MONETARY POLICY

APRIL 2, 2012

IS MONETARY POLICY NEUTRAL?

- **An enduring question in macroeconomics: does monetary policy have any important effects on the *real* (i.e, *real* GDP, consumption, etc) economy?**
- **Definition: Money (and hence monetary policy) is neutral if changes in the money supply (i.e., changes in monetary policy) have no effect on the real economy**
  - **Monetary policy is non-neutral if it does have effects on the real economy**
- **New Keynesian view: money is non-neutral (because prices are rigid/sticky, sometimes for long periods of time)**
- **RBC view: money is neutral (because prices are not rigid/sticky in any important way)**

WHERE IS MACROECONOMICS TODAY?

- Keynesian Macroeconomics
  - Ideology: Price rigidities/"sticky prices"
  - Policy stance: policy (fiscal and monetary) of crucial importance for macroeconomic performance
  - Methodology: econometric/statistical modeling
- RBC Macroeconomics
  - Ideology: Prices are not rigid or "sticky"
  - Policy stance: policy (neither fiscal nor monetary) not very important for macroeconomic performance
  - Methodology: dynamic general equilibrium modeling
- New Keynesian Macroeconomics ← Empirical evidence still EXTREMELY mixed on this
  - Ideology: Price rigidities/"sticky prices"
  - Policy stance: policy (fiscal and monetary) of crucial importance for macroeconomic performance
  - Methodology: dynamic general equilibrium modeling ← The enduring imprint of the RBC revolution
- A central issue in macroeconomics: monetary neutrality?
  - Does monetary policy have long-lasting effects on *real* economy?

IS MONETARY POLICY NEUTRAL?

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  - Monetary policy is non-neutral if it does have effects on the real economy
- New Keynesian view: money is non-neutral (because prices are rigid/sticky, sometimes for long periods of time)
- RBC view: money is neutral (because prices are not rigid/sticky in any important way)
- To seriously consider neutrality issue, need to finally explicitly think about money and monetary policy
  - It's only been in the background of the analysis so far…

THE ROLES OF MONEY

- The roles played by money
  - Medium of exchange
    - Eases double-coincidence of wants problem
  - Unit of account
    - A common "language" for all prices to be quoted in
  - Store of value
    - Bananas will perish in short amount of time, dollar bills won't

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- How to conceptually "model" money a surprisingly hard problem
  - Much more difficult than, e.g., "consumption-leisure framework" or "consumption-savings framework"
  - How to formally (mathematically) represent these roles of money?
- A shortcut: suppose money directly yields utility
  - Period-*t* utility function

$$u\left(c_t, \frac{M_t}{P_t}\right)$$

  - Money-in-the-utility-function (MIU) formulation
  - IMPORTANT: It's not M_t in the utility function, but rather M_t/P_t

REAL MONEY BALANCES

- M_t/P_t a key variable for macroeconomic analysis
- Unit Analysis (i.e., analyze algebraic units of variables)
  - Units(M_t) = \$
  - Units(P_t) = \$/unit of consumption
  - Units(M_t/P_t) = $\frac{\$}{\frac{\$}{\text{unit of consumption}}} = \$ \cdot \frac{\text{unit of consumption}}{\$}$

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- Utility (composite of medium of exchange, unit of account, store of value) depends on *real* money (M/P), not nominal money (M)
  - Measures the purchasing power of (nominal) money holdings…
  - …which is presumably what people most care about
- M_t and P_t can potentially grow at different rates
  - In which case real M_t/P_t fluctuate from one period to the next

MONEY MARKETS AND BOND MARKETS

- A prerequisite for analyzing monetary policy: understanding bonds and bond markets
- Bond markets and money markets tightly linked to each other
- What is a "bond?"
  - Simply put, a debt obligation (i.e., borrow funds today, repay at some future date with interest)

Macro Fundamentals

MONEY MARKETS AND BOND MARKETS

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- What is a "bond?"
  - Simply put, a debt obligation (i.e., borrow funds today, repay at some future date with interest)
  - Types of bonds

Conventional monetary policy operates through short-term bonds →

  - 30-day, 60-day, 90-day Federal government bonds
  - 1-year Federal government bonds
  - 2-year Federal government bonds
  - 5-year Federal government bonds
  - 10-year Federal government bonds
  - 30-year Federal government bonds
  - Foreign sovereign government bonds of various maturities
  - State and local government bonds of various maturities
  - Corporate bonds of various maturities
  - Coupon bonds – pay something back ("coupon payments") every so often until the final date of maturity
  - Zero-coupon bonds – only pay back at final date of maturity

BOND MARKETS

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- What is a "bond?"
  - Simply put, a debt obligation (i.e., borrow funds today, repay at some future date with interest)
- Simplify by supposing that all bonds are one-period zero-coupon government bonds – i.e., short-term bonds
  - Traditional simplification for analysis of monetary policy
  - Understanding how short-term bond is priced
    - Key to understanding how all bonds are priced
    - Key to understanding how all sorts of financial assets are priced
  - Also sheds light on the pricing kernel (recall from Chapter 8)
    - Stock prices linked to bond prices

Asset-pricing lurking in the background again…

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    - Key to understanding how all sorts of financial assets are priced
  - Short-term government bond a "riskless" debt instrument
    - U.S. government has never defaulted on (nominal…) bond payment
    - But excess inflation a backdoor way of "defaulting"…
    - (Important concept(s) for financial accelerator framework later….)

