



UNIVERSITY OF WARSAW
Faculty of Economic Sciences

Exchange Rates I: The Monetary Approach in the Long Run

Part 2

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A quick reminder

Money Growth, Inflation, and Depreciation

Combining (3-4) and (3-5), we can now solve for the inflation differential in terms of monetary fundamentals and compute the rate of depreciation of the exchange rate:

$$\underbrace{\frac{\Delta E_{\$/\epsilon,t}}{E_{\$/\epsilon,t}}}_{\substack{\text{Rate of depreciation} \\ \text{of the} \\ \text{nominal exchange rate}}} = \underbrace{\pi_{US,t} - \pi_{EUR,t}}_{\text{Inflation differential}} = (\mu_{US,t} - g_{US,t}) - (\mu_{EUR,t} - g_{EUR,t}) \quad (3-6)$$
$$= \underbrace{(\mu_{US,t} - \mu_{EUR,t})}_{\substack{\text{Differential in} \\ \text{nominal money supply} \\ \text{growth rates}}} - \underbrace{(g_{US,t} - g_{EUR,t})}_{\substack{\text{Differential in} \\ \text{real output} \\ \text{growth rates}}}$$

3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

- When we use the monetary model for forecasting, we are answering a hypothetical question: What path would exchange rates follow from now on *if prices were flexible and PPP held?*

Forecasting Exchange Rates: An Example

- Assume that U.S. and European real income growth rates are identical and equal to zero (0%). Also, the European price level is constant, and European inflation is zero.
- Based on these assumptions, we examine two cases.
 - Case 1: A one-time increase in the money supply*
 - Case 2: An increase in the rate of money growth*

3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

Forecasting Exchange Rates: An Example

Case 1: A one-time increase in the money supply

- a) There is a 10% increase in the money supply M .
- b) Real money balances M/P remain constant because real income is constant.
- c) These previous two statements imply that price level P and money supply M must move in the same proportion, so there is a 10% increase in the price level P .
- d) PPP implies that the exchange rate E and price level P must move in the same proportion, so there is a 10% increase in the exchange rate E .

3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

Forecasting Exchange Rates: An Example

Case 2: An increase in the rate of money growth

At time T the United States will raise the rate of money supply growth to rate of $\mu + \Delta\mu$ from a steady fixed rate μ .

- a) Money supply M is growing at a constant rate.
- b) Real money balances M/P remain constant, as before.
- c) These previous two statements imply that price level P and money supply M must move in the same proportion, so P is always a constant multiple of M .
- d) PPP implies that the exchange rate E and price level P must move in the same proportion, so E is always a constant multiple of P (and hence of M).

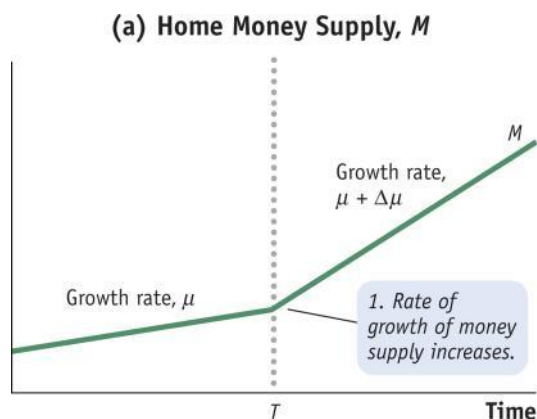
3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

Forecasting Exchange Rates: An Example

FIGURE 3-6 (1 of 4)

An Increase in the Growth Rate of the Money Supply in the Simple Model



Before time T , money, prices, and the exchange rate all grow at rate μ . Foreign prices are constant. In panel (a), we suppose at time T there is an increase $\Delta\mu$ in the rate of growth of home money supply M .

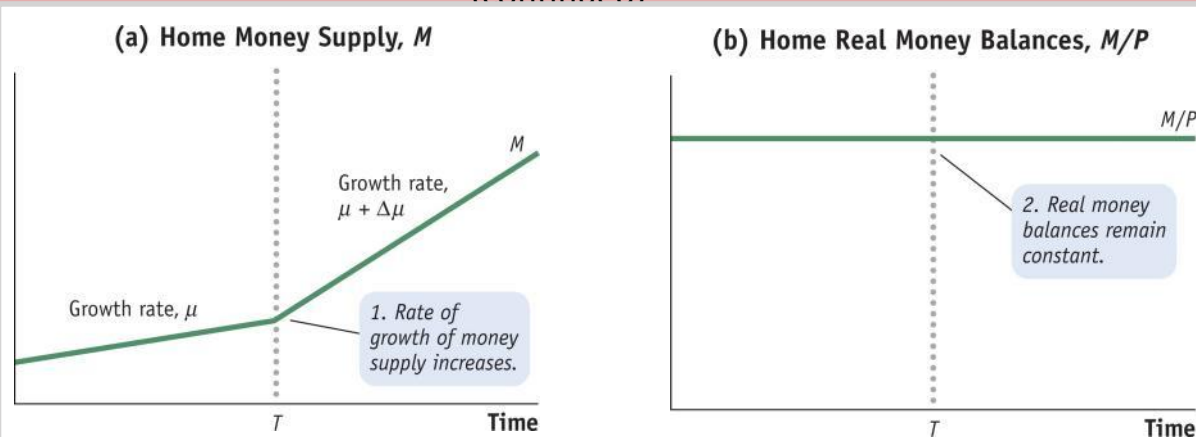
3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

Forecasting Exchange Rates: An Example

FIGURE 3-6 (2 of 4)

An Increase in the Growth Rate of the Money Supply in the Simple Model
(continued)



In panel (b), the quantity theory assumes that the level of real money balances remains unchanged.

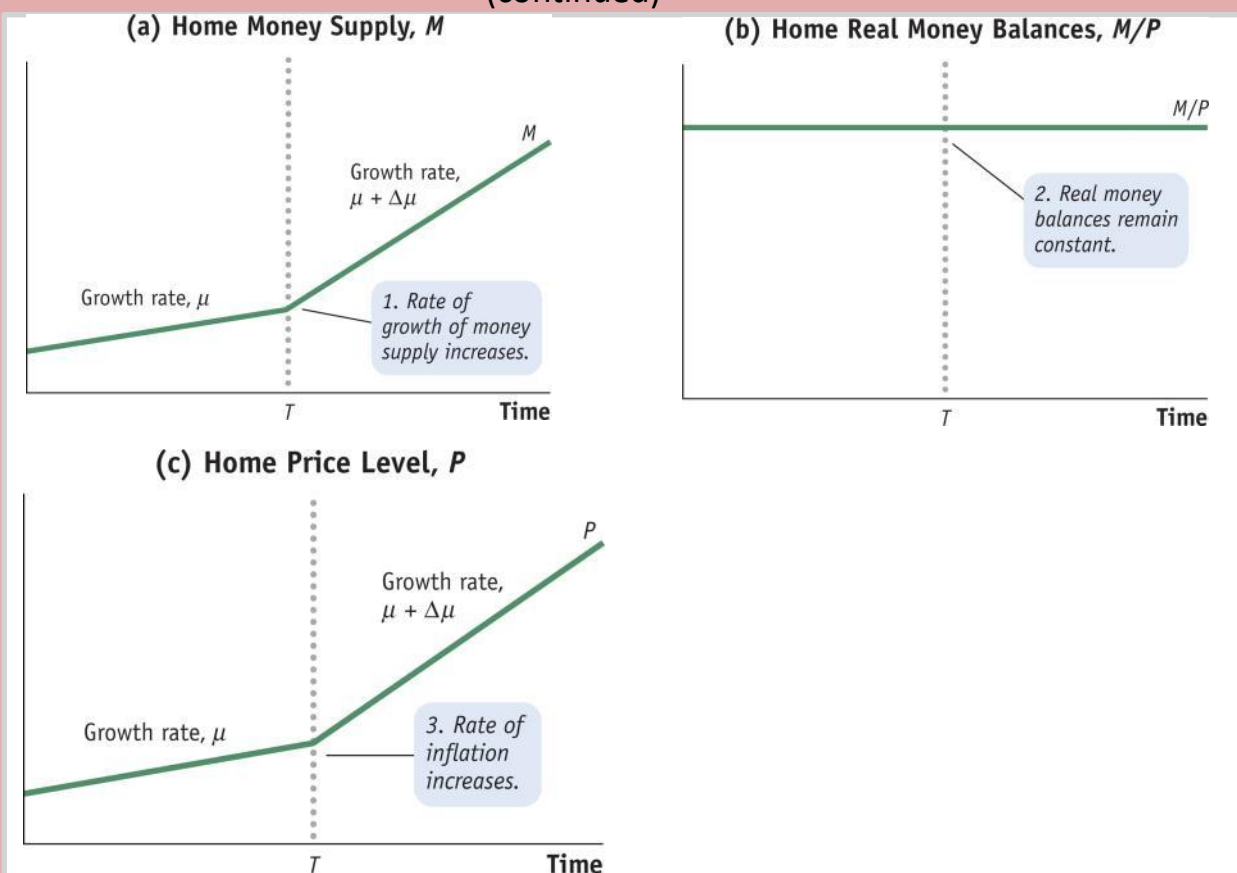
3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

