Short Run: Reality, Theory, Policy

Goods-Services Market Equilibrium and "IS Curve"

(part 1/3)

T. Kam

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Outline of Talk

Learning Objectives

- Using empirical observations of business-cycle data to inform the design of a simple model.
- Model as:
  - interpretive framework for observed behaviour in short-run/business-cycle data
  - laboratory for studying controlled experiments: shocks and policy changes
- We study this in **three** building blocks:
  - **the IS curve**
  - PC curve
  - the MP curve

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- **First building block** of our short-run model: **the IS curve**
  - describes the short-run relationship between *endogenous* real interest rate and output
  - represents *equilibrium* (demand = supply) in goods/services market
- **Visual Intuition of IS curve**
  - **Exogenous Shocks** to consumption, investment, government purchases, or net exports—"aggregate demand shocks"—***shift*** the IS curve.
  - **Endogenous Change** in policy (interest rate and/or inflation)—***movement along*** IS curve.
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Motivation: Empirical Regularities and Modelling Choice

Language

- We'll use phrases like:
  - "the short run"
  - "(over) the business cycle"
  - "cycle"
  - "economic fluctuations"

  to denote the same idea about the *short run outcomes* of an economy.

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- Notation:
  - $\Delta(\pi_t) := \pi_t - \pi_{t-1}$: one-period change inflation rate
  - $Y_t - \bar{Y}_t$ is called "output gap":
    - $\bar{Y}_t$: long run (potential) output level (in Mishkin, this is Y_t^P)
    - Y_t : date-t actual output level (cycle component of observed output)
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- Given observed data, or historical event, or recorded case study of a crisis ...
- We want our insights on these short run outcomes to be disciplined *equilibrium solutions* emerging from a well-defined model.
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- If we agree on the premise of our model, we then use it to perform alternative experiments:
  - external shocks — e.g. what if China's demand for Australian export fall? What if the U.S. Fed raises its federal funds rate? What if there is a collapse of "consumer confidence" in housing/retail?
  - (fiscal and/or monetary) policy changes — e.g. What are the effect on inflation and unemployment if the RBA decides to raise interest rates? What are the effects of raising GST?

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Tools Required

Techniques:

- Curve sketching technique (how to draw graphs of linear functions)
- Elementary algebra: substitutions, simplifications

Economics:

- National Accounting
- Long-run vs. short run
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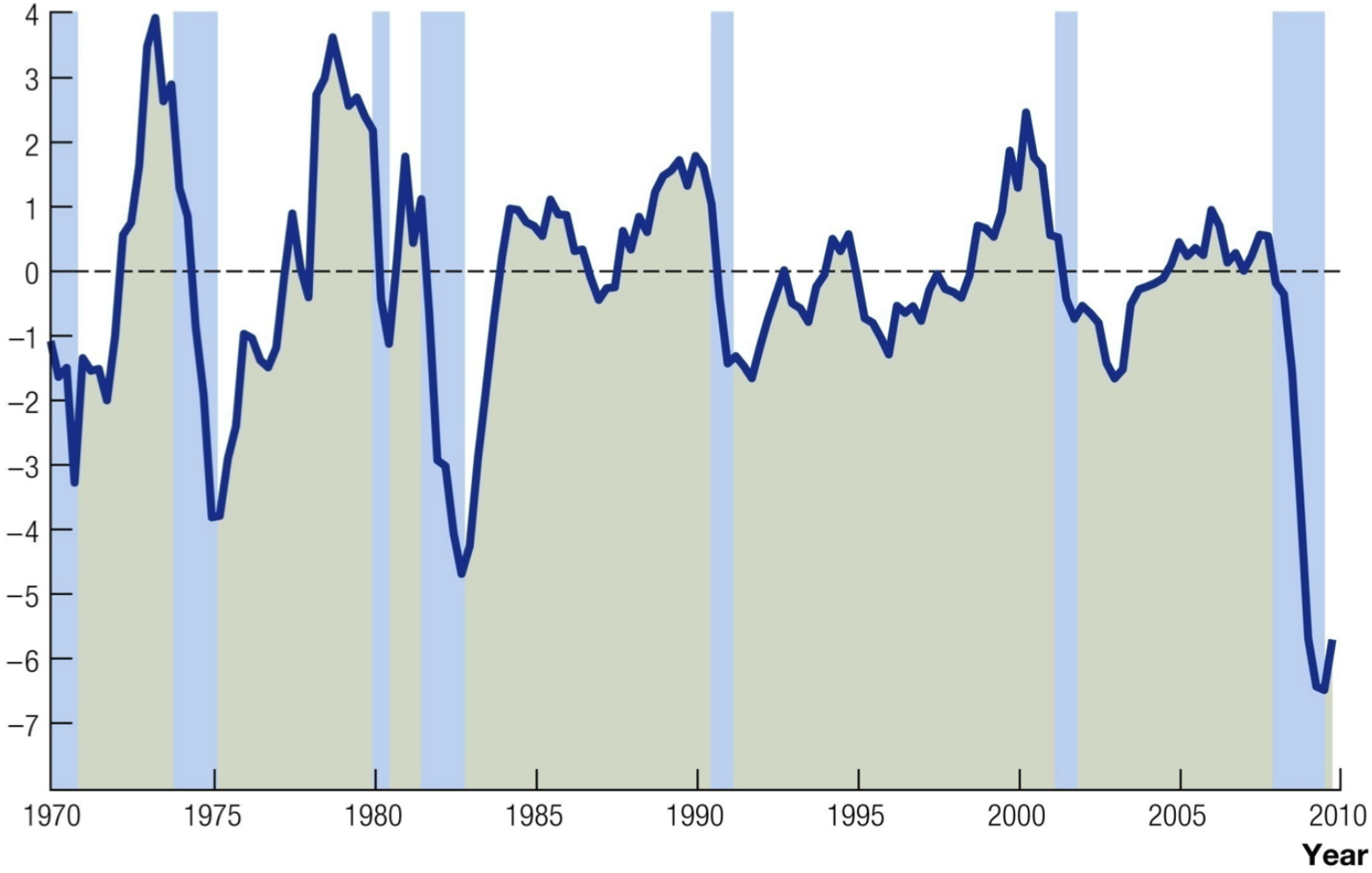
What do we see out there?



