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Exchange Rates I: The Monetary Approach in the Long Run Part 2

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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:

$$\underbrace{\frac{\Delta E_{\$/€,t}}{E_{\$/€,t}}}_{\substack{\text{Rate of depreciation}\\\text{of the}\\\text{nominal exchange rate}}} = \underbrace{\pi_{\text{US},t} - \pi_{\text{EUR},t}}_{\text{Inflation differential}} = (\mu_{\text{US},t} - g_{\text{US},t}) - (\mu_{\text{EUR},t} - g_{\text{EUR},t}) \quad (3\text{-}6)$$

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

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

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.

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.

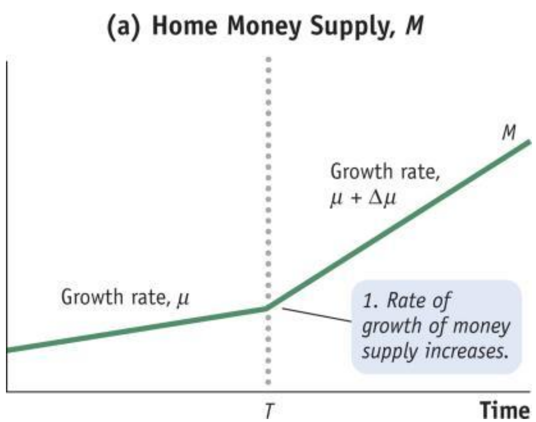
c) These previous two statements imply that price level P and money supply M must move in the same proportion, so P is always a constant multiple of M.

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).

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

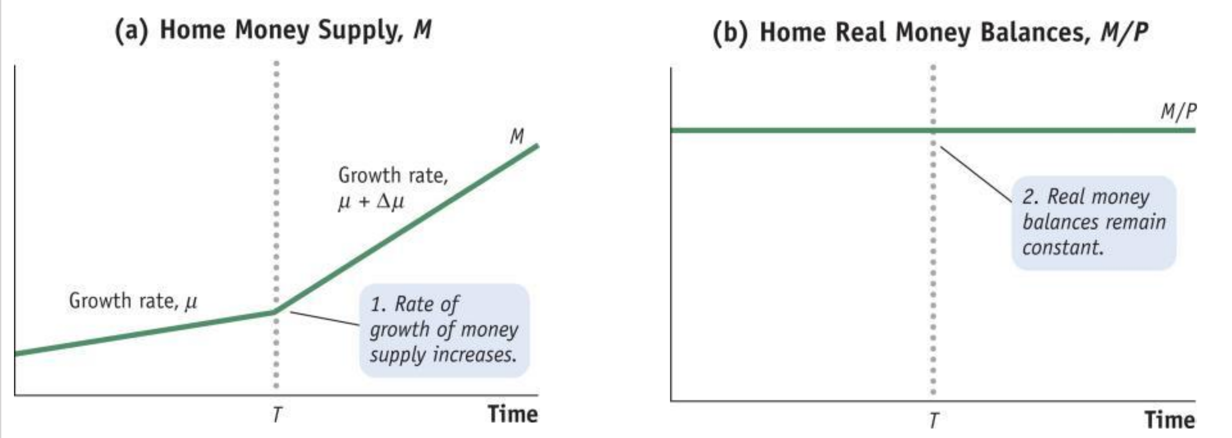


Before time T, money, prices, and the exchange rate all grow at rate μ. Foreign prices are constant. In panel (a), we suppose at time T there is an increase $\Delta\mu$ in the rate of growth of home money supply M.

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)