Forecasting Exchange Rates: An Example

FIGURE 3-6 (3 of 4)

An Increase in the Growth Rate of the Money Supply in the Simple Model
(continued)



After time T , if real money balances (M/P) are constant, then money M and prices P still grow at the same rate, which is now $\mu + \Delta\mu$, so the rate of inflation rises by $\Delta\mu$, as shown in panel (c).

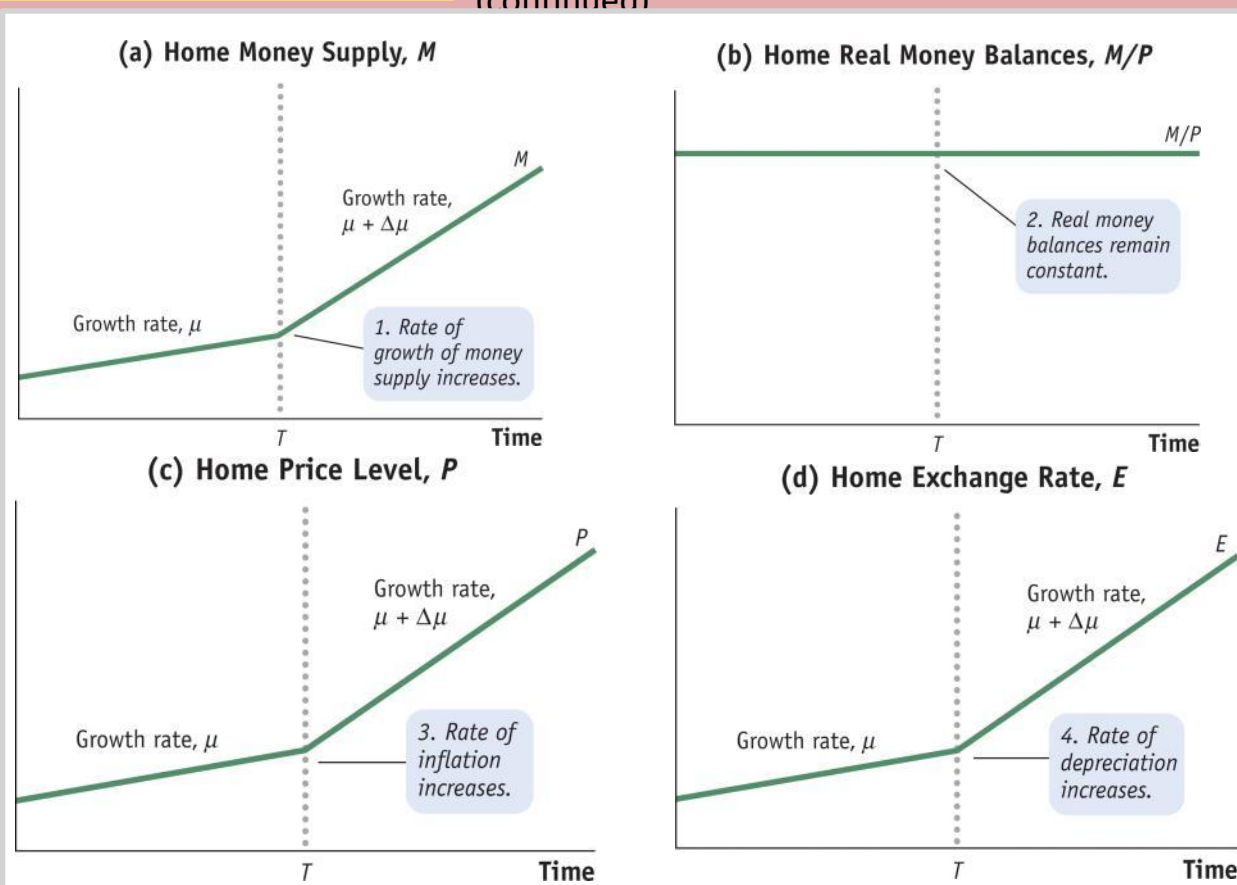
3 The Monetary Approach: Implications and Evidence

Exchange Rate Forecasts Using the Simple Model

Forecasting Exchange Rates: An Example

FIGURE 3-6 (4 of 4)

An Increase in the Growth Rate of the Money Supply in the Simple Model
(continued)

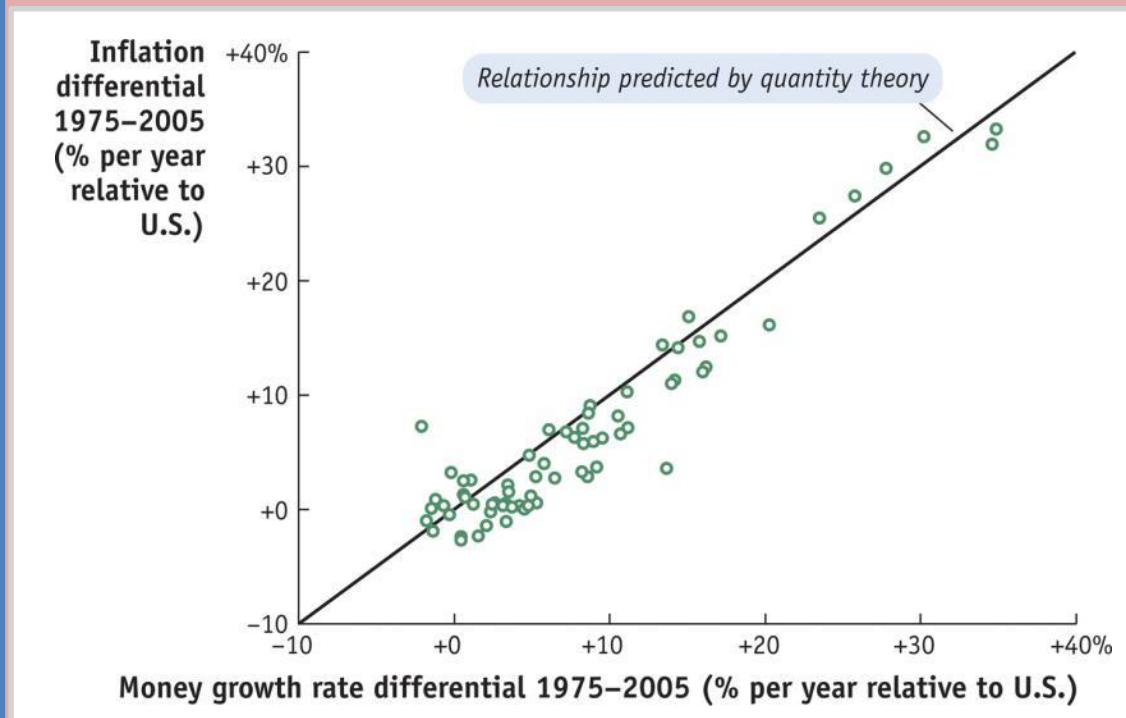


PPP and an assumed stable foreign price level imply that the exchange rate will follow a path similar to that of the domestic price level, so E also grows at the new rate $\mu + \Delta\mu$, and the rate of depreciation rises by $\Delta\mu$, as shown in panel (d).

