Honors - Economic Analysis III

Lecture 0: Introduction

Simon Mongey

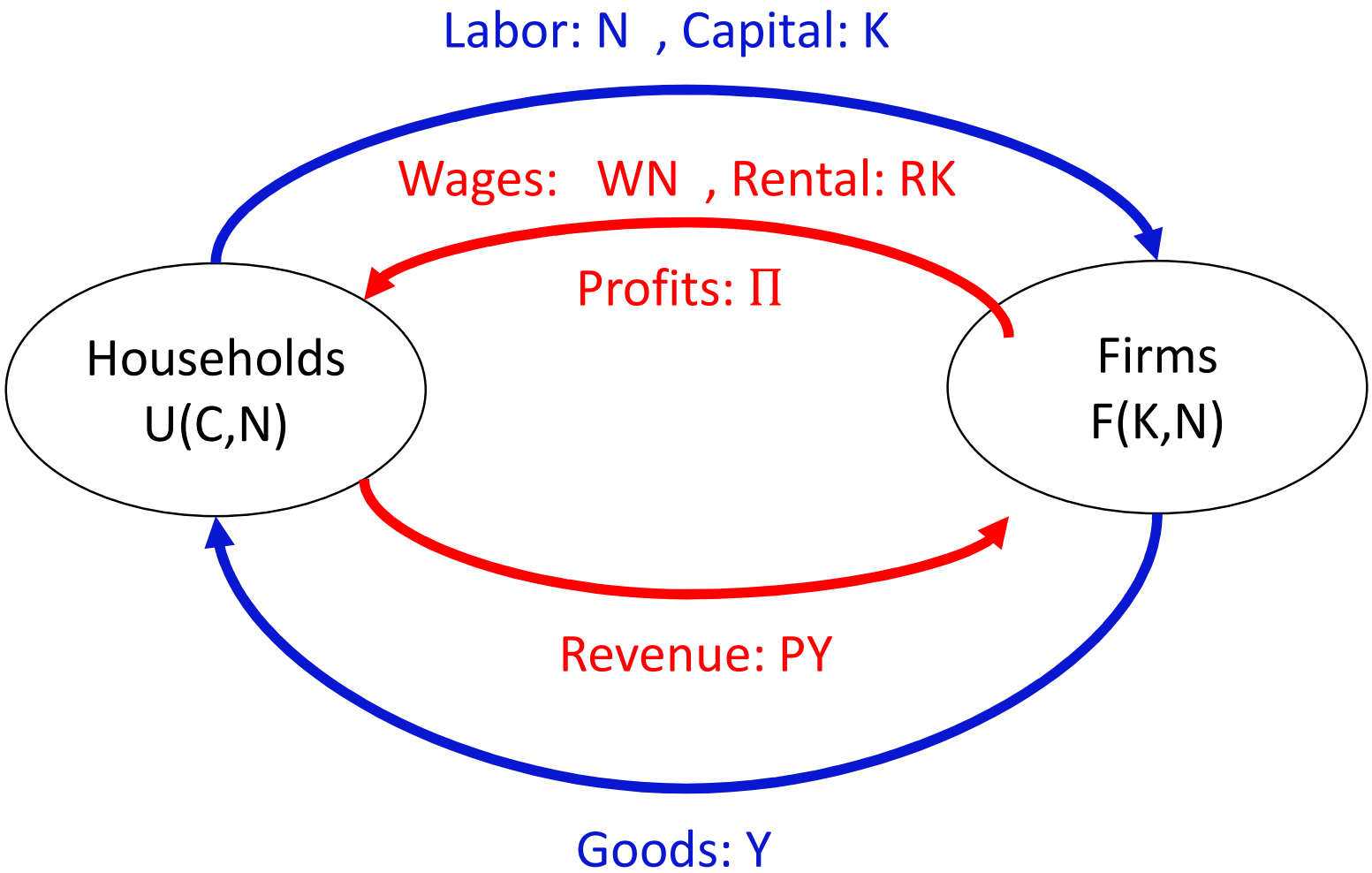
Winter, 2021

This course

- *Questions*
  - How does the economy grow?
  - How does it respond to changes?
  - What determines output, consumption, investment?
  - How are assets (stocks, government bonds) valued?
  - How do individuals in the economy bear risk?
  - How do these answers change under different government policies?
- *Answers*
  - Build on *general equilibrium neo-classical model* from micro
    1. *Consumers*: Consume, save, supply labor
    2. *Firms*: Produce, invest, demand labor
    3. *Markets*: For goods, bonds, stocks, labor

Structure of the macroeconomy

Supply and demand of labor, capital, goods.



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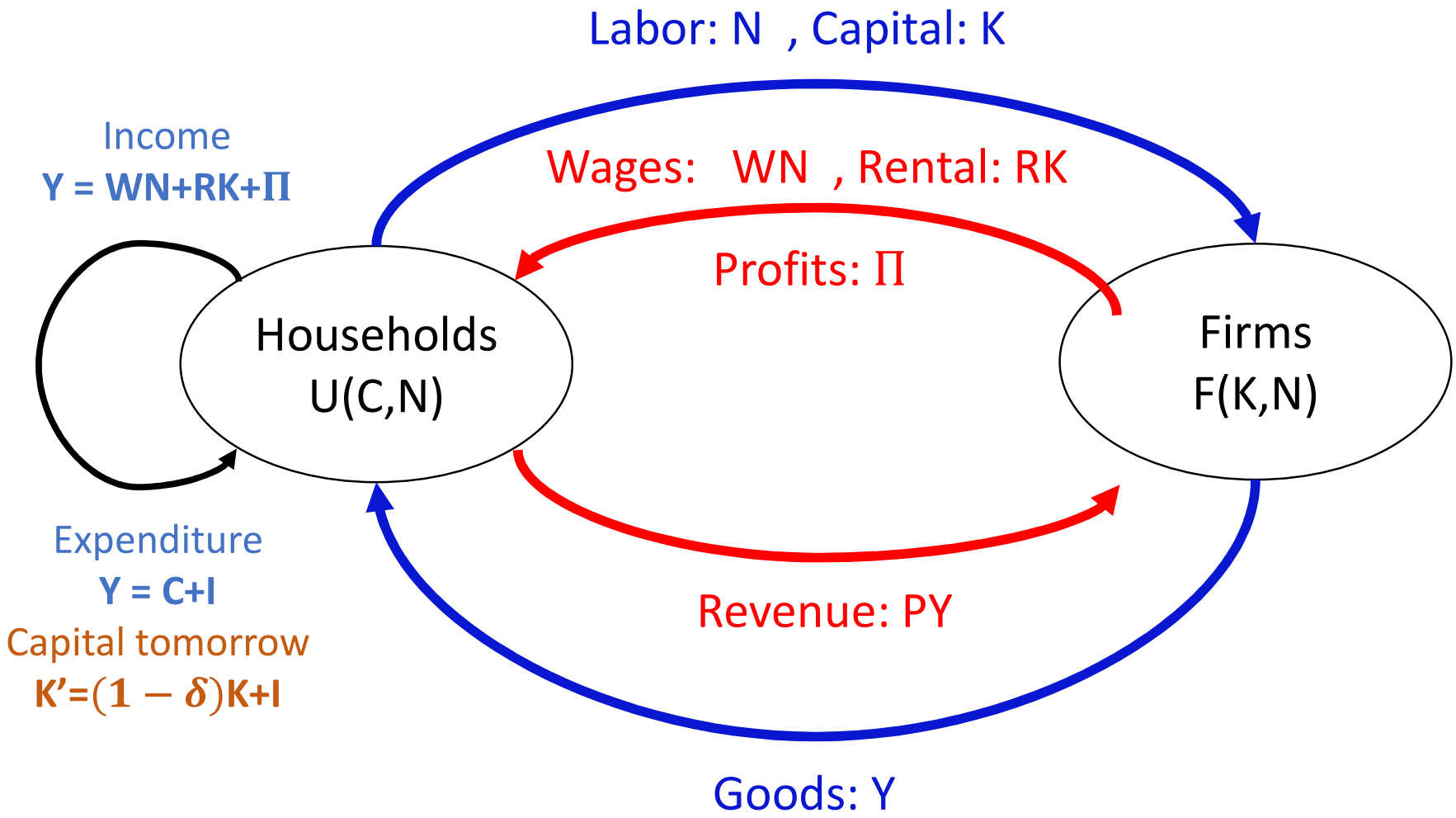