Percentage "output gap" (U.S.): $(Y_t/\bar{Y}_t - 1) \times 100\%$

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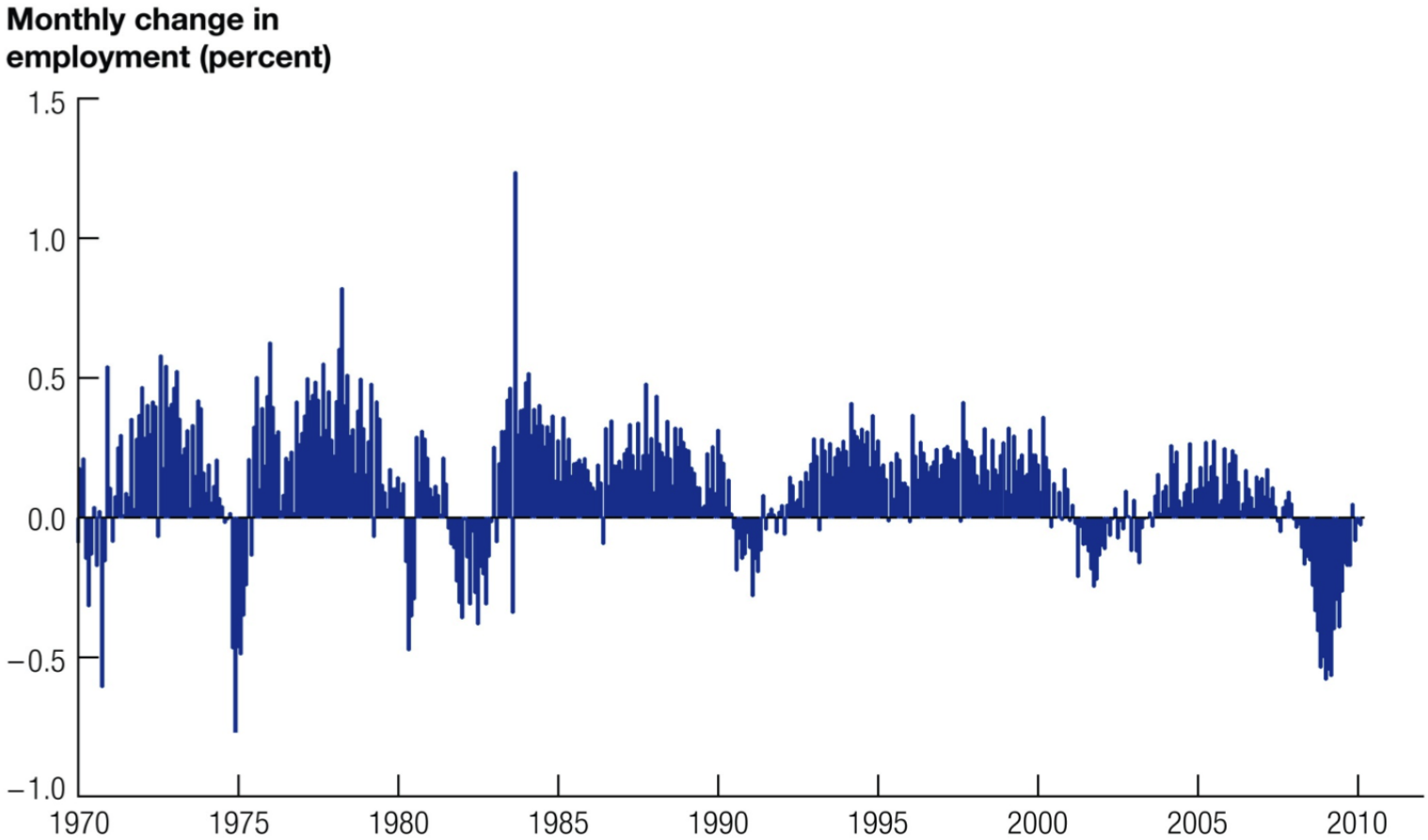

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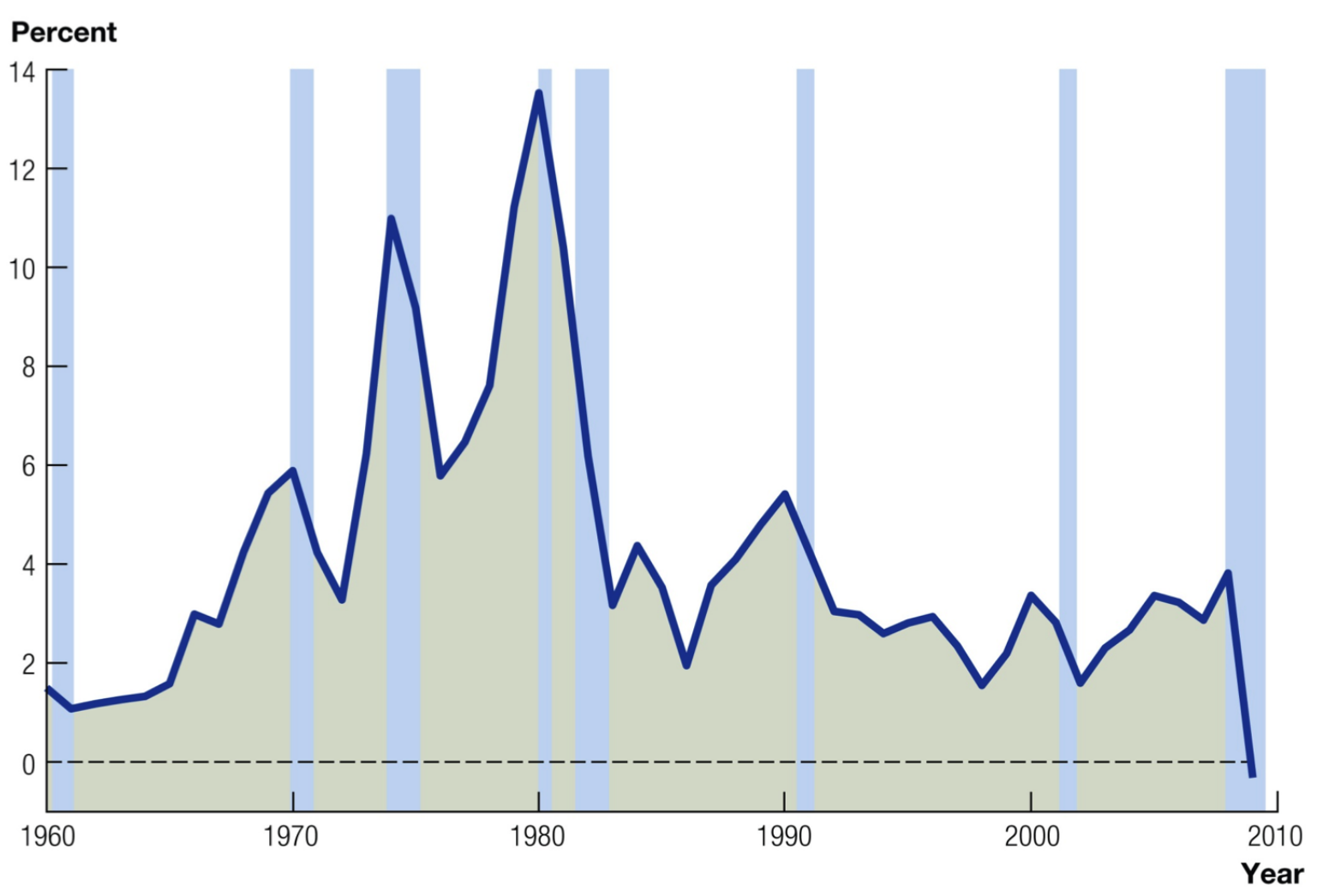

U.S. Inflation Rate

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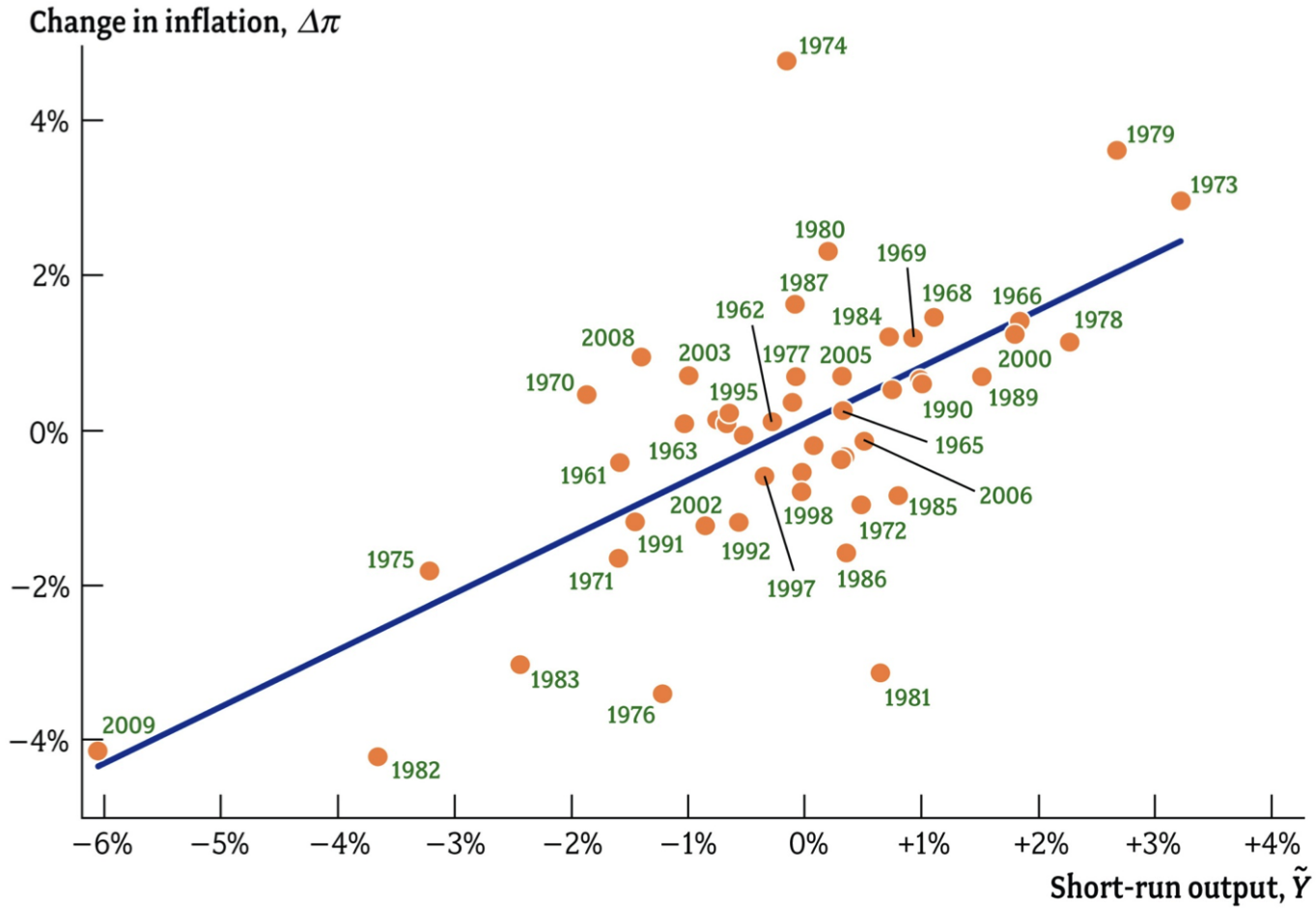

