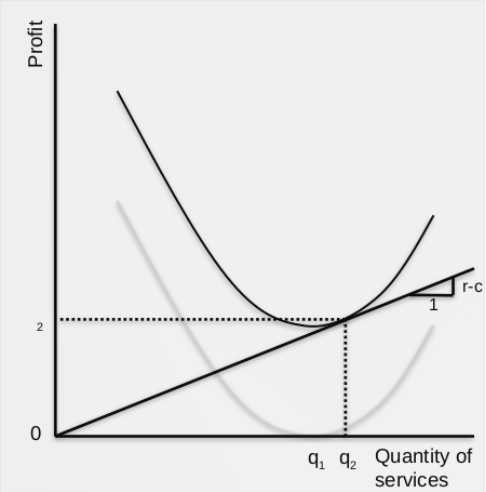


Figure 28: Before Calibration

- Payer reimburses hospital fixed price π_i equal to the cost of treating the patient under cost-based reimbursement $C(q_1)$
- Slope of profit line is equal to the marginal cost of increasing quantity by one unit
- Physician chooses quantity of services q_3 to maximise utility and hospital makes profit π_3
- Hospital has lower costs $C(q_3)$ but patients benefit is worse $B(q_3) < B(q_1)$

Quantity of services q_1 pure cost based system, we see a drop in quantity of services from here and an increase in profit, optimal solution is worse

Prospective payment price P is based on historical, across everyone in market. Over time price is calibrated and lowered to reflect lower costs hospitals now providing. Profit line intersects IC. But notably because indifference curves are vertically parallel q_3 stays the same

After calibration

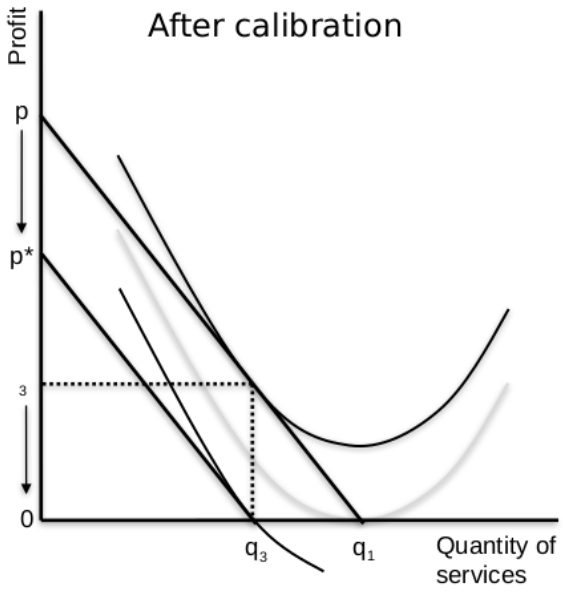


Figure 29: After Calibration

- Over time, the payer updates the prospective payment, p*, to reflect new costs $C(q_3)$
- Profits fall to zero
- Patients benefit remains less than in comparison to cost-based reimbursement system $B(q_3) < B(q_1)$

Scenario 4 : Under Prospective Payment System (Imperfect Agent)

- Previous results derived for case of perfect agency, if MRS = 1 the doctor weights marginal profit and marginal health gains equally.
- In case of imperfect agency ...
  - If MRS < 1 : Doctor weights hospital profits above patient's health gain
  - Doctor will choose the quantity of services that maximises profits without (or with little) consideration for patient's health benefits
  - If benefits to the patient is assumed to equal full societal benefits, PPS leads to an "under supply" of health care
  - This could occur if hospitals can successfully put pressure on doctors to five preference to profits

Findings Indifference curve is a lot shallower, relative to perfect agent curve p_3, provide lower quantity, intensity of services q_4. But in doing so, benefit of q_4 is worse than benefit q_3 The physician chooses quantity of services q_4 to maximise utility and hospital makes profit π_4. The hospital has lower costs $C(q_4)$ and higher profits π_4 than in perfect agency scenario But patient benefit is worse $B(q_4) < B(q_3)$

Essentially, over time, the payer updates the prospective payment, p*, which is lower than under perfect agency

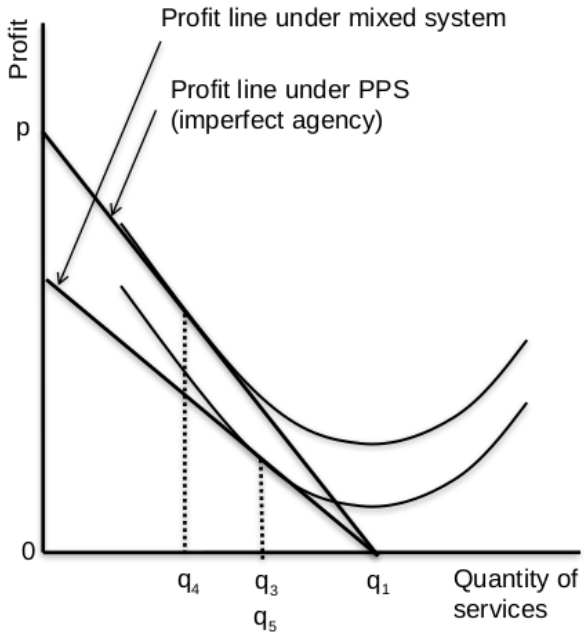
Mixed Payment System Still fixed prospective payment for treating payment but also cost-based payment that is fraction of cost, reimburse some of cost. Fixed prospective

Set prospective payment

Physician has lower utility, but at q_5

Even if doctors do care bit more about profit, can still devise system where they produce as if they equally valued patient benefit and profits.

This has some real world values, looking at spain only 20% of hospital fee reimbursed but also have FFS. May be more private hospitals for example, reducing the amount of prospective payments



In summary, **Ellis & McGuire (1986)** formalise how different payment systems can yield different results.

Models give idea of what may to expect in real life - but are these assumptions realistic?

Ellis and McGuire better in this respect, incorporating patient benefit, but still need to look at empirical evidence - evaluating adoption of other health care systems.

4 hour A&E target - target setting, can we translate this into salary?

Recap

- Ellis and McGuire - best scenario with imperfect agent is mixed situation
- Assumptions may not hold in real world
- Findings may not translate in practice

- Theoretical models are good but not the be all and end all since we make a lot of assumptions → empirics are needed

Empirical Evidence on Reimbursement Systems

Numerous empirical papers assessing the impact of reimbursement on

- Activity measures
- Health care costs and expenditure
- Quality measures (proxies)
- Adverse impacts (upcoding, shifting of patients)

Different approaches to do so

- Most studies exploit introduction of new reimbursement system. Say a before and after comparison, and comparing changes with a control group
- Others exploit changes within payment systems - say the extent to which payments become more or less prospective

Exercise 1. *Moreno-Serra & Wagstaff (2010) Relating back to the grey figure Using country level data from 1990 to 2004, comparing budgets for healthcare systems → Say Estonia from global budget to cost based reimbursement system from 2002, compare this to Turkey for example Look at the switch from global budget to prospective payment system too Setting is that these countries were moving away from communism, looking at multiple outcome measures (hospital activity - admissions, length of stay, bed, bed occupancy. Public private hospital spending)*

Fundamentally, we cannot observe say Estonia in 1992 that can say what would have happened has the system not been introduced As a second best we use the countries that didn't change as a control group, for those that switched systems. ***Simple DiD***

$$Y_{it} = \alpha + \sigma \quad treat_i \quad + \delta \quad post_t \quad + c\beta D_{it} + X_{it}\gamma + e_{it}$$

Where y_{it} is any measure of hospital performance (say admissions), i is country, t is time

$$D_{it} = \quad treat_i \cdot \quad post_t$$
$$X_{it} = \quad observable\ time\ varying\ factors$$

Where we condition on time varying factors $y|X_{it}$ Pre : post = 0, $D_{it} = 0$ here we have just α Counterfactual If no change in post $\delta post_i = 0$ - in this case didn't need counterfactual In pre post $= 0$ so β still switched off, but treat is $\alpha + \sigma$, then in post the difference difference is β

Their Model :

$$Y_{it} = \beta_1 FFS_{it} + \beta_2 PPS_{it} + X_{it}\gamma + \alpha_i + \theta_t + e_{it}$$

This model allows for s different starting point along y axis for every different country 3 country Example, 1 global budget, 1 switches to FFS, 1 prospective

$\alpha_{gb} < \alpha_{FFS} < \alpha_{PPS}$ - on X axis. Global budgets to begin with Country fixed effects α_i control for 'base level differences' Year level FF control for time level differences (say shocks) across time. Together = TWFE

Model Assumptions

Parallel trends

' in the absence of treatment, the trends in the outcome for treated units (conditional on observable time varying factors) would have followed the same trends as observed for the control units'

Potential violations (may fail if non-parallel trends)

- Non-parallel trends, when
    1. Unobservable tie varying factors differ between treatment and control group
    2. Treatment and control group affected by different exogenous shocks over time
    3. Natural ceiling / floor effects affect treatment and control group differently
- Selecting into treatment (reverse causality) - countries switching systems may be switching into a system based on outcome (global budgets not working in first place)
    - Units may self select into treatment based on outcome
- Spillover effects between treatment and control group - if looking at treated and not within hospitals, there may be some effect here we need to think about
    - Learning or substitution effects, or joint production or migration

Comparing Estonia with turkey, something could change in turkey that doesn't in Estonia after 1992 that could have an effect on mortality and hence invalidate the control group for the analysis.

This paper runs a DiD model, requiring the parallel trends assumption, if we try to relax this potential violation by allowing trends to differ.

2nd model : random trend model or trend adjusted DID now allows for different underlying trends between countries to begin with and factor in these trends when devising the counterfactual, running time variable allows for linear trends in one country.

Extends base model to control for assumption that all countries face same trend over time, but relying on extrapolation of linear trend - assuming linearity

Differential trends model - for all countries that switched to PPS and all they switched to FFS - allow for unique - control for non linear time trends across countries that switched. Random trends relaxes parallel trends assumption.

Importantly, they test parallel trends in pre-policy periods and check whether statistically parallel to each other

Concerns about reverse causality - countries that switch into might be fundamentally different from those that don't. Test this with model

Including lead dummies is almost like a placebo test - for whether they observe a difference in the data before the change happened - thus suggesting reverse causality may be an issue.

Hypothesis - positive effect on admissions activity, but even larger effect for PPS - under cost based - billed for item of service so treat more intensively but PPS may be encouraged to (DRG at admission level) treat less intensively to decrease cost

Results - find significant increase Note since country level analysis, we require country-level data

Testing assumptions

- Chi squared - if significant use model
- Tests are looking to see whether trends in pre policy period are different from each other
- At least in pre period, can argue trends are parallel
- Find increase in STR in diabetes - may have been some selection for treatment - but only one specific outcome (diabetes) so could be that controls included in the model are controlling for decision to switch systems

Countries implement changes at different times - differential time as a treatment - simple model may be biased under differential treatment timings

External Validity - only looks at global budget to FFS or PPS, so doesn't consider blended systems, thus questioning the nuance.