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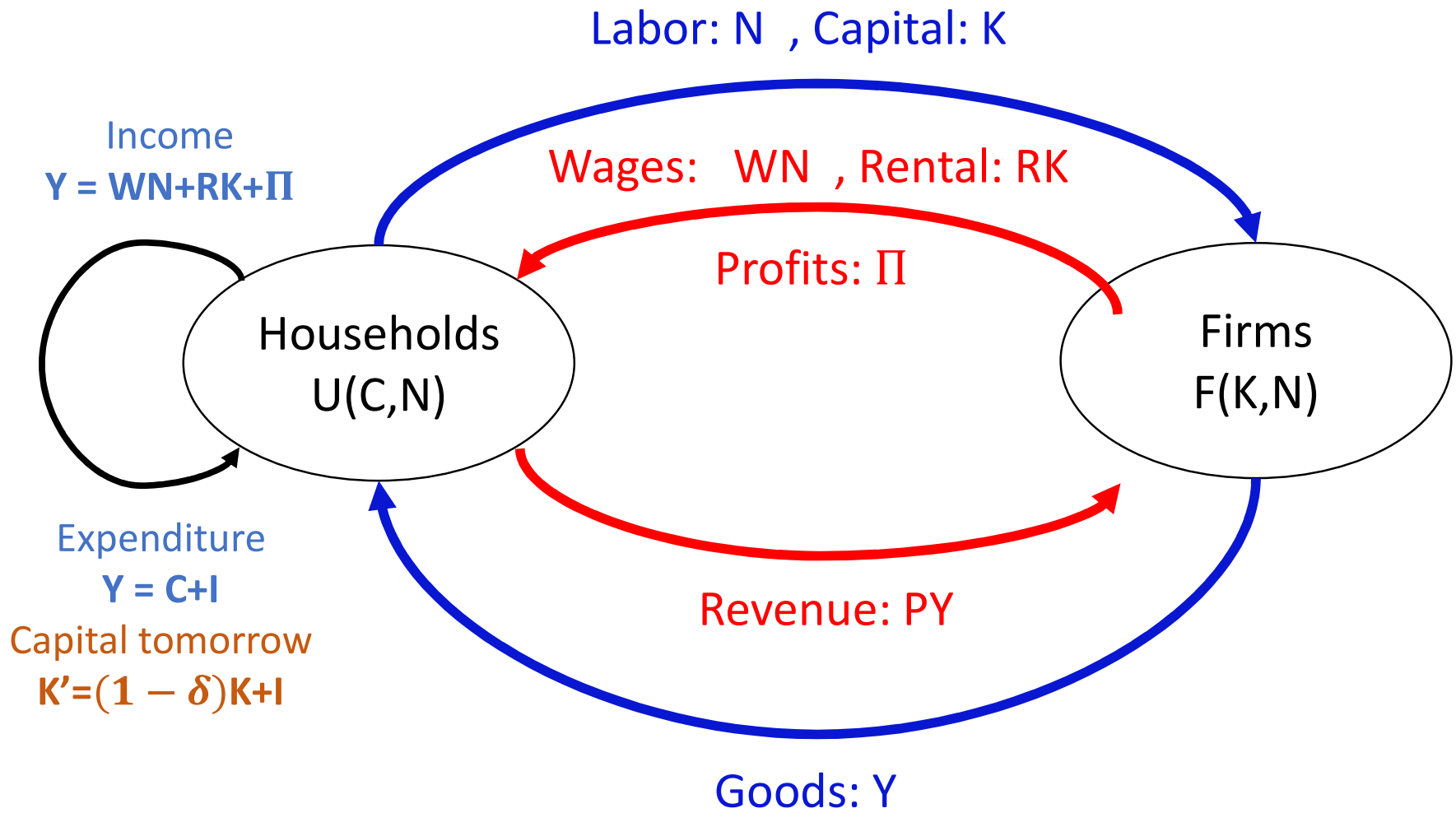
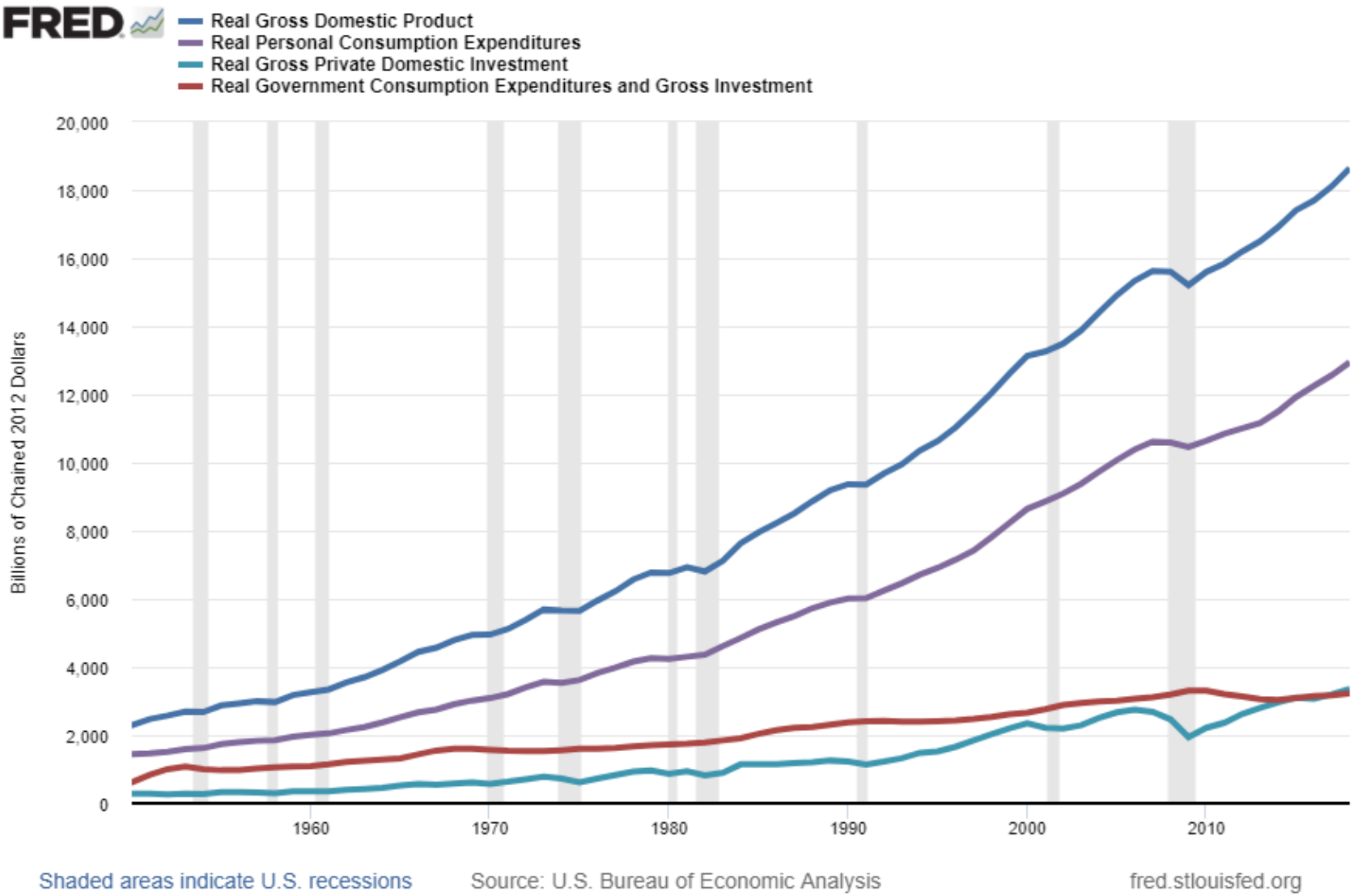
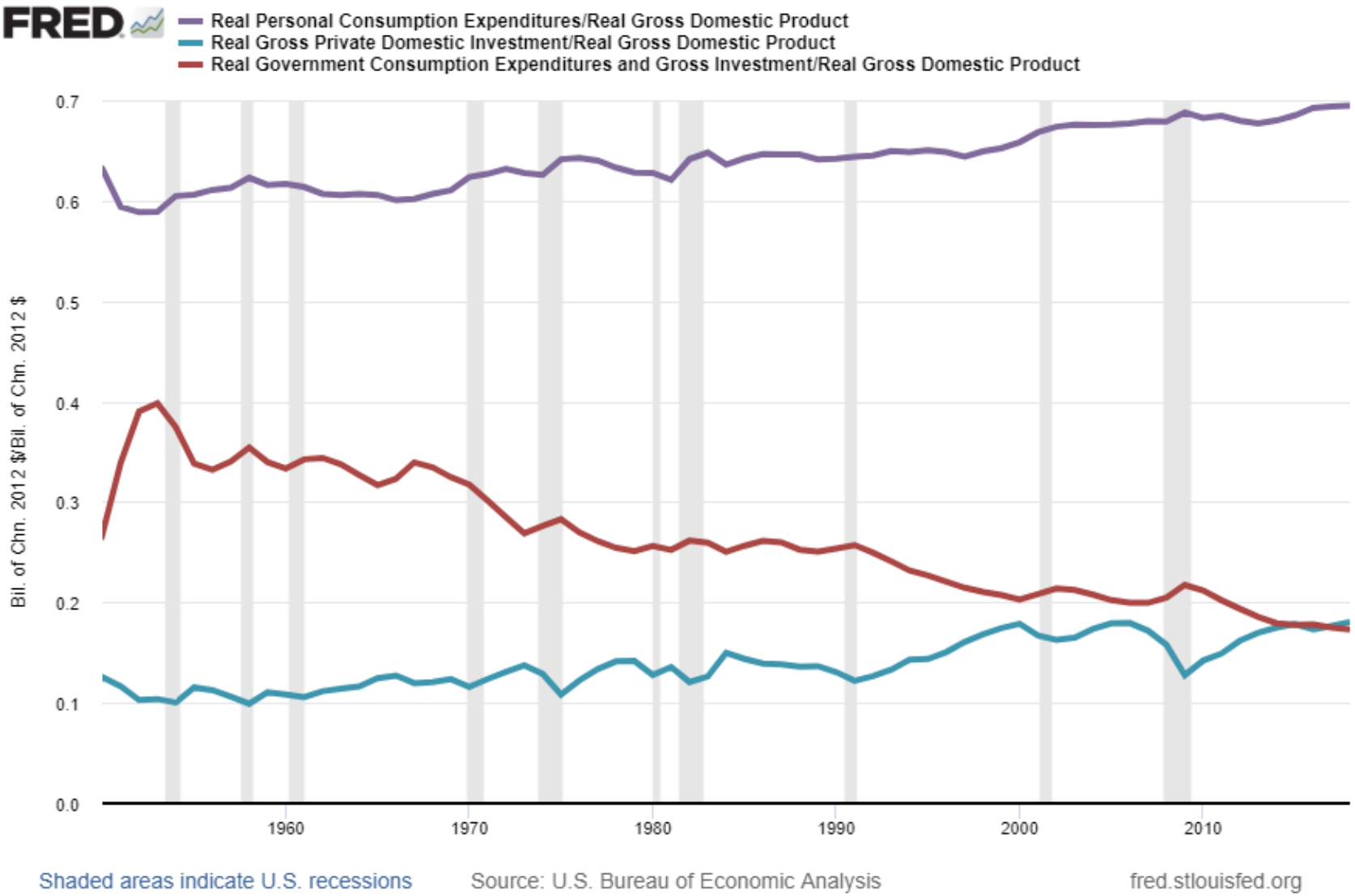


