Quantitative Techniques for Competition Analysis

An Overview, with Application to Z Energy–Chevron

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3 Modern Demand Estimation

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What is "Quantitative Analysis"?

Primary goal: To document quantitative evidence

- E.g. Pricing patterns; market shares; sales patterns; discounts; profit margins; effects of entry / exit

This may or may not involve statistical / econometric analysis

- E.g. Demand estimation; cost function estimation; merger simulation

The latter involves more **assumptions**, because you are making further predictions

Road Map

(1) Market Definition

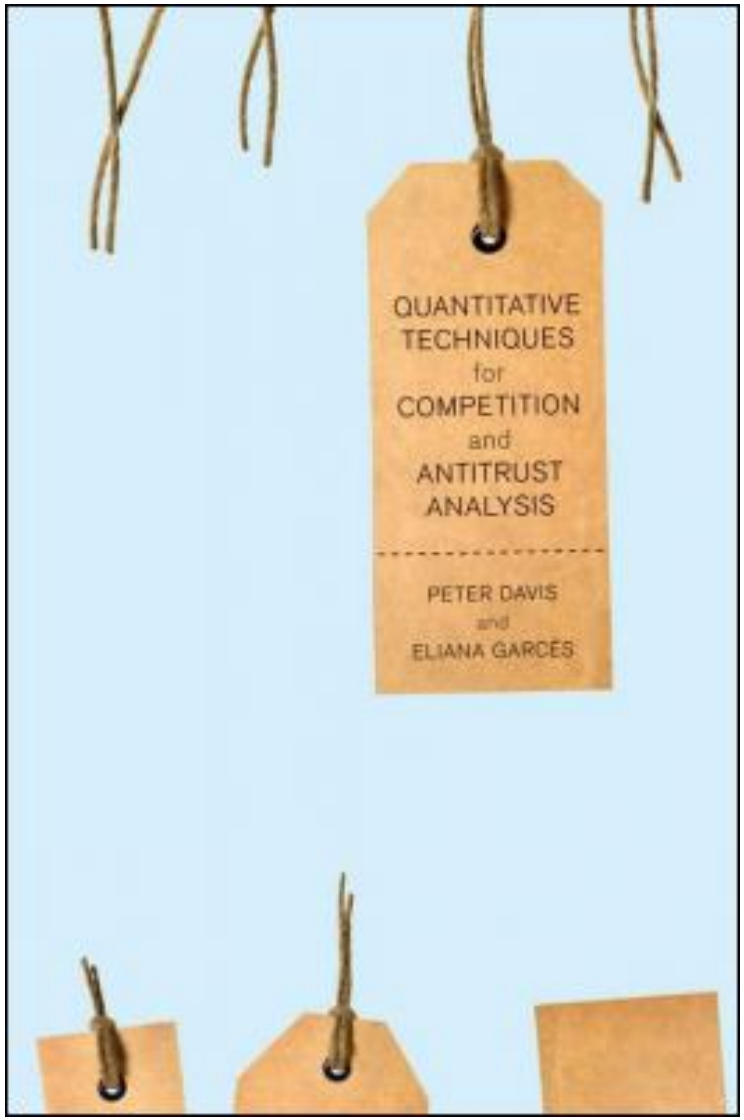
(2) Modern Demand Estimation

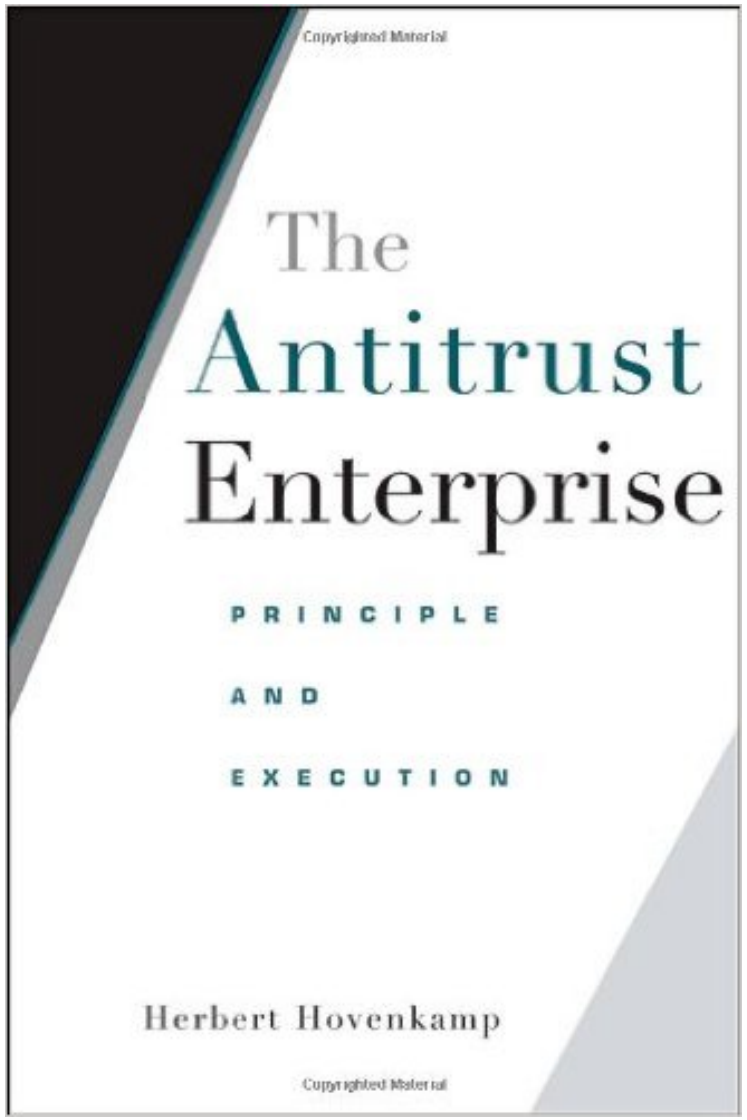
(3) Merger Simulation

This is **not** a clean, linear one-way street!

Rather, there's lots of back-and-forth between (1) & (2)

2 excellent books:





I reference mainly the first one

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Market Definition: An Old Enemy

Usual first step in merger analysis

Goal: Identify all **relevant competitors**

Needed for later calculations of: market shares; concentration index

Intuitive, quick, easy methods are preferred

But still there's much debate!

(As competition policy moves away from **"form-based"** reasoning towards **"effects-based"** analysis, market definition is no longer all-important)

What Defines an Antitrust Market?

2 sides of the same coin:

- **Constraints from competitors** on each others' price or other dimensions of competition, e.g. capacity, quality, innovation