Lecture 4: Topics in the supply, regulation and financing of healthcare

Wed 28 Feb 14:58

[Topic 2 Lecture 2]

Last lecture we discussed:

- How financing arrangements in health care are different
- And as such... price competition is typically absent
- And that instead... provides tend to compete for patients in non-price dimensions (e.g. quality, waiting times, complementary services - visiting times)

2.6 Rationale For Incentivising Quality of Healthcare

However, patient demand does not always reflect quality

- Information asymmetry between patient and provider - patient is uncertain about the outcome of 'consuming healthcare' or may not be aware if all relevant aspects of quality
- Health care is an experience good - the quality of the good cannot be known until after consumption, thus questioning the link between quality of care and demand

Though, there may be limited incentives to competed for patients, this may be due to

- Few hospitals/practices in an area (a degree of monopoly power)
- Not all payers allow free choice of provider

Table 7.2 Incentives offered by three hospital payment models

	Objective					
	Increase activity	*Expenditure control*	*Improve quality*	*Enhance efficiency*		
				Technical	*Cost*	*Allocative*
Cost-based/ fee-for-service	Strong	Weak	Strong*	Weak	Weak	Weak
Global budget	Weak	Strong	Moderate	Weak	Moderate	Moderate
'Pure' DRG-based hospital payment	Moderate	Moderate	Moderate	Strong	Strong	Moderate

*However, quality of care could be adversely affected, as the incentive to increase activity may lead to the provision of inappropriate and potentially harmful services (see Chapter 8 of this volume).

Barriers to Quality Without incentives to change behaviour...

- Practitioners may base decisions on outdated information and practice norms
- Healthcare providers may lack the incentives to respond to new advancements
- Healthcare providers may perceive other goals as more important to pursue

Room for improvement E.g. UK context...

- Harms or nearly harms 850,000 patients a year in the UK (NAPS, 2005)
- 12,000 preventable deaths per year in the UK (hogan et al, 2012)
- Estimated cost to the English NHS £1-2.5 Billion per ear (frontier economics, 2014)

E.g. US context

- 44-98,000 preventable deaths in the US (to err is human)
- Suggested that misalignment of incentives in the dominating payment system (DRG based payments) was a potential explanation (2001 report)

Quality Improvement Initiatives

The payer is therefore often required to intervene...

- To include a change in the behaviour of healthcare providers
- In line with the needs of the patient

There are numerous approaches that have been taken to improve quality:

- Clinical services network to encourage collaboration between providers
- Opening the market to private providers to increase competition for patients
- Integration of healthcare systems to improve the quality of care provided to patients with multicomorbidities
- Various different initiatives, *integrating* health care systems and initiatives. Hospitals were previously separate from primary care, social care etc.
- National quality improvement programmes to educate and inform providers about new developments and best practice
- *Quality incentive schemes*

Quality incentive schemes

A quality incentive scheme is an intervention that uses incentives to reward or penalise the performance of healthcare providers based on a set of measurable quality indicators

This is a popular methods used by governments and countries across the world, with the logic being to:

- Address principal-agent problem
- Reallocate risk of the provider
- Motivate provides to allocation effort in line with objective of the population

Defining Quality

6 domains of healthcare quality (STEEEP)

1. *Safe* - avoiding harm to patients from the care that is intended to help them
2. *Timely* - reducing waits and sometimes harmful delays
3. *Effective* - providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit
4. *Efficient* - avoiding waste, including waste of equipment, supplies and effort
5. Equitable - is care provided same across different groups of people (protected characteristics) (or even coastal towns receiving lessor healthcare)
6. *Patient-centred* - providing care that is respectful and responsive to individual patient preferences, needs, and values

Ultimately need to consider all dimensions of quality and to categorise, if we are going to incentive effectively

But we can categorise them into

1. At the individual level (1, 2, 3, 6) - whether individuals can access health structures and processes of care which they need and whether the care received is effective
2. At the population level (4, 5) - the ability to access effective care on an efficient and equitable basis for the optimisation of health benefit / well-being for the whole population

Donabedian - Conceptualisation of quality

- *Structure of care* - the settings technology and human resources available where the delivery of care takes place
  - E.g. The number of CT / MR scanners available at a hospital
  - In measuring or incentivising structure of care, how does a facility ultimately care? It is the activities carried out rather than the facility itself? Say certain treatment, for recommended best practices
- *Processes of care* - the activities that are carried out as part of the delivery of care
  - E.g. Whether a CT/MR scan has been undertaken during treatment of acute stroke patients
  - But how can we measure everything a doctor does?
- *Outcomes of care* - The effects of the care that has been carried out (sometimes in the short, immediate, and long term)
  - E.g. 30-day mortality after stroke treatment
  - To get around this we can incentivise patient outcomes instead, say 30 day stroke mortality - incentivising CD scans after stroke (is a best practice)

2.7 Incentivising Quality

Main examples There are three types of incentive schemes

1. Public reporting

2. Target setting
3. Pay for performance

All three schemes rely on the use of measurable quality indicators ... but differ in how they incentivise providers to change their behaviour

Public Reporting

To decrease information asymmetry, so we know where to go for best quality care such that places have to start competing on care to get people to start registering there.

Like exam scores, perceived being monitored or assessed by colleagues, to incentivise.

Care quality commission (CQC) Ratings etc

Target Settings How well a provider is performing, 4 hour A&E waiting target. This will create incentives to hit this since they will be granted with greater autonomy and financial incentives as a incentive.

Say promotion or job loss incentives for staff within hospital.

Can provide common mission - to aim towards. *Targets and Terror* is an example where the consequences could be large for a poorly performing management → managers losing jobs etc

Pay For Performance Provided the hospital/doctor is not fully benevolent, a financial reward or penalty for performance of providers

Quality of Outcomes Framework

Different dimensions of quality - % of asthma patients who have had review recently - a process measure

Most are process measures, some outcome measures → more indicators / measures = more money ($\sim$ 20% of income). Linked with public reporting

But the scheme, since doctors have relative autonomy they have some discretion over the criteria they can set it to some degree. But creates income incentive, especially due to owning mechanisms of practices.

Processes, Structures, Outcomes Boils down to **what** to incentive - no scheme can target everything, and also applicable for *who* to incentive, individuals, teams, wards, organisation

How to measure performance? Absolute say rank of mortality rate in country (30 day). Or say relative performance or performance improvements, it maybe unfair to say 5% mortality rate level for the whole country.

Who is monitoring data? If it is self reported - is there potential for gaming or unintended consequences?

How to incentivise?

- Supporting levers - practices may not know if not collected data before
- Advance in quality scheme - incentivising 23 hospitals in Manchester to participate in financial quality dimensions (voluntary - all participated)
- Say if was reverse to penalise, like opt out - thus linking to how we frame incentives
- Types of payments - payment structure - linear, target payment, tournament

- Bonuses

P4P has variation in how incentive shames are designed, comparing effects across schemes can result in differences and whether we can really compare them

Spillover Effects

- Health care providers are often responsible for
  - Multiple patients with different conditions
  - Multiple take on day to day basis

  Holmström & Milgrom's (1991)
  - Treating a patient or 'tasks' may be substitutes or complements - this could be driven by various things - joint factors in production - incentivising improvements in treatments of stroke may lead to investment that also benefits other conditions
  - On the flip side, there may be effort / resource substitution

Gaming

Schemes could also create adverse incentives to 'game' the system

- Exploiting loopholes in design or incentive schemes
- Providing that reward from gaming outweighs the risk of detection and penalty
- Eg selection of payments - cream skimming of patients where it is easier to meet incentive targets , dumping of patients where it is more difficult to meet incentive target
- Changes in coding practices - it is sometimes possible to increase reward by implying changing coding practices. It is often nominal change that does not affect patient care It is only when incentive rewards depend on provider information

Evidence on Quality Incentive Schemes

Exercise 2. *Gaughan et al. 2019* [**Moreno-Serra & Wagstaff (DiD model)**] *Incentivising same-day discharges In England there is payment by results, for certain HRGs (knee replacement etc), the payment a hospital received weren't based on average payment but built in the PPS to incentive performance of hospitals To define a day case as a period of care in which they essentially didn't stay overnight → evidence to say this is safer 60% should be sent home in practice it is 19%*

PPS - before this scheme was introduced, hospital was reimbursed average case of that treatment regardless of day case or not, thus there is a financial incentive to treat as day case - but maybe this is to do with logistics of this - day case hospital rooms etc. But this scheme increased price difference between day case and night, in some cases 66% If patient stayed overnight, gets paid less than before the scheme, but if same day bayed more Study looks at hospital level data, 157 planned and 34 recommended conditions in which 32 conditions are targeted y variable is day case rate, a proportion is low, then after incentive happens shoots up, then looking at non-incentivised conditions, we can identify the change

This study to deal with ceiling and floor effects, estimates synthetic control method Using data on all conditions, an algorithm weights the conditions to come up with a synthetic control group to follow same trend in pre, and then extrapolates this to post thus, by matching on outcomes through pre-intervention,

assuming the synthetic control group affected by the same time varying unobservable and same ceiling / floor effects (ie relax the parallel trends assumption)

Robustness Checks

1. *non parallel trends - test - compare trends in pre policy period (did). SC - examine performance of SC model in pre policy period*
2. *spillover effects from treatment to control - potential bias - positive spillovers if improvements in day case facilities. Negative spillovers if physicians prioritise incentivised procedures. With test would be to restrict the control group to conditions from different specialty / department*

[Recap]

Conclusion *mixed results, there is positive policy response for 14 of 32 incentivised conditions maybe the benevolence factors etc do we believe results? Would we expect to find same in other countries should we expand the scheme if there was ceiling effect there might not be this effect for other conditions*

Tutorial

[Tutorial]

1)

i) Health care policymakers have widely introduced mechanisms to incentivise providers of health care to improve care quality.

Give three reasons why policymakers might introduce incentive schemes to improve quality of health care.

Reimbursement systems could incentive cost reduction over quality

EG, a prospective payment system could incentivise providers to reduce quantity of services provided to a patient if only reimbursed per admission

Under a global budget, providers may reduce quality to save on costs (fixed budget, keep costs down as much as pass)

Prospective payment - once in hospital there is not many incentives to treat properly

Iv) Model 4 preferred since it is most flexible, under assumptions they are equal, but fixed effects is preferred.

V) Do we think the underlying assumptions of DiD are going to hold

Since we cannot directly test that treated units would follow this trend had they not been treated.

Looking at potential violations [**Assumptions Slide**], out of 23 hospitals in Manchester. There is the same trusts and organisation thus there might be some learning effects, incentivising improvements in say stroke care, this may get passed along. Substitution effects may be harder, but doctors may send

Non incentivised as control but incentivised may be sending more complicated or expensive patients here

Thus would we have expected this drop had the policy not been introduced. If dropping because of spillover effect, then we may be under estimating the effect of the policy.

Selection into treatment - say hospitals are allowed to volunteer, they may be set to benefit more form the scheme, say the reduction in the blue line, we may not see quite the same jump.

Non-parallel trends due to all potential violations, by assuming constant effects we assume parallel trends.

