

How to know if your public health policy will/did work

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PART 1

A Public Health Problem

Barbados SSB Tax 2015



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Assessing the impact of the Barbados sugar-sweetened beverage tax on beverage sales: an observational study

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Abstract

Background: The World Health Organization has advocated for sugar-sweetened beverage (SSB) taxes as part of a broader non-communicable disease prevention strategy, and these taxes have been recently introduced in a wide range of settings. However, much is still unknown about how SSB taxes operate in various contexts and as a result of different tax designs. In 2015, the Government of Barbados implemented a 10% ad valorem (value-based) tax on SSBs. It has been hypothesized that this tax structure may inadvertently encourage consumers to switch to cheaper sugary drinks. We aimed to assess whether and to what extent there has been a change in sales of SSBs following implementation of the SSB tax.

Methods: We used electronic point of sale data from a major grocery store chain and applied an interrupted time series (ITS) design to assess grocery store SSB and non-SSB sales from January 2013 to October 2016. We controlled for the underlying time trend, seasonality, inflation, tourism and holidays. We conducted sensitivity analyses using a cross-country control (Trinidad and Tobago) and a within-country control (vinegar). We included a post-hoc stratification by price tertile to assess the extent to which consumers may switch to cheaper sugary drinks.

Results: We found that average weekly sales of SSBs decreased by 4.3% (95%CI 3.6 to 4.9%) compared to expected sales without a tax, primarily driven by a decrease in carbonated SSBs sales of 3.6% (95%CI 2.9 to 4.4%). Sales of non-SSBs increased by 5.2% (95%CI 4.5 to 5.9%), with bottled water sales increasing by an average of 7.5% (95%CI 6.5 to 8.3%). The sensitivity analyses were consistent with the uncontrolled results. After stratifying by price, we found evidence of substitution to cheaper SSBs.

Conclusions: This study suggests that the Barbados SSB tax was associated with decreased sales of SSBs in a major grocery store chain after controlling for underlying trends. This finding was robust to sensitivity analyses. We found evidence to suggest that consumers may have changed their behaviour in response to the tax by purchasing cheaper sugary drinks, in addition to substituting to untaxed products. This has important implications for the design of future SSB taxes.

Keywords: Sugar-sweetened beverages, Evaluation, Fiscal policy, Obesity prevention, Diabetes prevention

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BMC

The public health problem in Barbados

- Systematic reviews / meta-analyses: greater SSB consumption is associated with increased risk of high bodyweight, type 2 diabetes, hypertension, coronary heart disease
- Barbados:
 - NCDs estimated to account for > 75% of the total disease burden, with cardiovascular (20.4%), cancer (12.7%), type 2 diabetes (6.2%) and chronic respiratory diseases (2.4%) accounting for a substantial proportion
 - Adult rates of overweight and obesity estimated to be 74.2% and 43.4% (respectively) for women, and 66.2% and 23.4% for men
 - Rates of diabetes estimated to be 18.7%, compared to an estimated global rate of 9.3%
 - Average SSB consumption = 2.0 to 2.4 servings/day compared to a global estimate of 0.6 servings/day

Response

In June 2015, the Minister of Finance introduced a 10% tax on SSBs, framed as a response to the rising NCD burden, with a focus on the established links between diabetes and SSB consumption:

It is now an indisputable reality that Barbados is on the verge of a national crisis with regards to persistent health problems ... One of the major afflictions in this category ... that has escalated in the past few decades is that of diabetes mellitus, which is now a major cause of sickness, amputation and morbidity on the island. ... In Barbados, as is also the case in many other jurisdictions where diabetes is a major challenge, one of the products which is known to be heavily used by unsuspecting populations is sweetened beverages.

The Question Here for Us

- How could you *predict* whether the tax would have the desired effect on sales / consumption / health?
- How could you *evaluate* whether it did?
- These involve singular causal claims

Help with this question

- We offer a ‘thick’ theory of singular causation
- That underwrites a variety of (generally familiar) ways to evidence it

PART 2

The Theory

About the theory

- 7 interlocking components
- Mostly familiar
- Generally uncontroversial
- But seldom assembled together to make a proper theory



About the theory

- An informative theory
 - Like a good scientific theory, it tells a lot about the concept in view
- Not a deep theory but it does an essential job:

It spawns a **well-grounded** category scheme for evidencing singular causal claims

- Answering: ‘What kinds of information count as evidence for causation in the single case?’

About the theory (cont.)

Not nec and suff conditions

- Impossible to do well
- Without an informative theory alongside, nec and suff conditions are of little use

All the work of justifying evidence as evidence gets done by other assumptions

- Eg, causal Bayes nets axioms
- But too often not stated let alone defended

Consider the counterfactual account!!