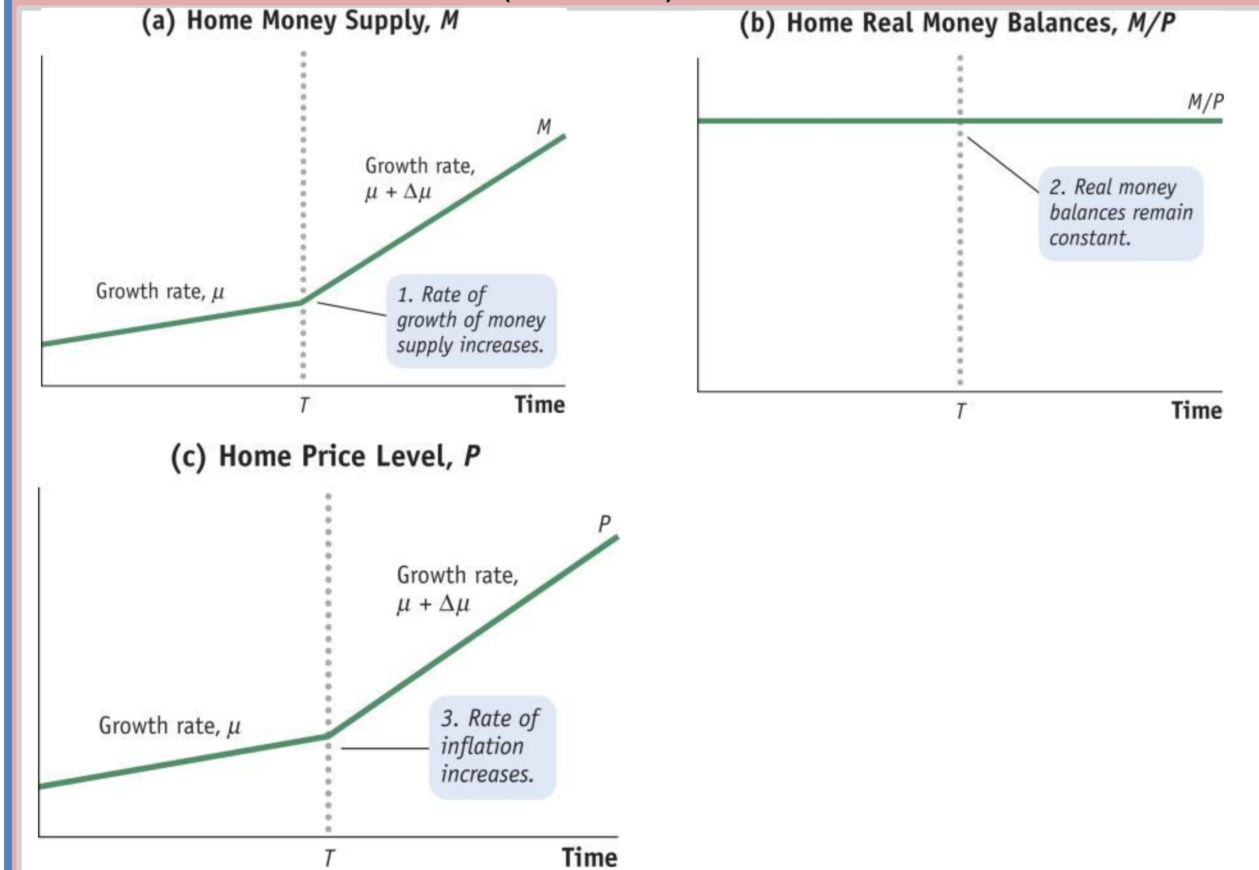


In panel (b), the quantity theory assumes that the level of real money balances remains unchanged.

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)

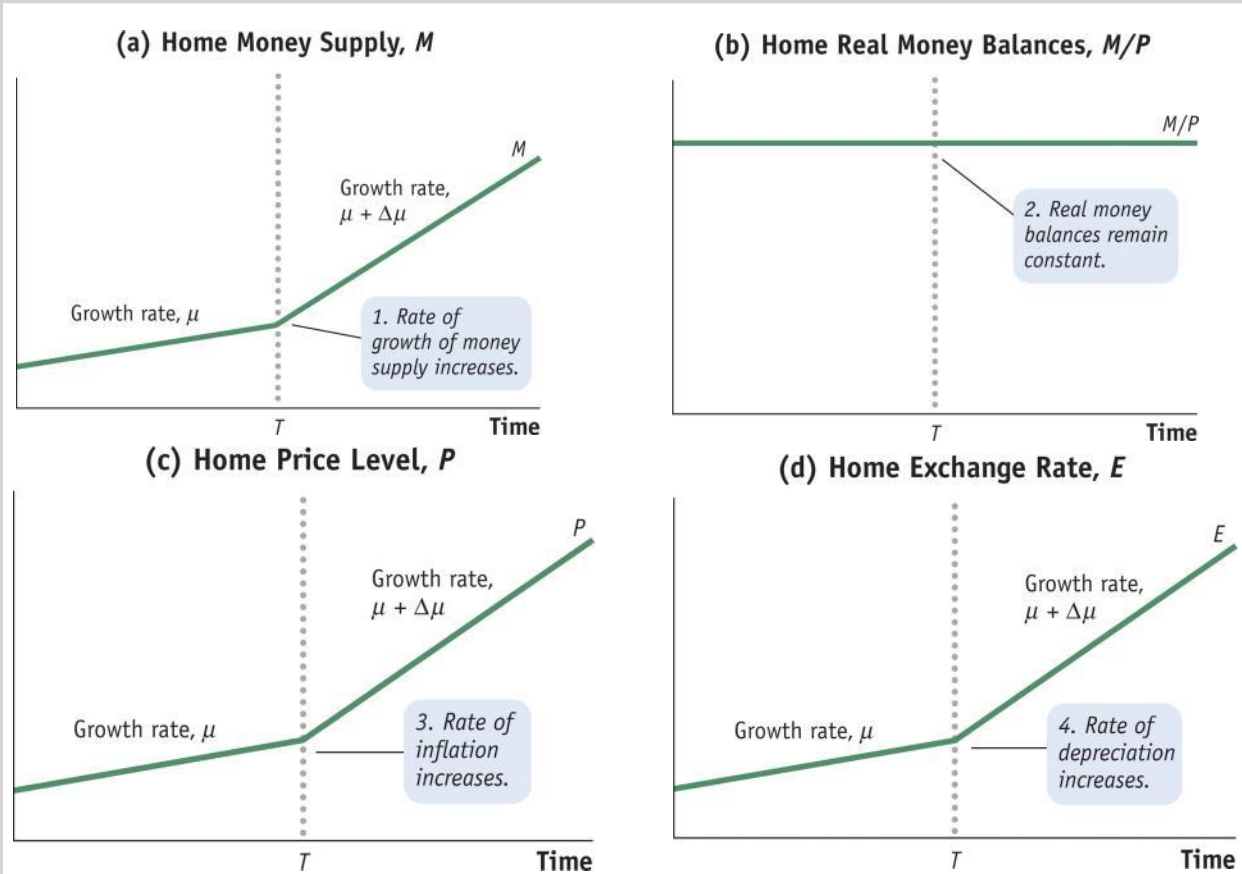


After time *T*, if real money balances (*M*/*P*) are constant, then money *M* and prices *P* still grow at the same rate, which is now $\mu + \Delta\mu$, so the rate of inflation rises by $\Delta\mu$, as shown in panel (c).

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)