Which may be affected by the characteristics that vary over time that may affect our outcome that we don't control for. Or say exogenous shock, that is some shock affecting say mortality rate other than say incentive scheme (Covid?). Exogenous shocks at country level are more prevalent, but comparing different hospitals, especially at geographical distance as opposed to patients within the same hospital, it is harder to argue this.

Looking at mortality rates proportion of patients attending the hospital that die within 30 days, is bounded by 0 so may be more cautious of floor effects

Testing Take data just from pre policy period, we have variable whether hospital was incentivised or not, equal to 1 in first year, 2 2nd so on. Measuring β coefficient, allows the slide to be sloped, then we can interact I_j variable with time trend will give us indication of whether we have parallel trends throughout the pre policy period

Rather than just testing per period we can directly model time trend and changing time trend with DiD, then we might want to select which model to estimate both and compare.

Including lagged variables of treatment effects to see whether there was any effect before the incentive was introduced (placebo test), this would give a warning signing that hospitals are selecting into treatment.

Lead dummies - is there an effect when we don't expect to see one

Spillover effects - we could exclude hospitals located near the treated hospitals if we were worried about learning or substitution effects.

When running a DiD, different violations may lead to different concerns.

Lecture 5: Economic Evaluation

Wed 06 Mar 15:05

[**Economic Evaluation in Health Care**]

3 Resource Allocation II: Technical Efficiency (Economic Evaluation)

[**Chapter 1**], [**Chapter 8**] - [**Chapter 12**]

Overview

- Why is an economic evaluation needed in healthcare?
- What is an economic evaluation
- How do we measure costs and benefits
- Where does our data come from?

Health care is expensive, it varies widely across countries. This leads to the problem of healthcare provision.

The amount of spending per capita not only varies but is still a signifiant amount of GDP spent on health care.

The key message is that this is a large sum of money, expenditure is a key part of a political manifesto.

But at the same time we have substantial innovations happening, with new drugs and treatments.

The question to what health care services should be made available in terms of opportunity costs is also a key element.

Ultimately, this is about efficiency and trying to maximise health from a budget. Hence economic evaluation techniques seek to inform efficient allocations, "making sure we are on productivity frontier".

At Its Core Economic evaluation is the comparison of costs and benefits of two or more interventions

As an example, the Covid pandemic and vaccines. Did it reduce the spread or mortality? But also the societal benefits such as people not away from work, I there are health and *wider societal* impacts.

Comparing the benefits of an intervention to its costs, for any new drug to go on the market, they require evidence that they exhibit value for money. For vaccines we didn't follow this process due to timing. But for a new cancer drug, health economists provide information rather than decisions.

Costs And Benefits

Examples of costs

- Typically monetary, essentially opportunity costs benefits that could have been obtained alternatively
- Such as healthcare costs, individual (out of pocket) costs, carer costs, non-healthcare costs (indirect costs - productivity - can work or work at full capacity)

Benefits

- Natural clinical units
- Utility
- Monetary units

Perspective

Broadly, societal costs and benefits, as opposed to a health care sector or individual or patient level - there must be clarity regarding this

But can we really compare these? At different perspectives, it would take a broader societal view, and then it is questions such as diverting this money away from healthcare, taking this perspective away leads to ill-comparisons.

Do we trust individual perceptions of health, or do we decide to have an individual clinician to decide on the benefits of a new drug → should they be objective (blood sugar counts) or subjective (ability to get dressed). These broadly inform the measurement of benefit

- Whose perspective of health
- Subjective or objective
- Specific or general

Making these decisions, mean that all economic evaluations are normative.

We want this so that our evaluations are consistent, rather than one looking at Covid cases vs mortality, we need guidance to ensure comparability between economic evaluations.

Since we are trying to decide what to provide, but these may have different impacts within health so ideally a common measure enables us to compare and contrast.

Welfare Economics Looking at the social desirability of any set of arrangements, for example the state of the world or allocation of resources, solely in terms of the utility obtained by individuals.

Social welfare function is the sum of *individual utility*, individuals maximise their own utility so their valuation of a service is what matters. Such that valuations by healthcare professionals are irrelevant. There are arguments against this and whether because of information symmetry and information caps we have can ever truly lead to the welfarist argument.

Pareto Principle

We can talk about weak pareto improvement where one improves and the other is the same, strong pareto

Not really concerned with equity, depending on the stance you take, but point is do we believe that peoples evaluations of health will differ depending on how poor they are. If they are, inequality issues may favour those who value the service more.

Placing a monetary value on a drug that favours the rich, they will be prepared to pay much more for it, basing on this will suit the rich rather than the poor since they place less value on this.

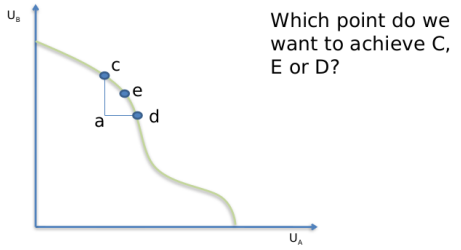


Figure 30: Utility Possibility Frontier

Social Welfare Functions

Where we value each individual utility equally,

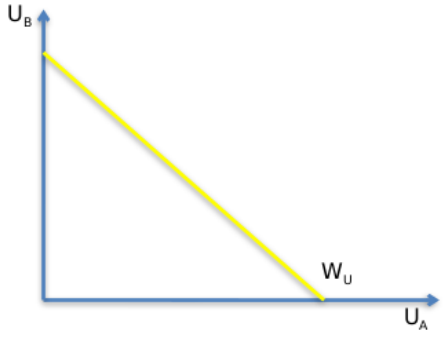


Figure 31

Bernoulli-Nash convex curve

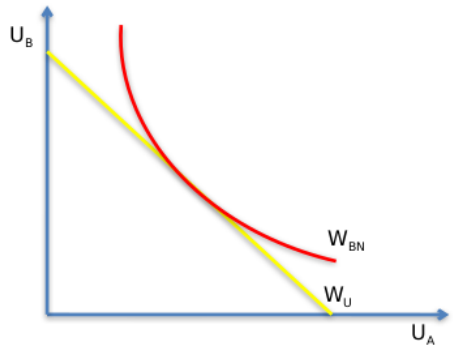


Figure 32

In a welfarist world, we get a point where we are interested in total utility, if this is the same at all point of the curve there is an additional

Issues

Need to be able to measure and compare utility, individuals may measure differently, and we assume individual make utility maximising choices

There are also issues around ordinal measurements, these may not be compatible between people.

The biggest 2 issues are that we can argue this is appropriate in health care, but for these issues we should question should we ask individuals there valuing. Secondly there is a strand of economists that believe health is an important part of utility, so why don't we maximise health as opposed to utility. This would potentially fix the differing valuations of utility at different ability to any points.

Therefore, there has been a push to non welfarism - rejecting individual valuations of utility and instead extra welfarism with a focus on health.

Extra Welfarism One of the issues with looking at health is that we might be missing some form of opportunity cost, missing some impacts of new drug / treatment on society. Imagining we are head of an economy

Types of Economic Evaluation

1. Cost minimisation analysis
2. Cost consequence analysis
3. Cost benefit analysis
4. Cost effectiveness analysis
5. Cost utility analysis

Cost-Minimisation Analysis

Comparing the costs of 2 approaches, and whichever costs the least. With the assumption there is no impact on benefits, which is of course risky.

Say different versions of COVID vaccines, is there any chance the effects of the vaccines are different. Then this doesn't lend itself to a cost minimisation approach. But is more likely to be done by health care system.

Cost-Consequence Analysis

Listing the costs and benefits, largely because of data issues. It would be very expensive to ask individual perceptions, it is much quicker to look at things this way and present them (as *health economists*), but the issue is there is no clear-cut decision to be made.

Cost-Benefit Analysis

Costs and benefits valued in monetary units, this is welfarist, asking individuals their valuations.

Cost-effective analysis

How effective it is, from a particular measure of health. But comparing health outcomes is an issue. Leading to

Looking at single health effect, assuming no other effects are present. Say blood sugar levels lead to increase in mortality, without picking up other effects on mortality.

Range of different treatments or services, it is difficult to make decisions, a common measure of unit helps evaluation. Cost effectiveness is quite limiting in this perspective.

Cost-Utility Analysis

The benefit measure is *quality of adjusted life years*, sort of like ranking health from 0-100, aligning with quality of life outcome.

Allows the comparison of different measures of health, say eyesight to teeth. Helping the decision maker working out the best value for money.

We can see costs as inputs and benefits of outputs, depending on study perspectives and whether we want to compare across health outcomes. An issue with the Covid vaccine was that whether it had a long enough study time.

Combining Costs And Benefits

Average cost effectiveness ratio ACER = costs of intervention / benefit of intervention

Gives cost per unit, lower the better

Incremental cost effectiveness ratio Compare two mutually exclusive interventions, additional costs (benefits) than the next most effective. ICER - additional cost of alternative / additional benefit of alternative. This is related to ACER, when the next most effective intervention is doing nothing, but can more benefit be produced at a lower cost?

The cost effectiveness plane summarises these

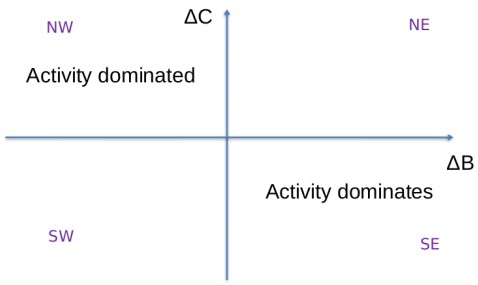


Figure 33

We can draw a y = x Rc curve where to the right is producing a year of prefect health at a lower cost than the max we are prepared to pay whereas the left is the cost is higher than what we are prepared to pay.

Example. *Three different interventions, looking at life years gained*

Intervention	Cost (£)	Life years gained	ICER (1)
A	300	30	10
B	500	40	20
C	600	50	10

Figure 34

Which is inherently a health effect, thus cost effectiveness territory here (as opposed to utility) Ranking by cost - 300 / 30 gives incremental cost ratio as 10 It is cheaper to provide c than it is b, we would remove b here, since this is clearly cheaper (extended dominance) ICER is smaller then there is extended dominance

Cost Effectiveness Threshold The cost effectiveness plane summarises since we can never be clearly sure following a range of ICER, but here we can calculate the probability, those under the threshold are cost effective, so the probability it is cost effective is the proportion under the threshold.

Thresholds do not guarantee budgets maximise benefits, the marginal opportunity cost of the resources should be assessed, this requires all current and potential interventions to be taken into account and all reassessed when budgets and interventions change.

However, the scope is important, are we maximising utility from the health sector or entire state budget, say the utility gained from more regular refuse collections.

The key things within health care budgets is *opportunity costs*, a rare disease affecting 1 person doesn't have the same benefits as something affecting 1000 patients.

[**Economic Evaluation in Health Care**]

[**Economic Evaluation in Health Care 2**]

3.1 How do we Measure Costs And Benefits

Measuring Benefits

What is Value

Monetary valuations of benefits

We can infer from behaviour the revealed preferences, where Hedonic pricing is the price determined by internal and external factors of the good. We can look at over the counter medicines and their price premiums to determine

One argument is that we can just use the market. There is roughly a common range of prices, then if we take the market as a reflection of value, we value say yoghurt at just over £1. We can also infer value looking at different goods but with different traits say fast action or liquid form.

