EXCHANGE RATES I: THE MONETARY APPROACH IN THE LONG RUN

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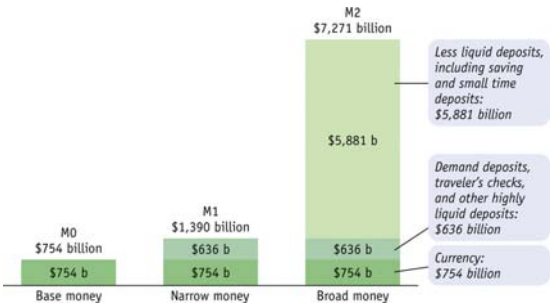
What Is Money?

- **Money** is an object that serves three functions:
  - Store of value
    - Money is an asset that can be used to buy goods in the future.
    - Financial assets (stocks and bonds) and property are other stores of value that are not money.
  - Unit of account
    - How prices are expressed.
    - A unit of account is used to measure value of different items.
  - Medium of exchange
    - Money is generally accepted as a means of payment for goods.
    - Money is the most liquid form of payment: an asset that is easily converted into goods and services

Measurement of Money

- Different measures of money
  - Monetary base = Currency
    - Currency in circulation plus currency in banking system
  - M1 = Currency in circulation + demand deposits
    - Demand deposits are checking accounts payable on demand by the bank customer.
  - M2 = M1 + other less liquid assets
    - Other less liquid assets include savings accounts, small time deposits, and money market mutual funds.

M0, M1, and M2 in the United States (2007)



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The Supply of Money

- We will focus on M1, the predominant type of money that we use for transactions.
- We will assume that the nominal money supply M = M1 is controlled by the central bank.
  - In fact, the central bank directly controls only part of M, namely the monetary base (M0).
  - However, central banks can indirectly control M1 by using interest rate policies and other tools (such as reserve requirements) to influence the total amount of bank deposits created (M1 – M0).

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The Demand for Money: A Simple Model

- We assume that the demand for nominal money is driven by the need to use money to undertake transactions.
- In the simplest model, the **quantity theory**: the amount of transactions assumed to be proportional to the dollar value of nominal income PY (where real income is Y).

$$\underbrace{M^d}_{\substack{\text{demand} \\ \text{for money (\$)}}} = \underbrace{P \times Y}_{\text{nominal income (\$)}} \times \underbrace{\bar{L}}_{\text{a constant}}$$

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The Demand for Money: A Simple Model

- Rearrange to get an expression for the demand for real money balances (nominal value of money demand deflated by the price level P):

$$\underbrace{\frac{M^d}{P}}_{\substack{\text{demand}\\ \text{for real}\\ \text{money}}} = \underbrace{\bar{L}}_{\text{a constant}} \times \underbrace{Y}_{\text{real income}}$$

- The demand for real money balances is a constant multiple of the real income level Y.

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Equilibrium in the Money Market

- The demand for money balances must equal the supply (denoted M):

$$M = \bar{L}PY$$

- Rewriting this expression, the demand for real money balances must equal the real money supply:

$$\frac{M}{P} = \bar{L}Y$$

- In the long run, prices are flexible. Prices adjust to equal real money demand and real money supply.

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The Monetary Approach: A Simple Model of Prices

- Solving for the price level in each country:

$$P_{US} = \frac{M_{US}}{\bar{L}_{US}Y_{US}} \qquad P_E = \frac{M_E}{\bar{L}_E Y_E}$$

- **Fundamental equations of the monetary model of the price level**
  - These expressions say that the price level P is determined by the ratio of nominal money supplied M to nominal money demanded (LY).
  - Prices rise if there is “more money chasing fewer goods”

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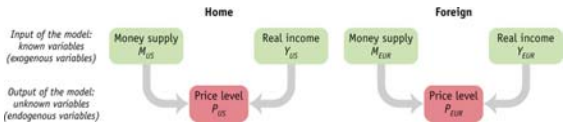
The Monetary Approach: A Simple Model of Prices

- Building blocks:



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The Monetary Approach: A Simple Model of the Exchange Rate

- Recall that PPP shows us the relationship between the price level and exchange rates.
  - PPP says E equals the ratio of the price levels.