APPLICATION

Evidence for the Monetary Approach

FIGURE 3-7



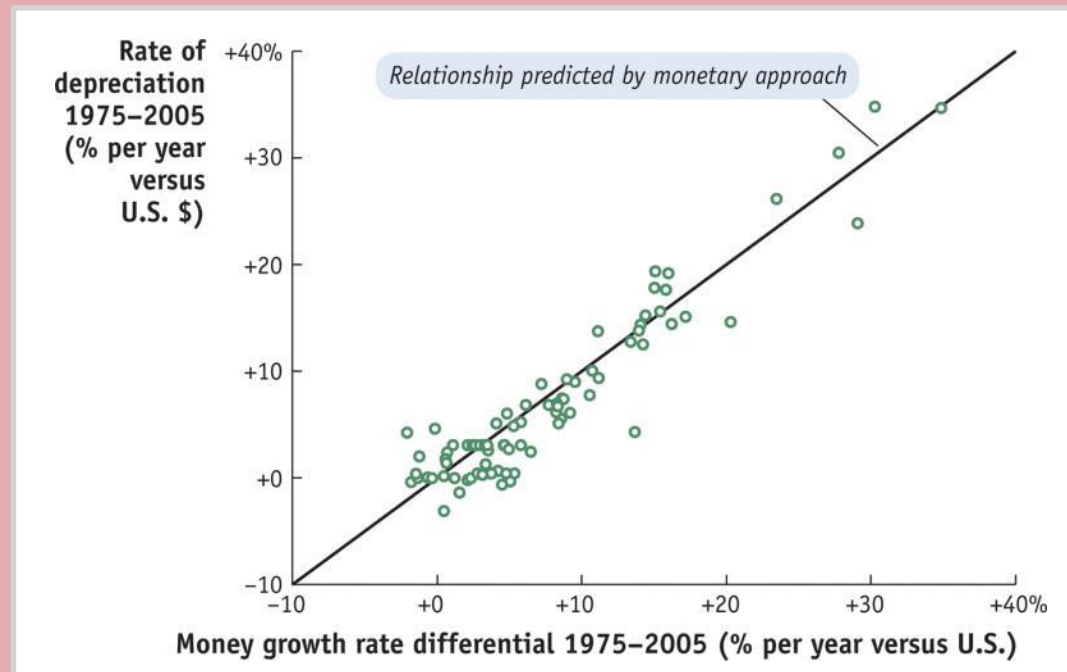
Inflation Rates and Money Growth Rates, 1975–2005 This scatterplot shows the relationship between the rate of inflation and the money supply growth rate over the long run. The correlation between the two variables is strong and bears a close resemblance to the theoretical prediction of the monetary model that all data points would appear on the 45-degree line.

Inflation and money growth: The monetary approach to prices and exchange rates suggests that increases in the rate of money supply growth should be the same size as increases in the rate of inflation.

APPLICATION

Evidence for the Monetary Approach

FIGURE 3-8 Money Growth Rates and the Exchange Rate, 1975–2005



This scatterplot shows the relationship between the rate of exchange rate depreciation and the money growth rate differential relative to the United States over the long run. The data show a strong correlation between the two variables and a close resemblance to the theoretical prediction of the monetary approach to exchange rates, which would predict that all data points would appear on the 45-degree line.

Money growth and the exchange rate: The monetary approach to prices and exchange rates also suggests that increases in the rate of money supply growth should be the same size as increases in the rate of exchange rate depreciation.

APPLICATION

Hyperinflations

The monetary approach assumes long-run PPP, which generally works poorly in the short run. There is one notable exception to this general failure of PPP in the short run: **hyperinflation**.

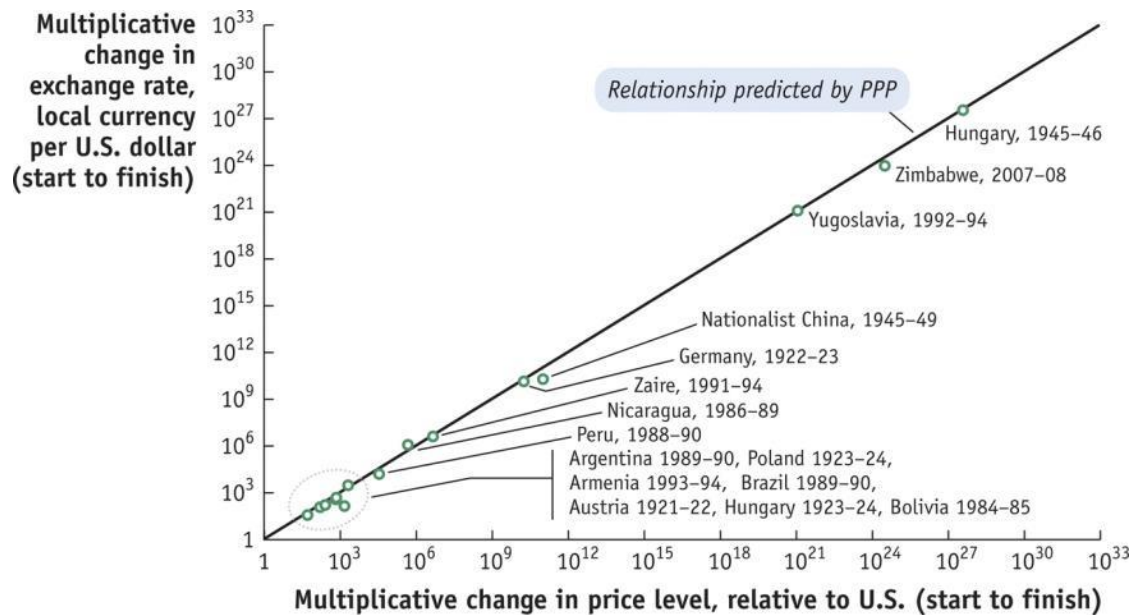
- Economists traditionally define a hyperinflation as a sustained inflation of more than 50% *per month* (which means that prices are doubling every 51 days).
- In common usage, some lower-inflation episodes are also called hyperinflations. An inflation rate of 1,000% *per year* is a common rule of thumb (22% per month).
- Hyperinflations usually occur when governments face a budget crisis, are unable to borrow to finance a deficit, and instead choose to print money.

APPLICATION

Hyperinflation

PPP in Hyperinflation

FIGURE 3-9



Purchasing Power Parity During Hyperinflation The scatterplot shows the relationship between the cumulative start-to-finish exchange rate depreciation against the U.S. dollar and the cumulative start-to-finish rise in the local price level for hyperinflation in the twentieth century. Note the use of logarithmic scales.

