The Mundell-Fleming Model

How international capital mobility alters
the effects of macroeconomic policy

Lecture 13:

Mundell-Fleming model with a fixed exchange rate

- Fiscal expansion
- Monetary expansion
- Automatic mechanisms of adjustment

Lecture 15: Practical policymaking problems

Lecture 16:

Mundell-Fleming model with a floating exchange rate

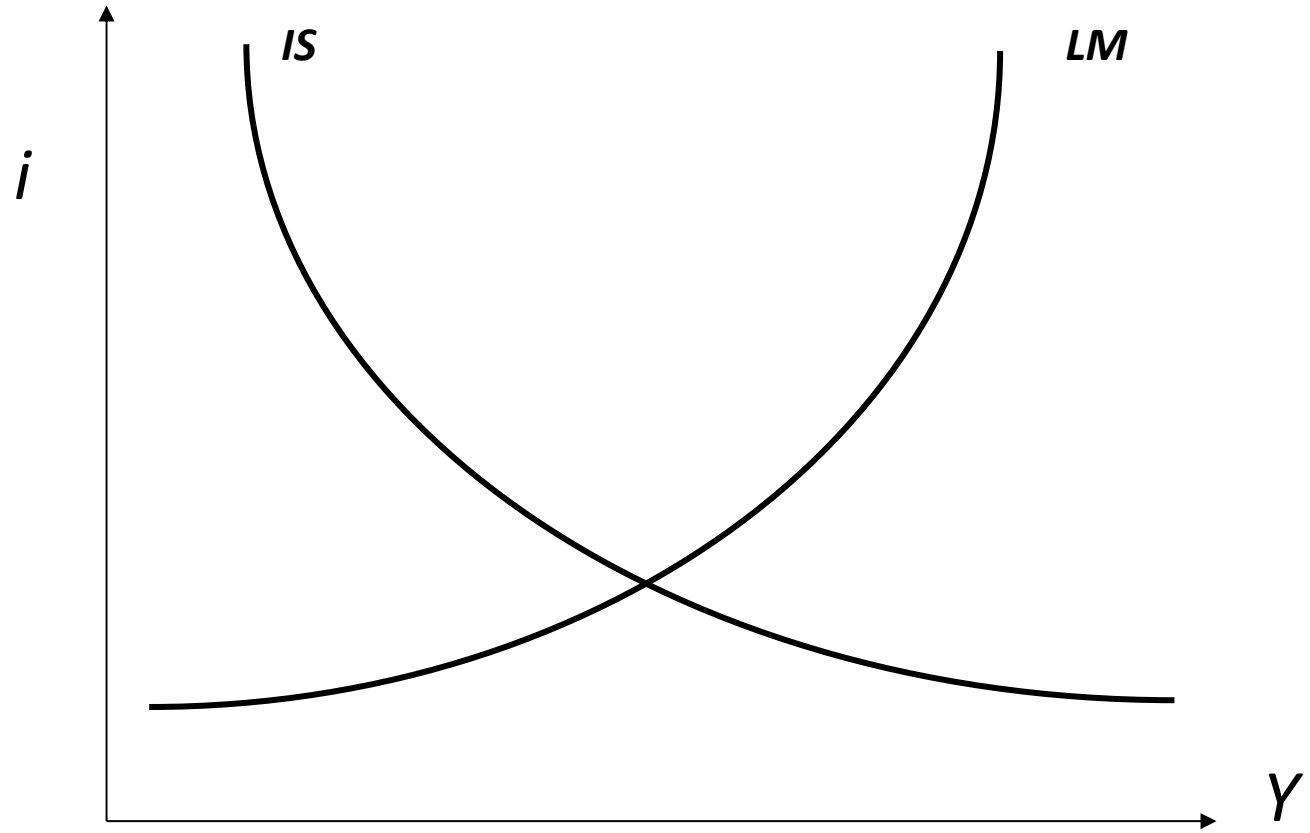
Lecture 17:

Mundell-Fleming model with perfect capital mobility

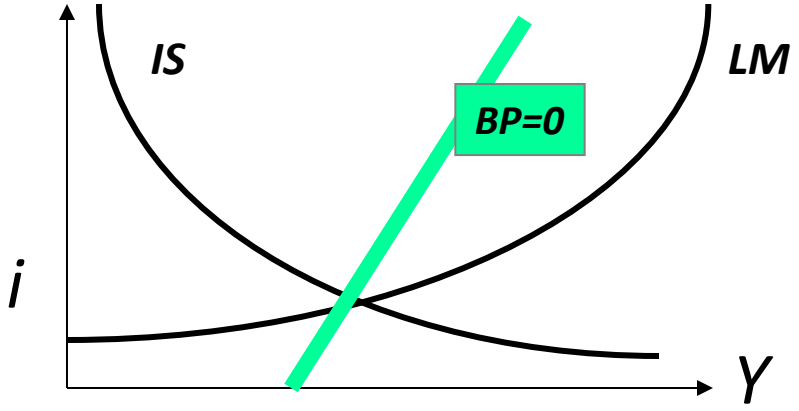
The Mundell-Fleming equations with a fixed exchange rate

IS: $Y = \frac{\bar{A} - bi + \bar{X} - \bar{M}}{s+m}$

LM: $\frac{\overline{M1}}{\bar{P}} = L(i, Y)$



The Mundell-Fleming equations with a fixed exchange rate, continued



$$BP = TB + KA$$

$$TB = \bar{X} - \bar{M} - mY$$

New addition: capital flows respond to interest rate differential

$$KA = \overline{KA} + \kappa\,(i - i*)$$

$$BP{=}0: \quad \bar{X} - \bar{M} - mY + \overline{KA} + \kappa\,(i - i*) = 0$$

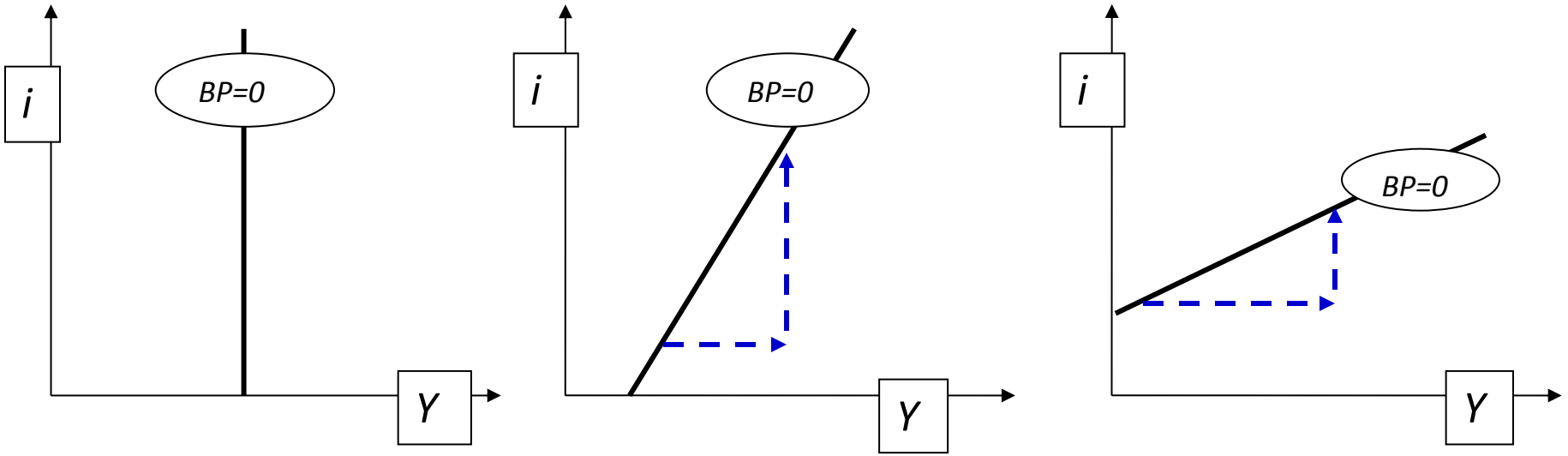
Solve for interest differential:

$$(i\text{-}i^*) = \left(\frac{1}{\kappa}\right)[(-\overline{KA} - (\bar{X} - \bar{M})] + \left(\frac{m}{\kappa}\right)Y.$$

$$BP{=}0: \qquad (i\text{-}i^*) \;=\; \left(\frac{1}{\kappa}\right)\left[\left(-\overline{KA} - (\bar{X}-\bar{M})\right)\right] \;+\; \left(\frac{m}{\kappa}\right) Y \,.$$

The slope is (m/κ).

$\kappa = 0$ $\qquad$ $\kappa > 0$ $\qquad$ $\kappa >> 0$



Capital mobility gives some slope to the *BP=0* line:.

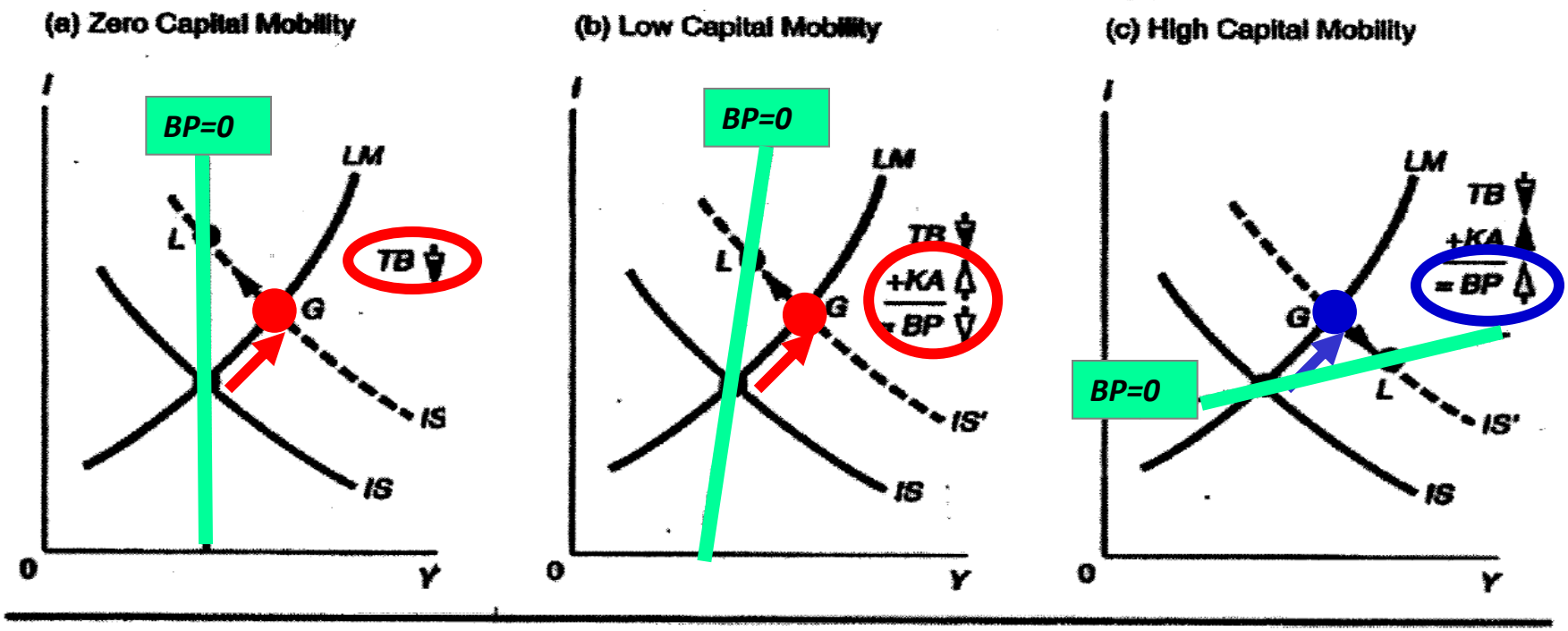
A rise in income and the trade deficit is consistent with *BP=0* …