- **Market power**: How much can a firm raise price above competitive level?

Limits to market power:

- **Demand Substitutability**: If price increases by x%, how many consumers switch away, and to what products?
- Supply Substitutability: If price increases by x%, can other producers switch to produce this product?

Quantitative Evidence: Price Correlation

Identical products should have identical prices (plus any "transport cost")

(Arbitrage would eliminate any price difference)

If products are similar (but not identical), then their prices should be **similar** (plus any "substitution cost") and should **co-move**

Caution: Other factors can also cause high price correlation:

- Supermarkets' regional / national pricing strategy
- Common cost change (e.g. oil price)
- Common demand change (e.g. hotel & rental cars in holiday)
- **Spurious correlation**: If both time series have a trend, their correlation will approach ± 1

Quantitative Evidence: Natural Experiments

Cleaner source of price variation:

Exploit an **exogenous change** (e.g. marketing experiment) to the price of **one** of the merging goods

("Exogenous" = unanticipated price change that is not a result of a common demand / cost change)

Simple way to gauge **consumer response** (own- and cross-price **elasticities**) without further assumptions on demand model

Direct Estimation of Substitution Patterns

Diversion Ratios: "If P_A increases, what fraction of lost sales will go to product B, C, etc.?"

2 ways to measure:

1. **Revealed Preference**: look at individual purchases / market shares data, and how that depends on prices, product characteristics, consumer demographics, etc.

