Topic 1: ‘Big questions’ and basics

Compulsory readings:
Baye and Prince textbook, Chapter 1
The Nature of the Firm. Ronald Coase. *Economica*. 1937
Price as a quality signal: Some additional experimental results. W. Bradford Cornell. *Economic Inquiry.* 1978

Optional readings:
What if your manager’s work could be replaced with an algorithm?

Key concepts:
- Prices play two major roles - rationing and signalling - which can be in conflict. Many other systems can play these roles in production processes.
- Firms exist because internal rule systems are a method of organisation that is more efficient than pricing systems
- Maximising current profits maximises NPV if growth rate unaffected. Otherwise there can be a trade-off between current and future profits.
- Maximising any firm objective involves evaluating at the margin whether an additional choice increases net benefit (profits) or not

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What do prices do?

While the textbook doesn’t start with the question I will. Like the fish swimming in and ocean of prices we never stop to look at it. We don’t even realise what the water is doing - we don’t see it because it is all around us all the time.

According the standard view prices allocate resources amongst competing needs through a kind of ‘meta-market’ auction across all goods and services. Even Soviet central planners used prices widely as a rationing system.

But there are many non-price allocation mechanisms as well, and these I want to briefly touch on some examples, because they will be important in terms of the norms of various industries within which price setting takes place.

Rationing

Quotas
During wartime economy-wide rationing was common, with each household receiving ration cards that allowed for a set amount of goods of each type to be consumed in a period. This was to ensure that resources required for the war effort were no diverted to domestic uses through outbidding on price.

In Western Australian there is a 15% domestic gas reservation policy. This is a rationing system that ensure that local gas users are not always exposed to the global price.

Rule systems and hierarchy
Within firms non-price rationing is the dominant form of allocating resources through internal sets of rules (procedures, systems etc). An employment contract does not set tasks and prices for each of them, but sets a price for a period of time in which the employer will comply with the internal rules. More on this later.

Prices in fact are part of a meta-system of rules about trade, contracts and money.

In healthcare economists assess the welfare implications of funding through Quality Adjusted Life Years (QALYs), which is an attempt to inform the rules to allocate resources in a way that maximises gains to life from finite budgets.

Google search results are rationed by rules, not prices, though the use of prices through sponsored links etc. has increased.

Water restrictions were rule-based - watering gardens on different days etc.

Queuing
Use of the road space is rationed through an intricate set of rules, and pure space is rationed by queuing during peak times. Even when prices are used, queuing occurs. I've never seen anyone 'outbid' someone to improve their place in line at the supermarket checkout.

Trust and reciprocity
The informal economy is by some estimates between 18-44% the size of the formal economy in most countries. Household production, be it cooking, cleaning, education, maintenance and repairs etc, are not rationed by price, but through informal reciprocation within cooperative groups. In many ways the use of monetary systems merely formalises the relative quantities of contributions in a large reciprocal national network.

Also requiring trust and reciprocity are contributions to common pool resources. Open-source code, where the few contribute to the gain of the many is one example. Even national taxes involve a degree of trust; contributions to taxes are almost always above what is enforceable by law. The trust that fosters this honesty in the tax system is known as 'tax morale'.

Revisiting the water conservation problem we also had 'shaming' of households into conservation.

In sum, non-price rationing is far more common in the economy than price-rationing. Our focus in this subject however is mainly on prices and how to use them to good effect in business decisions.

Signalling

Quality
In a world were information is never complete, many customers will take a price as a signal of quality. We essentially rely on others to screen out high-price low-quality goods, thus generating a reliable rule of thumb that higher price goods are better quality. See Reading by Cornell, 1978.

Planning and reciprocity

What if setting and sustaining stable prices has a value itself when your customers rely on predictable input costs?