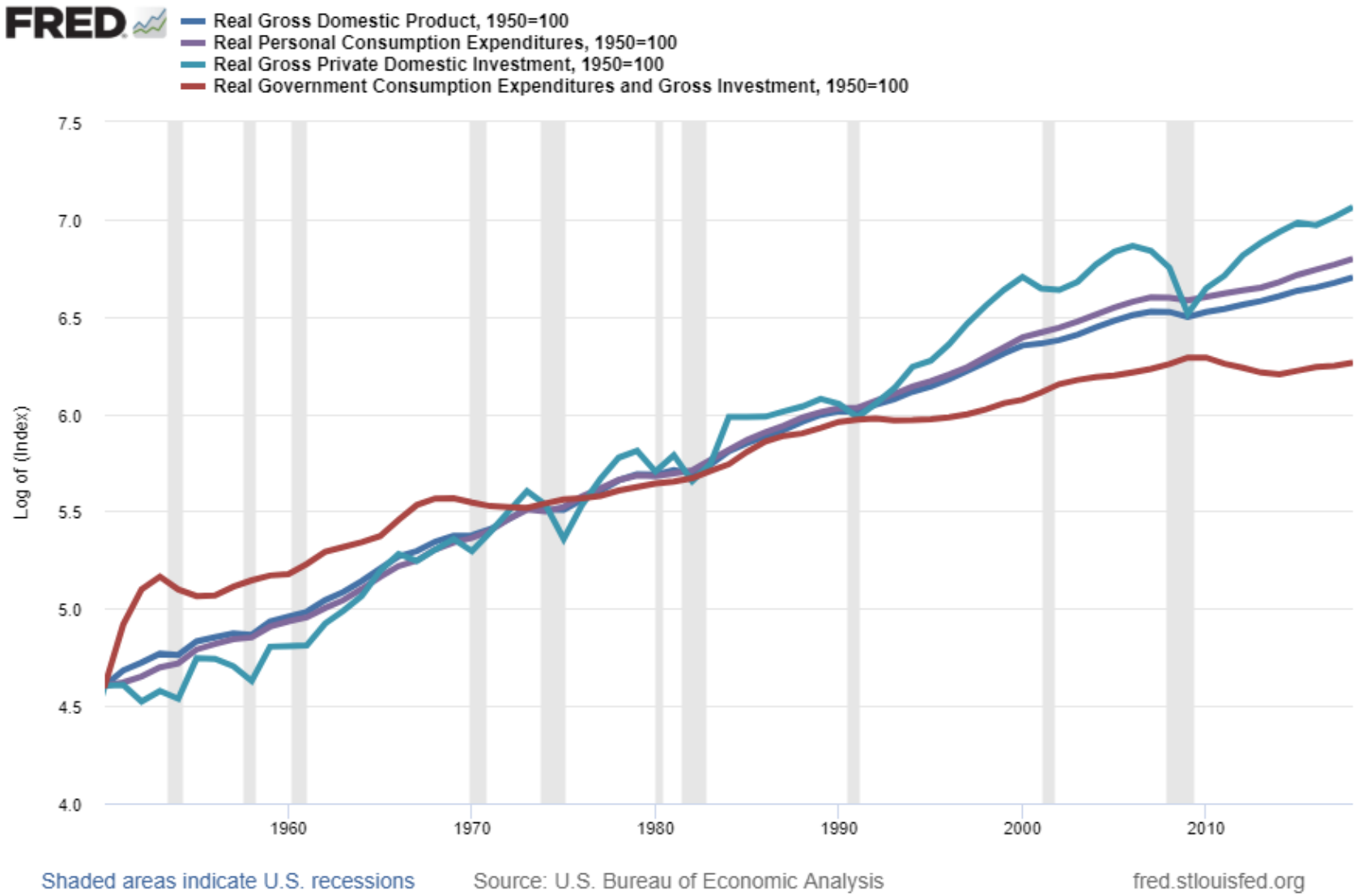
- *Government*: Taxes on payments to fund government spending: G



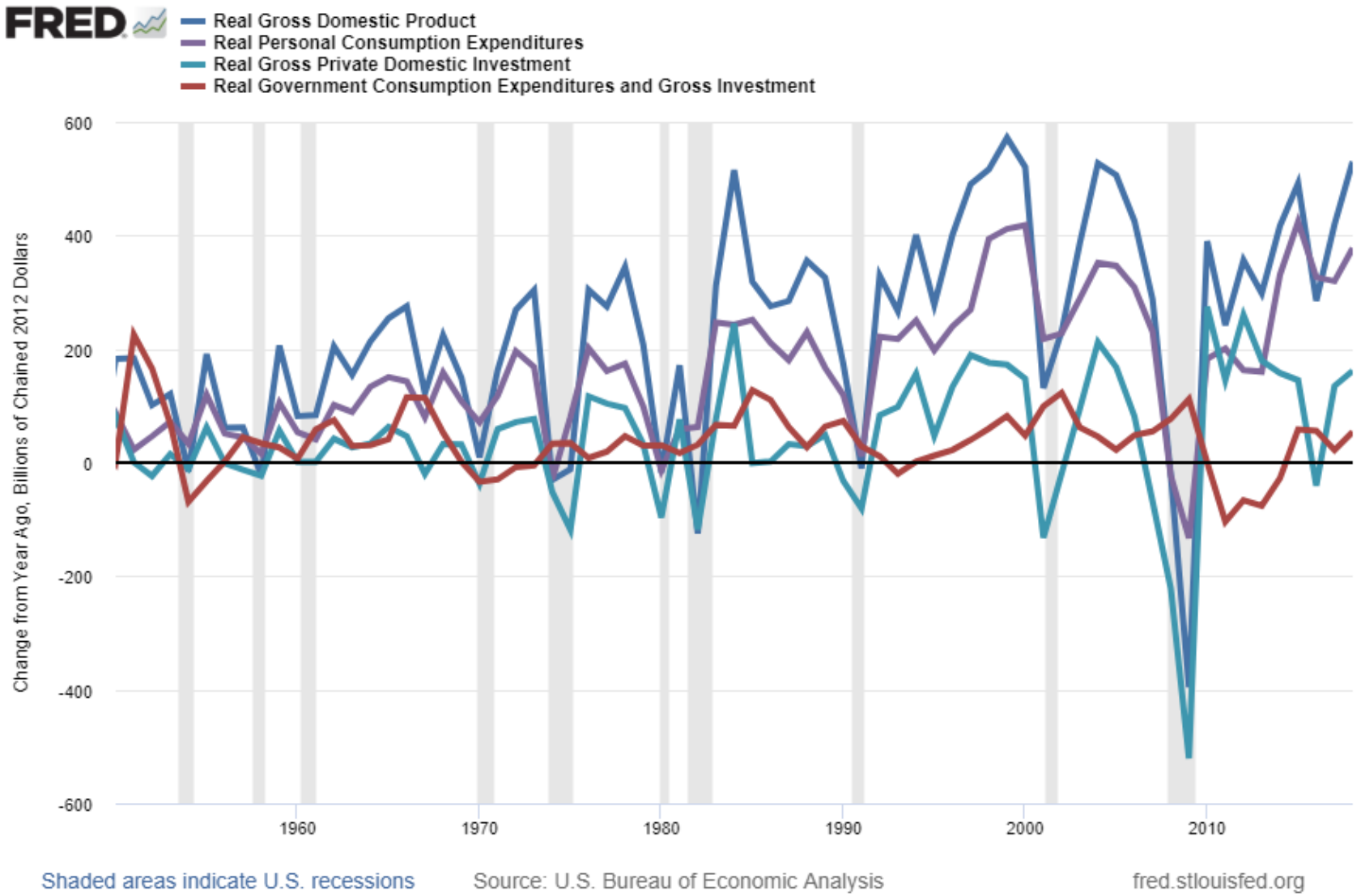
- Output Y, Consumption C, Investment I, Government G: $Y = C + I + G$



- Shares: C/Y, I/Y, G/I



- Long run growth: $\log Y_t - \log Y_{1950}$



- Short run changes: $\log Y_t - \log Y_{t-1}$

Housekeeping

- *Lectures*
  - 2×80 minutes, Online, Tue/Thu: 2:40-4:00pm
  - Please try to skim through lecture slides *before* coming to class
  - Main resource for study are lecture slides and problem set solutions
- *Discussion*
  - TA: Santiago Franco: sfranco@uchicago.edu
  - 1×50 minutes, Online, TBD
  - Go through solutions to problem sets
  - There will be additional, examinable material covered!
  - If you want to focus on a particular area, please email Santiago by the end of *Monday*

Office hours

- *Simon*
  - After class on Tuesday until 5:00pm
  - Office: Zoom (same link as class)
- *Santiago*
  - TBD

Assessment

- *Problem sets*
  - 7 problem sets. 20% of grade.
  - Online by end of Tuesday. Due in TA session of following week
  - Weeks 1, 2, 3*, 6, 7, 8, 9 *: two weeks to complete
  - Go to Santiago's office hours

- *Mid-term exam*
  - 80 minutes. 35% of grade.
  - In class, Thursday February 11, Week 5

- *Final exam*
  - 120 minutes. 45% of grade (70% if do better than mid-term)
  - TBA, Thursday March 18

Programs

- *MATLAB*
  - Download and install using the University student license
  - Will be used for problem set solutions and examples in class
  - Excel will also come in handy

- *Writing*
  - I recommend using *Lyx* which is a LaTeXtype-setting software
  - New programs for collaboration: OverLeaf (?)

- *Canvas*
  - **All** class announcements will be through Canvas
  - Email me or message questions on Canvas, if the question / answer is relevant to everyone I will post it out as an announcement
  - *I will **assume** that you have read all announcements on Canvas ... make sure emails of the alerts go through to your primary inbox!*

- *St. Louis Fed's - FRED*
  - Use for data related tasks

Textbooks

- Due to the advanced nature of the course and the wide range of subjects covered, there is no required textbook for this class.
- The class will be self-contained, and slides / problem set solutions will be the most useful reference. The following books are recommended for different purposes:
  - R.J. Barro,*Macroeconomics*, 5th ed. MIT Press, 1997.
    - Standard undergraduate text, useful for intuition but below the level of this course
  - M. Doepke, A. Lehnert, and A.W. Sellgren, Macroeconomics, 1998
    - A PDF document that supplements Barro, designed for Chicago second year undergraduate course. More rigorous than Barro, but still below the level of this course
  - M. Wickens, *Macroeconomics*, 2nd ed
    - Comprehensive reference for advanced undergraduates and masters
  - Ljunqvist and Sargent, *Recursive Macroeconomic Theory*, 4th ed
    - Graduate textbook, simplified versions of chapters and exercises in this text will be the core of this course.

