Case Solving for Economists

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This set of notes is meant for economists like myself who want to become better at solving *cases*. That is, small, concrete problems supposed to be solved (fairly) quickly using analytical tools with only limited quantitative analysis. Despite the fact that cases are involved in a lot – if not most – hiring processes, economists are often not taught directly how to approach case solving. At first, I was daunted by the notion of a framework and the sheer number of different frameworks that exist. I came to realise that much of the content of these frameworks, I already knew from my economics degree. It was just packaged in a different way.

To me, a framework is simply a *structure* for your thoughts. But the same thought can be packaged in many different ways, implying that many frameworks can be applied to the same thought[1]. This also implies that you can invent a thousand frameworks trying to structure the same thought. There are infinite ways of cutting the same cake. Some of these ways are clearly better than others, and sometimes it is not as clear. But either way, it will require a lot of mental memory if you want to remember all these different and somewhat arbitrary ways of structuring the same thought.

To help my memory (which is not great) I like to track the vast number of frameworks back to a single set of thoughts, if possible. Then I am able to reason my way from there. I believe this is a more robust method than brute memorising, especially for application under pressure. So that is what I try to do here. I try to tie these 'businessy' terms and frameworks back to economic method. In particular, you'll see that I think of these cases as *optimisation problems*, which is something any economist should be very familiar with. If you've studied economics, I hope this will be of some help to you too.

Structure I divide these optimisation problems into two categories. Those related solely to optimising for some monetary value of a single entity. I call these *business performance problems*. The most typical example is maximisation of profits of a single business. The other category is *policy problems* which are characterised by (typically) involving more than one entity (e.g. the state *and*

[1] If you ask me, a lot of these frameworks are *quite poor*, which I think is evidenced by the fact that whenever someone refers to frameworks, they immediately say "don't follow them" or "break away from the framework" or "you should make your own frameworks".

the citizen) as well as optimising for more than a monetary value, i.e. non-monetary variables such as *health, education, safety,* etc. Before that, I provide some reflections on the importance of properly structuring a case. Finally, I include some useful maths.

1 General considerations

Most often, case solving is used to let a candidate show her ability to structure her own thoughts and demonstrate her ability to communicate clearly. In this section, I provide some general considerations on case solving.

1.1 Structure is key

An essential component for successful case solving is structure along all subparts of the case solving, especially as the ability to provide clear structure is often considered as important as (if not more important than) providing the right solution. A case can be broken into the following subparts:

1. Problem identification
2. Problem solving
3. Recommendation and synthesis

Most of the effort is addressed to the second step — however the first and the third steps are equally important.

1.1.1 Problem identification

Identifying and understanding the problem at hand provides the foundation for further case solving. Hence, after the case has been read out, one should:

Ask Ask clarifying questions

Synthesise Synthesise the information provided

Hypothesise Consider putting out a hypothesis, if you can

1.1.2 Problem solving

While it is of course important to solve the problem correctly, communicating well and providing a clear structure is often as important as providing a good solution. In the next section, I'll cover some methods and frameworks that are helpful for solving the actual problem. I recommend building problem trees, which allow you to break down a question into branches and sub-branches. It is important to find the right balance between the width and the depth of the tree.

The width refers to how many different levers you identify. The depth refers to how specific a solution you're able to provide. Say you're trying to come up

with levers to decrease costs for a business. Providing many different options increases the width of the problem tree. Making them more and more specific increases the depth of the tree. My recommendation is to provide a sufficient width covering the most important options and then - depending on how much time you have - dive deep on 1-2 of the most important branches (or levers).

Crucially, when communicating your problem solving later, always cover all the levers before diving deeper into the branches, e.g., saying: "I've identified 5 levers for reducing costs, including x, y, z, v, w. Diving deeper into x, I can break that lever into the following three buckets, x_1, x_2 and x_3.", and so on.

Mutually Exclusive, Collectively Exhaustive (MECE) Each layer of the problem solving tree should be Mutually Exclusive and Collectively Exhaustive. That is, it should cover all the potential options (for reducing cost, say) without overlapping. It is a gold standard, and sometimes you have to go with silver. However, it is often helpful to have ready some ways to break down a lever in a MECE way, such as:

- Internal v. external
- Monetary v. non-monetary
- Short-term v. medium-term v. long-term
- Top v. middle v. bottom (of management, say)

Another great way of breaking something down in a MECE way is by using maths. If you decompose a sum into its individual parts, you're naturally doing it in a MECE way (otherwise it would not sum!). If you use maths to break down things (as I like to do), take extra care to communicate clearly. What might be clear to you and your economics friends might not be clear to others.