   If product is brand new (e.g. iPhone), there is no historic data

2. **Stated Preference**: Survey customers and ask them to choose in hypothetical situations

   Survey design details matter, e.g. clear description of alternatives, without being overwhelming

Measuring Price Constraints: SSNIP Test

If competitors B, C impose a price constraint on A, then they are "**worth monopolizing**" for firm A

Could a hypothetical monopolist implement a "small but significant non-transitory increase in price" (5-10% per year) **profitably**?

The antitrust market is the **smallest** set of products over which a hypothetical monopolist can implement a SSNIP

Data we need:

- Products' price-cost margins, at actual **competitive prices**
- Candidate market's own-price elasticity

So we don't need a full set of cross-price elasticities

"Cellophane Fallacy"

U.S. vs. DuPont (1956). 2 possible market definitions:

	"All cellophane paper"	"All flexible packaging material"
DuPont market share	75%	25%

At **prevailing prices**, the court found lots of substitution from cellophane to other materials

Thus, the court chose market as "all flexible packaging material"

Problem: DuPont is already monopolizing the cellophane market

Economic theory: a monopoly operates at the **elastic** portion of the demand curve. Of course you find **more** substitution there

So, SSNIP gives you a **bigger** antitrust market if you start with monopoly prices, rather than competitive prices


Mom says
I'm so fresh
and so clean
(sometimes)—
she ought to
wrap me in
Cellophane
to keep me
that way.
Everything's at its best in Cellophane
• Cellophane keeps things clean
• Cellophane keeps things fresh
• Cellophane lets you see what you buy
DU PONT
Cellophane


"The best things in life come in Cellophane"
"You SEE what you buy-no guesswork."
"Foods come fresh-stay fresh longer-less waste."
"...and things in Cellophane are clean and sanitary."
DU PONT
Cellophane
DUPONT
BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

Critical Loss Analysis

"How much do **sales** need to drop to render a 5% price increase unprofitable?"

(Similar in spirit to SSNIP)

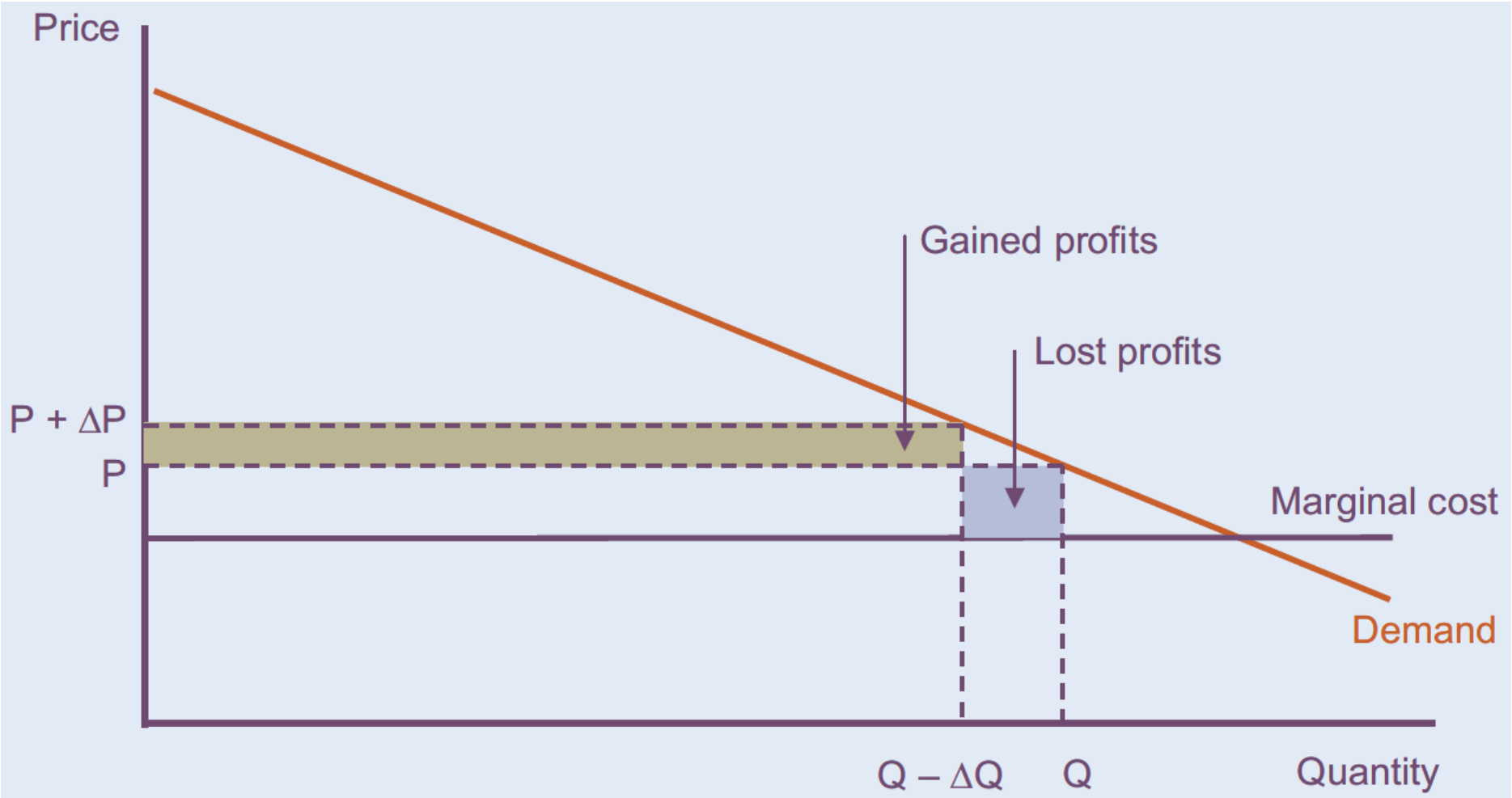
Actual loss usually not equal to critical loss