$$\underbrace{E_{\$/€}}_{\text{exchange rate}} = \underbrace{P_{US}/P_E}_{\text{ratio of price levels}}$$

  - Substituting for prices using the money market equilibrium conditions we get the **Fundamental equation of the monetary model of the exchange rate**

$$\underbrace{E_{\$/€}}_{\text{exchange rate}} = \underbrace{\frac{P_{US}}{P_E}}_{\text{ratio of price levels}} = \frac{\left(\frac{M_{US}}{\overline{L}_{US}Y_{US}}\right)}{\left(\frac{M_E}{\overline{L}_E Y_E}\right)} = \underbrace{\frac{(M_{US}/M_E)}{(\overline{L}_{US}Y_{US}/\overline{L}_E Y_E)}}_{\substack{\text{relative nominal money supplies} \\ \text{divided by} \\ \text{relative real money demands}}}$$

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The Monetary Approach: Money, Growth, and Depreciation

- The monetary theory can be also expressed in terms of rates of change.
  - Let growth rate of money supply M be μ :

$$\mu_{US,t} = \underbrace{\left(\frac{M_{US,t+1} - M_{US,t}}{M_{US,t}}\right)}_{\text{rate of money supply growth in U.S.}}$$

  - Let growth rate of real income Y be g :

$$g_{US,t} = \underbrace{\left(\frac{Y_{US,t+1} - Y_{US,t}}{Y_{US,t}}\right)}_{\text{rate of real output growth in U.S.}}$$

  - These expressions apply to growth rates in Europe too.

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The Monetary Approach: Money, Growth, and Depreciation

- The levels equation

$$P_{US} = \frac{M_{US}}{\bar{L}_{US} Y_{US}}$$

- The same equation in growth rates (L is assumed to be constant for the moment):

$$\pi_{US,t} = \mu_{US,t} - g_{US,t}$$

- *Important result: inflation equals the excess of money growth over real output growth.*
- Same for Europe: $\pi_{E,t} = \mu_{E,t} - g_{E,t}$

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The Monetary Approach: Money, Growth, and Depreciation

- Where does that get us?
  - To some clear and testable predictions.
  - Combining these expressions with Relative PPP we can obtain expressions relating the rate of depreciation, the inflation differential, and money and output growth rates.

$$\underbrace{\frac{\Delta E_{\$/€,t}}{E_{\$/€,t}}}_{\text{rate of depreciation of the nominal exchange rate}} = \underbrace{\pi_{US,t} - \pi_{E,t}}_{\text{inflation differential}} = (\mu_{US,t} - g_{US,t}) - (\mu_{E,t} - g_{E,t})$$

$$= \underbrace{(\mu_{US,t} - \mu_{E,t})}_{\substack{\text{differential in} \\ \text{nominal money supply} \\ \text{growth rates}}} - \underbrace{(g_{US,t} - g_{E,t})}_{\substack{\text{differential in} \\ \text{real output} \\ \text{growth rates}}}$$

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Exchange Rate Forecasts Using the Simple Model

- Assumptions in a simple policy experiment
  - Both countries
    - Constant money growth rate μ , fixed level of output Y
  - Foreign
    - Money growth μ is zero, inflation π is zero
- Consider two cases:
  - **Case 1**: Home money growth μ is zero, inflation π is zero. Home implements a one-time x% increase in *M*.
  - **Case 2**: Home money growth μ is positive, inflation π is positive. Home increases its rate of money growth μ by $\Delta\mu$
- What happens to key economic variables according to the monetary approach in each case?