We can also look at extensions to insurance and trade off with cost and cover.

Or, we can look at *avoiding behaviours* in which we observe premiums for safety features, say airbags, seatbelts and crash helmets

Or we can look at the value of statistical life, measuring value of health through wage premiums. Can we say in jobs with exposure to hazards, there is a premium for working with more dangerous chemicals

Or the time travel method, looking at how far people will travel to see a specialist

Stated Preferences where instead of actual behavioural responses to price changes, we could ask individuals how much they would be willing to pay in surveys

Contingent Valuation Method - in which we ask individuals for valuations contingent upon a hypothetical scenario. These may be closed ended (discrete / binary choice), open ended (no value or preference), payment scale

Benefits : Natural Units

Cost effectiveness world, clinical measure such as blood count or length of life from new treatment.

Assumed that comparators differ in only the one measure you capture (say length of life). But what if quality of life is impacted here and the decision is the other way around?

Cost effectiveness approach is thus limited, since we assume no side-effects.

Quality of Life

But how would we compare two different outcomes?

Entering cost utility analysis, we look at some measure of quality of life that is health related.

If we can get a good instrument, measure, tool for this, we can compare different things. Say eye treatments, teeth treatments and mobility treatments.

QUALY is a well known measure in health used in health interventions.

ICER and QUALY is fine to use interchangeably, if we use QUALY - we are in cost utility analysis world.

If there are impacts ons several aspects of health, QUALY is used to pick up several different impacts

Some of issues with CUA, CBA and CEA - they don't say how they are distributed. Instead the focus is on maximising a measure of health/ monetary measure/

But this fails to take into account the impact of one population more than another etc. And fails to take into account subjective quality of life.

Indicators

- We want an unambiguous measure of benefit (to identify a causal relationship) that is comparable and can be valued
- Reliability - does the instrument generate consistent results
- Validity - does the instrument
    1. Correlate with known valid measures?
    2. React in wags suggested by theory
    3. Appear to measure what it is supposed to
- Responsiveness - does the instrument respond to changes in health
- Feasibility - is the instrument able to use

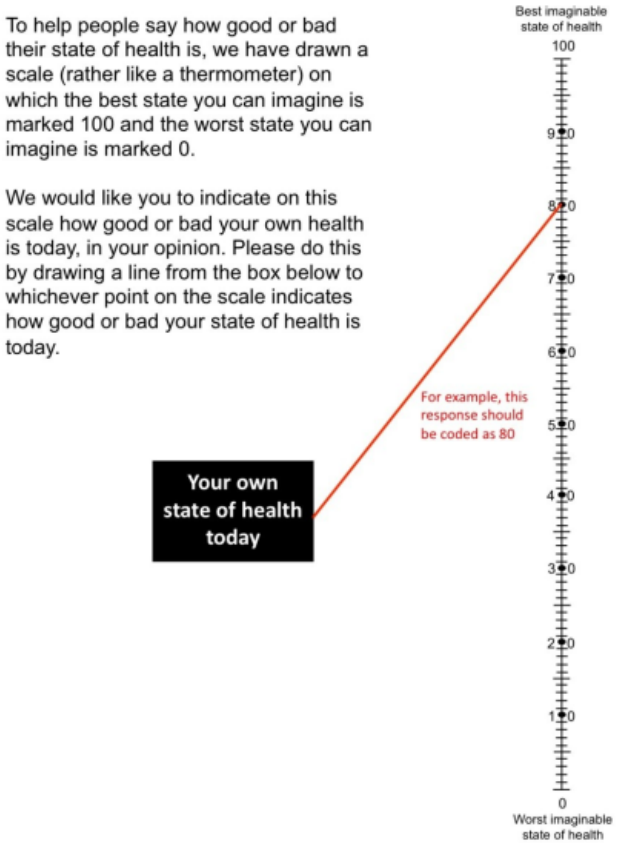


Figure 35: EQ5D VAS

Eq-5d

5 dimension measure. Questionnaire that covers 5 dimensions related to health, each with 3 levels. Thought here is some subjectivity in what the levels should be, somebody has decided on mobility, self care, ability to perform activities, anxiety & depression, pain and discomfort.

Extra welfarist - someone else has decided what matters for utility But at the same time, we are rating this as individuals, saying how we are. Although, 243 outcomes from the questionnaire. But we can say for example 3211 is better than 32123 but not that 3211 is better than 23211.

Therefore this motivates the use of an index of weights to identify whether mobility is more important than self care (used for example here). 1 better than 2, better than 3. Although it is likely, it all depends on the relative weight given to the measures, say really bad mobility but individual might be more concerned about mental health.

Ranking the EQ-5D What does society feel are appropriate to weight different values. Asking how much years of full health is equivalent to

Health Gains And The Eq-5d

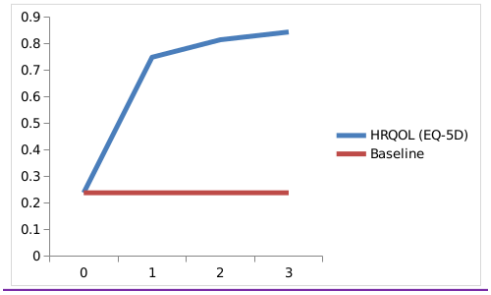


Figure 36

The area under the curve (assuming linear progression)

If number of blue lines, then subtract one from another to calculate baseline QUALYs

Which Benefit Measure to Use?

All have problems around equity, there is not much distributional cost effective analysis under this. Thus we require a threshold

Welfarist argument, CE only captures health utility. CBA is welfarist, relying on assigning a monetary value to utility. QUA is a mixture, someone is making decisions on what should matter for health related quality of life, could argue this is reflecting individuals utility and their views on how important those health views are.

Measuring Costs

Should we be looking into wider impacts beyond health, costs have similar issues. Drummond et al (2005) advocate a societal perspective, however this has in the past caused concerns since if you think f budgeted heath care sector, it makes sense to maximise based on own budgets, rather than other sectors. And thus it is appropriate for health care sector to overlook health care costs.

In reality, focus is often on health care budgets, this perspective includes impact on productivity.

Situation where we look at reference case, where we are told how NHS England should take and benefit measurement should be used. It is the NICE guidance that was questioned, that was rejected with potential impacts on equity. Want to identify changes in health care costs, given cost of medication, cost of administrator (nurse etc., location costs, and anything that is impacted that the health sector has to pay for, essentially everything that needs to be paid for. Then to quantify and cost these. But cost for drugs often dominate these.

Even if these have all been identified, this involves some form of data collection. Though there are tariffs for certain costs such as bed day etc. But it is important to note some providers may be inefficient and this may be higher. There are also shadow pricing where other measures are used to work out price. Then as with all economic evaluations, it is important to note the perspectives captured and the number of ways it can be done. Which will then provide a strong case for why these should be provided.

Discounting - accounting for time preferencing, discounting future health for health today. But we also discount costs and benefits in the future accordingly.

3.5% is the current rate to discount benefits.

3.2 Where Does Our Data Come From?

Trial Based Economic Evaluation Within study economic evaluations occur using data form within a trial

- Patients are randomised to treatment
- Benefits and costs are captured
    1. NICE guidance on aspects to cover include
        - Benefit measure to assess
        - Perspective to take
        - Uncertainty and missing data
- ICER estimated
- The follow up may not capture all impacts on benefits and costs - thus requiring the need to adopt modelling approaches

There is an important place for trials, capturing information on costs and QUALYs but *only for 5 years*. But these effects are likely over a lifetime, but trials mean we can only speak for these 5 years

Thus we need to understand the longer term impacts, or where we don't have money to run expensive trials.

Modelling-based Economic Evaluation

There is often lots of data to collate, say trial data, cost of care data and estimation of QALYs with and without treatment. There is much uncertainty in data, thus uncertainty in results and us having to deal with probabilities.

Decision Analytic Models

How uncertainty can be reduced so decision-makers can interpret evidence. Models connect different healthcare options and the outcomes associated. To quantify uncertainty by assigning probabilities to choice events

Decision trees

Used for one off decisions, particularly suited to

- Acute care problems
- Only only diseases
- Short term diagnostic / screening decisions

The key steps are to stricture the tree, to estimate probabilities, estimate outcomes and analyse the tree.

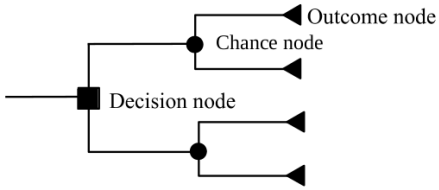


Figure 37: Decision Tree Structure

Example. *Medicine administered in a heart attack*

People who are having a heart attack can be given some medicine which has been shown to increase the probability of them recovering, however there is a risk they will suffer an adverse event (bleed) The research question is is the heart attack medicine cost effective

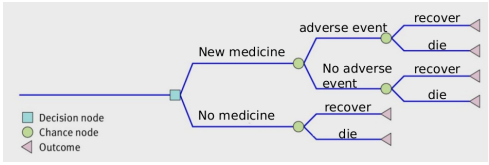


Figure 38: Decision Tree For Medicine

We estimate probabilities from published studies, using trial data or observation (existing) data Or a meta analysis aggregating from multiple sources

For each branch following a chance node, the conditional probability P is needed

$$P = \frac{Number\ Following\ That\ Branch}{Number\ Leaving\ Chance\ Node}$$

Probabilities are numbers between 0 and 1, and the probability for all branches out of a given chance node add to 1.

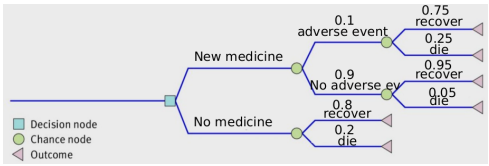


Figure 39: Entering Probabilities

Entering outcomes

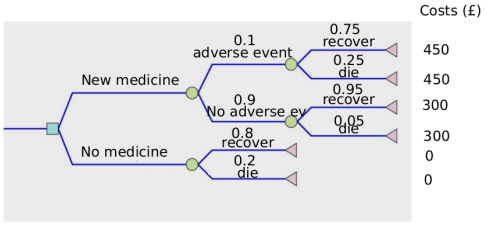


Figure 40

Analysing the decision tree, start from the right and work backwards through he decision tree. At each chance node fro the RHS, calculate the expected costs and QALYs at each expected chance node.

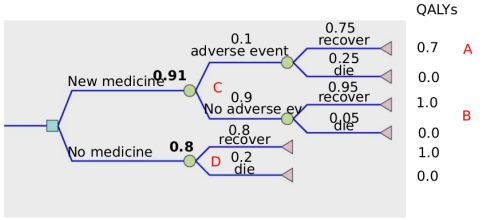


Figure 41

Calculated expected costs on each arm and multiply together, same for B. Then obtained expected QALY for A and B, then compare to C.

Rollback calculations. 0.8 to 0.9075, QALY for no treatment and for medicine.