The components of the theory

1. Formal features (asymmetry, transitivity – of the ‘right’ sort)
2. Initial cause and final effect connected by a **process**
3. Cause are **INUS** conditions (representable in POEs)
4. Cause produce effects through **activities**
5. Governed by **tendency laws**
6. The causal possibilities in a setting can be represented in a **singular causal equation model**
7. The **underlying social/political/cultural/economic/geographical structure** is what affords some processes and makes other unlikely



From theory to warrant

- The theory underwrites a categorization of types of local evidence relevant to singular causal claims
- It shows the role these play
- And justifies that they **are** evidence
- Understanding the role the separate pieces of evidence play is important for making an overall judgment about the strength of a case for the singular causal claim

Local evidence vs evidence from afar

Typically evidence from afar comprises

- Claims that the causal claim holds somewhere / widely / in a given type of setting / everywhere
- Theory that implies the causal claim
- ...

**We are concerned with LOCAL evidence
about THIS setting at THIS time**

The components of the theory

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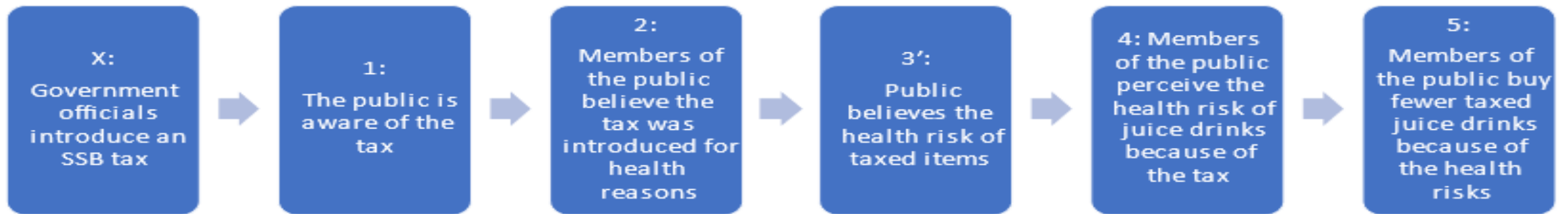
Start with component 2 -- processes

- This justifies producing a standard 'box and arrows' theory of change
- That plays a central role in evidencing the overall singular causal claim
- For the Alvarado ex post evaluation of the Barbados SSB tax, there were 2

SSB process: Via a price effect



Via signaling effect



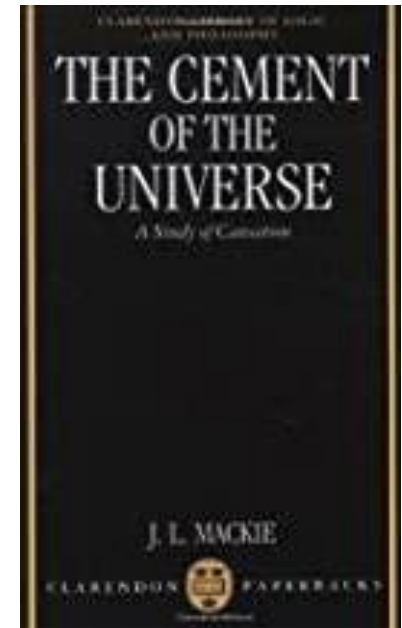
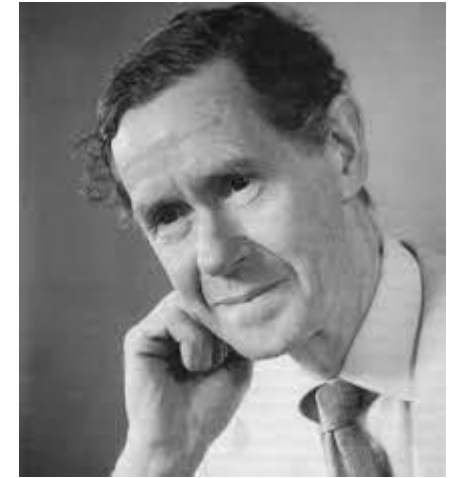
Theory component 3

Causes are INUS conditions (JL Mackie)

$$O(u) \text{ c}\equiv B(u)\&C(u) \vee W$$

$$y(u) \text{ c}=\beta(u)x(u) + w(u)$$

- NOT 'INUS conditions are causes'
 - Think 'spurious correlation'
- RHS are the possible causes of E/y for u in this setting at this time



$B(u)/\beta(u)$ = ‘Moderators’/ ‘Interactive variables’