***if* higher interest rates attract a big enough capital inflow.**

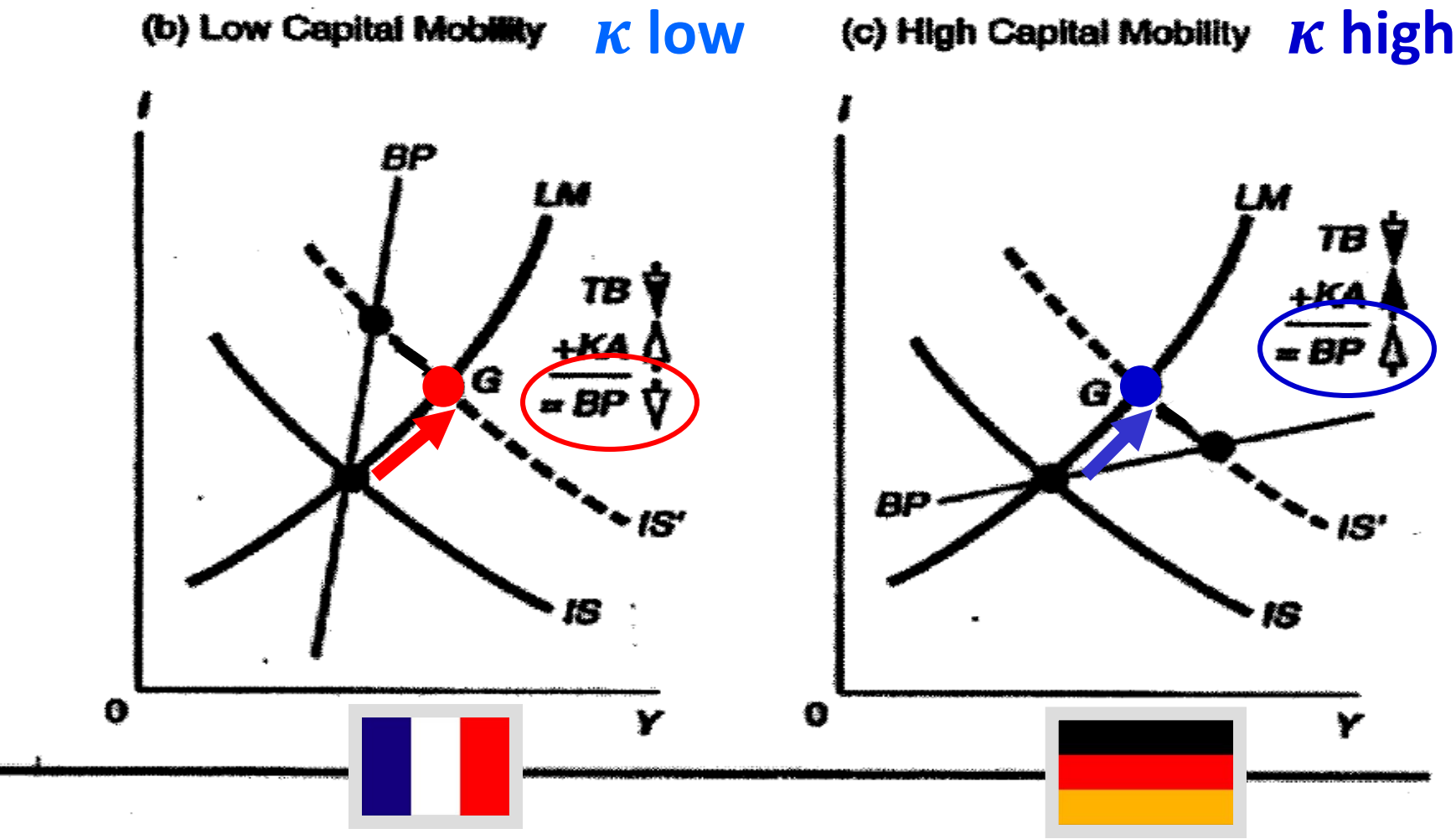
FIGURE 23.2 FISCAL EXPANSION UNDER FIXED EXCHANGE RATES

(a) Regardless of the degree of capital mobility, a fiscal expansion shifts the IS curve out, raising Y and i at G and worsening the TB. If capital mobility is low (b), then the capital inflow, KA, is smaller than the trade deficit and the overall BP is negative. If it is high (c), then KA is larger than the trade deficit and BP is positive.

$\kappa = 0$ $\kappa > 0$ $\kappa >> 0$



Experiment: Fiscal expansion. The capital inflow is either less than enough to give a surplus in the overall balance of payments, or *more* than enough, depending on the degree of capital mobility.



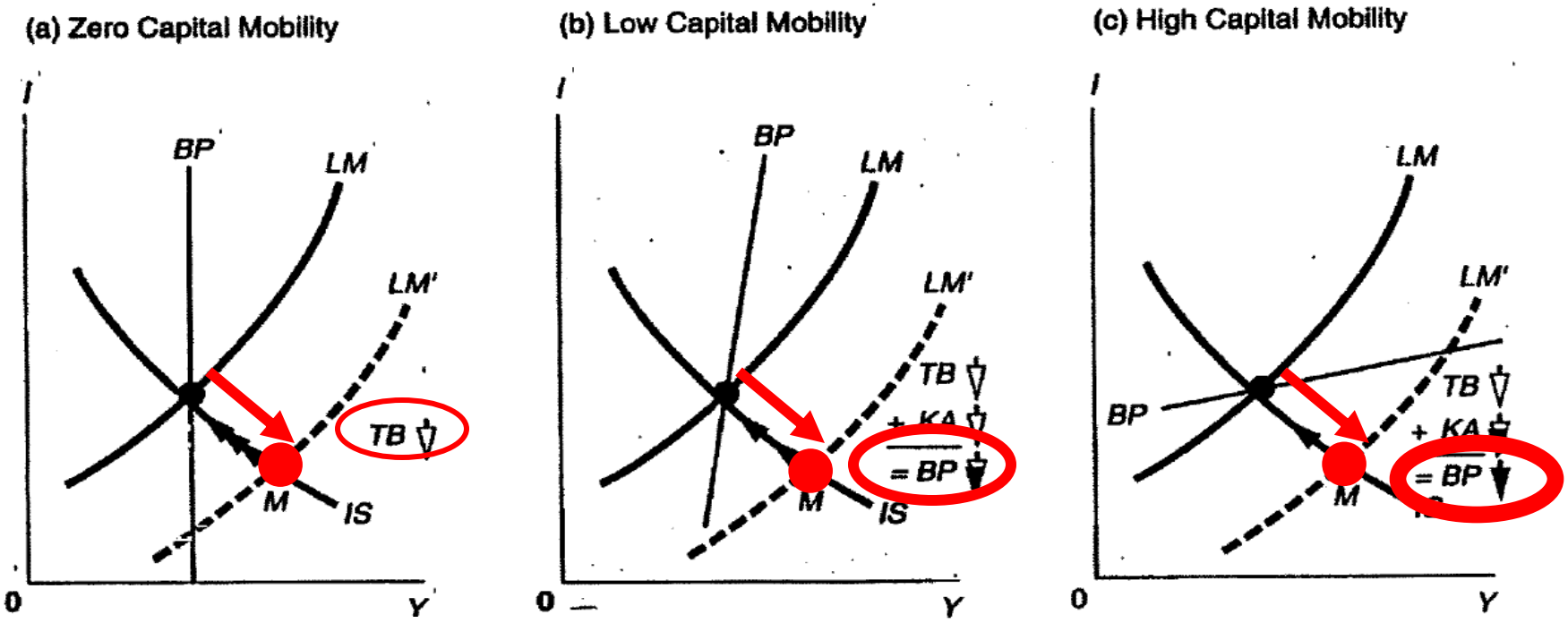
Example: France 1981.
The Mitterrand fiscal expansion did not attract enough capital inflow to finance fully the TD.

Example: Germany, 1990-91.
The Unification fiscal expansion attracted more than enough capital inflow to finance TD.

FIGURE 22.3 MONETARY EXPANSION UNDER FIXED EXCHANGE RATES

(a) Regardless of the degree of capital mobility, a monetary expansion shifts the LM curve out, lowering i and raising Y at M, and worsening the TB. (b) With low capital mobility, an outflow through the KA supplements the trade deficit, so that the overall BP deficit and speed of reserve outflow are greater. (c) With high capital mobility, the speed of reserve outflow is greater still.

$\kappa = 0$ $\kappa > 0$ $\kappa >> 0$



Experiment: Monetary expansion

=>TB ↓

A capital outflow adds to BoP deficit.

The overall balance of payments deficit is bigger, the bigger is *k*.

Automatic mechanisms of adjustment

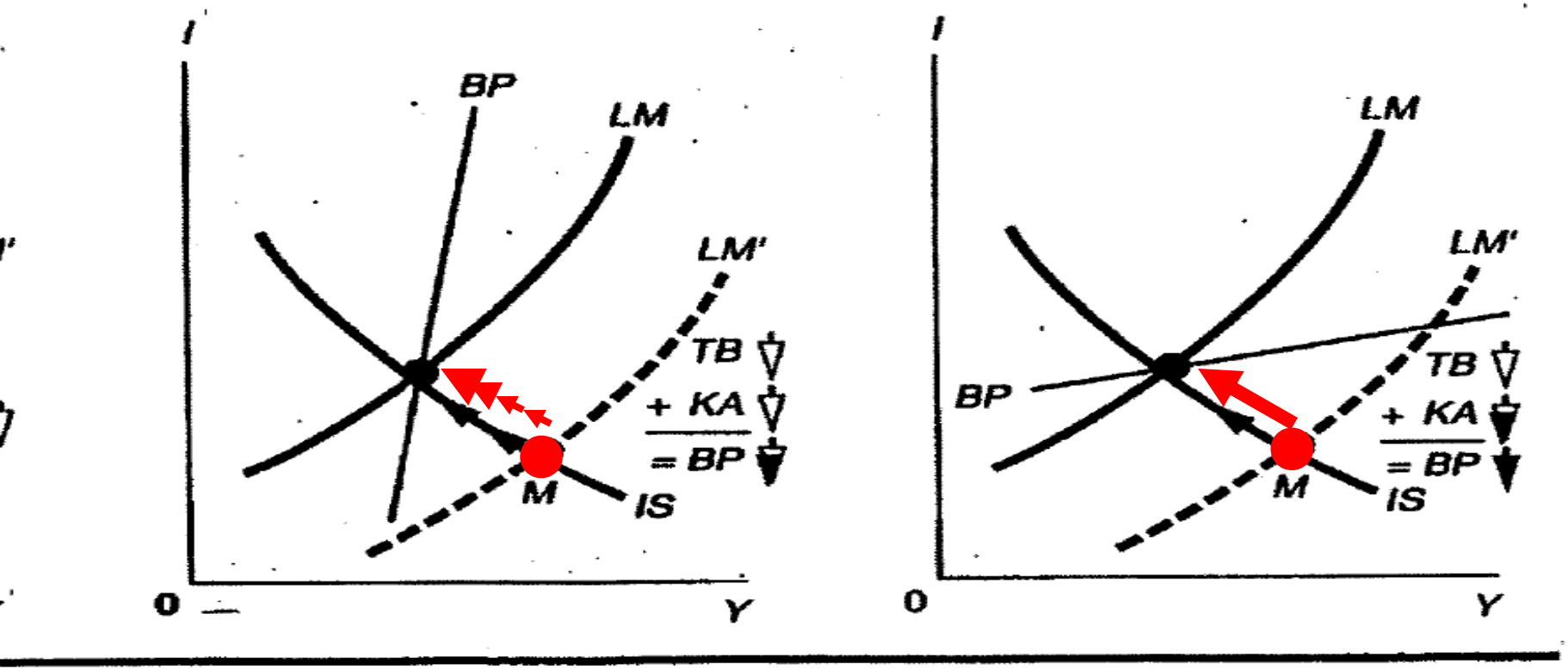
1. Money supply (via reserve flows)

2. Exchange rate (via demand for currency)

3. Price level (via excess demand for goods)

4. Indebtedness
   (via current account or budget deficit)

1st automatic mechanism of adjustment: Reserve flows (MABP)



If outflow is sterilized, economy remains at point ***M.***

If unsterilized, money flows out – – faster and faster as *k* is higher.

≡ "Offset" to monetary expansion.

A 2nd automatic mechanism of adjustment: Floating exchange rate

- If, at a given exchange rate, a country would have a BoP deficit, then under floating the currency depreciates.
  - Enhanced competitiveness (=> $\bar{X} \uparrow$) shifts *IS* & *BP=0* curves right.
  - Equilibrium occurs at:
    - a higher level of *Y*.
    - *BP*=0.
- If, at a given exchange rate, a country would have a BoP surplus, then under floating the currency appreciates.
  - Uncompetitiveness (=> $\bar{X} \downarrow$) shifts both the *IS* & *BP=0* curves left.
  - Equilibrium occurs at:
    - a lower level of *Y*.
    - *BP*=0.
- as we will see in Lecture 16.

Appendix:
Mundell-Fleming model illustrated by the example of BoP surpluses in Emerging Markets

- (1) Causes of surpluses
  - 1990-97
  - 2003-12
- (2) Alternative ways to manage inflows.

