

# SHOCKS

MARCH 30, 2009

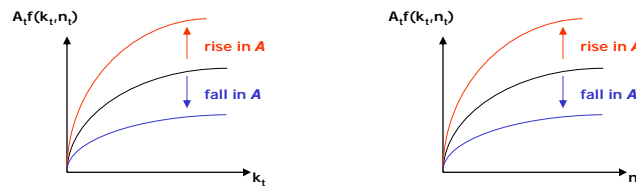
*Introduction*

## BASICS

- ❑ **Shock/shifter**
  - ❑ **Definition:** Some unexpected event that affects economic fundamentals and hence decisions, but which is unexplained or unexplainable
- ❑ Introducing shocks into our frameworks (consumption-leisure, consumption-savings, infinite-period) will “get them moving”

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  - **Total Factor Productivity (TFP) Shocks** – unexpected changes in  $A_t$  in the production function  $A_t f(k_t, n_t)$

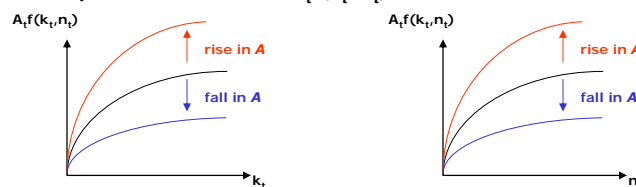


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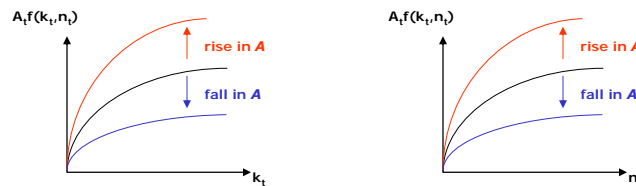
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Changes in  
“consumer  
confidence”

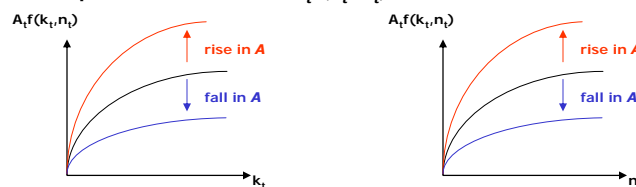
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“SUPPLY  
SHOCK”

“DEMAND  
SHOCK”

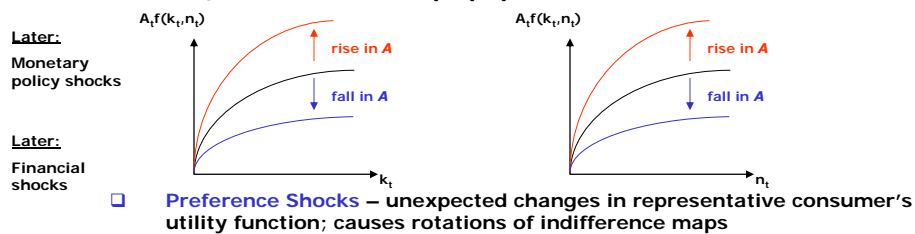
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## TFP IN COBB-DOUGLAS PRODUCTION FUNCTION

- ❑ Revisit the commonly-used functional form in modern quantitative macroeconomic models
 
$$\text{output}_t = A_t f(k_t, n_t) = A_t k_t^\alpha n_t^{1-\alpha}$$
- ❑ Describes the empirical relationship between aggregate output, aggregate capital, aggregate labor, and **level of sophistication of technology (TFP)**
  - ❑ (How to measure TFP in Chapter 13)
- ❑ Cobb-Douglas form useful for illustrating effects of TFP shocks

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- Causes change in marginal product of labor

$$mpn_t = \frac{\partial \text{output}_t}{\partial n_t} = A_t f_n(k_t, n_t) = A_t (1-\alpha) k_t^\alpha n_t^{-\alpha}$$

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Recall  $mpk$  is foundation for capital/investment demand

