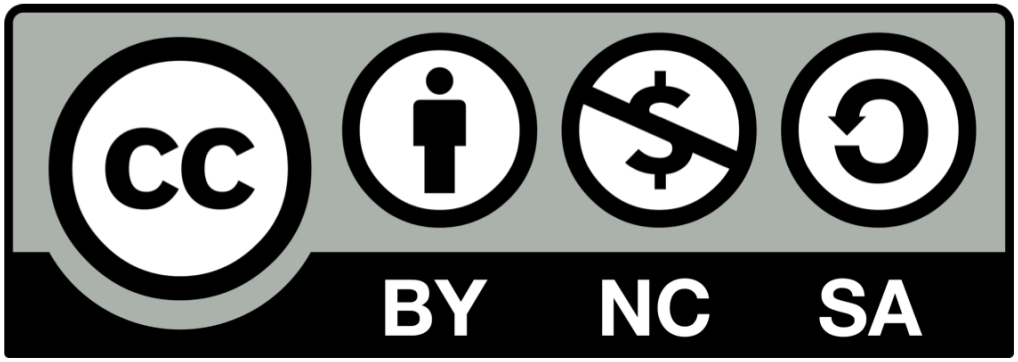
Economic Evaluation

Measuring and Valuing Cost

TVEE
TEACHING VACCINE
ECONOMICS EVERYWHERE

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Overview

- Costs - theory and definitions
  - Economist's definition
  - Types of costs
- Costs in cost-effectiveness analysis
  - General approach
  - Which costs to include?
  - Perspective of the analysis
- Cost of vaccine programs
  - General approach
  - Which costs to include?
- Adjustments to costs
  - Inflation
  - Discounting
  - Currency

Objectives

- To measure cost by perspective

Costs By Perspective

Table 6.1 Costs Under Alternative Perspectives

Cost Element	*Societal*	*Patient and Patient Family*	*Self-Insured Employer*	*Public or Private Insurer*[a]	Managed-Care Plans
Medical care (aggregate)	All medical care costs	Out-of-pocket expenses	Covered expenses[b]	Covered payments	Covered services
"Units"	All units	Those paid out-of-pocket	Those covered	Those covered	Those covered
"Price"	Opportunity cost (including admin. cost)	Amount paid out-of-pocket	Amount paid + admin. cost	Amount paid + admin. cost	Marginal cost
Patient time cost for treatment or intervention	Cost of all time used	Opportunity cost to patient	Only if affects productivity, paid sick time, admin. costs	None	—[c]
Marketed caregiving	All costs	Out-of-pocket expenses	Covered payments	Covered payments	Covered payments
Unmarketed, informal care giving	All costs	Opportunity cost to caregiver	None	None	—[c]
Transportation and other nonmedical services	All costs	All costs	None	None	None
Sick leave, disability, other transfers, (taxes?)	Admin. costs only	Amount received	Amount paid by employer + own admin.	Amount paid by insurer + own admin.	If any paid

a. Third-party insurers.

b. Net of tax treatment.

c. If high, this could lead to a loss of enrollment and business.

Briggs, Andrew H., Karl Claxton, and Mark J. Sculpher. Decision modelling for health economic evaluation. Oxford University Press, USA, 2006.

Example: Gupta et. al

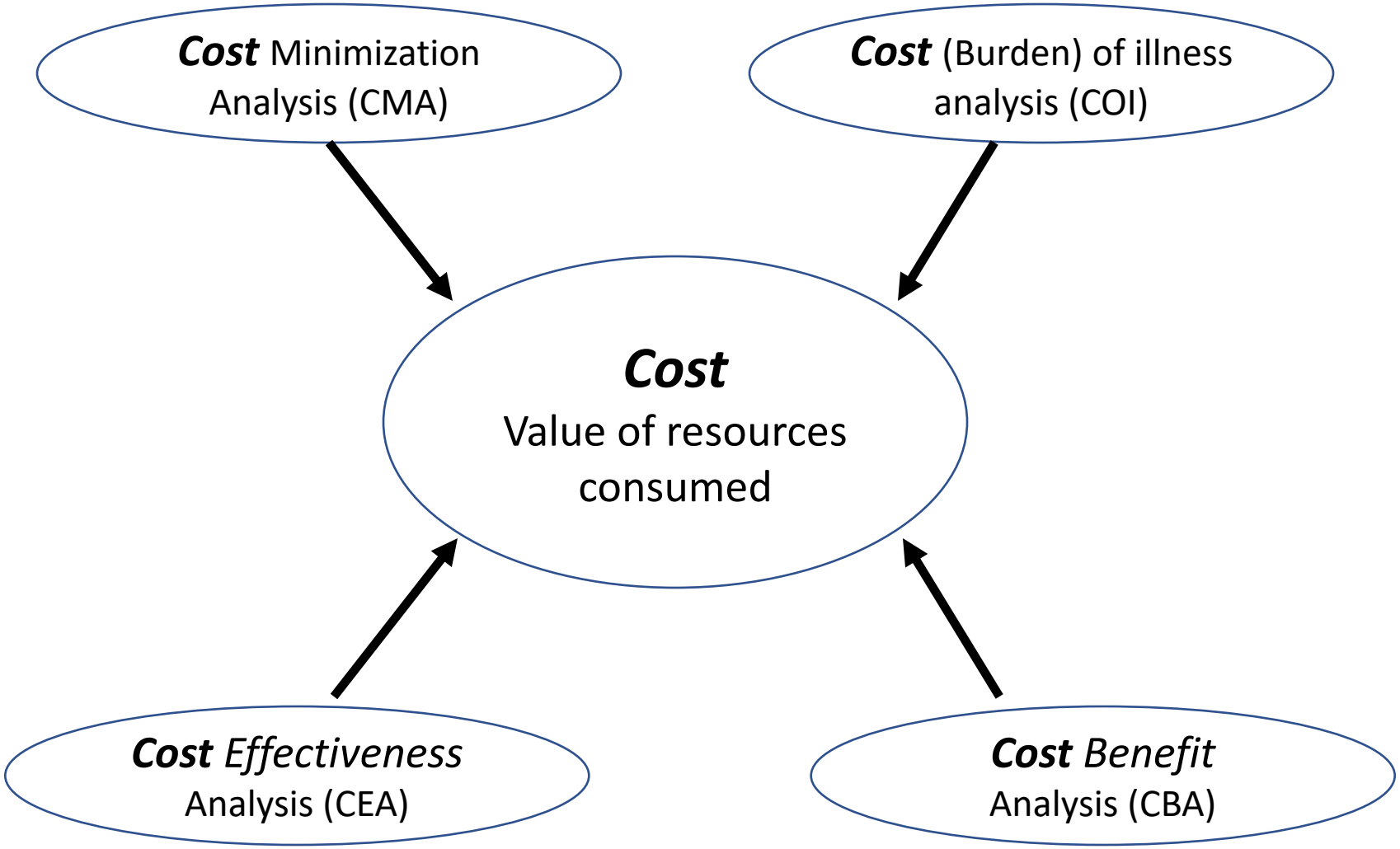
Table 3 Estimated cost of treatment from government and societal perspectives (US$)