If actual loss > critical loss, 5% price increase is unprofitable, then the market is deemed larger

Naturally, if current margin is large, critical loss will be small. So it suffers from the same "Cellophane fallacy" as SSNIP!

Economics lesson: Margin and elasticity are **not** independent!
For profit-maximizing firms, they are **inversely** related

Critical Loss Analysis



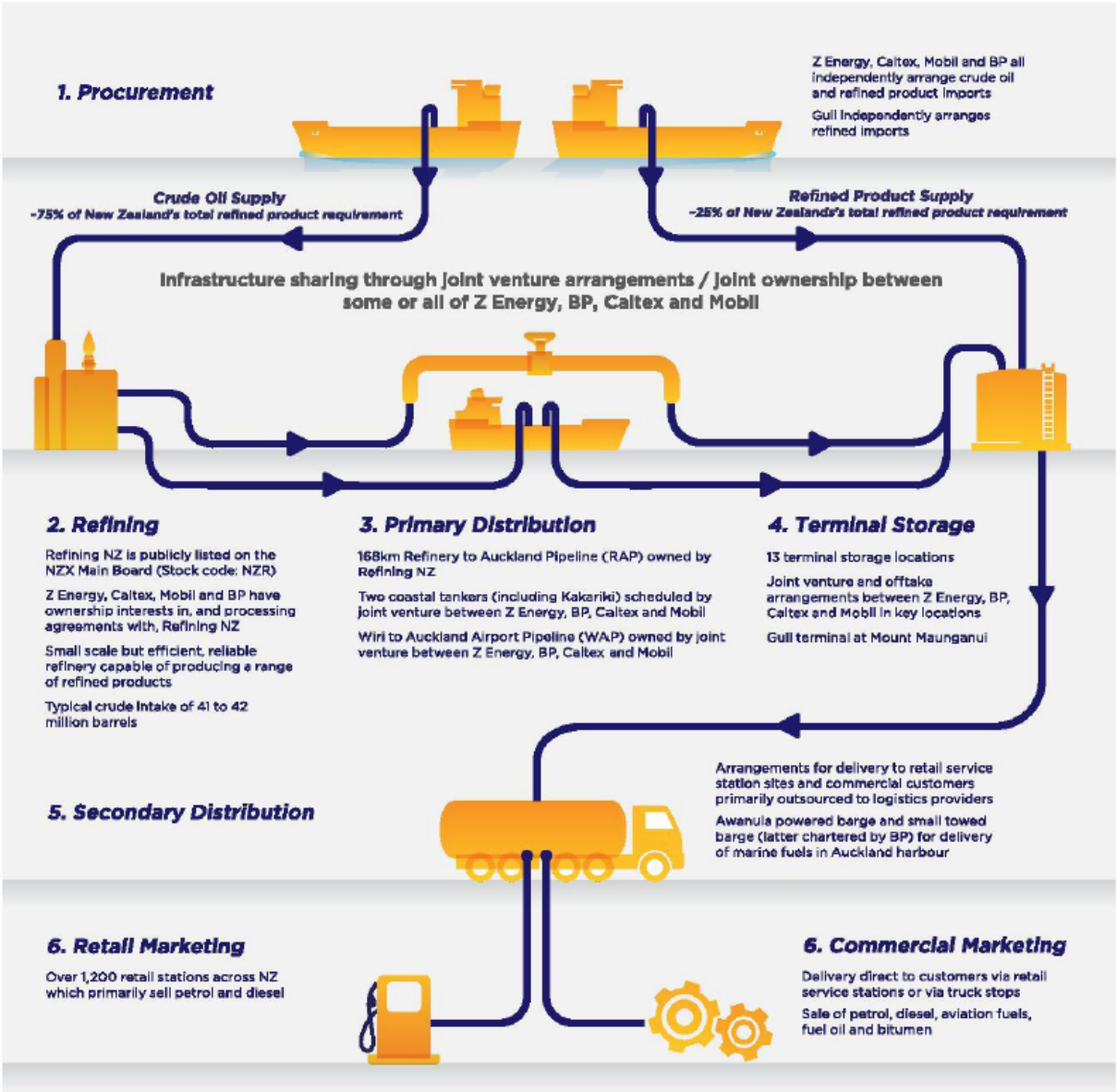
From: `http://www.oxera.com/Oxera/media/Oxera/downloads/Agenda/Hypothetical-monopolists.pdf`

Proposed Z Energy–Chevron Merger

Actual or potential overlaps:

1. Processing capacity at NZRC (New Zealand Refining Company)
2. Services from distribution assets:
   - Coastal shipping; Pipelines; Truck loading facilities; Road transport; Storage terminals; Aviation fuel refuelling
3. Wholesale petroleum products to other fuel suppliers
4. Commercial supply:
   - Aviation fuels; Marine fuels; Bitumen; Petrol; Diesel; Kerosene; Lubricants
