# Slides for International Finance

## Purchasing Power Parity

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2025-02-24

# Preview

- Purchasing power parity
  - Commodity price parity
  - Absolute PPP vs. Relative PPP
- Classical model of price determination
  - LR neutrality of money
  - Fisher effect
  - magnification effect
- Monetary approach to flexible exchange rates
  - Exchange rates in the long run
- Real exchange rate determination
  - PPP shortcomings
  - nominal vs. real shocks

# Law of One Price

**Law of One Price (LOP):** identical goods have identical prices.
ensured by arbitrage (given low transactions costs)

**Commodity Price Parity (CPP):** the international LOP.

$$P_i = EP_i^*$$

# Economic Laws

Economic “laws” are just points of reference:

- not like physical laws
- violations *expected*
- violations stimulate investigation

# Commodity Price Parity (CPP)

Example:

- Two fast-food restaurants: one in New York, and one across the border in Montréal.
- assume markets are competitive and that transportation costs and barriers between markets are not important.

$$P^{US}_{burger} = (0.95 USD/CAD) \quad \times \quad P^{CA}_{burger}$$

Here $P^{US}_{burger}$ = price of burger in New York, $P^{CA}_{burger}$ = price of burger in Montréal, and 0.95 USD/CAD is the CAD-USD exchange rate.
CPP applies the law of one price: the price of the same burger (using a common currency to measure the price) in the two cities must be the same.

# CPP Example

**On 02 March 2021:**

- 1oz of gold sold in New York for about USD 1736
- 1 oz also sold in London for GBP 1241.36
- One GBP sold in both locations for about USD 1.4

Gold satisfies CPP: $1736 \approx 1.4 * 1241.36$

Source: various.

# Exchange Rate Models: SR vs. LR

Models predict how exchange rates behave.

**SR model:** A “Keynesian" story about the money market:

money $\rightarrow$ interest rates $\rightarrow$ exchange rate

**LR model:** A “Classical" story about the money market:

1. money $\rightarrow$ price level $\rightarrow$ exchange rate
2. money growth $\rightarrow$ inflation $\rightarrow$ depreciation

# “Long-Run” Models

Meaning of LR is *always* model specific

Here: the model is the simplest “Classical” model

- all prices adjust; all markets in equilibrium
  - “all” = goods, services, factors of production

**Purpose of LR models:**

- predict future tendencies
- anchor LR expectations
- do *not* describe SR exchange rate behavior

# Real Exchange Rate

The real exchange rate (q):

- rate of exchange of goods and services across countries.
- *relative* price of goods and services across countries.
- price of foreign goods and services in terms of domestic goods and services:

$$q = EP^* / P$$

$EP^*$ = domestic currency price of foreign goods
$P$ = domestic currency price of domestic goods

# Units of the Real Exchange Rate

$$
\begin{aligned}
q_{\frac{US}{EU}} &= (\#USD/EUR)\frac{\#EUR/\text{basket}_{\text{EU}}}{\#USD/\text{basket}_{\text{US}}} \\
&= \frac{\#\text{basket}_{\text{US}}}{\text{basket}_{\text{EU}}}
\end{aligned}
$$

# Real Exchange Rate Depreciation (↑q)

$$q = EP^*/P$$

**real depreciation:**

- a rise in q
- foreign commodities cost more in terms of domestic commodities

**Example:** a real depreciation of the USD

- US products buy fewer foreign products
- our ability to trade off US goods for EU goods declines

# Real Exchange Rate Appreciation ($\downarrow q$)

$$q = EP^*/P$$

**real appreciation:** a fall in q

foreign commodities cost less in terms of domestic commodities

**Example:** a real appreciation of the USD

- US products buy more foreign products
- our ability to trade off US goods for EU goods improves

# Purchasing Power Parity (PPP)

Core PPP idea:

- real exchange rate (q) is constant
- exchange rate movements match relative price movements

# Absolute Purchasing Power Parity

- the application of the law of one price across countries for "baskets" of goods and services.
- average price levels determine the exchange rate.
- the domestic currency has the same purchasing power in all countries.

$$P = EP^* \qquad \Longrightarrow \qquad q = 1$$

$P$ = level of domestic prices (e.g., US)
$P^*$ = level of foreign prices (e.g., CA)
$E$ = exchange rate (e.g., CAD-USD 0.95)

# Absolute Purchasing Power Parity (Absolute PPP)

Absolute purchasing power parity:

$$E = P/P^*$$

**Example:**

- P = USD 300 per basket
- P* = EUR 200 per basket
- absolute PPP
  $E = P/P^*$ = USD 300/EUR 200 = 1.5 USD/EUR
  (the EUR-USD exchange rate is 1.5)
- 1.5 USD buys the same amount of goods as 1 EUR
  *therefore* 1.5 USD buys 1 EUR

# Two Forms of PPP

**Relative PPP:** $E = qP/P^*$ with $q$ relatively constant

Exchange rates are proportional to the level of relative average prices across countries

**Absolute PPP:** $E = P/P^*$

Exchange rates equal the level of relative average prices across countries; $q = 1$

**Both:** exchange rate changes (depreciation) match changes in prices (inflation) between two periods:

$$\frac{E_t - E_{t-1}}{E_{t-1}} = \pi_t - \pi_t^*$$

where $\pi_t$ = inflation rate from period t-1 to t.

# PPP: An Implication

Recall

$$q = EP^* / P$$

Apply growth-rate algebra to transform this to:

$$\widehat{q} = \widehat{E} + \widehat{P^*} - \widehat{P}$$

Use the notation $\pi$ for $\widehat{P}$. Then

$$\widehat{q} = \widehat{E} + \widehat{P^*} - \widehat{P}$$

# Constant Real Exchange Rate

Recall

$$\widehat{q} = \widehat{E} + \widehat{P^*} - \widehat{P}$$

Now suppose that the real exchange rate ($q$) is constant (i.e., $\widehat{q} = 0$).

$$0 = \widehat{E} + \widehat{P^*} - \widehat{P}$$

$$\widehat{E} = \widehat{P} - \widehat{P^*}$$

# Conditions for absolute PPP:

The conditions for *absolute* PPP are extremely demanding.

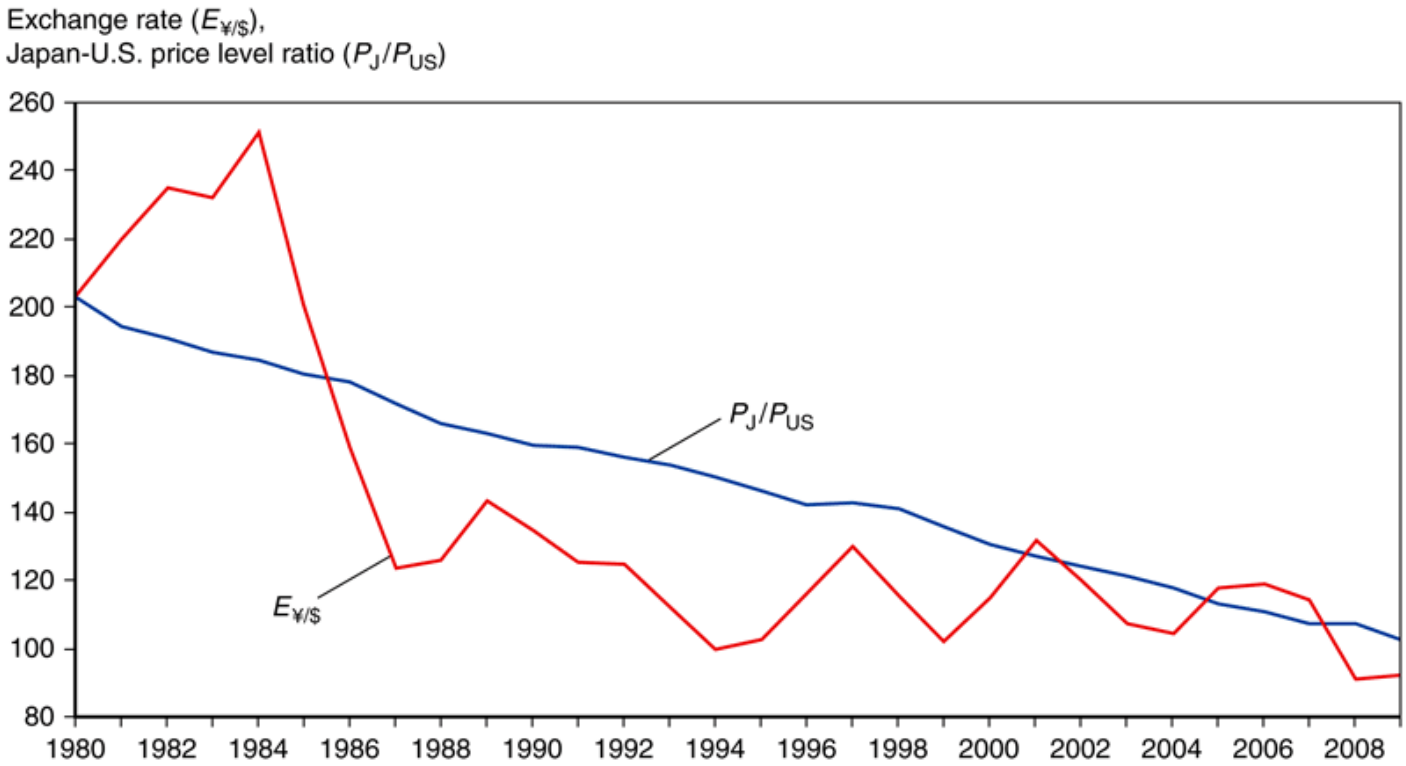
- CPP for every commodity
- identical index-basket construction

Absolute PPP is essentially the LOP for price indices.
Price indexes do not meet the conditions for absolute PPP.
So absolute PPP is largely for classroom convenience; relative PPP has more real-world relevance.

# Shortcomings of PPP

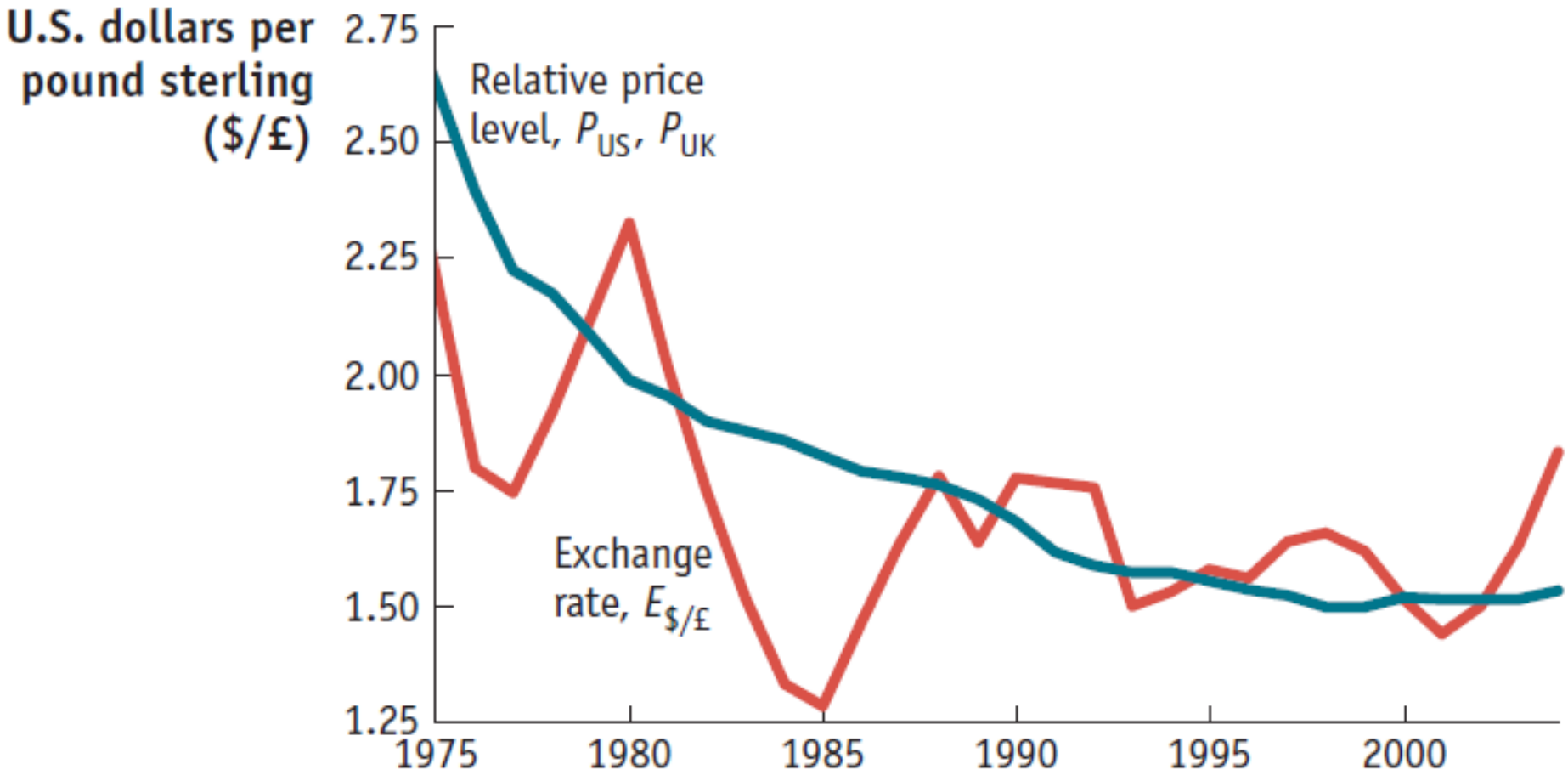
- Little empirical support for absolute PPP.
  - The prices of identical commodity baskets, when converted to a single currency, differ substantially across countries.
- Relative PPP is more consistent with data, but it also poorly predicts exchange rates in the short run.

# The Yen/Dollar Exchange Rate and Relative Japan-U.S. Price Levels, 1980–2009




Source: KOMIF Fig 5-2 (KOMIE 16-2) Data Source: IMF, International Financial Statistics. End-of-year data.