Note: $\tilde{Y}_t := (Y_t/\bar{Y}_t - 1) \times 100\%$ i.e. output gap as percentage deviation of short run actual output from long run potential output.

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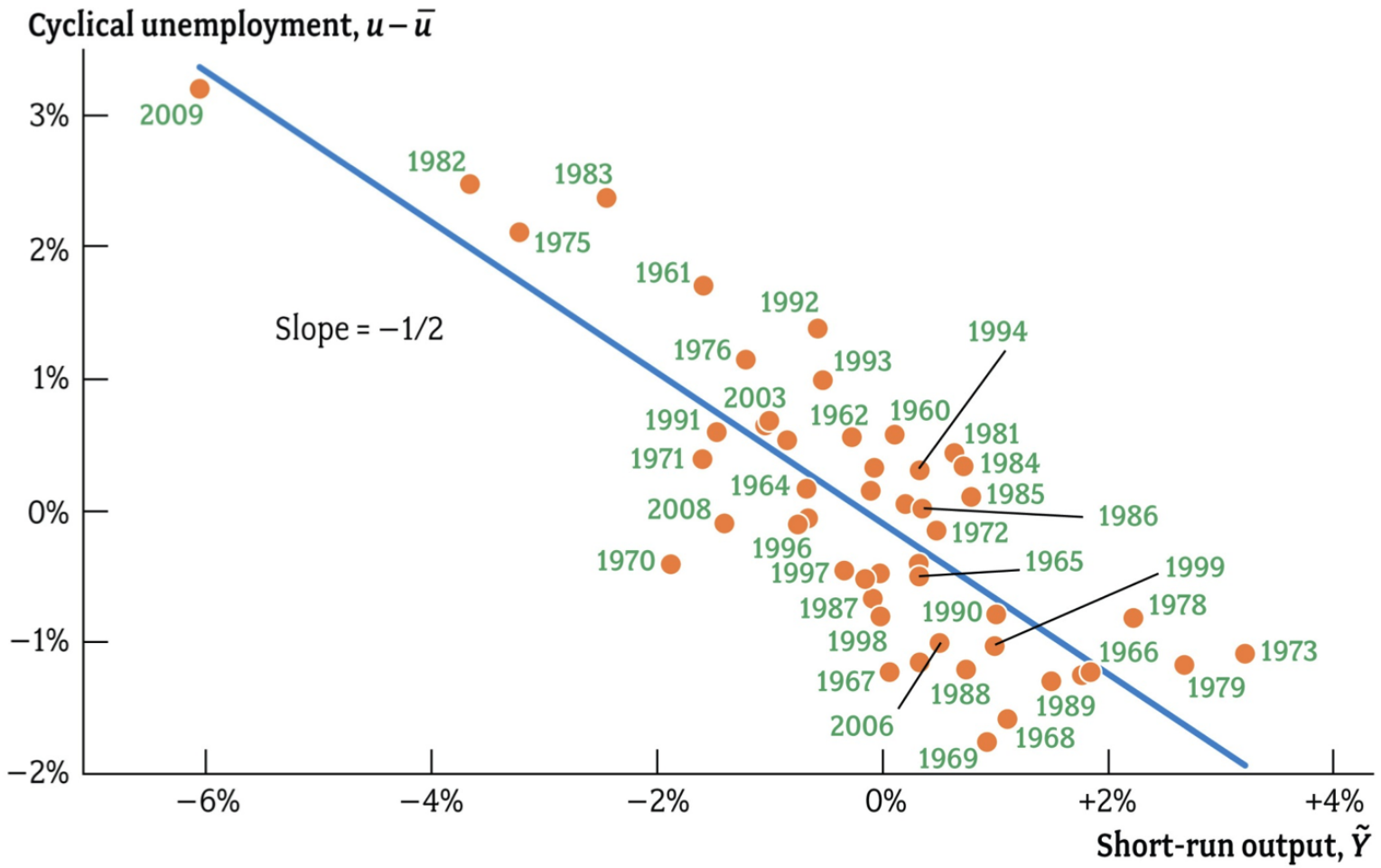

Note: $u_t - \bar{u}_t$ i.e. percentage deviation of short run unemployment rate from some long-run "natural rate".

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Motivation

We see some (short run) empirical regularities

1. Observed fluctuations in economic activity (output) around some long-run trend
2. Fluctuations in output appear as cycles of peaks and throughs: with irregular amplitudes and frequencies
3. Recessions typically associated with falls in inflation rate
   - **Procyclical inflation:** Positive correlation between inflation growth and short run output
4. Expansions associated with lower unemployment
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How do we model these relationships?

- We want a model that is able to capture ideas about "aggregate shocks" and "policy changes" in the short run.
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  - We return to this *empirical point* when we're done understanding this model.
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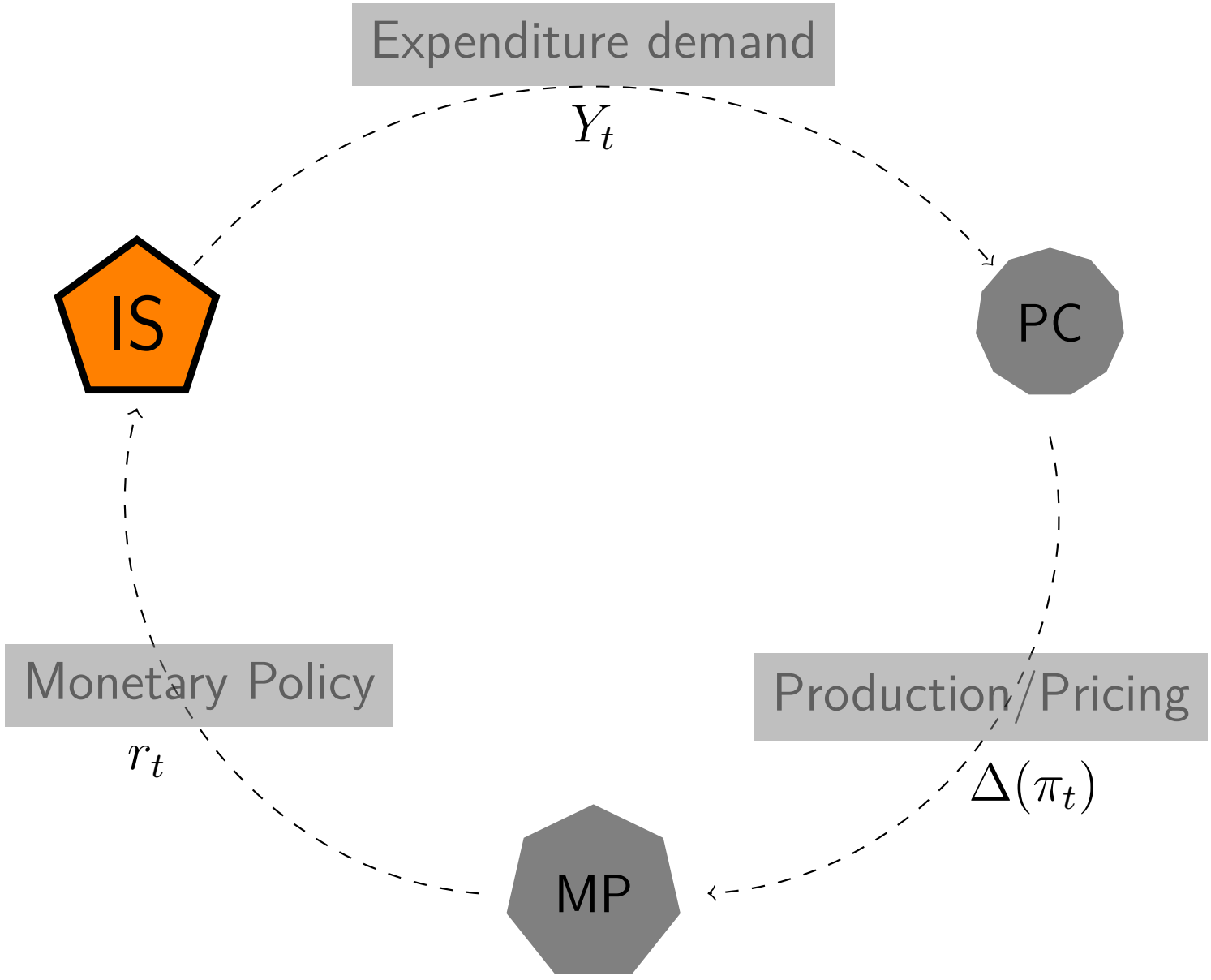