In normal times. Decoupling amidst severe recession?

BOND MARKETS

- **Key relationship between price of a bond and nominal interest rate**

Bonds priced according to present-value of future payoff

$$P_t^b = \frac{FV_{t+1}}{1+i_t}$$

- **Notation**
  - P^b_t: nominal price of a one-period bond
  - i_t: nominal interest rate between period t and period $t+1$
  - FV_{t+1}: face-value of bond (i.e., how much will be repaid in $t+1$)

  In reality, ***many*** different values of *FV* ($100, $1000, $10,000, etc…)

BOND MARKETS

- **Key relationship between price of a bond and nominal interest rate**

Bonds priced according to present-value of future payoff

$$P_t^b = \frac{1}{1+i_t} \quad \Longleftrightarrow \quad i_t = \frac{1}{P_t^b} - 1$$

IMPORTANT: inverse relationship between P^b and i

- **Notation**
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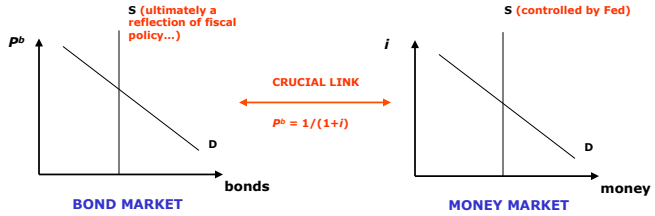
  In reality, ***many*** different values of *FV* ($100, $1000, $10,000, etc…)
  Simplify and assume *FV* = 1 (will get main ideas across)

- **Inverse relationship between price of a bond and nominal interest rate – critical**

- **Short-term bond markets are/have been the conventional channel through which Federal Reserve conducts monetary policy**

MONEY MARKETS AND BOND MARKETS

- Short-term bond markets and money markets tightly linked to each other



- *i* can be thought of in two (mirror-image) ways
  - The interest payoff of a bond
  - Opportunity cost of holding money
    - Each unit of wealth held as a dollar is a unit of wealth *not* held as a bond, which entails the loss of chance to earn interest (i.e., opportunity cost)
    - *i* is interpreted as "the price of money"

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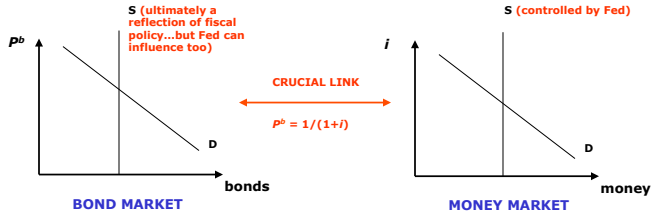

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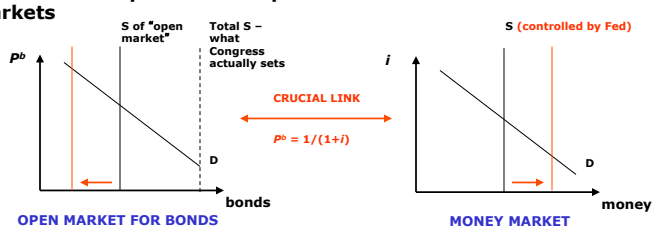
- Conventional monetary policy
  - Basic macro: Fed open-market operations conducted via short-term bond markets, so Fed operations do affect bond supply

MONEY MARKETS AND BOND MARKETS

- Basic macro: open-market operations conducted via short-term bond markets

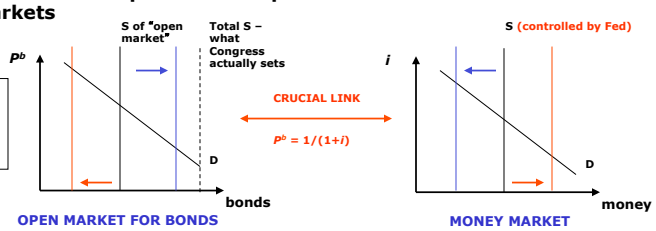


- Expansionary monetary policy by Fed
  - Fed buys short bonds from financial sector, reducing open-market supply…
  - …by printing new money, increasing its supply in money market…
  - …which causes short-term *i* to decrease

MONEY MARKETS AND BOND MARKETS

- Basic macro: open-market operations conducted via short-term bond markets

Review from intro macro notes or Chapter 11-12 in macro refresher



- Expansionary monetary policy by Fed
  - Fed buys short bonds from financial sector, reducing open-market supply…
  - …by printing new money, increasing its supply in money market…
  - …which causes short-term *i* to decrease
- Contractionary monetary policy by Fed
  - Fed sells short bonds to financial sector, increasing open-market supply …
  - …in exchange for money, decreasing its supply in money market…
  - …which causes short-term *i* to increase

A More Expansive View of Monetary Policy?