# GBP-USD Exchange Rate and Relative Price Levels

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# Deviations from PPP

PPP may not hold due to

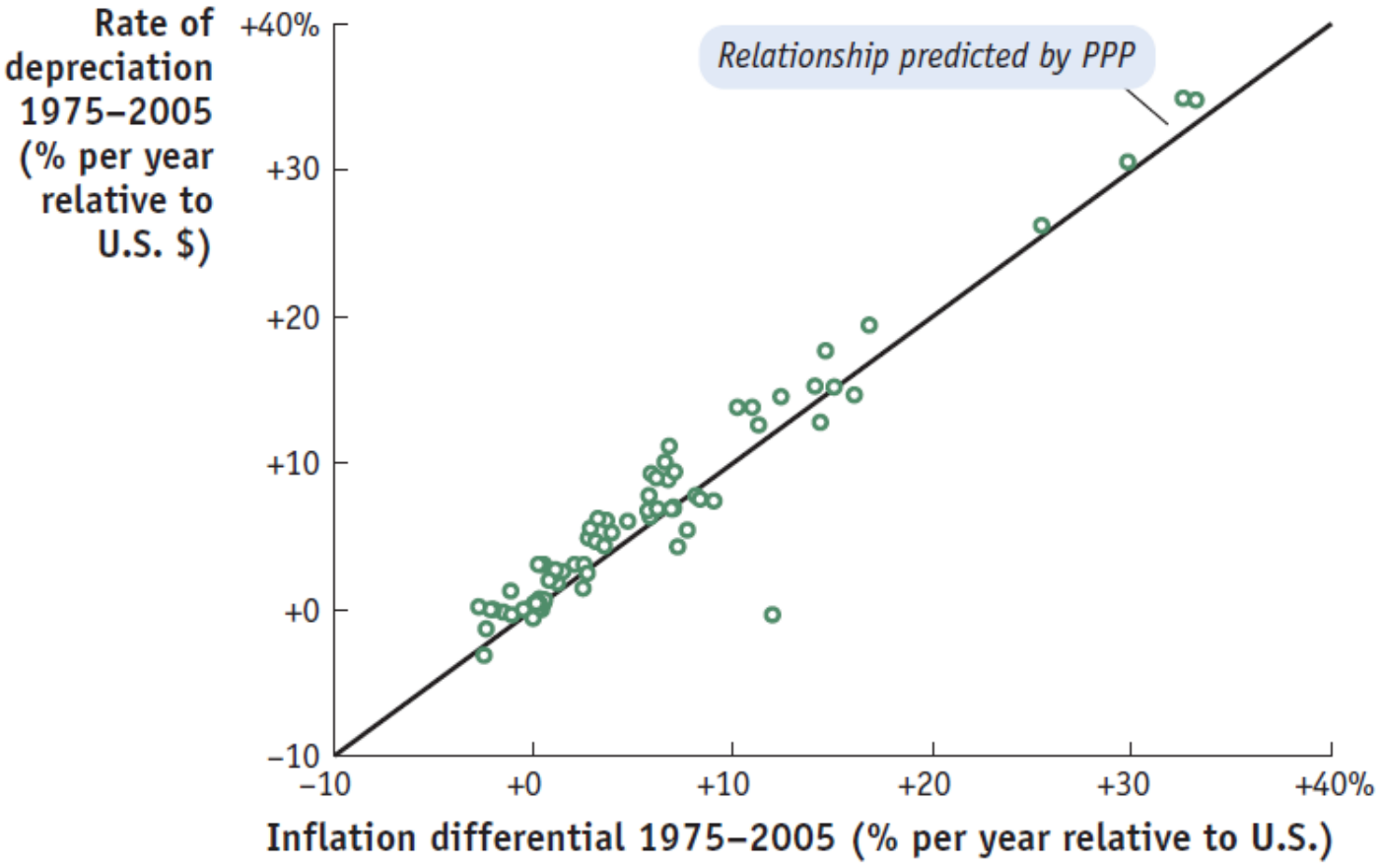
- violations of the law of one price
  - Trade barriers
  - non-tradable products
  - Imperfect competition
- divergent price index construction (different baskets of goods and services)

# Deviations from PPP: Barriers to Trade

Barriers to frictionless trade are the most fundamental source of PPP deviations:
Trade barriers and non-tradable products $\rightarrow$ one price need not hold in two markets.

- Transport costs
- governmental trade restrictions
- non-tradeable goods
  - some services are not readily tradable (classic example, haircuts).
- The greater the barriers to trade, the greater the possible deviation from PPP.

# Depreciation and Inflation Differentials (82 Countries)




Source: Feenstra and Taylor chapter 14

Supportive of relative PPP!

# Monetary Approach to Flexible Exchange Rates (MAFER)

Flexprice MAFER Assumptions:

- relative PPP
- Classical model of price-level determination

The monetary approach uses monetary factors to predict how exchange rates adjust in the **long run**.

## Note

For simplicity in the classroom, we sometimes use absolute PPP.

# Classical Model of Price-Level Determination

**Money market in equilibrium:** the real money supply ($M/P$) equals real money demand ($L$).

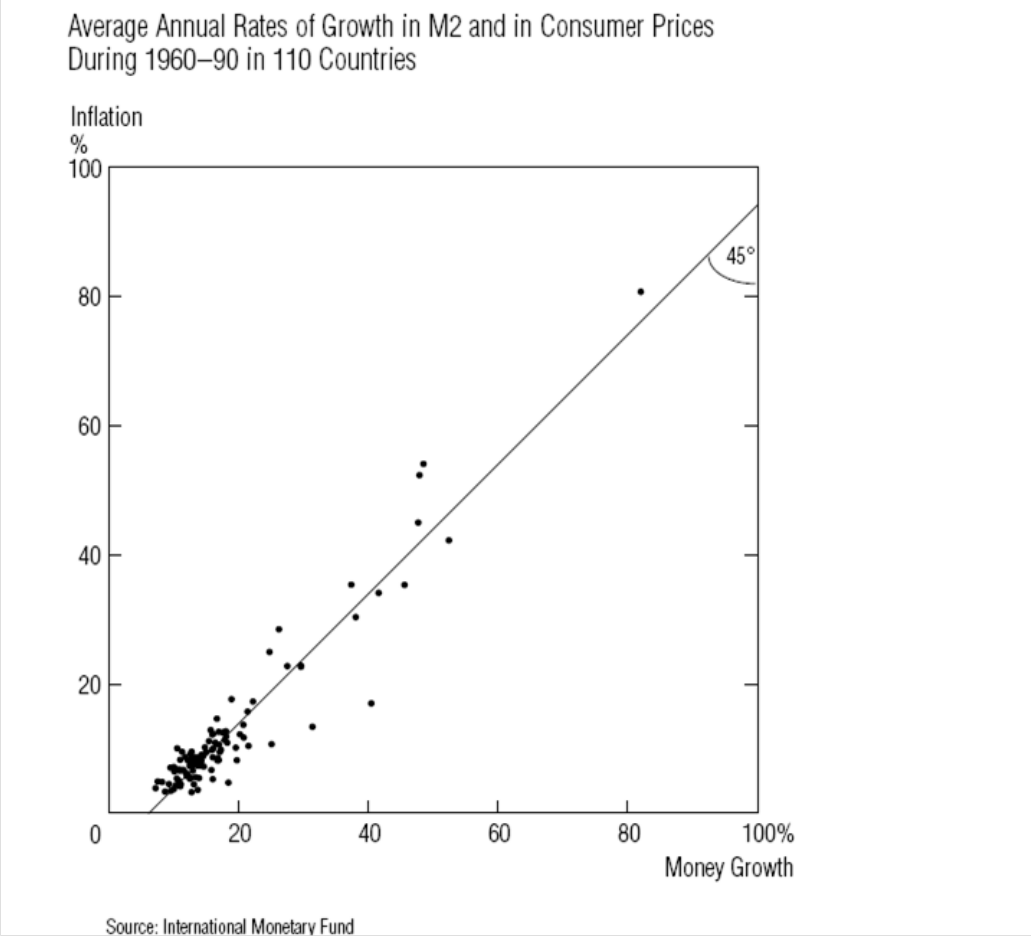
**Flexible prices clear money market:** $P$ moves, not $R$

$$\frac{M}{P} = L[R, Y] \quad \Longrightarrow \quad P = \frac{M}{L[R, Y]}$$

# Classical Model of Inflation Determination

**Key implication:** inflation ($\widehat{P}$) driven by money growth ($\widehat{M}$).

$$\widehat{P} = \widehat{M} - \widehat{L}$$

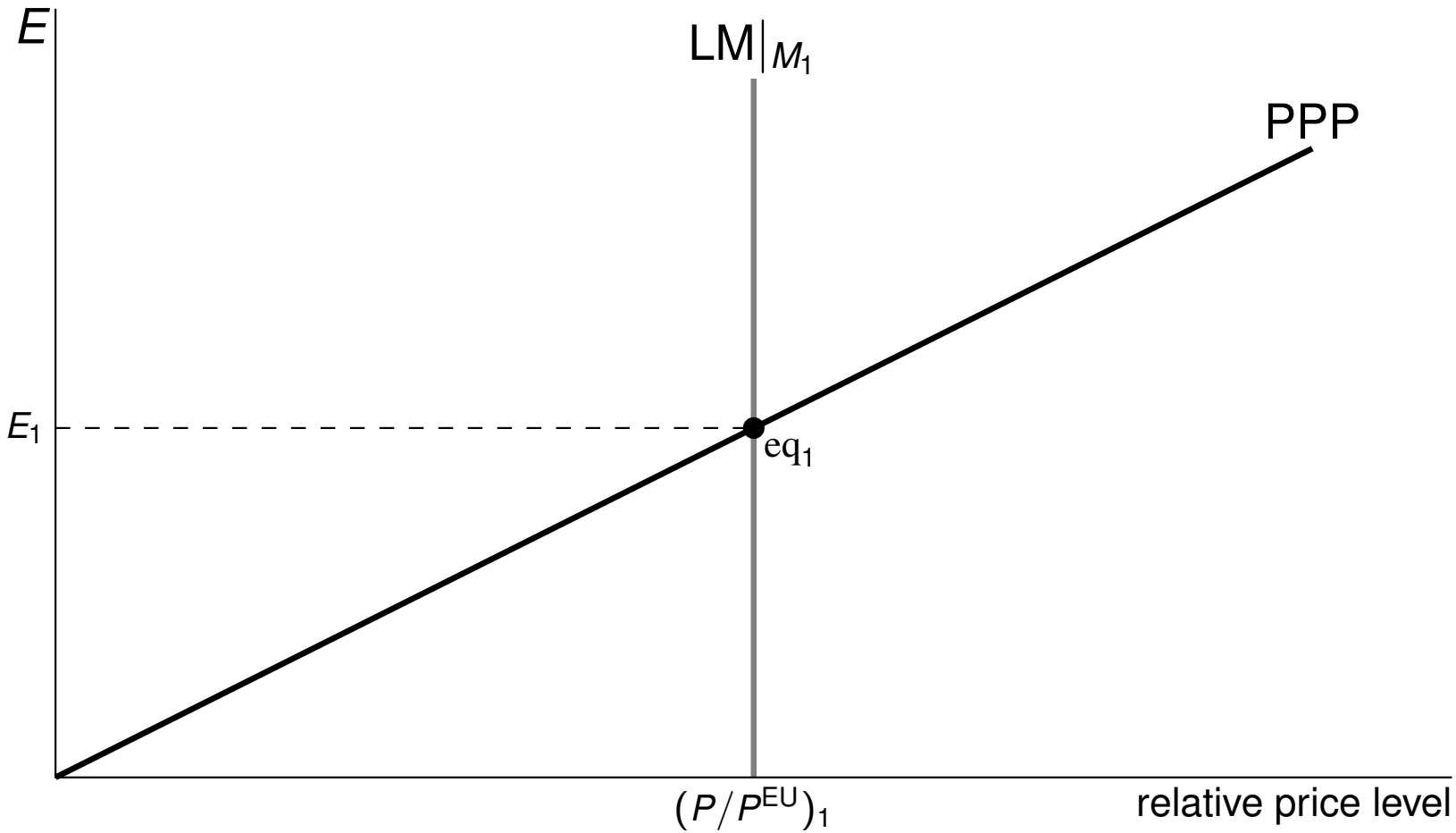


# Classical Model of Relative Price-Level Determination

**Determination of relative price level:**

$$P = M/L[R, Y]$$
$$P^* = M^*/L^*[R^*, Y^*]$$
$$\frac{P}{P^*} = \frac{M/M^*}{L/L^*}$$

# Equilibrium in a Classical Model



# MAFER Predictions

**positive money supply (level) shock:**

- $\uparrow$P and $\uparrow$E proportionally
- R does not change

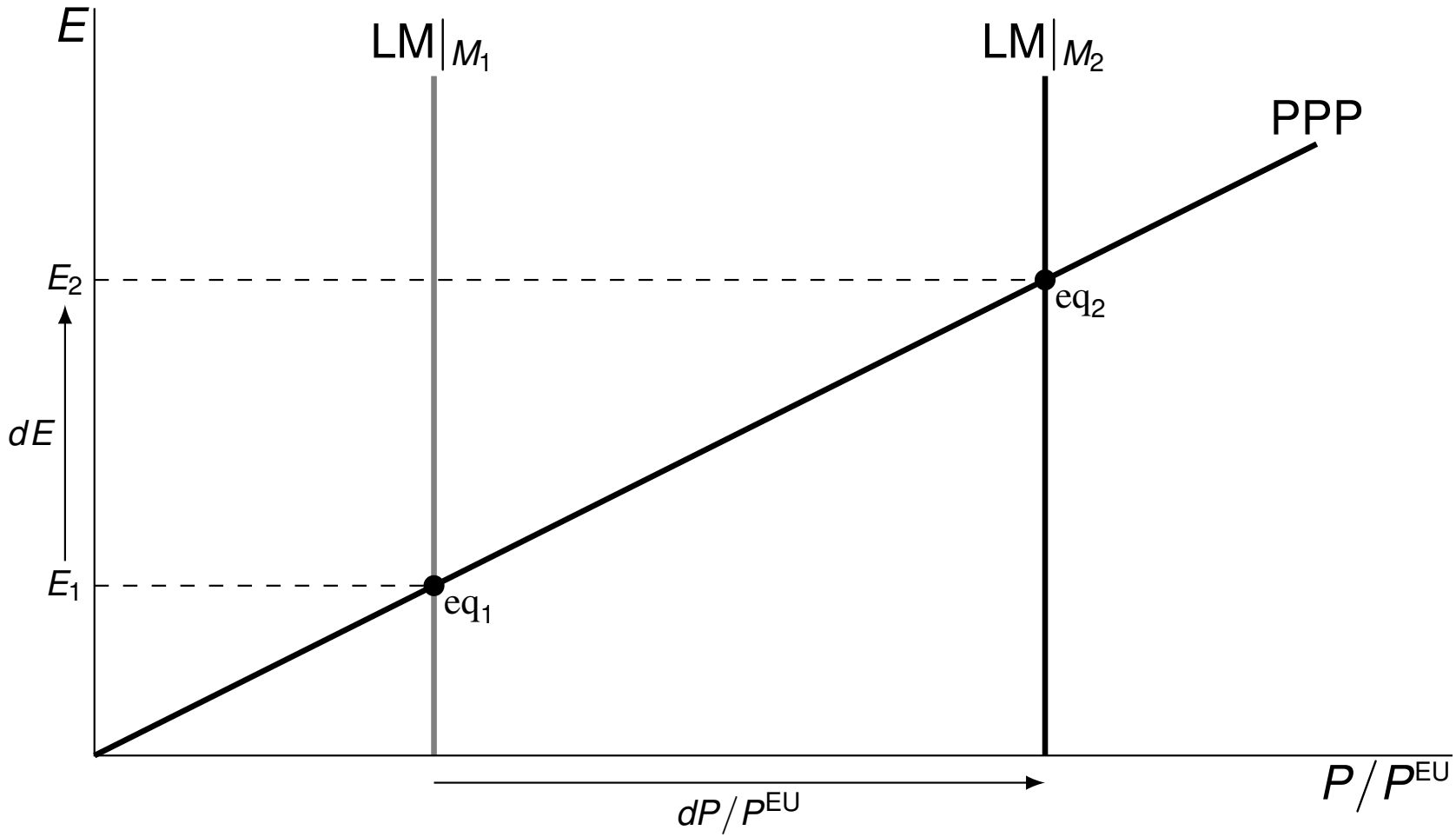
**positive output shock:**

- $\downarrow$P and $\downarrow$E roughly proportionally
- R does not change

We need to explore these predictions.

