Economics

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Preface

This is a live document, and is full of gaps, mistakes, typos etc.

Part I

Exchange economies

Chapter 1

Intermediate goods

1.1 Movitation

1.2 Expropriation

1.3 Property rights

1.4 Coalition formation

1.5 Trade-off between expropriation and internal security

1.6 Trade-off between internal security and external security

Chapter 2

Edgeworth boxes

2.1 Trade

2.1.1 Edgeworth box

So now we have a framework for how agents can interact. We want to model trade, what games can do this?

To do this we introduce the Edgeworth box. This is a rectangle where the length of the x and y axes represent the total amount of those goods, and points on the box represent allocations of the goods. There is an initial endowment of goods.

$x = \{0.2, 0.8\}$

$y = \{0.8, 0.2\}$

[Put box here]

Their respective utility functions are:

$u_a = f_a(x_a, y_a)$

$u_b = f_b(x_b, y_b)$

In this example we use:

$u_{a,b} = x^{0.5}y^{0.5}$

We can add indifference curves to this box, which intercept at the endowment.

[Put box here]

The agents would be better off if they could trade so that they both had half of a unit of each good.

$x = \{0.5, 0.5\}$

$y = \{0.5, 0.5\}$

However they could also both be better off with

$x = \{0.6, 0.6\}$

$y = \{0.4, 0.4\}$

[Box here]

There are many such trades which could be made, which agents would rank differently.

There are also points where no further trade would be agreed by both parties. For example with the above outcome, any further trade would make at least one party worse off.

Such points are called Pareto efficient. That is, if a point is not Pareto efficient at least one party can be made better off without harming others.

[Box here]

Chapter 3

Auction theory

3.1 Introduction

3.1.1 Introduction

3.2 English auctions

3.2.1 English auctions

In an English auction bidders make ascending bids on a product, each bid needing to be higher than the last.

These are open auctions. Each bid is visible to all participants.

The price paid is the final bid.

3.2.2 English auctions

In an English auction bidders make ascending bids on a product, each bid needing to be higher than the last.

These are open auctions. Each bid is visible to all participants.

The price paid is the final bid.

3.3 Dutch auctions

3.3.1 Dutch auctions

In a Dutch auction the auctioneer decreases the price until a single bid is received.

These are open auctions. Each bid is visible to all participants.

The price paid is the bid.

3.4 Blind auctions

3.4.1 Blind auctions

Blind auctions are sealed-bid auctions. Participants cannot view other bids.

The price paid is the highest bid.

3.5 Vickrey auctions

3.5.1 Vickrey auctions

Vickrey are sealed-bid auctions. Participants cannot view other bids.

The price paid is the second-highest bid.

Chapter 4

Advanced auction theory

4.1 Auctions for multiple items

Chapter 5

Commodity markets

5.1 Exchange design

5.1.1 Tick size

5.1.2 Latency

5.1.3 Pre-trade transparency

5.1.4 Post-trade transparency

5.1.5 Circuit breakers

5.1.6 Public exchanges

5.1.7 Dark pools

5.1.8 Over-The-Counter (OTC)

5.2 Order types

5.2.1 Order book

5.2.2 Passive orders

5.2.3 Stop-loss orders

5.2.4 Resting orders

5.2.5 Limit orders

5.2.6 Wash trading

5.2.7 Orders on multiple exchanges

5.3 Intermediaries

Chapter 6

Money

6.1 Money commodities

6.1.1 Money is liquid and information efficient

Liquidity of money

Liquidity (dont always want a goat)

Alice fishes and Bob hunts, and they trade meat and fish with each other. This much fish for that much meat. This all works perfectly well until Carol, Dan and Eve come along, who wants to trade berries, wood and furs. Now agreeing how much of this for that becomes more complicated, for every good theres a ratio relative to every other good.

So they agree a new system, they collect all of the shells on the island and use these to trade with each other. Now they only have to remember a price for each good.

We want divisibility of money.

Information requirements of money

Information requirements $(n-1)+(n-2)$ etc v $(n-1)$

$\sum_{i=1}^{n} n-i$

$n^2 - \sum_{i=1}^{n} i$

$n^2 - \frac{n(n+1)}{2}$

$$\frac{n(n-1)}{2}$$

Compared to $n-1$ when money is used.

Stability

Don't want to be used for other purposes, demand could fluctuate more, more wasteful.

6.2 The price level

6.2.1 The equation of exchange

As theres only so much stuff out there, an increase in the amount of money moving around with cause inflation.

This can be shown as:

$MV = PQ$

The amount of money (M) multiplied by the velocity at which money moves (V) must be equal to the average price (P) multiplied by the quantity of stuff (Q). This isnt a theory, its an accounting identity.

6.2.2 Money demand

6.2.3 Inflation

6.2.4 Nominal and real prices

If previously one fish trades for two chunks of meat, we would expect the shell price for fish to be twice as high as the shell price for meat. Relative prices between all goods could be maintained for any price for meat. If all prices doubled, one fish would still get you two chunks of meat.

Nominal prices are those that are actually seen in markets, real prices refer to these prices adjusted for the price level. For example all prices doubling would double all nominal prices but affect no real prices. Doubling only the nominal price of fish would increase the real price of fish, and decrease the real price of other goods.

6.2.5 The quantity theory of money

The quantity theory of money states that velocity of money is stable and so increases in the money supply cause proportionate increases in prices.

While the supply of money does impact inflation, the velocity of money has a habit of moving around a fair bit. In addition, what we might think of as an increase in the money supply may not in fact be one. For example quantitative easing undertaken in the aftermath of the financial crisis massively pumped massive amounts of base money into the financial system, but at the same time banks were deleveraging and holding more reserves, shrinking the money multiplier. The net effect was modest for the overall supply of money.

6.3 Exchange rates

6.3.1 Exchange rates

Interest rate parity

What determines an exchange rate? Consider someone in the US choosing between investing at home or in the UK. Returns in the US are 4% over the next year and otherwise identical investments in the UK offer 3%.

Is the US investment better? Not necessarily - as the UK bond is valued in pounds, the investor will also consider changes to the exchange rate over the period. If the value of the pound is expected to increase sufficiently over the period then the 3% bond would be a better investment.

If the investor can freely choose between the two there are no capital controls - expected movements in the exchange rate equal current differences in returns. If the value of pounds was above this level then investors would sell pounds and buy US investments until this relationship was restored. This is known as interest rate parity.

$Return_USD = Return_GBP/dfracExchangerate_{nextyear}Exchangerate_today$

Next, lets break down what the returns include. If inflation is 1%, then a 3% nominal return only gets you (roughly) 2%.

$Return \approx inflation + real$

OK, so now we have a link between changes to the exchange rate and differences in inflation and real (inflation adjusted return).

Chapter 7

Consumer choice in one period

7.1 Utility functions recap

7.1.1 Utility functions

We have $U = f(\mathbf{x})$.

Throughout this we will be using a Cobb-Douglas utility function, and discuss the properties of other utility functions at the end.

We have $U = \prod_i x_i^{\alpha_i}$.

7.1.2 Marginal utility

The marginal utility of product x_1 is:

$\frac{\delta}{\delta x_1} f(\mathbf{x})$

For Cobb-Douglas:

$U = \sum_i x_i^{\alpha_i})$.

$\frac{\delta}{\delta x_1} f(\mathbf{x}) = \frac{\delta}{\delta x_1} \prod_i x_i^{\alpha_i}$

$\frac{\delta}{\delta x_1} f(\mathbf{x}) = \frac{1}{x_1} \alpha_1 \prod_i x_i^{\alpha_i}$

7.1.3 Indifference curves

We have $U = f(x, y)$

An indifference curve is a curve where a consumer is indifferent to all points on it.

$f(x, y) = c$

7.1.4 Marginal rate of substitution

The marginal rate of substitution is the amount of one good that a customer is willing to give up for another.

This is the gradient of the indifference curve.