Look-ahead: Schematic of IS-PC-MP model (to come).

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Keep a watch out for these things!

Look-ahead!

Three building-block components: IS, PC and MP. Watch out for:

- *what* each component represents!
- *how* they come together to represent overall (short-run) equilibrium requirements:
  - IS: Goods/services market
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- *how to use* IS-PC-MP to "fit the facts" and to understand various experiments: shocks and policy change case studies.

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Block 1/3: The IS Curve

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The IS Curve

Spoiler!

- The central bank exerts a substantial influence on the level of economic activity in the short run.
- Sets the rate at which people borrow and lend in financial markets.
- The basic story is this:

$$\uparrow i_t \overset{Fisher, sticky-prices}{\Longrightarrow} \uparrow r_t \Longrightarrow \downarrow I_t, C_t, NX_t \Longrightarrow \downarrow Y_t \Longrightarrow \downarrow (Y_t - \bar{Y}_t)$$

  - i_t : nominal interest rate (e.g. RBA's policy "cash rate")
  - r_t : real interest rate
  - I_t : investment
  - $Y_t - \bar{Y}_t$: short-run output gap (deviation of actual output from *exogenously given* potential)

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The IS Curve

Spoiler!

- The basic **causal-chain** story is this:

$$\uparrow i_t \overset{Fisher, sticky-prices}{\Longrightarrow} \uparrow r_t \overset{\underset{markets}{Fin./Money}}{\Longrightarrow} \downarrow I_t, C_t, NX_t \overset{\underset{markets}{Goods/Services}}{\Longrightarrow} \downarrow (Y_t - \bar{Y}_t)$$

- We'll see: this story is a *relationship between* r_t and Y_t, arising from **equilibrium in goods/services markets.** Meaning?
- In turn: this depends strongly on *"sensitivity" of aggregate investment demand to (real) interest rate*. What does this mean?

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The IS Curve

From final goods market clearing to IS

- The **IS curve**
  - captures the relationship between interest rates and output in the short run;
  - is the *locus or set of points* (Y_t, r_t) *such that we have goods/services expenditure demand equalling production supply*.
- **Trivia:** Why is the short-run goods/services market equilibrium condition called "the IS curve"? Where does IS come from?

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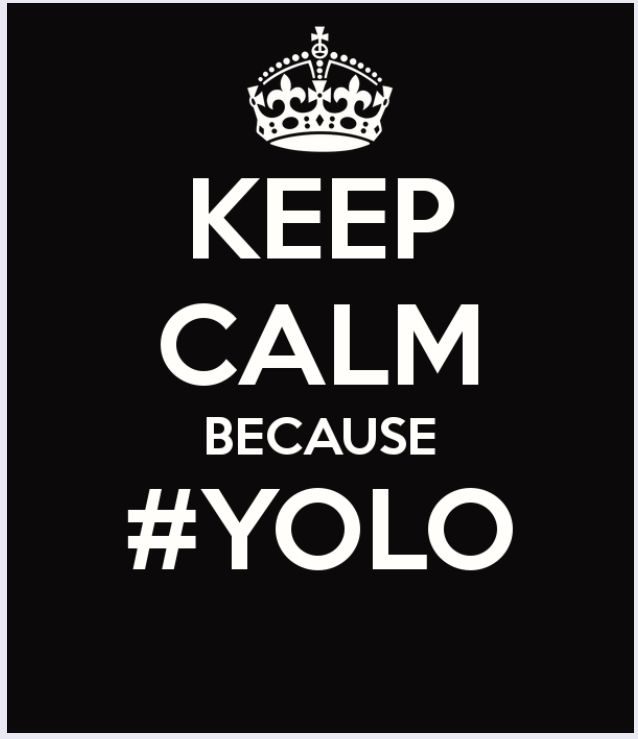
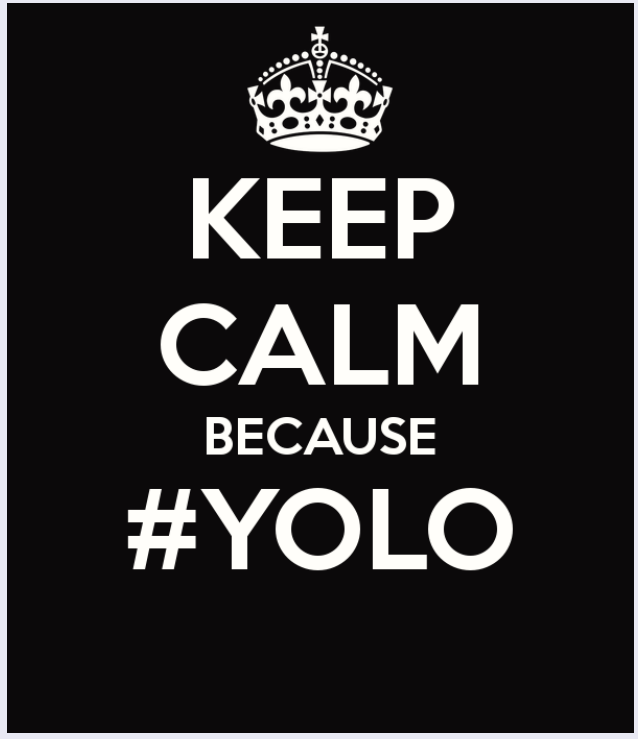


- In what follows, things might appear gnarly at first sight.
- Take a deep breath and take it in slowly.
- You may need to go back a few times.
- We'll break things down into bite-size steps.
- When we put it together at the end it won't be as scary as you thought!