Modifications of the model will modify these predictions.

# Money Shock in Flexprice MAFER



# M Shock: Compare and Contrast

**SR model:**

- "sticky" prices
- $\uparrow$M $\rightarrow$ $\uparrow$M/P
- $\uparrow$M $\rightarrow$ exchange rate overshooting
  SR movement > LR movement

**MAFER:**

- "flexible" prices
- $\uparrow$M $\rightarrow$ $\uparrow$P proportionally: M/P unchanged
- $\uparrow$M $\rightarrow$ $\uparrow$E proportionally: **no overshooting**
- neutrality of money
  no real changes

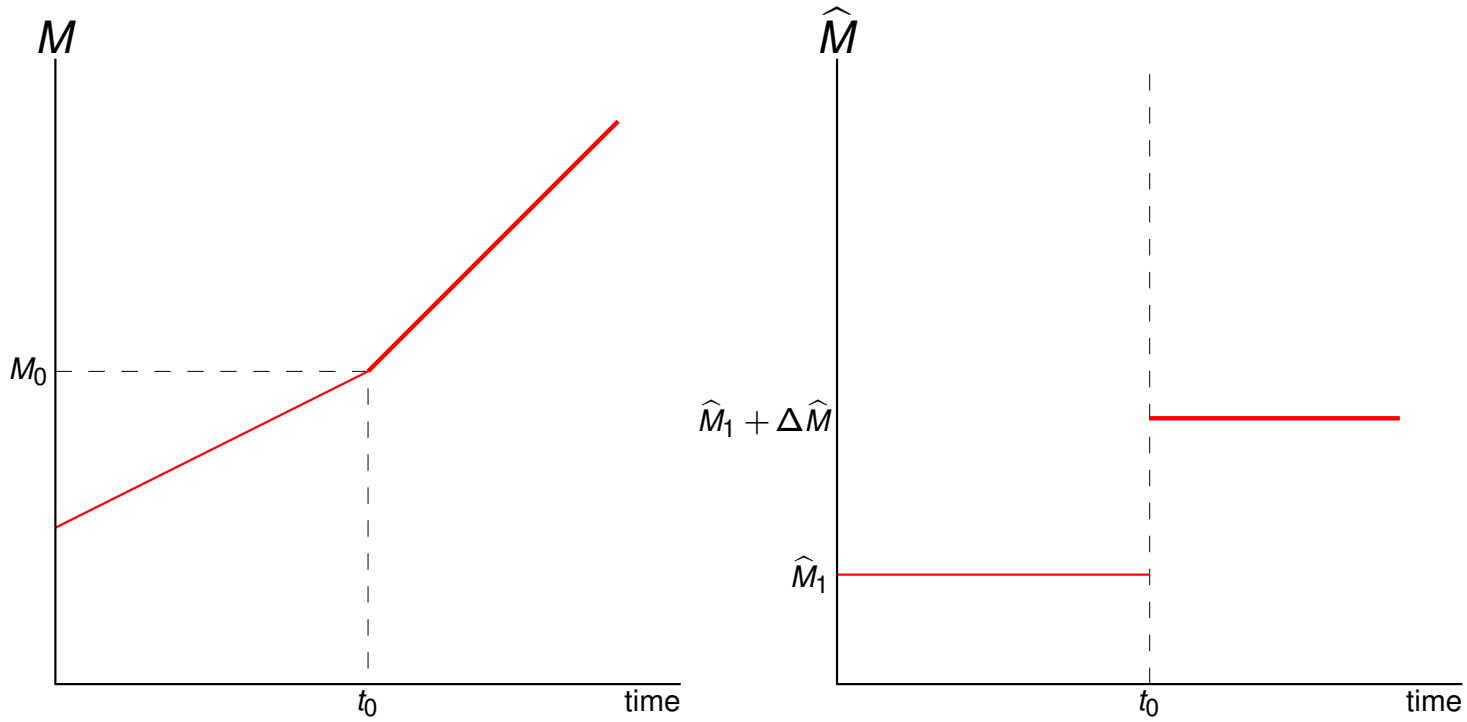
MAFER may seem to impose neutrality of money even in the SR, so that SR movement = LR movement.
**But** really it is just a LR model (aside from hyperinflations).

# New Experiment: Change in Growth of M

**New Experiment!!**

- Suppose that at time $t_0$, the U.S. central bank unexpectedly increases the *growth rate* of the money supply by 5% per year.

# Permanent Increase in Domestic Money Growth




Compare KOMIE 16-1

## Note

M is measured on a ratio scale.

# Classical Model Prediction

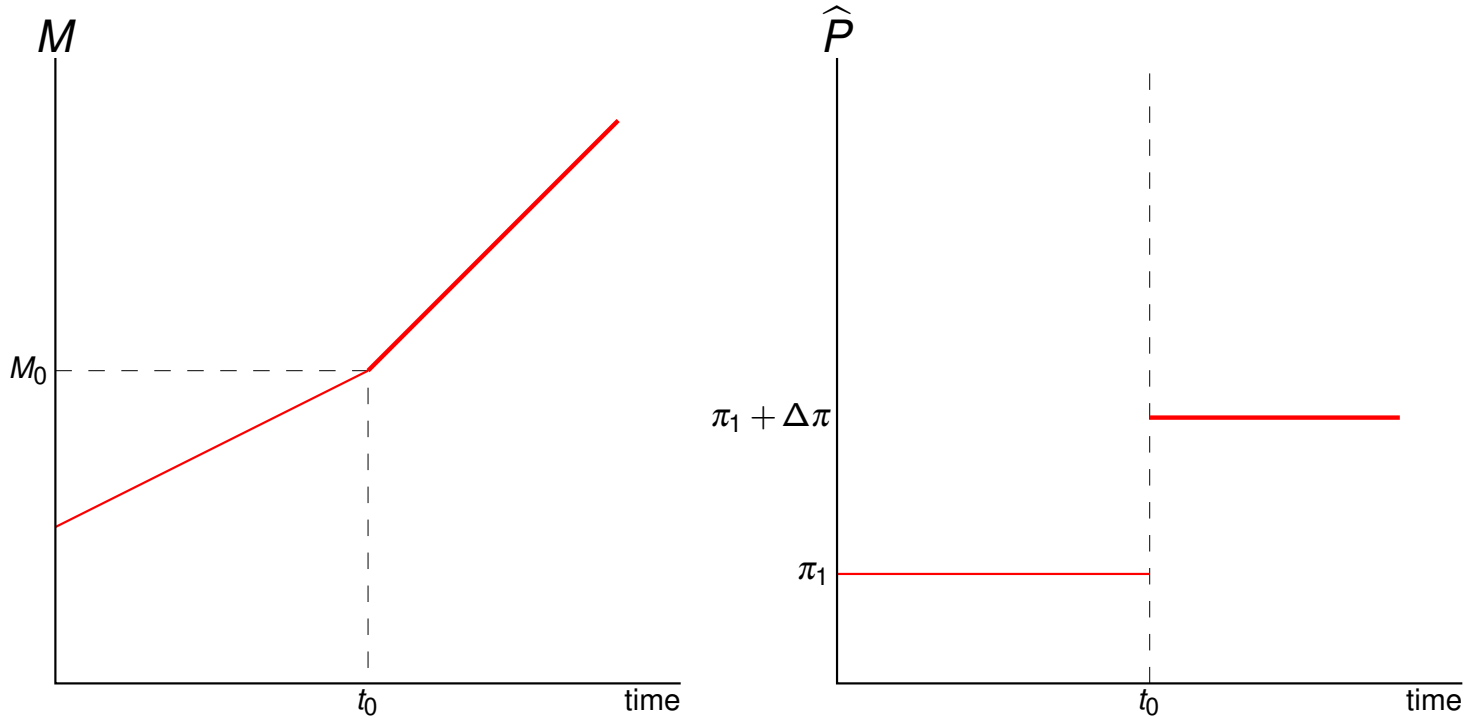
- The inflation rate rises by 5% per year

$$\pi_{new} = \pi_{old} + \Delta\pi = \pi_{old} + 5\%$$

## Note

$\pi \equiv \%\Delta P \equiv \widehat{P}$ (three different notations)

# Permanent ↑M Growth → ↑P Growth




Compare KOMIE 16-1 (KOMIF Fig 5-1)

## Note

$M$ is measured on a ratio scale.

$\pi \equiv \widehat{P}$

# MAFER Prediction

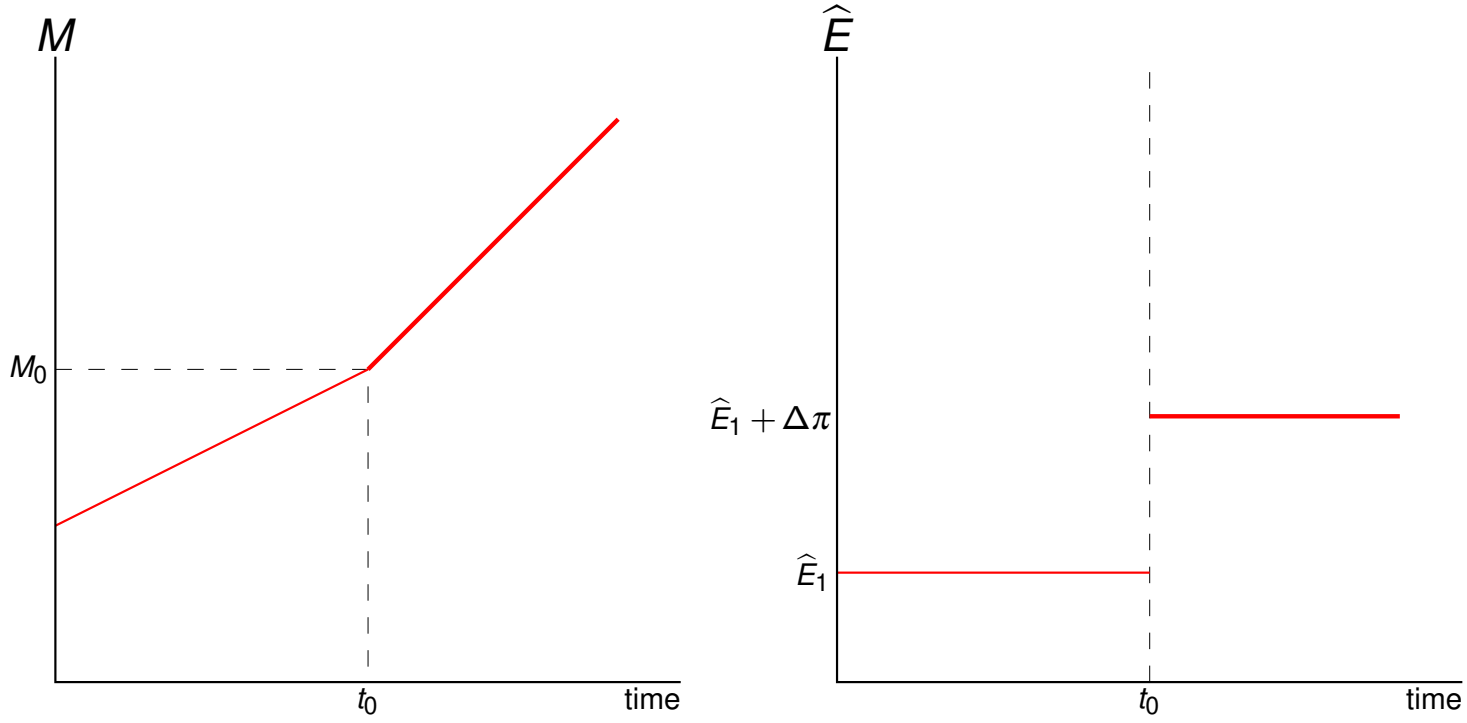
Exchange-rate rate rises by 5% per year

$$\begin{aligned}\widehat{E}_{\text{new}} &= \widehat{E}_{\text{old}} + \Delta\widehat{E} \\ &= \widehat{E}_{\text{old}} + \Delta\pi \\ &= \widehat{E}_{\text{old}} + 5\%\end{aligned}$$

**Core concepts:**

- Classical model implies $\Delta\pi = \Delta\widehat{M}$.
- PPP implies $\Delta\widehat{E} = \Delta\pi$.

# Permanent ↑M Growth → ↑E Growth




## Note

$M$ is measured on a ratio scale.

$\pi \equiv \widehat{P}$

PPP implies $\Delta\widehat{E} = \Delta\pi$.