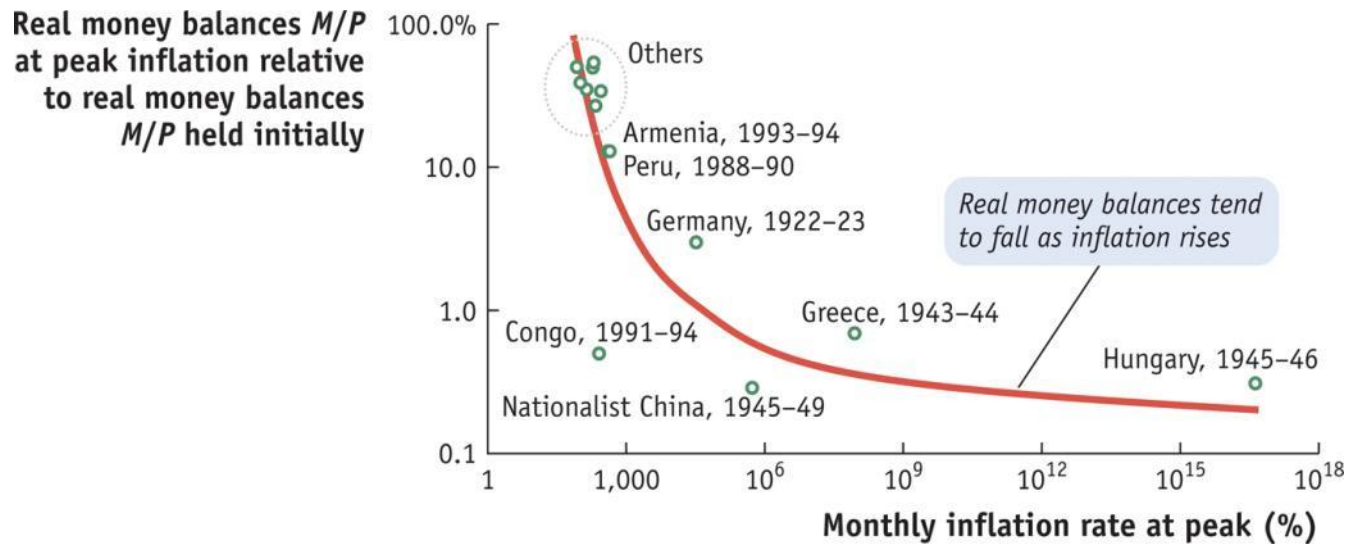
The data show a strong correlation between the two variables and a very close resemblance to the theoretical prediction of PPP that all data points would appear on the 45-degree line.

APPLICATION

Hyperinflations

Money Demand in Hyperinflations

FIGURE 3-10



The Collapse of Real Money Balances During Hyperinflations This figure shows that real money balances tend to collapse in hyperinflations as people economize by reducing their holdings of rapidly depreciating notes. The horizontal axis shows the peak monthly inflation rate (%), and the vertical axis shows the ratio of real money balances in that peak month relative to real money balances at the start of the hyperinflationary period. The data are shown using log scales for clarity.

4 Money, Interest Rates, and Prices in the Long Run: A General Model

The trouble with the **quantity theory** we studied earlier is that it assumes that the *demand for money is stable*, particularly with respect to changing nominal interest rates, and this is implausible.

- We will now explore a more general model that allows for money demand to vary with the nominal interest rate.
- We consider the links between inflation and the nominal interest rate in an open economy.
- We then return to the question of how best to understand what determines exchange rates in the long run.

4 Money, Interest Rates, and Prices in the Long Run: A General Model

The Demand for Money: The General Model

- A rise in national dollar income (nominal income) will cause a proportional increase in transactions and, hence, in aggregate money demand (as is true in the simple quantity theory).
- A rise in the nominal interest rate will cause the aggregate demand for money to fall.

$$\underbrace{M^d}_{\text{Demand for money (\$)}} = \underbrace{L(i_{\$})}_{\substack{\text{A} \\ \text{decreasing} \\ \text{function}}} \times \underbrace{PY}_{\text{Nominal income (\$)}}$$

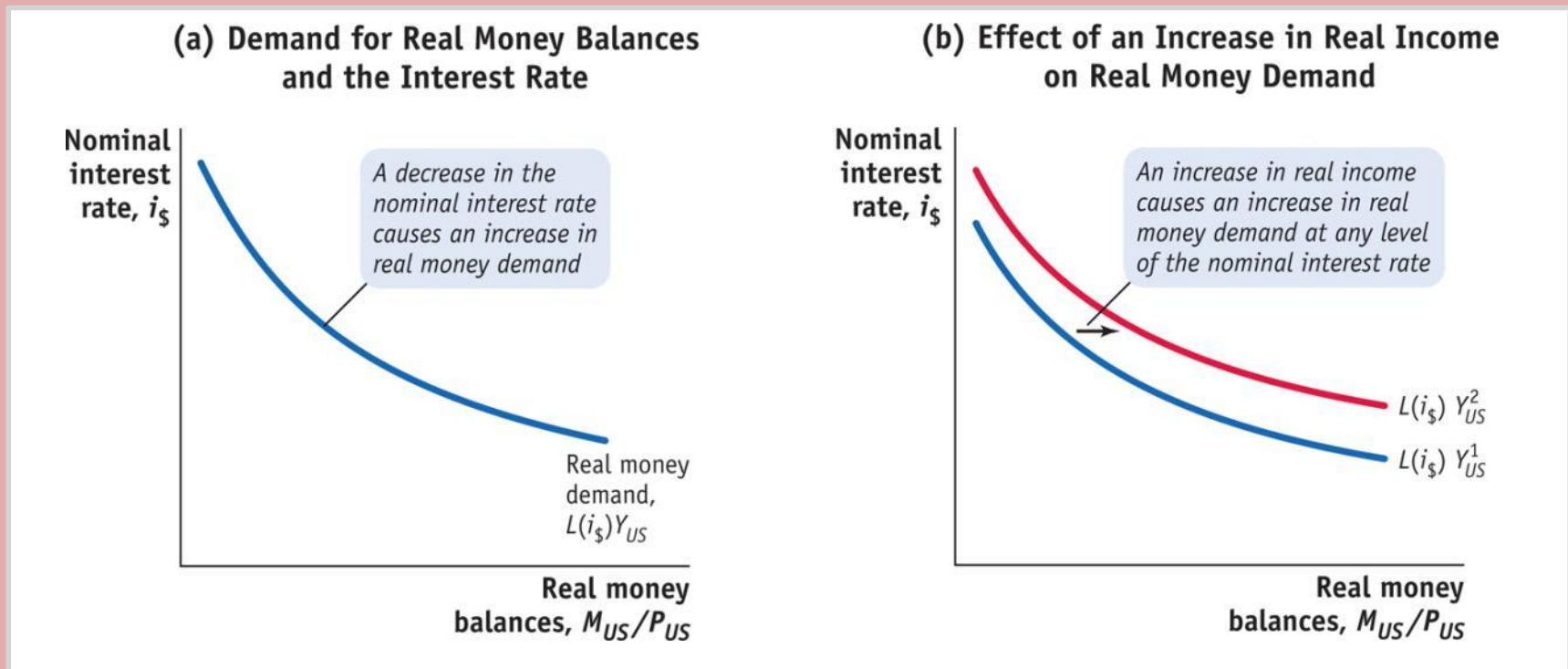
- Dividing by P , we derive the demand for real money balances:

$$\underbrace{\frac{M^d}{P}}_{\text{Demand for real money}} = \underbrace{L(i_{\$})}_{\substack{\text{A} \\ \text{decreasing} \\ \text{function}}} \times \underbrace{Y}_{\text{Real income}}$$

4 Money, Interest Rates, and Prices in the Long Run: A General Model

The Demand for Money: The General Model

FIGURE 3-11 The Standard Model of Real Money Demand



Panel (a) shows the **real money demand function** for the United States. The downward slope implies that the quantity of real money demand rises as the nominal interest rate i_s falls. Panel (b) shows that an increase in real income from Y_{US}^1 to Y_{US}^2 causes real money demand to rise at all levels of the nominal interest rate i_s .