Then we can similarly do the same for costs

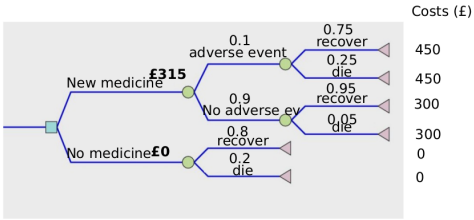


Figure 42

Limitations of decision trees

We need to be able to assess full implications of each possibility (patient pathway). They are less suitable for longer-term outcomes and struggle to handle recurrence.

Markov Models

- Markov models represent disease processes that evolve over time
- They are suited to modelling the progression of chronic disease
- Can handle recurrence
- Estimate long term costs and life years gained / QALYs

Elements

- Markov states should be mutually exclusive and exhaustive
- Markov cycle length is a fixed period of time
- The choice of cycle length should
  - Depend on the timing of events in disease process
  - Depend on the study question and available data
- Transition probabilities
  - Transition from one state to another at end of single cycle
  - Fixed transition probabilities out of each state, adding up to 1
- Markov Rewards
- There are values assigned to each health state that represent the cost and utility of spending one cycle in that state

Discrete Event Simulation

Some of the issues with decision trees an be addressed in other ways, such as the prior 2 models

Note. ***Equity***
Throughout the lecture equity has not been a factor of approaches taken (beyond limitations of WTP) The ICER concerns efficiency - which intervention generates health at a lower cost The impacts on inequalities are not considered, what if the two interventions affect different sub-groups differentially

Economic evaluation is solely grounded in efficiency.

3.3 Tutorial

1a) Summarise the key similarities and differences between the three frameworks for economic evaluation: cost-effectiveness analysis, cost-utility analysis, and cost-benefit analysis

If outcome was BMI, this is cost effectiveness, looking at a health measure such as this would negate other health measure, but this is expected since it cost utility analysis – hopefully capturing other aspects, so that we can comapre and contrast other disease areas big difference, although both trying to measure health, cost utility is utuity derived from QoL Talk about cost effectiveness plane, whether it affects decision, why

Cost-benefit - positive worth doing, negative not.

b) 3 approaches differ wrt to assumptions made regarding SWF

We are not specifying the SWF, these are concerned with maximising efficiency, not concerned with equity in any sense Not the distribution of benefit, just maximising the benefit in society CE analysis is extra welfarist, with argument that health is key part of utility function Not welfarist - not asking individual what that health decision should be, somebody has decided CB is welfarist CUA - unclear - mixture of the 2 - extra-welfarist - people are asked different health measures, but someone else has decided that matters for your QoL thus welfarist however utility values are obtained (messy) because utility values have come from representative ample of population (what they value this health statement as), so that is quite welfarist

2a) First calculate ICURs, rank by cost, comparator for a is do nothing, ICUR = thousand pounds per QALY

3a) cost ratios independent

4) economic evaluation - new thing to do

In this case, new drug to improve peoples health, more effective but comes with increased risk of adverse event

3.4 Guest Lecture - Within Trial Economic Evaluation

Steps to do economic evaluation using real world data How to construct QALYs and clinical measures, such as interventions with control and treatment groups (CBD)

As an economist, we inform on whether the cost of the treatment is justifiable or not, and whether the resources can be used somewhere else in better form

Typical Data / Variables In a regression analysis we need to convert into monetary units, for this we need to obtain unit costs, this data won't come from trials, we need to know and collect this data

Benefits

- Mostly in developed world, use EQ5D data. We can do cost effectiveness analysis ,for each remission from depression yoiu need to spend X, but whether this is useufl use of funds cannot be studied here, need to check impact of say cancer vs depression on QALY

Data formatting

Panel or wide form cross section data, can formulate in either way but wide format is needed Sat dependent variable is QALY, need to control for QALY for best trial? EPNDS - baseline - age, epnds level, eq5d,

Panel data format - can make it so for each participant have data at say 3 points in time, baseline - 4 and 12 months

Create utility index before wide format, also better to calculate unit costs in this panel before changing to wide format

QALY calculated for whole year, EPDS after 3 months

Need to control for baseline differences in control vs treatment groups

Randomisation doesn't mean treatment and control groups are same

Roshni Trial Intervention Treatment Cost of intervention

Treatment as usual - can use the standard services (GP or hospital, whatever they like) But treatment is group based participation in CBT

Depression measured by scale EPDS (1-27) an ordinal variable How to define remission from depression - if the score is below 10 on epds, then the person is remitted from depression

Primary outcome, do cost effectiveness analysis, data collected at baseline, 3 and months after

2 outcomes Remission dummy (<10) QALYs - response to eq5d - need to convert into utility index using weights (these are separate for countries)

Developing countries don't do cost utility analysis, using mainly cost effectiveness

What is cost of QALY gain and remission?

To calculate costs using CSRI

3.5 Guest Lecture 2 - Economic Evaluation Using Decision-analytic Modelling

Just an example of one method being used to analyse the decision This is just to give you a real life model to use decision-analytical models (decision-tree)

Journal - why economic evaluation

Background Resource allocation, we have limited resources(budget), we need to spend these on multiple things Do we rely need to invest in these new medicines? We should look at the benefits and costs in this case, and whether there are improvement over what is in practice already

We need evidence to support the decision making, and how it will be challenging

What is decision modelling?

Gathering all evidence from trial, model, literature and guiding the decision

5 objectives to structure all dimensions of decision making

1. Structure
2. Evidence
3. Evaluation
4. Uncertainty, variability and heterogeneity (population can be different)
5. thus paving a path for future research

From trial to model

Why does decision making involve modelling?

RCT are gold standard, so that treatment allocation is random, and we can collect characteristics (health related QALY). Was considered as vehicle for economic evaluation, since gets evidence directly from trials. But has limitations

- limited data - only on comparator groups you have considered in a trial which is determined in randomised groups
- short follow-ups (year or so)
- cannot collect all evidence important to make a decision by using trial only
- when moving from trial to model, get information from literature, trial and survey data and expert opinions
- can use information on estiamtes from different sources
- can incorporate uncertainty (1 parameter with smaller CI vs another) or looking at different population subgroups

1. which is the population under study
2. this is related to decision problem (not every decision problem is for everyone)
3. draw boundaries for problem
4. conceptualising decision model (population and subpopulations, interventuins, comparators and options and getting the methods right - to finalise the model, think about the time period, to make the decision for current or long time period (say investing now and impact over 40 years / lifetime))

Time frame is thus important, looking at only the costing side, we need to be sure of the population and the health system funding under consideration The patient may or may not have to spend for the intervention, whether to include the patient cost or healthcare cost only

Economic arguments for mandating LGBT+ health training Cervical screening

- Bisexual and lesbian populations access this less
- to see whether training specially designed for this population may break the barrier of access to health care services for these populations

Model is decision tree so that we can see the impact in a 5 year timeframe since NHS requires a smear test within this period. NHS - health system perspective - publicly funded Outcome - cancer case averted Uncertainty - changed the cost, in another changed population subgroups

Decision tree

[inc fig here]

2 branches - current practice and training branch, proportion of smear test would be higher due to

Decision tree allows to capture each outcome that occurs in each branch If proportion doing smear test increases, that population would increase probability of cancer detection, but the likelihood is that this is early detection and thus the treatment would be less costly due to early stage capturing compared to a later stage diagnosis But likelihood of testing in bisexual and lesbian populations are different

Outcome is cancer case detected

Calcualte ISAs, cost and outcome, compare interventino with standard of care

Thresholds are defined for each disease area (in QALYs) , comparing to this (cancer case detected or avoided) we dont have thresholds Here, we took number of thresholds and whether it makes sense

More outcome is better, but at what cost? Here fewer cancer cases for a very mild increase in cost (one time training cost) plus it will have spillovers to other LGB training

So that the healthcare system is providing a more equitable acess to healthcare (so every subgroup can access and access similarly)

Limitations

- broader LGB population ignored (lesbian and bisexual only)
- health outcome is cancer case avoided, assuming this is uniform for health population (there is an age group where probability of cervical cancer rates are higher) meaning it is not uniform for all the population groups
- non-monitory training arm - no training is happening in training arm
- assume that in the 5 year time frame, everybody is tested once, not multiple times

But still, due to decision modelling and trees, the evidence has enabled (using data from literature) the quantification of the impact on various subpopulation groups

But, this is only decision tree Compared to Markov models, a decision tree is for a shorter time period But for long term impacts (new drug / technology), utility or effectiveness would stay for the next 30-40 years, and here we would see impacts over these time periods, and how can we understand the long term investment decisions.

Use decision tree parameters in Markov Models to understand longer term impacts

Lecture 6: Demand for Health

Wed 10 Apr 15:00

[Economic Evaluation in Health Care 2]

3.6 Outline

1. The demand for health vs health care - wants demands and needs
2. Are the markets for health and health care special? Demand functions
3. Supplier induced demand - the theory, whether this is a real issue
4. Aggregate demand for health care
5. Measuring health

3.7 Health And Health Care

Derived Demand For Healthcare

- Demand for healthcare is a derived demand
- People do not want healthcare for the sake of it, it is demanded to improve one's health
- If we can alter the demand for health (exercise), then we can also alter the demand for healthcare

- Increasingly, more focus (from policymakers) on the social determinants of health. Thinking about what factors that aren't formal healthcare services can affect health (Pollution, environment, etc.

Wants, Demands And Needs

In order to understand the economics of health and health care it is important to understand the wants, needs and demand for health and health care by consumers

- Wants : the desire to consume something
- Demands : wants + the ability and willingness to pay for something
- Needs : the capacity to benefit from the consumption of something

Not all wants are needs (cosmetic surgery, wont demand since too expensive vs needing it, Or, whether would choose to go Dentist if free)

What Makes Health Different

The demand for health and health care can be analysed in very similar ways to the demand for other goods and services

Health Production

- Lack of control - the process of producing health lacks the control that other activities have
- Lack of tradability - the output of production of health cannot be sold to a third party

Markets For Health Care

Most healthcare systems are a complex mix of private and public sector activities. Government involvement in the finance and provision of health care is common

An important reason fir this is the *inherent uncertainty* surrounding health and health care

Patients don't behave the same as consumers, nor do doctors behave the same ways as firms. Doctors aren't there to profit maximise, they are an altruistic individual there to serve the needs of patients.