Compare KOMIF Fig 5-1 (KOMIE 16-1)}

# MAFER Predictions

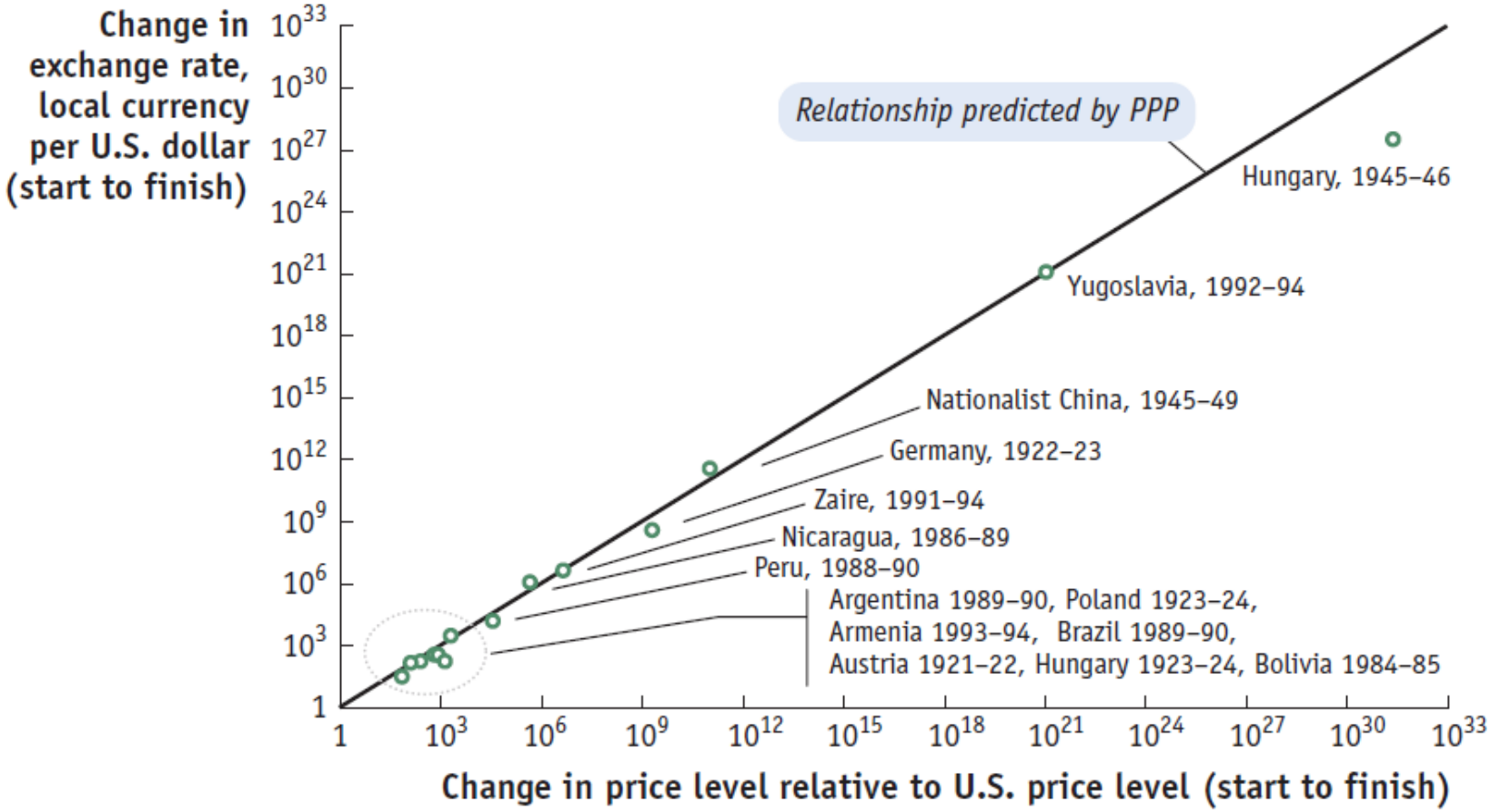
**money growth rate shock** ($\Delta \widehat{M} > 0$):

- $\uparrow \pi = \uparrow \widehat{M}$ (Classical model)
- $\uparrow \widehat{E} = \uparrow \pi$ (PPP)

Sustained higher money growth $\rightarrow$

- sustained higher inflation (notation: $\widehat{P}$ or $\pi$)
- sustained higher depreciation (notation: $\widehat{E}$ or $(E_{t+1} - E_t)/E_t$)
- inflation and depreciation increase in step ($\widehat{E} = \pi$ by PPP)

# Some 20th Century Hyperinflations

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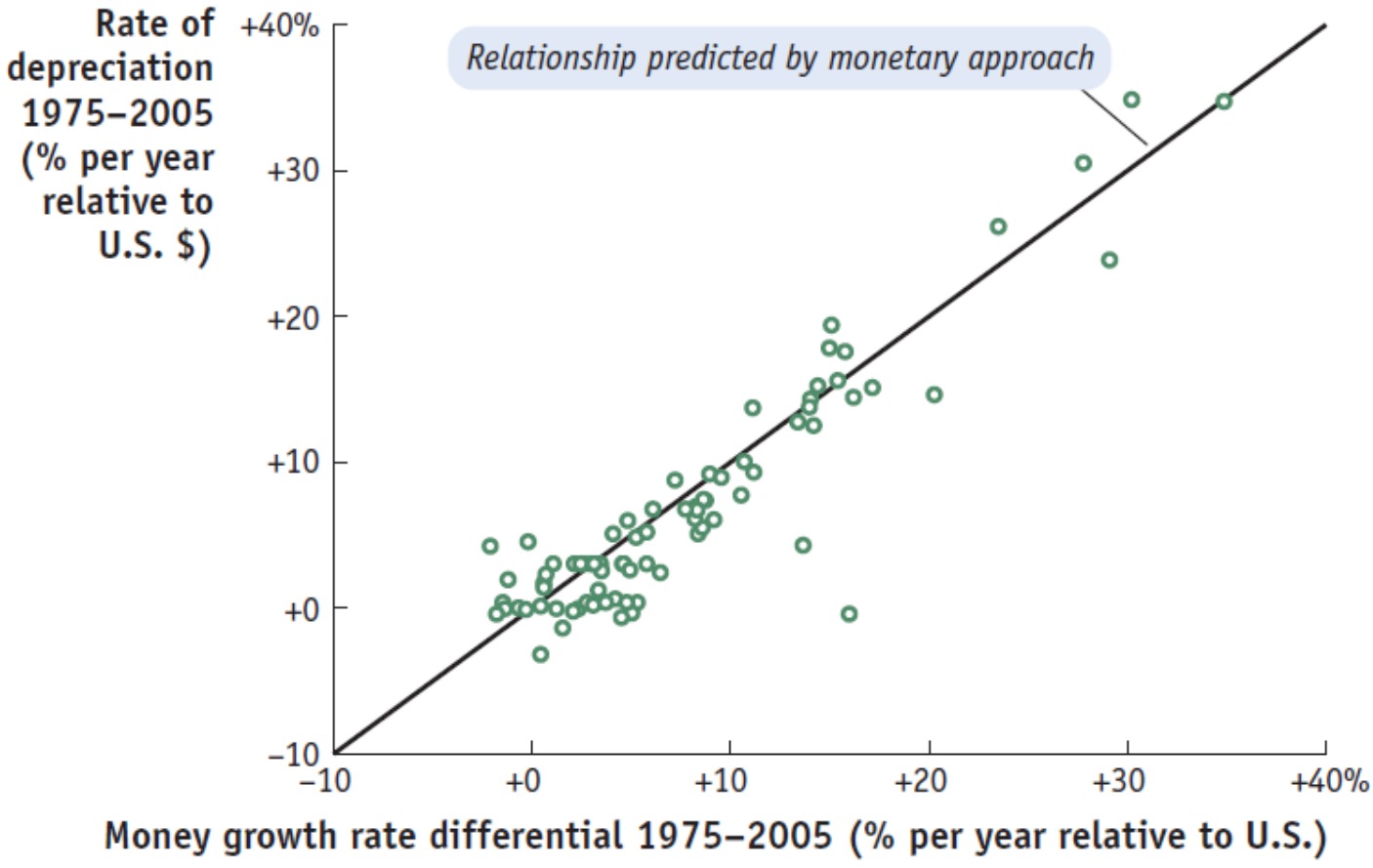
Data Source: Cagan (1956); Petrovic and Mladenovic (2000 JMCB)

# Money Growth and Depreciation (82 Countries)

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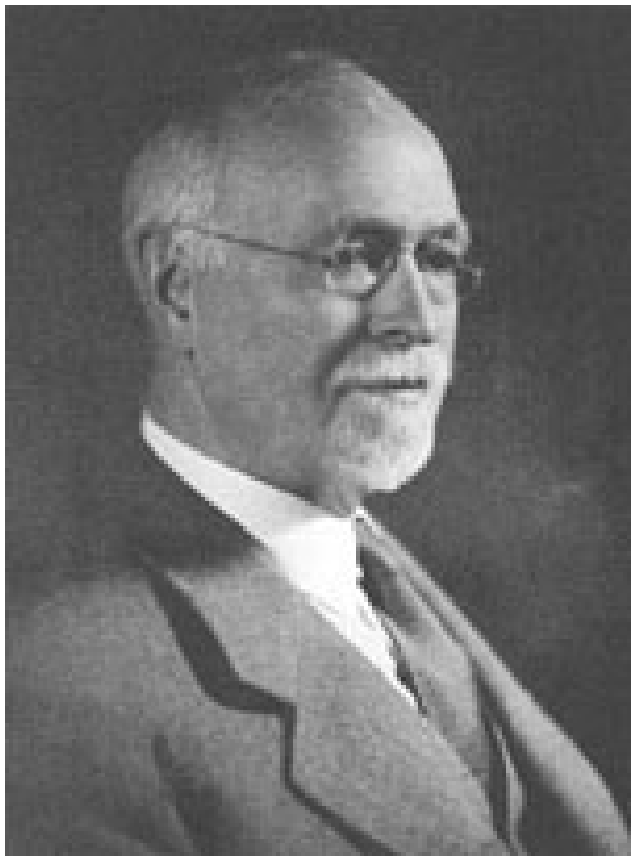
Data Source: IFS

# The Fisher Effect

# Irving Fisher (1867–1947)



**1888** BA from Yale

**1891** First Yale PhD in Econ

**17 Oct 1929** Most famous prediction: “Stock prices have reached what looks like a permanently high plateau.” (Oct 28–29 were called “Black Monday” and “Black Tuesday” as NYSE share prices collapsed.)

**1930** *The Theory of Interest*

# Real Interest Rates

**Real interest rate:** inflation-adjusted interest rate
measured in terms of real output

- savers can buy more goods and services when their assets pay real interest
- borrowers can buy fewer goods and services when they must pay real interest on their borrowing

**Ex ante real interest rate:** nominal interest rate less expected inflation

$$r^e = R - \pi^e$$

- borrowers and savers should respond to the ex ante (i.e., expected) real interest rate
- this is the basis of the Fisher effect

# New Consideration: Fisher Effect

Fisher Effect:

$$\uparrow \pi^e \rightarrow \uparrow R$$

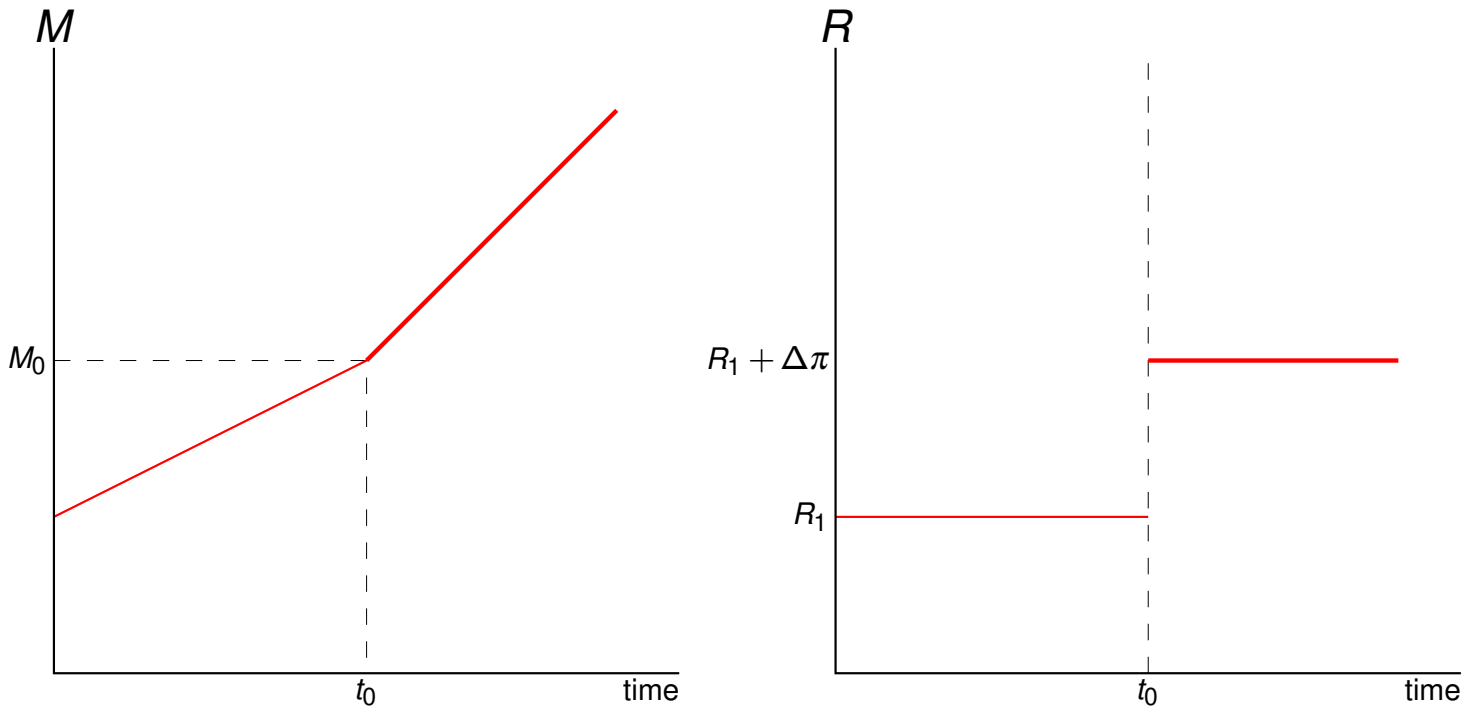
**Fisher effect example:** if expected inflation rises by 5%, the interest rate will also rise 5%.

**Implication:** a sustained rise in inflation ($\uparrow \pi$) eventually causes an equal increase in the nominal interest rate ($\uparrow R$).