1. Support factors



2. Absence of derailleurs

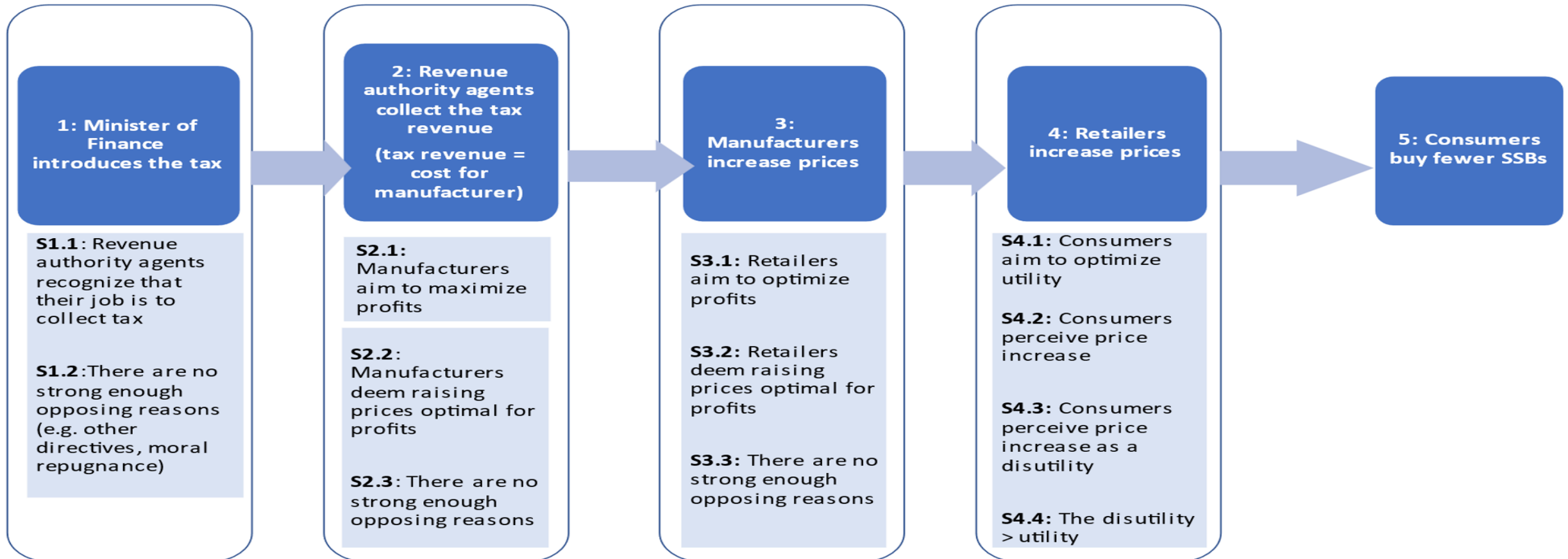


Epidemiologist pies— for each step in the process

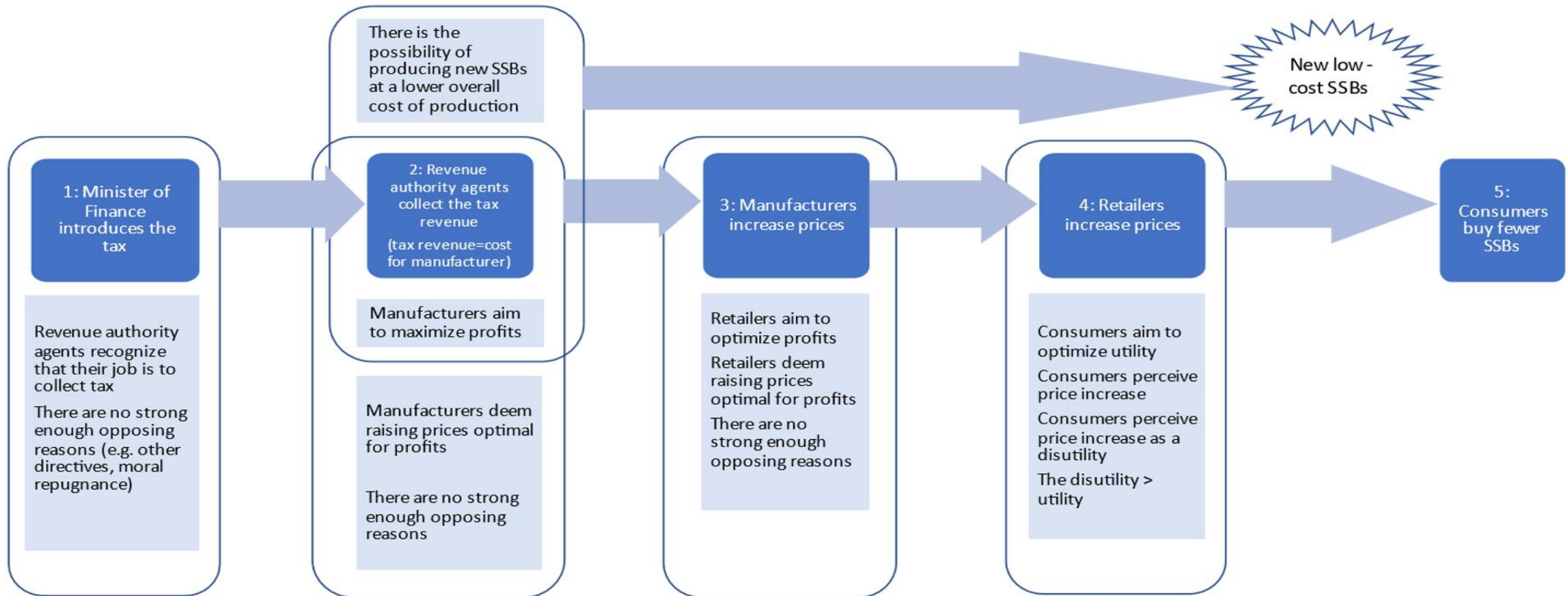
SSB tax
Step 1