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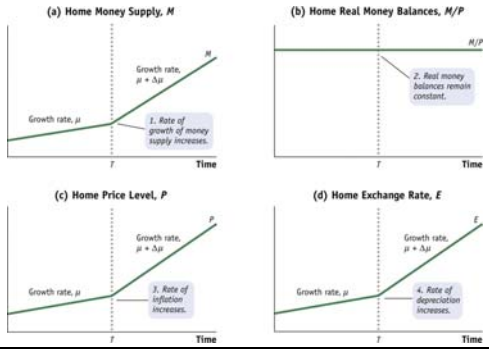
Exchange Rate Forecasts Using the Simple Model

- **Case 1**: One-time x% increase in money supply M
  - Real money balances remain unchanged (Y fixed).
  - The home price level P increases by x% (quantity th).
  - The exchange rate E increases (depreciat) by x% (PPP).
  - Result: a one-time jump of x % in all nominal variables.
- **Case 2**: Home increases rate of money growth μ by $\Delta\mu$
  - We discuss this case first using a diagram…

Exchange Rate Forecasts Using the Simple Model

Case 2: Home increases its rate of money growth μ by $\Delta\mu$



Exchange Rate Forecasts Using the Simple Model

- Case 2: Home increases rate of money growth μ by $\Delta\mu$
- Before the change:
  - M, P and E were all growing at rate μ .
- After the change:
  - Real money balances M/P remain unchanged (Y fixed).
  - The home inflation rate increases by $\Delta\mu$.
  - The rate of exchange rate depreciation increases by $\Delta\mu$ percentage points.

Evidence for the Monetary Approach

- Two tests:
- Test 1: Any change in the money growth rate differential should be reflected one-for-one with a change in the inflation differential.
- Test 2: Differentials in money growth rates should reflect changes in the exchange rate.

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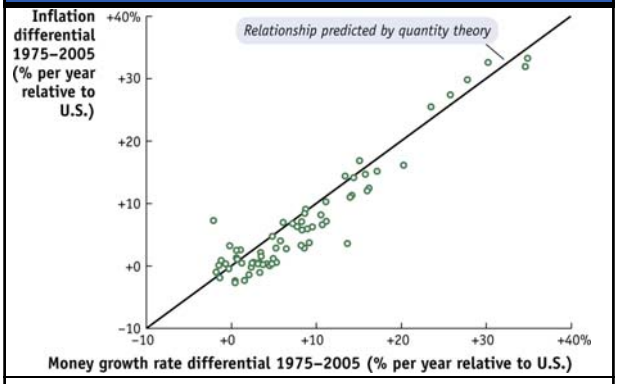
Evidence for the Monetary Approach



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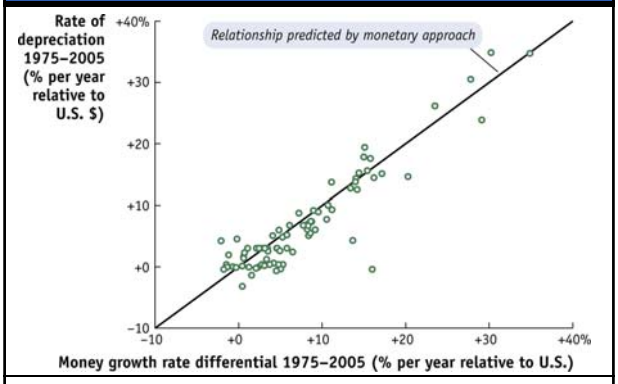
Evidence for the Monetary Approach



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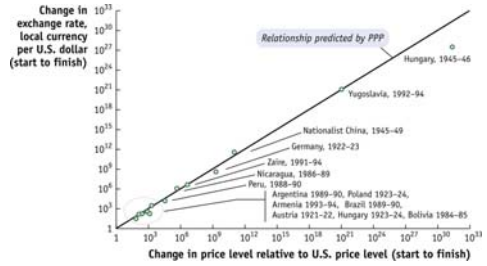
Evidence for the Monetary Approach

- There are two possible reasons why these relationships many not hold *exactly* in the data.
  - First, real income growth may change over time, reflecting another source of inflation differentials.
  - Second, we assumed the money demand parameter L was constant. We relax this assumption in the following section to incorporate interest rates into the model.

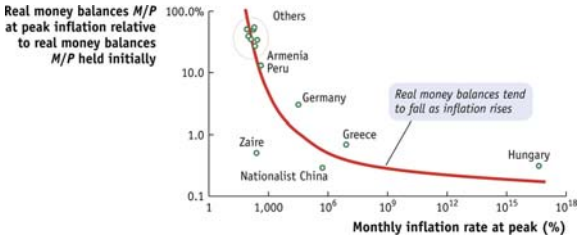
Evidence from Hyperinflations

- Hyperinflation occurs when the monthly inflation rate equals 50% or more over a sustained period.
  - Relative PPP predicts the large inflation differentials should lead to equally large depreciations in the currency.