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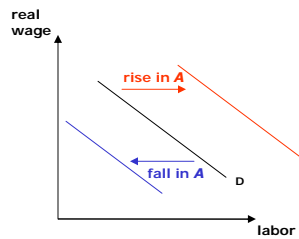
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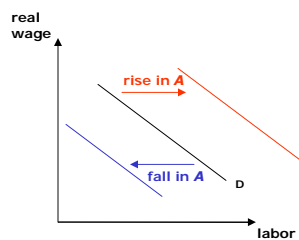
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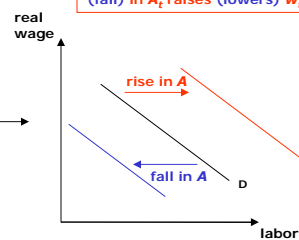
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Firm-level labor demand function

Sum over all firms



Aggregate-level labor demand function

- **IMPORTANT:** TFP shocks shift the labor demand curve

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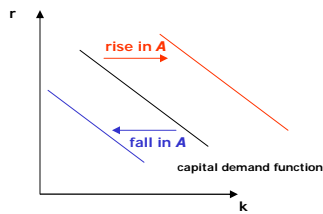
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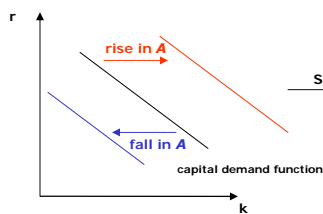
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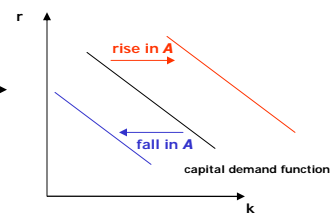
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Firm-level capital demand function

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- **IMPORTANT:** TFP shocks shift the capital demand (and hence investment demand – recall  $inv_t = k_{t+1} - k_t$ ) curve

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## PREFERENCE SHOCKS

- Illustrate idea using consumption-leisure model
  - Preference shocks in consumption-savings model: Practice Problem Set 6
  
- Utility function (modified from Chapter 2):  $u(Bc, l)$ 
  - $c$ : consumption
  - $l$ : leisure
  - $B$ : preference shifter, with  $B > 0$ 
    - Chapter 2: were implicitly considering  $B = 1$

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    - ❑ "Cultural" events that alter individuals' desires
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- ↑ Could interpret as the foundation of "consumer confidence"

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The effects of **B** here affect indifference curves

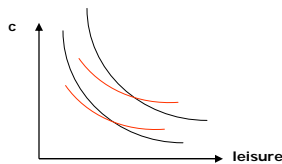
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The effects of **B** here cancel out (affects numerator and denominator in same way)

## PREFERENCE SHOCKS AND INDIFFERENCE MAPS

$$MRS_{c,l} = \frac{\partial u / \partial l}{\partial u / \partial c} = \frac{1}{B} \cdot \frac{u_2(Bc, l)}{u_1(Bc, l)}$$

**IF B RISES**



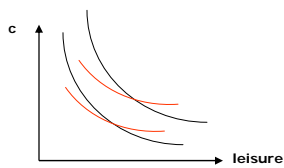
Rise in **B** flattens all indifference curves (i.e., lowers **MRS** at any point in  $c$ - $l$  space).

Interpretation: each unit of  $c$  more valuable, so **decreased willingness** to trade  $c$  for one more unit of  $l$

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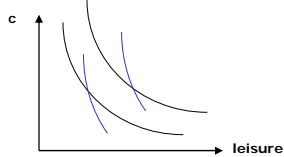
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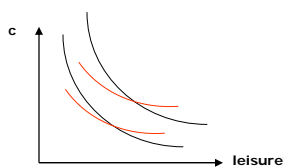
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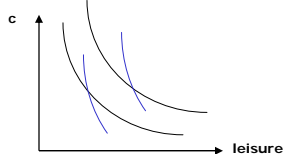


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Superimpose a budget line:  
optimal choice of **c** and **l**  
clearly affected by shock to **B**