- Conventional monetary policy: interest-rate targeting via open-market operations
- What else is monetary policy and how else can it be conducted?
  - Unconventional policy measures an important issue the past few years
- Allow Fed to purchase other assets, not just short-term U.S Treasuries
  - i.e., let it conduct other market operations besides only conventional short-bond open-market operations
- Allow Fed to issue its own bonds (legal issues unclear)

Beyond Conventional Monetary Policy

A More Expansive View of Monetary Policy?

- Conventional monetary policy: interest-rate targeting via open-market operations
- What else is monetary policy and how else can it be conducted?
  - Unconventional policy measures an important issue the past few years
- Allow Fed to purchase other assets, not just short-term U.S Treasuries
  - i.e., let it conduct other market operations besides only conventional short-bond open-market operations
- Allow Fed to issue its own bonds (legal issues unclear)
- Bail out/lend to banks and firms in times of distress ("lender of last resort")
- "Communicate" with the public and markets about "how the economy is doing"
  - A confidence-management role
  - Bernanke has given quarterly press briefings since April
- Current focus on quantitative easing/credit easing – is there a QE3 coming?
  - Purchase assets not conventionally used in policy implementation (term derives from Friedman's "quantity of money" theories)

MONETARY POLICY IN THE INFINITE-PERIOD ECONOMY

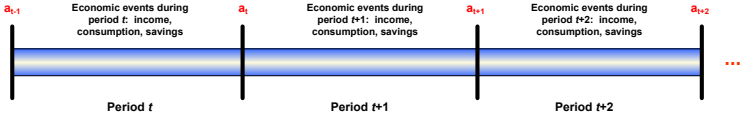
APRIL 2, 2012

BASICS

- **Extend our infinite-period framework**
  - **Introduce money and bonds into the Chapter 8 framework**
  - **So now three types of assets (stocks, short-term bonds, money) for representative consumer to use for savings purposes**
- **Will allow us to think further about what the "pricing kernel" is**
- **Will allow us to think about connection between bond prices and stock prices**
- **Will allow us to think about issue of monetary neutrality (the main issue in the RBC vs. New Keynesian debate)**
  - **i.e., does money (and thus monetary policy) have important consequences for *real* (i.e., consumption and real GDP) variables?**
- **Index time periods by arbitrary indexes *t*, *t*+1, *t*+2, etc.**
  - **Important: all of our analysis will be conducted from the perspective of the very beginning of period *t*...**
- **Sequential Lagrangian analysis (with money in the utility function)**

BASICS

- **Timeline of events**



- **Notation**
  - c_t: consumption in period t
  - P_t: nominal price of consumption in period t
  - Y_t: nominal income in period t ("falls from the sky")
  - a_{t-1}: real stock holdings at beginning of period t/end of period t-1

BASICS

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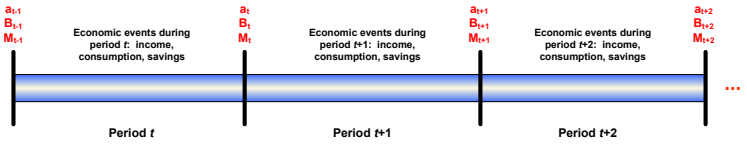

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Now *three* types of assets consumers can use for savings purposes

  - a_{t-1}: real stock holdings at beginning of period t/end of period t-1
  - M_{t-1}: nominal money holdings at beginning of period t/end of period t-1
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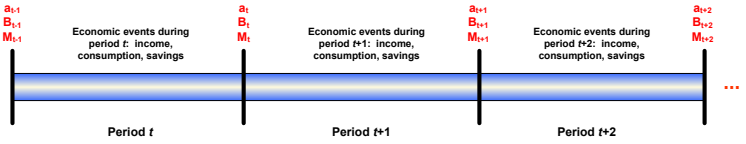

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  - S_t: nominal price of a unit of stock in period t
  - D_t: nominal dividend paid in period t by each unit of stock held at the start of t
  - Pb_t: nominal price of a bond in period t
  - i_t: nominal interest rate on a bond purchased in t and which pays off in t+1
  - π_{t+1}: net inflation rate between period t and period t+1
  - y_t: real income in period t (= Y_t/P_t)

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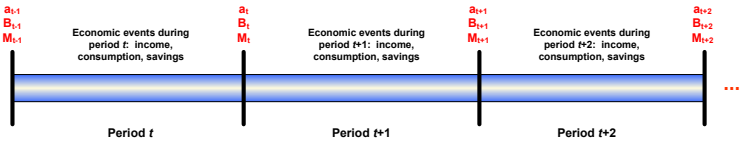

- **Notation**
  - c_{t+1}: consumption in period t+1
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  - Y_{t+1}: nominal income in period t+1 ("falls from the sky")