Health facility	Travel cost	Total drugs and diagnostics cost					
		Non-severe pneumonia	Severe pneumonia	Meningitis	NPNM	Sequelae Minor	Sequelae Major
Cost to government							
Government cost per patient per outpatient visit							
Sub-centre	1.5	0.2	0.5	0.6	0.6	0.2	0.5
Primary health care facility	1.0	0.2	0.5	0.6	0.6	0.2	0.5
Secondary health care facility	1.4	3.0	6.0	7.2	7.2	3.0	6.0
Tertiary health care facility	2.1	17.0	87.0	104.4	104.4	17.0	87.0
Government cost per inpatient bed day							
Primary health care facility	4.6	10.0	25.0	30.0	30.0	10.0	25.0
Secondary health care facility	6.1	25.0	84.0	100.8	100.8	25.0	84.0
Tertiary health care facility	8.3	71.0	147.0	176.4	176.4	71.0	147.0
Cost to household							
Household cost per patient per outpatient visit							
Government health centre / private pharmacy	1.0	1.2	3.0	3.6	3.6	1.2	3.0
Government primary hospital	2.0	1.2	3.0	3.6	3.6	1.2	3.0
Government secondary hospital	3.0	95.0	192.0	230.4	230.4	95.0	192.0
Government tertiary hospital / private health facility	6.0	150.0	250.0	300.0	300.0	150.0	250.0
Household cost per inpatient bed day							
Government primary hospital	2.0	1.0	5.0	6.0	6.0	1.0	5.0
Government secondary hospital	3.0	1.0	36.0	43.2	43.2	1.0	36.0
Government tertiary hospital / private health facility	6.0	5.0	129.0	154.8	154.8	5.0	129.0

Sources: ICMR (2008), Madsen *et al.* (2009), Hussain *et al.* (2006), NSSO (2006).

Note: NPNM = non-pneumonia, non-meningitis.

Role Of "Costs" In Economic Analysis



Costs - Theory And Definitions

Measuring Cost Of A Resource: Market Prices

One approach to establishing the cost of a resource is to determine market prices.

Economists believe that, under *appropriate conditions*, the observed price will equal the "true economic value" of the particular item.

Characteristics of the economists "competitive market"

- Many buyers and sellers
- Buyers are well informed about product characteristics and quality
- Historical price information is readily available
- Transactions between buyers and sellers are voluntary
- Transaction price established through mutual agreement (bargaining)

...does this characterize the market for medical products and services?

Opportunity Costs versus Accounting Costs

- **Opportunity costs** is the value of the next best alternative that is foregone when another alternative is chosen
  - Volunteer (unpaid) nursing students who help out during vaccination campaigns
  - Unused vaccine refrigerator space that will be occupied by inventory of a new vaccine
- Includes explicit and implicit costs
  - Explicit costs are costs that involve a spending or disbursement of money
  - Implicit costs are costs that do not involve an outlay of cash

- **Accounting costs** would be counted from a financial (bookkeeping) perspective, but would not be counted as an opportunity cost in an economic analysis
  - Duties, tariffs, and taxes are an example of what economists call a **transfer payment** where money changes hands, but no resource is consumed and no net societal opportunity is lost
  - In this case, aside from the cost of collecting the tax, no resources are consumed by the tax

Variable Versus Fixed Costs…

Variable Costs
- Cost of the program/service is related to the quantity or volume of services

Fixed costs
- Cost of the program/service does not change as a function of volume

		Duration over which resource is consumed	
		Capital	**Recurrent**
Relationship between resource and output	**Fixed**	Buildings Equipment Vehicles	MDs RNs Other staff
	Variable	Personal protective equipment	Medicines IV fluids

Slide courtesy S Resch

What is the Aim of Costing?

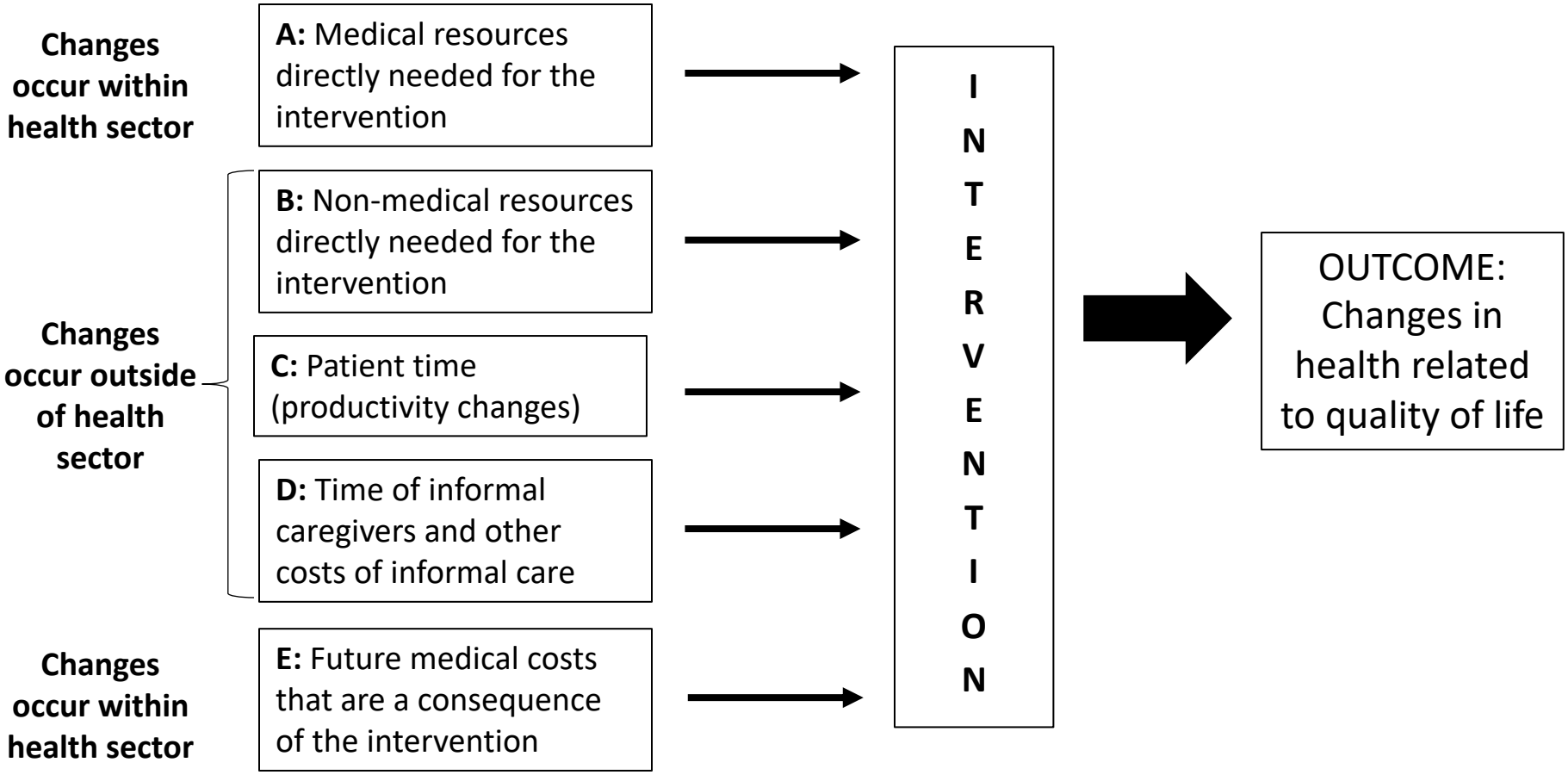
Value the use of scarce of resources needed to produce a certain health effect

$$\text{ICER} = \frac{\text{Value of change in use of health care resources} + \text{Value of change in use of non-health care resources} + \text{Value of change in use of patient time for treatment} + \text{Value of change in use of family caregiver time} + \text{Value of change in patient productivity (work)}}{\text{Change in Output (e.g. quantity and quality of life QALY - DALY}}$$

Weighing the sacrifices against the gains of the intervention to determine the relative desirability of such intervention

Source: Neumann 2017

Which Resource Changes Need to be Identified, Measured and Valued?