$MRS(x_1, x_2) = \frac{MU(x_1)}{MU(x_2)}$

$MU(x_1) = \frac{1}{x_1}\alpha_1 \prod_i x_i^{\alpha_i}$ $MU(x_2) = \frac{1}{x_2}\alpha_2 \prod_i x_i^{\alpha_i}$

$MRS(x_1, x_2) = \frac{\frac{1}{x_1}\alpha_1 \prod_i x_i^{\alpha_i}}{\frac{1}{x_2}\alpha_2 \prod_i x_i^{\alpha_i}}$

$MRS(x_1, x_2) = \frac{\frac{1}{x_1}\alpha_1}{\frac{1}{x_2}\alpha_2}$

$MRS(x_1, x_2) = \frac{\frac{\alpha_1}{x_1}}{\frac{\alpha_2}{x_2}}$

7.1.5 Elasticity of substitution

7.2 The utility maximisation problem

7.2.1 First-order conditions

We have a utility function:

$U = f(\mathbf{x})$

And the constraint:

$\sum_i (x_i - c_i)p_i \leq 0$

This gives us the constrained optimisation problem:

$L = f(\mathbf{x}) - \lambda \sum_i (x_i - c_i)p_i$

The first-order conditions are:

$L_{x_i} = \frac{\delta}{\delta x_i} f(\mathbf{x}) - \lambda p_i = 0$

Or:

$\lambda = \frac{MU(x_i)}{p_i}$

This means for any pair we have:

$\frac{MU(x_i)}{p_i} = \frac{MU(x_j)}{p_j}$

For the Cobb-Douglas utility function the first-order conditions are:

$\frac{\delta}{\delta x_1} f(\mathbf{x}) = \frac{1}{x_1}\alpha_1 \prod_i x_i^{\alpha_i}$

$L_{x_i} = \frac{\delta}{\delta x_i} f(\mathbf{x}) - \lambda p_i = 0$

7.2.2 Marshallian demand

We can write a demand function:

$x_i = f(I, \mathbf{p})$

We can derive this from the first-order conditions of a specific utility function.

7.2.3 Own-price elasticity of demand

We have our Marshallian demand function:

$x_i = x_{di}(I, \mathbf{p})$

The derivative of this with respect to price is the additional amount consumed after prices increase.

$\frac{\delta}{p_i} x_{di}(I, \mathbf{p})$

For the Cobb-Douglas utility function, this is:

$\frac{\delta}{p_i} x_{di}(I, \mathbf{p})$

In addition to the derivative, we may be interested in the elasticity. That is, the proportional change in output after a change in price.

$$\xi_i = \frac{\frac{\Delta x_i}{x_i}}{\frac{\Delta p_i}{p_i}}$$

$$\xi_i = \frac{\Delta x_i}{\Delta p_i}\frac{p_i}{x_i}$$

For the point-price elasticity of demand we evaluate infintesimal movements.

$$\xi_i = \frac{\delta x_i}{\delta p_i}\frac{p_i}{x_i}$$

7.2.4 Constant price elasticity of demand

If the point-price elasticity of demand is constant we have:

$$\xi_i = \frac{\delta x_i}{\delta p_i}\frac{p_i}{x_i} = c$$

This means that small changes in the price at low level cause large changes in quantity.

7.2.5 Arc-price elasticity of demand

We may have price changes which are non-infintesimal.

$$E_d = \frac{\Delta Q/\bar{Q}}{\Delta P/\bar{P}}$$

Where $\bar{Q}$ and $\bar{P}$ are the mid-points between the start and end.

7.2.6 Super elasticty of demand

If elasticity is constant super elasticity is 0.

7.2.7 Veblen goods

The demand curve is sloping up.

7.3 Cross-price elasticity of demand, complements and substitutes

7.3.1 Cross-price elasticity of demand

We have our Marshallian demand function:

$x_i = x_{di}(I, \mathbf{p})$

The derivative of this with respect to price is the additional amount consumed after prices increase.

$\frac{\delta}{p_i} x_{di}(I, \mathbf{p})$

7.3.2 Complements

7.3.3 Substitutes

7.3.4 Diversion ratio

7.4 Income effects

7.4.1 Engel curves and income elasticity of demand

The Engel curve shows demand for a good as a function of income.

Derivative $x_{di} = x_{di}(I, \mathbf{p})$

$\frac{\delta}{\delta I} x_{di}(I, \mathbf{p})$

Income elasticity of demand $\xi_i = \frac{\delta x_{di}}{\delta I} \frac{I}{x_{di}}$

7.4.2 Normal goods

As income rises, demand also rises.

This is the same as saying the income elasticity of demand is above 0.

$\xi_i = \frac{\delta x_{di}}{\delta I} \frac{I}{x_{di}}$

7.4.3 Inferior goods

An inferior good is one where the demand falls as income increases.

This is the same as the income elasticity of demand being less than 0.

7.4.4 Necessities

Necessities are goods which increase in demand as income rises, but by a smaller proportion.

The income elasticity of demand is between 0 and 1.

7.4.5 Luxuries

Luxuries are goods which increase in demand as income rises, by a larger proportion.

The income elasticity of demand is above 1.

7.4.6 Ordinary goods

As price rises, demand goes down.

7.4.7 Giffen goods

As price rises, demand goes up. Not because of the slope of the demand curve, but because the income effect and inferior effect are strong.

Substitution means you buy less.

Income means you buy less generally, but move towards inferior goods.

7.4.8 Income effect

7.4.9 Slutsky equation

7.5 Indirect utility functions

7.5.1 Indirect utility functions

The normal utility function is:

$U = f(\mathbf{x})$

We have our demand:

$x_{di} = x_{di}(I, \mathbf{p})$

7.5.2 The indirect utility function

We can plut this in to get:

$U = g(I, \mathbf{p})$

7.6 The expenditure minimisation problem

7.6.1 The expenditure function

7.6.2 Shephard's lemma

7.6.3 Hick's demand

7.6.4 Roy's identity

7.7 Specific utility functions

7.7.1 Cobb-Douglas utility function

$U = A\sum_i X_i^{\alpha_i}$

7.7.2 Leontief utility function

$U = \sum_i X_i^{\alpha_i}$

7.7.3 Constant Elasticity of Substitution (CES) utility function

For some constant r.

$U = A[\alpha_i X_i^r]^{\frac{1}{r}}$

7.7.4 Almost Ideal Demand System

7.7.5 Representative consumer

7.8 Other

7.8.1 Consumer surplus

7.8.2 Aggregating to demand curves

Aggregating individual preferences to the demand curve for a product

Move Representative consumers here.

Chapter 8

Consumer choice under uncertainty

8.1 Uncertainty

8.1.1 Expected utility theory

Chapter 9

Discrete choice

9.1 Random utility

9.1.1 Continuous utility functions

With non-discrete choice a consumer chooses how much of product x to consume.

The utility function is of the form:

$U_i(x_1, ..., x_m; d)$

And the consumer chooses how much of x_i to consume to maximise this, subject to the budget constraint.

We include features relating to the individual, d.

9.1.2 Discrete choice

The utility customer i gets from product j is:

$U_{ij} = f_i(p, d) + \epsilon_{ij}$

The customer chooses the product with the highest utility.

9.1.3 The outside option

We need to know the market share of the outside option. Do this theoretically. Eg number of customers in area, and 1 per day.

9.2 Linear random utility functions

9.2.1 Price preferences

We start with a simple model, where the customer has price preference.

$U_{ij} = -\beta_i p_{ij} + \epsilon_{ij}$

9.2.2 Product characteristics

$U_{ij} = \alpha_i x_j - \beta_i p_{ij} + \epsilon_{ij}$

9.2.3 Individual characteristics

$U_{ij} = \alpha_i x_j - \beta_i p_{ij} + \theta_j d_i + \epsilon_{ij}$

9.2.4 The general form

We can convert this to the form:

$U_{ij} = \Theta z_{ij} + \epsilon_{ij}$

9.3 Modelling homogeneous preferences with multinomial logit

9.3.1 Modelling homogeneous preferences with multinomial logit

9.3.2 Recap

Our model is:

$U_{ij} = \Theta z_{ij} + \epsilon_{ij}$

$U_{ij} = \alpha_i x_j - \beta_i p_{ij} + \theta_j d_i + \epsilon_{ij}$

9.3.3 Homogeneous model

We model all customers as having the same preferences.