5. Retail supply:
   - Petrol; Diesel; Kerosene; Lubricants
6. Franchise market for independent retailers

New Zealand's Refined Products Supply Chain



(From: `http://www.comcom.govt.nz/dmsdocument/13371`)

Market Definitions in Z Energy–Chevron

3 dimensions:

- **Vertical**: upstream services markets; downstream output markets
- **Horizontal**: different petroleum products among outputs
- **Geographic**: especially in retail markets

Product market definitions relatively straightforward: no obvious substitutes for upstream services or petroleum products

Geographic markets typically defined by some driving radius

- Prof. Hausman uses 2km and 5km for retail markets
- More sophisticated approach may look at traffic patterns, e.g. highway vs. residential area have different catchment areas

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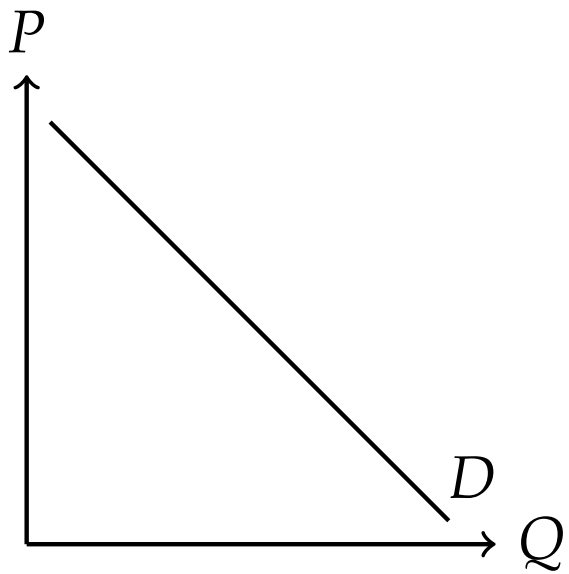
Isn't Demand Pretty Straightforward?