Evidence from Hyperinflations

- In our simple model L is constant and real money balances M/P remain constant (assuming Y fixed).
- Not true in reality, especially in hyperinflations (where M/P falls much more than output). Why?



The Demand for Money: The General Model

- Simple model: quantity theory assumes L is a constant
  - For a given level of real output Y, the level of real money balances M/P is assume constant
- Why might people adjust their level of money balances?
  - The more general theory assumes that L isn't constant, and depends inversely on the opportunity cost of holding money.
  - What is the opportunity cost of holding money?

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The Demand for Money: The General Model

- Assume an individual decides how much money she wants to hold, based on the costs and benefits of holding money, relative to an alternative asset.
  - *Benefits of holding money*
    - Individuals hold money to conduct everyday transactions.
    - From the quantity theory of money used in the simple model, assume this is proportionate to nominal income PY.
    - As PY increases, transactions increase, so the quantity of money balances demanded will decrease.
  - *Costs of holding money*
    - Compared with other assets, money earns no interest.
    - The opportunity cost is i, the nominal interest rate.
    - As i increases, the opportunity cost of holding money rises, so the quantity of money balances demanded will decrease.

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The Demand for Money: The General Model

- Moving from the individual or household level up to the aggregate or macroeconomic level, we can infer that the aggregate **money demand** will behave similarly:
  - All else equal, a rise in national dollar income (nominal income) will cause a proportional increase in transactions and, hence, in aggregate money demand.
  - All else equal, a rise in the nominal interest rate will cause the aggregate demand for money to fall.

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The Demand for Money: The General Model

- Mathematically:
  - Nominal money demand

$$\underbrace{M^d}_{\substack{\text{demand}\\ \text{for money (\$)}}} = \underbrace{P \times Y}_{\text{nominal income (\$)}} \times \underbrace{L(i)}_{\substack{\text{a decreasing}\\ \text{function}}}$$

  - Therefore, the **real money demand function** is

$$\underbrace{\frac{M^d}{P}}_{\substack{\text{demand}\\ \text{for real}\\ \text{money}}} = \underbrace{L(i)}_{\substack{\text{a decreasing}\\ \text{function}}} \times \underbrace{Y}_{\text{real income}}$$

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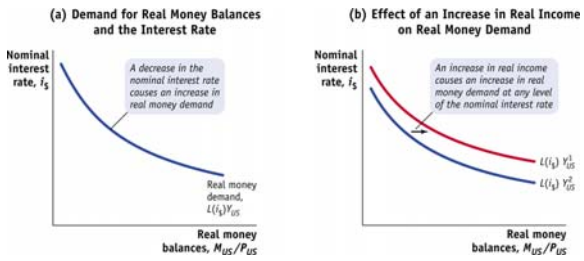
The Demand for Money: The General Model



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Long-Run Equilibrium in the Money Market

- Money market equilibrium is determined by the intersection of real money supply and real money demand:

$$\frac{M}{P} = L(i)Y$$

- This equilibrium condition implies that changes in the nominal interest rate play a role in the fundamental equations we developed in the simple model above.
- But… what determines i?

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Inflation and Interest Rates in the Long Run

- Recall: We are building a long run theory
  - Much is unchanged in the general model as compared to the simple model.
  - Same key assumptions:
    - price flexibility
    - PPP determines the behavior of exchange rates
    - monetary model for the determination of prices
- Modification:
  - The addition of the term *L(i)* in the monetary model is only useful if we have a theory of where the interest rate comes from in the long run.
  - What can we do? Take PPP and UIP and see what they imply in the long run…

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Inflation and Interest Rates in the Long Run

- Combine two expressions that are equal:
  - Relative PPP (and take expectations)

$$\underbrace{\frac{\Delta E^e}{E_{\$/€,t}}}_{\text{expected rate of dollar depreciation}} = \underbrace{\pi^e_{US,t} - \pi^e_{E,t}}_{\text{expected inflation differential}}$$

  - UIP (approximation)

$$\underbrace{\frac{\Delta E^e_{\$/€}}{E_{\$/€}}}_{\text{expected rate of dollar depreciation}} = \underbrace{i_\$}_{\substack{\text{net dollar}\\ \text{interest rate}}} - \underbrace{i_€}_{\substack{\text{net euro}\\ \text{interest rate}}}$$

  - Right hand sides must be equal.