$U_{ij} = \alpha x_j - \beta p_{ij} + \theta_j d_i + \epsilon_{ij}$

9.3.4 The multinomial logit assumption

If errors are IID and extreme we get:

$$P_{ij} = \frac{e^{\Theta z_j}}{\sum_k e^{\Theta z_k}}$$

9.3.5 The outside option

A user has the option of not buying anything.

$U_0 = 0$

This gives us the following shares:

$$P_{ij} = \frac{e^{\Theta z_j}}{e^0 + \sum_{k=1} e^{\Theta z_k}}$$

$$P_{ij} = \frac{e^{\Theta z_j}}{1 + \sum_{k=1} e^{\Theta z_k}}$$

9.3.6 Own-price elasticity of demand

$$P_{ij} = \frac{e^{\Theta z_j}}{1 + \sum_{k=1}} e^{\Theta z_k}$$

$$P_{ij} = \frac{e^{\alpha x_j - \beta p_j + \theta_j d_i}}{1 + \sum_{k=1} e^{\alpha x_k - \beta p_k + \theta_k d_i}}$$

$$\frac{\delta P_{ij}}{\delta p_j} \frac{p_j}{P_{ij}} = -\beta p_j (1 - P_{ij})$$

$$\frac{\delta P_{ij}}{\delta p_k} \frac{p_j}{P_{ij}} = \beta p_k P_{ij}$$

This means that the lower the price, the lower the own price elasticity of demand.

This means that mark ups are higher for cheaper goods, which doesn't always match reality.

This can be adjusted by changing the form. For example we could use $\ln p$ or p^2.

However, we are still getting the shape by assumption.

9.3.7 Cross-price elasticity of demand

9.3.8 Getting aggregate market shares

$s_j = \frac{1}{n} \sum_i P_{ij}$

9.4 Modelling homogeneous preferences with nested logit

9.4.1 Nested logit

With IID all goods are equal substitutes. If prices rise customers will switch to others in proportion to market size.

In practice if the price of a cheap car rises, there will be more substitution to other cheap cars than expensive cars.

Nested logit can address this.

9.4.2 Estimating the nested logit model

As with the multinomial logit model, we have prices, market shares and product characteristics.

9.4.3 Own-price elasticity of demand

9.4.4 Cross-price elasticty of demand

9.5 Modelling heterogeneous preferences with individual characteristics

9.5.1 Recap

In the multinomial logit model we had:

$P_{ij} = \frac{e^{\Theta z_j}}{1 + \sum_{k=1} e^{\Theta z_k}}$

9.5.2 Adding customer characteristics

If z_j just includes product characteristics then we have homogeneous preferences.

We can include customer level data in z_j, for example individual income, location, age etc.

9.5.3 Estimation

As before, we want product characteristics and prices.

However rather than market share we instead use customer level information.

9.6 Modelling heterogeneous preferences with mixed logit

9.6.1 Modelling heterogeneous preferences with mixed logit

Using demographic data

Part II

Intertemporal consumer theory

Chapter 10

Saving, stockpiling and risk-free debt

10.1 Saving

10.1.1 Savings

Alice starts cutting back on meat to save shells for the future. This gives Bob a dilemma; he has less income so he can either:

- Continue spending, drawing down on his shells; or
- Spend less (for simplicity, on fish).

In the first case Alices savings are equal to Bobs borrowing, and net saving is zero. In the second case, Alice cant get the extra shells to save, because Bob is not buying her fish. Net savings are also zero.

This is cash saving. In the real world total savings can be above zero because of stockpiling and investment.

10.2 Stockpiling

10.2.1 Stockpiling

Lets consider what happens if Alice tries to save money by producing more fish. If she uses the additional shells from this to buy more goods, she hasnt saved. If she doesnt sell them she hasnt acquired any additional shells.

While building up stockpiles isnt giving Alice more money now, the economy is producing more that it is consuming, and so this is an investment in the future.

10.3 Saving

10.3.1 Securities

Alice wants to build a new fishing rod to catch more fish, but doing so will require a lot of resources from others. She has to persuade others to lend her shells, and in return she promises to pay back more shells in future with all extra shells shell get from selling more fish.

The other villagers are now saving. They are consuming less, and this surplus is being used by Alice. Note that the villagers are not necessarily holding a different amount of shells as a result of this activity. The value, in shells, of this investment is equal to the value of savings.

10.4 Interest rates

10.4.1 Securities

Annual returns/yield/interest rates

Bonds and coupons

Maturity

Internal rate of return

Discounted cash flow

debt structuring, refinancing after rates change, terms balanaced over time v focused on one period?

10.5 Debt in different currencies

10.5.1 Covered interest arbitrage

10.5.2 Uncovered interest arbitrage

Chapter 11

Intertemporal consumer choice

11.1 Discounted utility

11.1.1 Discounting

Time inconsistency (hyperbolic discounting). again, this should mirror ai. page overview if necessary. call it that?

11.2 Intertemporal budget constraint

11.2.1 Budget constraint

$\sum_{t=T} C^t(1+r)^{-t} = \sum_{t=T} Y_t(1+r_t)^{-t} + W_T$

W_t is wealth endowment at time T.

11.2.2 The Euler equation

If we have exponential discounting we have:

$U_T = E[\sum_{t=T}^{\infty}(1+\delta)^t U(C_t)]$

The first-order conditions give us:

$u'(x_t) = (1+\delta)(1+r_t)u'(x_{t+1})$

11.2.3 The Euler equation with liquidity constraints

$u'(x_t) = (1+\delta)(1+r_t)u'(x_{t+1}) + \lambda_{t+1}$

11.2.4 The Euler equation with continuous time

11.2.5 Marginal propensity to consume

11.3 Renewal

11.3.1 Switching costs

11.4 Household finance

11.4.1 Household wealth and liquidity

Hold cash, equity, bonds, mortgages.

11.4.2 Mortgages

11.4.3 Fixed and variable rates

11.4.4 Expense and income timing

11.5 Other

11.5.1 Elasticity of intertemporal substitution

11.5.2 Habit formation

Different utility function.

11.5.3 Durable goods

Can wait to purchase. depends on expected prices in future.

11.5.4 Buying or owning

production of other commodities. house produces rentable space eg if you own house, you have rentable space each period.

depreciation? 1 for something like rent, maybe 0.01 for long term asset

Chapter 12

Contract theory

12.1 Motivation

12.1.1 Introduction

Want to commit but cannot.

12.2 Cooperation without contracts

12.2.1 Co-operative games

12.3 Basic contracts

12.3.1 Defining contracts

contracts specify what agents will do under different future outcomes

12.3.2 Enforcement

Enforcers.

Determining violation.

What happens following violation

Third parties. can sign contract and punish those who deviate.

12.3.3 Assessment of damages

12.4 Incomplete contracts

12.4.1 Complete contracts

12.4.2 Incomplete contracts

12.5 Default contracts

12.5.1 Introduction

Impositions without contracts. ie, laws.

Can have competition for previous type of contract, not this.

Defaults for contracts page. specific to jurisdiction.

12.6 The principal-agent problem

12.6.1 Introduction

12.7 Moral hazard

12.7.1 Introduction

12.8 Adverse selection

12.8.1 Introduction

Part III

Producer theory

Chapter 13

Pricing homogeneous goods

13.1 The economic profit function

13.1.1 Profit

The profit of a firm is the difference between revenue and costs.

$\pi = pq - c$

Where q is the amount producted, and p is the price, and c is a function of production.

13.1.2 Maximising profit

$\pi = pq - c$

The firm's production q affects the market price p.

$\frac{\delta \pi}{\delta q} = \frac{\delta}{\delta q}[pq - c]$

$\frac{\delta \pi}{\delta q} = p + q\frac{\delta p}{\delta q} - \frac{\delta c}{\delta q}$

The firm chooses Q to maximise profits.

$p + q\frac{\delta p}{\delta q} = \frac{\delta c}{\delta q}$

The right side is marginal costs (MC), the left is marginal revenue.