4 Money, Interest Rates, and Prices in the Long Run: A General Model

Long-Run Equilibrium in the Money Market

$$\underbrace{\frac{M}{P}}_{\text{Real money supply}} = \underbrace{L(i) Y}_{\text{Real money demand}} \quad (3-7)$$

Inflation and Interest Rates in the Long Run

With two relationships, PPP and UIP, we can derive a striking result concerning interest rates that has profound implications for our study of open economy macroeconomics. We use:

$$\underbrace{\frac{\Delta E_{\$/\epsilon}^e}{E_{\$/\epsilon}}}_{\text{Expected rate of dollar depreciation}} = \underbrace{\pi_{US}^e - \pi_{EUR}^e}_{\text{Expected inflation differential}} \quad \text{and} \quad \underbrace{\frac{\Delta E_{\$/\epsilon}^e}{E_{\$/\epsilon}}}_{\text{Expected rate of dollar depreciation}} = \underbrace{i_{\$}}_{\text{Net dollar interest rate}} - \underbrace{i_{\epsilon}}_{\text{Net euro interest rate}}$$

4 Money, Interest Rates, and Prices in the Long Run: A General Model

The Fisher Effect

- The nominal interest differential equals the expected inflation differential:

$$\underbrace{i_{\$} - i_{\epsilon}} = \underbrace{\pi_{US}^e - \pi_{EUR}^e} \quad (3-8)$$

Nominal interest rate differential

Nominal inflation rate differential
(expected)

- All else equal, a rise in the expected inflation rate in a country will lead to an equal rise in its nominal interest rate.
- This result is known as the **Fisher effect**.
- The Fisher effect predicts that the change in the opportunity cost of money is equal not just to the change in the nominal interest rate but also to the change in the inflation rate.

4 Money, Interest Rates, and Prices in the Long Run: A General Model

Real Interest Parity

- Rearranging the last equation, we find

$$i_{\$} - \pi_{US}^e = i_{\text{€}} - \pi_{EUR}^e$$

- Subtracting the inflation rate (π) from the *nominal* interest rate (i) results in a **real interest rate** (r), the inflation-adjusted return on an interest-bearing asset.

$$r_{US}^e = r_{EUR}^e \quad (3-9)$$

- This result states the following: *If PPP and UIP hold, then expected real interest rates are equalized across countries.* This powerful condition is called **real interest parity**.
- Real interest parity implies the following: Arbitrage in goods and financial markets alone is sufficient, in the long run, to cause the equalization of real interest rates across countries.

4 Money, Interest Rates, and Prices in the Long Run: A General Model

Real Interest Parity

- In the long run, all countries will share a common expected real interest rate, the long-run expected **world real interest rate** denoted r^* , so

$$r_{US}^e = r_{EUR}^e = r^*$$

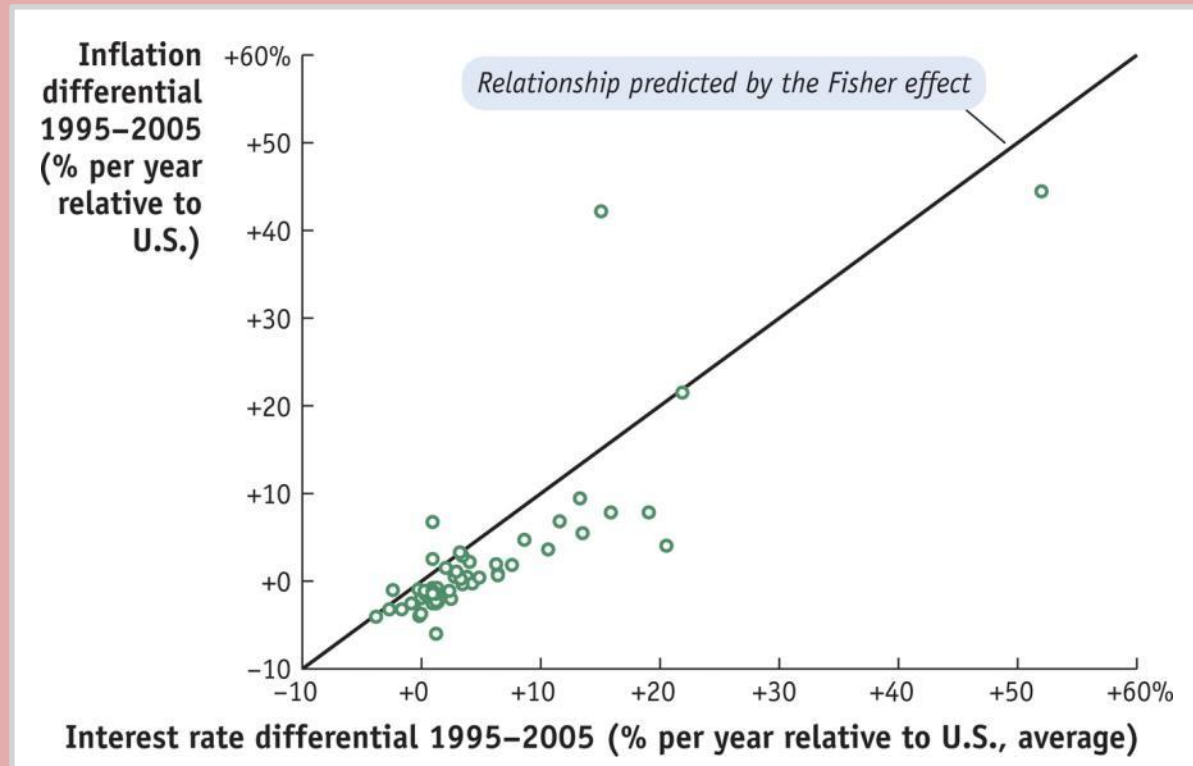
- We treat r^* as an exogenous variable, something outside the control of a policy maker in any particular country.
- Under these conditions, the Fisher effect is even clearer because, by definition,

$$\begin{aligned} i_{\$} &= r_{US}^e + \pi_{US}^e = r^* + \pi_{US}^e \\ i_{\text{€}} &= r_{EUR}^e + \pi_{EUR}^e = r^* + \pi_{EUR}^e \end{aligned}$$

APPLICATION

Evidence on the Fisher Effect

FIGURE 3-12



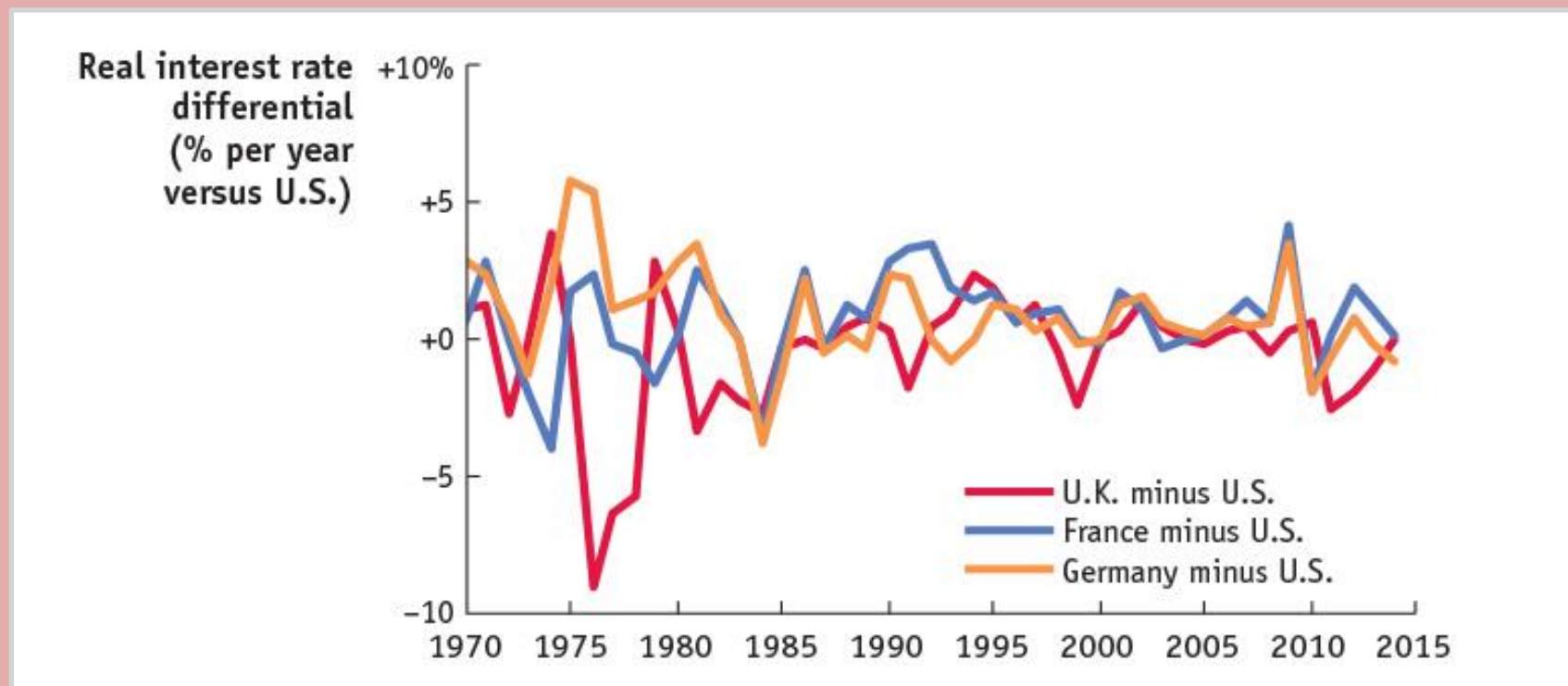
Inflation Rates and Nominal Interest Rates, 1995–2005 This scatterplot shows the relationship between the average annual nominal interest rate differential and the annual inflation differential relative to the United States over a 10-year period for a sample of 62 countries.