(1) Causes of BoP Surpluses in EM Countries

e.g., 1990-97

I. "Pull" Factors (internal causes)

1. Monetary stabilization => LM shifts up

2. Removal of capital controls => κ rises

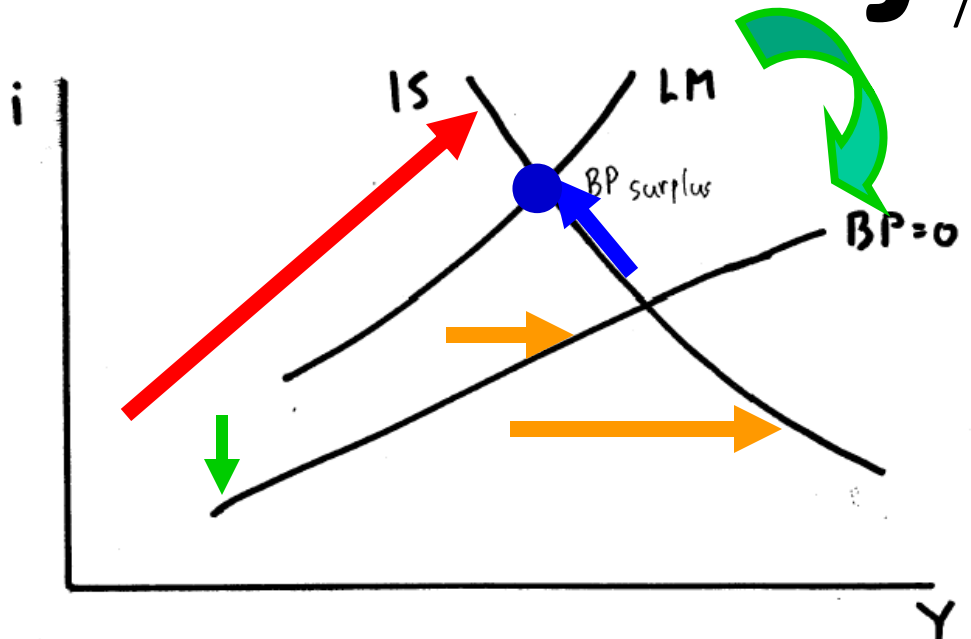
3. Spending boom => IS shifts out/up

II. "Push" Factors (external causes)

1. Low interest rates in rich countries => *i down =>**

2. Boom in export markets =>

} BP shifts down /out



Causes of BoP Surpluses in EM countries 2003-08 & 2010-12

- Strong economic performance (especially China & India)

-- IS shifts right.

- Easy monetary policy in US and other major industrialized countries (low *i*)*

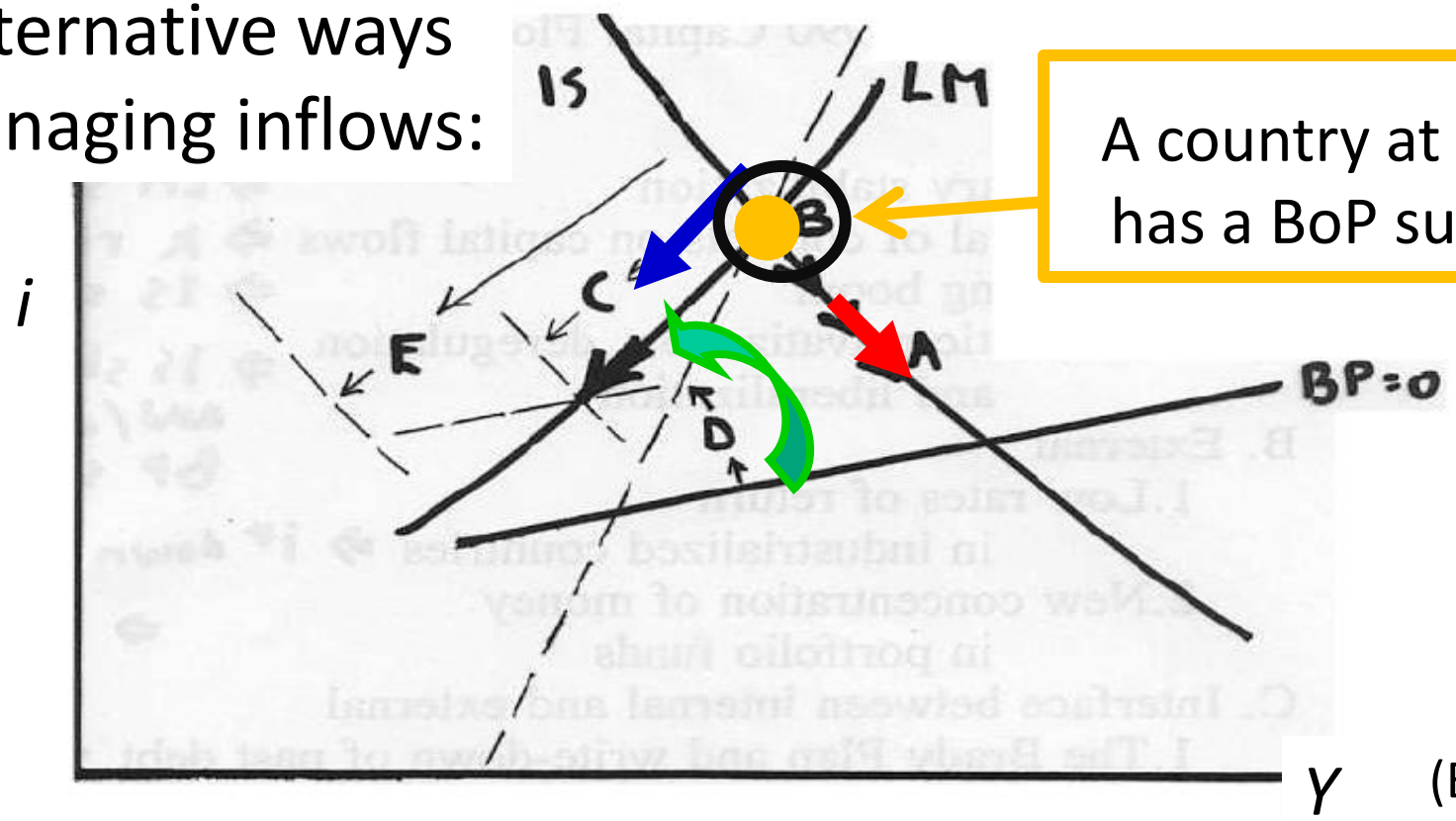
-- BP shifts down.

- Big boom in mineral & agricultural commodities (esp. Africa & Latin America)




-- BP shifts right.

(2) Alternative ways of managing inflows:



A country at point **B** has a BoP surplus.

A. Allow money to flow in (can be inflationary) ⇐ (Each way has a drawback.)

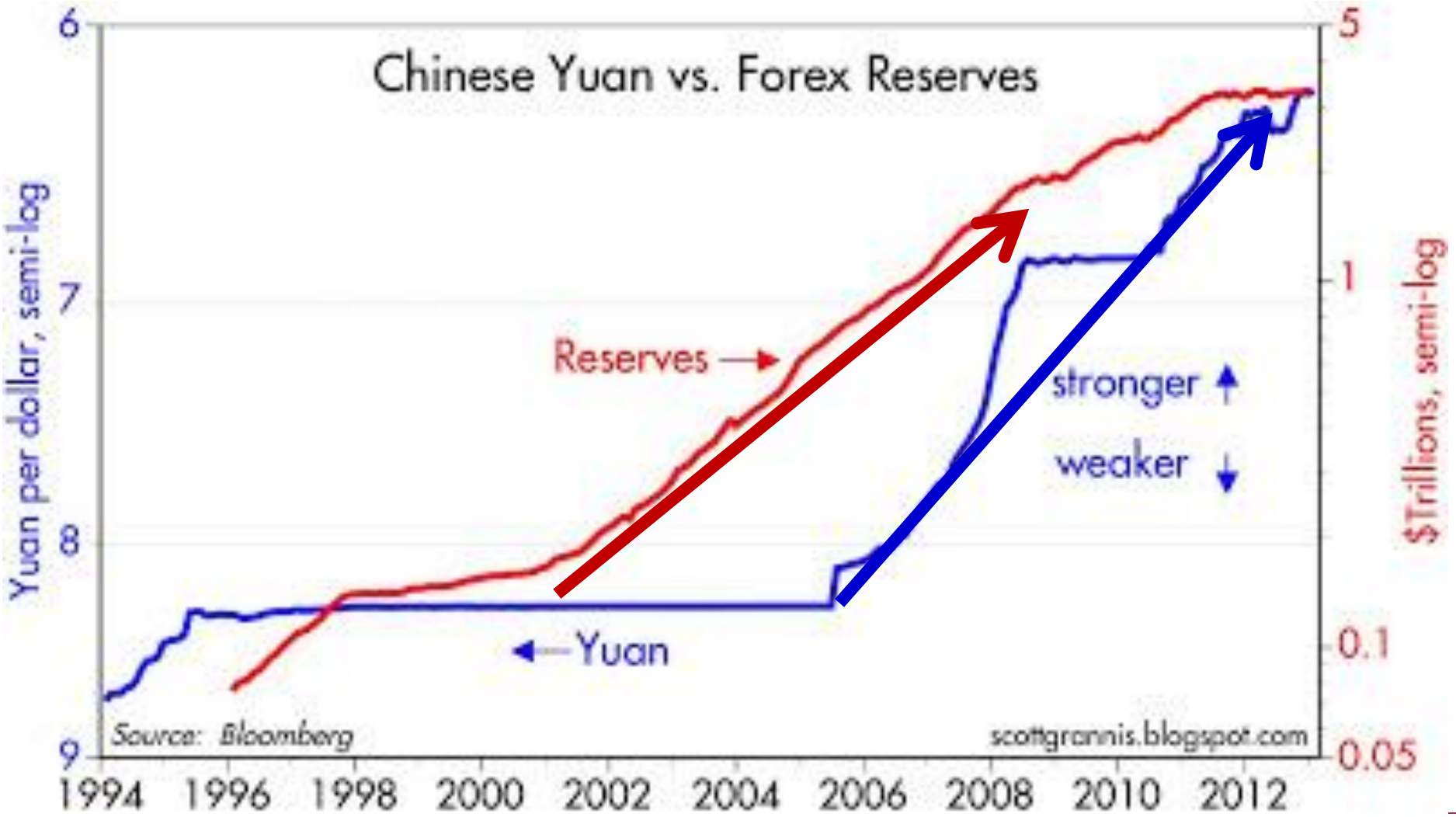
B. Sterilized intervention (can be difficult) ⇐

C. Allow currency to appreciate (lose competitiveness) ⇐

D. Reimpose capital controls (can impede efficiency) ⇐

China initially took its BoP surplus as fx reserves.

But it also allowed RMB appreciation (2006-12).



Lecture 15: Problems/Applications of discretionary policymaking

1. Targets & instruments revisited

2. Practical difficulties of policymaking

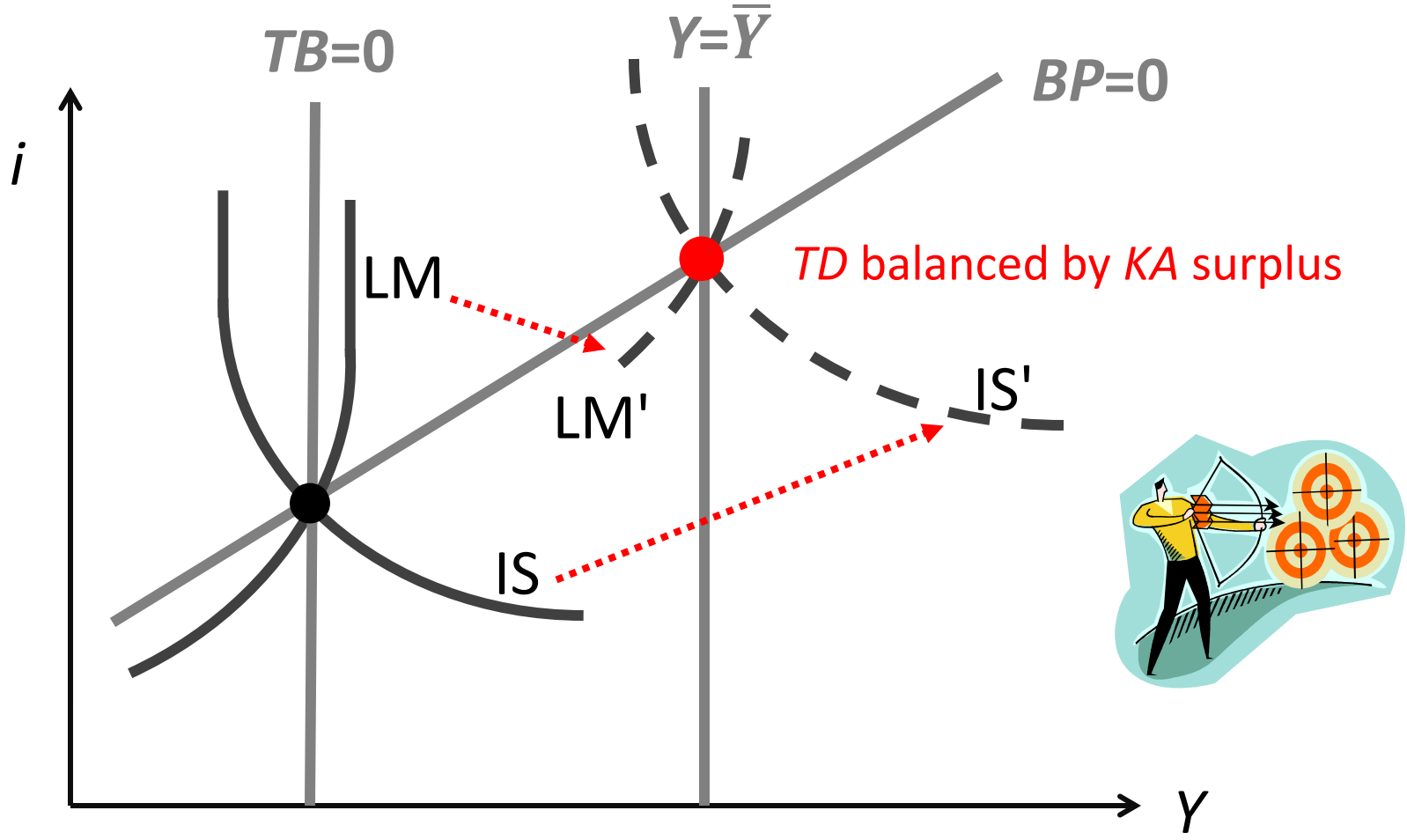
3. Zero Lower Bound

- Appendix: The case of China's inflows 2003-12

1. Targets & instruments revisited

- When we first showed the need to have as many independent policy instruments as goals, monetary & fiscal policy were not independent.
- Now, with capital mobility, they have somewhat independent effects on external balance, provided it is defined as *BP=0* (rather than just *TB=0*).
- The reason: they have opposite effect on capital flows, because they have opposite effects on interest rates.
- => Even with a fixed exchange rate, the proper combination of monetary & fiscal policy can attain internal & external balance at the same time.