$p[1 + \frac{q}{p}\frac{\delta p}{\delta q}] = MC$

We know that the price elasticity of demand is: $\epsilon = \frac{p}{q}\frac{\delta q}{\delta p}$

So we have:

$p[1+\frac{1}{\epsilon}] = MC$

$p = \frac{\epsilon}{1+\epsilon}MC$

13.1.3 Intensive and extensive margins

$revenue = pq$

$MR = p + q\frac{\delta p}{\delta q}$

p is the extensive margin.

$q\frac{\delta p}{\delta q}$ is the (negative) intensive margin.

monopoly pricing. when lower prices, gain money on extensive margin. lose money on intensive margin.

13.2 Cournot competition

13.2.1 Cournot competition

With competition, the elasticity of demand refers to the whole market, not just a single producer. Instead we have:

$\epsilon = \frac{p}{Q}\frac{\delta Q}{\delta p}$

$Q = \sum_j q_j$

We now get:

$p[1+\frac{q}{Q}\frac{\delta Q}{\delta q}\frac{Q}{p}\frac{\delta p}{\delta Q}] = MC$

$p[1+\frac{\mu}{\epsilon}] = MC$

Using the firm's size elasticity: $\mu = \frac{q}{Q}\frac{\delta Q}{\delta q}$

With monopoly this is:

$\mu = 1$

13.3 Bertrand competition

13.3.1 Bertrand competition

Each player decides what price to sell at.

Firms who price above the lowest have no sales. Prices converge to cost.

13.4 Perfect competition

13.4.1 Perfect competition

13.4.2 Hotelling's lemma

13.4.3 Short-term supply function

13.4.4 Long-term supply function

13.4.5 Price elasticity of supply

13.5 Pricing in repeated rounds

13.5.1 Stackleberg competition

Sequential Cournot competition.

There is a first-mover advantage.

13.5.2 Explicit and tacit collusion

13.5.3 Monitoring and enforcing collusion

13.6 Other

13.6.1 The law of one price

Chapter 14

Production and intermediate goods

14.1 Production functions

14.1.1 Production functions and marginal products

Production functions

A firm produces Q using inputs X.

$Q = f(X_1, ..., X_n)$

Marginal products

This is the marginal utility, adapted for the production setting.

$MP = \frac{\delta}{\delta x_1} f(\mathbf{x})$

Diminishing marginal returns

This says that marginal returns decrease as the use of a factor increases.

$\frac{\delta^2}{\delta {x_1}^2} f(\mathbf{x}) < 0$

14.1.2 Marginal and average costs

14.1.3 Average total cost

14.1.4 Long-run average incremental cost

14.1.5 Isoquants

Isoquants are indifference curves for firms.

We have a production function: $Q = f(X)$.

An isoquant is defined for each c $f(X) = c$, where X is a vector.

14.1.6 Marginal rate of technical substitution

This is the marginal rate of substitution, adapted for firms.

$MRTS =$

14.1.7 Marginal and average costs

14.1.8 Average total cost

14.1.9 Long-run average incremental cost

14.2 Choosing production inputs

14.2.1 Isoquants

Isoquants are indifference curves for firms.

We have a production function: $Q = f(X)$.

An isoquant is defined for each c $f(X) = c$, where X is a vector.

14.2.2 Marginal rate of technical substitution

This is the marginal rate of substitution, adapted for firms.

$MRTS =$

14.3 Specific production functions

14.3.1 Cobb-Douglas production function

$Q = A\sum_i X_i^{\alpha_i}$

14.3.2 Leontief production function

$Q = \sum_i X_i^{\alpha_i}$

14.3.3 Constant Elasticity of Substitution (CES) production function

For some constant r.

$Q = A[\alpha_i X_i^r]^{\dfrac{1}{r}}$

14.4 Input-output tables

14.4.1 Input-output tables

14.5 Specific production functions

14.5.1 Marginal rate of transformation

14.5.2 Production-Possibility Frontier

14.5.3 Other

Production functions

A firm produces Q using inputs X.

$Q = f(X_1, ..., X_n)$

Marginal products

This is the marginal utility, adapted for the production setting.

$MP = \frac{\delta}{\delta x_1} f(\mathbf{x})$

Diminishing marginal returns

This says that marginal returns decrease as the use of a factor increases.

$\frac{\delta^2}{\delta {x_1}^2} f(\mathbf{x}) < 0$

14.5.4 Passthrough

14.5.5 Monopsony and monopoly power

Chapter 15

The Robinson Crusoe model

15.1 Introduction

Chapter 16

Basic general equilibrium

16.1 Introduction

16.2 Productive efficiency

16.2.1 Production-possibility frontier

16.2.2 Productive efficiency

16.3 Allocative efficiency

16.3.1 Allocative efficiency

16.3.2 Pareto efficiency

16.3.3 Kaldor-Hicks efficiency

Chapter 17

Taxation

17.1 Introduction

17.1.1 DiamondMirrlees

Chapter 18

Externalities

18.1 Introduction

Chapter 19

Public goods

19.1 Introduction

19.1.1 Ramsey pricing

Chapter 20

Welfare economics

20.1 Introduction

Part IV

Industrial organisation

Chapter 21

Pricing heterogeneous goods

21.1 Trade

21.1.1 Horizontal competition

Assured and contestable demand

So buyer wants 100 from incumbent, and 50 more.

First 100 are assured. 50 are contestable.

Cournot, bertrand mean entrant gets something

However rebates from incumbant blocks entrant.

eg reduce unit price for all if sales above certain amount

21.2 Product differentiation

21.2.1 Hotelling competition

Compete on quality, features, on an axis. For example 2 shops in equilibrium are next to each other on road, to capture both on either side.

21.2.2 Vertical differentiation

quality and price. everyone prefers high quality, but different preferences for tradeoff

21.2.3 Horizontal differentiation

different preferences for characteristics. eg car colour

21.2.4 Bertrand competition with differentiated products

$q_1 = a - b_1 p_1 + b_2 p_2$ $q_2 = a - b_1 p_2 + b_2 p_1$

21.3 Pricing multiple products

21.3.1 Bertrand competition with differentiated products

Can have competing products.

Chapter 22

Price discrimination

22.1 Price discrimination

22.1.1 Barriers to resale

22.1.2 First-degree price discrimination

perfect. have complete knowledge of customers

22.1.3 Second-degree price discrimination

discounts for quantity. egindustrial orders. have no knowledge of customers

22.1.4 Third-degree price discrimination

different for different groups. eg student discount. have knowldege of groups

22.1.5 Two-part tariff

22.1.6 The Coase conjecture

22.1.7 The Pacman conjecture

Chapter 23

Industrial organisation

23.1 More on monopoly pricing

23.1.1 Two-part tariffs

23.1.2 Price discrimination

23.1.3 First degree price discrimination

Customer pays reservation price.

Requires firm to know reservation price.

23.1.4 Second degree price discrimination

Price varies by quantity ordered.

23.1.5 Third degree price discrimination

Different prices to different customer segments.

23.2 Natural sources of market power

23.2.1 Returns to scale

23.2.2 Network effects

23.2.3 Subscription services

23.2.4 Heterogeneous efficiency

23.3 Horizontal single good

23.3.1 Entry Rate (ER)

23.3.2 Entrant Relative Size (ERS)

23.3.3 Exiter Relative Size (XRS)

23.3.4 Exit Rate (XR)

23.3.5 Limit pricing

23.3.6 Horizontal mergers

Scale benefits.

23.3.7 Bresnahan-Reiss entry model

23.4 Horizontal single good

23.4.1 Tying

23.5 Vertical

23.5.1 Restriction of access

23.5.2 Vertical mergers

Remove double margin.

Prevent supply to competitors.

23.6 Merger simulation

23.7 New product types

23.7.1 Identifying new products

eg car reach consumer needs in different ways, different way of looking at their demand function

23.7.2 Selling to customers

retail? to businesses (cold calling?)

23.7.3 Maintaining market share

23.8 Other

23.8.1 Vertical production and margin squeeze

23.9 Practical pricing

23.9.1 The problem

Firms dont have access to elasticity information.