Support factors – via price mechanism



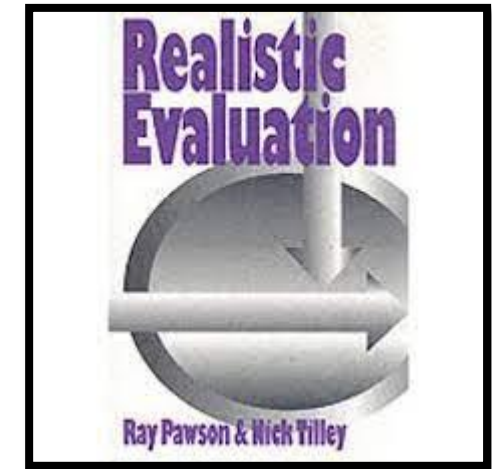
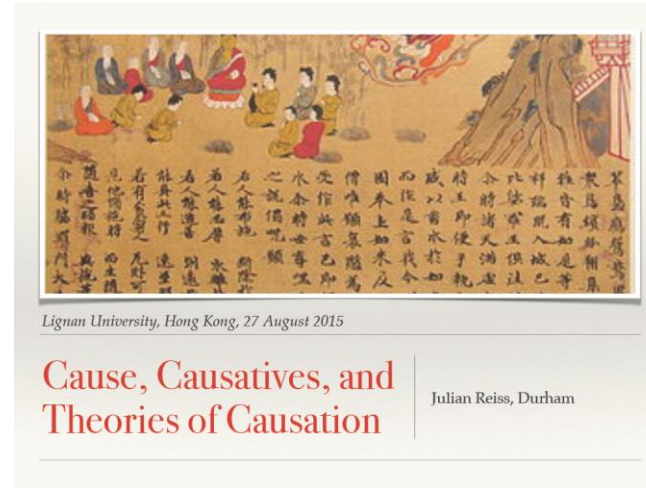
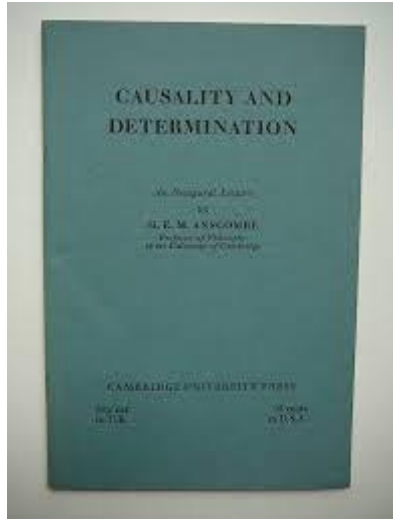
Derailer—via price mechanism



Components 4 & 5:

Activities and Tendency principles

Components 4 & 5: Activities and Tendency principles



University



Components 4 & 5: **Activities** and Tendency principles

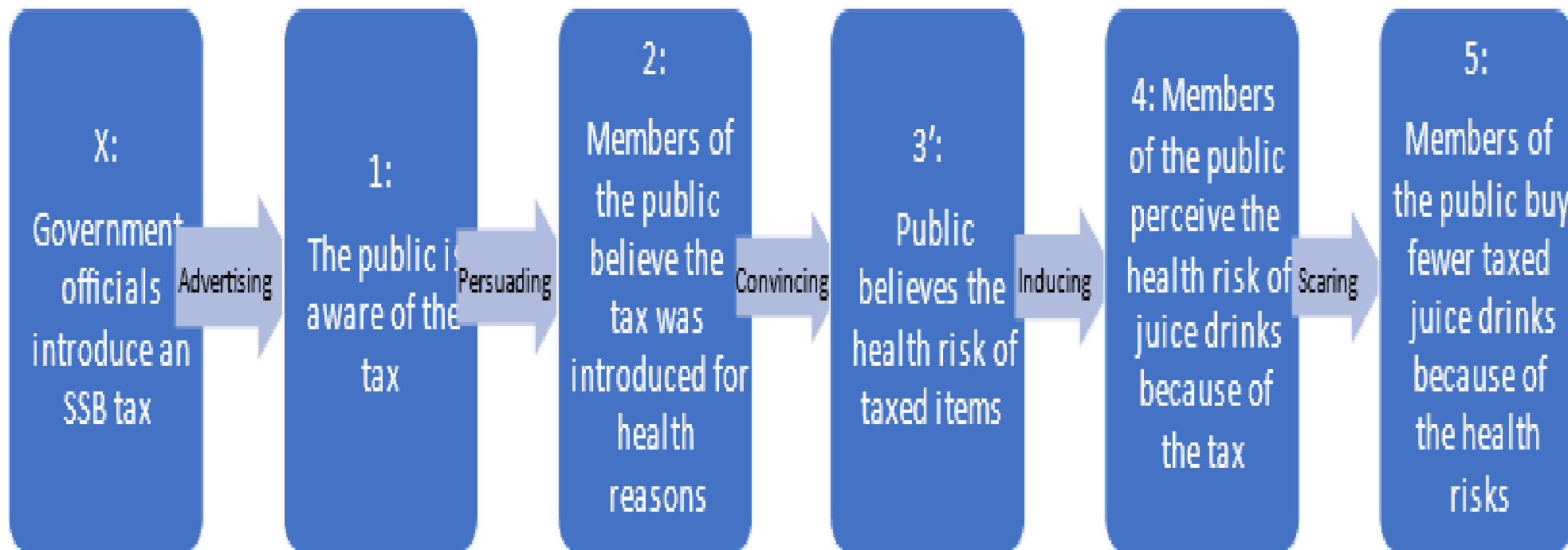
- Causes don't just sit there miraculously followed by their effects
- They DO something to produce the effect:

Price effect: the tax **makes SSBs more costly**

Signaling effect: the tax **warns people of the health hazards**

Components 4 & 5: Activities and Tendency principles

3' → 4: the public's belief in the health risk of taxed items – plus their recognition that it is SSBs that are taxed and their belief that the government would not deceive them about this – *induces* the public to believe that SSBs are risky.



Components 4 & 5: Activities and **Tendency principles**

WHY BELIEVE that warning the public that SSBs are risky induces them to avoid them?

WHY BELIEVE that making SSBs more costly reduces sales of them?

Because of 2 familiar general principles:

- Warning people that something is dangerous induces them to avoid it
- Increasing the cost of something reduces the quantity of it purchased

Clearly not 'laws' like the law of gravity

Rather..... **Tendency principles**

When it comes to warrant we agree with Donald Davidson



- Justifying that a fact cited as evidence **IS** evidence for singular causation...

Relies on supposing the singular connection occurs
in accord with a general causal principle

- Though not strict principles but
- **Tendency principles**

Components 4 & 5: Activities and **Tendency** principles

Ala JS Mill, Jan Elster and me



Tendencies and their principles

- Tendencies do not usually obtain everywhere
- The principles are usually expressed as GENERICS
- They often 'contradict' one another (we have many opposing tendencies!)
- They don't usually tell what will result
- But describe what the cause **tends to**
 - You may have to **trigger** the cause
 - The indicated effect is not the observed outcome because **other causes also influence it**
 - Still, the cause may push the outcome in the direction indicated

Why tendency principles matter

We suppose that the presence of support facts and absence of derailers (or presence of guards against them) **ARE** evidence for a singular causal connection ala Mackie

BUT...

What justifies supposing that THESE PARTICULAR factors are support factors/ derailers/ safeguards?