In theory, there exists a precise mix of monetary & fiscal policy that will hit both internal balance and BP=0.



2. Practical difficulties of policymaking

Lags: between the change in a policy instrument and the response in the economy

Uncertainty with regard to:

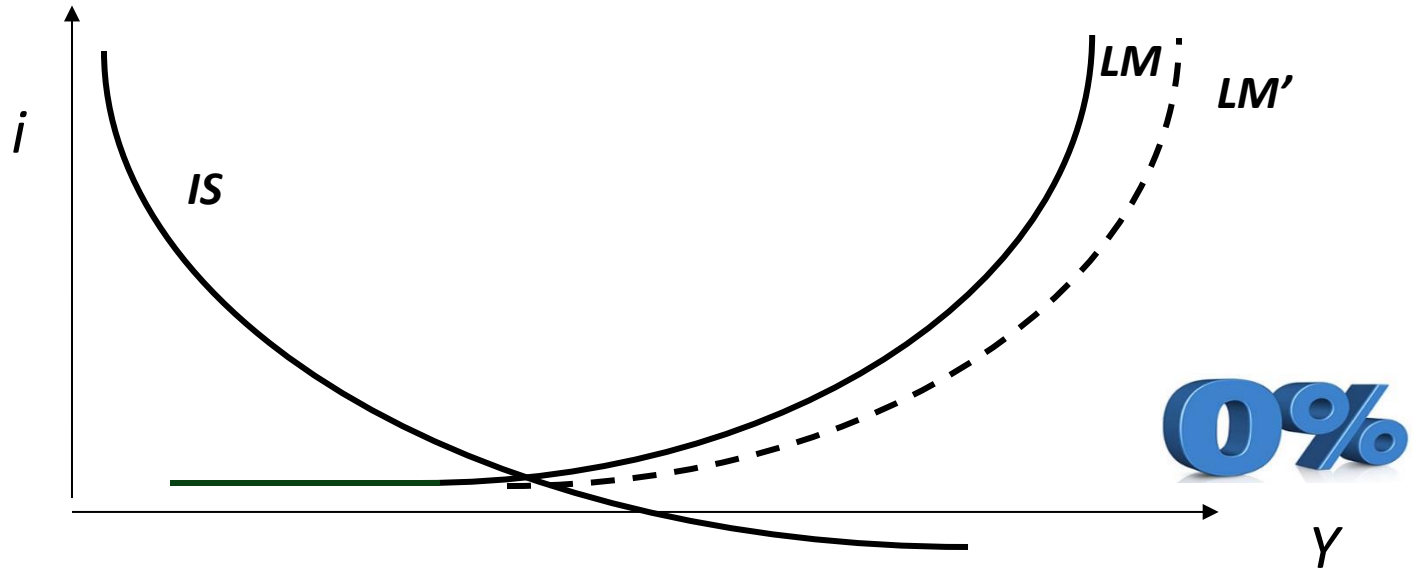
- the current position of the economy ("baseline");
- future disturbances ("shocks");
- the correct model (e.g., multipliers).

Expectations on the part of the public

Political Constraints

3. Liquidity trap or "Zero Lower Bound"

Does monetary policy lose effectiveness?



- ZLB: Increases in the money supply by the central bank are absorbed without further lowering *i* , the short-term rate.
  - E.g., Japan in late 1990s.
  - US, UK, ECB 2008-16.

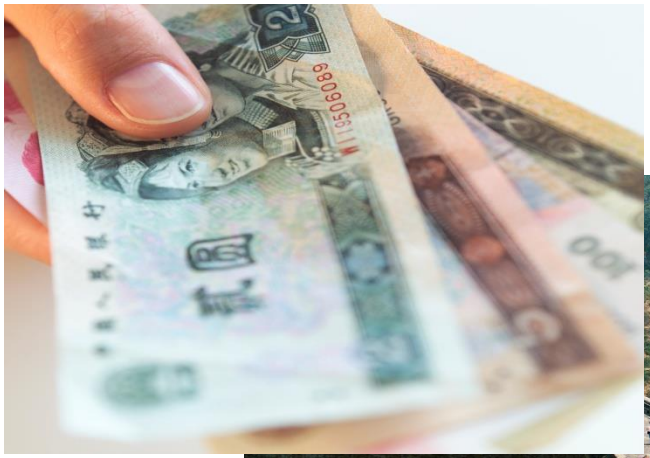
Liquidity trap or Zero Lower Bound, continued

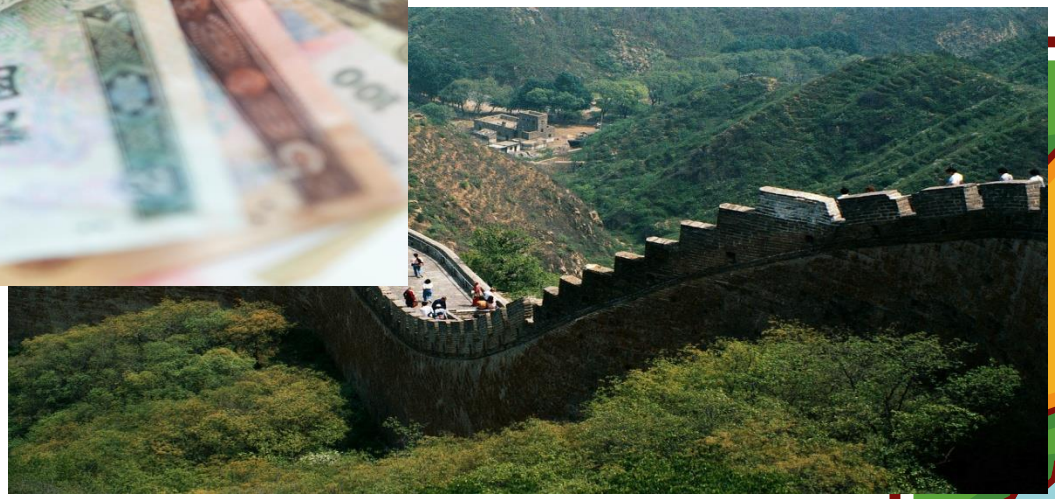
- But central banks can still have effects via other channels:
  - Exchange rate depreciation
  - Boosting asset prices:
    - equities & real estate
  - Raising expected inflation,
    - thus lowering the *real* interest rate
  - Lowering the *long-term* interest rate.

- Especially via some "unconventional" tools:
  - Quantitative Easing
  - Forward guidance.

End of Lecture 15:
Problems/Applications of discretionary policymaking

Appendix:
China's inflows, 2003-12,
including attempts to sterilize them, continued

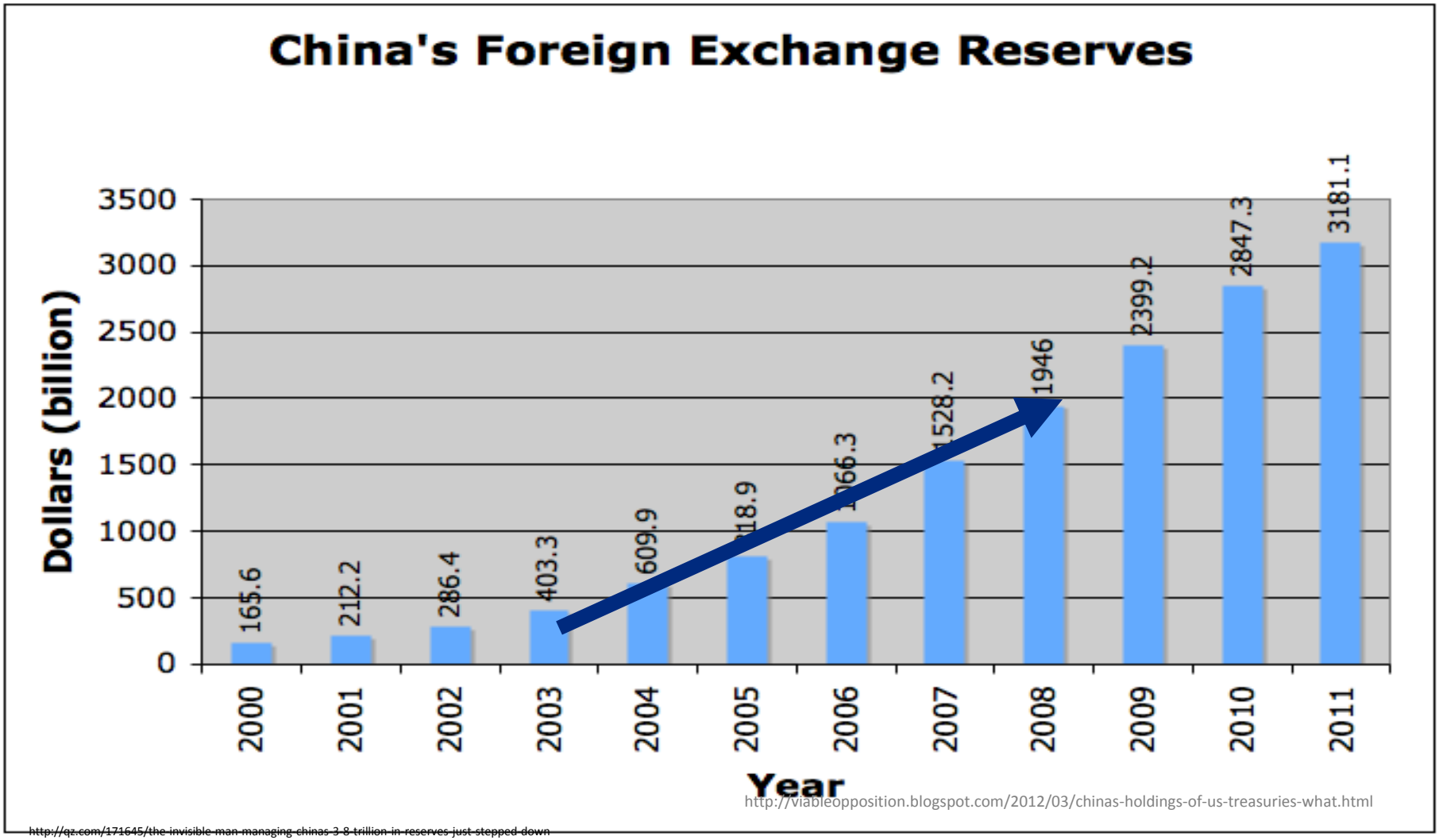




Recall that China ran large BoP surpluses after 2003.

=> R rising every year.

at an increasing rate.