Now *three* types of assets consumers can use for savings purposes

  - a_t: real stock holdings at beginning of period t+1/end of period t
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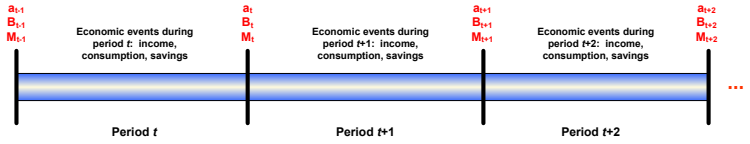
  - Pb_{t+1}: nominal price of a bond in period t+1
  - i_{t+1}: nominal interest rate on a bond purchased in t+1 and which pays off in t+2
  - π_{t+2}: net inflation rate between period t+1 and period t+2
  - y_{t+1}: real income in period t (= Y_{t+1}/P_{t+1})

BASICS

- **Timeline of events**



- **Notation**
  - **And so on for period t+2, t+3, etc...**

BUDGET CONSTRAINT(S)

- **Extend budget constraints from Chapter 8 stock-pricing framework to now include three distinct types of assets: stocks, money, and short-term bonds**
- **Need infinite budget constraints to describe economic opportunities and possibilities**
  - **One for each period**
  - **In period t**

$$\underbrace{P_t c_t + P_t^b B_t + M_t + S_t a_t}_{\text{Total outlays in period } t} = \underbrace{Y_t + M_{t-1} + B_{t-1} + S_t a_{t-1} + D_t a_{t-1}}_{\text{Total income in period } t}$$

Total outlays in period t: period-t consumption + stocks to *carry into period* t+1 + money to *carry into period* t+1 + bond purchases

Total income in period t: period-t Y + income from stock-holdings *carried into period* t (has value S_t and pays dividend D_t) + money-holdings *carried into period* t + bond-holdings *carried into period* t (each unit repays FV = 1)

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Total outlays in period *t*: period-*t* consumption + stocks to *carry into period t*+1 + money to *carry into period t*+1 + bond purchases

Total income in period *t*: period-*t* *Y* + income from stock-holdings *carried into period t* (has value S_t and pays dividend D_t) + money-holdings *carried into period t* + bond-holdings *carried into period t* (each unit repays *FV* = 1)

  - **In period *t*+1**

$$\underbrace{P_{t+1} c_{t+1} + P_{t+1}^b B_{t+1} + M_{t+1} + S_{t+1} a_{t+1}}_{\text{Total outlays in period } t+1} = \underbrace{Y_{t+1} + M_t + B_t + S_{t+1} a_t + D_{t+1} a_t}_{\text{Total income in period } t+1}$$

Total outlays in period *t*+1: period-*t*+1 consumption + stocks to *carry into period t*+2 + money to *carry into period t*+2 + bond purchases

Total income in period *t*+1: period-*t*+1 *Y* + income from stock-holdings *carried into period t*+1 (has value S_{t+1} and pays dividend D_{t+1}) + money-holdings *carried into period t*+1 + bond-holdings *carried into period t*+1 (each unit repays *FV* = 1)

  - **And identical-looking budget constraints in period *t*+2, *t*+3, *t*+4, etc.**

LAGRANGE ANALYSIS: SEQUENTIAL APPROACH

- **Step 1: Construct Lagrange function (starting from *t*)**

$$u(c_t, M_t / P_t) + \beta u(c_{t+1}, M_{t+1} / P_{t+1}) + \beta^2 u(c_{t+2}, M_{t+2} / P_{t+2}) + \ldots$$

First the lifetime utility function....(no different than Chapter 8, except now with MIU)

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$$+\lambda_t\left[Y_t + (S_t + D_t)a_{t-1} + M_{t-1} + B_{t-1} - P_t c_t - S_t a_t - M_t - P_t^b B_t\right]$$

...then the period *t* constraint...

$$+\beta\lambda_{t+1}\left[Y_{t+1} + (S_{t+1} + D_{t+1})a_t + M_t + B_t - P_{t+1}c_{t+1} - S_{t+1}a_{t+1} - M_{t+1} - P_{t+1}^b B_{t+1}\right]$$

...then the period *t*+1 constraint...

$$+\beta^2\lambda_{t+2}\left[Y_{t+2} + (S_{t+2} + D_{t+2})a_{t+1} + M_{t+1} + B_{t+1} - P_{t+2}c_{t+2} - S_{t+2}a_{t+2} - M_{t+2} - P_{t+2}^b B_{t+2}\right]$$

...then the period *t*+2 constraint...

$$+\beta^3\lambda_{t+3}\left[Y_{t+3} + (S_{t+3} + D_{t+3})a_{t+2} + M_{t+2} + B_{t+2} - P_{t+3}c_{t+3} - S_{t+3}a_{t+3} - M_{t+3} - P_{t+3}^b B_{t+3}\right]$$

...then the period *t*+3 constraint...

$$+\ldots$$

Infinite number of terms

LAGRANGE ANALYSIS: SEQUENTIAL APPROACH

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...then the period *t*+1 constraint...