Assessment of an intervention requires an examination of all costs (and consequences) regardless of who bears the burden or where they occur in society.

Source: Brower et al. 2001

Examples Of Different Types Of Costs

Category of Cost	Examples
Health care resources	• Hospital, ambulatory care, home care • Medications, bed days, procedures • Tests, ancillary services, professional fees, facilities • Time patients' spend during treatment and medical care
Non-health care resources	• Childcare • Transportation
Patient time for treatment	• Patient time waiting for medical care • Patient time receiving medical care
Family caregiver time	• Family time • Uncompensated caregiver time
Patient productivity	• Patient's lost or impaired ability to work due to morbidity • Patient's lost productivity due to premature mortality

Examples of Costs Incurred and Offset

Costs incurred	Costs offset
• Attributable to cases (e.g. hospitalized cases, outbreak cases) that fail to be averted	• Attributable to cases (e.g. hospitalized cases, outbreak cases) that are averted due to vaccine
• Attributable to adverse events resulting from disease or vaccine	• In some circumstances can be very influential on the incremental cost-effectiveness ratio
• Attributable to intervention or vaccine program implemented	
• [Potentially, attributable to health care received because a premature death was averted]	

Does Price Measure Opportunity Cost?

- At a general level in economics
  - Yes, in most cases
- In health care
  - Not always, especially for hospital services
- Health care does not meet most criteria for being a perfectly competitive market
- What is price in health care anyway?
  - What is charged?
  - What is paid by insurer?
  - What is paid by insurer and patient?

More on Costs vs. Charges

- Charges do not necessarily represent social opportunity costs
- In contrast, the amount paid by a payer does represent the cost from the payer's perspective
  - Key to note that this may still differ from the amount charged
- Need to make adjustments to charges
  - Particularly at hospital level
  - Cost-to-charge ratio can be used

Which Costs to Measure?

- Depends on perspective
- Perspective: From whose viewpoint is the study being conducted?
- A cost may be incurred from one perspective but not from another
  - e.g. patients' travel costs are a cost from the societal and patient/ family perspective but not a cost from the Ministry of Health perspective
- Include value of all goods, services and other inputs that may change because of the intervention(s) being considered. This includes <u>all</u> **variable costs**
- Include many **fixed costs,** where these will <u>change</u> because of intervention(s). Vehicles, equipment, buildings, overheads are all consumed over time and by interventions
- Only costs that **truly do not vary** due to intervention(s) being modeled should be excluded

Costing Process

How Do We Estimate Costs?

Step 1: **Identify** resources used

- What resource use is induced by the treatment or program either directly or as a result of the treatment or program's effects

Step 2: **Measure** resources used

- What quantity of each resource is needed per person or per state?

Step 3: **Value** resources used

- How much does each resource cost in monetary terms?

Collecting Cost Data

Step 1: Identify resources used

Identify streams of disease and healthcare-related events events and their associated resource use

- Hospitalizations
  - Associated with acute disease
  - Associated with chronic sequelae

- Visits
  - Associated with acute disease
  - Associated with chronic sequelae

Steps 2 & 3: Measure and Value Resources Used

- Step 2: Measure resources used
  - Inpatient services
    - Hospital days by type
    - Major procedures
    - Tests
    - Medications
  - Visits
    - Office
    - Minor procedures
    - Tests
    - Medications
  - Direct non-medical costs
  - Time costs

Step 3: Value resources used

- Unit costs from
  - National payment schedules
  - Reimbursements
  - Billing data adjusted by revenue center codes
  - Cost accounting data
  - Micro-costing
- Quantities and costs from
  - Questionnaires, diaries, logs

Collecting Cost Data

STEP 2 and 3: Measure and Value Resources, Other Approaches

- Cost allocation: Expenditures may be used as basis for developing
  costs for specific services

- Charge adjustment: Ratio-of-charge-to-cost used to adjust claims
  data (charges)

- Gross costing: cost per hospitalization or cost per visit estimated using National Fee Schedules or similar

Other Approaches to Measuring and Valuing Resources



Primary data collection to build variable and fixed cost estimates and subsequent analysis to build cost per case

Ingredient-based approach using a mix of data sources to populate health resource utilization and unit costs

Secondary data analysis of clinical, administrative, and financial databases using **health services** methods, includes use of charge data

Allocation methods by distributing budgets or expenditures down to categories, such as “per ward admission” or “per clinic visit”

Challenges in Measuring and Valuing Resource Changes

- No straightforward method of valuation
  - Patient time to seek and undergo treatment is difficult to value
  - Societal costs of traded services (physician's time or care in a nursing home) uncertain
  - Tariffs for services may be a poor approximation of costs
- Health sector is far from being a perfectly competitive, transparent market
  - Only in such markets are prices proper indicators of the opportunity costs of medical services
  - Hence the need to estimate costs in other ways
    - For example, using specific cost calculations or shadow prices where no market price exists

Other Considerations

- Uncertainty
  - Sampling (degree to which point estimates will differ as a result of the fact that the estimate is based on a sample from a population)
  - Model (uncertainty in the structure of the model and process of the model)
  - Parameters (uncertainties in the estimates of disease epidemiology, response to treatment, and vaccine efficacy)
- Internal validity
  - Is the study designed to appropriately measure difference in costs?
- External validity
  - Can costs be generalized? Are costs representative?

Cost of Vaccine Programs

Cost Of Vaccine Delivery

Assume vaccine delivery is integrated into existing EPI program with vaccination occurring in health clinics

Variable Costs

Item	Capital	Recurrent
Vaccine doses	Capital items last > 1 year	Recurrent items consumed within 1 year
Supplies		
Labor		
Fuel		
Patient time		

Fixed Costs

Item	Capital	Recurrent
Clinic space	Capital items last > 1 year	Recurrent items consumed within 1 year
Overhead		
Surveillance		
Cold chain		
Social mobilization		
Training		

Data Collection Options: Program Costs

Variable Costs

Item	Method
Vaccine doses	PAHO Revolving Fund prices; include insurance & freight
Supplies	WHO GPRM; MSH Drug Price Guide; Drug Topics Red Book
Labor	Survey; Time-motion; Ministry of Health Wage Tables
Patient time	Survey for time amount; value with average gross wages

Fixed Costs

Item	Method
Clinic space	Market price, annualize, allocate based on minutes used
Overhead	Step-down allocation of facility-level costs?
Surveillance	Proportion of vaccine budget; allocate based on vaccine type?
Cold chain	Refrigerators alloc. based on vaccine volume (‘semi-fixed’)
Social mobiliz.	One-time push at launch, annualize
Training	Large training at launch treated as capital, plus recurrent amt. based on staff turnover