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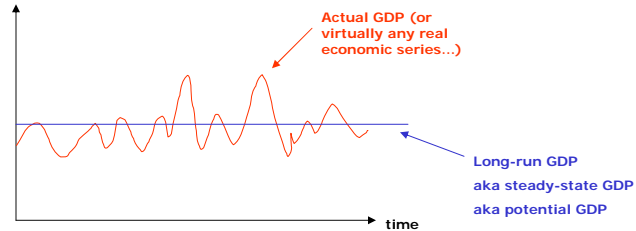


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## PREVIEW OF BUSINESS CYCLE THEORY

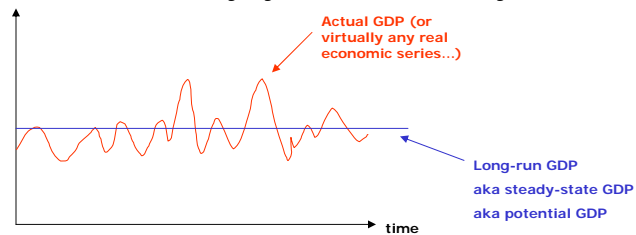
- ❑ Modern macro view: periodic ups and downs of macroeconomic activity driven fundamentally by (various and many) shocks



- ❑ Supply shocks: TFP shocks, others
- ❑ Demand shocks: preference shocks, monetary policy shocks (Chapter 14), others

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- ❑ Shocks over time lead to changes over time in
  - ❑ Consumers' incentives to work, save, and consume
  - ❑ Firms' incentives to hire, invest, and produce

Economy's response(s) to shocks mediated through labor markets, capital markets, and goods markets

# INTERTEMPORAL CONSUMPTION- LEISURE FRAMEWORK

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*Introduction*

## BASICS

- **Consumption-Leisure Framework**
  - Foundation for goods-market demand and labor-market supply
  - Optimality condition
$$\frac{\partial u / \partial l}{\partial u / \partial c} = (1-t)w$$
- **Consumption-Savings Framework**
  - Foundation for (period- $t$ ) goods-market demand and asset-market supply
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$$\frac{\partial u / \partial c_1}{\partial u / \partial c_2} = 1+r$$

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$$\frac{\partial u / \partial c_1}{\partial u / \partial c_2} = 1+r$$
- ❑ Bring together consumption-savings margin with the consumption-leisure margin
- ❑ Utility function:  $v(c_1, l_1, c_2, l_2) = u(c_1, l_1) + u(c_2, l_2)$ 
  - ❑ Dropping the assumption from simple (Chapter 3 and 4) two-period framework that income “falls from the sky”
  - ❑ Representative consumer has to work for his (labor) income in **each period**

Can put a  $\beta$  here

## UTILITY AND BUDGET CONSTRAINTS

- ❑ Utility function:  $v(c_1, l_1, c_2, l_2) = u(c_1, l_1) + u(c_2, l_2)$
- ❑ Budget constraints
  - ❑ Period-1 budget constraint (nominal terms)
 
$$P_1 c_1 + A_1 - A_0 = iA_0 + (1-t_1)W_1(168-l_1)$$
  - ❑ Period-2 budget constraint (nominal terms)
 
$$P_2 c_2 + A_2 - A_1 = iA_1 + (1-t_2)W_2(168-l_2)$$

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$$P_2 c_2 + A_2 - A_1 = iA_1 + (1-t_2)W_2(168-l_2)$$
- Derive (nominal) LBC as usual (solve P2BC for  $A_1$  and insert in P1BC)
 
$$P_1 c_1 + \frac{P_2 c_2}{1+i} = (1-t_1)W_1(168-l_1) + \frac{(1-t_2)W_2(168-l_2)}{1+i} + (1+i)A_0$$

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$$P_2 c_2 + A_2 - A_1 = iA_1 + (1-t_2)W_2(168-l_2)$$
- Derive (nominal) LBC as usual (solve P2BC for  $A_1$  and insert in P1BC)
 
$$P_1 c_1 + \frac{P_2 c_2}{1+i} = (1-t_1)W_1(168-l_1) + \frac{(1-t_2)W_2(168-l_2)}{1+i} + (1+i)A_0$$
- Or in real terms (work out details yourself)
 
$$c_1 + \frac{c_2}{1+r} = (1-t_1)w_1(168-l_1) + \frac{(1-t_2)w_2(168-l_2)}{1+r} + (1+r)a_0$$