Outline

Week	Lecture 1	Lecture 2	Problem set
1	Terminology	Solow model	**1.** Solow model / GDP
2	Neo-classical model - Centralized	NCM - Dynamics	**2.** NCM
3	NCM - Decentralized	NCM - Fiscal policy	**3.** NCM + taxes
4	NCM - Fiscal policy / dynamics	Dynamic programming I	—
5	Dynamic programming II	*Mid-term*	
6	Dynamic programming III	Labor supply	**4.** Dyn. programming
8	Real business cycle model	RBC - Results	**5.** Labor supply
9	Asset pricing I	Asset pricing II	**6.** Asset pricing
10	Complete mkts - Centralized	Complete mkts - Decentralized	**7.** Complete markets
11	Risk - Incomplete mkts	*No class*	

- *Welfare properties*
  - Centralized (planner) $\rightarrow$ Decentralized (competitive equilibrium)
- *Risk*
  - None (Solow, Neo-classical), Agg. (RBC, Assets), Individual (Comp/Incomp. markets)
- *Dynamics*
  - Trends (Solow), Transitions (NCM), Fluctuations (RBC, Assets)

Terminology

- Course will focus on *macroeconomic dynamics*
- Consider a function $F : \mathbb{R}_+ \to \mathbb{R}_+$ ... this is our *'model'*

$$X_{t+1} = F\Big(X_t\Big)$$

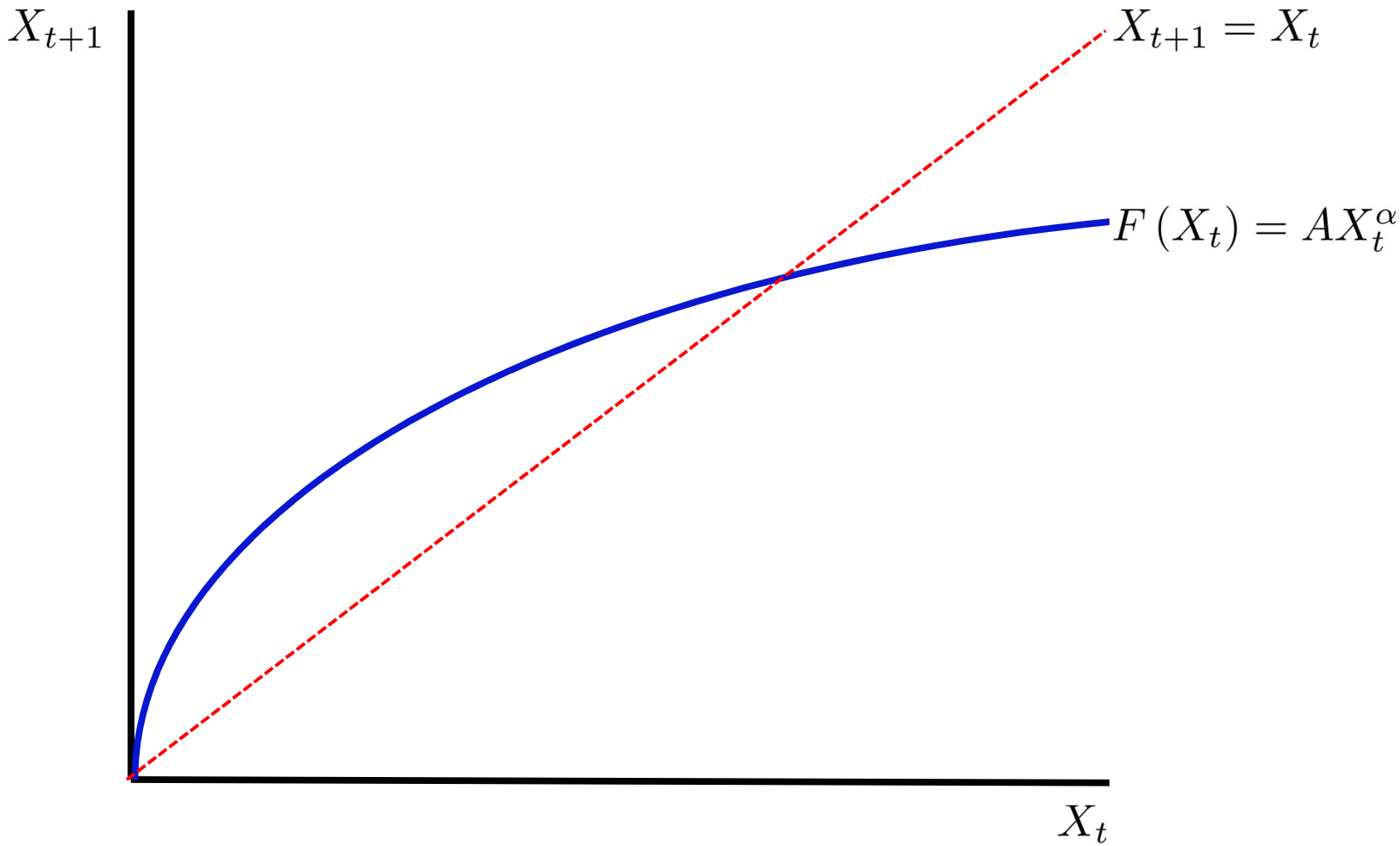
- We will be interested in the properties of the *time-series* $\{X_t\}_{t=0}^{\infty}$
- We will call X_0 the *initial condition*
- We will say that the *steady-state* value of X_t is $\overline{X}$ that satisfies

$$\overline{X} = F\Big(\overline{X}\Big)$$

- We will refer to X_t as an *endogenous variable*
- Suppose $F(X_t) = \widetilde{A}X_t^{\alpha}$, we will refer to α as a *parameter* ... we will refer to $\widetilde{A}$ as an *exogenous variable*

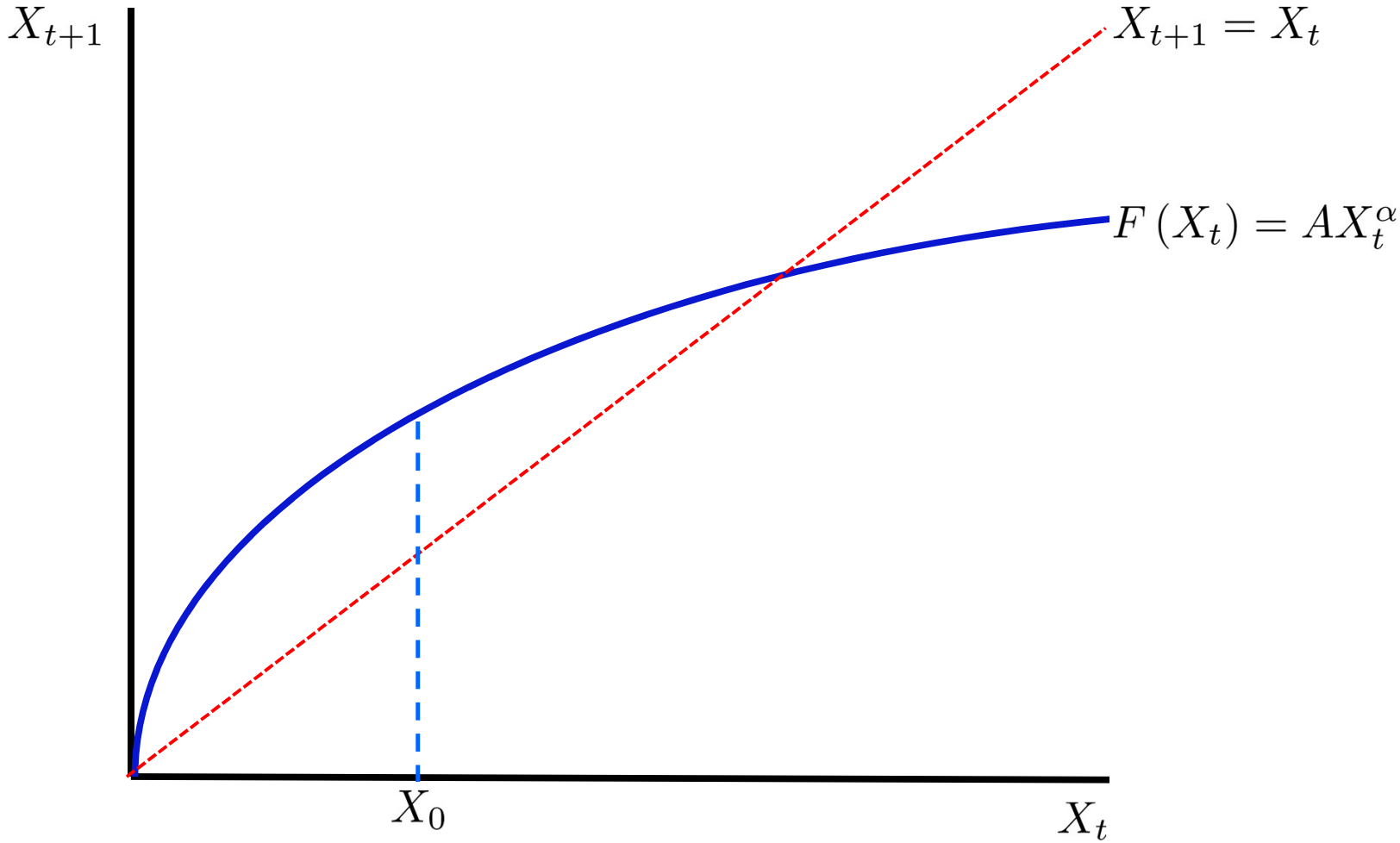
Terminology

Properties of function $X_{t+1} = F(X_t)$.