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...then the period *t*+3 constraint...

$$+\ldots$$

Infinite number of terms

- **Step 2: Compute FOCs with respect to c_t, a_t, B_t, M_t, ...**

with respect to c_t:	$u_1(c_t, M_t/P_t) - \lambda_t P_t = 0$	Equation 1
with respect to a_t:	$-\lambda_t S_t + \beta\lambda_{t+1}(S_{t+1} + D_{t+1}) = 0$	Equation 2
with respect to B_t:	$-\lambda_t P_t^b + \beta\lambda_{t+1} = 0$	Equation 3
with respect to M_t:	$\dfrac{u_2(c_t, M_t/P_t)}{P_t} - \lambda_t + \beta\lambda_{t+1} = 0$	Equation 4 (need chain rule of calculus to compute this)

ASSET PRICING REVISITED

$$u_1(c_t, M_t/P_t) - \lambda_t P_t = 0 \quad \text{Equation 1}$$
$$-\lambda_t S_t + \beta\lambda_{t+1}(S_{t+1} + D_{t+1}) = 0 \quad \text{Equation 2}$$
$$-\lambda_t P_t^b + \beta\lambda_{t+1} = 0 \quad \text{Equation 3}$$
$$\frac{u_2(c_t, M_t/P_t)}{P_t} - \lambda_t + \beta\lambda_{t+1} = 0 \quad \text{Equation 4}$$

- **Equation 2 →** $S_t = \left(\frac{\beta\lambda_{t+1}}{\lambda_t}\right)(S_{t+1} + D_{t+1})$ **STOCK-PRICING EQUATION**

Period-*t* stock price = Pricing kernel × Future return

- **Much of finance theory concerned with pricing kernel**
  - **Theoretical properties**
  - **Empirical models of kernels**
- **Pricing kernel where macro theory and finance theory intersect**
  - **Lagrange multipliers where macro and finance intersect – an idea that will be important in the financial accelerator framework**

ASSET PRICING REVISITED

$$u_1(c_t, M_t/P_t) - \lambda_t P_t = 0 \quad \text{Equation 1}$$
$$-\lambda_t S_t + \beta\lambda_{t+1}(S_{t+1} + D_{t+1}) = 0 \quad \text{Equation 2}$$
$$-\lambda_t P_t^b + \beta\lambda_{t+1} = 0 \quad \text{Equation 3}$$
$$\frac{u_2(c_t, M_t/P_t)}{P_t} - \lambda_t + \beta\lambda_{t+1} = 0 \quad \text{Equation 4}$$

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Period-*t* stock price = Pricing kernel × Future return

- **Equation 3 →** $P_t^b = \frac{\beta\lambda_{t+1}}{\lambda_t}$ **BOND-PRICING EQUATION**
- **Price of short-term bond *is* the pricing kernel**
  - **Stock prices and bond prices are connected**
  - **Most (all?) asset prices fundamentally connected to short bond prices**
  - **Finance: pricing kernel reflects the price/return of the least risky asset in the economy – U.S. Treasury short-term bonds**

ASSET PRICING REVISITED

$$u_1(c_t, M_t/P_t) - \lambda_t P_t = 0 \quad \text{Equation 1}$$
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  Period-*t* stock price = Pricing kernel × Future return

- **Equation 3 →** $P_t^b = \frac{\beta\lambda_{t+1}}{\lambda_t}$ BOND-PRICING EQUATION
- **Recall** $P_t^b = \frac{1}{1+i_t}$
- **→ can express pricing kernel as** $\frac{\beta\lambda_{t+1}}{\lambda_t} = \frac{1}{1+i_t}$

FISHER EQUATION

$$u_1(c_t, M_t/P_t) - \lambda_t P_t = 0 \quad \text{Equation 1}$$
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$$\frac{u_2(c_t, M_t/P_t)}{P_t} - \lambda_t + \beta\lambda_{t+1} = 0 \quad \text{Equation 4}$$

- **Combining stock-pricing equation with bond-pricing equation →**

$$1 + r_t = \frac{1+i_t}{1+\pi_{t+1}} \quad \text{FISHER EQUATION}$$

FISHER EQUATION

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- **Combining stock-pricing equation with bond-pricing equation →**

$$1 + r_t = \frac{1 + i_t}{1 + \pi_{t+1}} \quad \text{FISHER EQUATION}$$

  - **Fisher equation a relationship between returns on nominal bonds and returns on stock (finance theory: "no-arbitrage" condition)**
  - **(See derivation in Chapter 14)**
  - **Bonds: "riskless asset"**
  - **Stock: "risky asset"**

- **Fisher equation was a building block of two-period model**

- **Recall approximate form: $r \approx i - \pi$**

CONSUMPTION-MONEY OPTIMALITY CONDITION

Begin with equation 4:

$$\frac{u_2(c_t, M_t/P_t)}{P_t} - \lambda_t = -\beta\lambda_{t+1}$$

↓ Use $\beta\lambda_{t+1} = \lambda_t P^b_t$ from equation 3

$$\frac{u_2(c_t, M_t/P_t)}{P_t} - \lambda_t = -\lambda_t P_t^b$$

↓ Divide through by λ_t

$$\frac{u_2(c_t, M_t/P_t)}{\lambda_t P_t} - 1 = -P_t^b$$

↓ Use $\lambda_t P_t = u_{1t}$ from equation 1

$$\frac{u_2(c_t, M_t/P_t)}{u_1(c_t, M_t/P_t)} = 1 - P_t^b$$

↓ Use $P^b_t = 1/(1+i_t)$

CONSUMPTION-MONEY OPTIMALITY CONDITION

$$\underbrace{\frac{u_2(c_t, M_t/P_t)}{u_1(c_t, M_t/P_t)}}_{\text{MRS (between consumption and } \underline{\textit{real}} \text{ money holdings)}} = \underbrace{\frac{i_t}{1+i_t}}_{\text{price ratio (between consumption and money)}}$$