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The Fisher Effect

- Relative PPP and UIP imply:

$$\underbrace{i_\$ - i_€}_{\text{nominal interest rate differential}} = \underbrace{\pi^e_{US} - \pi^e_E}_{\substack{\text{nominal inflation rate differential}\\ \text{(expected)}}}$$

  - This is known as the **Fisher effect.**
  - An increase in the inflation rate in one country leads to a one-for-one increase in the nominal interest rate in that country.

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Real Interest Parity

- This expression can be rewritten as:

$$i_{\$} - \pi^{e}_{US} = i_{€} - \pi^{e}_{E}$$

  - This is known as **real interest parity**.
  - Real interest parity implies that (expected) real interest rates should be equal across countries:

$$r^{e}_{US} = r^{e}_{E}$$

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Real Interest Parity

- According to real interest parity, we can define an expected world interest rate r* for all countries:

$$r^{e}_{H} = r^{e}_{F} = r^{*}$$

- Nominal interest rates in the home and foreign countries are therefore given by r* plus expected inflation in each country:

$$i_H = r^{*} + \pi^{e}_{H} \qquad i_F = r^{*} + \pi^{e}_{F}$$

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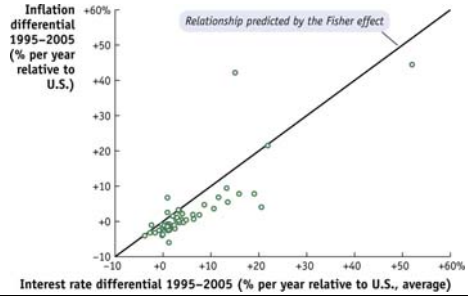
Evidence on Fisher Effect

- The Fisher effect: nominal interest rate differentials should move one-for-one with inflation differentials.



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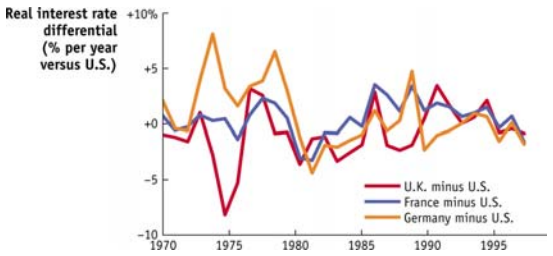
Evidence on Real Interest Parity

- RIP: real interest rates should equalize in the long run.



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The Fundamental Equation of the General Model

- Same as the basic (quantity theory) model except that the constant L is replaced by a decreasing function L(i):

$$\underbrace{E_{\$/€}}_{\text{exchange rate}} = \underbrace{\frac{P_{US}}{P_E}}_{\text{ratio of price levels}} = \frac{\left(\frac{M_{US}}{L_{US}(i_\$)Y_{US}}\right)}{\left(\frac{M_E}{L_E(i_€)Y_E}\right)} = \underbrace{\frac{(M_{US}/M_E)}{(L_{US}(i_\$)Y_{US}/L_E(i_€)Y_E)}}_{\substack{\text{relative nominal money supplies}\\ \text{divided by}\\ \text{relative real money demands}}}$$

  - Not much changes:
  - E is still a ratio of price levels (PPP)
  - P is ratio of money supply M to real money demand L(i)Y
  - Thus: The basic model is adequate for analysis if interest rates i are stable in the long run.

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Exchange Rate Forecasts Using the General Model

- Revisit Policy Predictions, Case 2 to see what's new:
- Assumptions
  - Both countries
    - Constant money growth rate μ , fixed level of output Y
  - Foreign
    - Money growth μ is zero, inflation π is zero
  - Home
    - Money growth μ is positive, inflation π is positive
- Home increases its rate of money growth μ by $\Delta\mu$
  - What happens to key variables in the long run (flexible price) case, when we use the **general model** and L = L(i)
    - NB: Assume inflation and interest rate are constant before and after the policy change. We can verify assumption later as a consistency check.