Terminology

Properties of function $X_{t+1} = F(X_t)$. Initial condition X_0



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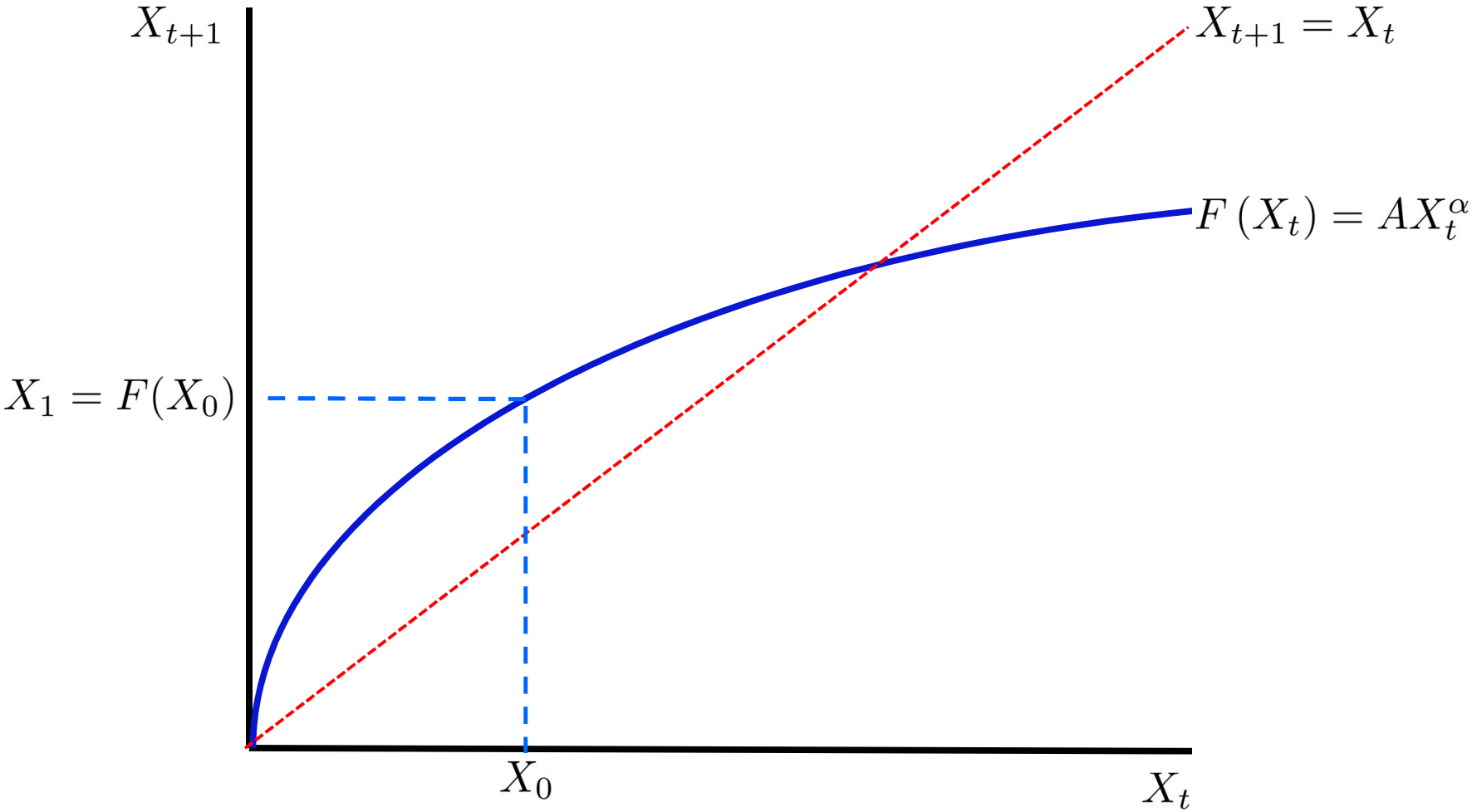
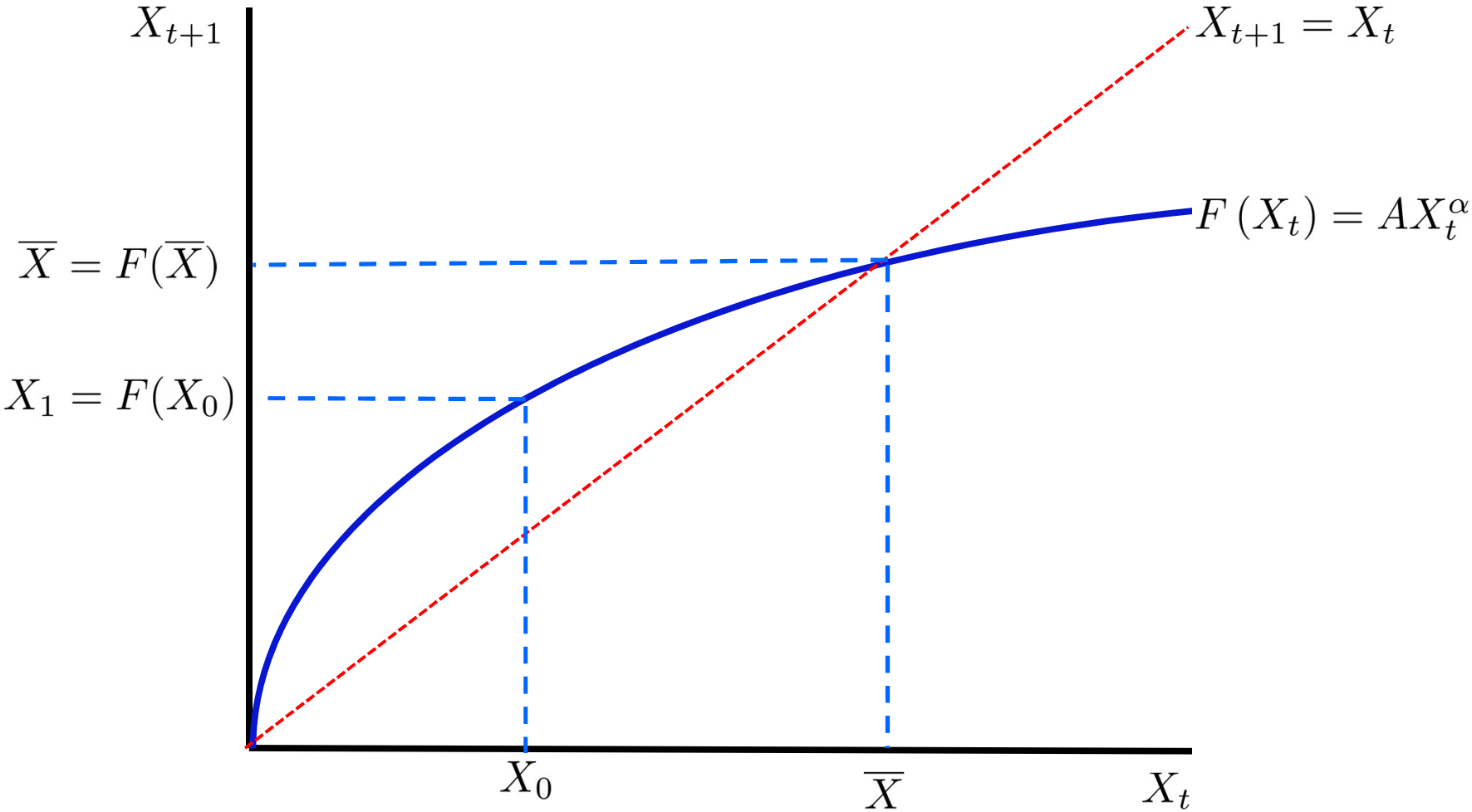


Terminology

Properties of function $X_{t+1} = F(X_t)$. Initial condition X_0. Steady state $\overline{X}$.



Questions

- *Steady state*
  - What are the properties of the steady-state of the economy?
  - e.g. *If people saved more would average consumption be higher or lower?*

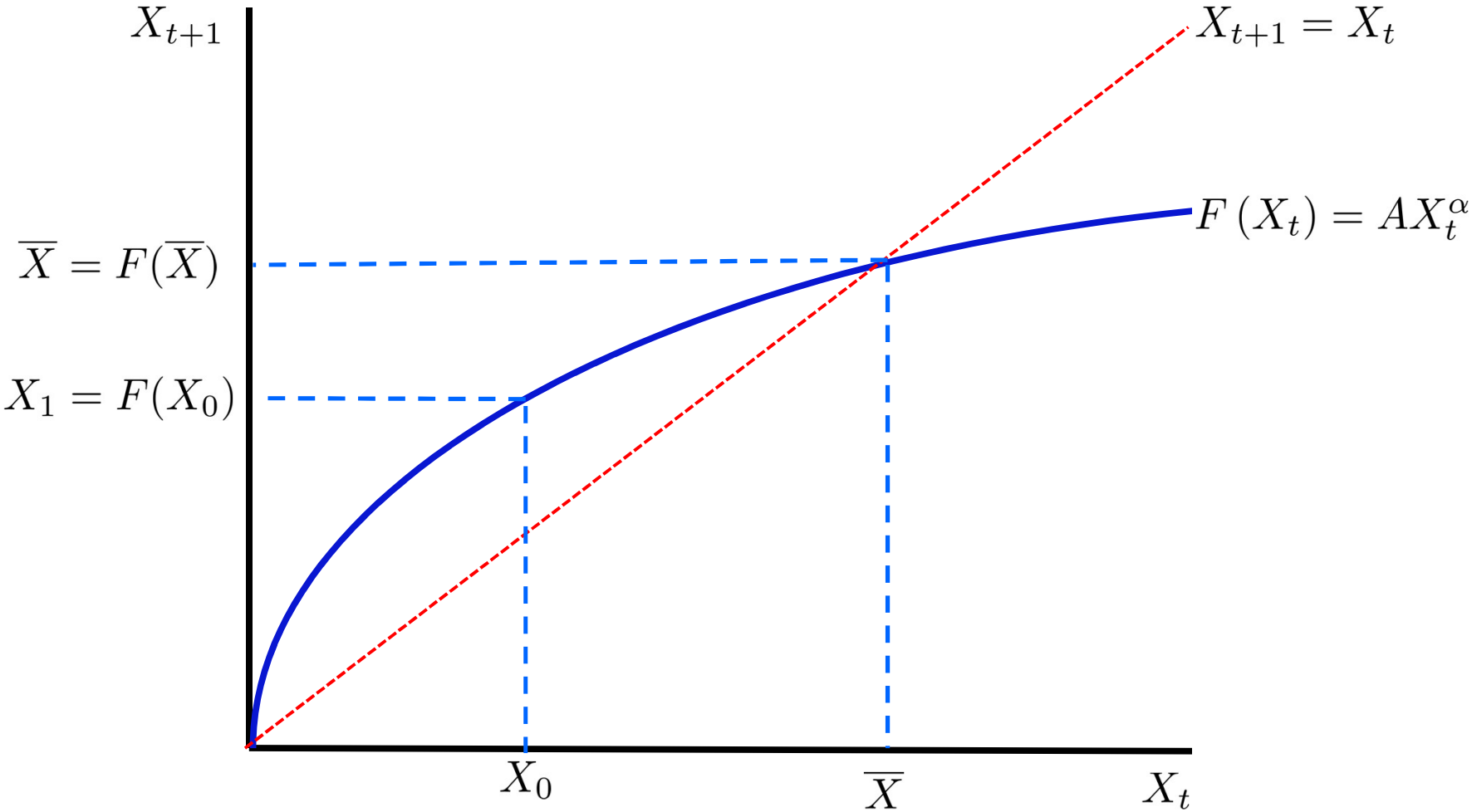
- *Transition dynamics*
  - Given an initial condition X_0, does X_t converge to $\overline{X}$?
  - How quickly does it converge?
  - e.g. *One country has half the K_0 as another, which grows faster?*