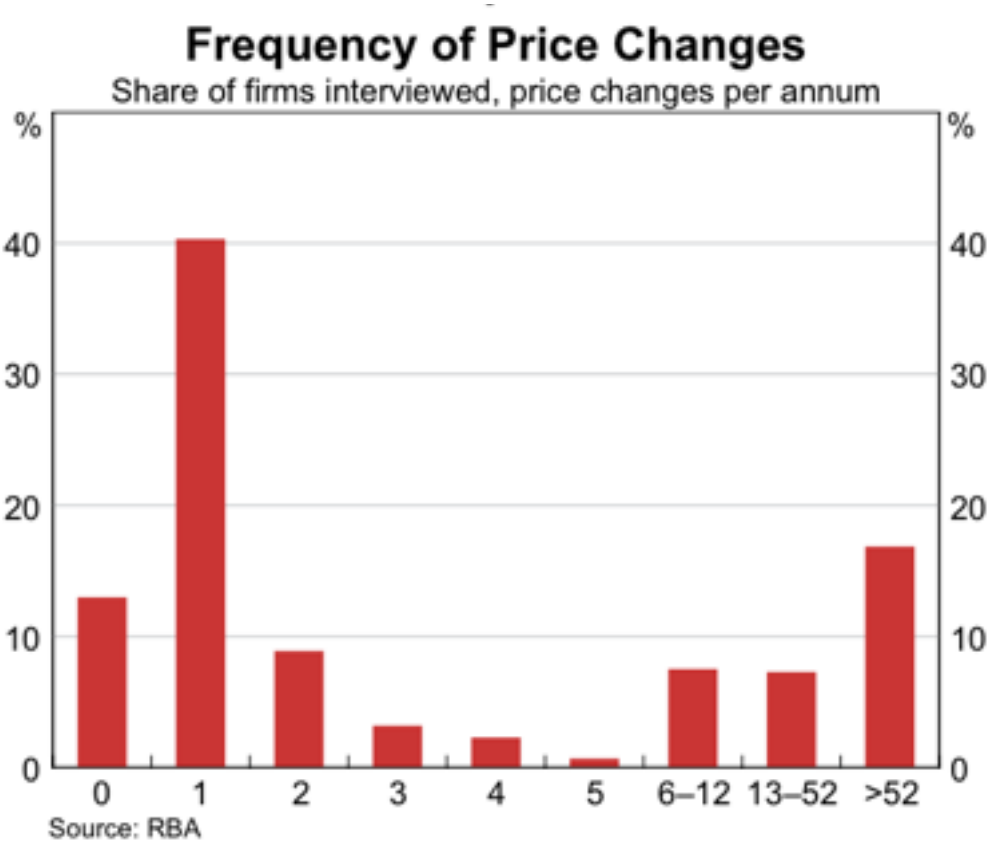
While a price level can signal quality, the stability of prices can signal trust, which is especially important between individuals and firms conducting repeated trade. It avoid the situation “I bought this on Friday for $20 now I come back to buy more on Monday and it’s $30, what gives?”

Some authors (such as Fieke van der Lecq) have argued that prices are a coordination device that reduces uncertainty for forward planning. If I know what my input prices with relative accuracy I can plan large long-term investments relying on those inputs.

Another factor in price stability and planning involves the norms of a market. Why can fruit and petrol prices be changed daily or weekly, but the price of fridges or cars is mostly unchanged?

As a rule the more durable a good is (the longer it lasts), the less prices will changed. With fresh food the cost of storage makes it profitable to reduce prices to sell more of the food that would spoil instead of other food that will last longer.

The larger and longer the price relationship, the more each party will rely on the trust and goodwill of the other. For example large construction projects are rarely fixed price contracts and contain clauses to share the risk of additional costs between the construction company and the client.



The above chart is from RBA research into the pricing practices of Australian firms. The striking part about this is just how infrequently most prices change, with the median firm changing prices less than once per year. The other surprising part is how widely pricing practices vary across firms, with around 17% changing prices more than once per week.

What characteristics of the firms and their markets are likely to be responsible for these findings?

Production opportunity
Prices, like profits, are a signal. One of the interpretations of the signal is in terms of production opportunities for new goods and services. If input costs are being set in one market, and output costs in another, the difference between these prices is a signal about whether a new production technique will be profitable.

When are prices inappropriate?

Price gouging (also widely known as profiteering) is the practice of raising prices to capitalise in (usually) temporary market power due to external circumstances.