The Idea of Discounting

- Discounting in cost-effectiveness is similar to discounting in finance
  - The concept of present value
- The present value of the loan is the amount borrowed from the bank
  - This is different from the cash flow which is paid back with interest over time and amounts to more than the amount of the loan
- The present value of a retirement account is the amount available on the day a person retires
  - This is different from the cash flow which is what a person consumes during retirement and will be more than the amount originally in the account
    - What is not consumed each year earns interest

Mechanics of Discounting

Calculating the present value of money needed for a stream of payments over time is like asking "what amount of money do we need in the bank at the start of the time period so that we can pay all the expenses over time when the money in the account earns interest at the discount rate

- Suppose we need to spend $1,000 in year 1 and $1,000 in year 2
- The cash flow is $2,000
- The present value is less than $2,000
- The money "left in the bank" after the first year will earn interest
- Suppose we use a 3% discount rate as was originally recommended by the US Panel

- How much money do we need in year 1 to have $1,000 in year 2 with a 3% discount rate?
  - $1000/1.03 (Note that the denominator is 1 plus the discount rate)
  - The result is $971
- Thus the present value of two years worth of $1,000 expenditures is $1,971

Other Caveats about Discounting

- Over more than one year, discounting is essentially the same as working with a compound interest rate
- In finance, if you leave $1,000 in the bank for two years, it will earn 3% interest on the $1,000 in the first year and the entire sum of money will earn 3% interest in the second year
  - In other words, there is interest on the interest
- Calculating the present value is identical
  - The further in the future the cost or effect that is being discounted, the larger the impact
- Rule of thumb (the rule of 72):
  - Divide 72 by the discount rate
  - The result is the number of years in which costs or effects will be worth only half what they are at present
  - This gives us some idea of the different impact of higher discount rates
    - Higher discount rates always imply less value on the future

Does Discounting Make That Much Difference?

- In just a year or two the value of costs and effects will be close to the present value
- Over time it can have a much larger impact
  - Suppose there was a lifetime intervention that began in childhood and cost $300 per year over 70 years of life

    expectancy
  - The cash flow is 70 x $300, or $21,000
- The present value of this cash flow at a 3% discount rate is only

  $8,999

Should There Be One or Two Discount Rates?

- Some have argued for discounting health at a lower rate than costs
  - This would favor prevention
  - It has been argued that being healthy in the future is more valuable
  - It has been argued that society will be willing to pay more for health in the future
- Others have countered that there should not be any advantage for prevention and that any changes to value should be reflected in other ways in the calculation of cost-effectiveness or the threshold that is used to make decisions rather than using different discount rates

Why Do You Need To Adjust For Inflation?

- Prices generally go up over time
- Sometimes prices go down
- However prices change, we want the prices reported (and that we read about) to reflect currency reality
  - Given publication delays, sometimes dollar figures that we see in the literature can be reported as figures from one or two years prior to publication
- Why are all data not current?
  - Sometimes studies take multiple years
    - Planning, implementation, follow-up, data analysis and reporting
  - Sometimes using data from the literature that were reported several years ago
    - In modeling exercises we will almost always use data that are as much as five years old

General Inflation vs. Medical Care Price Inflation

- In some countries, can obtain data on different inflation rates for different sectors of the economy
- Generally recommend using the rate that is most directly relevant to the resources being used
- However, no inflation measure is perfect
- Difficulty with inflation measures
  - Use a "basket" of goods to estimate price changes over time
  - Does change in prices reflect change in quality rather than just price increases?
  - What if individuals change their consumption patterns as a result of price changes?
    - Does the basket of goods used for calculation capture this or not?
    - Not usually

Variation in Inflation Across Countries

Data in the United States	Data in Other Countries
• Can find data at the Bureau of Labor Statistics Web site www.bls.gov	• Can find inflation data - On the World Bank Web site <www.worldbank.org> under the data and research tab
• The US government calculates the rate of inflation for the economy in general and for many sectors within the economy	• Can find inflation data - On the World Bank Web site <www.worldbank.org> under the data and research tab - In the CIA World Factbook online https://www.cia.gov/library/publications/the-world-factbook/
• Data from the Web site sometimes tell us about the inflation rate but sometimes just provide an index—a number that allows the user to calculate the relative price change between any two points in time	• Key distinction from the US data is that the consumer price index in the US can be used to adjust between any two points in time. When using data from the World Bank or the CIA it is necessary to piece together a long-term rate using year-by-year data

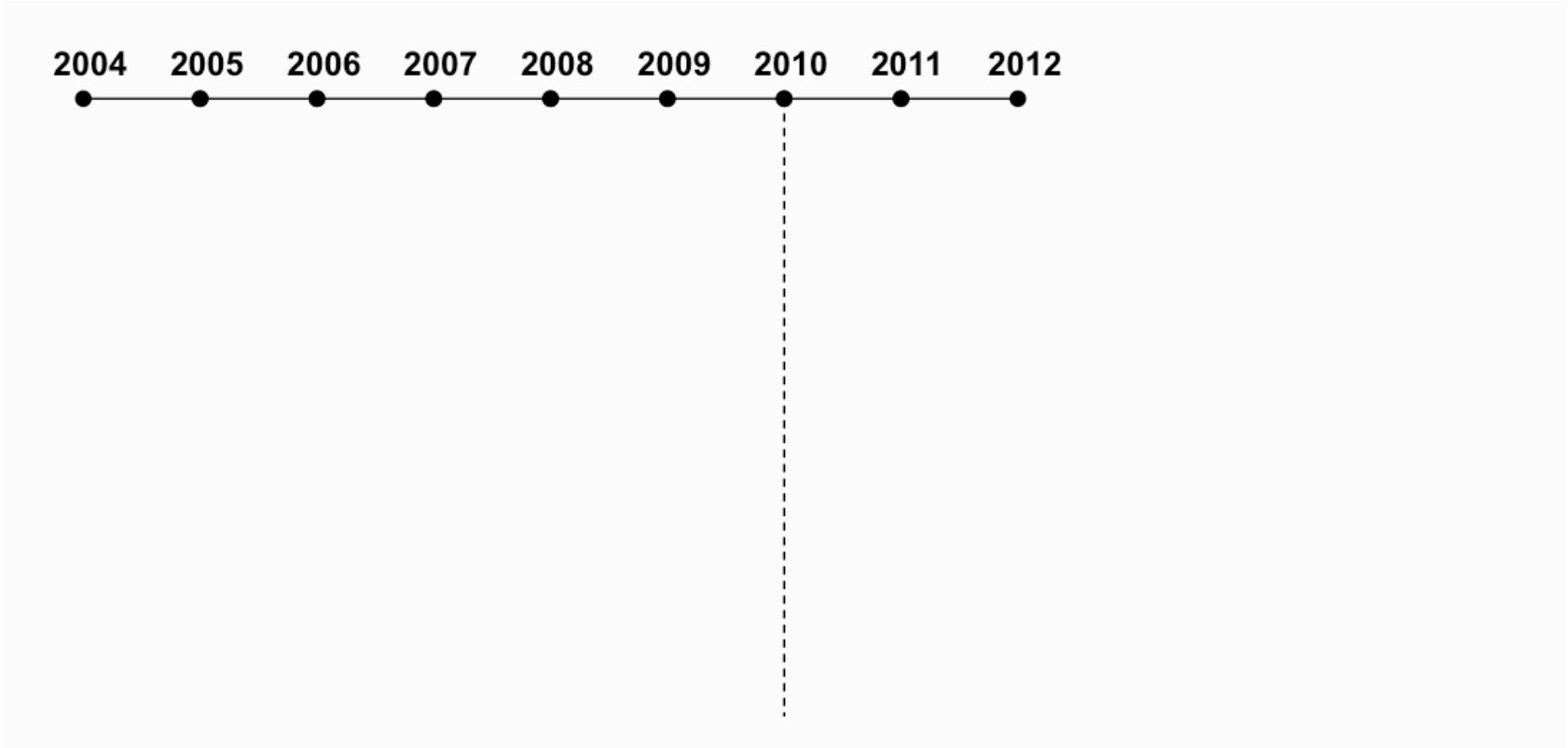
Purchasing Power Parity

- Purchasing power parity can be thought of similarly to the "Big Mac Index" that has been published in The Economist
  - Could also think of a caffe latte (from Starbucks) or a foot-long sub (from Subway) index
- The key question is whether a Big Mac value meal that costs $5 in the United States could be purchased with the $5 converted into Japanese yen, Australian dollars, or Tanzanian schillings
- When purchasing power parity is used, the result is referred to as international dollars
  - It is quite interesting, but there are no actual international dollars in existence used to purchase things