This graph from EC101 is not "wrong", but it doesn't address:

- **Discrete** purchases (e.g. one car / house)
- Demand in real life is more often **non-linear**
- Abundance of **substitutes** in consumer products, and their effects on demand of this product
- Consumers have **different tastes**
- How to estimate this curve from **observed data** (P, Q)

Modern Demand Systems

In most retail settings with an abundance of products, each with many substitutes, we estimate a demand **system** that includes **all substitute products**, not only that single product's demand

The demand system captures all inter-product effects

Of course, you need (P, Q) data from all products involved

2 kinds of demand systems:

- Continuous Choice Models
- Discrete Choice Models

Continuous Choice Demand Models

"Toy" Example: 3 orange juice products A, B, C

Simplest demand system: 3 equations; $3 \times 3 = 9$ parameters

$$\begin{cases} Q_A & \text{as a function of:} \quad P_A, P_B, P_C \\ Q_B & \text{as a function of:} \quad P_A, P_B, P_C \\ Q_C & \text{as a function of:} \quad P_A, P_B, P_C \end{cases}$$

More sophisticated version: AIDS (Almost Ideal Demand System)

- restricts model parameters to agree with consumer choice theory
- includes consumer income and product expenditure share

Warning: If you have 100 products, you will need 100 equations and 10000 parameters!!

Discrete Choice Demand Models

Discrete choice models' major advantages:

- **Scalable**: no more overwhelming number of parameters
- Able to recognize **product characteristics**

E.g. Orange juices have 2 characteristics: "sweetness"; "pulpiness"

Discrete choice model for orange juices has only **1 equation**:

Q_i **as a function of:** P_i**, all other prices, sweetness**$_i$**, pulpiness**$_i$

Usual functions used: "Logit" or "Probit"

Foundation of “Logit” / “Probit” Models

“Logit” & “Probit” are not just purely econometric models

Both have a deep **“behavioral foundation”**: They model consumers choosing the product that gives them **highest utility**

Utility is a function of the product’s price and characteristics

Thus, a product with big market share must have characteristics that appeal to consumers

“Fancy logit” models allow customers to have **different tastes**

These have become the established workhorse in economics literature

What Can You Do Next?

A well-estimated demand system allows you to:

- Estimate own- and cross-price **elasticities**
  - "If P_A increases by 1%, how much do Q_A, Q_B, Q_C change?"
- Use cross-price elasticities to gauge how similar / substitutable the products are, which helps:
  - check the **market definition**
  - gauge how **anti-competitive** merger is
- Calculate change in consumer surplus for **welfare** analysis
- Perform **counterfactuals** / "**experiments**"
  - "How much price increase will the merger bring?"
  - "How much cost saving is needed to cancel out this price increase?"

Demand Estimation in Z Energy–Chevron

In **each** market (e.g. “petrol retail supply in Mt. Wellington”), demand can be estimated with either:

- **Individual-level purchase data** with prices, consumer demographics

  This is the ultimate luxury: makes estimation easy

- **Aggregated market share data** with prices, in daily / weekly / monthly frequency

  Purchase decisions less transparent; more to tease out. Biggest innovation in empirical I.O. (Industrial Organization) in the past 20 years is developing techniques to do so

Demand Estimation in Z Energy–Chevron: Uses

Are Z and Chevron particularly close substitutes (i.e. large cross-price elasticity) in some markets?

Merger of 2 close substitutes is more anti-competitive

Estimate loss in consumer welfare if Z and Chevron raise price by x%

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What is "Structural" Merger Simulation?