When problem trees don't work More often than not you should try to structure your problem in a problem tree. However, sometimes problem trees don't work. My best workaround in those cases - or for analysing one of the end-points in a problem tree - is to create a (two-by-two) matrix, e.g., you break down two variables into their values (e.g., gender into men and women and other v. age into above or below 40 years). For each of the squares you can then evaluate that specific combination of the two variables.

1.1.3 Recommendation and synthesis

You should always remember to provide a recommendation at the end, showcasing that you're able to convert your analysis in the problem solving step into actionable recommendations. If you're applying for a job in consulting, say, that is what you will be spending a lot of your time on. It shows that you don't do analysis for the sake of analysis - but because it matters. Therefore, always finish a case by providing a short recommendation.

If you cannot provide a recommendation (maybe because there is none, or your analysis is ambiguous), then provide a synthesis of the problem, what you have analysed and finally, what your next steps would be to solve the problem.

1.2 A few suggestions

- When doing an analysis, always consider whether a historic comparison or a benchmark comparison (e.g. with other companies) is relevant.
- For exhibit interpretation, always ask 'So what?'. Can we build a hypothesis and/or rule out some levers or options?
  - Ideally, you can make some small calculations based on the exhibit
  - Remember to focus on a few aspects, rather than just providing a long list of things. That makes it more interesting.
- When doing the synthesis, always provide the conclusion first. Then give a *number* of reasons, e.g. "There are three reasons why the company should ..."

1.2.1 Suggestion for structure

Based on the above, I suggest the following structure for many problems:

- Define the problem
  - Objective of the case (e.g. enter a new market)
  - Timeline
  - Goal (e.g. a specific numerical figure)
- Analyse the information
- Structure an approach (consider a framework)
  - For short cases: Build one layer, and focus on the most interesting aspects. It is mostly okay if that layer turns out not to be the one you continue with in the next step of the case solving.
- Develop a recommendation or synthesis

2 Business performance problems

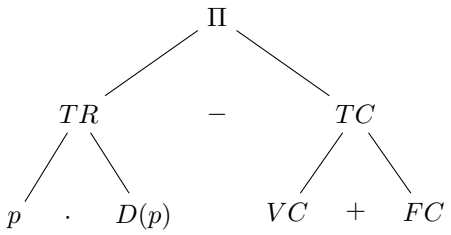
By *business performance problems,* I am thinking of problems with a goal to improve some monetary measure (in contrast to some non-monetary value such as health or life expectancy). The most common one is *profits*. In addition, the focus is on improving the performance of a single entity, typically a single business.

2.1 Improve profitability

This is one of the most typical case problems and one you should be fast at breaking down in order to get to the more interesting conversations. Consider the following equation for breaking down profitability

$$\begin{aligned}\Pi &= TR - TC \\ &= p \cdot D(p) - VC - FC\end{aligned}$$

where p is price, $D(p)$ is demand (which depends on price). FC are fixed costs and VC are variable costs. This is a familiar way for me to break down profitability mathematically. The important part is that it can equally be provided as a problem tree:



Factors that might affect demand Based on a problem tree (or equation) like the above you are better equipped to talk about the different things that could impact the end-points of the tree. Don't overdo the maths (unless it is helpful) - simply consider the tree or the equation a support for presenting your ideas and impact factors. For demand $D(p)$, say, some of the factors that could impact it are provided below. The sub-bullets are then further examples of factors that might affect that factor.

- Company market share
  - Product-related factors
    - Product Quality
    - Product Mix
    - Breadth of Product Line
    - Depth of Product Line
  - Service-related factors
    - Added services can increase demand for the product.
  - Distribution-related factors
    - Faster, better distribution might increase the demand
- Overall market size

  - The economic situation

- Price of product
  - Cost-based
  - Value-based
  - Competitive pricing
  - Pricing based on supply and demand

Factors that might affect price If we are in a fully competitive market, the company cannot affect prices - the company is a price taker. However, there might also be 'irrational' pricing: If (sales) employees' incentives do not align with the overall company incentive (incentive to increase quantity rather than value per sale).