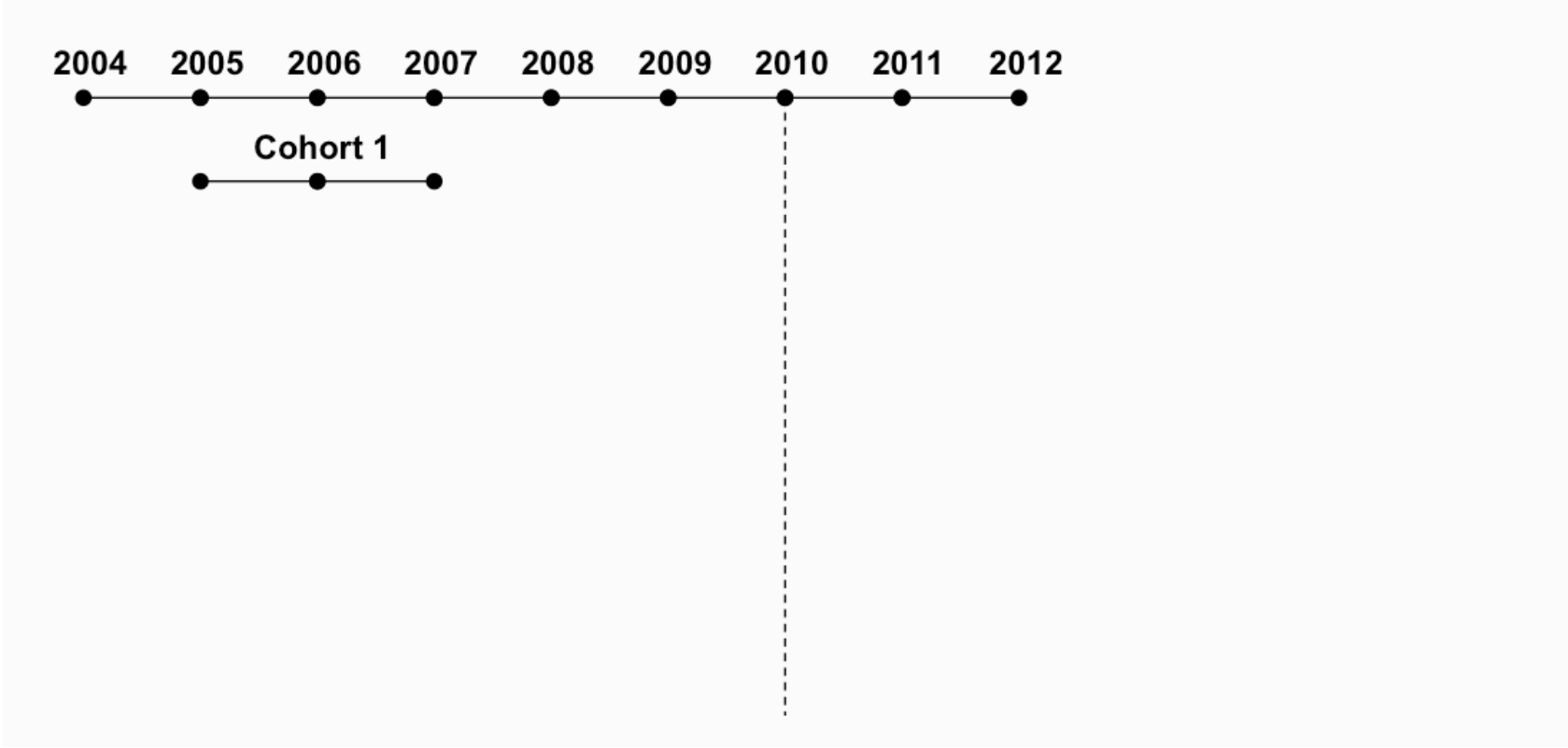
Currency Conversion or Inflation First?

- If cost data are available from several years earlier in a low- or middle-income country, should the figures be adjusted for currency conversion or inflation first?
  - There is a debate in the literature, but the general approach is to adjust for inflation using data from the country of origin and then to convert to the major currency in which the results will be reported

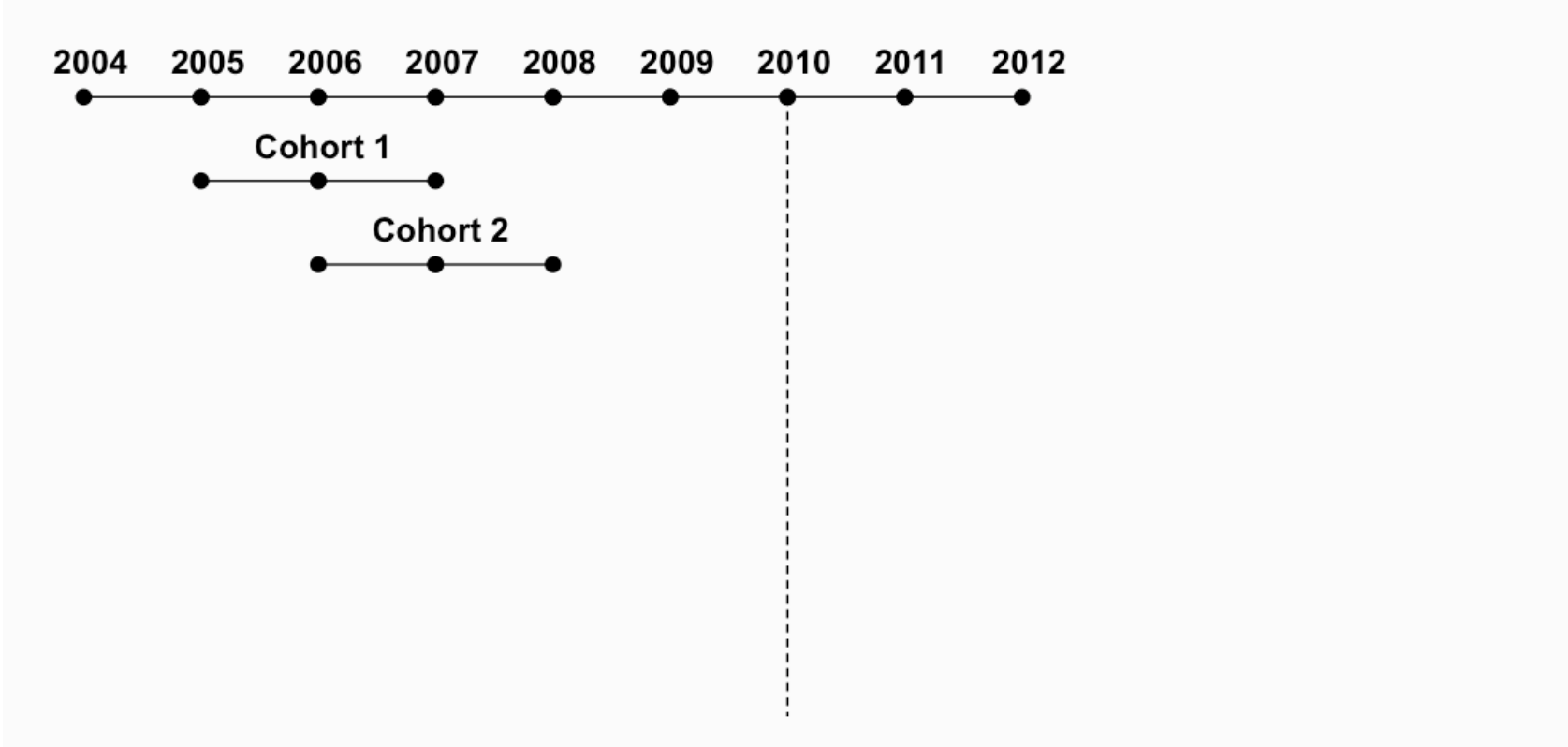
Putting it All Together: Schematic Diagram of Inflation Adjustment and Discounting