Arrow (1963)

- Patients behave differently to consumers
  - Judging the product is difficult, there is no ability to test or shop around
  - There is an asymmetry of information - we know considerably less than 'sellers', medical professionals know more than patients
  - Externalities and interdependencies are important - Vaccines can also affect your health
- Doctors behave differently to firms
  - Restricted entry to the industry - Medicine school
  - Advertising and over competition is virtually absent
  - The motivation is clinical need, rather than profit,
  - Doctors price discriminate ethically

- Insurance can help, but is far from perfect

Why Patients Are Different to Consumers

- In the UK, most people tend to go to their nearest GP / Hospital
- In the US there is more shopping around
- Judging the product in healthcare is not necessarily the same
- Key question is where to go for treatment and why
- Asymmetry of information, its possible that medical professionals are trying to 'induce' demand. Principal agent problem, can the patient be fully sure the medical professional acting fully in the best interest of the patient

Externalities

Restricted entry

- Reducing the element of choice for a patient
- High sunk cost, both financially and opportunity
- Very highly regulated
- The supply of doctors in the UK is falling, due to lower wags, more are moving the Australia

Advertising

- In the UK, there is virtually no advertising
- The medical centres / hospitals / GPs do not need to look for patients, as patients typically find them
- The NHS is a monopoly over health care
- Private insurance is low in the UK

Doctors vs Firms

Motivation

- Doctors take the Hippocratic oath to uphold ethical and medical standards, with the idea being a firms aim is to maximise profit, but docotrs have a different underlying motive to maximise health
- This means that they inherently behave different to workers in otehr sectors, it it hard to measure health, and more so to maximise

Ethical price discrimination

- Pharmacist prescription costs, this can add up. But for lower incomes this is reduced, so health care is made more affordable
- Everyone has the right to healthcare, most things are free from the NHS
- NHS dentists are cheaper than private dentists
- Not everybody can undergo breast reduction surgery, but this is offered on the NHS (after series of checks)

Not everyone can get medicaid, but these also may not be able to afford private health care, this is market failure.

Determinants of Demand

Price

- Demand curves show the relationship between prices and the quantity demanded
- If price increases, then quantity decreases (LEWD)
  - Prices for health and health care (especially in the UK)
  - The shape of the demand curve is not always downward sloping, once laser eye surgery us bought, should never be demanded again
  - Prices of medical treatments are different to other goods

Income

- Shifts the BC
- But is income a proxy for the opportunity cost of time?
- Normal vs inferior goods

Is healthcare a necessity or luxury?

There are complements and substitutes, say two fillings and two tooth extractions.

Price of filling increases, demand for extraction will decrease (substitutes)

If the demand for GP Visits increases, the price for prescriptions will increase

Tastes and lifestyles

A lot of times there are different consumers caused by different tastes, local vs general, tablets or powder. These can be driven by social norms, and can change by time, smoking was fashionable in the 1950s, but now we know this is not desirable.

Therefore lifestyles also change over time

Whereas expectations can also change, in Scotland almost all adults in the 1940s had teeth extracted, but now it is expected to keep them as long as possible.

Recently large increase in demands for cosmetic procedures

This can be seen inn the overturning of HRT drugs that were carcinogenic in the 00s, but now these resutls have been overturned and there has been an increase in demand for these drugs

Rise in Obesity

Rising rates of obessity are major causes of concerns in many countries. Obesity is an important risk factor for many health conditions

Population size and composition

Growing populations, a larger demand for healthcare. But this might not be the case for a influx of younger people, looking at Italy there, age can affect the supply of health and NHS resources.

An increasingly aging population (japan, Italy), as this becomes a larger proportion of working po[pupation, there are issues with financing, therefore rising health expenditures are linked to ageing populations

Estimating demand functions

- We usually can observe the demand for health care services, say hjow many visits to dentist were made
- $Q = Q^D = D(P, I, P_C), P_S, T, \text{Oral health}, \text{Non-price costs})$
- Price elasticity of demand = percentage change in quantity divided by the percentage change in price
$$\varepsilon_P^D = \frac{dQ}{dP} \times \frac{P}{Q}$$
- Income elasticity of demdn : percentage change in quantuty divided by get percentage change in income
$$\varepsilon_I^D = \frac{dQ}{dI} \times \frac{I}{Q}$$

But, there are problems with using demand in health and health care

- Health is not tradeable
- Health care has a derived demand
- Wants and effective demand
- Needs
  - Capacity to benefits
  - Implications of basing resource allocation on need instead of demand

Supplier Induced Demand

One of the key characteristics of health care is *uncertainty*, in terms of diagnoses, available treatments, effectiveness of treatments

Some uncertainty is irreducible, where neither a doctor or patient can be certain

However much uncertainty is one-sided

- Individuals (usually) lack the medical training and knowledge to make truly informed choices
- Principal-agent problem : doctor is an 'agent' acting on behalf of the 'principal'
- It is often assumed / found that doctors do not behave as 'perfect agents', known as *supplier induced demand* (physician induced)
- Doctors engage in some 'persuasive activity to shift the patients demand curve in or out according to the physicians self-interest' (McGuire, 2001)

Potential supplier induce demand jj

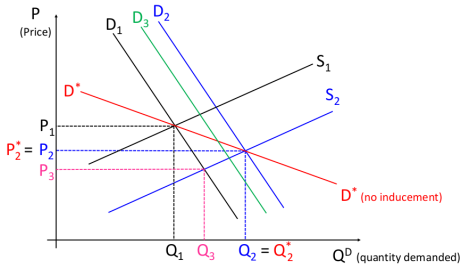


Figure 43

there is an increase in supply from doctors, upselling, accessing different healthcare.

shifting demand form p1 to p3, q1 to q3

if then after this, this causes an increase in demand, this causes a shiftfrom d1 to d2

But to really measure demand, this is assuming a certian level of price elasticy (gradient), but if prices are more elastic, there is a shift in supply

if the demand curve was D*, a shift in supply would lead us to the same point

if demand is misspecified, if demand curve is not downward sloping (luxury or normal good), price increases, quantity increases. Still assume downward sloping demand curves

criticisms

we would hope that the oath means that doctors behave in this manner

Due to the funding of hospitals, (special tariffs for NHS on patient groups in UK) There are sometimes incentives to cost surgeries more and thus leading to different incentives and fee for services, that may be a reason for why supplier induced demand happens

Dentistry in Switzerland

- Field experiment conducted where a 'test patient' who did not require any dental treatment was sent to 180 different dentists for recommendation on treatment plants
- In 28% of visits, over treatment was recommended
- There was considerably less over-treatment when patients had higher SSES (socio economic status)
- Also looked at different characteristics of the dentist, dentists with lower utilisation (smaller waiting times for appointments) were more likely to recommend unnecessary treatments
- However, dentists in areas with more competition do not behave differently to those in less competition, in contradiction to the purse SID hypothesis

GPs in Norway

- Looking at evidence of SID amongst Norwegian primary care physicians
- 2 types of GPs, contract and salaried
- 1 are paid by patient and for what treatments they performs, so have incentives to induce demand

- 2 are paid a flat rate salary, so have no incentive to induce demand
- Neither group increase their output as a response to an increase in physician density
- Authors argue this refutes the notion of SID as group could induce demand if they wish

3.8 Measuring Health

- Health is a highly valued asset. Other assets are often ranked lower in the preference scale of most people

Mortality

- Government recorded figure, at various levels, age standardised measures too

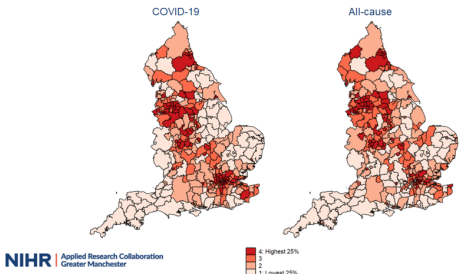


Figure 44: National Variation in Mortality Rates (March to July 2020)

Life expectancy

- National, regional, LA level
- Average age people in an area are expected to live for
- Age 50, age expect that person to live to

Life expectancy and mortality are both at an area level, rather than individual.

Also a measure of HealthY, the years of healthily life expectancies, but these again are measure of regional health.

Self-Assessed Health

A more individual measure, quite basic but papers have found it to be an accurate predictor of health, especially among the elderly

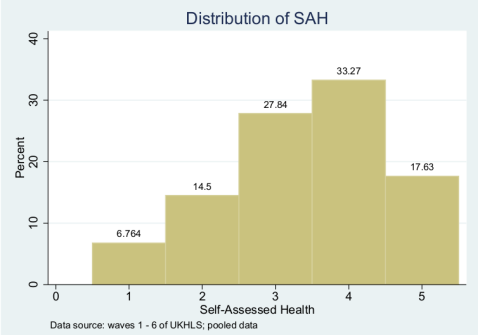


Figure 45

Quite generic, and subjective. People may not want to say they have excellent health

Satisfaction with Health

EQ5D

A measure of quality of life, based on a questionnaire (mobility, self care, pain and discomfort, anxiety and depression)

A 'scoring' algorithm is then applied to responses to give a number that is designed to represent health status

From -0.5 to 1, where 1 = full health and 0 = death

Can calculate QALY and calculate cost effectiveness,

Absolute or relative position

These are based on subjective valuations of health,

Summary

Measuring health is inherently quite difficult, but still a measure of health is better than none. Self-assessed health is used a lot,

Health economics considers the supply of health care as well as demand

Assumption of no indifferent markets

Lecture 7: Modelling choices about health : The Grossman Model

Wed 17 Apr 15:02

[Topic 4 Lecture 1] [Topic 4 Lecture 2]

4 Demand For Health

Recap

Grossman model addresses how health care is different and is production and consumption good, but major criticism is that it doesn't incorporate inherent uncertainty.

Consumer Theory

- Utility is the level of satisfaction that consumers obtain from the consumption of goods

$$U = U(x_1, \ldots, x_n)$$

- Marginal utility is the additional utility gained from one more unit of good x_i

$$MU_{x_i} = \frac{\Delta U}{\Delta X_i} = \frac{\partial U}{\partial x_i}$$

- Consumers are assumed to be rational, their behaviour is consistent with their aims, they act in their own interest to maximise well being
- Properties of rationality, given more than one 'bundle' of goods:
  - Complete (can express preferences for all bundles)
  - Transitive
  - Non satiable

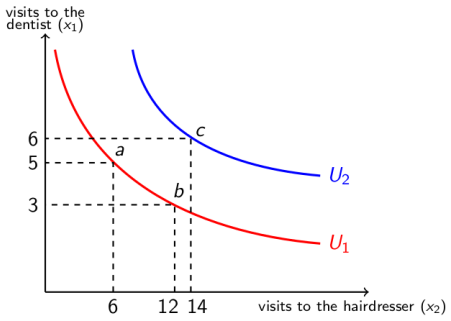


Figure 46: Indifference Curves

Rational - more is always better

With these indifference curves we can also compute the MRS, but they generally allow us to compare different bundles.

Diminishing MU due to the convexity of the curve.

Budget Constraints And Maximisation

We can only maximise utility subject to budget constraints (a function of income and current prices)

Downward sloping, indicating that it has to be less than the income level, if maximising, we can obtain the MRS after we diff y wrt x.