- *Dynamics following shocks*
  - Suppose we are initially in steady-state: $X_0 = \overline{X}$
  - Suppose $\widetilde{A}$ jumps up to $\widetilde{A}' > \widetilde{A}$ forever, what happens to $\{X_t\}_{t=0}^{\infty}$?
  - e.g. *The government doubles income taxes, what happens in short/long run?*
  - e.g. *Productivity falls, but only temporarily, what happens?*

- *Comparative statics*
  - How do the answers to the above depend on α?
  - e.g. *If people are more tolerant of risk, do stocks have lower or higher returns?*

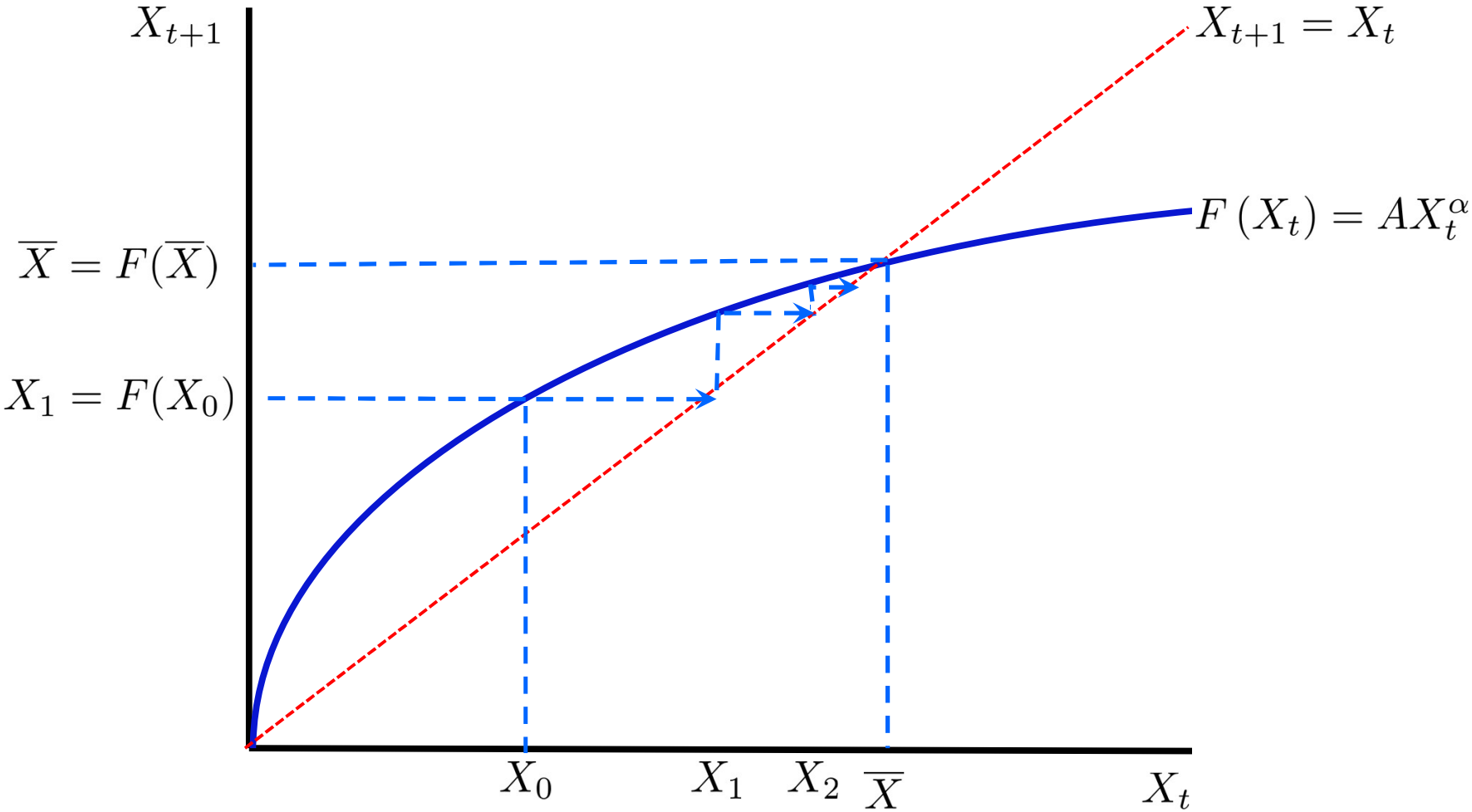
Terminology

Properties of function $X_{t+1} = F(X_t)$. Initial condition X_0. Steady state $\overline{X}$.



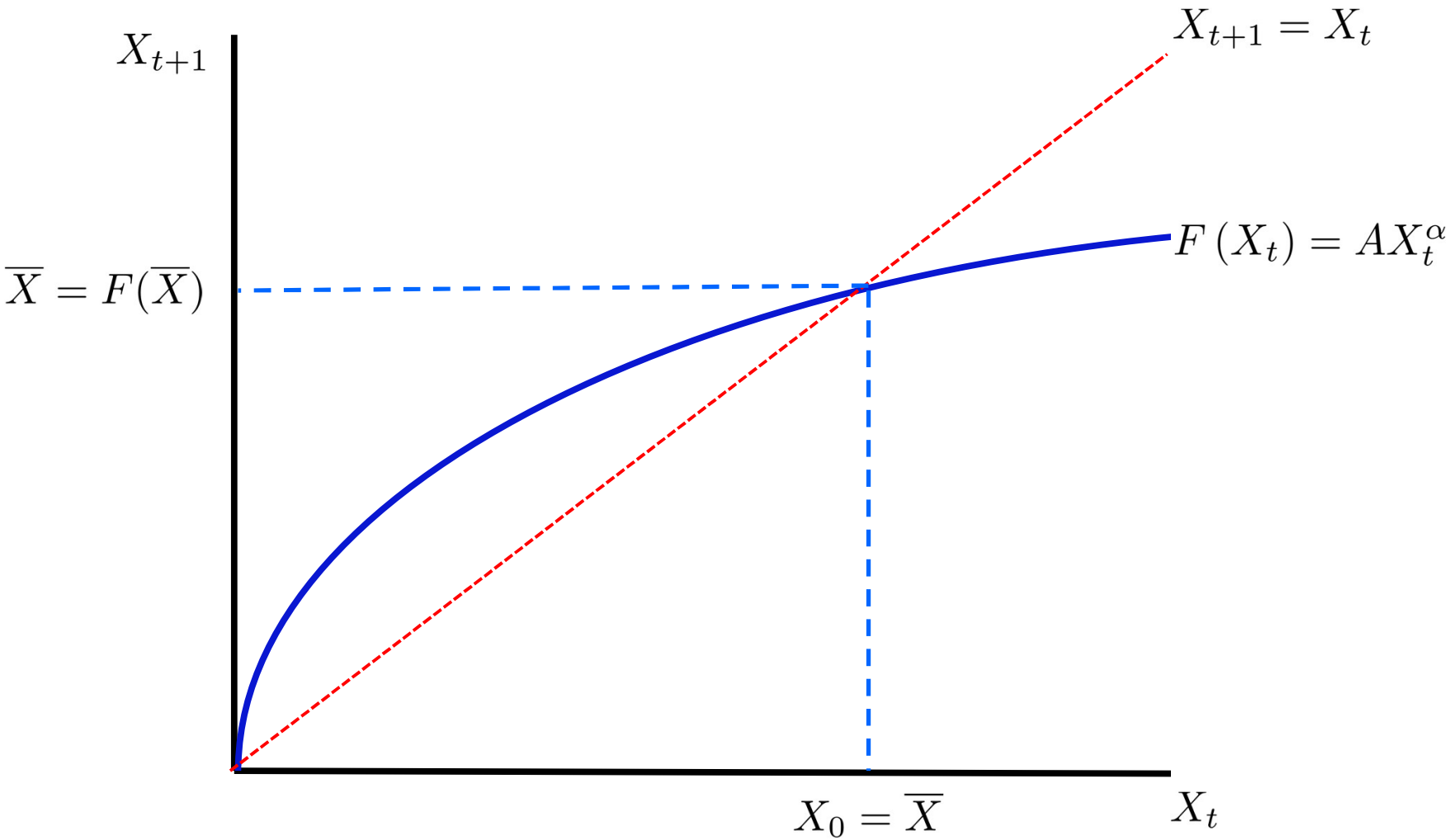
Terminology

Properties of function $X_{t+1} = F(X_t)$. Initial condition X_0. Steady state $\overline{X}$. Transition dynamics from initial condition $X_0 \to \overline{X}$



Terminology

Properties of function $X_{t+1} = F(X_t)$. Initial condition X_0. Steady state $\overline{X}$. Transition dynamics from steady-state following a shock: $A' > A$.