2.1.1 Further breakdown of cost

You might decide that costs are the most interesting and therefore start breaking them down further. Here are some typical categories for breaking down costs:

- Fixed costs, FC
  - General and administrative costs (G&A)
    - Marketing, sales, underwriting, finance, HR
  - Research and Development (R&D)
- Variable costs, VC
  - Raw material
    - Quantity
      - Efficiency
    - Price
      - Better price with existing supplier
      - New supplier
      - Substitutes
      - Partnering with other buyers
  - Labour

2.2 Other business performance problems

In the appendix, I provide a long list of the types of business performance problems that one might encounter as well as the typical frameworks that I have found helpful for solving them. In many places, I'm gathering the well-known frameworks (e.g., of Victor Cheng). In some places, I'm providing a more mathematical approach to breaking down the problem.

3 Policy Questions

Policy problems are (mostly) not about optimising some monetary value, and also not concerned only about a single entity. The primary method for dealing with those is to provide a cost-benefit analysis and couple it with a risk analysis. With the policy questions, there are fewer fixed frameworks. However, often you can use the cost-benefit analysis to zero in on some important issues and then break that further down (e.g., using a problem tree that you are familiar with).

3.1 Cost-Benefit (and Risks)

Cost-benefit analysis should be divided first by the parties involved. Then it can be divided by costs/benefits related to e.g. facilities, personnel, etc. Remember to always couple it with a risk analysis to provide further flavour.

3.2 Typical factors to include

When analysing a policy, it can be a good idea to consider how the following factors are affected:

- What is the change in preferences?
- What is the change in environment?
- What is the change in demographics?
  - Gender, age, socioeconomic background, etc.
- Is there any geographical variation?
  - National, regional, local

4 Maths

Quick maths is the name of the game. There are books and apps to practise your maths skills. Most important, though, is to know your fractions. I'm including a table of the most helpful fractions. You should be familiar with all - and being quick with $^{x}/_{9}$ and $^{x}/_{11}$ can set you apart.

	$x/0.3$	$x/6$	$x/7$	$x/8$	$x/9$	$x/11$	$x/12$	$x/15$	$x/20$	$x/25$
1	3.333	0.167	0.142857	0.125	0.111	0.0909	0.083	0.067	0.05	0.04
2	6.667	$1/3$	0.285714	–	0.222	0.1818				
3		–	0.428571	0.375	0.333	0.2727				
4		$2/3$	0.571428	–	0.444	0.3636				
5		0.833	0.714285	0.625	0.555	0.4545				
6		1	0.857142	–	0.666	0.5454				
7		–	1	0.875	0.777	0.6363				
8		–	–	1	0.888	0.7272				
9					1	0.8181				
10						0.9090				

Ways to remember

Table 7 It follows the sequence 142857. If you're dividing 1 by 7 then start on the lowest number (rank 1) which is 1. Then the number is 0.142857. If you're dividing 3 by 7, start on the third smallest number, i.e. 4: $3/7 = 0.428571$.

Table 9 Repeat the numerator infinitely after the decimal point.

Table 11 If dividing 2 by 11 the first number is $2 - 1 = 1$. The second number is $9 - (2 - 1) = 8$, repeat infinitely. If dividing 7 by 11, the first number after the decimal point is $7 - 1 = 6$ the second number $9 - 6 = 3$. This is the pattern.

5 Financials

Finally, you should know your financials. I'm including a list of the most relevant ones for reference.

Present value The present value PV of a payment paid for N number of periods is given as:

$$PV = \sum_{t=0}^{N} \frac{C_t}{(1+r)^t},$$

where r is the discount rate (e.g. the interest rate), C_t is the payment in year t. C_t might be the net value, i.e. inflow minus outflow, to give the *net present value*. Commonly, one regards an initial investment at $t = 0$ which then pays a dividend from $t = 1$ onwards. In this case, the formula can be adapted to:

$$PV = \sum_{t=1}^{N} \frac{C_t}{(1+r)^t} - \text{Investment}$$

Perpetuity Assume that the same amount C_t is paid out in perpetuity. Then the present value of the perpetuity is given as:

$$PV = \frac{C}{r}$$

Assume that the perpetuity grows at a fixed rate g, then the present value is:

$$PV = \frac{C}{r - g}$$

Compound Annual Growth Rate (CAGR) CAGR measures the smoothed annual growth rate of returns. It is calculated as follows:

$$\text{CAGR} = \left(\left(\frac{\text{Ending Value}}{\text{Beginning Value}} \right)^{\frac{1}{n}} - 1 \right) \times 100\%.$$

It means that if the *CAGR* of an entity (e.g. a market) is 4 pct. over 5 years, then the total growth is $1.04^5 - 1 = 0.217$. This might however reflect the fact that one year the market increased more than 4 pct. and another year less than 4 pct.