In a famous research article, Daniel Kahneman and co-authors surveyed people about the appropriateness or fairness of raising prices in a variety of situations. For example

> Question 1. A hardware store has been selling snow shovels for $15. The morning after a large snowstorm the store raises the price to $20. Please rate this action as:
> Completely fair Acceptable Unfair Very unfair

In that example 82% of respondents thought that raising prices was unfair. The conclusion of this and later research is that indeed fairness is a constrain on short-run profit maximisation in many circumstances.

Uber, the new taxi/ride-share services, operates a pricing policy called surge pricing, that increases prices in response to local demand. This type of pricing system naturally will increase taxi prices following a local emergency, public transit strike, sporting event, or other similar circumstance. Such pricing methods have been widely criticised as unfair, and Uber has recently agreed to limit surge pricing during emergencies.

There is hence a conflict at the heart of using price allocation systems. The rationing function that results from profit-seeking in the short run often often undermines the signalling function of prices required for long run investment and stability of production networks. One of those signalling functions includes the fairness constraint on short-term price gouging.

If prices allocate resources, why do firms exist?

Why don't micro-chip manufacturers also make consumer computers? Why doesn't the airforce build it's own planes? Why does Brisbane City Council assemble it's own buses?

1. Using prices has a cost, just like all allocation systems
2. Top down direction of resources is often more efficient than pricing every intermediate step
3. This means a single contract can 'nest' many obligations

Ronald Coase puzzled over this way back in 1937 [assessable reading], sparking the 'transaction cost' view of a firm.

Transaction cost view

Where there is potential conflict between profit-maximising incentives of two producers it may be better to avoid this by merging into a single entity that maximises the joint profit.

Think of a supplier who makes a crucial input to the next stage of production. You can think of Apple computers relying on Intel to make their micro-processors. If there are very few suppliers in the market who can make substitutes (i.e. Apple has no alternative to Intel), then the supplier can

‘hold the buyer to ransom’ and extract more profits for themselves. This conflict can be costly, and more importantly, time consuming.

In the terms in Baye Chapter 1, this is a type of consumer-producer rivalry, where the consumer is also a producer at a later stage in the production chain.

It may be easier to merge the two activities into a single entity run though a top-down hierarchy that specifies who does what and how each person or sub-group will relate to each other. Apple is now making more of their own chips to provide itself autonomy. Where mergers don’t happen, dependent relationships such as this can also lead to rather complex contracting to avoid such conflicts and work towards mutually beneficial outcomes.

Additionally firms may choose to merge with competitors to avoid producer-producer rivalry. Where companies in a market must compete for a roughly fixed pool of customers it may pay to merge with a competitor. Not only can this decrease costs through economies of scale, but will reduce customers ability to find substitutes and increase the pricing power of the firm. Because of this pricing power such mergers are often subject to review by the Australian Competition and Consumer Commission.

Characteristics of Transactions Can Affect Transaction Costs

Specialised vs general assets

One major element determining whether a firm will undertake parts of the production process internally is the specificity of the process. Where there is a large market of similar substitute goods, such as primary minerals, energy and agricultural products, there may be few benefits of bringing this production into the hierarchal firm structure. If a supplier tries to extort you, or their business fails, you can find a new supplier.

However where you are reliant on your supplier to invest in specialist equipment to satisfy your input requirements, you will face a conflict between your interests, since you have no substitutes if the supplier fails or tries to raise prices. This happens in large scale production, such as roads, military hardware, and so forth. Some of the worlds largest companies become entrenched in WWII through their role as military suppliers, such as Boeing, ThyssenKrupp, Rolls-Royce, etc.

Brand names and reputation

Where firms operate in many locations under the same brand they need to maintain consistent service and reputation. Franchise relationships are a type of ‘firm within a firm’ that allows for top-level negations with suppliers, and a hierarchy of systems dictating a set of firm functions while leaving others to the discretion of the franchisee.

Additionally, even in cases where a large market for a specific input exists, a brand may find it worthwhile merging or entering this market to ensure a consistent ‘brand experience’. Again, Apple springs to mind with their retail venture. Also, Virgin Australia has been branching out into more the travel services, such as valet parking, airport lounges, plane maintenance (rather than lease) etc.