MONEY DEMAND

- Consumption-money optimality condition the foundation of money demand function
- Example: suppose $u\left(c_t, \frac{M_t}{P_t}\right) = \ln c_t + \ln\left(\frac{M_t}{P_t}\right)$
- Thus, $u_1\left(c_t, \frac{M_t}{P_t}\right) = \frac{1}{c_t}$ and $u_2\left(c_t, \frac{M_t}{P_t}\right) = \frac{1}{M_t / P_t}$ (no chain rule this time…)

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- Consumption-money optimality condition (for this utility function…) is

$$\frac{P_t c_t}{M_t} = \frac{i_t}{1+i_t}$$

Isolate the M_t/P_t term

$$\frac{M_t}{P_t} = c_t \cdot \left(\frac{1+i_t}{i_t}\right)$$

REAL MONEY DEMAND FUNCTION: depends positively on c_t and negatively on i_t (i_t is the opportunity cost of money)

- Will use this money demand function to analyze
  - The monetary neutrality debate
  - The long-run (aka steady-state) connection between monetary policy and inflation

MONETARY POLICY IN THE INFINITE-PERIOD ECONOMY: SHORT-RUN EFFECTS

APRIL 2, 2012

IS MONETARY POLICY NEUTRAL?

- An enduring question in macroeconomics: does monetary policy have any important effects on the ***real*** (i.e, *real* GDP, consumption, etc) economy?
- **Definition**: Money (and hence monetary policy) is neutral if changes in the money supply (i.e., changes in monetary policy) have no effect on the real economy
  - Monetary policy is non-neutral if it does have effects on the real economy
- New Keynesian view: money is non-neutral (because prices are rigid/sticky, sometimes for long periods of time)
- RBC view: money is neutral (because prices are not rigid/sticky in any important way)
- MIU framework allows us to consider how/why monetary policy is or is not neutral

MONEY DEMAND

CONSUMPTION-MONEY OPTIMALITY CONDITION

$$\underbrace{\frac{u_2(c_t, M_t/P_t)}{u_1(c_t, M_t/P_t)}}_{\text{MRS (between consumption and } \textit{real} \text{ money holdings)}} = \underbrace{\frac{i_t}{1+i_t}}_{\text{price ratio (between consumption and money)}}$$

NOTE: consumption-money optimality condition and money demand function are the *same thing*, just viewed from different points of view

Using utility function $u\left(c_t, \frac{M_t}{P_t}\right) = \ln c_t + \ln\left(\frac{M_t}{P_t}\right)$, generate money demand function

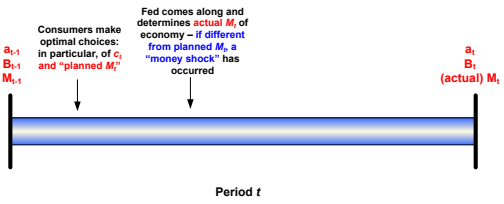
REAL MONEY DEMAND FUNCTION: depends positively on c_t and negatively on i_t (i_t is the opportunity cost of money)

$$\frac{M_t}{P_t} = c_t \cdot \left(\frac{1+i_t}{i_t}\right)$$

- Use money demand function to illustrate effects of money (monetary policy) shocks
- Gets at core of neutrality debate
- Let's be even more precise about the timing of events…

MONETARY NEUTRALITY DEBATE

- Precise timing of events within period *t*

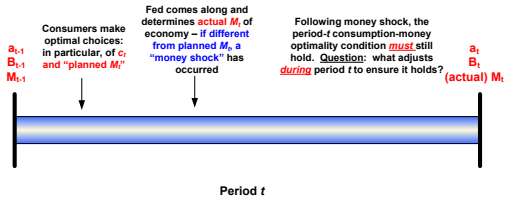


Notation:
"demand" ~ planned
"supply" ~ actual

- Fed sets "supply of M_t" after consumers makes their choices of c_t and "demand for M_t" (and other choices, too…)
  - If actual M_t differs from planned M_t, money shock has occurred

MONETARY NEUTRALITY DEBATE

- **Precise timing of events within period *t***



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- **Fed sets "supply of M_t" after consumers makes their choices of c_t and "demand for M_t" (and other choices, too…)**
  - **If actual M_t differs from planned M_t, money shock has occurred**
- **Question: which adjusts (P_t or c_t) to ensure consumption-money optimality condition holds? (simplify by assuming i_t doesn't adjust)**

$$\frac{M_t}{P_t} = c_t \cdot \left(\frac{1+i_t}{i_t}\right)$$

MONETARY NEUTRALITY DEBATE

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$$\frac{M_t}{P_t} = c_t \cdot \left(\frac{1+i_t}{i_t}\right)$$