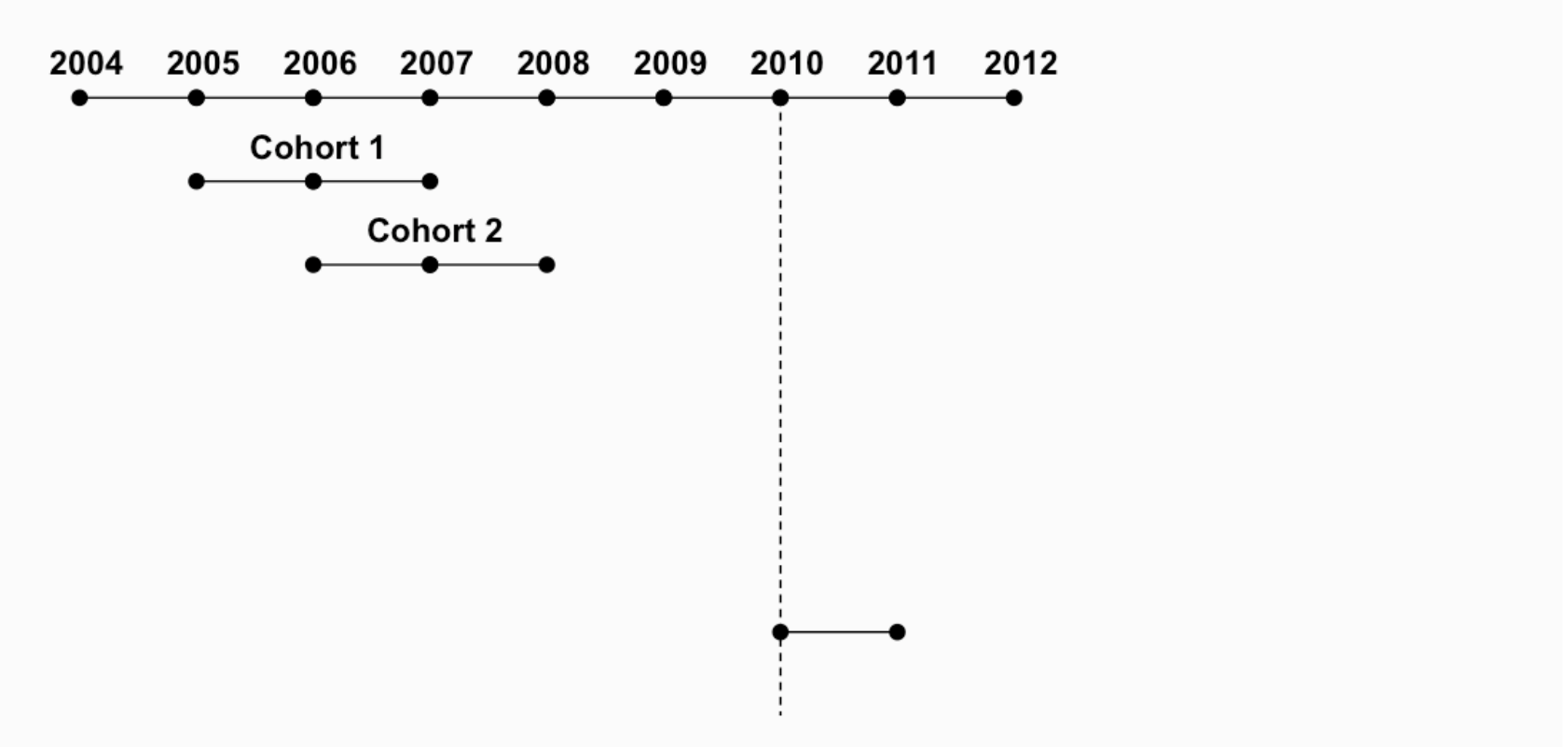
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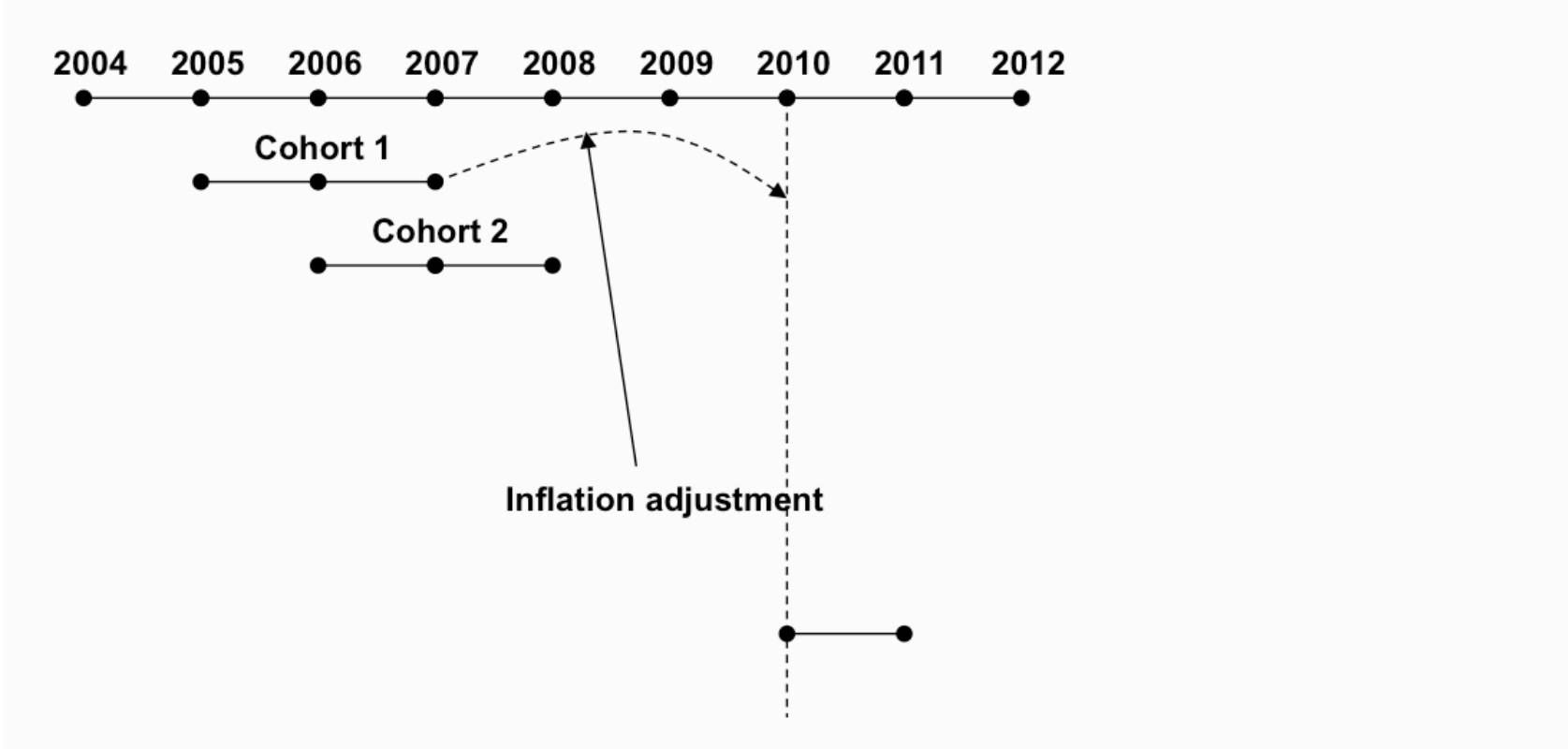
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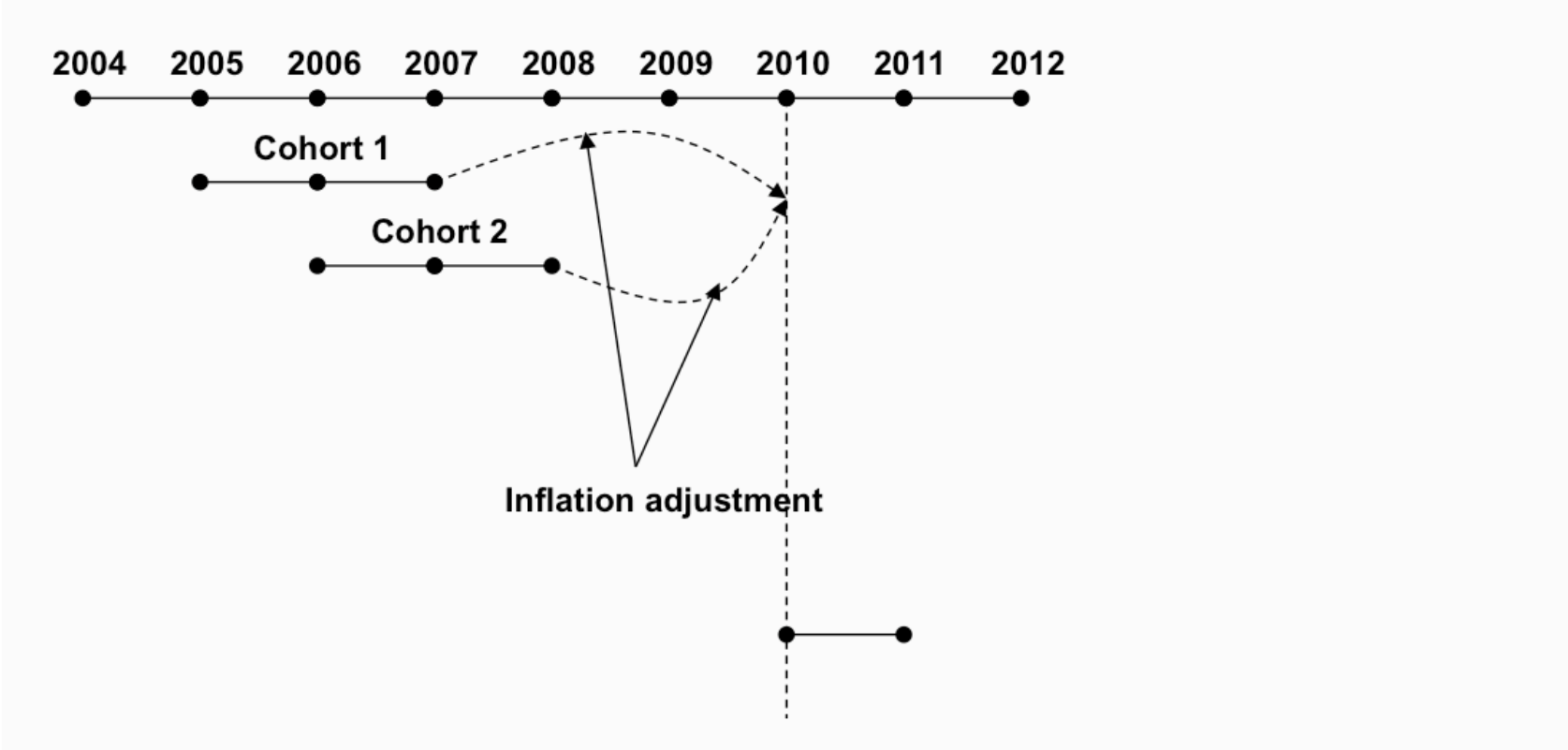