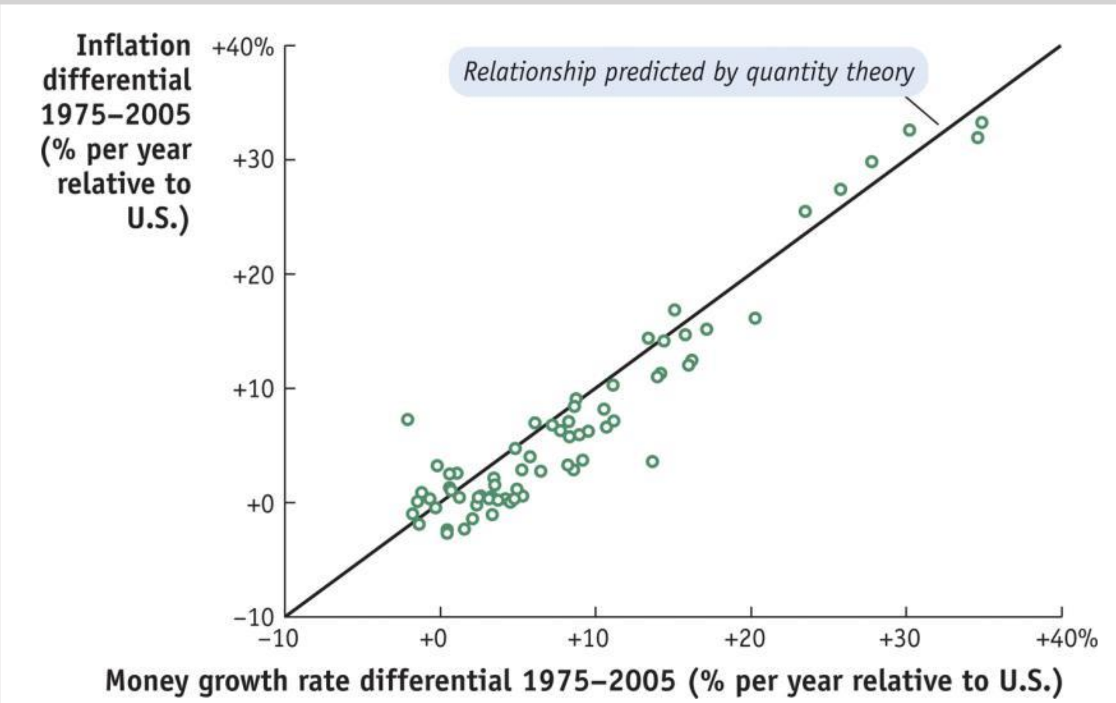


PPP and an assumed stable foreign price level imply that the exchange rate will follow a path similar to that of the domestic price level, so E also grows at the new rate $\mu + \Delta\mu$, and the rate of depreciation rises by $\Delta\mu$, as shown in panel (d).

APPLICATION

Evidence for the Monetary Approach

FIGURE 3-7



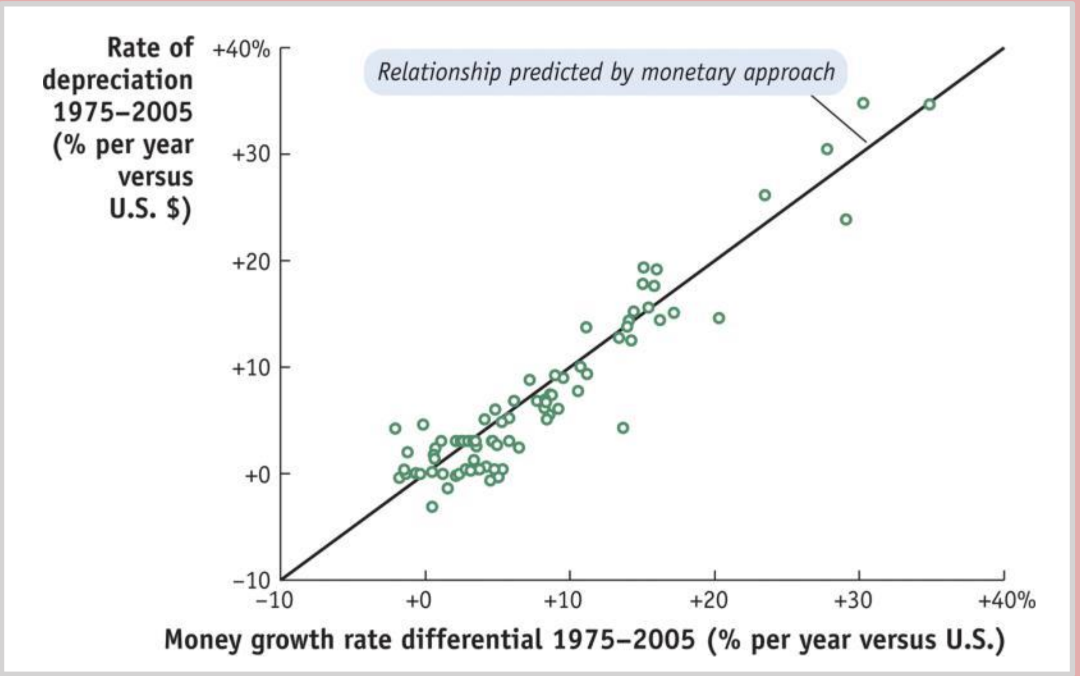
Inflation Rates and Money Growth Rates, 1975–2005 This scatterplot shows the relationship between the rate of inflation and the money supply growth rate over the long run. The correlation between the two variables is strong and bears a close resemblance to the theoretical prediction of the monetary model 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.

HEADLINES

The First Hyperinflation of the Twenty-First Century

By 2007 Zimbabwe was almost at an economic standstill, except for the printing presses churning out the banknotes.

- A creeping inflation—58% in 1999, 132% in 2001, 385% in 2003, and 586% in 2005—was about to become hyperinflation, and the long-suffering people faced an accelerating descent into even deeper chaos.
- By 2007 inflation had risen to 12,000%!
- This was one the five worst hyperinflations of all time.
- In 2008, the local currency disappeared from use, replaced by U.S. dollars and South African rand.

Currency Reform

Currencies can become extinct if they cease to function well and lose value rapidly (e.g., dollarization in Ecuador). If the currency survives, the government may *redenominate* a new currency unit equal to 10^N (10 to the power *N*) old units. Sometimes *N* can get quite large....

- In the 1980s, Argentina suffered hyperinflation. In June 1983, the *peso argentino* replaced the (old) peso at a rate of 10,000 to 1. In June 1985, the *austral* replaced the peso argentino at 1,000 to 1. Finally, in January 1992, the *convertible peso* replaced the austral at a rate of 10,000 to 1 (i.e., 10,000,000,000 old pesos).
- In 1946, the Hungarian *pengö* became worthless. By July 15, 1946, there were 76,041,000,000,000,000,000,000,000 pengö in circulation.