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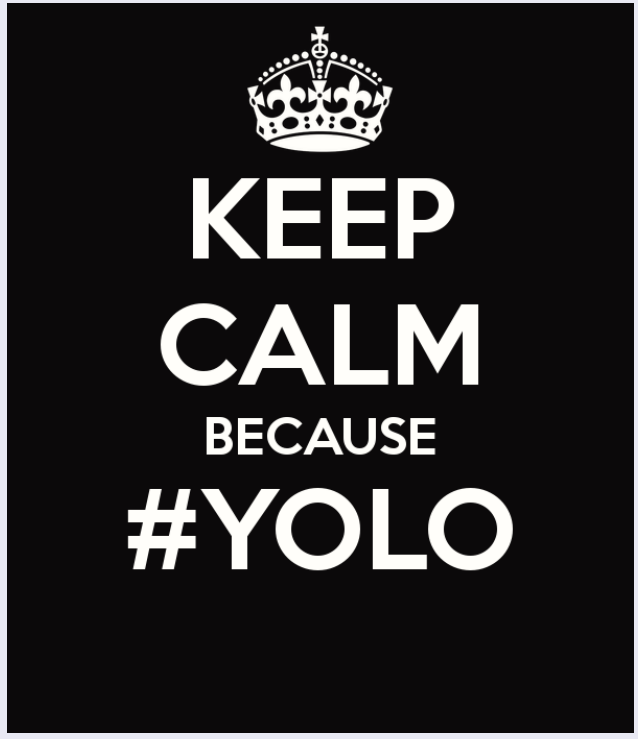

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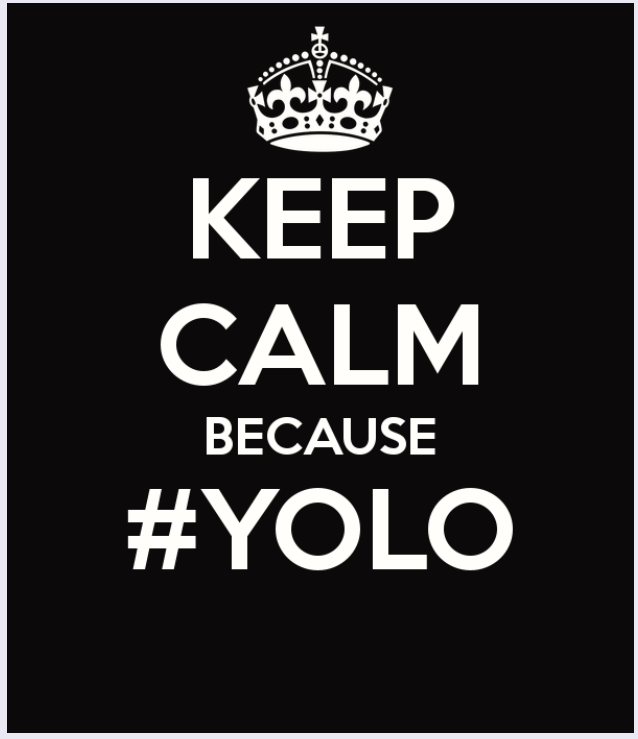

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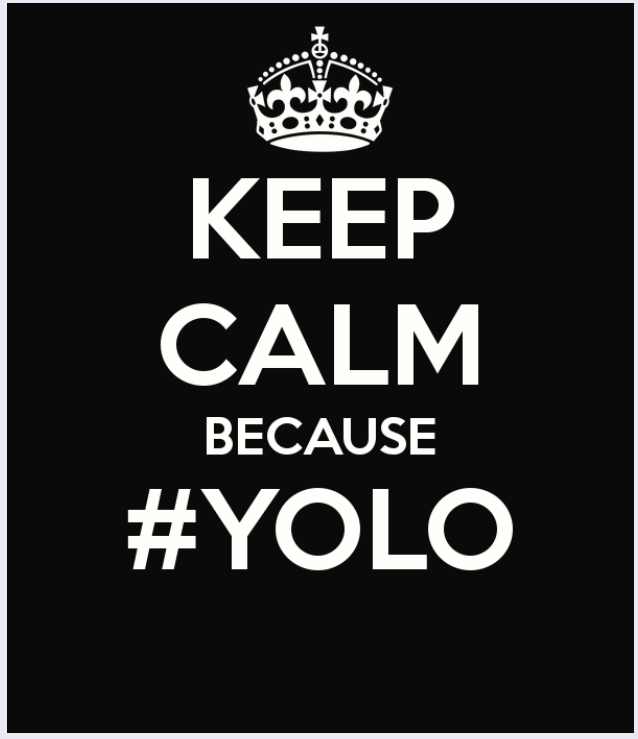

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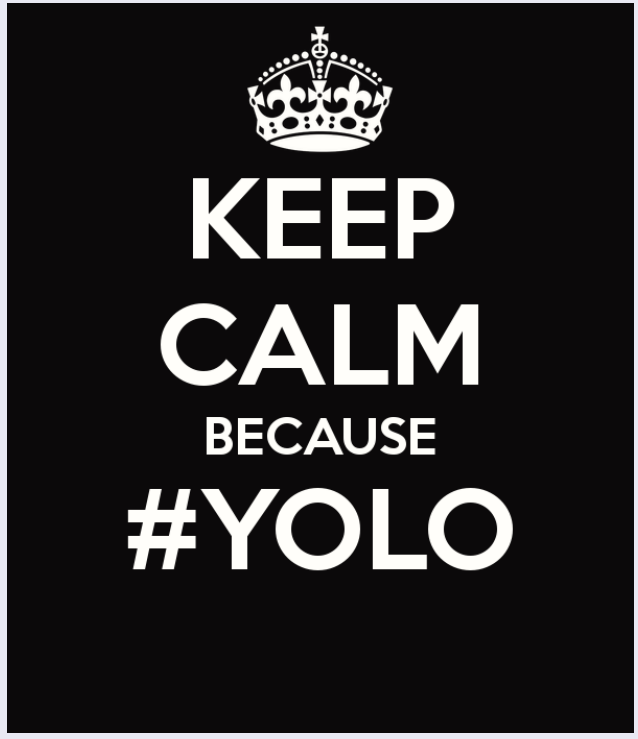

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The IS Curve

Aggregate expenditure

Step 1

Aggregate demand for goods and services

$$D_t \equiv C_t + I_t + G_t + NX_t$$

Aggregate supply by producers: Y_t.

The IS Curve

Aggregate expenditure: components (a model)

Step 2: Assumptions (Keynes-Hicks)

Model for component (expenditure) demands

$$C_t = \bar{C} + mpc \times (Y_t - T_t) - c \times r_t, \qquad 0 < mpc < 1,\ 0 \leq c < 1$$
$$G_t = \bar{G}$$
$$NX = \bar{NX} - x \times r_t, \qquad 0 < x < 1.$$
$$I_t = \bar{I} - d \times r_t, \qquad 0 < d < 1.$$

Note: no need to memorize! These assumptions will be given to you. Know what they represent.

The IS Curve

Aggregate expenditure: components: consumption demand

$$C_t = \bar{C} + mpc \times (Y_t - T_t) - c \times r_t, \qquad 0 < mpc < 1,\ 0 \leq c < 1$$

Curent consumption demand depends on ...

- autonomous/exogenous consumption ... Interpretation?
- disposable (net of income-tax) income ... sensitivity is mpc. What does mpc stand for?
- current real interest rate ... with senstivity c. What does this mean?

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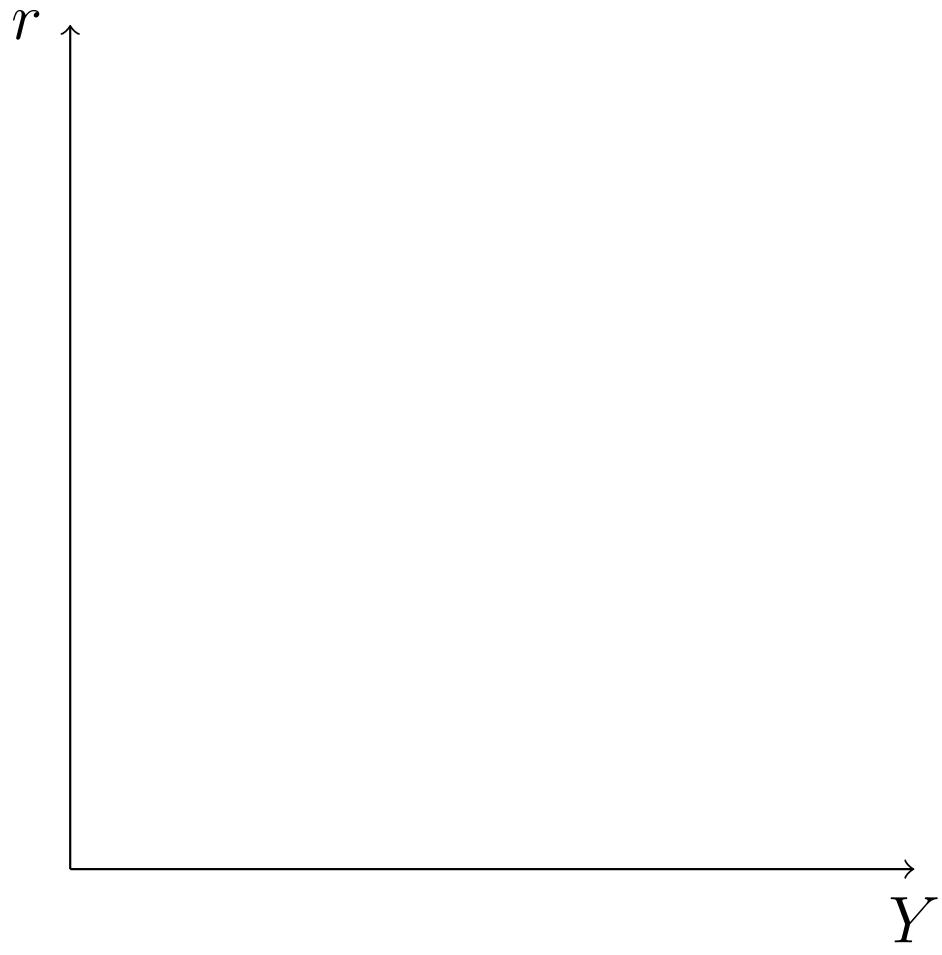
Aggregate expenditure: components: consumption demand