## UTILITY AND BUDGET CONSTRAINTS

- Utility function:  $v(c_1, l_1, c_2, l_2) = u(c_1, l_1) + u(c_2, l_2)$
- Budget constraints
  - Period-1 budget constraint (nominal terms)
 
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- Or if infinite number of periods
 
$$\sum_{t=0}^{\infty} \frac{c_t}{(1+r)^t} = \sum_{t=0}^{\infty} \frac{(1-t_t)w_t(168-l_t)}{(1+r)^t} + (1+r)a_0$$
  - Assuming  $r$  is constant every period (slightly more complicated expression if  $r_t$  varies every period)

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## CONSUMPTION-SAVINGS MARGIN

- Describes decision of how much to consume "today" (period  $t$ ) versus save for "tomorrow" (period  $t+1$ )
  - A decision that spans periods
- Think of as orthogonal to (i.e., independent of) the consumption-leisure margin
- Optimal choice (two-period model) described by

$$\frac{\partial u / \partial c_1}{\partial u / \partial c_2} = 1 + r$$

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- Recall: can think of infinite-period model as sequence of overlapping two-period models

## CONSUMPTION-LEISURE MARGIN

- Describes decision **within a period** of how much to consume versus how much to enjoy leisure
  - A decision that does **not** span periods
- Think of as orthogonal to (i.e., independent of) the consumption-savings margin
- Optimal choice (two-period model) described by

$$\frac{\partial u / \partial l_1}{\partial u / \partial c_1} = (1-t_1)w_1 \qquad \frac{\partial u / \partial l_2}{\partial u / \partial c_2} = (1-t_2)w_2 \qquad \text{i.e., for each of the two periods}$$

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- Consumption-leisure decision "looks the same every period" in infinite-period environment

## BUILDING BLOCKS OF MODERN MACRO THEORY

- ❑ Intertemporal consumption-leisure model is the foundation of almost all modern conceptual macroeconomic frameworks
  - ❑ Referred to as **Dynamic General Equilibrium (DGE) Models**
  - ❑ Both Real Business Cycle (RBC) models and New Keynesian (NK) models (the two dominant current schools of macroeconomic thinking)

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  - ❑ Keynesian-inspired macroeconometric models (1950 – 1970's)
  - ❑ DGE methodology (1980's – today)

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## A BRIEF HISTORY OF MACROECONOMICS

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## THE PHASES OF MACROECONOMICS

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  - ❑ Phase III: Dynamic General Equilibrium (DGE) methodology (1980's – today)
  - ❑ **Phase IV?**  
**What changes are forthcoming in the profession (policy-making and theory) spurred by current financial and economic downturn?**  
  
**Focus on linkages between financial markets and the macroeconomy?**  
  
**Who knows...**

## THE BIRTH OF MACROECONOMICS

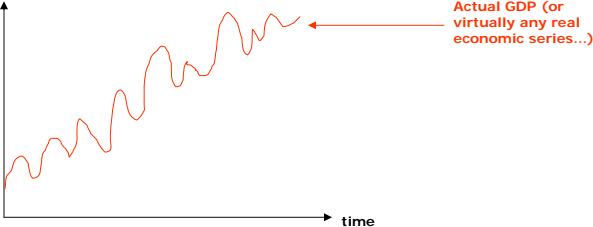
- ❑ **"Macroeconomics"** born as a field during and because of the Great Depression
  - ❑ Idea that government could/should regulate the periodic ups and downs of the economy rose to prominence
  
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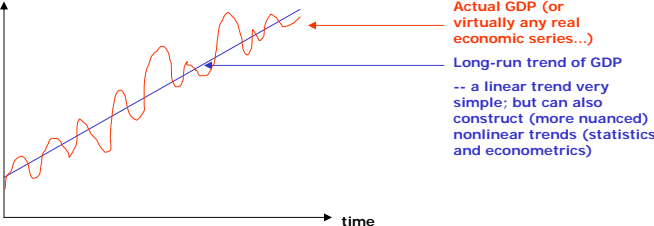
# LONG-RUN GROWTH VS. BUSINESS CYCLES