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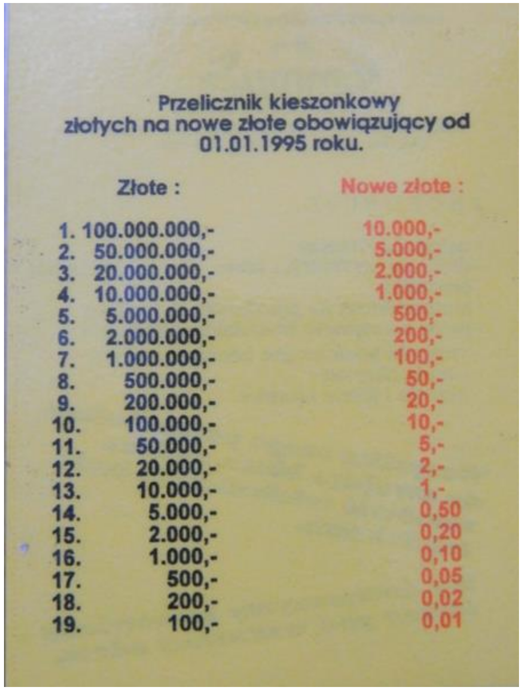

Przelicznik kieszonkowy złotych na nowe złote obowiązujący od 01.01.1995 roku.

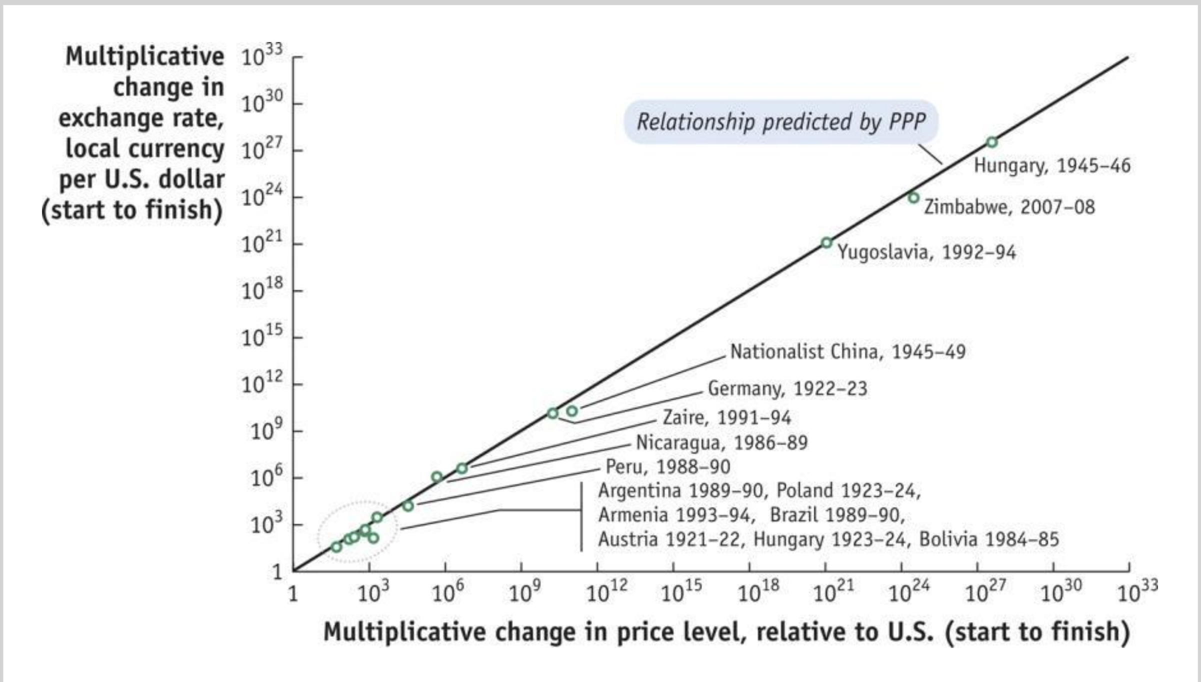
	Złote :	Nowe złote :
1.	100.000.000,-	10.000,-
2.	50.000.000,-	5.000,-
3.	20.000.000,-	2.000,-
4.	10.000.000,-	1.000,-
5.	5.000.000,-	500,-
6.	2.000.000,-	200,-
7.	1.000.000,-	100,-
8.	500.000,-	50,-
9.	200.000,-	20,-
10.	100.000,-	10,-
11.	50.000,-	5,-
12.	20.000,-	2,-
13.	10.000,-	1,-
14.	5.000,-	0,50
15.	2.000,-	0,20
16.	1.000,-	0,10
17.	500,-	0,05
18.	200,-	0,02
19.	100,-	0,01

APPLICATION

Hyperinflations

PPP in Hyperinflations

FIGURE 3-9



Purchasing Power Parity During Hyperinflations 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 hyperinflations in the twentieth century. Note the use of logarithmic scales.

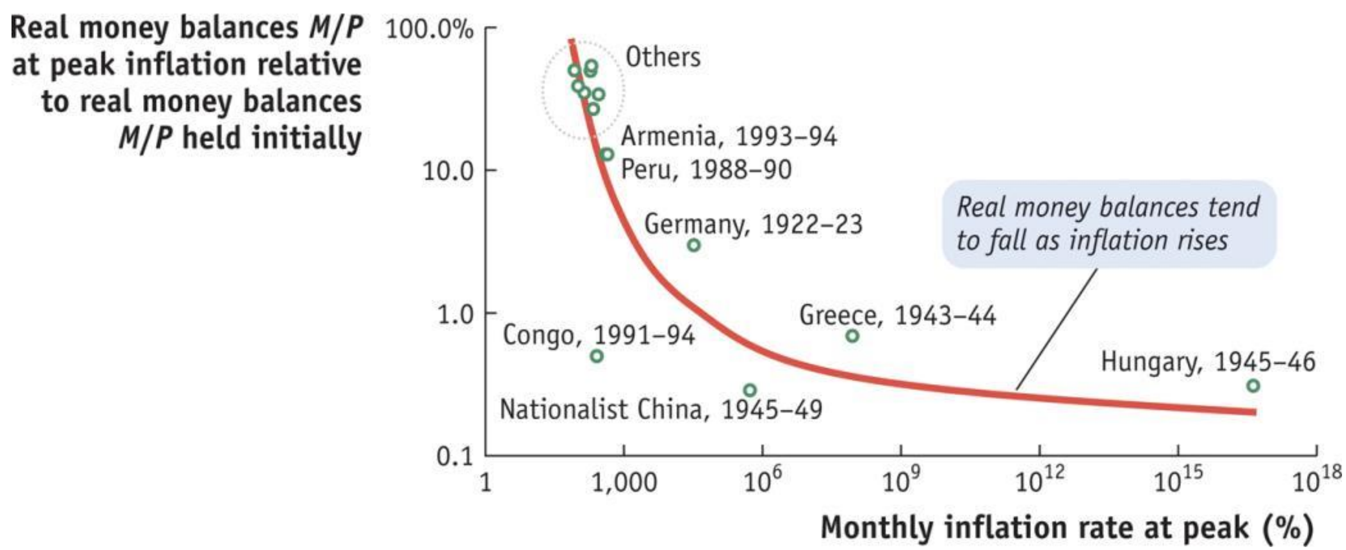
The data show a strong correlation between the two variables and a *very* close resemblance to the theoretical prediction of PPP that all data points would appear on the 45-degree line.