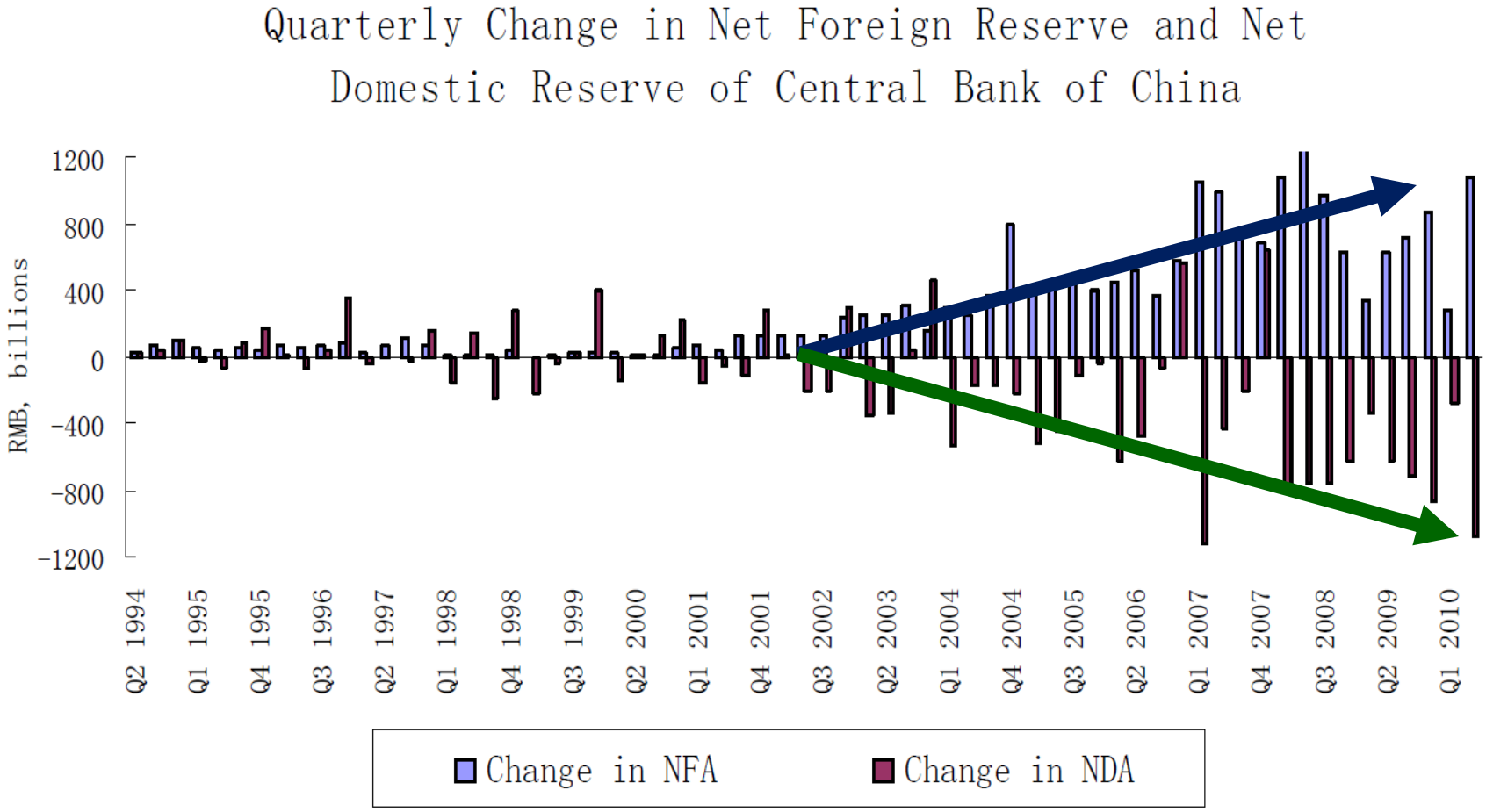


http://viableopposition.blogspot.com/2012/03/chinas-holdings-of-us-treasuries-what.html

http://qz.com/171645/the-invisible-man-managing-chinas-3-8-trillion-in-reserves-just-stepped-down

The People's Bank of China sold sterilization bills, taking cash RMB out of circulation (*dNDA/dt* < 0)

and so counteracted increases in Net Foreign Reserves.

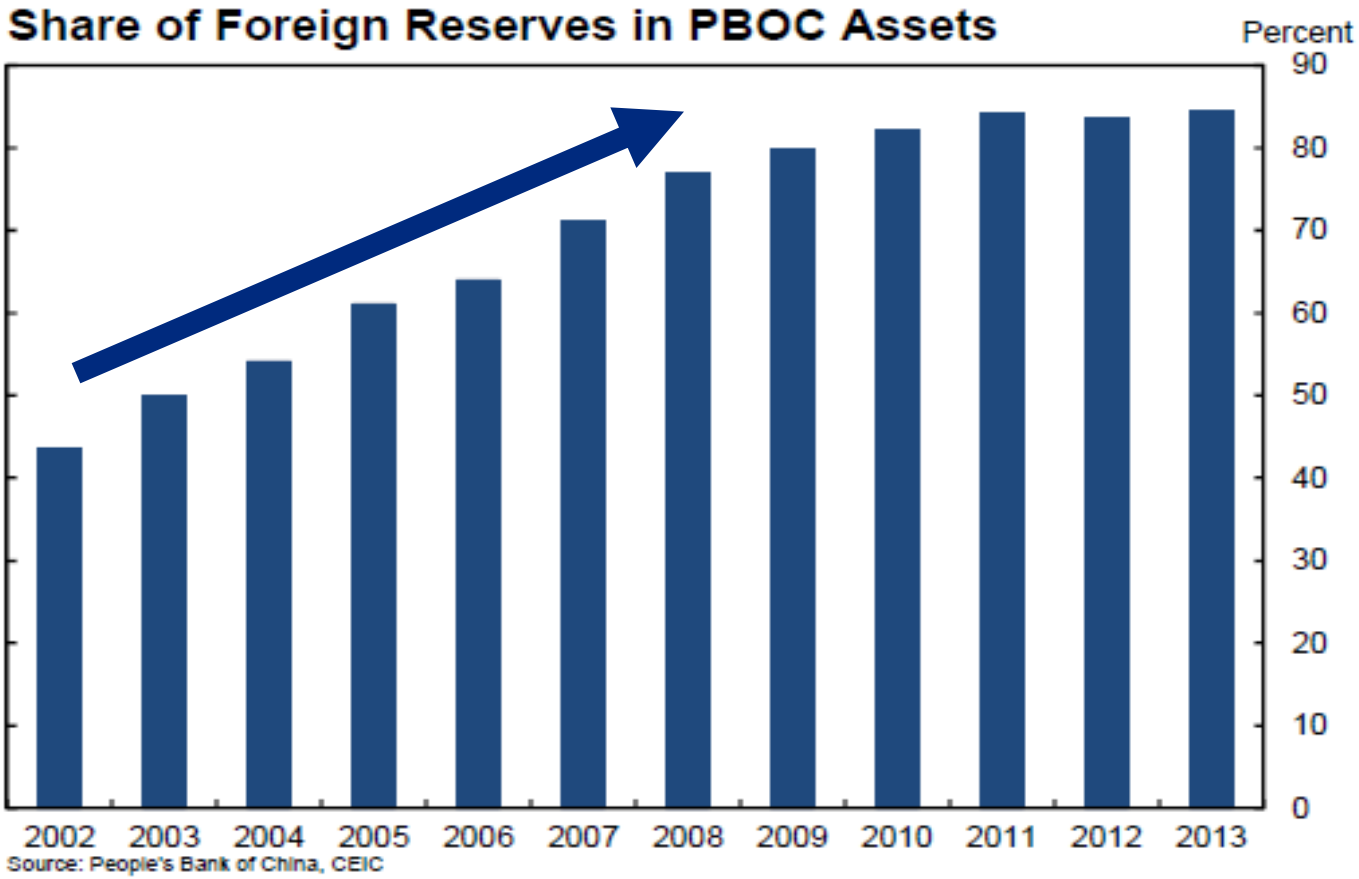


Source: Zhang, 2011, Fig. 1, p.47.

In 2007-08 China had more trouble sterilizing the reserve inflow than in 2004-06.

- PBoC began to have to pay higher domestic interest rates
  - and to receive lower interest rate on US T bills
  - => "quasi-fiscal deficit" or "negative carry."
- Inflation became a serious problem in 2007-08.
- Also a "bubble" in the Shanghai stock market.

The sterilization showed up as a steadily rising share of foreign reserves (vs. domestic assets) in the holdings of the People's Bank of China



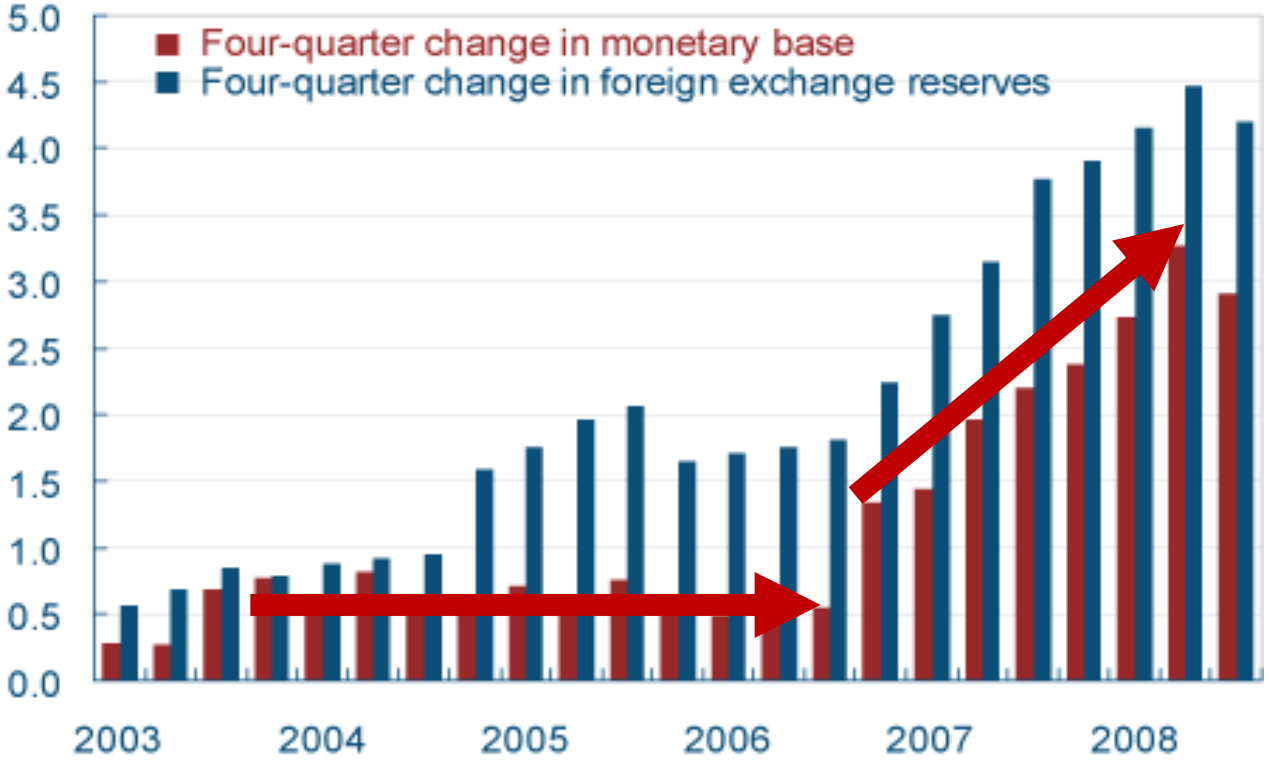
Chang, Liu & Spiegel, 2015, "Capital Controls and Optimal Chinese Monetary Policy" FRB SF WP 2012-13 Fig. 1, p.26

Sterilization eventually faltered:

Money accelerated sharply in 2007-08.