Answer:

An associated tendency principle

Warning people that something is dangerous induces them to avoid it →

Support factors

- They believe the warning signaled by the SSB tax
- They are able to avoid buying SSBs
- They understand that it is SSBs that are dangerous

OOOPS..the planners missed this

Many people did not recognize that JUICE drinks were also dangerous:
It was commonly called 'the soda tax'

Explicitly considering the principle helps you identify the support factors

Increasing the cost of something reduces the quantity of it purchased

Suppose all support factors are there

Still need the absence of derailers

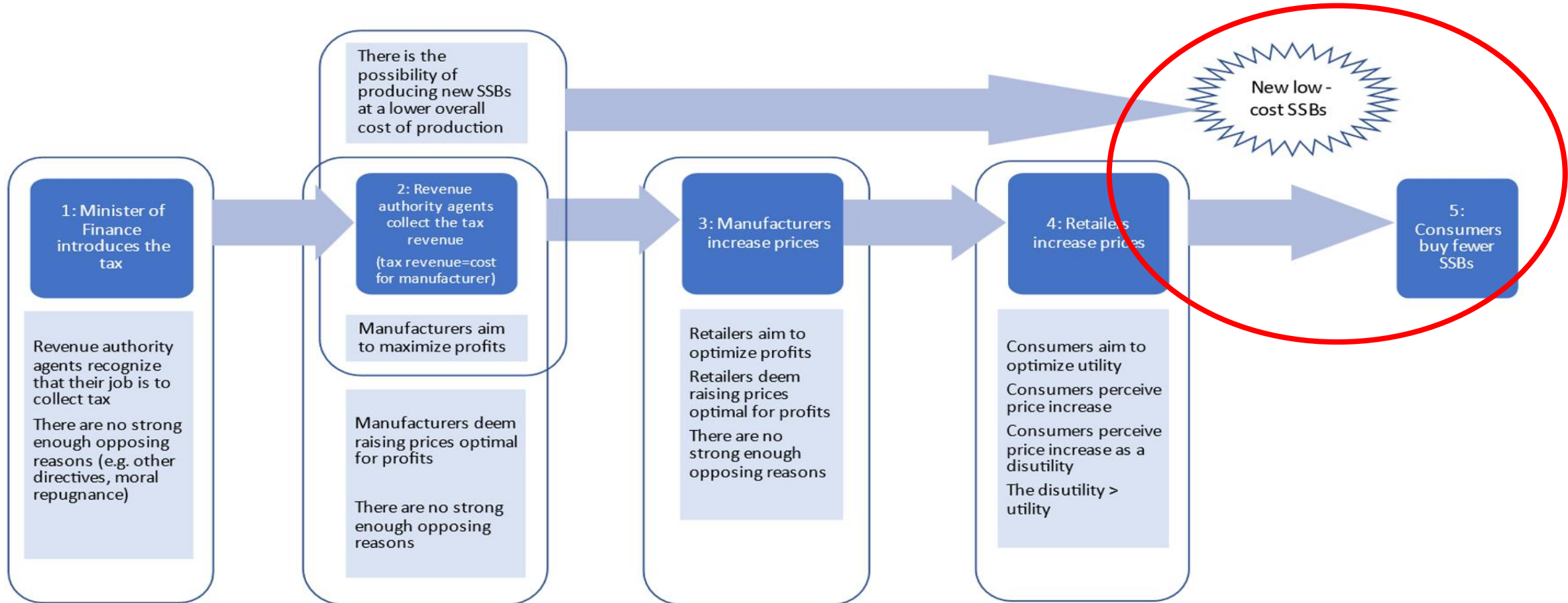
So: UNLESS derailed by (inter alia)

The operation of a competing tendency:

The substitution effect

Made possible by the invention of a cheaper way to produce and deliver to market other equally harmful, equally appealing SSBs

Derailer—via price mechanism



PART 2

Theory of singular causation

+

situation-specific ToC

→

Categories of roles local evidence can play

Evidence can play the role of supporting ...