23.9.2 Base on existing competitors

23.9.3 Gross Profit Margin Target

23.9.4 What The Market Will Bare

23.9.5 intertemporal strategies: sales max, market share max

23.10 Capital

23.10.1 Putty-putty capital

23.10.2 Putty-clay capital

Chapter 24

Pricing renewing customers

Chapter 25

Competition policy

25.1 Harm from anti-competitive behaviour

25.2 Assessing the impact of anti-competitive behaviour

25.2.1 Restrictions on competition by object and by effect

25.3 Merger policy

25.3.1 Merger simulation

25.3.2 Horizontal mergers

25.3.3 Vertical mergers

25.4 Market definition

25.4.1 SSNIP test

Small but significant and non-transitory increase in price

Would this cause customers to move elsewhere?

If we have demand at different prices we can estimate whether it is worth monopolising the market.

Because this lack of motivation may be because of competitor goods, we can include these to see if that market is worth monopolising.

For example: hiking up the price of one good may not be profitable. Therefore that is not a relevant market (though it could be!). Then we can see if hiking up the price of that good, and others, is profitable. If so, then it is a relevant market.

Note:

High elasticity may be because monopoly power is already being exerted

Identify smallest market where a monopolist could increas price profitably

How to do test? interview customers about whether increase in price would negatively affect them. want to know if they could switch.

If could switch at price rise of say 5

Can be used to estimate elasticity of demand

We can also look at the cost impact from cutting units. if high variable, then more appealing

We can expand to include substitutes. if substitutes make worth monopolisign, then merger can be concerning.

25.4.2 Market definition

Defining the relevant market

We want to see what market the monopolist can exert a profitable increase in price. This my not be all of their offerings.

The relevant market includes the good offered by the monopolist, along with relevant competitors in supply and demand

What is the product?

If we are considering a commodity it is easy to see that, say, steel supplied by one firm is comparable to that supplied by another. For other goods this is more complex.

For example, does Google provide search services, making it highly dominant? Or does it in fact provide advertising services for a small number of searches aimed at purchases? In the latter case it is a closer good to Amazon or Ebay.

Supply side substitution

If a price rise from a firm caused other firms to increase supply, this is relevant.

Would others be able to raise output?

Would others be able to enter the market?

Demand side substitution

If a price rise from a firm causes buyers to react, price increases will be less rewarding for the firm.

Assessment: Price elasticity of demand

Geographic market

May be many players but fewer locally. Threat of entry may still be a key motivation for price setting. Supply side substitution.

Vertical integration

Benefits: no double mark up.

2 monopolists both exert monopoly power, more deadweight loss. Integration solves this.

Contract theory argument. Dont want to be held if need change

Costs: can keep out downstream competitors

Facilitating collusion? Vertical integration allows upstream to monitor downstream price from their customer.

Restoring monopoly power?

Problem: to what extent can monopoly upstream abuse their power? One option is high price, but they could also do 2 part tariffs

But 2 part tariffs are unstable, as there is an incentive for the provider to offer the last downstream one a lower marginal cost.

Vertical integration then restores this power.

Chapter 26

Regulation

26.1 Introduction

Part V

Basic econometrics

Chapter 27

Econometrics of production

27.1 Measuring heterogeneous efficiency

27.1.1 Stochastic frontier analysis

27.1.2 Data envelopment analysis

Chapter 28

Econometrics using aggregate market data

28.1 The problem with estimating structural models

28.1.1 Structural supply and demand functions

Supply:

$Q_s = \alpha_1 + \beta_1 P + \gamma_1 I + \epsilon_1$

Demand:

$Q_d = \alpha_2 + \beta_2 P + \gamma_2 I + \epsilon_2$

Can't estimate because the equations are simulataneous.

To estimate, $cov(P, \epsilon_1)$ needs to be 0, but what is it?

$cov(P, \epsilon_1) = E[(P - E[P])(\epsilon_1 - E[\epsilon_1])]$ $cov(P, \epsilon_1) = E[(P - E[P])(\epsilon_1 - E[\epsilon_1])]$

28.1.2 The identification problem

28.2 Estimating reduced-form models

28.2.1 Structural supply and demand functions

Supply:

$Q_s = \alpha_1 + \beta_1 P + \gamma_1 I + \epsilon_1$

Demand:

$Q_d = \alpha_2 + \beta_2 P + \gamma_2 I + \epsilon_2$

Can't estimate because the equations are simulataneous.

28.2.2 Reduced form equations

Where supply is demand.

$Q_s = Q_d$

$\alpha_1 + \beta_1 P + \gamma_1 I + \epsilon_1 = \alpha_2 + \beta_2 P + \gamma_2 I + \epsilon_2$

$(\alpha_1 - \alpha_2) + (\beta_1 - \beta_2)P + (\gamma_1 - \gamma_2)I + (\epsilon_1 - \epsilon_2) = 0$

$(\beta_1 - \beta_2)P = -(\alpha_1 - \alpha_2) - (\gamma_1 - \gamma_2)I - (\epsilon_1 - \epsilon_2)$

$P = -\frac{\alpha_1 - \alpha_2}{\beta_1 - \beta_2} - \frac{\gamma_1 - \gamma_2}{\beta_1 - \beta_2} I - \frac{\epsilon_1 - \epsilon_2}{\beta_1 - \beta_2}$

We can construct something similar for Q. The results are reduced-form parameters with reduced-form errors.

28.2.3 More on reduced form

reduced form for perfect competition, and imperfect

issue is: supply function only defined for perfect competition.

how do you get equilibrium otherwise? what are the other reduced form equations? strucutral?

28.3 Using 2-stage OLS

28.3.1 Using IVs

Let's say the demand function is:

$Q_d = \alpha + \beta P + \epsilon$

How can we estimate this?

OLS will give biased results if P is correlated with ϵ.

We can estimate if we have an instrumental variable for P.

28.3.2 Power of IVs

need variation. if factor v important, little price movelemtn. may be hard to esimate that fact.

28.3.3 Locality of elasticity

we measure elsaticities as they are. there may be existing competition barriers which cause current substitution. without current monopolies, there may be more unique markets.

eg monopolist has product with sbustitutve, but it is only substitute because the monopolist has kept the price so high.

28.4 Examples of IVs

28.4.1 Cost data from firms

28.4.2 Weather

28.4.3 Exogeneous cost increases

28.4.4 Product characteristics

We can use the characteristics of products, and other products.

28.4.5 Price increases in other geographies

Assume only correlated with marginal cost in other geography.

28.4.6 Price changes of substitutes/complements

28.5 Using marginal cost data

28.5.1 Monopoly

In the monopoly model we have:

$\pi = pq - c$

$p[1 + \frac{q}{p}\frac{\delta p}{\delta q}] = MC$

The price elasticity of demand is: $\epsilon = \frac{p}{q}\frac{\delta q}{\delta p}$

$p[1 + \frac{1}{\epsilon}] = MC$

$\frac{1}{\epsilon} = \frac{MC}{p} - 1$

$\frac{p - MC}{p} = -\frac{1}{\epsilon}$

28.5.2 The Lerner index

The Lerner index is:
$\frac{p - MC}{p}$

28.5.3 Cournot model

With competition, the elasticity of demand refers to the whole market, not just a single producer. Instead we have:

$\epsilon = \frac{p}{Q}\frac{\delta Q}{\delta p}$

$Q = \sum_j q_j$

We now get:

$p[1 + \frac{q}{Q}\frac{\delta Q}{\delta q}\frac{Q}{p}\frac{\delta p}{\delta Q}] = MC$

$p[1 + \frac{\mu}{\epsilon}] = MC$

Using the firm's size elasticity: $\mu = \frac{q}{Q}\frac{\delta Q}{\delta q}$

With monopoly this is:

$\mu = 1$

In this model this is:
$\frac{p - MC}{p} = -\frac{\mu}{\epsilon}$

28.6 Measuring market concentration

28.6.1 HerfindahlHirschman Index (HHI)

The index is the sum of each firms market share squared.

For a monopolist this is 1, for a completely competitive market it is 0, or $\frac{1}{n}$.

$H = \sum_{i=1}^{n} s_i^2$

To normalise this between 0 and 1 we can use:

$H* = \frac{H - \frac{1}{n}}{1 - \frac{1}{n}}$

28.6.2 Concentration ratio

Proportion of output from given firms.

For example CR_5 is the proportion of output from the 5 largest producers.