Doubling time (and approximation) Take the present value PV as given and let the value grow at constant rate r every period t. That is, the measure experiences exponential growth. Then the future value is given as:

$$\text{FV} = \text{PV} \cdot (1 + r)^t$$

which we may rewrite as:

$$\begin{aligned} t \ln(1 + r) &= \ln \frac{\text{FV}}{\text{PV}} \\ t &= \frac{\ln \left({}^{\text{FV}}/_{\text{PV}} \right)}{\ln(1 + r)}. \end{aligned}$$

For the present value to double would mean that the fraction ${}^{\text{FV}}/_{\text{PV}} = 2$. Furthermore we can approximate $\ln(1 + r) \approx r$, such that the formula becomes:

$$t = \frac{\ln(2)}{r} \approx \frac{69.3}{r} \approx \frac{72}{r}.$$

The last approximation is used because 72 has many small divisors (1, 2, 3, 4, 6, 8, 9 and 12).

Growth rates If something grows with g_1 in period 1 and grows g_2 in period 2 (both g's might be either negative or positive) then the overall growth is given as:

$$g_{\text{tot}} = \frac{\xi \cdot (1+g_1) \cdot (1+g_2) - \xi}{\xi} = (1+g_1) \cdot (1+g_2) - 1 = g_1 + g_2 + g_1 g_2$$

Appendix

6 Business performance problems

The following is a list of different types of business performance problems and relevant frameworks or suggestions for solving them. The list includes:

1. Improve return on investment
2. Improve sales
3. New business opportunity
4. Increase company growth
5. Improve marketing
6. Improve human resources

6.1 Improve return on investment

The return on investment is the profits in relation to investment. Investments can be divided into variable investment (working capital) and fixed investment. Factors that might lead to a (unnecessary) build-up of inventory are:

- Number of products produced in advance
- Inaccurate demand forecasts

This might lead to tying too much capital in inventory that is eventually that risk of turning *obsolete*.

$$\text{ROI} = \frac{\text{Profit}}{\text{Investment}}$$

To improve this number there are two avenues.

- Increase profits
  - [See profitability tree]
- Reduce investment
  - Reduce fixed investment
  - Reduce variable investment

6.2 Improve sales

You are asked to improve the sales for a company. My suggestion is to break down total sales by:

$$\begin{aligned}
\text{Total Sales} &= \text{Transactions} \times \frac{\text{Value}}{\text{Transaction}} \\
&= \text{Traffic} \times \text{Conversion Rate} \times \frac{\text{Value}}{\text{Transaction}} \\
&= (\text{New Customer} + \text{Returning Customer}) \times \text{Conversion Rate} \times \frac{\text{Value}}{\text{Transaction}} \\
&= (\text{New Customer} + \text{Returning Customer}) \times \text{Conversion Rate} \times \frac{\text{P} \times \text{Q}}{\text{Transaction}}
\end{aligned}$$

6.3 New business opportunity

Business opportunities are typically questions such as: Should X enter a new market? Should X start producing a new product? The most common framework for solving them is the Victor Cheng CCCP framework.

6.3.1 Cheng Framework (CCCP)

- Customer
- Company
- Competition
  - Existing competition (do they have copies?)
  - Possible competition (can they copy?)
- Product
  - Profitability
    - Cost of introducing product
    - Potential revenues
  - Advantages vs disadvantages

6.3.2 Alternative approach

- Markets
  - Segmentation
  - Size (in numbers, currency)
    - Total number of customers
    - Expected sales per customer
    - Price per unit

        * Expected penetration percentage
    - Reliability or Conditions (shrinking, growing, stagnant)
    - Competition (in numbers and size)
- Financials
    - Potential revenue
        * Profits
        * Costs
- Risks
    - Legal
    - Experience
    - Reliability
    - Effect on current business

Other

- Laws of differentiation
- Increase in inventory.