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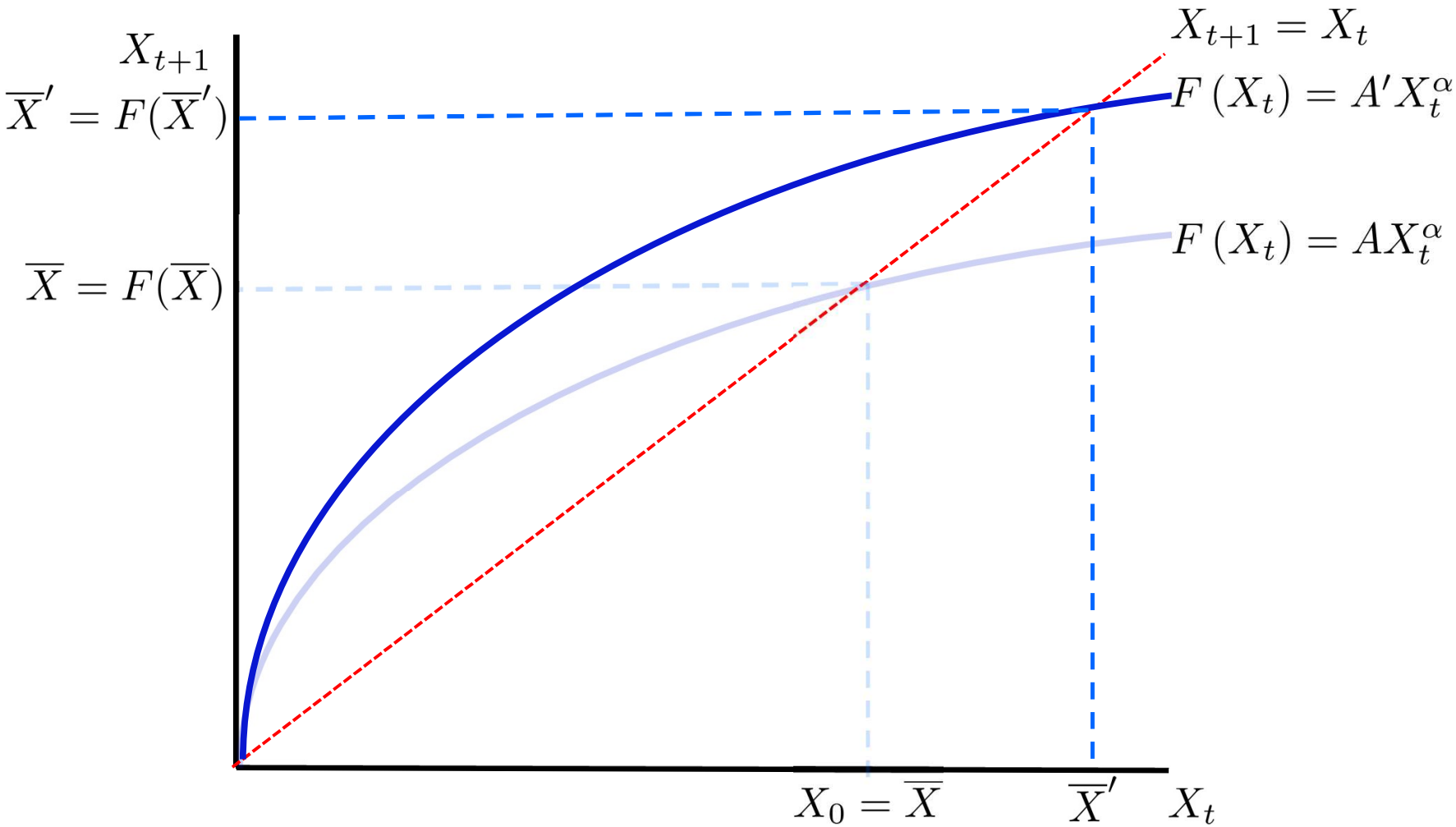

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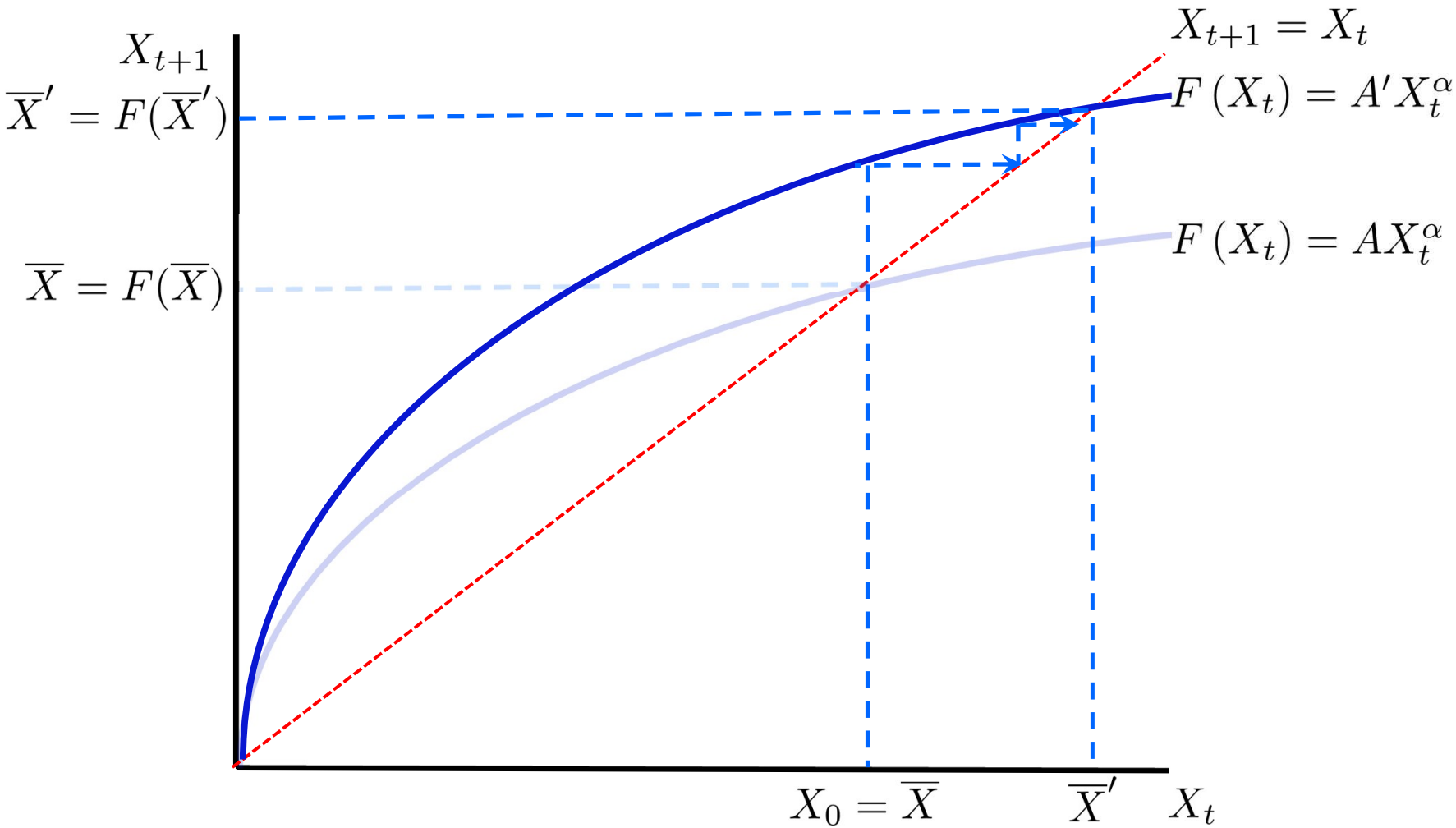

Tool

- We will often use *linearization* to help answer these questions

$$F\left(X_t\right) \approx F\left(X_{t-1}\right) + \left.\frac{\partial F(X)}{\partial X}\right|_{X=X_{t-1}} \left(X_t - X_{t-1}\right)$$

- This gives

$$X_{t+1} \approx X_t + \left.\frac{\partial F(X)}{\partial X}\right|_{X=X_{t-1}} \left(X_t - X_{t-1}\right)$$

- Manipulating

$$\begin{aligned} \frac{X_{t+1} - X_t}{X_t} &\approx \left\langle \frac{\partial F(X_{t-1})}{\partial X_{t-1}} \frac{X_{t-1}}{F(X_{t-1})} \right\rangle \frac{X_t - X_{t-1}}{X_{t-1}} \\ \Delta \log X_{t+1} &\approx \varepsilon_{F,X} \Delta \log X_t \end{aligned}$$

- *Intuition* - Economic quantities don't really have units!

Tool

- We will often use *linearization* to help answer these questions

$$F(X_t) \approx F(X_{t-1}) + \left.\frac{\partial F(X)}{\partial X}\right|_{X=X_{t-1}} (X_t - X_{t-1})$$

- This gives

$$X_{t+1} \approx X_t + \left.\frac{\partial F(X)}{\partial X}\right|_{X=X_{t-1}} (X_t - X_{t-1})$$

- Manipulating

$$\begin{aligned} \frac{X_{t+1} - X_t}{X_t} &\approx \left\langle \frac{\partial F(X_{t-1})}{\partial X_{t-1}} \frac{X_{t-1}}{F(X_{t-1})} \right\rangle \frac{X_t - X_{t-1}}{X_{t-1}} \\ \Delta \log X_{t+1} &\approx \varepsilon_{F,X} \Delta \log X_t \end{aligned}$$

- *Intuition* - Economic quantities don't really have units!