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.

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.

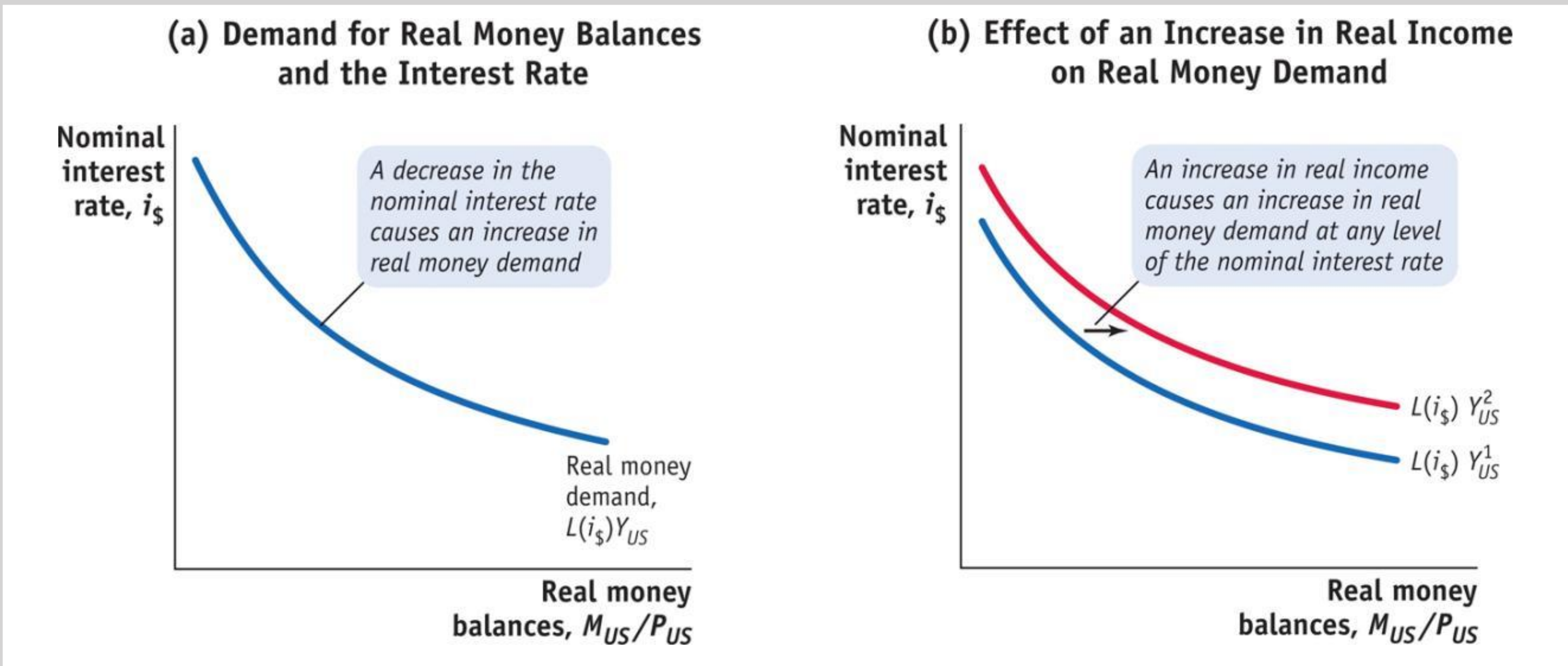
$$\underbrace{M^d}_{\substack{\text{Demand}\\ \text{for money (\$)}}} = \underbrace{L(i_{\$})}_{\substack{\text{A}\\ \text{decreasing}\\ \text{function}}} \times \underbrace{PY}_{\substack{\text{Nominal}\\ \text{income (\$)}}}$$

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

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

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 $i_\$$ falls. Panel (b) shows that an increase in real income from Y^1_{US} to Y^2_{US} causes real money demand to rise at all levels of the nominal interest rate $i_\$$.

Long-Run Equilibrium in the Money Market

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

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:

$$\underbrace{\frac{\Delta E^e_{\$/€}}{E_{\$/€}}}_{\substack{\text{Expected rate of dollar}\\ \text{depreciation}}} = \underbrace{\pi^e_{US} - \pi^e_{EUR}}_{\substack{\text{Expected inflation}\\ \text{differential}}} \quad \text{and} \quad \underbrace{\frac{\Delta E^e_{\$/€}}{E_{\$/€}}}_{\substack{\text{Expected rate of dollar}\\ \text{depreciation}}} = \underbrace{i_{\$}}_{\substack{\text{Net dollar}\\ \text{interest rate}}} - \underbrace{i_{€}}_{\substack{\text{Net euro}\\ \text{interest rate}}}$$

The Fisher Effect

- The nominal interest differential equals the expected inflation differential:

$$\underbrace{i_{\$} - i_{€}}_{\text{Nominal interest rate differential}} = \underbrace{\pi^e_{US} - \pi^e_{EUR}}_{\text{Nominal inflation rate differential (expected)}} \qquad (3\text{-}8)$$

- 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.

Real Interest Parity

- Rearranging the last equation, we find

$$i_{\$} - \pi^e_{US} = i_{€} - \pi^e_{EUR}$$

- 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.

$$r^e_{US} = r^e_{EUR} \qquad (3\text{-}9)$$

- 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.