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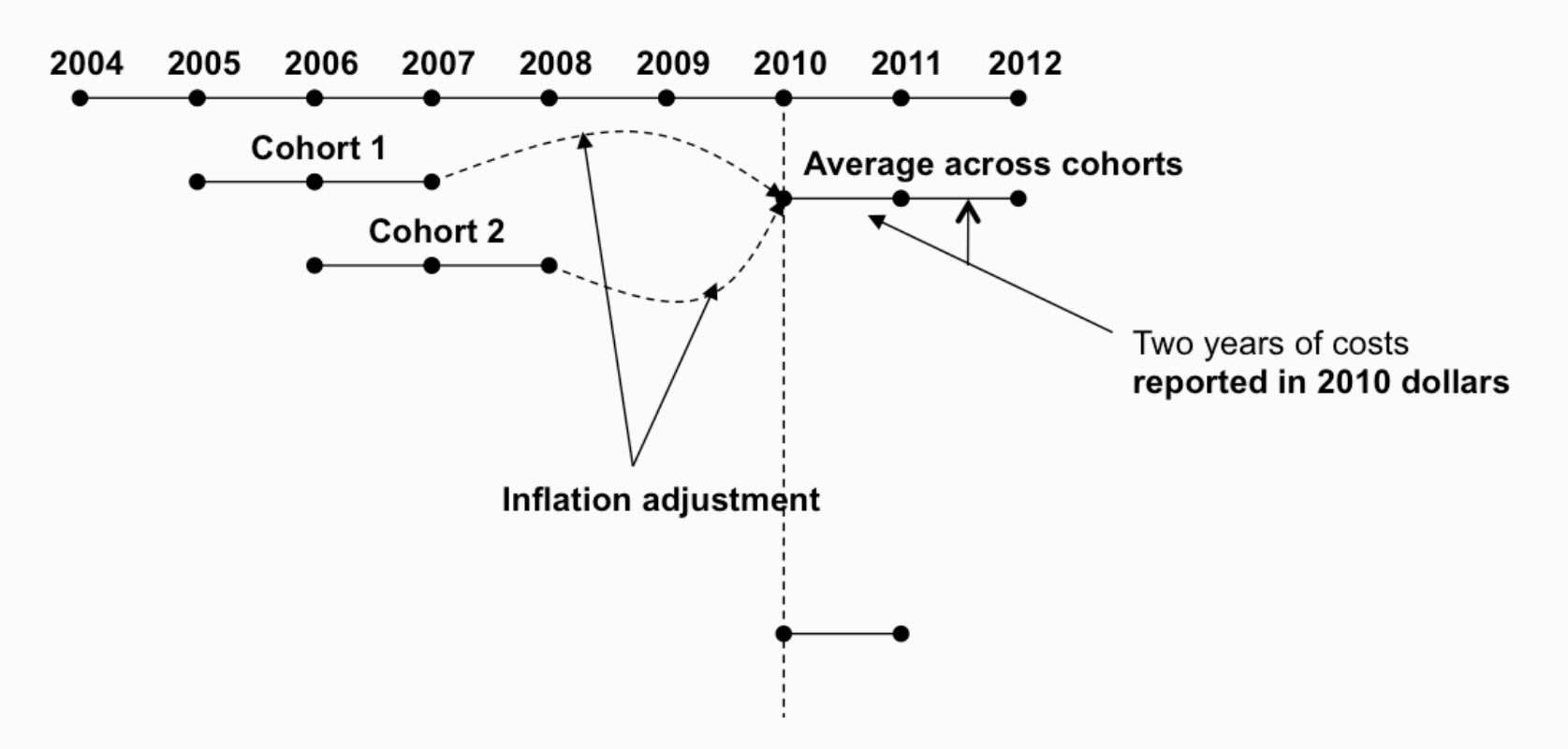
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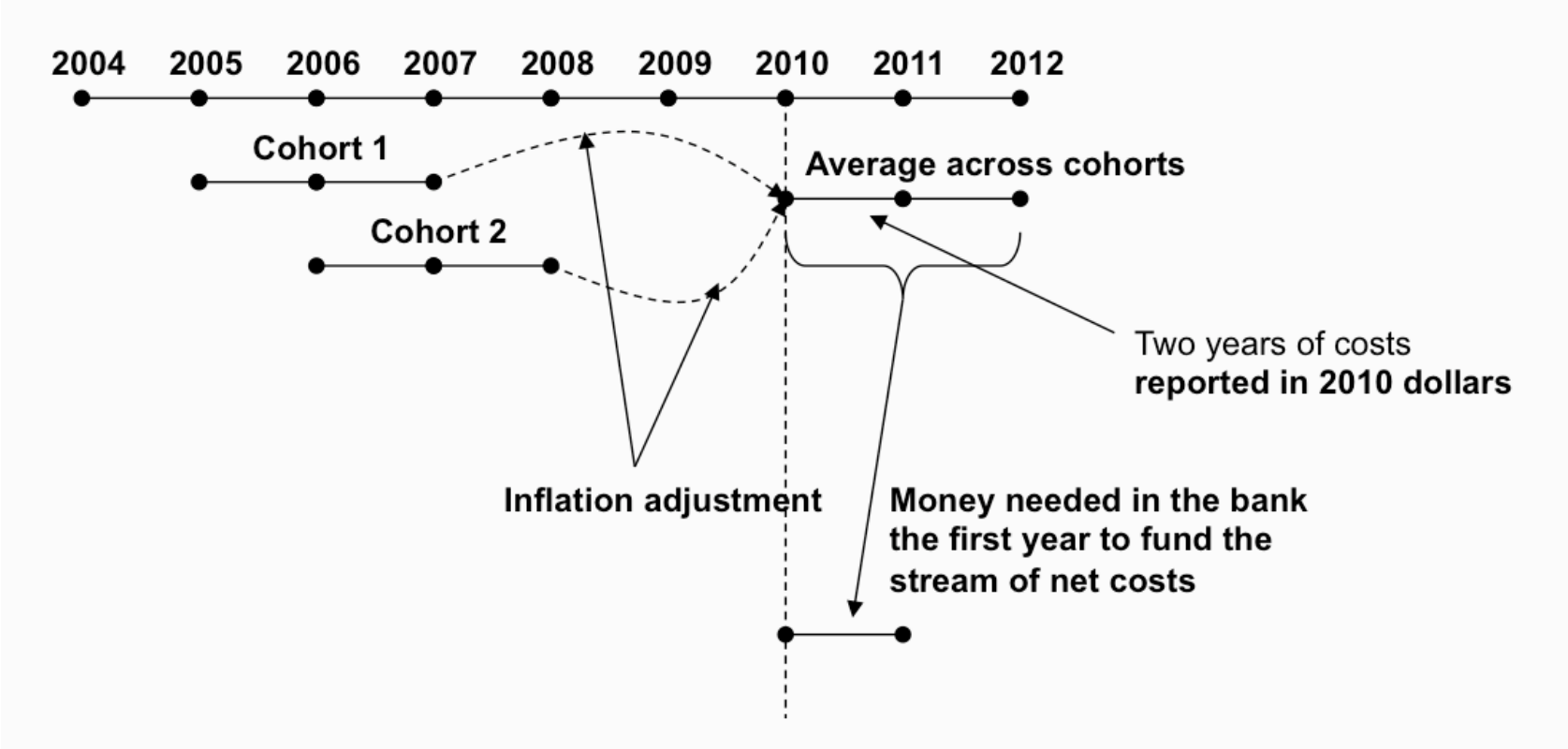
Putting it All Together: Schematic Diagram of Inflation Adjustment and Discounting