The correlation between the two variables is strong and bears a close resemblance to the theoretical prediction of the Fisher effect that all data points would appear on the 45-degree line.

APPLICATION

Evidence on the Fisher Effect

FIGURE 3-13 Real Interest Rate Differentials, 1970–2015



This figure shows actual real interest rate differentials over four decades for the United Kingdom, Germany, and France relative to the United States. These differentials were not zero, so real interest parity did not hold continuously. But the differentials were on average close to zero, meaning that real interest parity (like PPP) is a general long-run tendency in the data.

4 Money, Interest Rates, and Prices in the Long Run: A General Model

The Fundamental Equation Under the General Model

- This model differs from the simple model (the quantity theory) by allowing L to vary as a function of the nominal interest rate i .

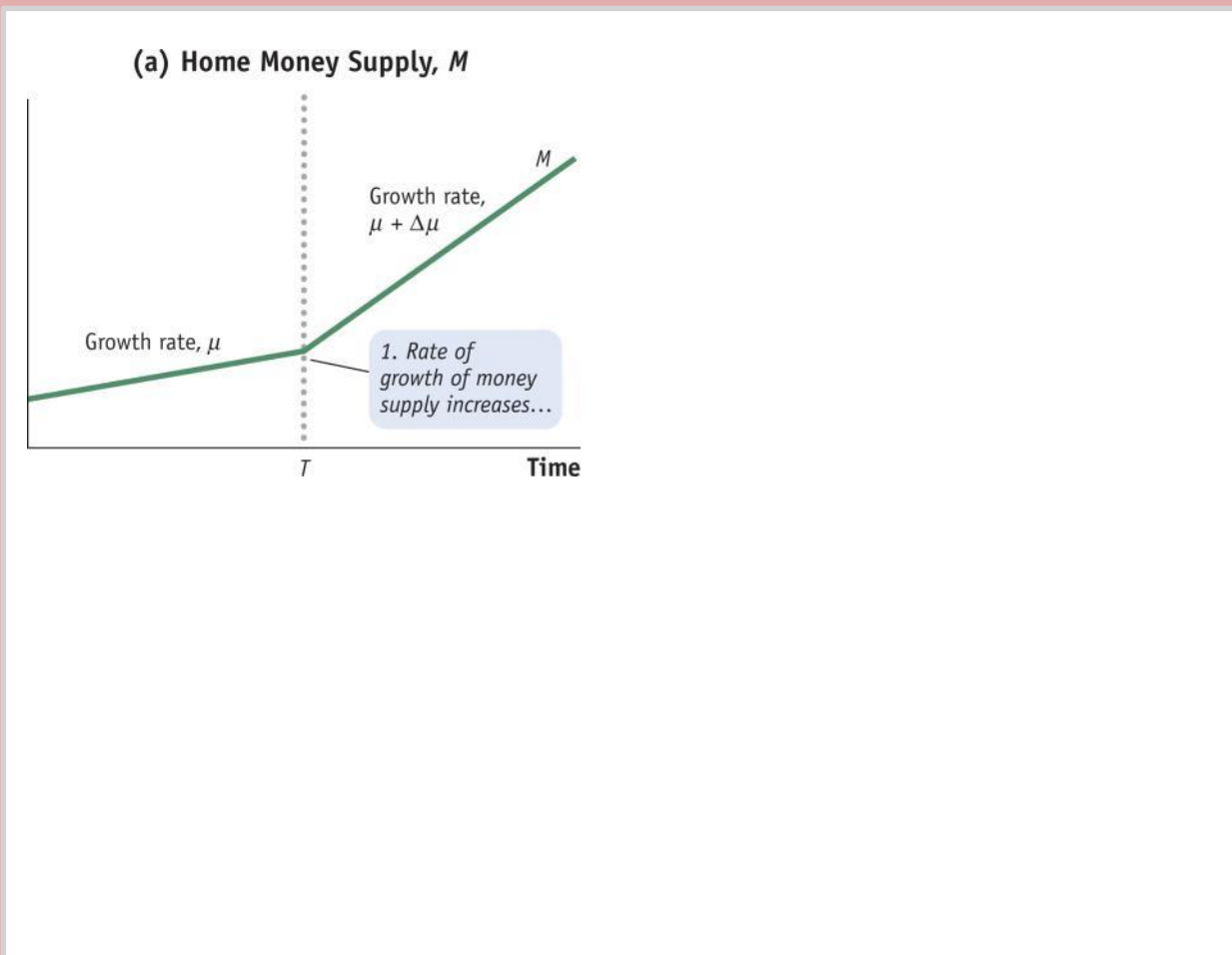
$$\underbrace{E_{\$/\epsilon}}_{\text{Exchange Rate}} = \underbrace{\frac{P_{US}}{P_{EUR}}}_{\text{Ratio of price levels}} = \frac{\left(\frac{M_{US}}{L_{US}(i_{\$}) Y_{US}} \right)}{\left(\frac{M_{EUR}}{L_{EUR}(i_{\epsilon}) Y_{EUR}} \right)} = \frac{(M_{US}/M_{EUR})}{\underbrace{(L_{US}(i_{\$}) Y_{US} / L_{EUR}(i_{\epsilon}) Y_{EUR})}_{\substack{\text{Relative nominal money supplies} \\ \text{divided by} \\ \text{relative real money demands}}}} \quad (3-10)$$

- When nominal interest rates change the general model has different implications from the simple model.
- We now reexamine the forecasting problem for an increase in the U.S. rate of money growth. We learn at time T that the United States is raising the rate of money supply growth from μ to a higher rate $\mu + \Delta\mu$.