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

$$r^e_{US} = r^e_{EUR} = r^*$$

- We treat *r** as an exogenous variable, something outside the control of a policy maker in any particular country.

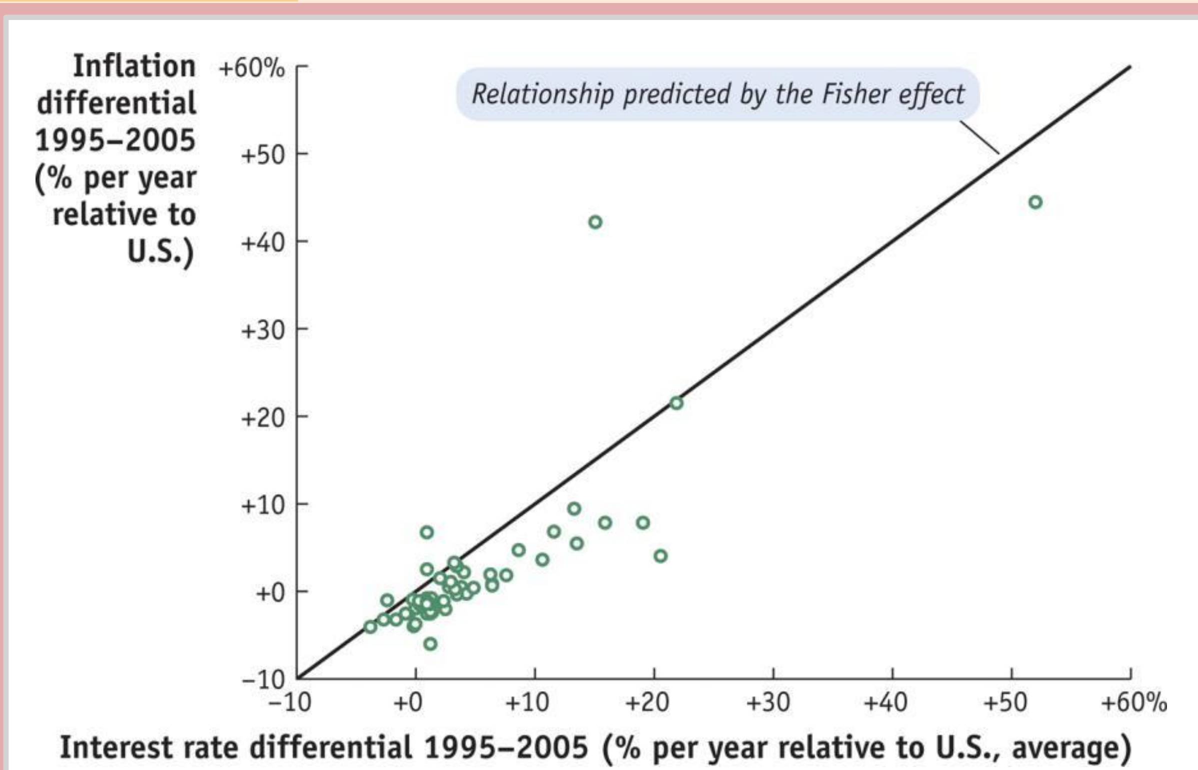
- Under these conditions, the Fisher effect is even clearer because, by definition,

$$i_{\$} = r^e_{US} + \pi^e_{US} = r^* + \pi^e_{US}$$
$$i_{€} = r^e_{EUR} + \pi^e_{EUR} = r^* + \pi^e_{EUR}$$

APPLICATION

Evidence on the Fisher Effect

FIGURE 3-12



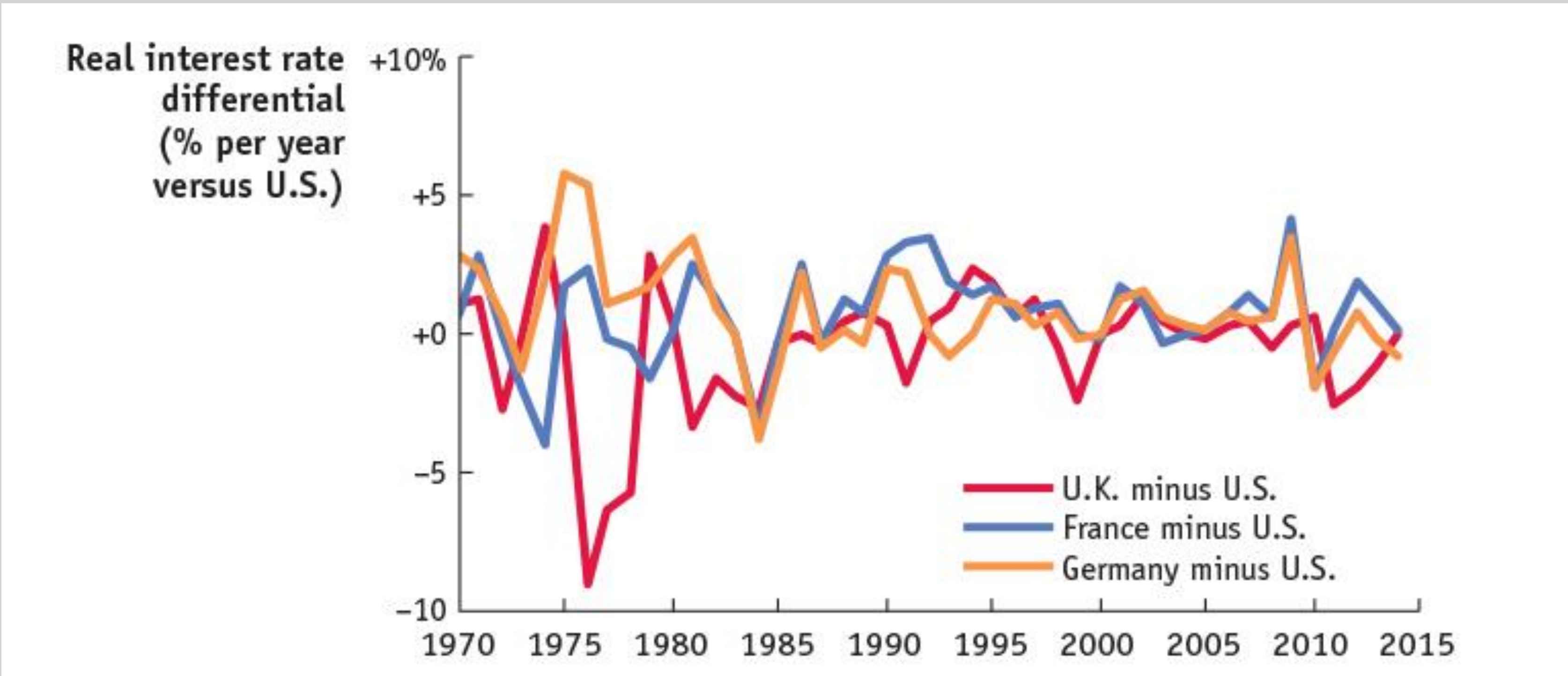
Inflation Rates and Nominal Interest Rates, 1995–2005 This scatterplot shows the relationship between the average annual nominal interest rate differential and the annual inflation differential relative to the United States over a 10-year period for a sample of 62 countries.