Putting it All Together: Schematic Diagram of Inflation Adjustment and Discounting



Putting it All Together: Schematic Diagram of Inflation Adjustment and Discounting



Summary: Measurement of Cost

- Measurement of costs is the foundation for tools of economic analysis commonly used to guide useful for informing health policy such as vaccine programs.
- Costing process
  - describe course of treatment or sequence of events
  - identify and quantify resources used
  - assign unit cost to each type of resource
- Common approaches to cost measurement
  - observe market prices (with caution!)
  - micro-costing (“ingredients”)
  - standard costs (WHO CHOICE)
- Once program costs have been determined, adjustments may be necessary (discounting, inflation, currency)

Exercise: Measuring and Valuing Cost

- Review questions in groups
- Discuss potential responses
- Respond to questions online

Discussion Questions (Quiz)

1. Which cost is not a fixed capital cost?
   a. Buildings
   b. Equipment
   c. Vehicles
   d. Medicines IV

2. The opportunity cost is
   a. the same for everyone pursuing this activity
   b. may include both monetary costs and forgone income
   c. always decreases as more of that activity is pursued
   d. usually is known with certainty
   e. measures the direct benefits of that activity

3. Opportunity costs arise in production because
   a. resources are unlimited
   b. resources must be shifted away from producing one good in order to produce another
   c. wants are limited in society
   d. monetary costs of inputs usually outweigh non-monetary costs
   e. the monetary costs of only a few resources are zero

4. A decrease in the productivity of labor is
   a. An increase in the productivity of labor
   b. An increase in fixed cost
   c. A decrease in the demand for the good produced by that firm
   d. An increase in demand for the good produced by that firm