- **Keynesian/New Keynesian view**
  - **P_t cannot adjust because prices are sticky**
    - **(Prices will adjust *later* (i.e, in period *t*+1 or later), just not in period *t*)**
  - **A positive (negative) money shock leads to a rise (fall) in c_t**
  - **Money (and hence monetary policy) is not neutral**

MONETARY NEUTRALITY DEBATE

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  - **A positive (negative) money shock leads to a rise (fall) in c_t**
  - **Money (and hence monetary policy) is not neutral**
- **RBC view**
  - **P_t can adjust because prices are not sticky**
  - **No reason for c_t to adjust (they do reflect optimal choices, after all…)**
  - **A positive (negative) money shock leads to no change (no change) in c_t**
  - **Money (and hence monetary policy) is neutral**
- **Empirical evidence for "how sticky" are prices is very mixed…**

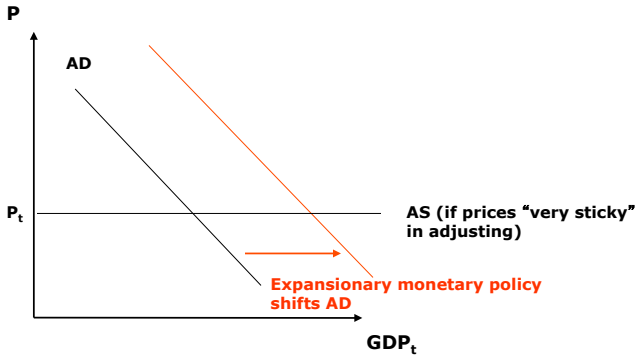
MONETARY NEUTRALITY DEBATE: EXAMPLE

- **Assume i_t = 0.125 is fixed**
- **Consumers' "planned" choices are c_t = 2 and M_t = 180**
- **This plan was made with P_t = 10 in mind**
- **Fed sets actual M_t = 270 (a positive money shock because actual M_t greater than planned M_t)**
- **Keynesian/New Keynesian view**
  - **P_t = 10 won't change (sticky prices)**
  - **c_t will rise (to c_t = 3) to make consumption-money optimality condition hold**
  - **Monetary policy is non-neutral**

$$\frac{M_t}{P_t} = c_t \cdot \left(\frac{1+i_t}{i_t}\right)$$

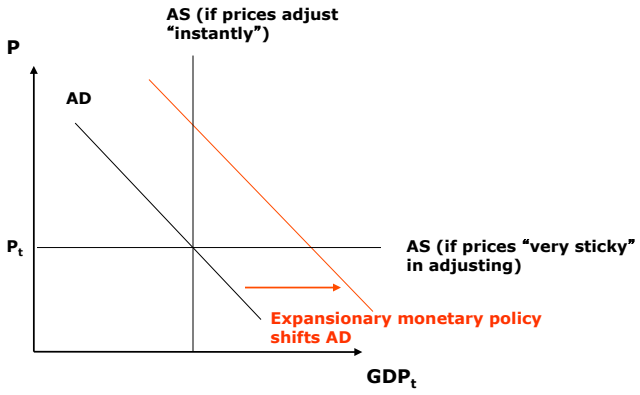
- **RBC view**
  - **Consumers' plan of c_t = 2 is what the economy really wants**
  - **P_t can fully and quickly adjust to accommodate this → P_t = 15**
  - **Monetary policy is neutral; only effect of monetary policy is on inflation**

MONETARY NEUTRALITY DEBATE



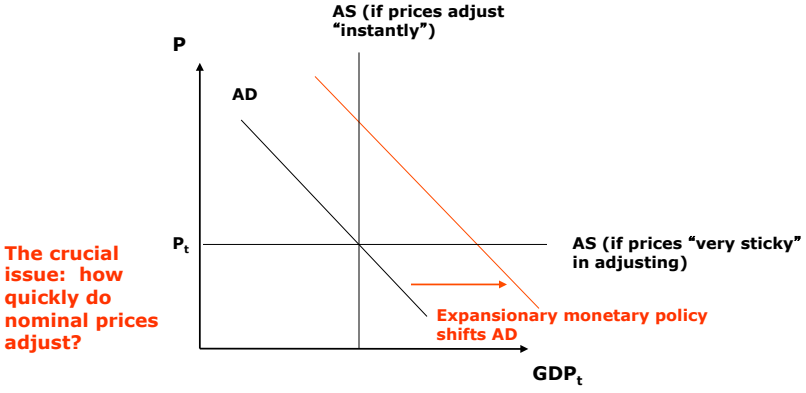
Period-t goods market

MONETARY NEUTRALITY DEBATE



Period-t goods market

MONETARY NEUTRALITY DEBATE

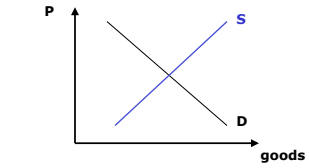


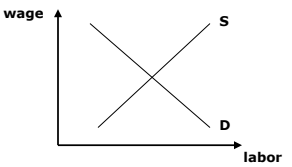
The crucial issue: how quickly do nominal prices adjust?