**Fisher effect:**

- $R = R_{\text{real}} + \pi^e$ (the Fisher effect)
- expected inflation matches inflation ($\pi^e = \pi$)
- $\rightarrow R = R_{\text{real}} + \pi$

# Permanent ↑M Growth → ↑R




Notes:

M is measured on a ratio scale. (Compare KOMIE fig 16-1.)

## Note

Remember, *permanent* is short for *expected to be permanent*! **Expectations change.**

# A New Effect on the Money Market

We now link expected inflation directly to money growth:

- $\uparrow \widehat{M} \rightarrow \uparrow \pi^e$ (expectations formation)
- $\uparrow \pi^e \rightarrow \uparrow$ R (Fisher effect)
- $\uparrow$R $\rightarrow \downarrow$L
- $\downarrow$L $\rightarrow \uparrow$P

The increase in nominal interest rates decreases the demand for real monetary assets. For the money market to be in equilibrium at the new R, the price level must rise so that money market equilibrium is maintained.

$$\underset{\uparrow}{P} = \frac{M}{L[\underset{\uparrow}{R}, Y]}$$

# MAFER and Increased Money Growth

- $\uparrow \widehat{M} \rightarrow \uparrow \pi^e$
- $\uparrow \pi^e \rightarrow \uparrow$ R
- $\uparrow$R $\rightarrow \downarrow$L
- $\downarrow$L $\rightarrow \uparrow$P $\rightarrow \downarrow$M/P
- $\uparrow$P$\rightarrow\uparrow$E (by PPP)

The exchange rate must rise (the dollar must depreciate) proportionately in order to maintain PPP:

$$E = q\frac{P}{P^*}$$

Thereafter, M and P rise faster by $\Delta\pi$, as does E (the direct rate).

- In order to maintain PPP, the domestic currency continues to depreciate proportionately.

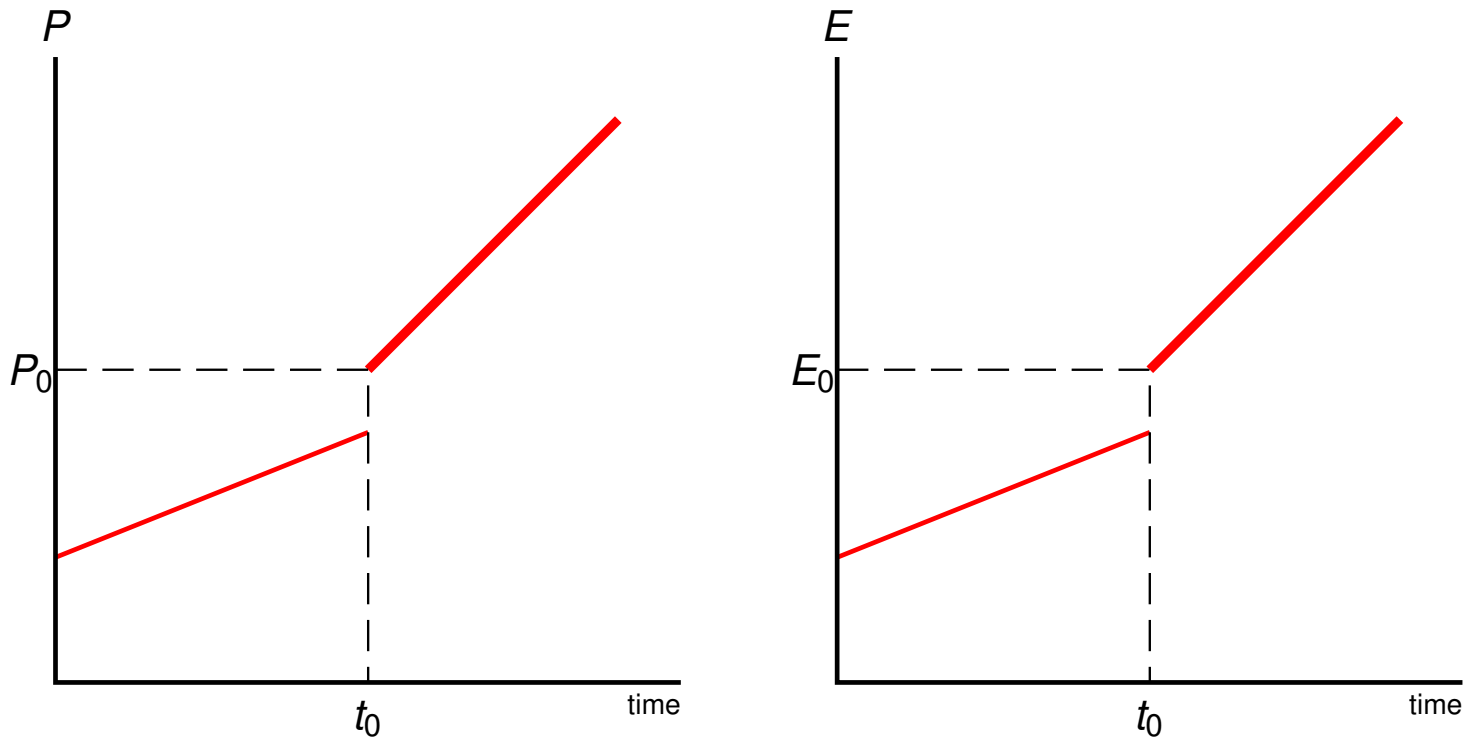
# New Prediction: Magnification Effect

**Magnification effect:**

- $\uparrow \pi \rightarrow \uparrow \pi^e \rightarrow \uparrow R$
- $\uparrow$R $\rightarrow \downarrow$L $\rightarrow \downarrow$M/P
- P must move **more** than M

Bottom line: P jumps and E jumps when policy changes.
The jump is the **magnification effect**, a response to $\uparrow$R

# Permanent Increase in Domestic Money Growth




Compare KOMIE 16-1

## Note

*P* and *E* are measured on a ratio scale.

PPP implies *E* is proportional to *P*

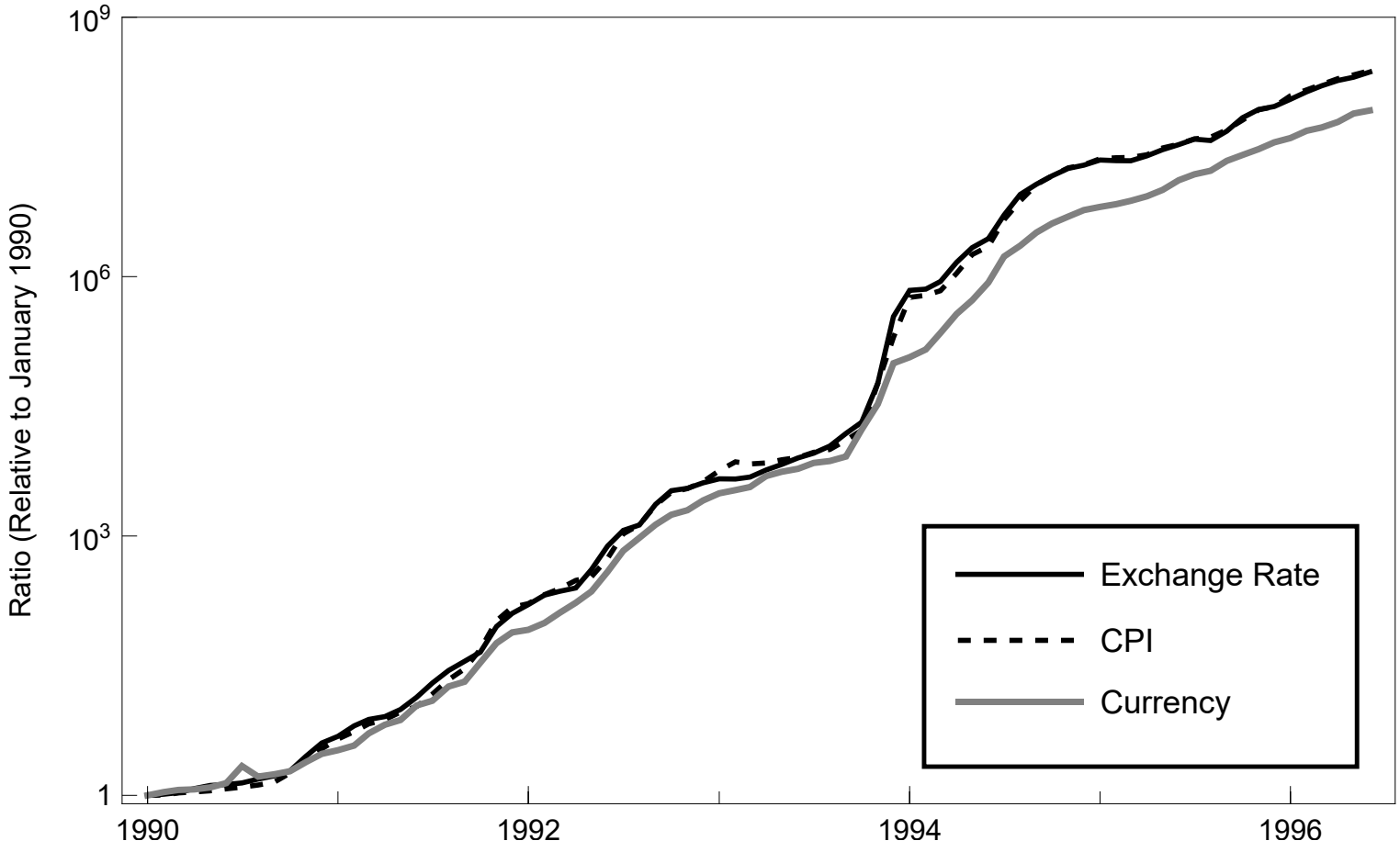
# Permanent ↑M Growth (MAFER)

- Permanent ↑M growth causes permanent ↑P growth
- the domestic currency must depreciate when domestic inflation exceeds foreign inflation (by PPP)

Furthermore:

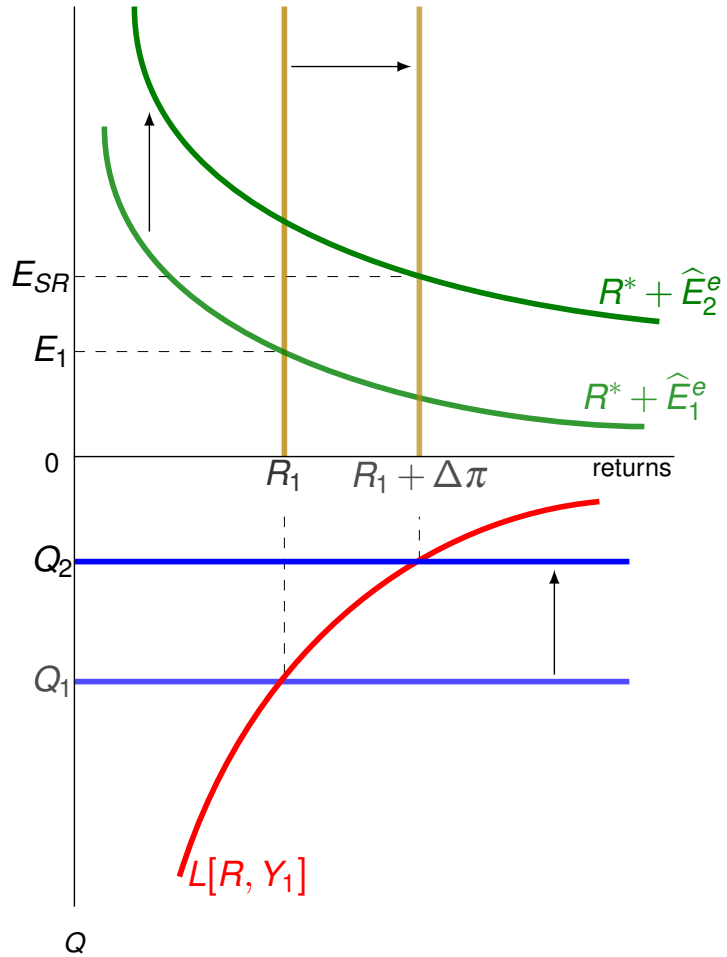
- $\uparrow \pi \rightarrow \uparrow \pi^e \rightarrow \uparrow R \rightarrow \downarrow L \rightarrow \uparrow P, E$
- Persistent domestic inflation increases expected inflation.
- Higher expected inflation causes a rise in the domestic nominal interest rate (by the Fisher effect).
- Higher R reduces desired real balances.
- Therefore, there is a magnification effect on P and E.

# Inflation in Zaire



# Two-Part Chart with Magnification Effect

Stretch our two-part chart to visualize the magnification effect: show **initial** ($t_0$) effects of ↑M **growth** in **flexp** MAFER




Note: Compare KOMIE Fig 16A

# Real Interest Parity

# Changes and Expected Changes

$$q = EP^*/P \implies \widehat{q} = \widehat{E} + \widehat{P^*} - \widehat{P}$$
$$\implies \widehat{q}^e = \widehat{E}^e + \widehat{P^*}^e - \widehat{P}^e$$

Write $\pi^e$ and $\pi^{*e}$ for $\widehat{P}^e$ and $\widehat{P^*}^e$.
Write $(E^e - E)/E$ for $\widehat{E}^e$ and $(q^e - q)/q$ for $\widehat{q}^e$.

$$q = E\frac{P^*}{P} \qquad \implies \frac{q^e - q}{q} = \frac{E^e - E}{E} + \pi^{*e} - \pi^e$$

# Real Interest Rate Differentials

**Anticipated Real Depreciation:**

$$\frac{q^e - q}{q} = \frac{E^e - E}{E} + \pi^{*e} - \pi^e$$

**UIP:**

$$R - R^* = \frac{E^e - E}{E}$$

**Together:** Anticipated changes in $q$ show up as a real interest differential.

$$\begin{aligned}\frac{q^e - q}{q} &= (R - R^*) + \pi^{*e} - \pi^e \\ &= (R - \pi^e) - (R^* - \pi^{*e})\end{aligned}$$

**PPP plus UIP** imply Real Interest Parity:

# Real Interest Parity

Real interest rate differentials (across countries) must equal expected changes in the real exchange rate.

$$(R - \pi^e) - (R^* - \pi^{*e}) = (q^e - q)/q$$
$$r^e - r^{*e} = (q^e - q)/q$$

RIP says that the real interest rate differential between countries equals to the expected change in the relative price of goods and services between countries.