Exercise

Sketch the graph of the consumption-to-potential-output function in (Y, r)-space.



Graph of aggregate consumption demand function.

The IS Curve

Aggregate expenditure: G demand component

Exercise

Sketch the graph of government expenditure demand function in the same (Y, r)-space:

$$G_t = \bar{G}$$

- As before, horizontal axis in units of final goods Y, and, vertical axis labelled with r
- But there is no Y or r here in the demand function for G_t. What to do?

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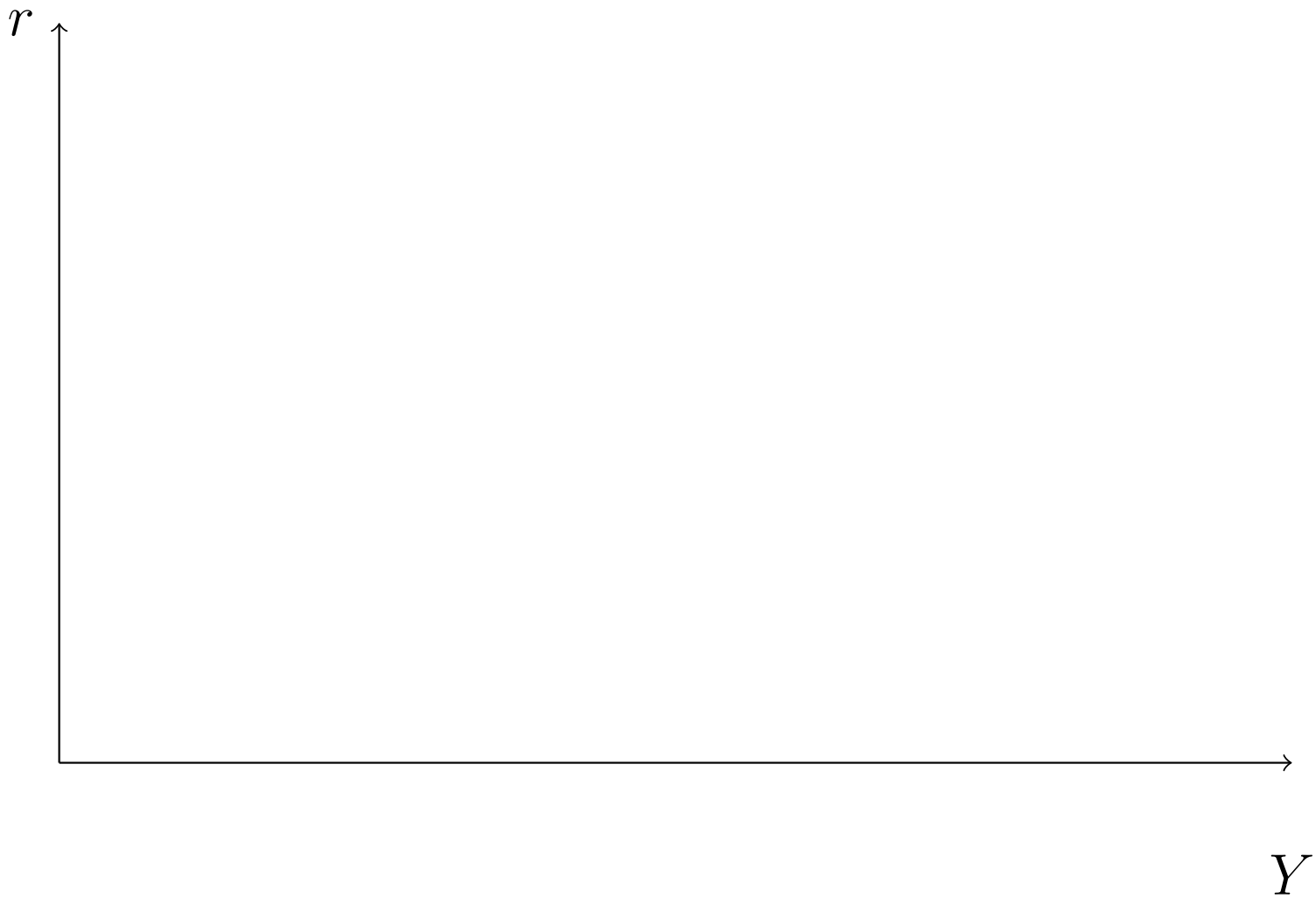

The IS Curve

Aggregate expenditure: NX components

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Sketch the graph of government expenditure demand function in the same (Y, r)-space:

$$NX = \bar{NX} - x \times r_t, \qquad 0 < x < 1.$$

Explain:

- what this assumption on *net exports behavior* says?
- what's the intuition behind it?
  - linkage between international demand for assets, the foreign exchange of currencies, and net exports ... (p.226)

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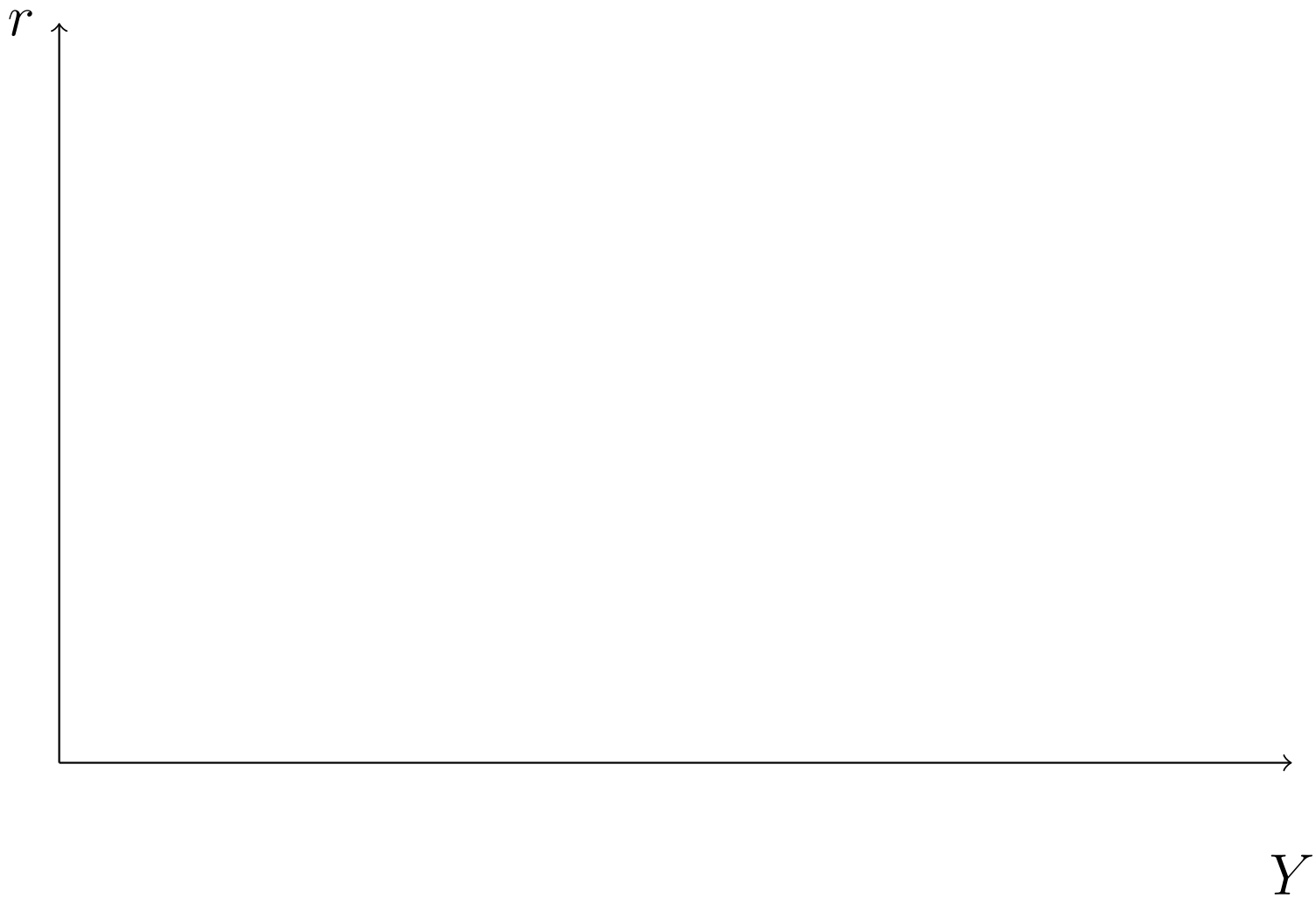