Exchange Rate Forecasts Using the General Model

FIGURE 3-14 (1 of 4)

An Increase in the Growth Rate of the Money Supply in the Standard Model

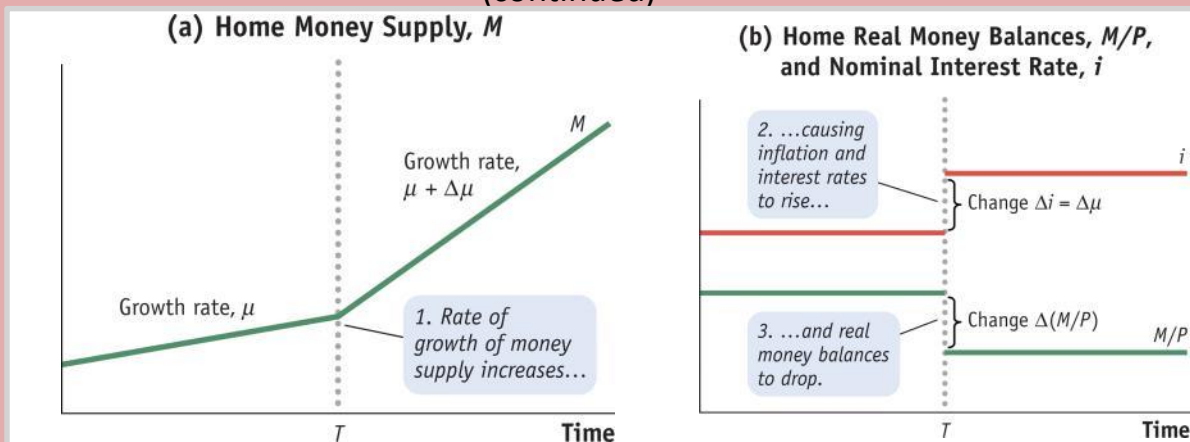


Before time T , money, prices, and the exchange rate all grow at rate μ . Foreign prices are constant. In panel (a), we suppose at time T there is an increase $\Delta\mu$ in the rate of growth of home money supply M .

Exchange Rate Forecasts Using the General Model

FIGURE 3-14 (2 of 4)

An Increase in the Growth Rate of the Money Supply in the Standard Model
(continued)

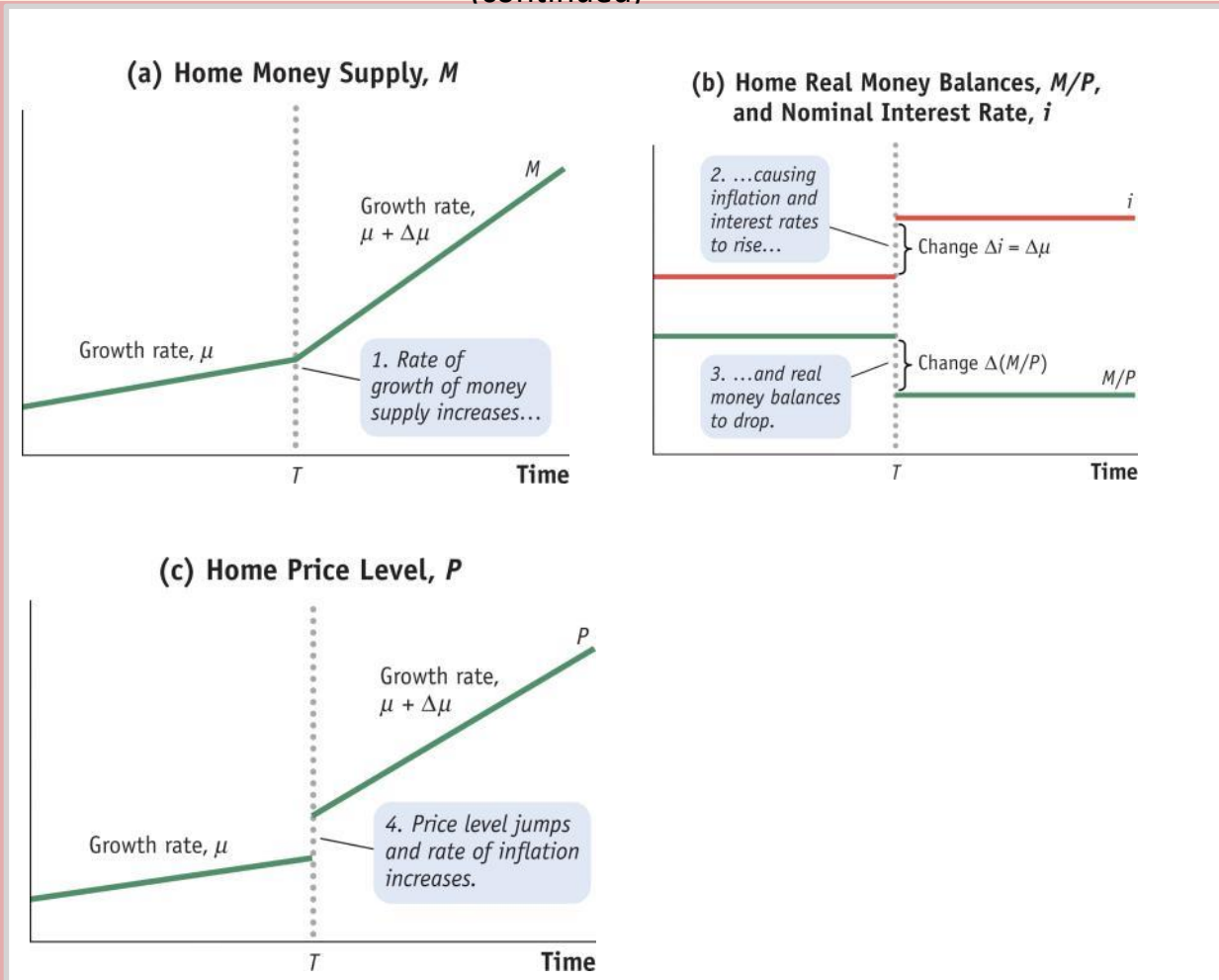


This causes an increase $\Delta\mu$ in the rate of inflation; the Fisher effect means that there will be a $\Delta\mu$ increase in the nominal interest rate; as a result, as shown in panel (b), real money demand falls with a discrete jump at T .

Exchange Rate Forecasts Using the General Model

FIGURE 3-14 (3 of 4)

An Increase in the Growth Rate of the Money Supply in the Standard Model
(continued)