28.6.3 Lerner index

Marginal profit. If high it suggests existing power prevents it from raising output.

$L = \frac{P - MC}{P}$

From 0 to 1.

28.6.4 Pivotal supplier index (PSI)

28.6.5 Residual Supply Index (RSI)

Chapter 29

Discrete choice estimation using aggregate market data

29.1 Discrete choice estimation

29.1.1 Discrete choice estimation with aggregate data

29.1.2 Discrete choice estimation with individual data

29.1.3 Omitted variable bias

If the producer sees customer characteristics we do not, then there will be a bias in our estimate.

Producers will set prices correlated with those characteristics.

29.1.4 The problem with alternative price data

We need alternative price data for this multinomial choice model.

These are not observed, and so we need to estimate them.

One option is to use list prices, or average prices, for all prices.

However, differences from this are likely correlated with individual characteristics, giving us bias.

29.1.5 Dummy variables for products

By adding a dummy for each product we control for unobserved variables. This adds a parameter for each product, which can increase the variance of the estimates. Adding the dummies affects the other estimators. We can fix this using minimum distance estimator. The error no longer includes unobserved characteristics.

Dummies for groups. These create fewer new parameters.

29.1.6 Using instrumental variables

29.2 Other

29.2.1 BLP demand curve estimation (Berry, Levinsohn, Pakes)

Chapter 30

Discrete choice estimation using customer level data

30.1 Discrete choice estimation with individual data

Chapter 31

Econometrics using stated preference

31.1 Stated preference

31.1.1 Stated preference

Part VI

Finance

Chapter 32

Risky debt

32.1 Defaults

32.1.1 Defaults

32.1.2 Haircuts

32.2 Pricing

32.2.1 Securities pricing

32.2.2 Hedging

32.2.3 Arbitrage

32.2.4 Efficient markets hypothesis

32.2.5 Risk-free rates

32.2.6 Capital Asset Pricing Model (CAPM)

32.2.7 Arbitrage Pricing Theory (APT)

32.2.8 Martingale pricing

32.2.9 Arbitrage

Pairs trading

Delta neutral strategies

Exchange arbitrage

Mean reversion

Scalping

Transaction cost reduction

Market making

Statistical arbitrage

Spoofing

Quote stuffing

32.2.10 Put-call parity

32.2.11 The fundamental theorem of arbitrage pricing

32.2.12 Yield curve

32.2.13 Primary and secondary markets

32.2.14 Secured and unsecured debt

32.2.15 Seniority

32.2.16 Instruments

Debt types: inflation protected, interest linked (SVR etc)

Chapter 33

Insurance and pensions

33.1 Insurance

33.1.1 Diviserifiable and systemic risk

33.2 Pensions

33.2.1 Workplace and non-workplace pensions

Chapter 34

Corporate finance

34.1 Equities

34.1.1 Equities and dividends

34.1.2 Market capitalisation

34.1.3 Buy backs

34.1.4 Dividend irrelevance theory

34.1.5 Return on Invested Capital

34.1.6 Earnings/share

34.1.7 P/E ratio

34.1.8 Stock splits

34.1.9 Timing

34.1.10 Buybacks vs dividends

34.1.11 ROCE

34.1.12 Difference between accounting profit and economic profit

34.2 Pricing equities

34.2.1 Discounted cash flow

34.2.2 Valuation multiples

34.2.3 Equity premium puzzle

Chapter 35

Derivative markets

35.1 Introduction

35.1.1 Money markets

35.1.2 Counterparties

Counterparties and counterparty risk.

35.1.3 Derivatives

35.1.4 Naked short selling

35.1.5 Options

35.1.6 Calls and puts

35.1.7 Strike price

35.1.8 Short selling

35.1.9 European options

35.1.10 American options

35.1.11 Options pricing

35.1.12 Black-Scholes equation

35.1.13 Black-Scholes formula

Chapter 36

Portfolios

36.1 Introduction

Chapter 37

Banking

37.1 Banking

37.1.1 Banks

Banks get revenue from their lending activities. Their costs include identifying investment opportunities and paying interest to depositors.

Is the bank system more wasteful because it has reserves? Not really reserves are needed because the bank deposits are on demand. If Alice received funds directly from each one she would keep some in reserve herself, in case someone demanded money back. What the bank does is:

- Make identifying investment opportunities simpler
- Matching short term depositors with long term borrowers

Investments and time requirements, and search costs for investment

37.1.2 Bank finance

If the bank wants to raise money for lending it can:

- Attract more deposits
- Raise equity
- Issue debt

Lets consider the latter two in more detail. Both issuing shares and debt will provide cash for reserves, but they create different risks. Repayments on deposits are made when depositors decide to take money out of the bank, repayments on equity are made when the bank decides to pay dividends, and repayments on debt are made as set out in the debt issue.

These present different risks using deposits puts you at risk of depositors withdrawing all at the same time, debt means that you may not have income to pay your debts.

Banks use a mix of different methods of raising money, reflecting these risks and the different costs.

Banks can lend to each other on the interbank market, and often do on a short term basis.

37.2 Payment systems

37.2.1 Payment systems

If Alice wants to pay Bob, she can give him shells, or tell the bank to move the shells from her box to his box. In reality there are multiple banks, and these must be able to talk to each other to facilitate payments.

So what happens if one bank needs to pay another? Without the payment system Alice would take the shells out of her bank, give them to Bob who would put them in his bank. A payment system effectively allows banks to send these shells to each other.

There are two types of interbank payment systems gross and net. A gross payment system means that for each transaction made, the banks transfer money across. Many of these transactions will in effect cancel out bank A pays bank B and bank B pays bank A. A net payment system looks out the net position at set times and them and transfers the difference.

Net payment system transfer less total money, and allow banks to hold lower reserves. For example if one payment would have caused bank A to run out of reserves, but was followed by a large inflow, then bank A would have been able to make its payments under a net system.

37.3 Other

37.3.1 Shadow banking

Non-banks also undertake lending. If an investment vehicle attracts savers and uses this money to lend to a company, this also increases the money supply, even though the investment vehicle is not a deposit taking bank.

37.3.2 Bank failure

Banks hold reserves to cushion against both an increase in withdrawals from depositors and in case their investments do not pay off. So what happens if reserves arent sufficient? This depends on whether the issue is on their liabilities (i.e. a run on the bank, causing a liquidity problem) or their assets (i.e. their investments turn sour, causing a solvency problem).

In the former case, the bank still has healthy assets but they may be unable to demand early repayment from those they have lent money to. One solution to this is for the bank itself to get a loan from another bank, to bridge this gap.

What if the underlying assets are weak and the bank cannot get a private loan? The bank fails. In addition to depositors not being able to access their money, this tends to increase the amount of reserves desired to be held by banks, decreasing the money supply.

The solvency of a bank depends on the quality of its assets, which may be hard for another bank to evaluate. This creates an information asymmetry problem, and leads to more cautious lending from banks.

37.3.3 Central banks

Central banks are government institutions which manages a states currency.

Central banks can create base currency, including by paying interest on reserves held and by purchasing assets using new money.

Lender of last resort

While other banks may be able to finance a solvent bank with liquidity problems, a central bank may want to do this even if private banks do not, because of the knock on impact of the collapse of a bank.

This provides incentives for banks to take excessive risk. Central banks attempt to manage this risk elsewhere, for example with reserve requirements.

Central banks issue their own currency for commercial banks to hold as base money. The currency could be claims on gold, but doesnt have to be, and today broadly isnt.

Commercial banks then hold central bank currency as reserves, and control the supply of central bank money.

Controlling money supply

Central banks can manipulate the supply of money and inflation in many ways.

Reserve requirements

Central banks can set reserve requirements for banks. If binding, this affects the money multiplier.

Open market operations

In the US banks lend to one another. The US Federal Reserve (the Fed) takes a measure of different lending rates to construct the Federal Funds Effective Rate, and targets a value for this rate. The Fed engages in repos and reverse repos to create or remove money until this is hit.

In a repo the Fed buys a security from a bank with new cash, and with the agreement that the bank will repurchase the security at a specified date with a specified price. This increases the supply of money, and therefore reduces the cost of interbank borrowing. A reverse repo works the opposite way.