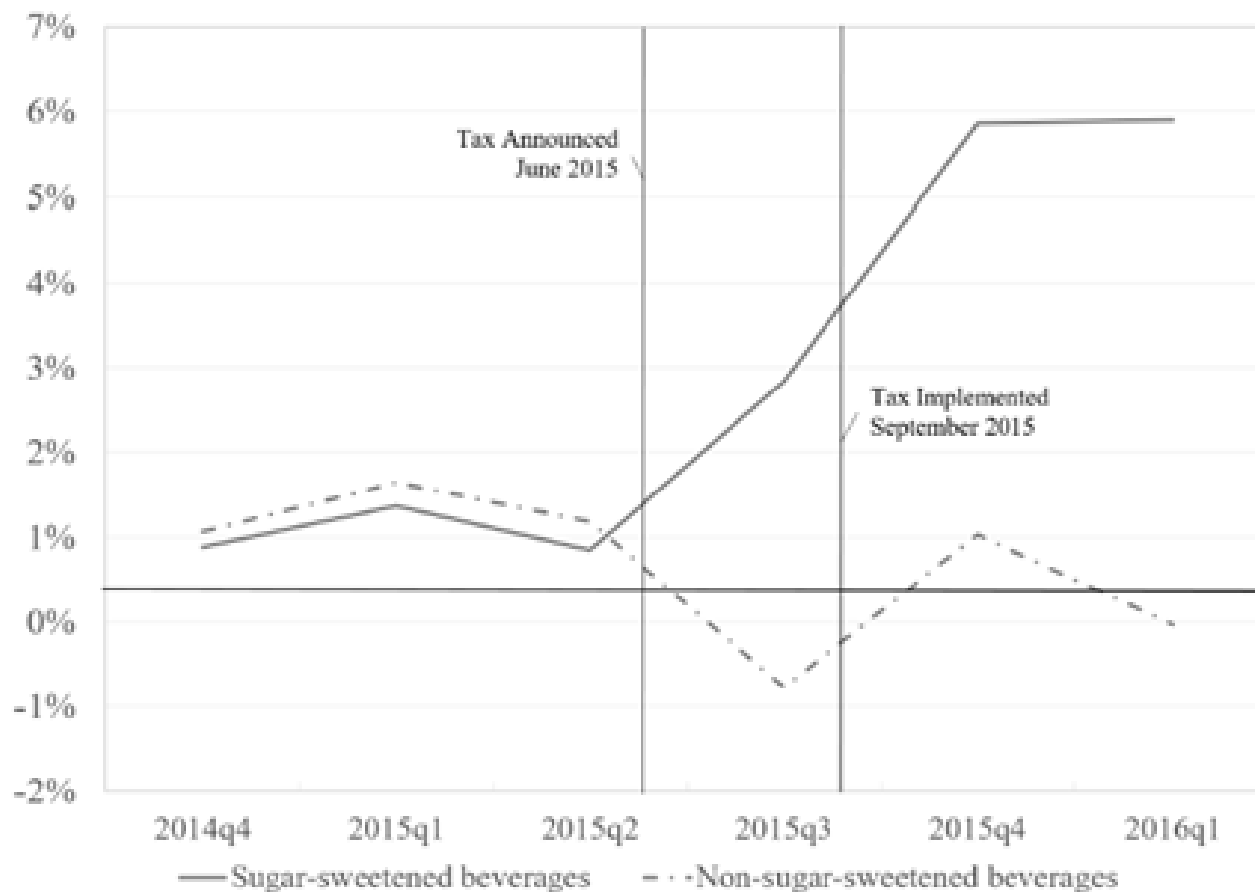
- Cause in box n occurs?
- Effect in box n+1 of the cause in box n occurs?
- Timing of the effect in box n+1 is right?
- Support factors for box n to contribute to box n+1 occur?
- Derailers from box n to box n+1 are absent or guarded against?
- Activity and causal principle from box n to box n+1 obtain?
- Underlying system is right to afford box n to cause box n+1?

Timing (Recall Bradford Hill)

- ‘In the two quarters after the tax took effect, the growth in average SSB prices compared to the previous year reached 5.9% while staying mostly flat, between 0 and 1% for non-SSBs.’
- But there was a wrinkle when it comes to timing

The two vertical lines correspond to June 2015, when the tax was first announced and to September 2015, when the tax was first implemented. It is possible that manufacturers or retailers may have increased prices following the announcement of the tax, in anticipation of the actual implementation date.

Figure: Year-over-year percent change in the average quarterly price per liter of sugar-sweetened and non-sugar-sweetened beverages, Barbados, 2014-2016¹

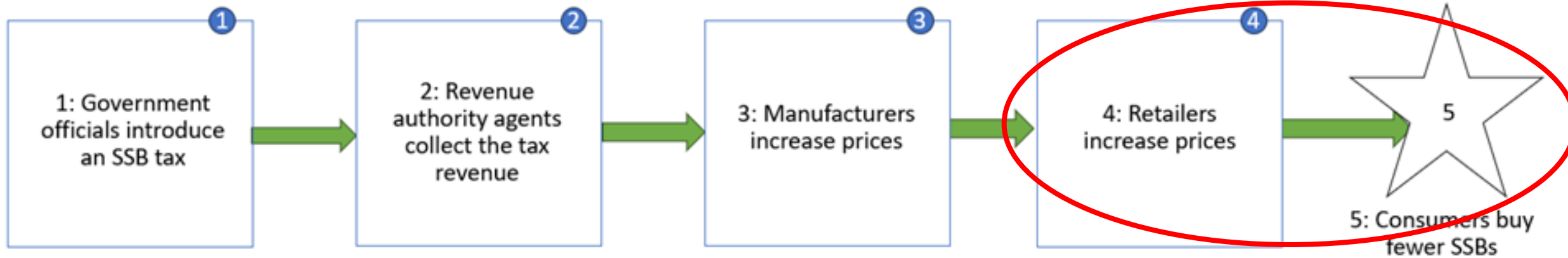


¹ The first line corresponds to June 2015 when the tax was first announced, and the second line corresponds to September 2015, when the tax was first implemented

Evidence can play the role of supporting ...