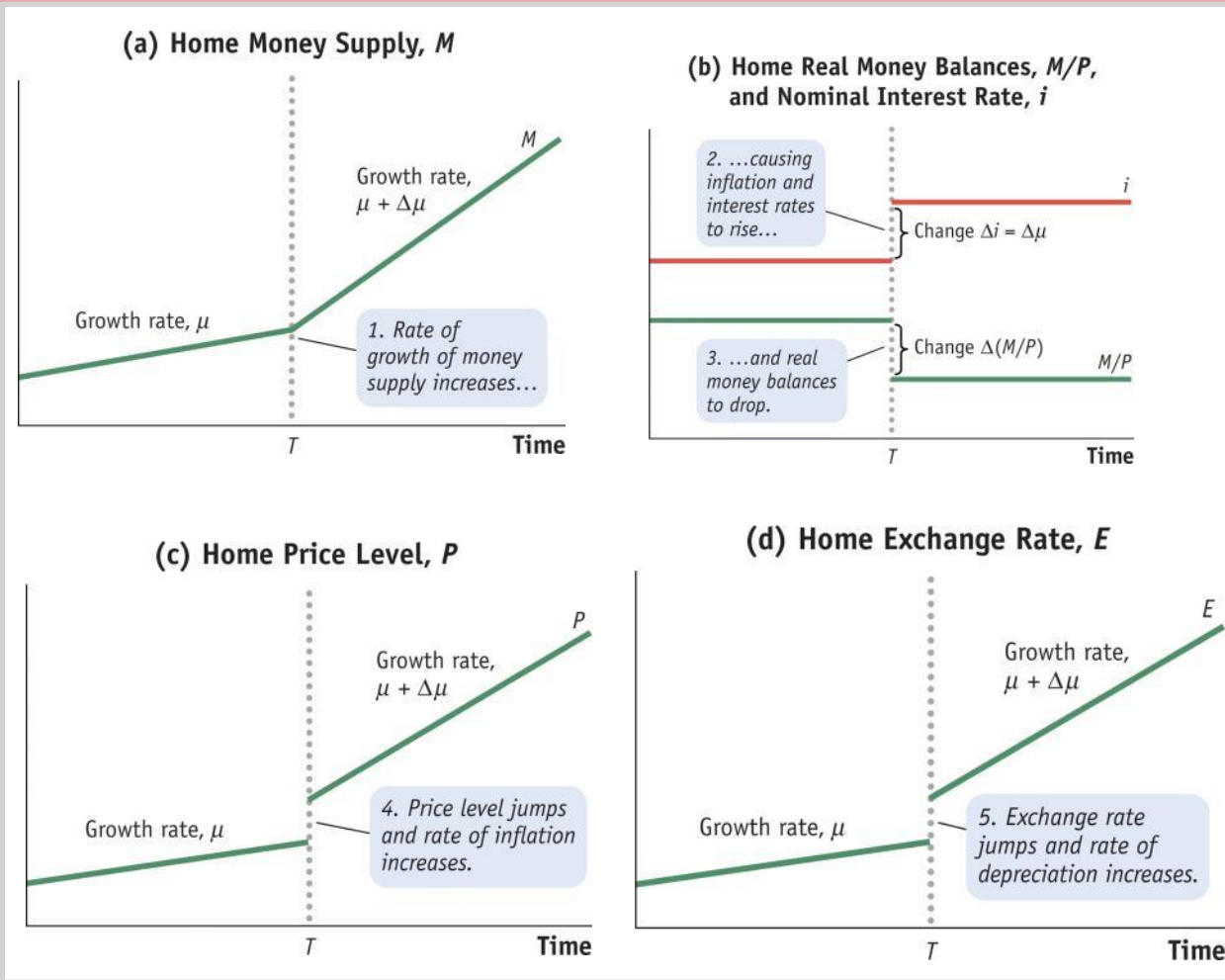


If real money balances are to fall when the nominal money supply expands continuously, then the domestic price level must make a discrete jump up at time T , as shown in panel (c).

Exchange Rate Forecasts Using the General Model

FIGURE 3-14 (4 of 4)

An Increase in the Growth Rate of the Money Supply in the Standard Model
(continued)



Subsequently, prices grow at the new higher rate of inflation; and given the stable foreign price level, PPP implies that the exchange rate follows a similar path to the domestic price level, as shown in panel (d).

5 Monetary Regimes and Exchange Rate Regimes

The Long Run: The Nominal Anchor

An overarching aspect of a nation's economic policy is the desire to keep inflation within certain bounds.

- To achieve such an objective requires that policy makers be subject to some kind of constraint in the long run. Such constraints are called **nominal anchors**.
- Long-run nominal anchoring and short-run flexibility are the characteristics of the policy framework that economists call the **monetary regime**.
- The three main nominal anchor choices that emerge are **exchange rate target, money supply target, and inflation target plus interest rate policy**.

5 Monetary Regimes and Exchange Rate Regimes

The Long Run: The Nominal Anchor

- **Exchange rate target:**

$$\underbrace{\pi_H}_{\text{Inflation}} = \underbrace{\frac{\Delta E_{H/F}}{E_{H/F}}}_{\substack{\text{Rate of} \\ \text{depreciation} \\ | \\ \text{Anchor variable}}} + \underbrace{\pi_F}_{\text{Foreign inflation}}$$

- We relabel the countries Home (H) and Foreign (F) instead of United States and Europe.
- Relative PPP says that home inflation equals the rate of depreciation plus foreign inflation. A simple rule would be to set the rate of depreciation equal to a constant.

5 Monetary Regimes and Exchange Rate Regimes

The Long Run: The Nominal Anchor

- **Money supply target:**

$$\underbrace{\pi_H}_{\text{Inflation}} = \underbrace{\mu_H}_{\substack{\text{Money supply growth} \\ \text{Anchor variable}}} - \underbrace{g_H}_{\text{Real output growth}}$$

- A simple rule of this sort is: Set the growth rate of the money supply equal to a constant, say, 2% a year.
- Again the drawback is the final term in the previous equation: Real income growth can be unstable. In periods of high growth, inflation will be below the desired level. In periods of low growth, inflation will be above the desired level.

5 Monetary Regimes and Exchange Rate Regimes

The Long Run: The Nominal Anchor

- **Inflation target plus interest rate policy:**

$$\underbrace{\pi_H^e}_{\text{Inflation (expected)}} = \underbrace{i_H}_{\substack{\text{Nominal interest rate} \\ \text{Anchor variable}}} - \underbrace{r^*}_{\text{World real interest rate}}$$

- The Fisher effect says that home inflation is the home nominal interest rate minus the world real interest rate.
- If the latter is constant, and the average home nominal interest rate is stable, inflation can be kept stable. But the target nominal rate must be adjusted if the world real interest rate changes, as seems to be the case recently.
- This nominal anchoring framework is increasingly common.

5 Monetary Regimes and Exchange Rate Regimes

TABLE 3-2

Exchange Rate Regimes and Nominal Anchors This table illustrates the possible exchange rate regimes that are consistent with various types of nominal anchors. Countries that are dollarized or in a currency union have a “superfixed” exchange rate target. Pegs, bands, and crawls also target the exchange rate. Managed floats have no preset path for the exchange rate, which allows other targets to be employed. Countries that float freely or independently are judged to pay no serious attention to exchange rate targets; if they have anchors, they will involve monetary targets or inflation targets with an interest rate policy. The countries with “freely falling” exchange rates have no serious target and have high rates of inflation and depreciation.

Type of Nominal Anchor	COMPATIBLE EXCHANGE RATE REGIMES				
	Countries without a Currency of Their Own	Pegs/ Bands/Crawls	Managed Floating	Freely Floating	Freely Falling (rapid depreciation)
Exchange rate target	✓	✓	✓		
Money supply target			✓	✓	
Inflation target (plus interest rate policy)			✓	✓	
None				✓	✓

APPLICATION

Nominal Anchors in Theory and Practice

- An appreciation of the importance of nominal anchors has transformed monetary policy making and inflation performance throughout the global economy in recent decades.
- In the 1970s and 1980s, most of the world was struggling with high inflation.
- In the 1990s, policies designed to create effective nominal anchors were put in place in many countries.
- Most of those policies have turned out to be credible, too, thanks to political developments in many countries that have fostered **central-bank independence**.

APPLICATION

Nominal Anchors in Theory and Practice

TABLE 3-3

Global Disinflation Cross-country data from 1980 to 2014 show the gradual reduction in the annual rate of inflation around the world. This disinflation process began in the advanced economies in the early 1980s. The emerging markets and developing countries suffered from even higher rates of inflation, although these finally began to fall in the 1990s.

	ANNUAL INFLATION RATE (%)						
	1980–84	1985–89	1990–94	1995–99	2000–04	2005–09	2010–14
World	14.1	15.5	30.4	8.4	3.9	4.0	4.1
Advanced economies	8.7	3.9	3.8	2.0	1.8	2.0	1.6
Emerging markets and developing countries	31.4	48.0	53.2	13.1	5.6	6.5	6.0

KEY TERMS

monetary approach to
exchange rates
law of one price (LOOP)
purchasing power parity
(PPP)
absolute PPP
real exchange rate
real depreciation
real appreciation
overvalued
undervalued
inflation
relative PPP

money
central bank
money supply
money demand
quantity theory of money
fundamental equation of
the monetary model of
the price level
fundamental equation of
the monetary approach
to exchange rates
hyperinflation
real money demand
function

Fisher effect
real interest rate
real interest parity
world real interest rate
nominal anchors
monetary regime
exchange rate target
money supply target
inflation target plus
interest rate policy
central-bank
independence

Thank You for your
attention!