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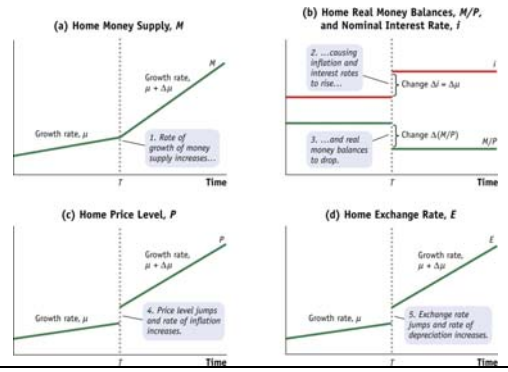
Exchange Rate Forecasts Using the General Model



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Exchange Rate Forecasts Using the General Model

- Results of an increase in the money growth rate:
  - The home inflation rate increases by $\Delta \mu$
  - The nominal interest rate increases by $\Delta \mu$.
  - A one-time decrease in real money balances M/P because of the increase in the nominal interest rate.
  - A one-time increase in P and E.
  - The rate of exchange rate depreciation increases by $\Delta \mu$ percentage points after E jumps up.
- The importance of expectations
  - If people know that a change in money growth is coming in the future, they will adjust their expectations of the inflation rate and exchange rates accordingly.
  - Even if a change is not implemented, expectation of a change has consequences for the variables in the model.

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Monetary Regimes and Exchange Rate Regimes

- Policy makers are concerned with costs of inflation
  - Inflation is unpopular and has macroeconomic costs
  - These costs are severe when inflation rates are high.
  - This is why **inflation targets** are desirable.
- The monetary approach shows how policymakers can choose among different **nominal anchors** to achieve their inflation goal.
  - The **monetary regime** they choose specifies what are the rules, objectives, policies followed by the central bank.
  - The **exchange rate regime** is part of the monetary regime, and must be consistent with it; is the exchange rate fixed or floating?

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The Long Run: Nominal Anchor via E

- **Exchange rate target**

$$\pi_H = \frac{\Delta E_{H/F}}{E_{H/F}} + \pi_F$$

  - Can be applied not just to pegs (E=constant), but also to crawls and managed float regimes.

- Tradeoffs
  - Pro: Simple and transparent.
  - Con: Possibility of "imported inflation" from other country.
    - With a fixed exchange rate, relative PPP means the home country inflation equals the foreign country inflation rate.
    - Choice of which country to fix to is crucial.

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The Long Run: Nominal Anchor via M

- **Money supply target**

$$\pi_H = \mu_H - g_H$$

- Tradeoffs
  - Pro: Mechanical. There is little decision-making for central bankers.
  - Con: Can only achieve target rate of inflation if real income growth is known.
    - Example: M growth 4%, Y growth 2% means inflation of 2%
    - What if Y growth is 1%? 3%?
    - Problem: nobody knows future real income growth, not even central bankers.

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The Long Run: Nominal Anchor via i

- **Inflation target plus interest rate policy**

$$\pi_H^e = i_H - r^*$$

- Tradeoffs
  - Pro: Flexibility for central bankers.
    - In the short run the central bank has the freedom to let i fluctuate **temporarily**, but in long run promises to set i on average at a "neutral level" dictated in the above equation by the inflation target plus the world real interest rate.
  - Con: Neither simple, nor transparent
    - Requires credibility, if central bankers are to assure people that expected rates of inflation and depreciation are firm.
    - As we see in the next chapter, serious instability results if people think the central bank has made a permanent change in its policy and the anchor is lost.

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The Choice of a Nominal Anchor

- There are two important considerations in choosing a monetary regime.
- Choosing more than one target (or weighting) can work sometimes, but it may be problematic.
  - Different regimes may call for different policy responses, causing confusion.
  - Success in anchoring inflation may be affected by a more vague and discretionary policy framework.
- A country with a nominal anchor sacrifices monetary policy autonomy in the long run.
  - Hitting the target will only be possible if the central bank picks the right levels of M or E or i.
  - Unpopular choices at times.