# Expected PPP

If financial markets expect (absolute or relative) PPP to hold, then expected exchange rate changes will equal expected inflation between countries:

$$q = EP^*/P \implies \frac{q^e - q}{q} = \frac{E^e - E}{E} + \pi^{*e} - \pi^e$$

$$(q^e - q)/q = 0 \implies 0 = \frac{E^e - E}{E} + \pi^{*e} - \pi^e$$

$$\implies \frac{E^e - E}{E} = \pi^e - \pi^{*e}$$

# Expected PPP and Real Interest Parity

If financial markets expect (absolute or relative) PPP to hold, then expected exchange rate changes will equal expected inflation between countries:

**real interest parity:** $(R - \pi^e) - (R^* - \pi^{*e}) = (q^e - q)/q$

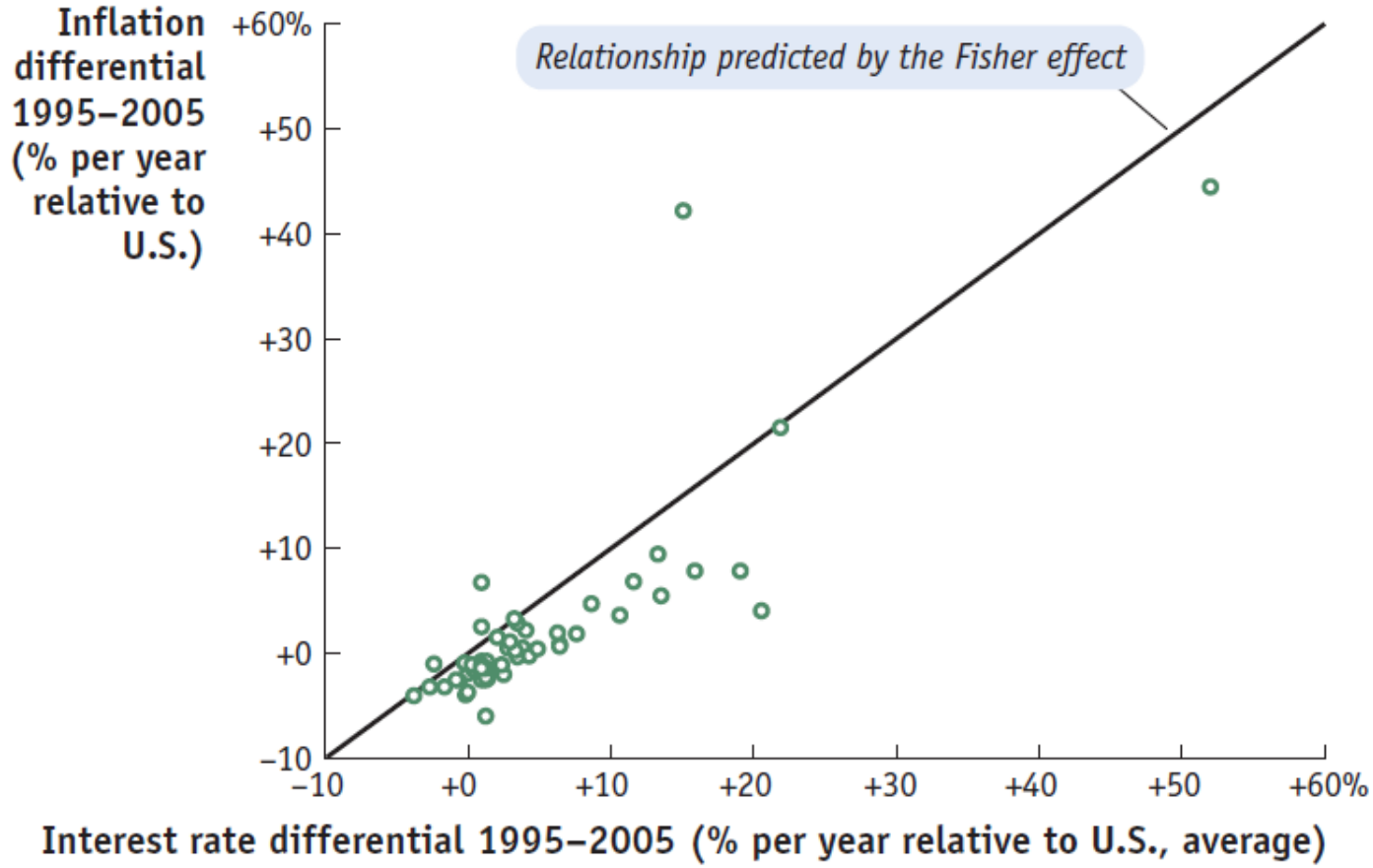
**expected PPP:** $(q^e - q)/q = 0$

**real interest rate equality:** $R - \pi^e = R^* - \pi^{*e}$

We also get an international version of the Fisher effect.

$$R - R^* = \pi^e - \pi^{*e}$$

# Interest Differentials and Inflation Differential (62 Countries)

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Data Source: IFS

# Burgernomics

# Computing Big Mac PPP

**Get the Following Data:**

- E: current exchange rate (direct rate; domestic terms; USD-FCU)
- P: local price
- P*: US price (*note* the Economist default: dollar base currency!)

**Computation:**

1. Eppp = P/P*
2. overvaluation = $\frac{E_{\text{ppp}}}{E} - 1$

**Equivalent Computation:**

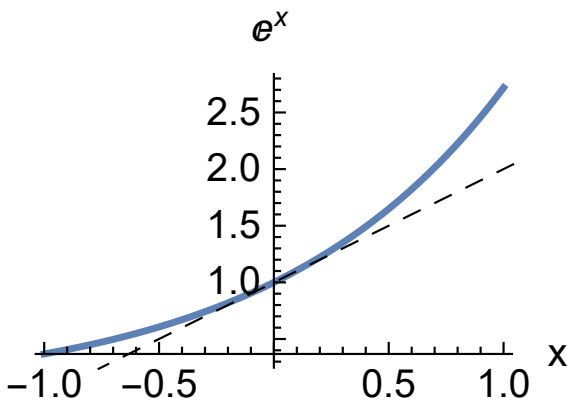
1. $q = EP^* / P$
2. overvaluation = $\frac{1}{q} - 1$

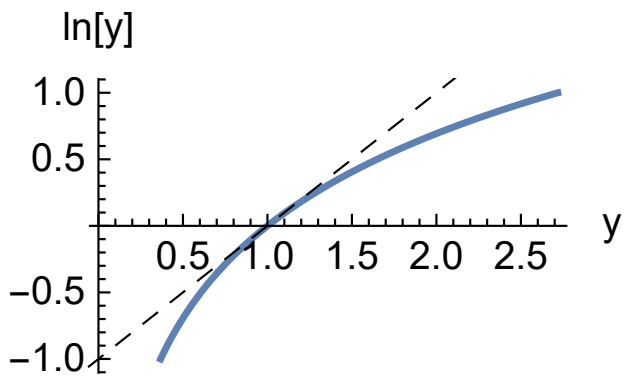
# Approximate Computation

1. $q = EP^*/P$ (the real exchange rate)
2. overvaluation = $1/q - 1$
3. overvaluation $\approx -\ln[q]$

**Explanation:**

Since $\ln[1+x] \approx x$, you can get a rough approximation of overvaluation as $-\ln[q]$. (This works best when $q$ is near 1.)



# Switzerland (CHF) 2025 Example:

https://www.economist.com/big-mac-index

Treating US as foreign country!

- P = CHF 7.20
- $P^*$ = USD 5.79
- Compute PPP rate: Eppp = P/P* = 7.20/5.79 = 1.24 CHF/USD
- Look up actual exchange rate ($E$): USD-CHF 0.90
- overvaluation = (Eppp/E -1) = $\left(1.24/0.90 - 1.0\right) \approx 0.38$

# Switzerland (CHF) Alternative Computations

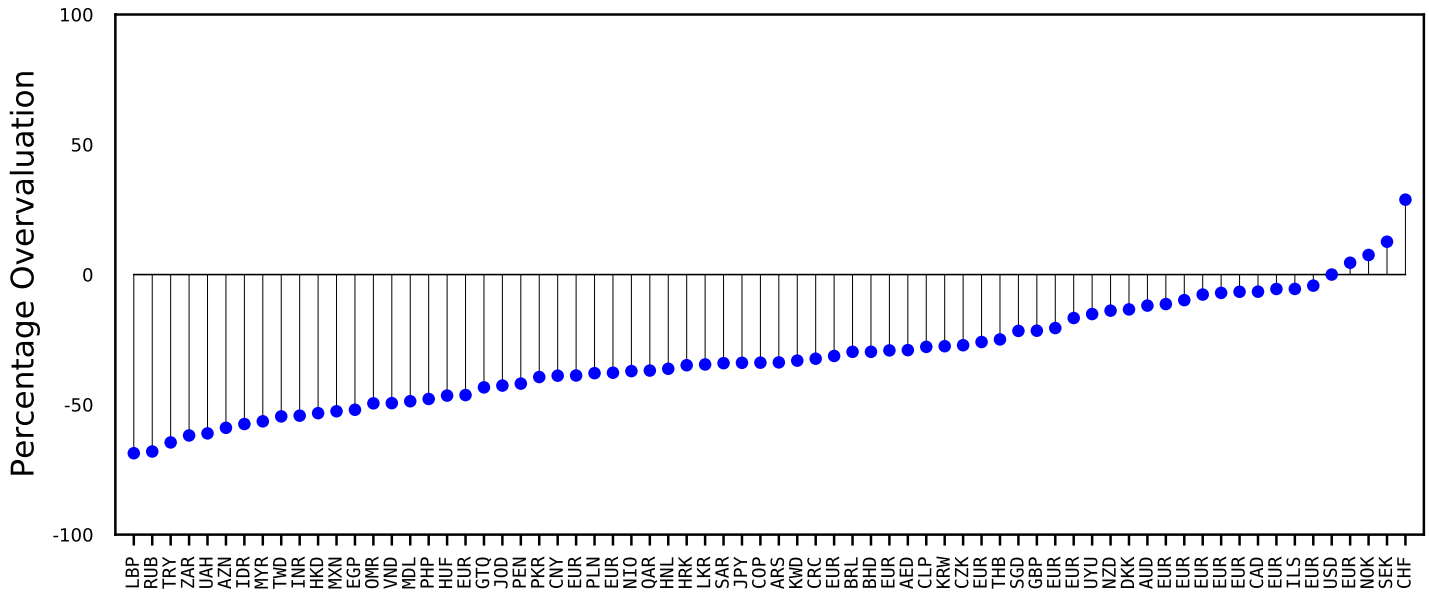
Using real exchange rate:

- q = EP*/P = 0.90 * 5.79 / 7.20 = 0.72
- overvaluation = $1/q - 1 = 1/0.72 - 1 \approx 0.3233$

*Logarithmic approximation*

- overvaluation = -ln(q) = -ln(0.72) = 32.33%

# Law of One Price for Hamburgers? (2021)




Data Source:

https://github.com/TheEconomist/big-mac-data

Additional information:

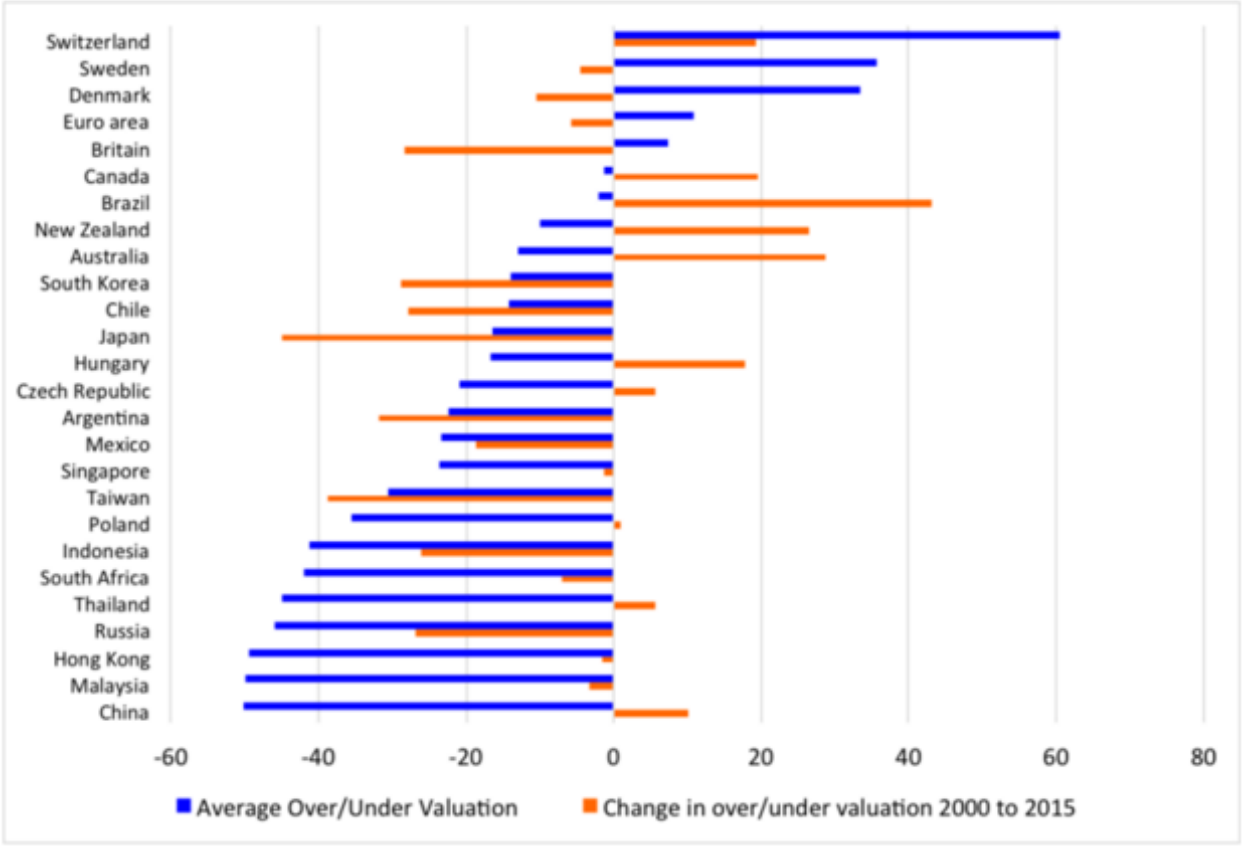
https://www.economist.com/big-mac-index

# China (CNY) 2022 Example:

Interactive chart from The Economist:
https://www.economist.com/big-mac-index
Note the autocorrelation in deviations.