The IS Curve

Aggregate expenditure: I demand components

$$I_t = \bar{I} - d \times r_t, \qquad 0 < d < 1.$$

What this assumption says:

- private investment demand is declining with the *real* rate of return on capital goods
- What is d capturing?
- What is $\bar{I}$?

Exercise

Sketch the graph of private investment demand function in the same (Y, r)-space.

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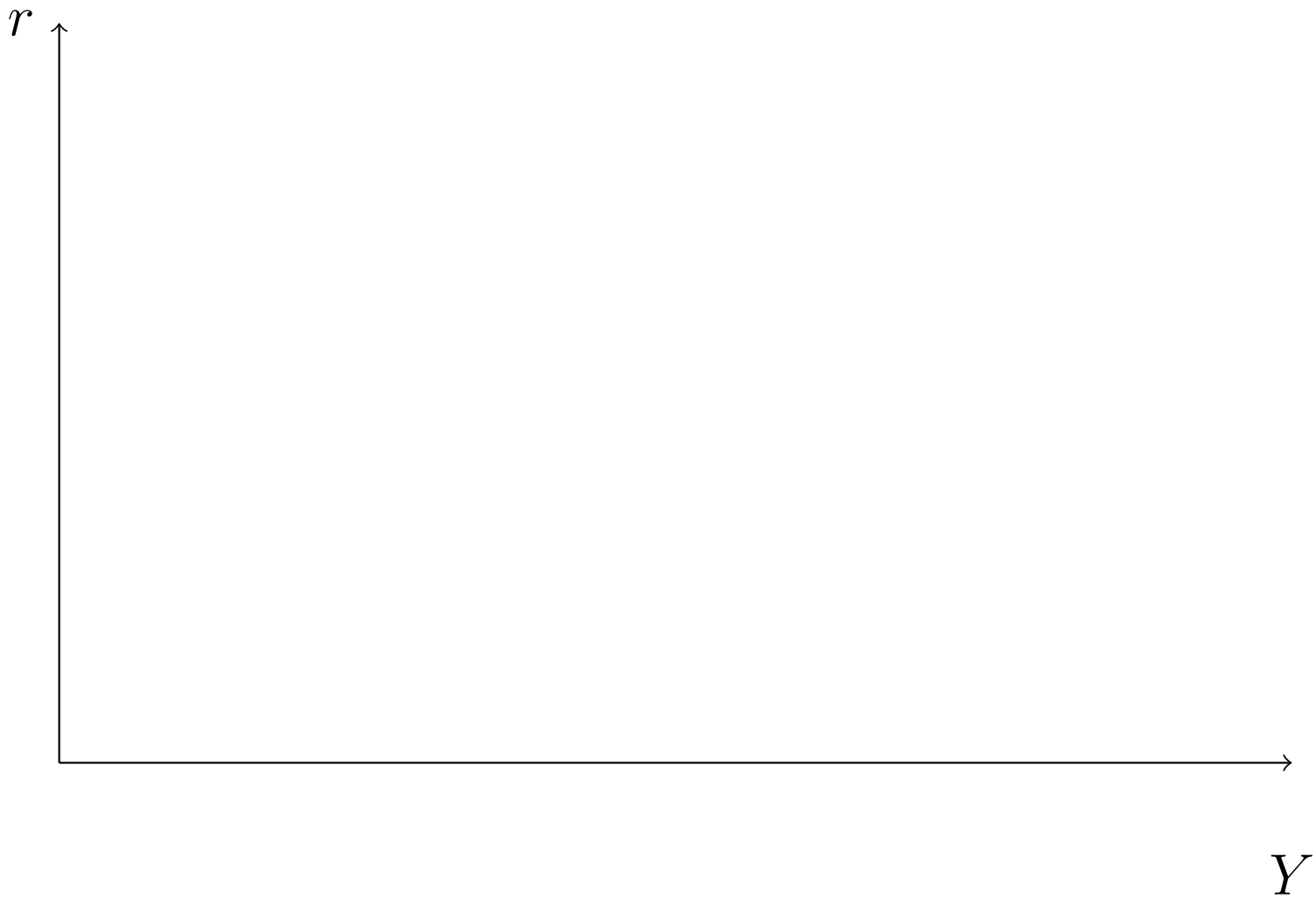

The IS Curve

Aggregate Demand and Model Assumptions

Step 3 ... Apply model assumptions

Total of aggregate expenditure demands components:

$$
\begin{aligned}
D_t &:= C_t + I_t + G_t + NX_t \\
&\underbrace{=}_{\text{by Step 2}} \left[\bar{C} + mpc \times (Y_t - T_t) - c \times r_t\right] \\
&\quad + \left[\bar{I} - d \times r_t\right] + \bar{G} + \left[\bar{NX} - x \times r_t\right]
\end{aligned}
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The IS Curve

Aggregate Demand= Aggregate production/income

Step 4 ... "equilibrium in goods/services market"

$$\begin{aligned} Y_t &= D_t \\ &= \left[\bar{C} + mpc \times (Y_t - T_t) - c \times r_t\right] + \left[\bar{I} - d \times r_t\right] + \bar{G} \\ &\quad + \bar{NX} - x \times r_t, \end{aligned}$$

also implies the national income accounting identity: (LHS) GDP (production/income); and (RHS) GDP (expenditure/demand).

Note:

- RHS also dependent on endogenous income Y_t!
  - Equilibrium (in goods/services market) is self-referential on Y_t. Why?
  - The circular economy and connection to national accounting. Meaning?

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The IS Curve

Goods and services market equilibrium

Step 4 ... tidy up

Goods-and-services *market* ***equilibrium*** dictates a particular set (or "locus") of possible equilibrium *outcomes* (Y_t, r_t).

This requirement shows up algebraically (i.e. tidy up) as:

$$\begin{aligned} Y_t &= D_t \\ &= \frac{\left[\bar{C} + \bar{I} + \bar{G} + N\bar{X} - mpc \times \bar{T}\right]}{1 - mpc} - \left[\frac{c + d + x}{1 - mpc}\right] r_t. \end{aligned}$$

How do we visualize this *goods-and-services* market equilibrium requirement?

The IS Curve

Goods and services market equilibrium: the visual representation

Step 4 ... from algebra to visual intuition

Goods-and-services *market* ***equilibrium*** equivalently rearranged as:

$$r_t = \underbrace{\frac{\left[\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T}\right]}{c + d + x}}_{\text{"vertical"-intercept}} \underbrace{- \left[\frac{1 - mpc}{c + d + x}\right]}_{\text{slope}} Y_t.$$

Visually: the set/locus of points (Y_t, r_t) satisfying good-and-services market equilibrium is defined by this linear relationship/restriction!