Trade-off between current and future profits

Firms typically maximising the present value of future profit streams within their financial constraints. Exactly how this works in practice is subject to many constraints and indeed, firms may be trying to maximise not just profits, but a variety of success metrics which may sometimes be in conflict. Typically however, these alternatives metrics are proximate inputs into long term profits.

For example, improving a firm's environmental credentials may also pay off in the long run as consumers shift preferences and the firm benefits from early adoption of environmentally safe materials and production processes. Moreover, these maximising decisions are undertaking in a highly uncertain environment, leading to a strong reliance on gut instinct and historical norms (more on uncertainty in week 11).

Profits are usually denoted as π in economics, and are revenues minus costs. Economics profits require all inputs to be accounted for as costs at their market price. For example, a small business should include the labour costs of its owners at the price of their alternative employment opportunities.

The present value of these profits are the discounted sum of profits into the future.

$$PV = \pi_0 + \pi_0(1+g)/(1+i) + \pi_0(1+g)^2/(1+i)^2 + \ldots + \pi_0(1+g)^n/(1+i)^n$$

$$PV = \pi_0 (1+i)/(i-g)$$

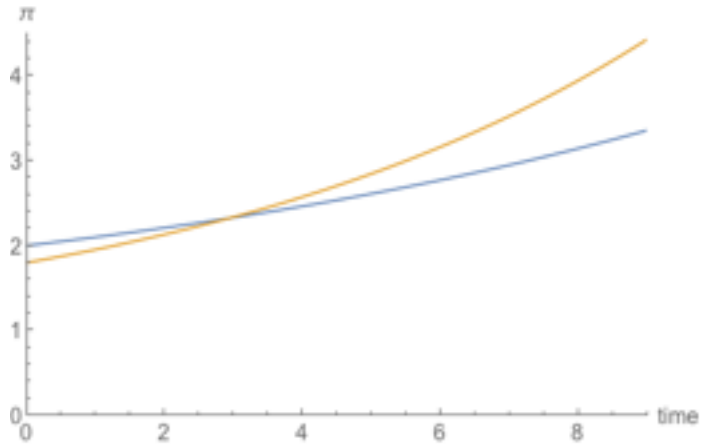
Assuming constant i and g, maximising present profits is equal to maximising the PV of future profits.

Say your current profit is $35,000, and you expect this to grow at 4%, while the interest rate is 8%. The present value of this profit stream is

35,000 (1.08/0.04) = 945,000

If the growth rate is 2%, then the PV is 630,000

But it is not strictly true in most cases that maximising current profit maximises the NPV, as it relies on the assumption that the growth rate in profits will be the same whether you start at one profit level or another. Which can't be true. There is a trade-off between current profits and growth rate as the graph below demonstrates. Here the yellow plot of profits over time starts lower, at 1.8, but grows faster, resulting in a higher present value of future profits.



Say we decrease profits in time zero so that they are a fraction, *x* of the alternative. A higher growth rate can more than make up for this short term reduction in profits. So what is that growth rate?

$g_N = i - x\ (i-g)$

where x is the new profit at time zero as a fraction of the old profit, and g_N is the new growth rate required to have the same present value. The example graph below shows how a lower current profit can be beneficial in terms of PV of profits if it can lead to higher sustained growth in profits. This growth may occur due to lock-in effects whereby early sales volumes lead to higher future sales volumes. Example include platform or network effects (also called two-sided markets)—more people with VHS players mean more VHS tape sales, more people on credit card payment platform, the more credit cards sold etc. We will discuss such effects in later weeks of the course.