# Big Mac vs PPP: Persistent Deviations

Big Mac Index: Percent of under- and over-valuation of currencies relative to the U.S. dollar, 2000–2015




Source: http://www.moneyandbanking.com/commentary/2015/2/2/a-big-mac-update

Data Source: The Economist

# Penn Effect

**Naive GDP comparison:** relative GDP = E GDP* / GDP

**Penn effect:** naive comparisons systematically exaggerate real per capita income ratios between poor and rich

**Empirics** Penn studies of Kravis-Heston-Summers real-income estimates, using actual local prices and incomes

**Theory** Balassa (1964) and Samuelson (1964)
Also: David Ricardo and Roy Harrod

# Paul Samuelson (1915-2009)

**1941** PhD from Harvard

**1947** *Foundations of Economic Analysis*

**1948** *Economics: An Introductory Analysis*

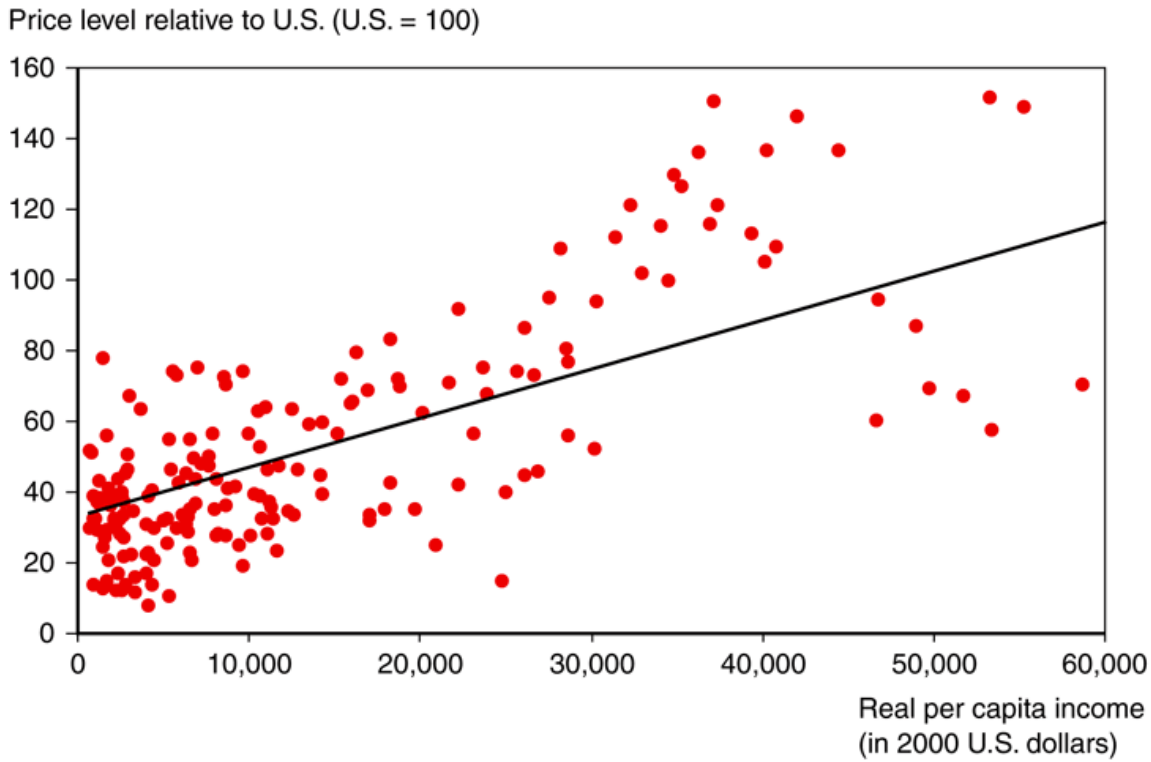
**1970** "Nobel" prize

**1973** famous prediction (in his textbook): the Soviet Union will catch up to the United States in per capita income by 1990

# Balassa-Samuelson Critique

- Price indices contain traded and nontraded goods
  - $P = f[P_t, P_{nt}]$
- Shifts in relative price can disrupt PPP
  - Ricardo (1817): high manufacturing productivity $\rightarrow$ costly nontraded goods
  - Samuelson (1964)
- disparate postwar growth rates
- income growth correlated with traded goods productivity
  - Dollar should look overvalued against low growth countries
- even if $P_t = EP_t^*$

# Price Levels and Real Incomes, 2004




Source: KOM Figure 16-3

Data Source: Penn World Table, Mark 6.2

# Penn World Table

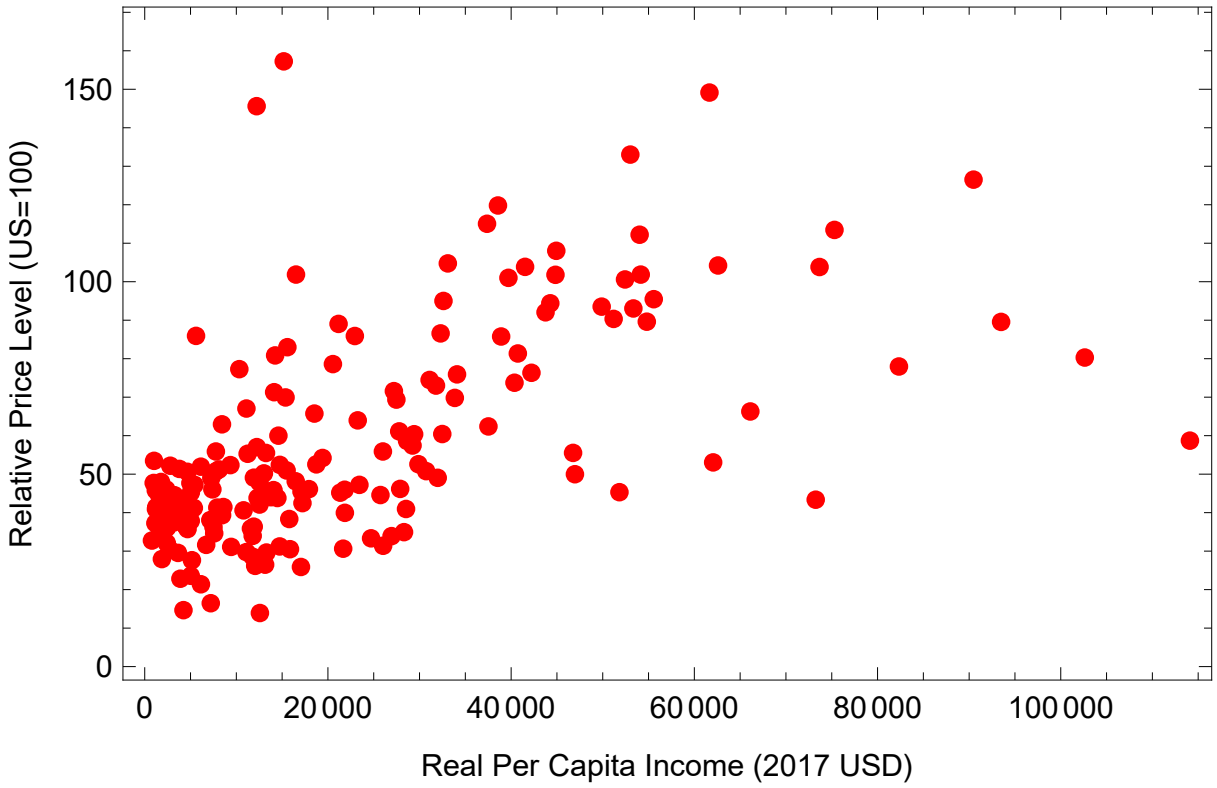
**PWT:**

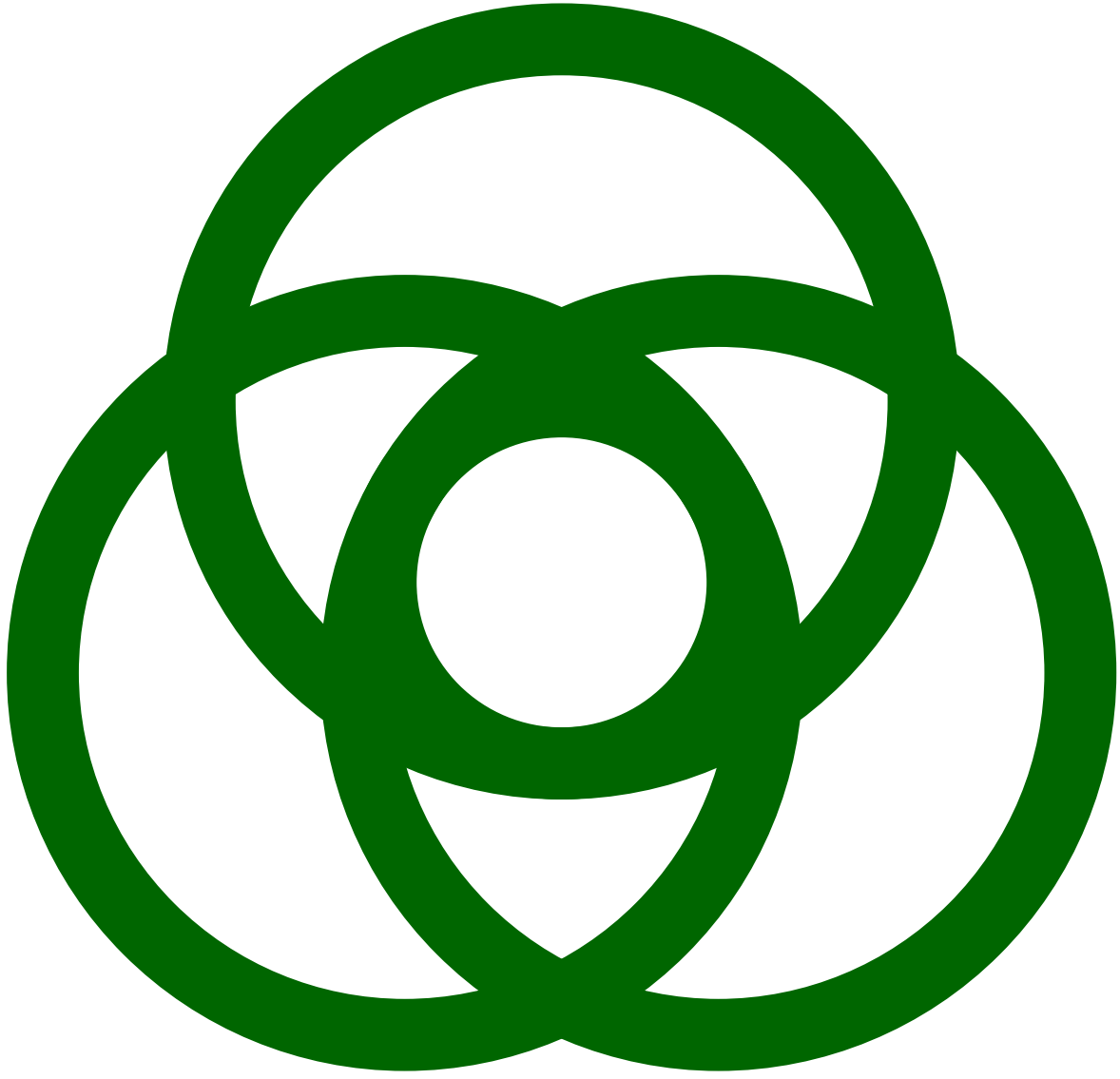
- an international database covering 183 countries since 1950
- information on relative levels of income, output, input and productivity
- Access to the data at https://www.rug.nl/ggdc/productivity/pwt/

Just download the Excel file and use it!
Variable documentation:

- CRAN is easiest/fastest: https://cran.r-project.org/web/packages/pwt10/pwt10.pdf

# Price Levels and Real Incomes, 2019





# Endogenous LR Real Exchange Rate

**PPP (absolute or relative):** a constant real exchange rate

$\rightarrow E = qP/P^*$ (with $q$ constant)

$\rightarrow \Delta$ relative price level determines $\Delta E$

$$\%\Delta E = \%\Delta(P/P^*)$$

A more general story tries to explain changes in the real exchange rate.

**Beyond PPP (absolute or relative):** endogenous LR real exchange rate

$$\%\Delta E = \%\Delta q + \%\Delta(P/P^*)$$

$$\widehat{E} = \widehat{q} + \widehat{(P/P^*)}$$

Now movements in nominal exchange rate then have two sources:

- changes in relative price levels
- changes in LR real exchange rate

# Determination of the Long-Run Real Exchange Rate

LR output ($Y$ and $Y^*$) depends on:

- factors of production
- technology.

LR demand (AD and AD*) depends on:

- the **relative** price of foreign products ($q = EP^*/P$)
- Relative prices determine the demand for domestic products **relative** to foreign products.
- when the real exchange rate depreciates, the relative demand for domestic commodities rises.