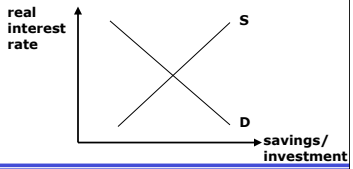
Period-t goods market

THE THREE MACRO (AGGREGATE) MARKETS

- **Goods Markets**
  - Demand derived from C-L framework (Shape of AS function?....depends how quickly nominal prices adjust)
- **Labor Markets**
  - Supply derived from C-L framework
  - Demand derived from firm theory in C-S framework
- **Capital/Savings/Funds/Asset Markets (aka Financial Markets)**
  - Supply derived from C-S framework
  - Demand derived from firm theory in C-S framework







MONETARY POLICY IN THE INFINITE-PERIOD ECONOMY: LONG-RUN EFFECTS

APRIL 2, 2012

MONEY AND INFLATION IN THE LONG-RUN

- **Question: what determines inflation in the long run (i.e., in steady-state)?**
  - **Use both period-(*t*-1) and period-*t* money demand functions to analyze**

Money demand function in *t*-1

$$\frac{M_{t-1}}{P_{t-1}} = c_{t-1} \cdot \left(\frac{1+i_{t-1}}{i_{t-1}} \right)$$

Money demand function in *t*

$$\frac{M_t}{P_t} = c_t \cdot \left(\frac{1+i_t}{i_t} \right)$$

Divide period *t* money demand by period *t*-1 money demand

$$\frac{M_t / P_t}{M_{t-1} / P_{t-1}} = \frac{c_t}{c_{t-1}} \cdot \left(\frac{1+i_t}{i_t} \right) \left(\frac{i_{t-1}}{1+i_{t-1}} \right)$$

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Recall definition of inflation $\pi_t = \frac{P_t}{P_{t-1}} - 1$

And now define the *money growth rate* in an analogous way: $\mu_t = \frac{M_t}{M_{t-1}} - 1$

$$\frac{1+\mu_t}{1+\pi_t} = \frac{c_t}{c_{t-1}} \cdot \left(\frac{1+i_t}{i_t}\right)\left(\frac{i_{t-1}}{1+i_{t-1}}\right)$$

Impose steady state: i.e., $c_{t-1} = c_t = c$, $i_{t-1} = i_t = i$, $n_t = n$, and $\mu_t = \mu$

$$\frac{1+\mu}{1+\pi} = \frac{c}{c} \cdot \left(\frac{1+i}{i}\right)\left(\frac{i}{1+i}\right)$$

Monetary Policy Analysis: Long-Run Effects

MONEY AND INFLATION IN THE LONG-RUN

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$$\frac{1+\mu}{1+\pi} = \frac{c}{c} \cdot \left(\frac{1+i}{i}\right)\left(\frac{i}{1+i}\right)$$

$$\mu = \pi$$

IN LONG RUN, RATE OF MONEY GROWTH = RATE OF INFLATION

MONETARISM

$\mu = \pi$ IN LONG RUN, RATE OF MONEY GROWTH = RATE OF INFLATION

- In steady state, inflation determined solely by how quickly central bank (Fed) expands (or shrinks) the nominal money supply
- This relationship the basis for the monetarist school of thought
  - Milton Friedman's famous dictum: "Inflation is always and everywhere a monetary phenomenon"
    - Policy translation: "A central bank should not worry about/try to control anything other than how quickly the money supply in the economy is growing. Keeping money growth under control will keep inflation under control."

Monetary Policy Analysis: Money and Inflation

MONETARISM

$\mu = \pi$ IN LONG RUN, RATE OF MONEY GROWTH = RATE OF INFLATION

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    - Policy translation: "A central bank should not worry about/try to control anything other than how quickly the money supply in the economy is growing. Keeping money growth under control will keep inflation under control."
  - Rose to prominence in mid- and late 1970's (during macro crises)
  - Largest policy influence in U.K., short-lived policy influence in U.S.
  - Largely died out as basis for serious policy advice by mid-1980's
- Nevertheless still viewed as fundamental "law" of macroeconomics
  - A concern today: Fed's "easy monetary policy" (read: Fed has increased money supply very rapidly) will generate a burst of inflation

MONETARY POLICY

- In short-run, do changes in monetary policy have effects on consumption and real GDP?
  - Keynesian/New Keynesian view: yes because prices are sticky
  - RBC view: no because prices are not sticky
- In long-run, changes in money growth rate
  - Only have effects on inflation
  - Have no effects on consumption and real GDP

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- In long-run, changes in money growth rate
  - Only have effects on inflation
  - Have no effects on consumption and real GDP
- Competing principles/theories influence policy-makers' decisions
- Basic models are guideposts for policy debates
- Actual policy-making quite messy
  - Requires lot of judgment
  - Requires hope/belief that basic models are at least *somewhat* useful guides to thinking
- Next: interactions between monetary policy and fiscal policy (Chapter 15)