- Decompose time series into trends and cycles



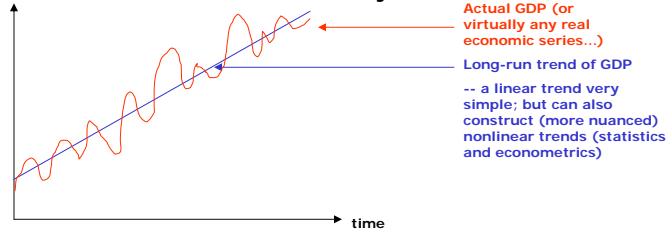
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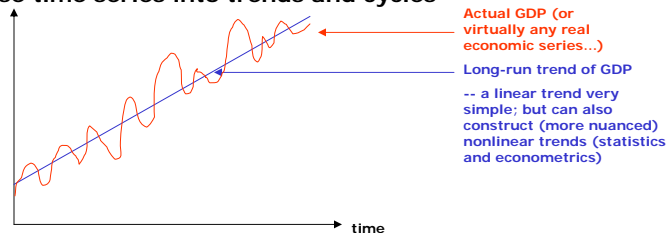
- Two clear patterns
  - Long-run growth
  - Frequent and sometimes big short-run fluctuations around long-run trend
- Are the short-run fluctuations tightly related to the long-run trend?
  - Conventional view in economics is "no"

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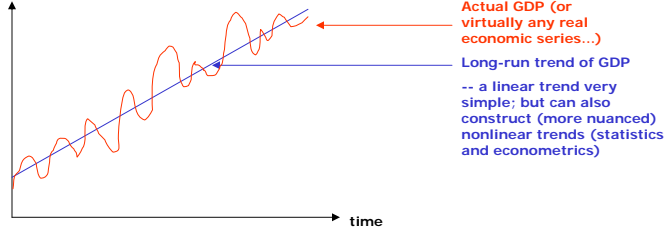
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- Are the short-run fluctuations tightly related to the long-run trend?
  - Conventional view in economics is "no"
  - But (very) recent work provocatively suggests answer may be "yes"
    - Linkage through R&D: R&D typically thought to be a driver of long-run growth...but perhaps cyclical fluctuations in R&D themselves have consequences for "business cycles" (much more research needed here...)

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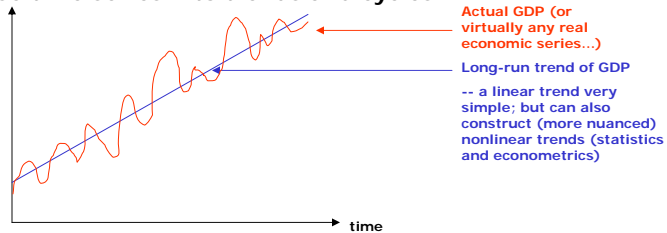
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  - Conventional view in economics is "no"
- Under the "no" view, a separation of fields
  - Studying the trend ("economic growth" and "development")
  - Studying the fluctuations ("macroeconomics")