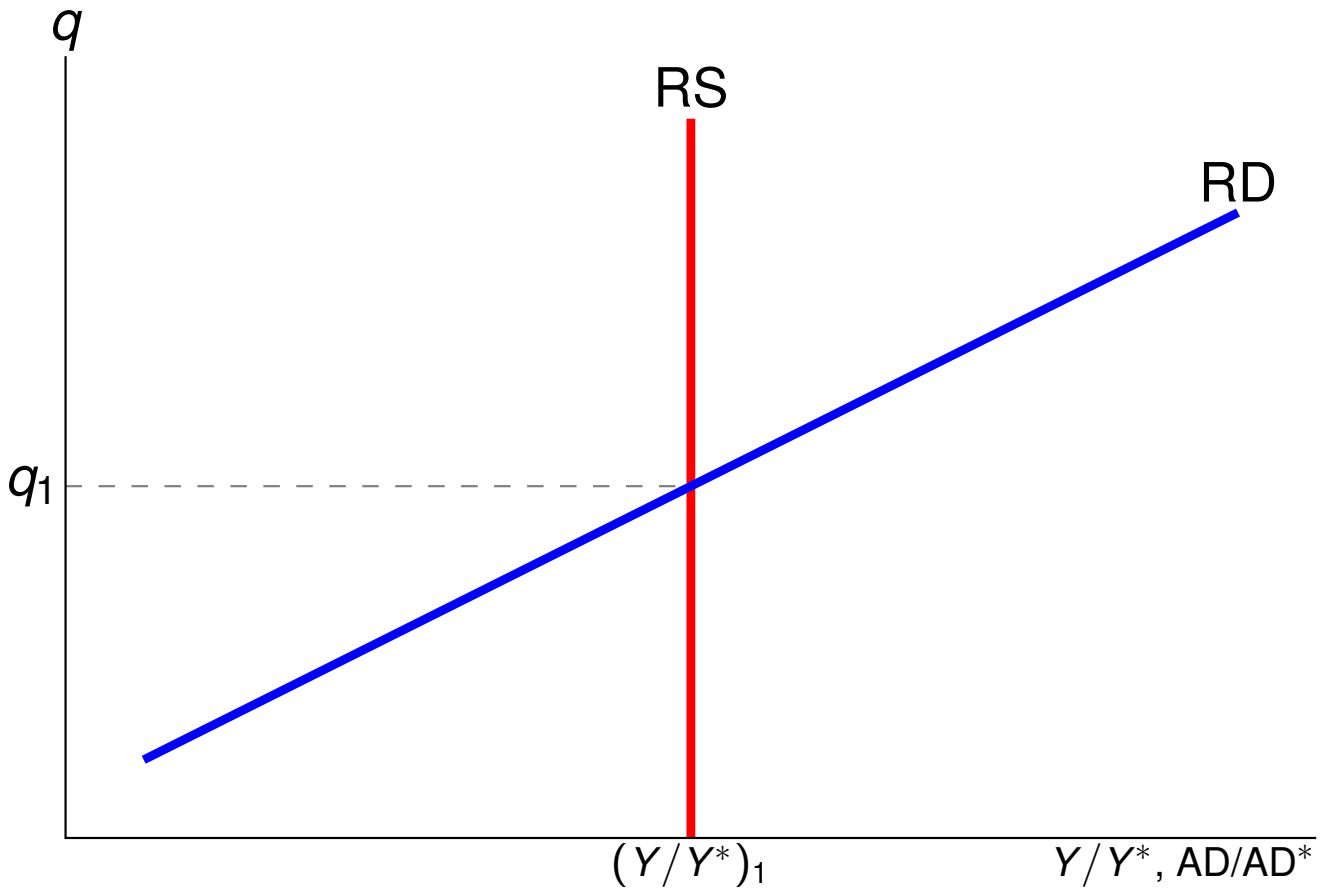
**Note:** Relative demand depends on relative prices (i.e., on prices or exchange rates), but relative output does not.

# LR Equilibrium Real Exchange Rate

**LR Equilibrium:** relative supply matches the relative demand (so there is no tendency for the relative price to change).

$$Y/Y^* = \mathrm{AD}/\mathrm{AD}^*$$

# Determination of the Long-Run Real Exchange Rate



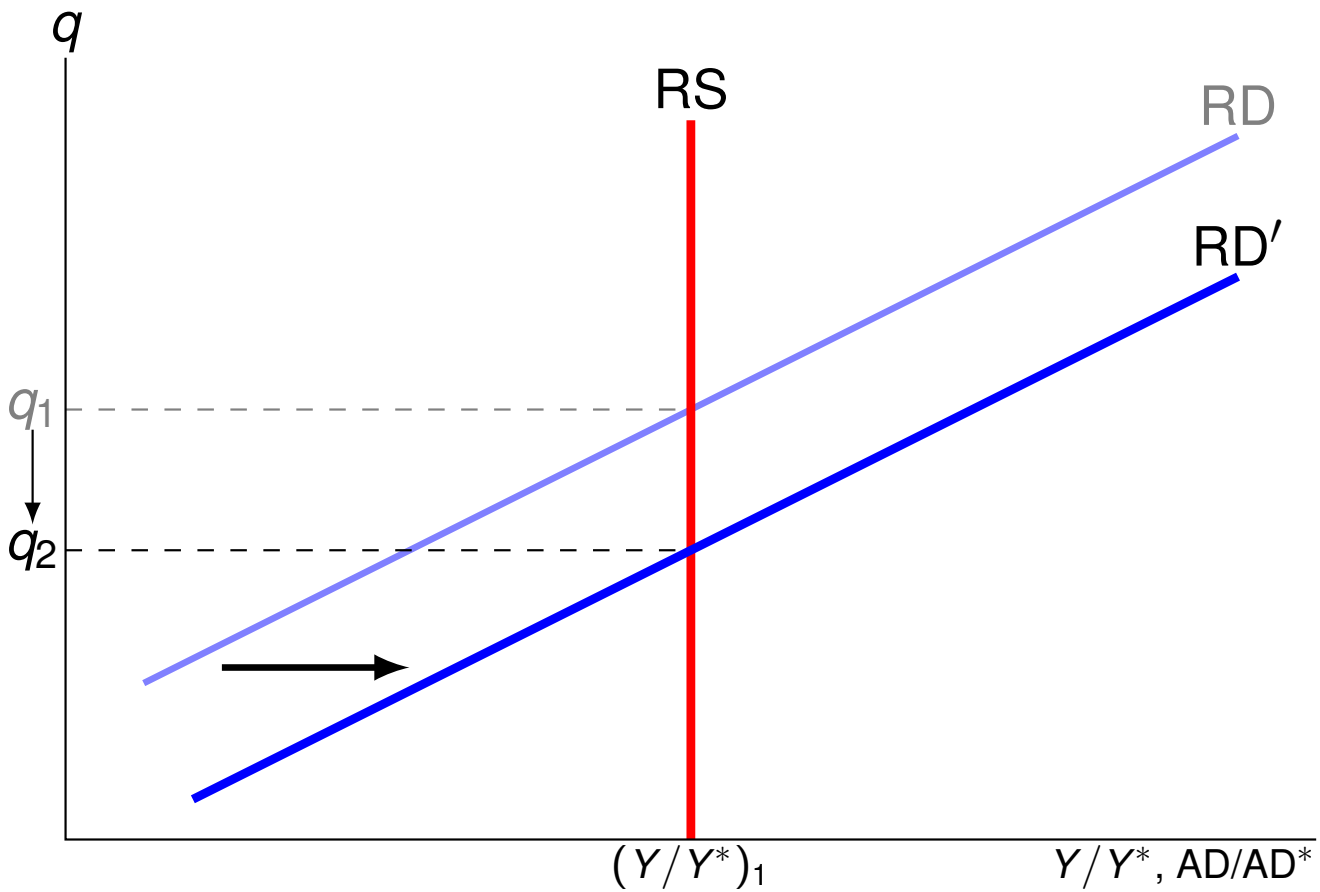

Compare KOMIE 16-4 (KOMIF Fig 5-4).

# Demand Shocks and LRRER

**Situation:** an increase in relative demand for domestic products

- ($\uparrow$Ex or $\downarrow$Im) $\rightarrow \downarrow$q
  - a real appreciation of the domestic currency
  - this is a rise in the price of domestic goods (P) relative to the price of foreign goods (EP*)
- real appreciation makes our exports more expensive and our imports less expensive
  $\rightarrow \downarrow$ relative demand
  $\rightarrow$ restoring equilibrium

# Demand Shocks and LRRER

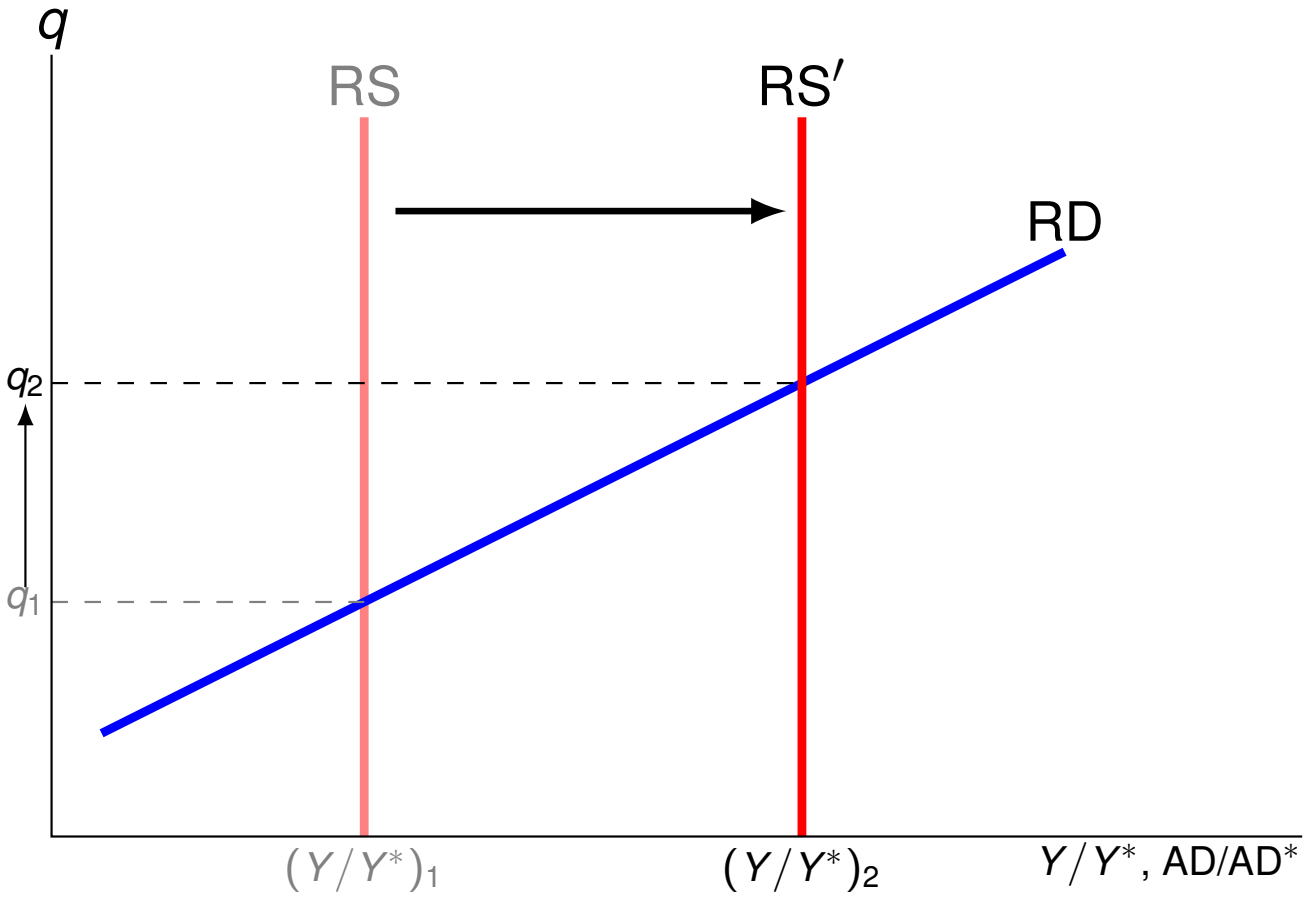


# Supply Shocks and LR RER

**Situation:** an increase in relative supply of domestic US products

- ($\uparrow$Y or $\downarrow$Y*) $\rightarrow \uparrow$q
  - a real depreciation of the domestic currency
  - this is a rise in the price of foreign goods (EP*) relative to the price of domestic goods (P)
- real depreciation makes our exports less expensive and our imports more expensive
  $\rightarrow \uparrow$ relative demand
  $\rightarrow$ restoring equilibrium

# Supply Shocks and LRRER



# The LR RER (Summary)

**Endogenizing the real exchange rate**

- produces a more general model of exchange rate determination

**The monetary approach still applies:**

- increases in monetary levels leading to price level increases.
- increases in monetary growth rates lead to persistent inflation (and corresponding changes in expectations).

**But now real factors also matter:**

- increases in relative demand for domestic products leads to a real appreciation.
- increases in relative supply of domestic products leads to a real depreciation.

# Nominal Exchange Rate Determination Redux

How does this change our theory of nominal exchange rate determination?

$E = q P / P^*$

**Monetary shocks**

- PPP still holds
- we have the same predictions as before.
- no changes in the real exchange rate

**Real demand shocks**

- the real exchange rate changes ($\uparrow AD \rightarrow \downarrow q$)
- the nominal exchange rate adjusts to produce the equilibrium real exchange rate

**Real output shocks**

- the real exchange rate changes ($\uparrow Y \rightarrow \uparrow q$)
- the nominal exchange rate situation is more complex. . .

# The Real Exchange Rate Approach to Exchange Rates (cont.)

- With an increase in the relative supply of domestic products, the real exchange rate adjusts to make the price/cost of domestic goods depreciate, but also the relative amount of domestic output increases. - This second effect increases the demand of real monetary assets in the domestic economy:

  $P = M / L(R,Y)$

  - Thus level of average domestic prices is predicted to decrease relative to the level of average foreign prices.
  - The effect on the nominal exchange rate is ambiguous:

    $E = q\ P / P^*$

# LR Model Summary: Effects of Money Market and Output Market Changes on E

- $\uparrow$ M $\rightarrow$ proportional $\uparrow$E
- $\uparrow$ M* $\rightarrow$ proportional $\downarrow$E
- $\uparrow$ AD $\rightarrow$ $\downarrow$ E
- $\uparrow$ AD* $\rightarrow$ $\uparrow$ E
- $\uparrow$ Y $\rightarrow$ ? E
- $\uparrow$ Y* $\rightarrow$ ? E

Compare KOMIF Table 16-1 (KOMIE 16-1)

# Summary

*The law of one price:*

- the same good in different competitive markets must sell for the same price
- (Assume: transportation costs and barriers between markets are not important.)

*Purchasing power parity:*

**Absolute PPP:**

- the law of one price for price indexes
- changing currencies does not change your purchasing power.

**Relative PPP** the nominal exchange rate moves with relative price levels

# Summary (cont.)

monetary approach to flexible exchange rates:

- assumes PPP and the Classical theory of prices
- Changes in the growth rate of the money supply influence inflation and exchange rates.
- Expectations about inflation influence the exchange rate.
- The Fisher effect shows that differences in nominal interest rates are equal to differences in inflation rates.

*Empirical support for PPP:*

**Weak in the short run,** due to trade barriers, non-tradable products, imperfect competition and differences in price measures.

**Stronger in the LR,** for relative PPP

# Summary: Real Interest Parity

**Real interest rate:** inflation-adjusted interest rate
(how much **purchasing power** savers gain and borrowers give up)

**Real interest parity:** says that real interest rate differential equals expected rate of real exchange rate depreciation
should hold under expected PPP

# Summary (cont.)

**real exchange rate:** the domestic product cost of foreign products.

*real exchange rate approach to exchange rates (RS-RD):*

- predicts that changes in relative demand and relative supply of products influence real and nominal exchange rates.
- generalizes the monetary approach (allows PPP violations)
- threfore, may allow deviations from real interest parity (since real interest rate differences equal the expected change in the real exchange rate)