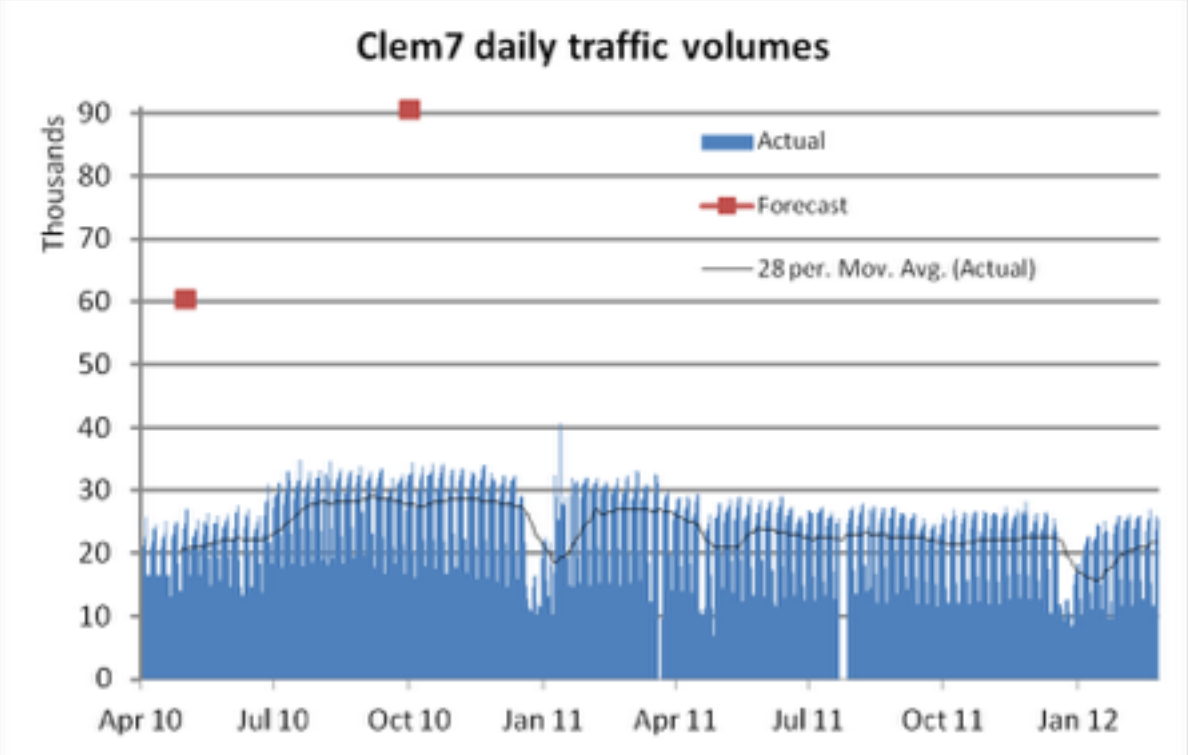
Let's take a concrete example of the trade-off between short-run profits and growth in profits. The Clem 7 Tunnel in Brisbane, a privately run toll road, where almost all costs are sunk - there are not costs in future periods, everything has been paid for, faces the problem of maximising the present value of future toll revenue.

Ignoring the bizarrely overestimated traffic forecasts, the problem once the road is constructed is to set the price to maximise the present value of all future revenues (maximising that will maximise NPV of profits since future costs are fixed).

Timeline:

March 15, 2010	:	Open to traffic with 3 week free use
April 6, 2010	:	Tolls introduced $2.95 (22,315 daily trips in June)
June 28, 2010	:	Tolls reduced to $2.00 (27,618 daily trips in July)
November 15, 2010	:	Tolls increases to $3.00

Was the toll reduction a good idea?



At first glance the toll reduction increased traffic volumes. But let's check the revenues

Total revenue = price x quantity

For the average June day, revenue = 2.95 x 22,315 = $65,829
For the average July day, revenue = 2 x 27,618 = $55,236

Therefore the price drop was not profit maximising in the shirt term.

If the previous expected rate of growth was 3%, interest rates were 8%, what additional growth could justify the price declines?

$g_N = i - x\ (i-g)$

with x = 55,236/65,829 = 0.84

$g_N = 0.08 - 0.84\ (0.08 - 0.03) = 0.038 = 3.8\%$

If this short run revenue reduction resulted in a 3.8% rate of growth in revenue instead of the previous 3%, then it could be justified. Common reasons for such pricing strategies include lock-in to platforms (VHS, mobile Apps, brand loyalty rewards) which protect markets from the entry of second movers, as well as basic preference/habit formation.

As a side note, the other alternative way to increase revenue for toll roads is to increase congestion on non-tolled roads. Hence, the prevalence of large private toll road owners creates some perverse political incentives - toll road owners want more congestion and can lobby for it.

In this case there was no traffic growth observed between July and November at all and the pricing decision was reversed in November with tolls increasing back to $3.