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## BUSINESS CYCLES

- Decompose time series into trends and cycles

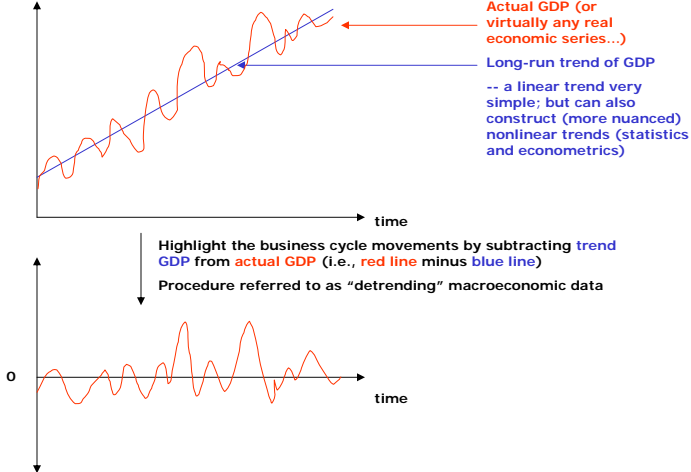


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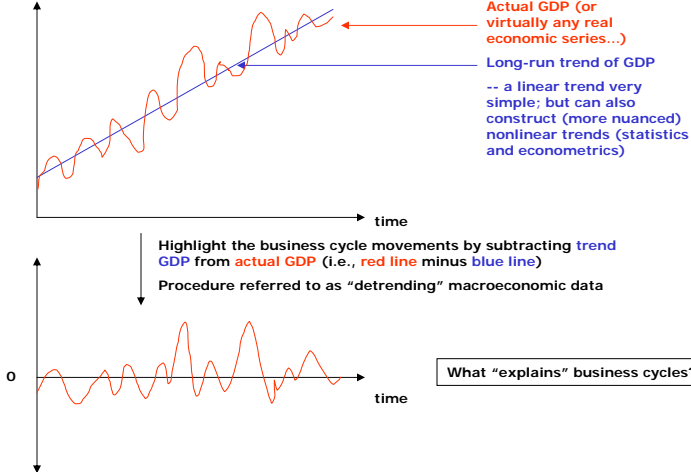
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## PRINCIPLES OF KEYNESIAN MACROECONOMICS

- ❑ **Basic Tenet:** price rigidities/inflexibilities characterize many goods markets and factor markets
  - ❑ “Sticky prices”
- ❑ (Many) other rigidities/inflexibilities affect markets’ functioning as well...
- ❑ ...but price (and wage) rigidities the central tenet
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- ❑ **Keynes’ General Theory** just a verbal description of things...

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## THE RISE OF MACROECONOMICS

- ❑ **“Macroeconomics”** born as a field during and because of the Great Depression
  - ❑ Idea that government could/should regulate the periodic ups and downs of the economy rose to prominence
- ❑ **John Maynard Keynes, *The General Theory of Employment, Interest, and Money* (1936)**
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- ❑ **Burns and Mitchell, *Measuring Business Cycles* (1946)**
  - ❑ First systematic accounting of the co-movement of various aggregates
    - ❑ i.e., GDP, consumption, employment, inflation, unemployment rate, etc...
- ❑ **How to “model”** (i.e., conceptually/rigorously/mathematically think about) business cycles?
  - ❑ Phase II: The big macroeconomic models

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## THE GLORY DAYS OF MACROECONOMICS

- ❑ **Big “Keynesian macroeconomic” models prominent by the 1960’s, led by**
  - ❑ Kennedy’s Council of Economic Advisers (Solow, Tobin, Samuelson)
  - ❑ MIT/Penn/Federal Reserve Board
  - ❑ ISLM and AS/AD model (Hicks, 1937) the conceptual core

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General idea of Keynesian-inspired macroeconometric models

$$\begin{aligned}
 x_{1t} &= \alpha_0 x_{2t} + \alpha_1 x_{3t} + \alpha_2 x_{3t} + \dots \\
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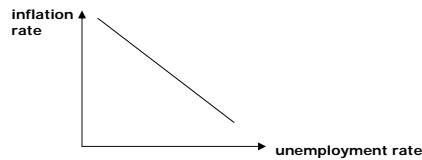
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- Basic approach: estimate (econometrically) these equations and use them for policy advice
  - In particular: estimate all the alpha coefficients using historical data and posit that this is how the macroeconomy “works”
- An approach to macroeconomic policy-making embodied most succinctly in the view and purported promise of the **Phillips Curve**

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## THE PHILLIPS CURVE

- A seemingly stable, predictable relationship between an economy’s inflation rate and unemployment rate