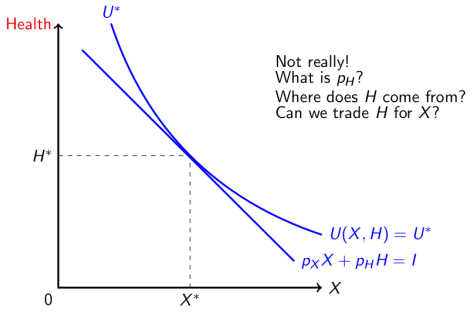


Figure 47

We don't really have a price on our health, and it is hard to derive this health

The indifference curve has an x and a h, this is where the Grossman model comes in

Criticisms of Applying Consumer Theory

- Self interest, rationality and utility maximisation can be overly simplistic
- For example, cancer-sufferers may prefer more risky treatment due to their health status
- When health is included, say caring and addiction in economic models, it comes down to the uncertainty and asymmetric information which are why consumer choice theory becomes slightly harder to justify in health settings
- People have different preferences, the stakes may be higher etc

Exercise 3. *Patient's choice of hospital in NHS*

a way to work out peoples preferences, say what it would take to favour an injection over a tablet DfH looked at waiting times and travel to a clinic information that hospitals are similar to home hospital 4.5 months reduction in waiting times vs 3-5 hours travel travel time of 3 hours vs travel time of 2 hours, along an indifference curve, peoples preferences were indifferent

The Grossman Model

Health care is not desired for its own sake, but to improve health (derived demand)

Primitives

- Founded on the view that health is a basic commodity
- Individuals produce health using both their own time and market good inputs, combined in package such as diet, lifestyle choices and healthcare
- Health also affects a persons ability to work (need to be suitably healthy to work) and hence provides an income. But income is assumed to come only from work
- Poor health reduces both an individual's utility and their ability to earn an income
- Health is a key component of human capital, in order to work you need to be health, in order to be healthy you need to work

- In the Grossman model, health is treated as capital, rather than a consumer good (as in consumer theory). Thus doesn't have issue of trading, or a 'good'
- At any point in time, an individual has a 'stock' of health. This can depreciate over time (ageing), and decreases with production and consumption of other commodities. But this can also be increased with investments (time, effort, knowledge, health, promotion, etc). Skills and knowledge further increases the efficiency of how an individual procures health (education improves skills and knowledge, therefore investments in education improve health)

Notation H : health, C consumption, u : utility, Y disposable income, M medical care, X consumer goods, q price of medical care, p price of consumer goods

Assuming all we want to spend budget on consumer goods.

Wagstaff representation

- Two commodities, health (H) and other consumption (C)
- Utility is gained from their consumption : $U = u(H, C)$
- Health is produced using medical care (M, with a price q) and consumption is produced using one input (X, with a price p)
- The individual has some income $I > 0$ (no time constraint here)
- We can then derive four diagrams linking all of these pieces of information

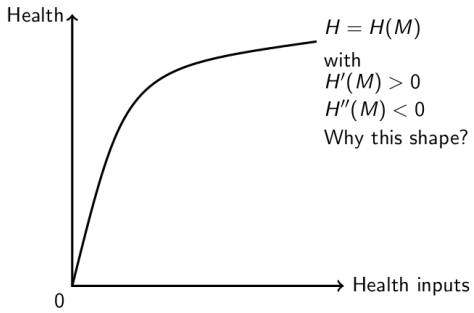


Figure 48: Relationship between expenditure on Medicare and health

Since this model doesn't include health in the income function, this means that there is some sort of welfare state.

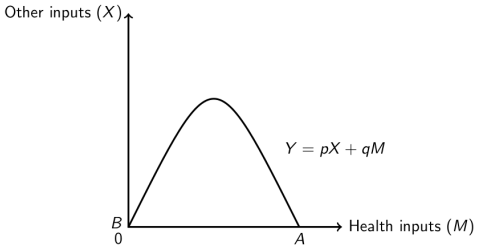


Figure 49: Budget constraint : alternative view

Previous BC assumes some sort of welfare state

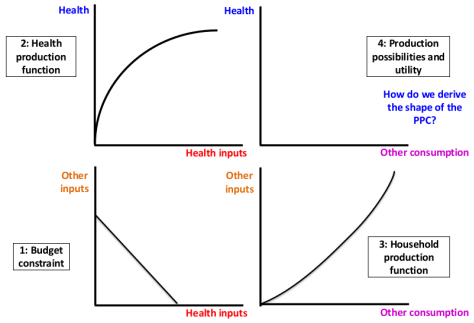


Figure 50: PPC

Shows the possible production of health and other consumption

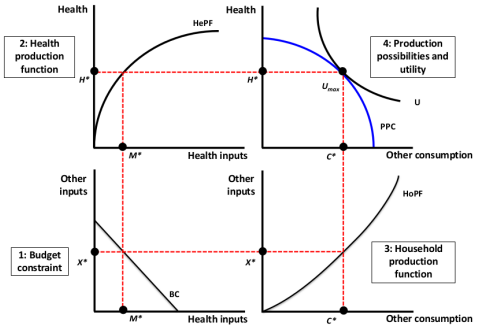


Figure 51

Individual bundles of health and consumption goods are dictated by where the ID curve meets the PPF, H* and C* Working backwards from this, at the 3rd quad, we have C* Given our BC, we have X* which means we can consume M* medical inputs, so our optical level of health is H*.

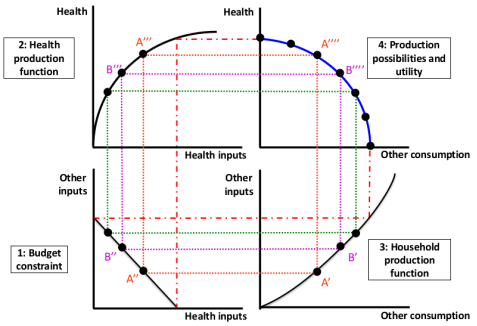


Figure 52

Maximising health good, but not getting utility from consumption goods,

Usefulness of the graphical representation of the Grossman model

Allows us to model the effects on health and the demand for health care in a number of scenarios (changes in income, prices, healthcare technology and health production).

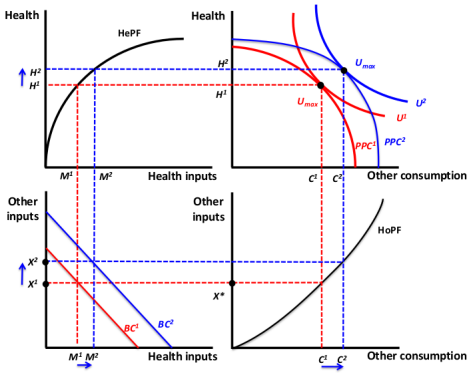


Figure 53

Outward shift in PPF, equilibrium decided on individuals Increase in income has allowed outward shift in PPC,

Outward shift in other consumption, shown in this quadrant, but as we go to left, smaller increase in health, as due to

All dictated by an individuals preference, and IDC meeting PPF

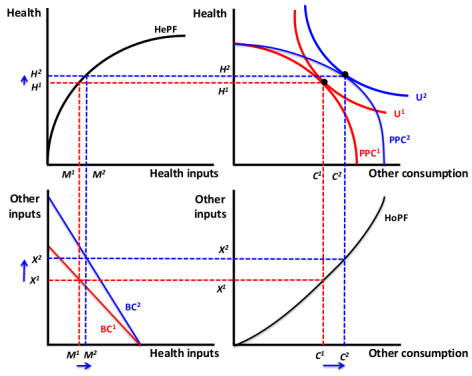


Figure 54

Since relative prices have gone down, they can now increase their consumption of medical goods, the change in price can be seen in the household consumption function, then arising from c_1 to c_2. Does assume disposable income, say if prices of eating out decreased (rather than gas+electric since disposable)

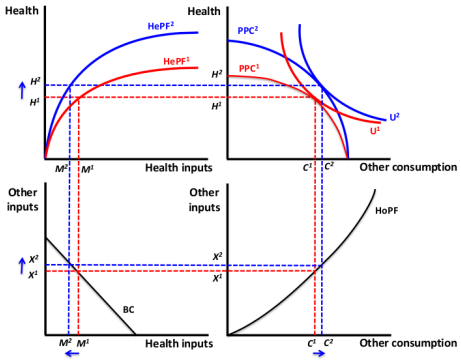


Figure 55: Increased health production

Shift outwards and also a change in PPF, increasing the availability health you can produce, given the change in the IDC, the goods you will forego for each other will change. Outward shift increases consumption, but also increase in overall health production to H_2

Investments in Health

Grossman model

Utility, maximised by health and consumption goods, but now we sum the health consumption and other consumption over time, as well as discount factor

This leads to different rates of preferences,

Health stock in period t is given by:

$$HS_t = HS_{t-1} - \delta_t + I_t$$

Ie, health stock today is health stock yesterday minus depreciation (δ) plus any investments made in health (I)

Both C and are produced within the household, and hence we can define each a production function

$$I_t = I(M_t, T_t^H, E_t)$$
$$C_t = C(X_t, T_t^C, , E_t)$$

Where T^H and T^C are the time spent in production of health or production of other goods, respectively, and E is a measure of education (proxy for human capital) Utility maximisation is subject to two constraints :

$$\text{time constraint:} T_t = T_t^H + T_t^C + T_t^W + T_t^S$$
$$\text{monetary budget constraint: } Y = T^W W = qM + pX$$

Maximise utility given maximisation of health production and other goods, subject to the time you have and income you produce given current health state

Solution is an equilibrium condition that states that an individual will continue making investments up until the marginal benefits of health capital equal its marginal cost

Criticisms

- Assumes individuals are consistent utility maximisers
- Assumes that individuals have perfect information
  - Perfect foresight about health
  - Know the rate of depreciation of their health
  - Understand the effects of health care and other consumption on their health
  - In the extreme, it assumes we all make rational well informed decisions about the date of our own death!
- Does not take into account uncertainty (asymmetric information)
  - Adverse health events (accidents, flu etc.
  - Do individuals really know the true effects of health care on health, or do they rely on experts

Recap on health and Grossman model

- Health is a capital stock that depreciates over time, it is both a production and consumption good
- Individuals choose health investments upto MU = MC
- Some predictions of the Grossman model have not been confirmed by empirical literature

Stylised Facts

1. Health is strongly associated with socio-economic status (SES) , irrespective of SES measure
2. SE inequalities in self-reported health increase until age 60 and narrow thereafter
3. Health insurance and access to medical care explain only a small fraction - occupation, health behaviours, and cognitive ability appear more important
4. Important reverse causality effect of ill health on labour force participation, income and wealth
5. Among the dimensions of SES, education seems to be the most important determinant
6. A large part of the health gradient may be due to early childhood endowments and investments

Can Grossman-type models explain stylised facts?

- 1, yes predicts positive association between health with wealth and education
- 2, no, constant returns to scale in health investment in its input lead to indeterminacy
- Problematic 3, 4, 6
- Grossman identifies some mechanisms through which health may differ by SES, but cannot explain SES differences in rate of change of health

Lecture 8: Empirical Studies on the demand for health

Wed 24 Apr 15:00

[Topic 4 Lecture 3]

4.1 Overview

4.2 Education And Health

The model predict higher education leads to higher health production

Motivation

- Why is the relationship between education and health so important, what are the policy motivations? (start well, live well, age well) / school readiness
- Medical care is only one input - own time use also important
- Health is a form of human capital, therefore is is natural to explore the relationship between health capital and other forms of human capital (schooling / education)
- "The one social factor that researchers agree is consistently linked to longer lives in every country where it has been studied is education. It is more important than race; it obliterates any effects of income." Gina Kolata, "A Surprising Secret to Long Life: Stay in School", New York Times
- Skill production with cognitive and non-cognitive skills key determinants of completed schooling and health as an adult
- Introduce concepts of self-productivity (skills produced early in life increase skills at later stages) and dynamic complementarity (early investments raise marginal productivity of later investments), which interact to generate multiplier effects
- Investments in adolescents have mcuh larger payoffs when earlier investments have been made
- Stress importance of non cognitive skills : big five personality traits (openness etc.