3 ingredients for modelling a market:

(1) Demand system
(2) Firms' cost structure / Supply
(3) Mode of competition / market structure

In the simplest merger, **only (3) changes**

To simulate a merger:

1. Estimate demand system and firms' costs using pre-merger data
2. Compute post-merger market equilibrium, using **new** market structure, but **same** demand parameters and firms' costs

"Toy" Example

3 single-product firms (A, B, C) in price competition pre-merger

Now firms A, B propose to merge

Express ownership structure with a 3×3 matrix:

Pre-merger

	A	B	C
A	1	0	0
B	0	1	0
C	0	0	1

Post-merger

	A	B	C
A	1	1	0
B	1	1	0
C	0	0	1

Identifying Market Structure

Ingredient (3) market structure is also the hardest to pinpoint

Is it primarily **competition** in:

- Price? (e.g. petrol)
- Capacity? (e.g. communication network)
- Advertising? (e.g. music albums)
- Innovation? (e.g. tech gadgets)

Could there be **cartel** / **collusion**?

Any interesting **dynamics**? Or **vertical** relationships?

Alternatively, are outcomes determined primarily through **auctions**?

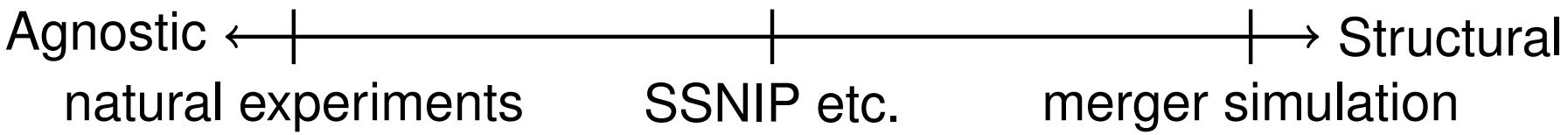
Or **negotiations**?

Assumptions in Simulation

Merger simulation necessarily relies on **structural assumptions** on: demand, costs, and market structure

If you want to **extrapolate** from existing data, of course you need to write down a model to direct where the extrapolation goes!

Spectrum on "comfort level" with assumptions:



In reality, it seems that:

- Not stating assumptions explicitly is not satisfactory scientifically
- But it gives legal advantage, making it less prone to challenge!

Merger Simulation vs. Market Forecast

A merger simulation is a **"counterfactual" experiment**:

What will market outcomes be, if **only one thing changes**, while all other parameters stay constant?

This is different from a market forecast, which tries to **incorporate all changes**, e.g. seasonal variations or demand / cost changes

Merger retrospective: Comparing **actual** post-merger outcomes to merger simulation results

A meaningful retrospective should filter out changes in demand and cost in post-merger period, before comparison

Merger Simulation in Z Energy – Chevron

In every market where Z Energy and Chevron overlap, you could conduct a merger simulation. Then you can answer:

- "How much price increase does the merger bring?"
- "How much cost saving is necessary to cancel out this price increase?"
- "Is this cost saving within plausible range?"

For retail markets, it's pretty safe to assume price competition

Much less obvious in other markets: upstream services; wholesale; commercial supply; franchise

(Upstream services using distribution assets are governed through joint venture agreements)

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Other Aspects of Z Energy–Chevron Merger

Cost influence / vertical exclusion

- Can the merged firm exert market power in the upstream service market, so to increase rivals' cost or limit their access?

Countervailing power

- Do big wholesale / commercial customers exert enough pressure on price?

Entry & expansion

- Do we have potential entrants? Is it easy to start supplying?
- Do current competitors have capacity to expand?

Coordination / collusion

- Does having one less competitor make price coordination / collusion easier?

Perfection is Not the Goal

No econometric study is “perfect”

You can never be absolutely sure that your result is the “truth”; but this does **not** mean you give it zero weight

Same as most statistical analyses, the biggest difficulty is in making good **judgments** on many intermediate steps along the way

Econometric techniques diffuse from academic literature to antitrust practice: Discrete choice models gain wide acceptance, in both screening and ex-post analysis; often as ammunition against less sophisticated models