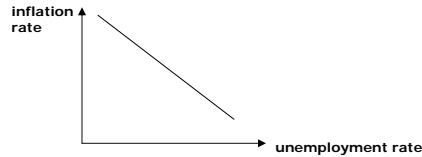


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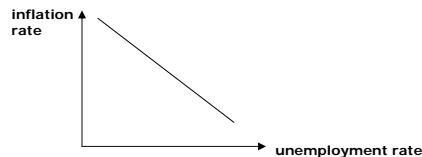
- Came to be the centerpiece of the Keynesian macroeconomic agenda
- **Came to be the centerpiece for policy advice...**
  - **...for fiscal policy** (given forceful voice during the Kennedy administration – CEA populated with future Nobel Laureates Robert Solow, James Tobin, Paul Samuelson...John Kenneth Galbraith a more muted enthusiast of this approach to policy formulation)

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  - **...and eventually for monetary policy**
    - Rise of an activist Fed: raising/lowering interest rates to "fine tune" macroeconomic performance

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## THE GLORY DAYS OF MACROECONOMICS

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General idea of Keynesian-inspired macroeconomic models  
 One of these equations is the Phillips Curve

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- Became widely used for policy-making...

## THE FALL OF MACROECONOMICS

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 x_{136t} &= \alpha_{5987} x_{1t} + \alpha_{5988} x_{13t} + \alpha_{5989} x_{69t} + \dots
 \end{aligned}$$

Dozens or hundreds of variables and equations, some of which describe how policy affects the economy

Say  $x_3$  and  $x_{13}$  are policy variables

- Became widely used for policy-making...
- ...until they “stopped working” in the 1970’s
  - Amidst a high-inflation environment (U.S. inflation between 15-20% in second half of 1970’s), sparked by OPEC oil embargoes

## THE FALL OF MACROECONOMICS

- Big “Keynesian macroeconomic” models prominent by the 1960’s, led by
  - Kennedy’s Council of Economic Advisers (Solow, Tobin, Samuelson)
  - MIT/Penn/Federal Reserve Board
  - ISLM and AS/AD model (Hicks, 1937) the conceptual core

General idea of Keynesian-inspired macroeconomic models  
 One of these equations is the Phillips Curve

$$\begin{aligned}
 x_{1t} &= \alpha_0 x_{2t} + \alpha_1 x_{3t} + \alpha_2 x_{3t} + \dots \\
 x_{2t} &= \alpha_3 x_{1t} + \alpha_4 x_{3t} + \alpha_5 x_{4t} + \dots \\
 &\vdots \\
 x_{136t} &= \alpha_{5987} x_{1t} + \alpha_{5988} x_{13t} + \alpha_{5989} x_{69t} + \dots
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- Lucas Critique (1976): The alpha’s themselves should be thought of / modeled as **functions** of government policy!

## THE LUCAS CRITIQUE

- Crucial inconsistency in Keynesian macroeconomic approach
  - The estimated coefficients (the alpha’s) themselves may change if policy (monetary and/or fiscal) changes!
  - In which case the macroeconomic approach **cannot** usefully give policy advice – unless one “knows”/makes assumptions about **how** the alpha’s themselves depend on policy...

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This “problem” was always present, but didn't reveal itself until the 1970's

March 30, 2009

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- ❑ Keynesian macroeconomic models are **not economic models**
  - ❑ Merely a statistical description of historical events
  - ❑ Economics: the study of how incentives influence behavior of individuals/market participants
  - ❑ A damning criticism of the entire macroeconomics profession...

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## THE FALL OF MACROECONOMICS

- ❑ **“Macroeconomics”** born as a field during and because of the Great Depression
  - ❑ Idea that government could/should regulate the periodic ups and downs of the economy rose to prominence
  
- ❑ **John Maynard Keynes, *The General Theory of Employment, Interest, and Money* (1936)**
  - ❑ Basic tenet: various “rigidities” in many markets lead to “disequilibria” that can last a long time
  
- ❑ **Burns and Mitchell, *Measuring Business Cycles* (1946)**
  - ❑ First systematic accounting of the co-movement of various aggregates
    - ❑ i.e., GDP, consumption, employment, inflation, unemployment rate, etc...
  
- ❑ **How to “model” (i.e., conceptually/rigorously/mathematically think about) business cycles?**
  - ❑ **Phase II: The big macroeconometric models**
    - ❑ **Death knell spelled by the devastating Lucas Critique**
  - ❑ **Phase III: Microeconomic foundations and DGE modeling**