The IS Curve

Goods and services market equilibrium: the visual representation

Example

$$
\begin{aligned}
r_t &= \underbrace{\frac{\left[\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T}\right]}{c + d + x}}_{\text{"vertical"-intercept}} - \underbrace{\left[\frac{1 - mpc}{c + d + x}\right]}_{\text{slope}} Y_t \\
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&= 12 - Y_t.
\end{aligned}
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- r-intercept is 12;
- slope is -1

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The IS Curve

Goods and services market equilibrium: the visual representation

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&= \underbrace{\frac{[1.1 + 1.2 + 3.0 + 1.3 - 0.6 \times 3.0]}{0.1 + 0.2 + 0.1}}_{\text{"vertical"-intercept}} - \underbrace{\left[\frac{1 - 0.6}{0.1 + 0.2 + 0.1}\right]}_{\text{slope}} Y_t \\
&= 12 - Y_t.
\end{aligned}
$$

- r-intercept is 12;
- slope is -1

The IS Curve

Goods and services market equilibrium: the visual representation

Exercise

Collect all the components you sketched earlier from Steps 1-3. Then ...

- add these graphs horizontally ...
- *et voila* ... you get visually/geometrically what we derived in Step 4, in terms of the **graph of the IS locus**.

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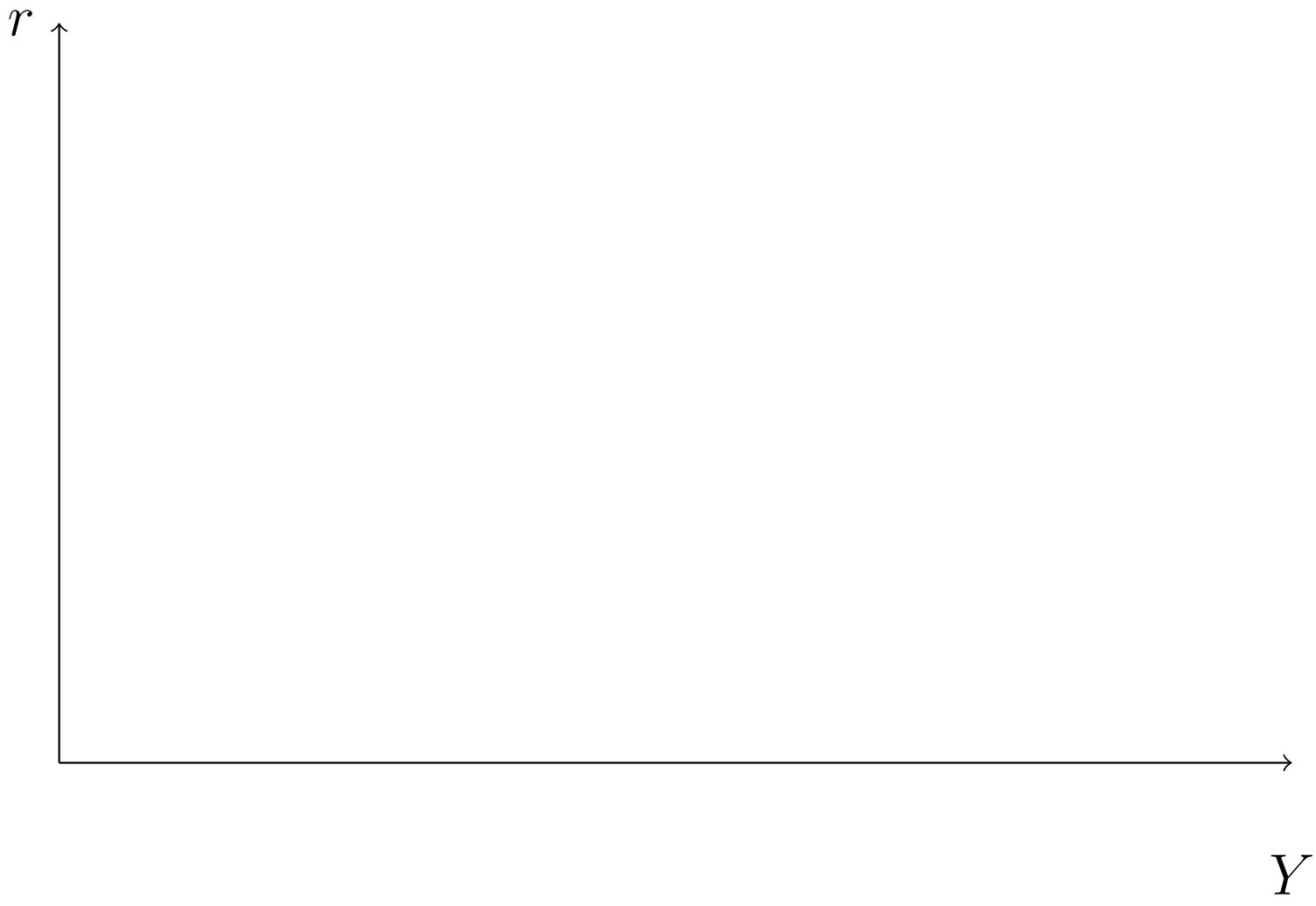

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- A concise summary of the requirement that in the short-run, good/services demands must equal aggregate supply.
- On the demand side, the IS curve embeds a bunch of (Keynes-Hicks) behavioural assumptions about these demands.
- Equilibrium in goods/services market is thus given by the restriction on how (Y, r) should behave in a short-run equilibrium:

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Slides: movement along the IS?

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- Note both r and Y are endogenous variables! The linear relation *says nothing about causality* between r and Y!
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  - The higher interest rate raises borrowing costs and makes domestic currency appreciate
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Short answer:

- Anything not labelled as Y and r on the axes in (Y, r)-space!

Precise answer:

- any shock to autonomous demand components: $\bar{C}, \bar{I}, \bar{G}, \bar{NX}, \bar{T}$
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  - How? In which direction?

Australian National University

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Imagine that China enters into a recession.

The net exports demand for Australian goods/services—e.g. gas, higher education, etc.— declines: $\downarrow \bar{NX}$

The IS curve shifts to the left, for every possible level of r_t.

Thus China's recession has an international effect on Australia's goods/services market equilibrium!

Exercise

Sketch the IS curve and its resulting shift from this Example.

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Using the IS Curve

Shocks: a fall in export demand (exogenous)

Using the IS Curve

Shocks: what shifts the IS?

Example

Suppose the Australian government decides to cut public spending, so $G_t = \bar{G}$ falls.

This lowers aggregate demand D_t.

The IS curve, reperesenting the balance of aggregate demand and supply, shifts to the left.

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Using the IS Curve

Shocks: a fall in government spending (exogenous)

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Shocks: what shifts the IS?

Example

Suppose the Australian government decides to cut public spending and taxes by the same amount, so $G_t = \bar{G}$ *and* $\bar{T}$ falls by the same amount.

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Sketch the IS curve and its resulting shift from this Example. Explain your reasoning using the IS curve you have derived.

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Shocks: a fall in government spending (exogenous)

Optional Non-Examinable Material (Mishkin, Section 7):

Microeconomic Foundations for IS

Microfoundations

- Microfoundations
  - The underlying microeconomic behaviour that establishes the demands for C, I, G, EX, and IM.

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Microfoundations

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- Consider consumption demand, C_t:
  - a model of consumer preferences; risk-averse consumers
    - people prefer a smooth path for consumption
    - they dislike a consumption path that involves large movements across dates and states of the economy

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  - If consumers are borrowing constrained, permanent income hypothesis breaks down.
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- An instrument to reduce fluctuations

Discretionary fiscal policy

- Includes purchases of additional goods in addition to the use of tax rates
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- Shows a negative relationship between output and the real interest rate

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- The most important are associated with the no-free-lunch principle imposed by the government's budget constraint.
- Depending on how government purchases are financed, they can also affect consumption and investment.
  - partially mitigating the effects of fiscal policy on short-run output

Conversation Pieces

... with your loved ones over dinner tonight

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- IS curve
- goods market equilibrium
- economic or short-run fluctuations
- observed output; short run output; potential output
- microfoundations; permanent income; consumption and tax smoothing
- shifts to and movements along IS

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