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.

The Fundamental Equation Under the General Model

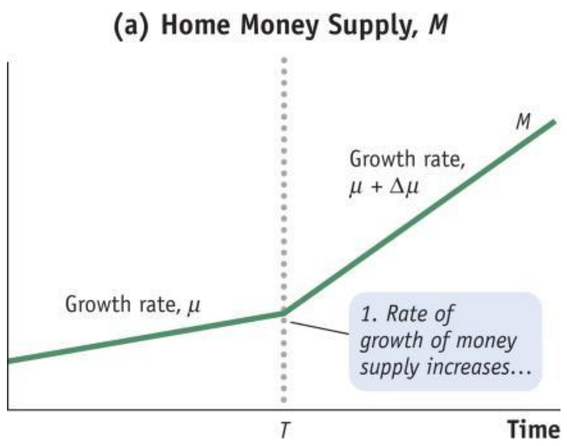
- This model differs from the simple model (the quantity theory) by allowing *L* to vary as a function of the nominal interest rate *i*.

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

- 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

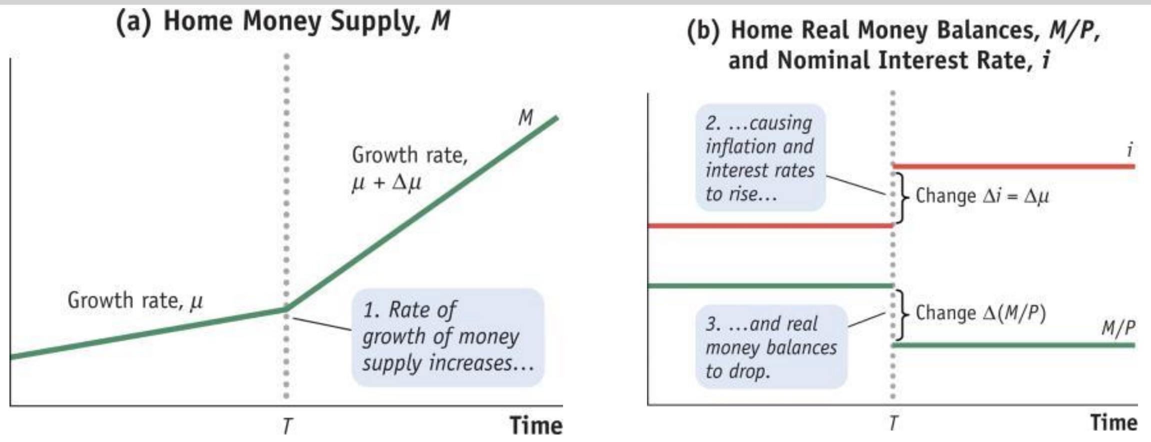
FIGURE 3-14 (1 of 4) An Increase in the Growth Rate of the Money Supply in the Standard Model



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

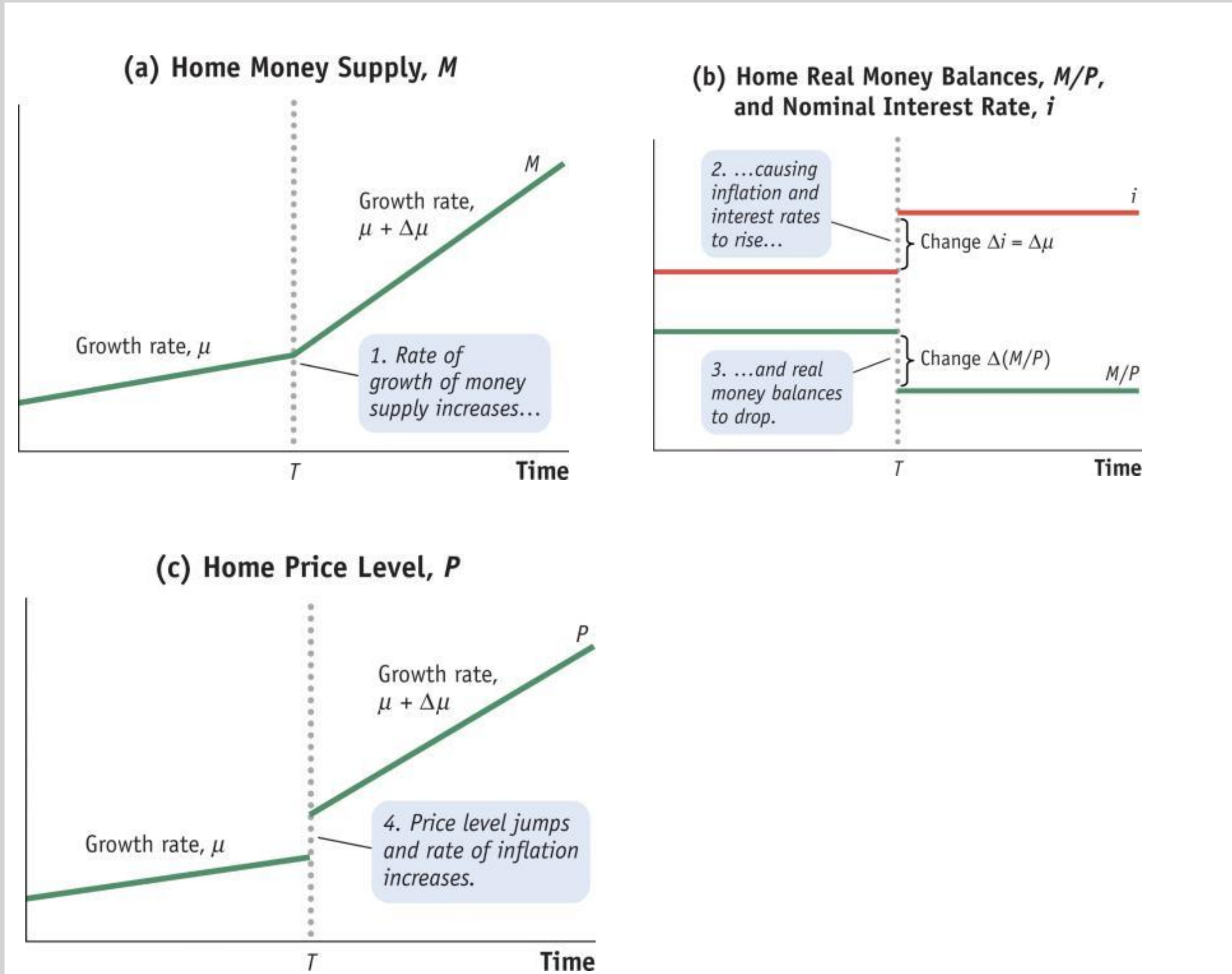
FIGURE 3-14 (2 of 4) An Increase in the Growth Rate of the Money Supply in the Standard Model (continued)