- Cause in box n occurs?
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SSB tax.... Via a price effect



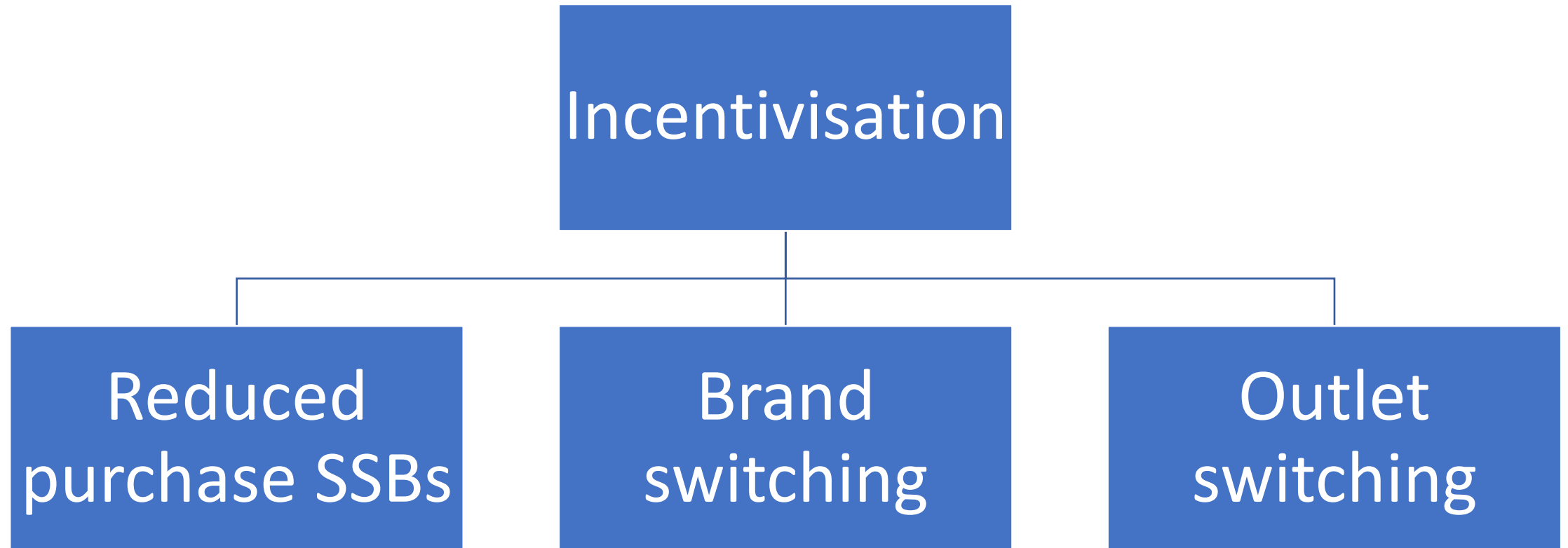
ACTIVITY = Incentivisation: the high price incentivises consumers to purchase less

PRINCIPLE = people act to maximise their expected utility

Evidence for this?

- **Reports** from consumers themselves
- **Side effects** that might have been produced as well had incentivization operated

Side effects of incentivisation to reduce purchase



Evidencing side effects

Outlet-switching

- ‘[A] sensitivity analysis ... highlighted the substantial **variation in SSB prices across store types**, creating the opportunity for consumers to **substitute towards lower-priced stores** in response to the introduction of a tax.’

Brand- & product-switching

- ‘After stratifying by price, we found evidence of substitution to cheaper SSBs.’
- ‘The Barbados SSB tax only addressed around 60% of soft drink-derived free sugars and did not clearly differentiate between high- and low-sugar SSBs. This highlights that the tax design may have incentivised substitution towards untaxed SSBs and in particular, towards higher-sugar untaxed SSBs.’

Alvarado 2020

PART 4: Conclusion

Why bother with all this?

1. Evidencing
that **each**
step in the
ToC occurs
matters



2. Our catalogue of evidence roles **shows the types of information** that can support a step in the ToC



3. Understanding the role each piece of evidence plays is a huge help in making an **overall assessment**



4. Solid grounding

- That these evidence types ARE evidence
- And why
- And just what roles they play

Are **underwritten by systematic theory** that almost anyone can accept

So: They are **rigorously supported as evidence types** (just like, they say, RCT results are)



Thank you & goodbye