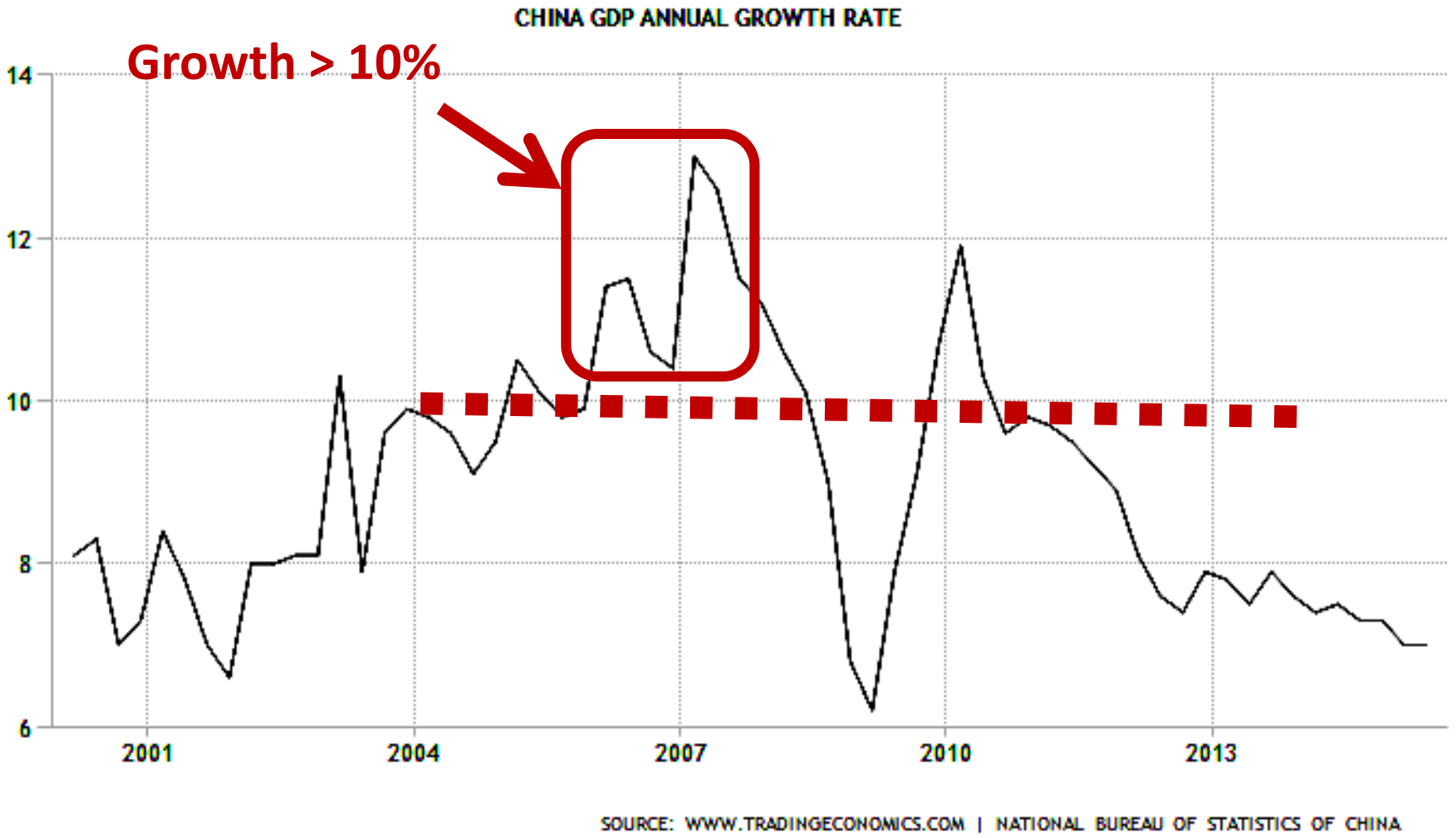
Sterilization of Reserve Flows

Trillions of renminbi



Source: International Monetary Fund, *International Financial Statistics*, January 2009.

Real growth > 10% in 2007-08



China's CPI accelerated in 2007-08.

China Consumer Price Inflation

Annual % change in prices, source: IMF

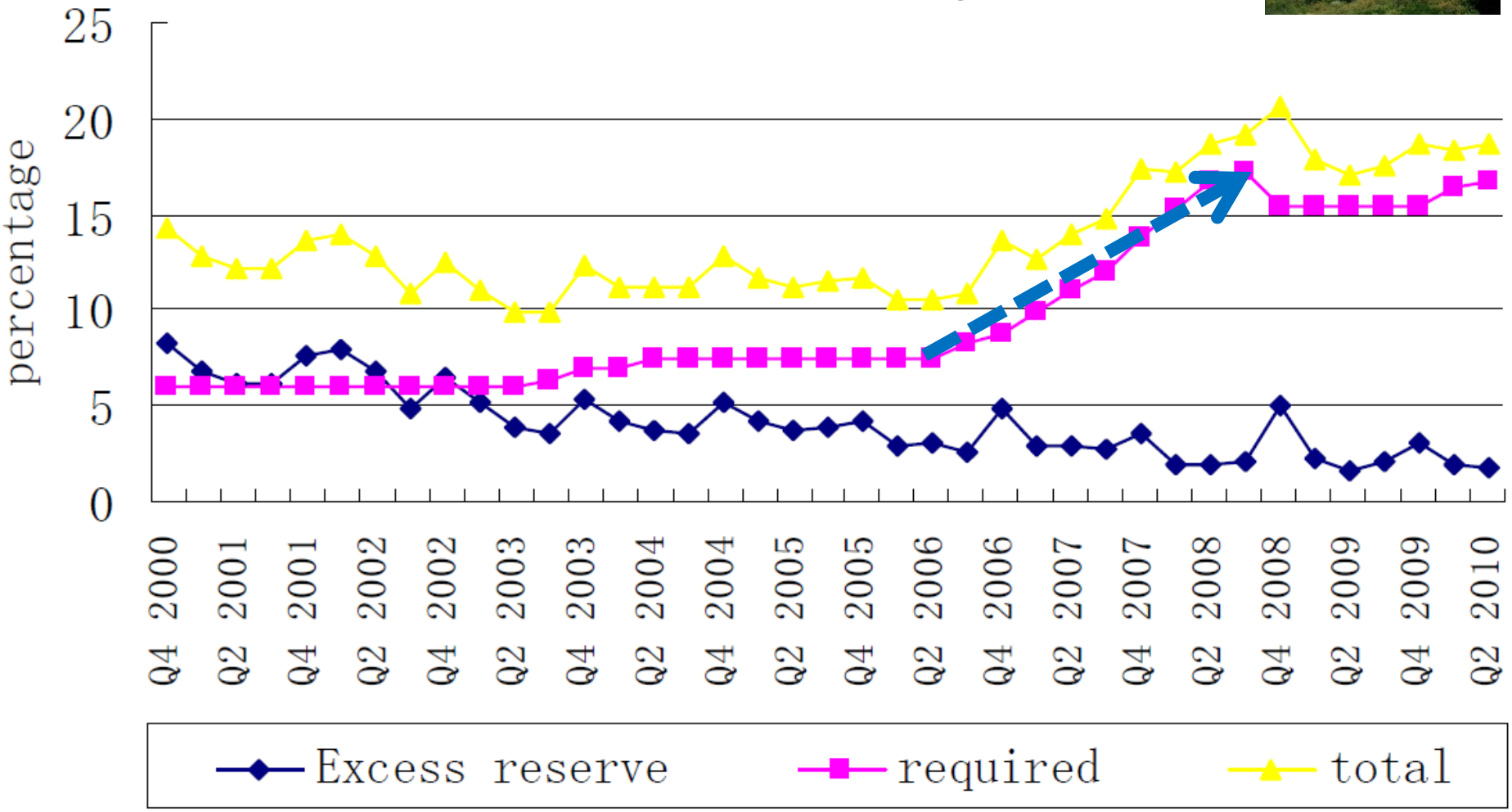
Source: Reuters EcoWin

2007-08 bubble in China's stock market

Data from EconStatsTM, Reuters, and major online news outlets such as the BBC & NYT.

The PBoC raised required reserve ratio for banks, continued

Source: Zhang, 2011, Fig.6, p.46.

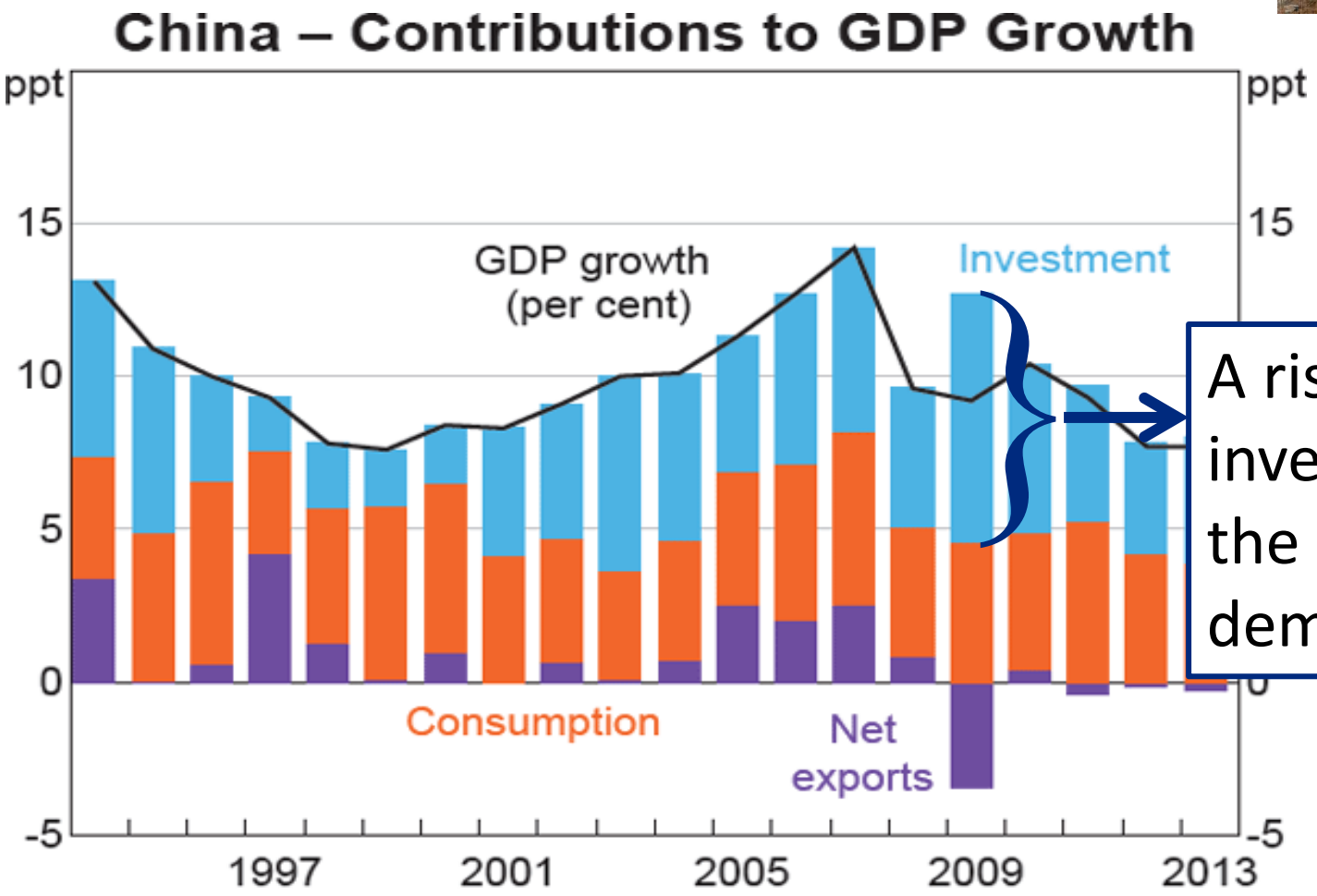


China was hit by the 2009 global recession

temporarily ending any problem of excessive monetary expansion.

2005-July 2015

Chinese government investment spending in 2009 counteracted the recession.



A rise in public investment offset the loss of export demand in 2009.