Econometrics Model

- We want to estate the effect of extra education on health
- So run a simple econometric model of form

$$\text{Health}_i = \alpha + \beta \text{Education}_i + \gamma X_i + \varepsilon_i$$

- Where
  - Health is some measure of health
  - Educano is some measure of educaiton (highest level, years of schooling etc)
  - X is a vecotr of other control variables
  - ε is a standard IID error term
  - i indexes individuals

Why β May Not be Causal

- Reverse causality - does E really cause H? or is E also affected by H?
- Omitted variable bias - are we really capturing/ measuring / accounting for **everything** that could influence H and also E?

- Misreporting (either of health outcome and or education) - there has been shown to be problems with health state classifications / misreporting, and has been shown to be affected by education

Possible Solutions?

To try and overcome these *endogeneity* issues on the past slide, there are three popular study designs, they are direct inclusion of third (omitted) variables, twin studies and instrumental variables.

Direct Inclusion of Omitted Variables

- All studies find positive and signifiant effects of completed schooling on at least some key measures fo adult health and beneficial health behaviours
- Van der pol (2011) - controls for time preference in dutch household survey, main outcome is self rated health, with other outcomes such as cigarette smoking, long term illness, BMI and obesity
- Another paper by conti and heckman (2010) - controlling for cognitive and non cognitive ability at age 10 and health at that age in examining outcomes at age 30 in 1970 British cohort study: outcomes included self-rated health, daily smoking, and obseity, *education effects bigger for those with more cognitive ability and for those with less non cognitive ability*

Van Der Pol (2011)

- Education as "most important correlate of health" (fuchs, 1982)
- But mechanisms are unknown
- Gross man : education improves health production and allocative efficiency
- Fuchs : no causal relation but due to third factors such as time preferences
- Time preferences : individuals preferences for current outcomes over future outcomes (two methods - revealed (observing behaviour) or stated preference (stated in experiment))

To

- Investigate the role of time preferences in education/haelth nexus using stated preference data
- One year of dutch household survey
- Focus on financial behaviour, missing other SES characteristics

Good to understand sample have in context of who we have in the sample Increase in 1 more continues education level (1-5) increases health by 0.089 (no controls)

Once include time preferences in model (unobserved factor), coefficient on β decreases

Once include more that might factor into education and health, this also decreases the impact of education on health

Including individuals level of income, coefficient did increase further

So originally, coefficient is over estimating, taking account of time preferences and household characteristics linked to education !

Using binary categorical levels of education, the base category was uni degrees, so as expected those with lower levels, had lower health

Same effect again, once start to control for omitted variable biases in the model, the coefficient decreases and r-sq increases

Risk attitude - interestingly time preferences inclusion with risk attitude, sign changes, so maybe the time preferences are picking up the risk attitude initially but once you include time preferences and risk attitude, this decreases the unobserved effect in the models.

Conclusion

- Education has a statistically significant and positive effect on health
- Only slightly reduced by the inclusion of time preferences
- Effect holds for other health outcomes, but not smoking
- Cross-sectional data precludes causal interpretation
- Omitted variable bias - not capturing lots of information
- Measurement error in self-assessed health
- Single (financial) measure of time preferences

Twin Studies

- Mixed evidence
- Behrman et al (2011) : no effect on adult mortality or hospitalisation in Danish twin registry, 2500 identical twin pairs
- Aim of paper : follow individuals for large part of life course and study effect of schooling on mortality and longevity (across different ages and time periods)
- Include twin fixed effects - to then control for genetic similarities but to study differences in schooling related to their mortality
- Sharing DNA negates the nature vs nurture argument - same genetic make-up so only thing that varies is their environment
- But environmental differences may be related to
    1. Birthweight : linking data on birth records
    2. Cognitive ability : height as correlate between IQ and early-life health
- 18k identical twins, linked to birth, schooling and death

4.3 Economics Resources And Health

We want to estimate the effect of economic conditions on health We could run a simple econometric model of the form

$$\text{Health}_i = \alpha + \beta\text{Economic conditions}_i + \gamma X_i + \varepsilon_i \tag{5}$$

where

- Health is some measure of health
- Economic conditions is some measure of the state of the macro economy

- X is a vector of other control variables
- ε is a standard IID error term
- i indexes individuals
- There are less issues around estimation of this model, than in the education case, although reverse causality and endogeneity could still be issues

The relationship between economic instability and health has long held interest

Dating back to Brenner 1979, who found a statistical association between mortality rate and unemployment rate in England and Wales

In theory, economic instability changes productivity of several factors

Ruhm (2000)

Results

Higher unemployment rates were linked to mortality Finally, looking at different time periods, this stayed consistent

Looking at deaths, higher unemployment rate was linked to lower mortality rates

Macro to look at overall effect Micro model to see mechanisms of why this is happening Finding higher unemployment rates linked to BMI

Overall, unemployment linked to more health indicators that are typically better

Higher rates of unemployment were linked to higher rates of physical activity (any and regular), fruit and veg consump, less fat consume

Finding was less clear, lower probability of attending those

Find strong inverse relationship between macroeconomic conditions on health and mortality, unemployment seems to increase exercise, increase fruit and veg consumption

4.4 Previous Exam Questions

Main thing : state why and how it will effect demand and the justification for this

After summarising and critiquing, state if believe

Demonstrate understand the papers, reading around the topic = extra marks

Economic intuition around the Grossman

Looking at recent research on scholar for what has cited this recently

4.5 Tutorial

Q: In what ways are patients (consumers of medical care) different to consumers of more traditional economic goods?

A: 1. Cant judge differences in service 2. Principle agent relationship - hoping advice received is in best inters, but this is unknown due to principle agent problem 3. Externalities (neg and pos) - vaccines, positive externality is that you are protected and that helps everyone else around you, but on flip side the negative is if you don't get, you are more likely to get the virus and be a spreader of which

Q: Discuss the issues around estimating demand curves for medical care. A: As price increases, quantity demanded decreases + vice versa. But this isnt so simple for healthcare

1. Determining the price can be quite difficult, particularly in UK NHS setting since they are free at point of service,so a better way to look at this is using income. Looking at opportunity cost of time, attending an appointment means you give up your time for this

2. Insurance markets, price is co payment which varies by person

3. Price to decrease massively, in market have to pay for everything, if tooth extractions Derived demand - tooth extraction only if you demand it, regardless of price of item, you won't demand this again

Is healthcare a luxury or necessity? Another example or common issue is expectations over the future, you cant predict your own health or population health on an individual level. This is sometimes easier to do on an area level rather than individual

As someones income increases, cosmetics (normal) may be more preffered to inferior goods

4. Q:What is Supplier Induced Demand (SID)? Is it likely that SID (or physician induced demand, as it is alternatively known) is likely to exist in reality? Why are there issues about testing for its existence?

A: amount of demand that exists beyond what would have occurred in a market in which all agents are fully informed

Figure SID - graphical

OG equilibrium is p1 q1, if there is an initial shift outwards, an increase in SID, shift in demand outwards to d2, subsequently shift to s2, creating new equilibrium point But argument, it don't exist, there is idea it might not have happened, that elasticities are misspecified

When financial gains involved, sometimes motivations may change

No evidence of SID empirically - potentially for misspecified demand curve - which feeds into diffuicutties in measuring deamnd curve like this +also that properties of p2 p3 are quite similar, whether there was or wasn't is hard to distinguish

Morris et al -

Q: Briefly summarise the Grossman model by considering the following points: (i) What does the model do? (ii) How it is different to more traditional microeconomic utility maximisation models? (iii) What assumptions does the model make? (iv) How realistic are the assumptions? (v) Can you think of any ways to improve the model

A: Health is basic commodity, produced from own investment in diet, exercise etc But there is also market structures impacting this Utility is function of health, but there may be some reverse causality here Health stock is function of health stock yesterday and investments in health

Rational individual's always want to maximise utility, main key components are that we max util subject to time constriants (health, consumption, working ,sick) But this feeds back into 2nd BC that feeds back into T^W

Derived demand - only demand health care when need it Require health to engage in work - it indirectly effects utility in other ways, health is not tradeable, cant trade consumption goods for health

Q: what assumptions does model make A: that individuals are fully rational, they consistently Max utility, they have perfect information, know rate at which health depreciates and impact of consumption goods, no unexpected shocks (isn't case)

We know people don't know their health deterioration rate, there is no certainty on the state you will be in, in the next period (healthy vs sick) - major drawback of model

Depreciation rate constant, the fundamentals of the model can be quite broad, applying this to the real world, the realism can be questioned Theory - all works in a vacuum, but in reality health shocks and income But overall, Grossman does provides good starting point for relationship between health and income

Grossman improvements - lots of ways to interpret this question, think critically In the thesis, forewords has extensions

1 drawback - time during health activities investing in health and time doing leisure are different, but for some this can be the same thing Has it or does it include mental health in the model - or is it more looking at physical health?

What we know assumptions + how it can be improved and realism in answer

Q: Wagstaff's 4 quadrant model of grossman model - draw each quadrant + explain how linked (practice)

A: q1 - BC - how price and income of each good is related health q2- health prod function - decreasing marginal returns, FOC pos, SOC neg, can only comnsume so much medical care, after this marginal returns decreases

q3 - household prod func - shape noticeably diff to q2 since foc soc both pos, inc at inc rate (more is better) q4 - PPF - both household and health prod functions, given by budget constraint Assuming individuals are utility maximising, equilibrium governed by bundles

This diagram has straight BC, another can start at 0, the next includes health in the income, assuming baseline levle of health to participate in labour market

Income - disposal income and welfare state to ensure basic level of health State State equilibrium points at starting point

Q: what happens when reducito in price of medical inputs, change in 4 quad diagram A: price reduction in medical inputs means that an individual for the same price can afford more medical goods, meaning a change in BC in q1, which changes PPF curve, so individual can use finances better creating outward shift in PPF, changing to a new equilibrium point governed

What happens to each quadrant? Increase health from h1 to h2 since for same income they can afford more medical inputs (depending on curves), there is also a shift in other consumption c1 to c2 due to x1 to x2 increase

Thus big ricochet of changes throughout whole model in the Grossman model

Given increase in health related factors, the increase is bigger for health related goods,

Same q but diff - other consumption goods decreased in price - expect outward increase so can afford slightly more healthcare goods

Doesn't have health included in BC, if did then expect to start at 0, expecting some level of nominal health to start engaging in employment to have income in first place

If health is bad, individual cannot generate income - meaning a non linear BC

Start at 0, increases in this shape, dotted line assuming fixed level of health

PPF start from 0, up and down, concave shape to it, health increasing at decreasing rate UL quadrant increasing at decreasing rate

Paper including Preferences and risk aversion - education and income relationship as expected