Quantitative easing is similar, and involves large scale purchases of assets. Unlike standard OMO quantitative easing target assets with a longer maturity, and so the central bank can simultaneously target the interbank overnight lending rate.

Undertaking such operations gives the central bank a balance sheet of financial assets.

Interest on reserves

Central banks can pay interest on the reserves held by commercial banks. This can be different for reserves above the required level.

Paying interest on required reserves increases the money supply and reduces the opportunity cost of depositing at the Fed. This removes the effective tax on reserves.

By paying interest on excess reserves the Fed reduces the incentive to lend elsewhere, and incentivises banks to hold additional reserves, compared to a given interbank lending rate.

Discount window

In addition to depositing at the central bank, banks can also borrow from it. This tends to be higher than interbank lending rates, and so is only used significantly in extreme circumstances.

In the UK it is this rate which is the official bank rate, with interbank lending rates (LIBOR) not directly managed.

Zero lower bound

If the central bank targets a lending rate of below 0%, a lender can obtain a better rate by holding physical cash instead. The zero lower bound refers to the limit of lending rates to be sustained at volume much below 0%.

37.3.4 Reserve currencies

37.3.5 Exchange rates

37.4 To banks

37.4.1 Bank currency

Alice has 10 shells at her bank. If she wants to pay Bob 10 shells for something, she can either take out and give him physical shells or inform the bank of a transfer.

If the bank allowed her to withdraw a claim on 10 shells, she could give this to Bob. This is how cash works.

37.4.2 Types of money

The supply of money has increased through the use of fractional reserves at the bank. There are different definitions of the money supply:

- M0: physical cash outside of banks (90 in our example above)
- MB: all cash (100)
- M1: M0 and bank deposits (120)

There are also additional measures, with increasing scope.

If Alice puts some of the money lent to her in the bank, this could have been lent out, recursively.

$Totalmoneysupply = \frac{Basemoney}{Reserveratio}$

The *moneymultiplier*, the ratio of total money supply to base money is equal to $\frac{1}{Reserveratio}$

37.4.3 Full reserve banking

Lets introduce a banker to those villagers, who sets up First Shell Bank. This bank is simply a location to store shells. This activity doesnt really change anything. If Alice needs another fishing rod she still as to persuade the same people to lend her the money, although now this will just involve putting the shells in a different box in the bank.

This bank keeps all of its assets as reserves, and so cannot itself lend to Alice.

37.4.4 Real effects of inflation

If there is unexpected change in money supply, prices will eventually need to update. This could happen immediately, with all prices doubling following a discovery of shells, for example. This would not affect any real (relative) prices.

If, however, some prices are slow to adjust, then their relative prices will change. This would result in prices no longer clearing. If the nominal price of fish is sticky and, prior to inflation, the supply of fish equalled demand for fish, then the inflation would cause the relative price to fall. This would mean that more was demanded than supplied, and output fell.

Price and wage rigidity varies across countries.

37.4.5 Borrowers and savers

If Alice owes Bob 10 shells, and there is a surprise increase in inflation, then Alice is better off and Bob worse off. Expected inflation, or debts in real terms, does not have this issue.

37.4.6 Multiple currencies

Previously we have discussed all money being in terms of shells. Either shells or claims on shells. Imagine another bank on a nearby island which has reserves in gold rather than shells. If someone at a shell bank wanted to pay someone at a gold bank, the shell bank would have to sell the shells, use this to buy gold, and send the gold to the gold bank. This is similar to how different countries trade with each other today.

Creating a new currency base can be lucrative. If someone collected a large amount of gold before gold was the base of currency, the value of that would increase.

Digital currencies are examples of this. Early mining is relatively cheap and can award a large proportion of the total currency. Digital currencies today at least arent used the same way as other currencies. If you pay someone in bitcoin, youre sending base currency, in a way that youre not for other payments.

37.4.7 Different banks

Alternatively, a bank could issue currency not in shells, but in dollars. If these dollars were exchangeable for different amounts of base currency, they would have different values.

37.4.8 Fiat currency

Instead of using a physical base, such as gold, a bank can also simply issue dollars without the ability to exchange these notes for anything else. As the value of these depends on their supply, high trust is needed in an issuer of fiat currency.

37.4.9 Optimal currency areas

The optimal area to be covered by a currency depends on fluctuations and trade. Having different currencies allows currencies to devalue, and for sticky price effects to be mitigated. At the same time, use of a single currency makes trade easier

The balance therefore depends on whether a region faces similar price stickiness, similar shocks, and large trade inside the area.

When a shock hits a currency area, and there are different levels of price stickiness across it, we would expect to see some areas hit worse than others. Having labour mobility, and fiscal transfers, can help mitigate the effect of such asymmetric shocks.

In a currency area an asymmetric shock and sticky prices will mean that goods in one region will be higher or lower in real terms than in equilibrium. This can cause persistent current account surpluses, as seen in the EU.

37.4.10 Impossible trinity

As inflation rates determine movements in the exchange rate, a central bank cannot at the same time:

- Control inflation;
- Control exchange rates; and
- Allow free capital flows.

37.4.11 Capital controls

If a government can prevent investors from freely choosing between investing in different countries, then interest parity does not apply.

This means that an investor with assets in the lower return country would benefit from getting around such controls.

37.4.12 Internal and external adjustment

We discussed above how nominal prices can be sticky. With trade this becomes more complex, as exchange rates can rapidly move.

A price may be sticky in pounds, but with a flexible exchange rate the price in dollars can rapidly change, and disequilibrium effects can be reduced.

Chapter 38

Institutional services

38.1 Contracts

38.2 Finance

38.3 Payments

38.4 Insurance

Part VII

Labour economics

Chapter 39

Labour markets and unemployment

39.1 Introduction

Chapter 40

Education

40.1 Introduction

Part VIII

International economics

Chapter 41

International economics

41.1 Introduction

Chapter 42

Migration

42.1 Introduction

42.1.1 Introduction

Part IX

Macroeconomics

Chapter 43

Monetary and fiscal policy

43.1 Monetary policy

43.1.1 Policy goals

Targets

Central banks can use monetary policy to achieve goals. Monetary policy directly affects inflation and exchange rates, but also losses in output which result from the stickiness of prices.

Due to the interaction of each of these targets, there are trade-offs in pursuing multiple goals. Reducing output volatility could require volatile inflation, and stabilising the exchange rate could destabilise inflation and output.

Export promotion

The theory behind currency manipulation is that by devaluating a currency exports are more competitive and so GDP will rise.

If a currency is devalued by printing large amounts of money, this will make exports cheaper temporarily if they take time to adjust their nominal prices upwards.

If a currency is devalued by imposing capital controls and intervening in capital markets, then the relative price of exports can be maintained below the level it would otherwise be at.

Chapter 44

Neoclassical economics

44.1 Introduction

44.1.1 Walras equilibrium

44.1.2 The ArrowDebreu model

44.1.3 The input-output model

44.2 Classical dichotomy

44.3 Neoclassical exogeneous growth models

44.3.1 The Harrod-Domar model

Introduction to growth models

We have output as a function of capital.

$Y = f(K)$

We also have capital dynamics.

$\dot{K} = I - \delta K$

$I = S = sY$

This gives us:

$\dot{K} = sY - \delta K$

Introduction

The production function is:

$Y = cK$

This gives us:

$\dot{K} = (sc - \delta)K$

Growth

$\dot{Y} = c\dot{K}$

$\frac{\dot{Y}}{Y} = c\frac{\dot{K}}{Y}$

$\frac{\dot{Y}}{Y} = c\frac{(sc - \delta)K}{cK}$

$\frac{\dot{Y}}{Y} = sc - \delta$

Per-capita growth

Per capita income is:

$y = \frac{Y}{L}$

$k = \frac{K}{L}$

44.3.2 The Solow-Swan model

Recap of growth models

As with the Harrod-Domar model we have output as a function of capital:

$Y = f(K)$

Capital dynamics:

$\dot{K} = I - \delta K$

$I = S = sY$

This gives us:

$\dot{K} = sY - \delta K$

Recap of the Harrod-Domar model

The production function of the Harrod-Domar model is:

$Y = cK$

And long-term growth of:

$\frac{\dot{Y}}{Y} = sc - \delta$

The Solow-Swan production function

We use a new production function:

$Y = K^\alpha (AL)^{1-\alpha}$

We add dynamics for technology and labour.