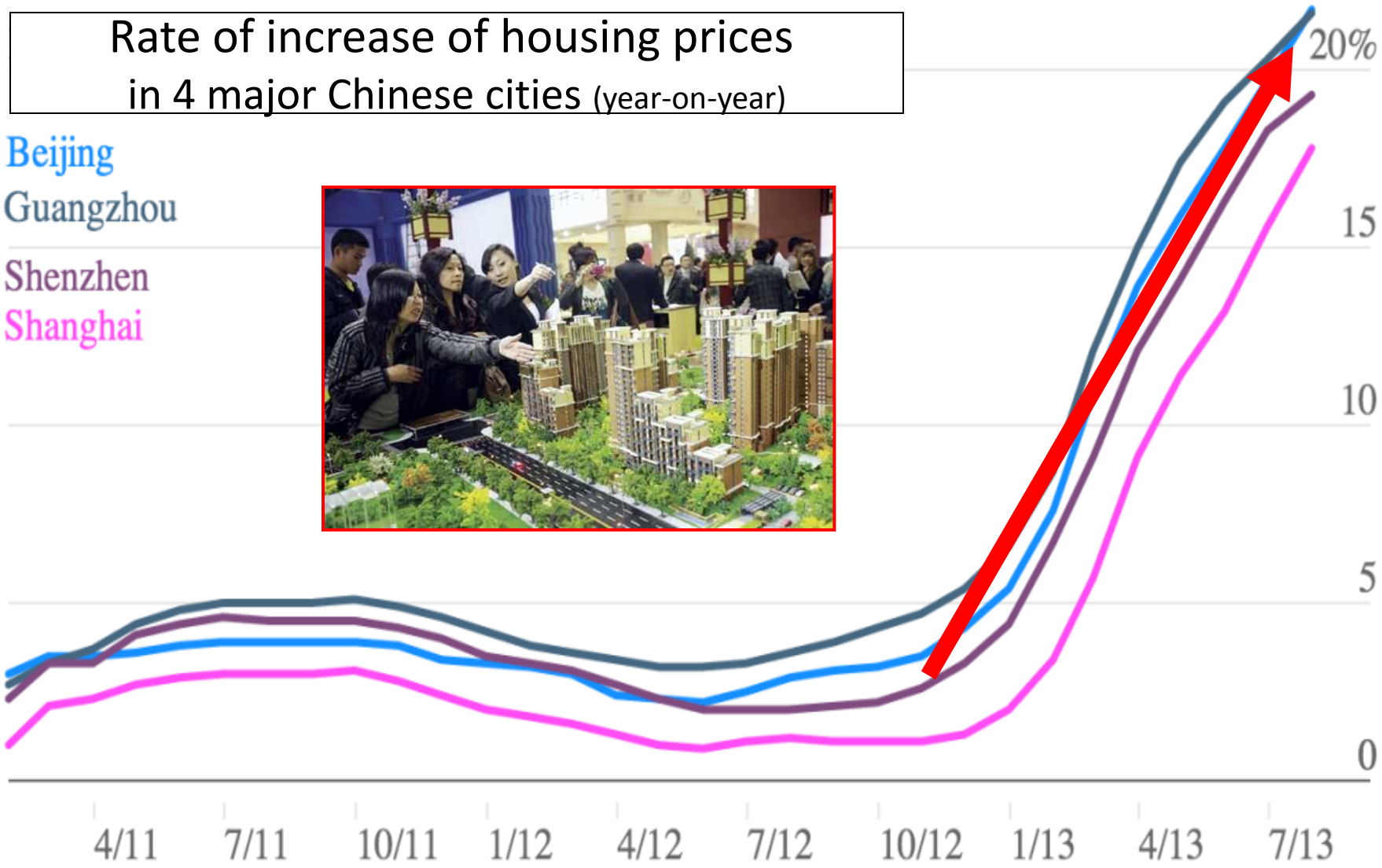
Reserve Bank of Australia

China's inflation broke sharply in 2008-09, But took off again in 2010-11.

Source: TradingEconomics.com; China Economic Information Net.

China's housing prices also took off again in 2013.

Rate of increase of housing prices
in 4 major Chinese cities (year-on-year)



Quartz | qz.com

Source: Gwynn Guilford — Sept. 6, 2013

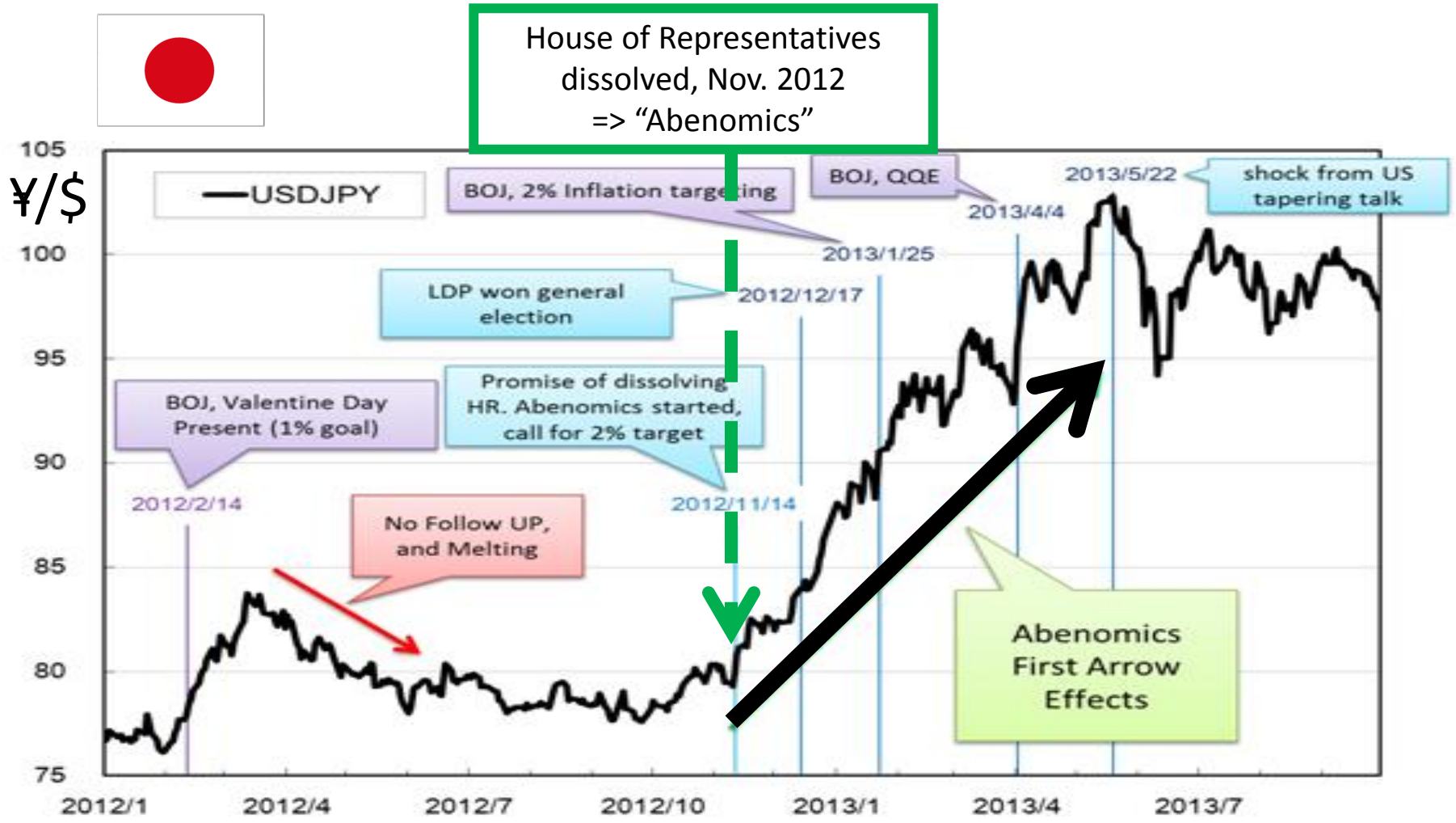
Data: National Bureau of Statistics

Lecture 16: Mundell-Fleming model with a floating exchange rate

- Rule: if result at a *given* exchange rate would be a BoP deficit, then result under *floating* is currency *depreciation*.
- Implications of capital mobility
  - Monetary expansion: high κ => extra stimulus via net exports => more effect on *Y*.
  - Fiscal expansion: high κ => crowding out of net exports => less effect on *Y*.
- Examples:
  - Monetary expansion (Japan 2013, ECB 2015)
  - & contraction (UK 1980, US 1980, Japan 1990)
  - Fiscal expansions (US twin deficits in early 1980s)




Example of monetary expansion (1): Abenomics depreciated the yen, 2012-2013



Takatoshi Ito, Dec.30, 2013 , ADB Institute http://www.asiapathways-adbi.org/2013/12/abenomics-progress-prospects-and-how-the-2020-tokyo-olympics-can-help-solve-japans-debt-problem/

Example of monetary expansion (2):

When ECB chief Mario Draghi announced QE Jan.22, 2015,

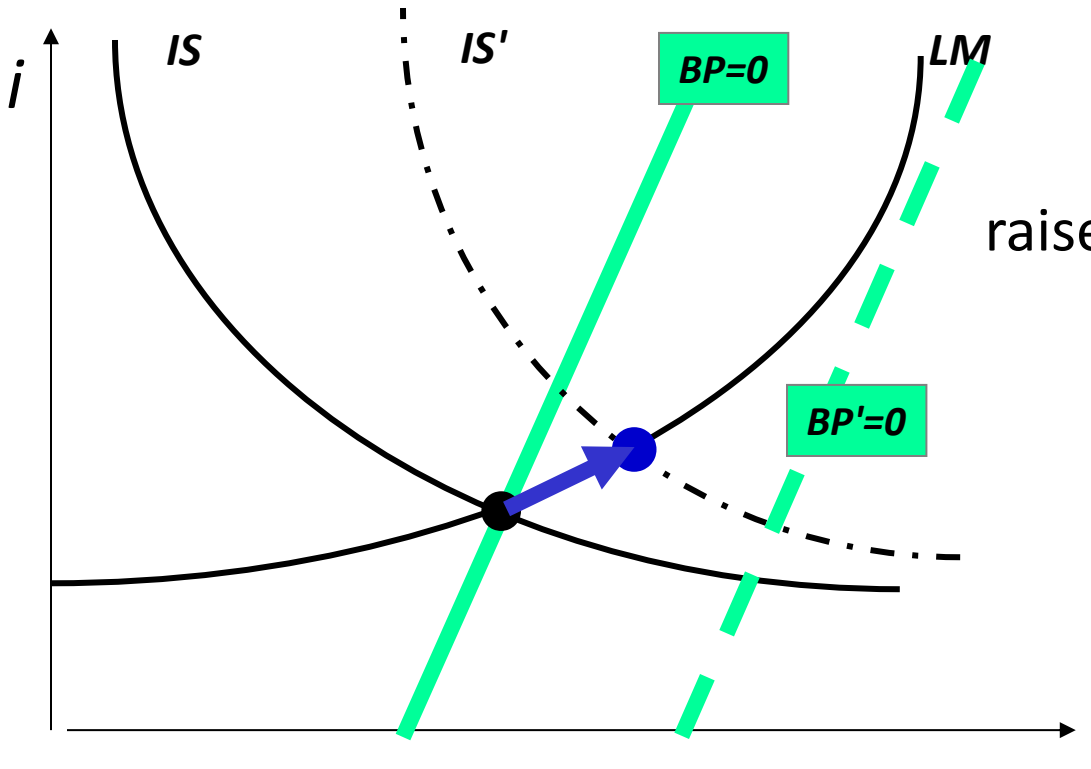
=> the euro depreciated.

The Mundell-Fleming equations when the exchange rate changes

IS: $Y = \dfrac{\bar{A} - bi + \bar{X}(E)}{s+m}$

LM: $\dfrac{\overline{M1}}{\bar{P}} = L(i, Y)$

$BP{=}0$: $(i\text{-}i^*) = -\left(\frac{1}{\kappa}\right)[(\overline{KA} + \bar{X}(E)] + \left(\frac{m}{\kappa}\right)Y.$



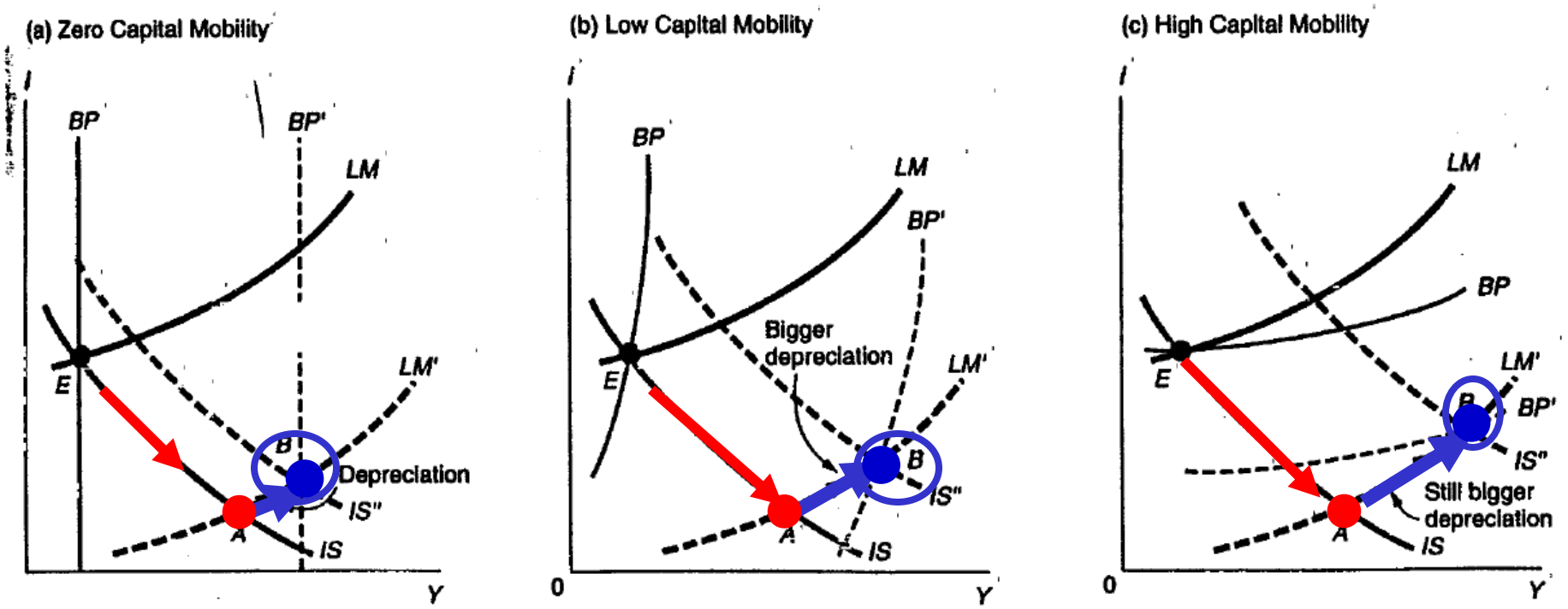
A depreciation (rise in *E*) raises net exports & so shifts *both* the ***IS*** & ***BP*** curves to the right, assuming the Marshall-Lerner condition holds.