6.4 Increase company growth

There's a multitude of different growth strategies, described by Ansoff's Growth Matrix

	Existing products	New products
Existing markets	**Protect/build** • Withdraw • Consolidate • Market penetration	**Product development** • With existing capabilities • With new capabilities
New markets	**Market development** • New segments • New territories • New user groups	**Diversification** • Related diversification • Unrelated diversification (new industries)

Diversification to new markets and new products is the riskiest of all the directions.

Overall framework

- Organic Growth
  - Penetration
  - Market Development
    - Geographically
    - New segments
    - New distribution
  - Product Development
    - Innovation
    - Brand Extension
    - Line extension
  - Diversification
    - Related diversification
      - Vertical
      - Horizontal
    - Unrelated diversification
- Inorganic Growth
  - Horizontal (Acquire Competitor)
  - Vertical (Supply Chain)
  - [See subsection]
- Strategic Alliance
  - Joint venture
  - Consortium
  - Franchising
  - Licensing
  - Contracting

Related diversification

Vertical integration Vertical integration implies integration in the supply chain, e.g. through acquisition of suppliers or customers. The reason for backwards integration might be the desire for control over quality, price and delivery. The reason for forwards integration might be the control over distribution, customer and markets. Overall, there's the access to information and the spreading of risk.

Horizontal integration Horizontal integration implies the integration of complementary products, such as other types of the same products (e.g. engines for different vehicles).

Unrelated diversification This might be relevant if the company can utilise its competences in new markets with new products. It might be in order to escape from an existing industry or to spread risk.

6.4.1 Mergers and Acquisitions

- Economic Potential/Financials
  - Potential revenue
    - Higher quantity
    - Price (service, product)
  - Overlapping costs
    - Fixed
    - Variable
  - Diversification (Risk)
- Strategic Fit
  Can be analysed using the CCCP-framework.
  - Synergies
  - Brand quality
  - Customer base overlap
  - Experience with mergers in the past
  - Structural differences
- Market reaction
- Cultural fit
  - Willingness
  - Potential issues in integration

Consider also talking of risks.

6.4.2 Evaluating growth methods

When evaluating organic, inorganic and strategic growth one might consider four parameters on which the three differ:

- Urgency
- Uncertainty (e.g. in alliances risks are shared)

- Soft capabilities (Culture, organisation)
- Modular capabilities (is it necessary to buy the whole company if one only needs a module?)

6.5 Improve marketing

When it comes to marketing, there are typically four P's to consider:

- Pricing
- Placement (distribution channels)
- Product
- Promotion

6.6 Improve human resources

One way to think of a model about human resources, is as a stock-flow model. That is considering 'how many enter' and 'how many exit'. It could be that a company is trying to increase its share of employees with a certain gender or ethnicity.

- Hiring
- Retention
  - Promotion
- Exits

7 Other related analyses

7.1 Analyse structure of an industry (Porter's five forces)

The framework is used to analyse the structure of an *industry* in order to determine corporate strategy. That is, it is aimed at analysing the environment rather than the company itself. It can serve as a guide for strategy aimed at gaining competitive advantage. The forces are:

- Competition in the industry
  - The higher the competition (number of competitors and similarity of products) the lower the power to control price.
- Potential of new entrants into the industry
  - Higher barriers to entry allow for higher prices.
- Power of suppliers

    - High power of suppliers (how unique is the input, how costly is it to change supplier, how many suppliers) leaves uncertainty on input prices.

- Power of consumers
    - Higher power of consumers leads to less power over price.
- Threat of substitute products
    - More substitutes, less power on price.

7.2 Analyse structure of a business

How should a business reorganise to grow in a new market? Consider the following functional areas:

- Commercial
    - Sales
        * Sales representative training
        * Staffing
    - Marketing
        * Promotion
        * Relationship management
- Operations
    - Finance
        * Revenue recognition
    - HR
    - Customer Service
        * Help desk
        * Software support
- R&D/Product Development
    - Engineering
    - Quality Control
    - Product Management

7.3 Provide a company valuation

There are a number of ways to value a firm:

1. Market capitalisation (number of shares times value of shares)
2. Earnings multiplier (multiply earnings by a price-to-earnings multiple)
3. Industry multiplier
4. Book value
5. Discounted future income
6. Liquidation value