Solving at the margin

One of the big economic ideas is called marginal analysis. Optimisation of many decisions requires looking at the marginal costs and benefits, not merely averages or totals. You will need to become familiar with this type of analysis.

Notation is B(Q) which denotes total benefits, B, as a function of output quantity, Q, and C(Q), which denotes total costs, C, as a function of quantity, Q. Q is a *control variable* - it is the units of some variable within the control of a manager and can be staff hours, output, marketing scope etc.

Marginal analysis looks at the derivative of benefits and costs with respect to a firm decision. Does the benefit of one more increment exceed the cost of one more increment of the variable? Marginal analysis is a useful way to frame the problem of how to maximise net benefits, N, or

N(Q) = B(Q) - C(Q).

Using the above table we can work through the example of a *discrete case*. In a discrete case the control variable can be set a certain points. Here it is whole number increments of Q. In many real situations decisions need to be made in batches, or increments. Do I order an extra 1,000 inputs, which is the minimum batch from the supplier?

In the below table we have a hypothetical situation where a control variable can be any whole number from 0 to 10 where we have an estimate of the total costs and benefits for each case. The marginal benefit column is the change in total benefits by going one increment up in the control variable (which is why the first row is black). Take Q from 0 to 1 and get 90 marginal benefit. Take Q from 1 to 2 and get 80 marginal benefit.

The marginal cost column does the same calculation for total costs.

The final column subtracts the marginal cost from the marginal benefit, thus allowing us to see at which point we should stop increasing the control variable in order to maximise net benefit. That

TABLE 1–1 Determining the Optimal Level of a Control Variable: The Discrete Case

(1) Control Variable *Q*	(2) Total Benefits *B(Q)*	(3) Total Costs *C(Q)*	(4) Net Benefits *N(Q)*	(5) Marginal Benefit *MB(Q)*	(6) Marginal Cost *MC(Q)*	(7) Marginal Net Benefit *MNB(Q)* Δ(4) or (5) – (6)
Given	Given	Given	(2) – (3)	Δ(2)	Δ(3)	
0	0	0	0	–	–	–
1	90	10	80	90	10	80
2	170	30	140	80	20	60
3	240	60	180	70	30	40
4	300	100	200	60	40	20
5	350	150	200	50	50	0
6	390	210	180	40	60	−20
7	420	280	140	30	70	−40
8	440	360	80	20	80	−60
9	450	450	0	10	90	−80
10	450	550	−100	0	100	−100

point raises where the marginal net benefit is 0. In this case when Q is 5. Note also that in this example the net benefits at Q = 4 are also 200, and hence both can be optimal stopping points. If we worked backwards from a high Q to a lower Q, because we take the difference from the previous discrete point, the optimal solution would be Q = 4.

In a more general *continuous case*, where decisions can be divided into very small increments, we can approximate the total benefit and total costs as a function of Q. The marginal benefits are the slope of the benefits curve with respect to the control variable [MB(Q) = B`(Q)], and the same for costs [MC(Q) = C`(Q)].

Taking the example in the textbook, say you study the cost structure of a firm with respect to a control variable and estimate that it can be represented by the following functions.