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

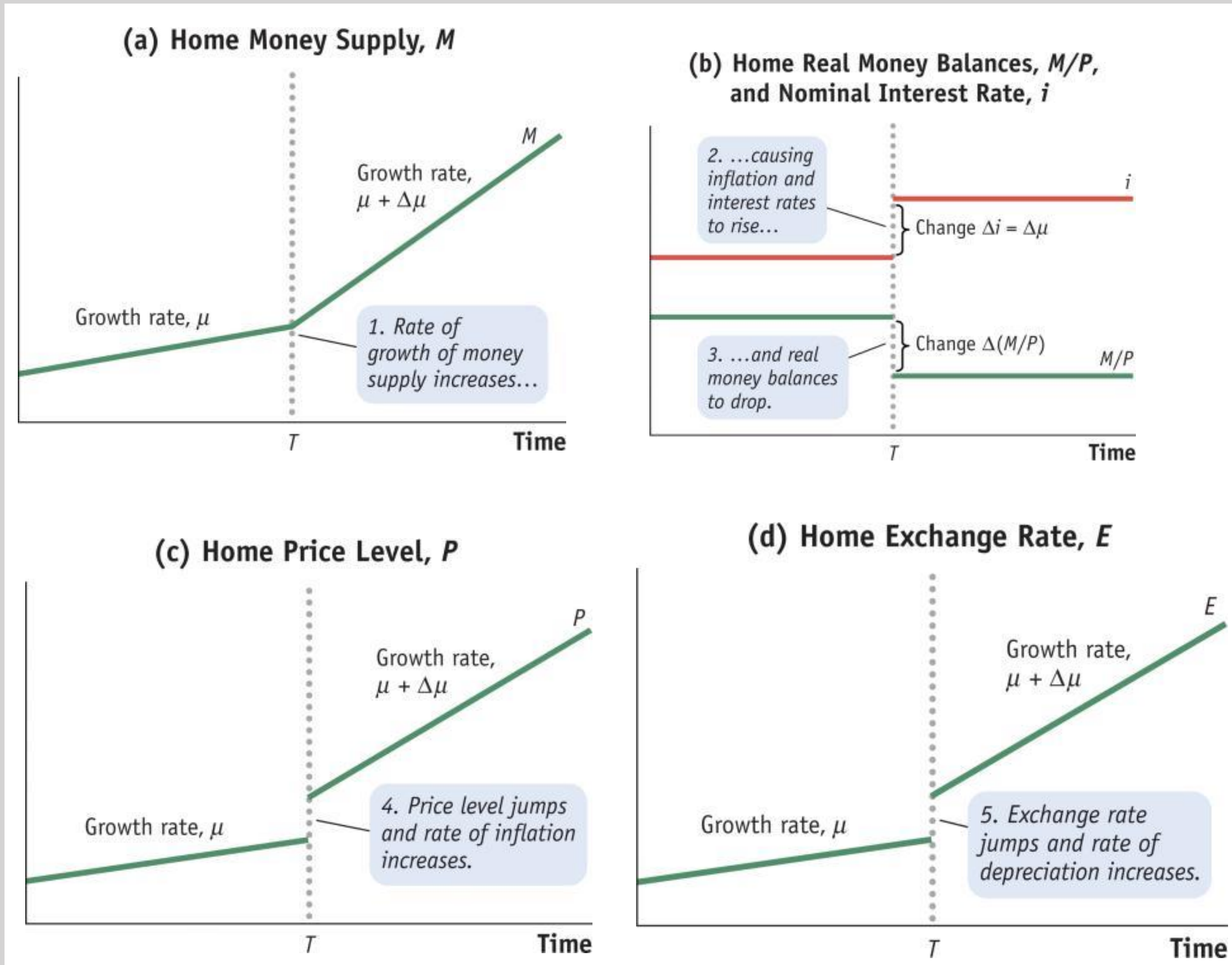
FIGURE 3-14 (3 of 4) An Increase in the Growth Rate of the Money Supply in the Standard Model (continued)



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).

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**.

The Long Run: The Nominal Anchor

- **Exchange rate target:**

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

Rate of depreciation | **Anchor variable**

- 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.

The Long Run: The Nominal Anchor

- **Money supply target:**

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

Money supply growth | **Anchor variable**

  - 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.

The Long Run: The Nominal Anchor

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

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

Nominal interest rate → **Anchor variable**

- 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.

	COMPATIBLE EXCHANGE RATE REGIMES				
Type of Nominal Anchor	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				✔	✔

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

Thank You for your attention!