$A_t = A_0 e^{gt}$

$L_t = L_0 e^{nt}$

$Y_t = K_t^\alpha (A_0 e^{gt} L_0 e^{nt})^{1-\alpha}$

Effective captial

$k_t = \frac{K_t}{A_t L_t}$

$Y_t = \frac{Y_t}{A_t L_t}$

The dynamics of effective capital is:

$\dot{k}_t = sk_t^\alpha - (n + \delta + g)k_t$

Steady state

In equilibrium effective capital is stable.

$\dot{k}_t^* = sk_t^\alpha - (n + \delta + g)k_t^8 = 0$

$sk_t^{*\alpha} = (n + \delta + g)k_t^8$

$k_t^* = \left(\frac{s}{n + g + \delta}\right)^{\frac{1}{1-\alpha}}$

44.3.3 The Mankiw-Romer-Weil model

We add human capital to the Solow-Swan model.

44.3.4 The Golden Rule savings rate

The Golden Rule savings rate is the rate which maximises long term consumption per capita.

If the savings rate is 0 there is no capital and no income. If the savings rate is 1 then then there is no consumption.

44.3.5 The Ramsey-Cass-Koopmans model

This is based on the Solow-Swan model, with an endogeneous savings rate.

44.4 Neoclassical endogeneous growth models

44.4.1 The AK model

Recap of growth models

As with the Harrod-Domar model we have output as a function of capital:

$Y = f(K)$

Capital dynamics:

$\dot{K} = I - \delta K$

$I = S = sY$

This gives us:

$\dot{K} = sY - \delta K$

Recap of the Harrod-Domar and Solow-Swan models

In the Solow-Swan model the production function was:

$Y = K^\alpha (AL)^{1-\alpha}$

In the Harrod-Domar model the production function was:

$Y = cK$

In the Solow-Swan model we also added population and technology growth

The AK model

In the AK model the production function is:

$Y = AK$

We keep population growth from the Solow-Swan model.

Per-capita income

$\dot{K} = sAK - \delta K$

$\dot{K} = (sA - \delta)K$

$k = \frac{K}{L}$

$\dot{k} = \frac{\dot{K}}{L} - \dot{L}\frac{K}{L^2}$

$\dot{k} = \frac{(sA - \delta)K}{L} - \dot{L}\frac{K}{L^2}$

$\dot{k} = (sA - \delta)k - k\frac{\dot{L}}{L}$

$\dot{k} = (sA - \delta - n)k$

$\frac{\dot{k}}{k} = sA - \delta - n$

44.5 Overlapping generations model

44.5.1 Introduction

Chapter 45

Neo-Keynesian economics and the neoclassical synthesis

45.1 Motivation

45.1.1 Output gaps

45.1.2 Phillips curve

45.1.3 Okun's law

45.2 Investment Saving - Liquidity preference - Money supply (IS-LM)

45.2.1 The Fisher equation

The Fisher equation shows the relationship between the real and nominal interest rates.

$(1 + i) = (1 + r)(1 + \pi)$

For small values:

$i \approx r + \pi$

45.2.2 The Keynesian cross and the Investment Saving (IS) curve

The Keynesian cross

We have:

$Y = C(Y - T(Y)) + I(r) + G + NX(Y)$

Where:

- Y is output
- C is consumption
- T is taxes
- I is investment
- r is the real interest rate
- G is government spending
- NX is net exports

The Keynesian cross plots:

Y

Against:

$C(Y - T(Y)) + I(r) + G + NX(Y)$

This identifies an equilibrium level of output.

The IS curve

The IS curve plots the equilibrium level of output from the Keynesian cross against the real interest rate.

As the real interest rate rises, investment and therefore output falls.

The slope of the IS curve

The slope of the IS curve depends on taxes and net exports.

45.2.3 The Liquidity preference - Money supply (LM) curve

Liquidity preference

Money demand is:

$L = L(i, Y)$

As income rises, demand for money rises.

As the nominal interest rate rises, the demand for money falls, due to the opportunity cost.

Money supply

Money supply is:

$\frac{M}{P}$

The LM curve

In equilibrium money supply and demand match. We have:

$\frac{M}{P} = L(i, Y)$

We can plot the level of output which corresponds to the nominal interest rate.

This is the LM curve.

The slope of the LM curve

45.2.4 The Investment Saving - Liquidity preference - Money supply (IS-LM) model

The IS curve plots output against the (real) interest rate. As (real) interest rates rise, investment and therefore output falls.

The LM curve plots output against the (nominal) interest rate. As output rises, (nominal) interest rates fall to ensure clearing.

As prices are fixed in the IS-LM model, we can use the real and nominal rates interchangably.

The IS-LM model identifies the intercepts of the two curves and the equilibrium output and interest rate.

This model takes prices, money supply, taxes and government spending to be exogenous.

Effect of monetary expansion

In the LM model a monetary expansion lowers interest rates.

In the IS-LM model this effect is lessened. The lower interest rates cause higher output, increasing money demand, and raising interest rates.

Effect of fiscal expansion

Is the IS model a fiscal expansion caused a corresponding increase in output.

In the IS-LM model this is lessened because the increase also causes more real money demand, raising interest rates, and lowering output.

45.3 Aggregate Demand - Aggregate Supply (AD-AS)

45.3.1 Aggregate Demand (AD)

For any given price level there is a corresponding IS-LM equilibrium, with an output level.

The Aggregate Demand curve models the relationship between the price level and equilibrium output.

As the price level rises, the real money supply falls. This means nominal interest rates rise to ensure LM equilibrium.

This rise in interest rates causes the IS curve to shift inwards, reducing output.

$Y_d = Y_d(\frac{M}{P}, G, T)$

The slope of the Aggregate Demand curve

45.3.2 Aggregate Supply (AS)

Aggregate Supply in neoclassical models

In neoclassical models Aggregate Supply does not depend on price.

Aggregate Supply in neo-Keynesian models

The Aggregate Supply curve is informed by the Phillips curve.

As prices rise, so too does output.

Firms could increase production as nominal prices rise, as nominal contracts on wages mean that real costs have fallen.

Slope of the Aggregate Supply curve

45.3.3 The Aggregate Demand - Aggregate Supply (AD-AS) model

45.3.4 The fiscal multiplier

45.4 Extentions

45.4.1 The Mundell-Flemming model

45.4.2 The Dynamic Aggregate Demand - Surprise Aggregate Supply (DAD-SAS) model

Chapter 46

New classical economics

46.1 Movitation

46.1.1 The Lucas critique

46.2 Microfoundations for the Aggregate Supply curve

46.2.1 The Lucas islands model

46.2.2 Adaptive expectations

46.2.3 Rational expectations

46.2.4 The Lucas Aggregate Supply (AS) function

46.2.5 The new classical Phillips curve

46.3 Microfoundations for the Aggregate Demand curve

46.3.1 Gorman polar form

46.3.2 Representative agents

Income inequality

The use of representative agents means that the model cannot incorporate effects of income inequality.

46.4 Real Business-Cycle (RBC) Dynamic Stochastic General Equilibrium (DGSE) models

46.4.1 Real Business-Cycle (RBC) Dynamic Stochastic General Equilibrium (DGSE) models

46.4.2 Estimating RBC DGSE models

46.4.3 The policy-ineffectiveness proposition

46.4.4 DGSEs as VARs

Chapter 47

New Keynesian economics and the new neoclassical synthesis

47.1 Monetary policy

47.1.1 Monetary policy rules

47.1.2 The Taylor rule

47.2 New Keynesian Phillips curve

47.2.1 The new Keynesian Phillips curve

47.3 Market failures

47.3.1 Efficiency wages

47.3.2 Staggered Calvo contracts

47.3.3 Menu costs

47.3.4 Imperfect competition

47.4 New Keynesian Dynamic Stochastic General Equilibrium (DGSE) models

47.5 Heterogenous agent models

47.6 Models with financial sectors