$*$ On the board - (i) Function of two variables, (ii) log and $\%\Delta$

Example - Macro Back-of-envelope 101

- Approximately, what is the effect of a 1 percent increase in C_t on Y_t?

$$Y_t = C_t + I_t + G_t \qquad , \qquad Y_t = F\left(C_t, I_t, G_t\right)$$

Example - Macro Back-of-envelope 101

- Approximately, what is the effect of a 1 percent increase in C_t on Y_t?

$$Y_t = C_t + I_t + G_t \qquad , \qquad Y_t = F\left(C_t, I_t, G_t\right)$$

- Take an approximation around average values: $\overline{X} := \mathbb{E}\left[X_t\right]$

$$F\left(C_t, I_t, G_t\right) \approx F\left(\overline{C}, \overline{I}, \overline{G}\right) + 1\left(C_t - \overline{C}\right) + 1\left(I_t - \overline{I}\right) + 1\left(G_t - \overline{G}\right)$$

- Manipulating

$$\frac{Y_t - \overline{Y}}{\overline{Y}} \approx \frac{\overline{C}}{\overline{Y}}\left(\frac{C_t - \overline{C}}{\overline{C}}\right) + \frac{\overline{I}}{\overline{Y}}\left(\frac{I_t - \overline{I}}{\overline{I}}\right) + \frac{\overline{G}}{\overline{Y}}\left(\frac{G_t - \overline{G}}{\overline{G}}\right)$$

- Answer given by average consumption $\overline{C}$ divided by average GDP $\overline{Y}$
- In the U.S. economy the share of consumption is? (Problem set 1)

Example - Macro Back-of-envelope 102

- Approximately, what is the effect of a 1 percent increase in N_t on Y_t?

$$Y_t = AN_t^{\alpha} K_t^{1-\alpha} \qquad , \qquad Y_t = F(N_t, K_t)$$

Example - Macro Back-of-envelope 102

- Approximately, what is the effect of a 1 percent increase in N_t on Y_t?

$$Y_t = AN_t^{\alpha} K_t^{1-\alpha} \quad , \quad Y_t = F(N_t, K_t)$$

- Take an approximation around N_t, K_t

$$Y_{t+1} \approx Y_t + \left(\alpha N_t^{\alpha-1} K_t^{1-\alpha}\right)(N_{t+1} - N_t)$$

- Manipulating

$$\frac{Y_{t+1} - Y_t}{Y_t} \approx \frac{\alpha N_t^{\alpha} K_t^{1-\alpha}}{Y_t} \frac{N_{t+1} - N_t}{N_t} = \alpha \frac{N_{t+1} - N_t}{N_t}$$

- Answer given by the parameter α
- How can we come up with an estimate of α? (Problem set 1)

Example - Macro Back-of-envelope 102

- Suppose this is the output of a profit maximizing firm

$$\Pi_t = \max_{K_t, N_t} P_t F(N_t, K_t) - R_t K_t - W_t N_t$$

Example - Macro Back-of-envelope 102

- Suppose this is the output of a profit maximizing firm

$$\Pi_t = \max_{K_t, N_t} \; P_t F\left(N_t, K_t\right) - R_t K_t - W_t N_t$$

- First order condition for N_t

$$N_t : \qquad 0 = P_t \times \left\{\alpha A N_t^{\alpha-1} K_t^{1-\alpha}\right\} - W_t$$

Example - Macro Back-of-envelope 102

- Suppose this is the output of a profit maximizing firm

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- First order condition for N_t

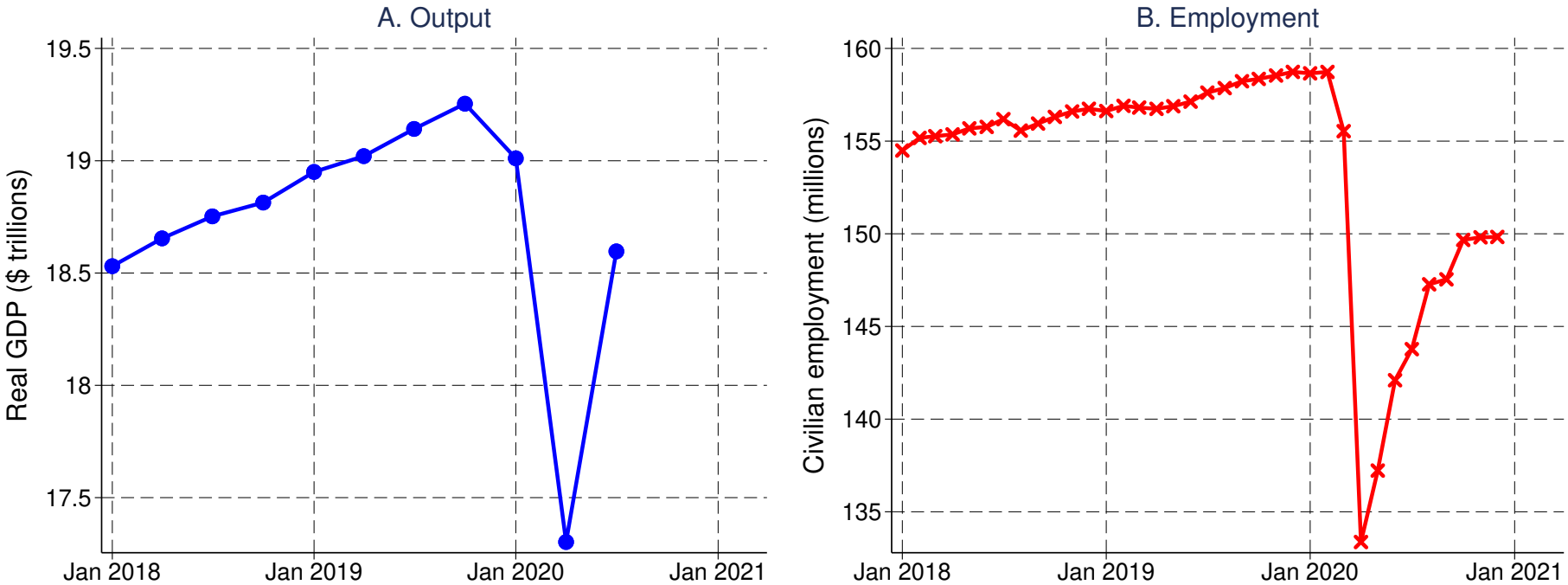
$$N_t : \qquad 0 = P_t \times \left\{ \alpha A N_t^{\alpha - 1} K_t^{1-\alpha} \right\} - W_t$$

- *Result* - *Under constant returns to scale, competitive pricing of inputs implies that factor shares equal output elasticities*

$$\frac{W_t N_t}{P_t Y_t} = \alpha$$

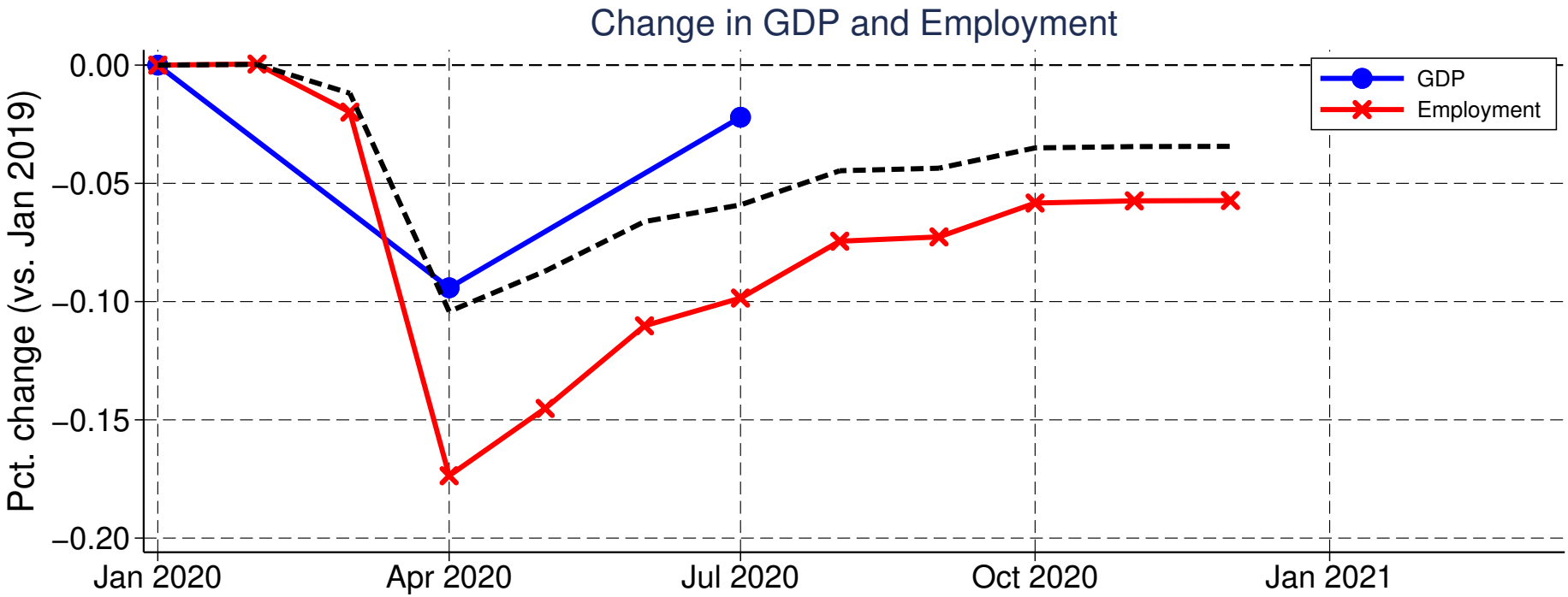
- In the U.S., labor share of revenue $\alpha \approx 0.60$
- Let $K_t = K_0$, $N_{t+1} = (1 + \gamma_N) N_t$ with $\gamma_N = 0.02$, then Y_t grows at 1.2%
- 10% percent decline in employment over 2020, $\approx$ 6% decline in GDP

Example - Macro Back-of-envelope 102



- Output - Y_t - Around 19 trillion
- Employment - N_t - Around 150 million workers $\approx$ 50% of pop.

Example - Macro Back-of-envelope 102



$$\underbrace{\Delta \log Y_t \approx \alpha \, \Delta \log N_t}_{\text{Black dashed line}} \quad , \quad \underbrace{\alpha = \frac{W_t N_t}{P_t Y_t} \approx 0.60}_{\text{Data}}$$

Covered

- Terminology
  - Exogenous variable, Endogenous variable, parameter
  - Steady state, transition dynamics, shock
  - Comparative statics
- Linearization
  - Functions of one variable, two variables
  - Elasticity
- Profit maximization
  - Firm problem, First order conditions
- *Next*
  - TA - Constant returns to scale production function
  - TA - Approaches to GDP: Income, Expenditure, Value added
  - Lecture - Growth facts, Solow model