$B(Q) = 300Q - 6Q^2$
$C(Q) = 4Q^2$

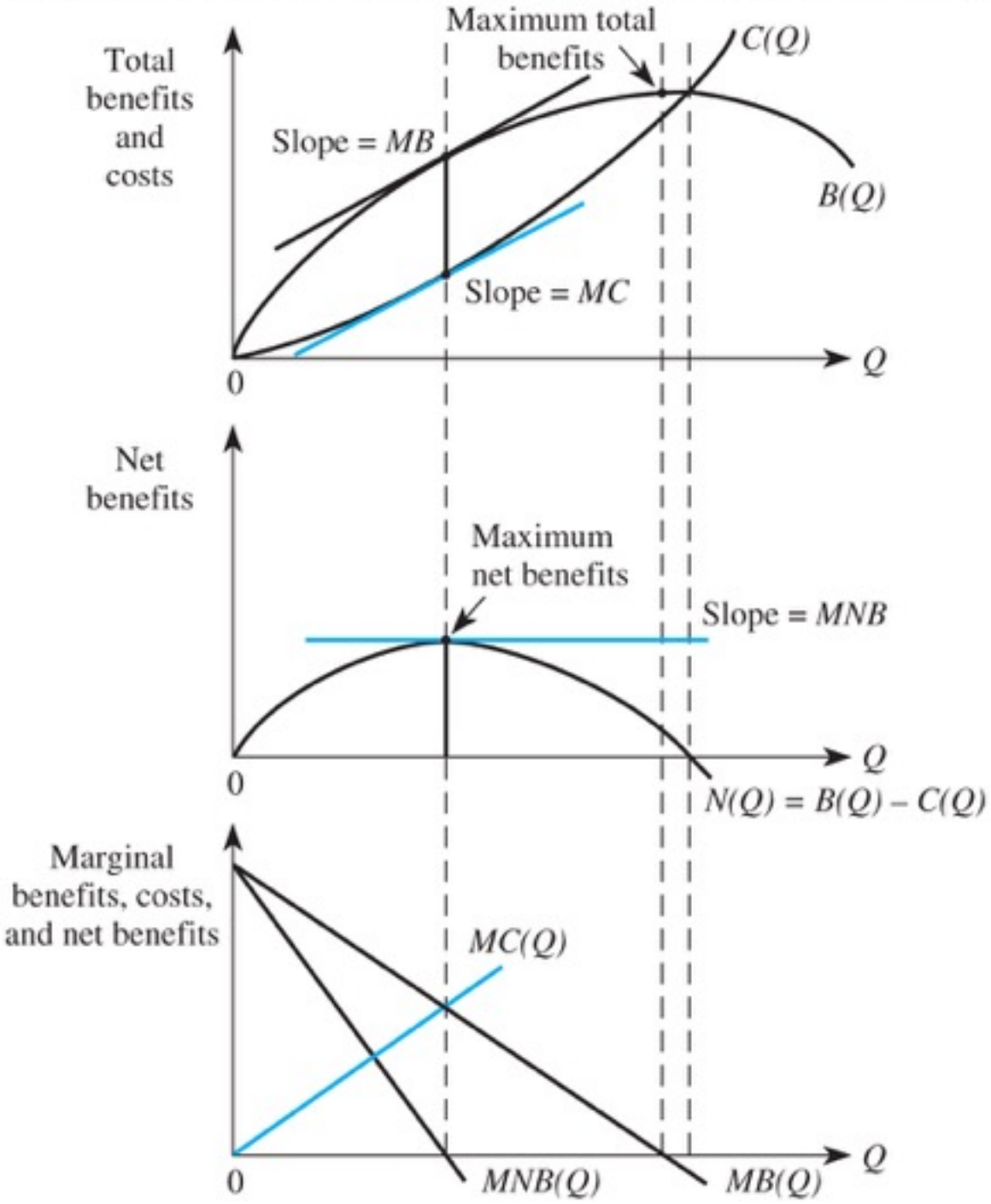
Take the derivative of both with respect to Q
MB(Q) = 300 - 12Q
MC(Q) = 8Q

They equate at the maximum so that 300 - 12Q = 8Q.
Therefore 300 = 20Q, and the level of the control that maximises net benefits is Q = 15

Substitute that in to calculate the net benefit B(15) - C(15) = 2,250

Notice that this type of analysis implies that prices and costs are a rationing tool for finding out the optimal amount of inputs to be devoted to particular production processes.

The graphs on the following page show the typical way in which a maximising decision can be viewed. Notice that maximisation requires diminishing returns.



This view of pricing as an optimal-stopping problem with respect to output quantity in a period dominates mainstream economic thinking and will form a core of this course, with the addition of competitive considerations (what will competitors do). The table below from the RBA's research on pricing shows how firms set prices by balancing a number of factors - input costs, market competitiveness etc.

Table 2: Firm Pricing 'Models'
Which of the following is most significant for the firm's price setting?

	Per cent of firms
More cost-focused	**49**
Cost plus fixed mark-up	23
Cost plus variable mark-up	26
More demand-focused	**45**
Market conditions	25
Competitors' prices	11
Level of demand	4
Customer sets price	5
Other	**6**

Source: RBA