Monetary Expansion

FIGURE 23.2 MONETARY EXPANSION UNDER FLOATING RATES

A monetary expansion shifts the LM curve out to LM', lowering i and raising Y. (a) Even without capital mobility, the trade deficit at A requires a depreciation, which further raises Y at B. (b) With some capital mobility, the balance of payments deficit is larger at A; this requires a larger depreciation, which raises Y even further at B. (c) With high capital mobility, the deficit at A, depreciation, and stimulus at B are all larger still.

$\kappa = 0$ $\kappa > 0$ $\kappa >> 0$



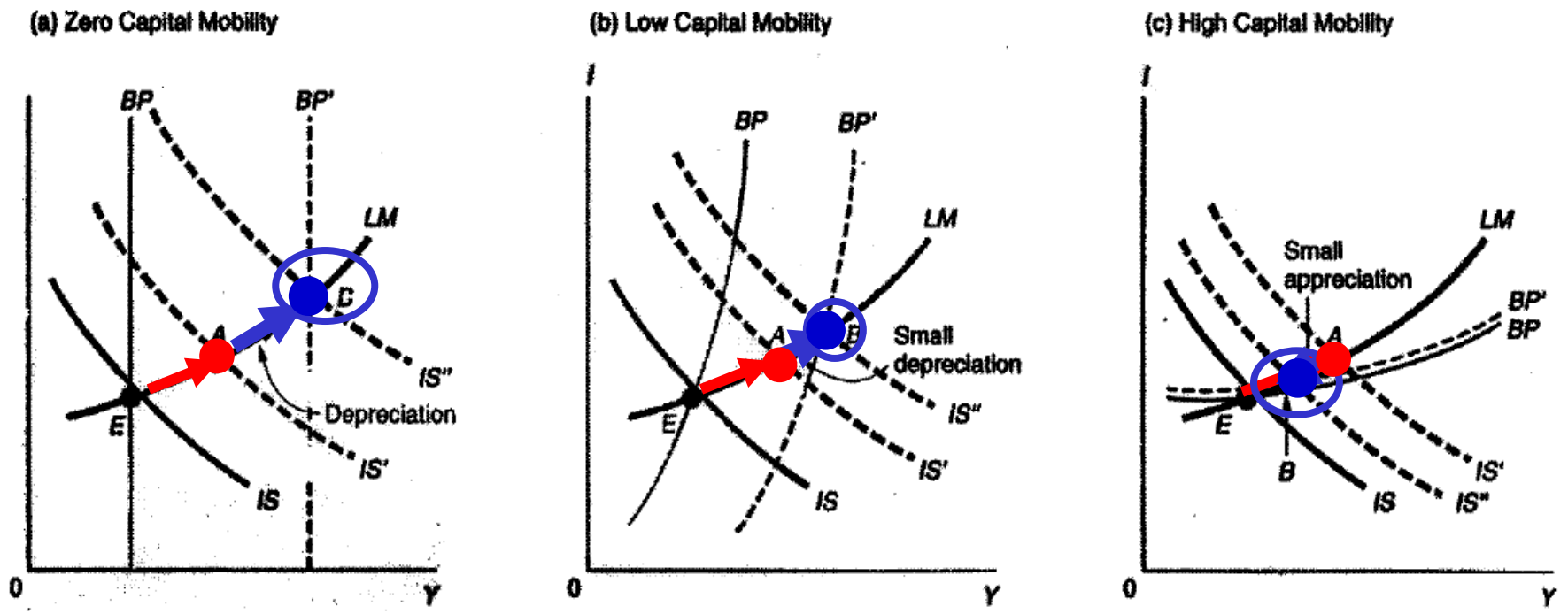
$i \downarrow$ => capital outflow => more depreciation => higher net exports

Fiscal Expansion

FIGURE 23.1 FISCAL EXPANSION UNDER FLOATING EXCHANGE RATES

A fiscal expansion shifts the IS curve to IS', raising Y and i to A. (a) Without capital mobility, the trade deficit at A requires a depreciation, which stimulates net exports and thus further raises Y to B. (b) With low capital mobility, the balance of payments deficit is smaller at A, so the required depreciation and the further stimulus to Y at B are smaller. (c) With high capital mobility, the balance of payments is in surplus at A, so a small appreciation is required, which discourages net exports; thus the increase in Y at B is smaller than in the earlier cases.

$\kappa = 0$ $\kappa > 0$ $\kappa >> 0$

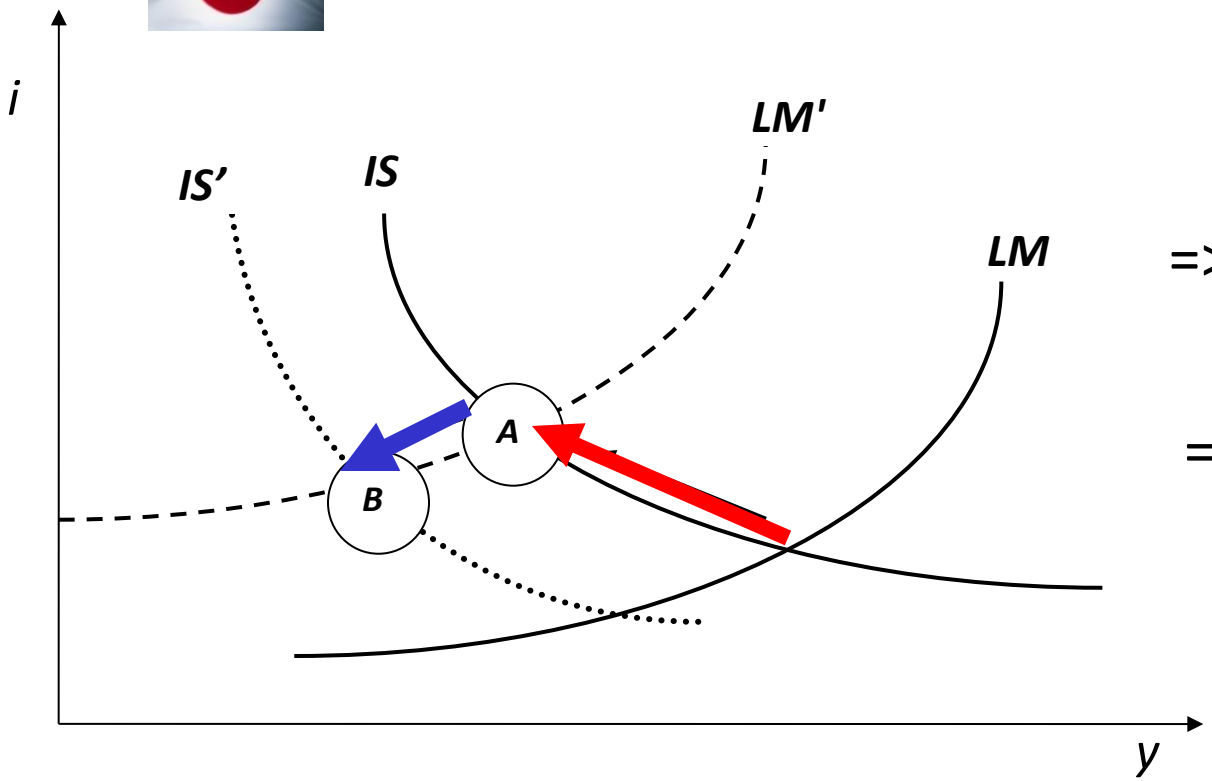


$i \uparrow$ => capital inflow => less depreciation => lower net exports

Examples of monetary contractions

under modern conditions of high κ and floating exchange rates

- Thatcher monetary contraction of 1979-82
- Volcker monetary contraction of 1981-82
- Japanese monetary contraction of 1990-92



In each case,
$i \uparrow$, $r \uparrow$ (at ***A***)

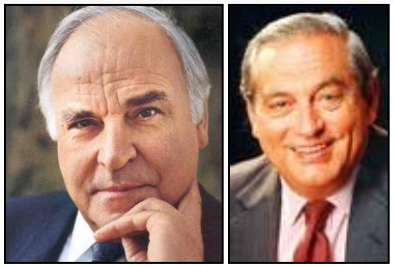
=> currency appreciated
=> net exports fell (***B***)

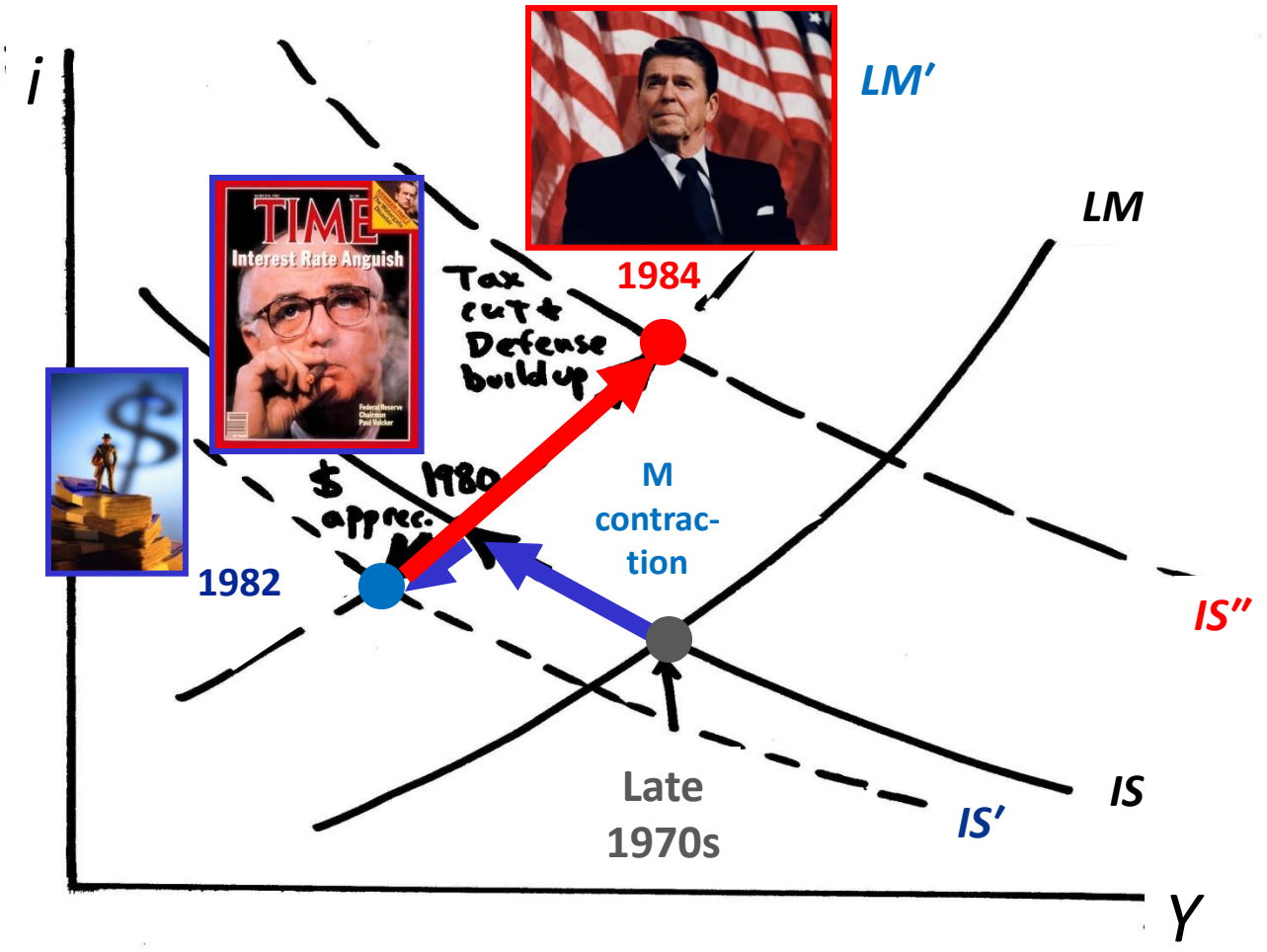
=> recession was more severe than in traditional monetary tightenings.

Examples of monetary/ fiscal mix:

1) Reagan-omics, 1981-84;

2) German union 1991-92.





The US shift in monetary-fiscal mix:

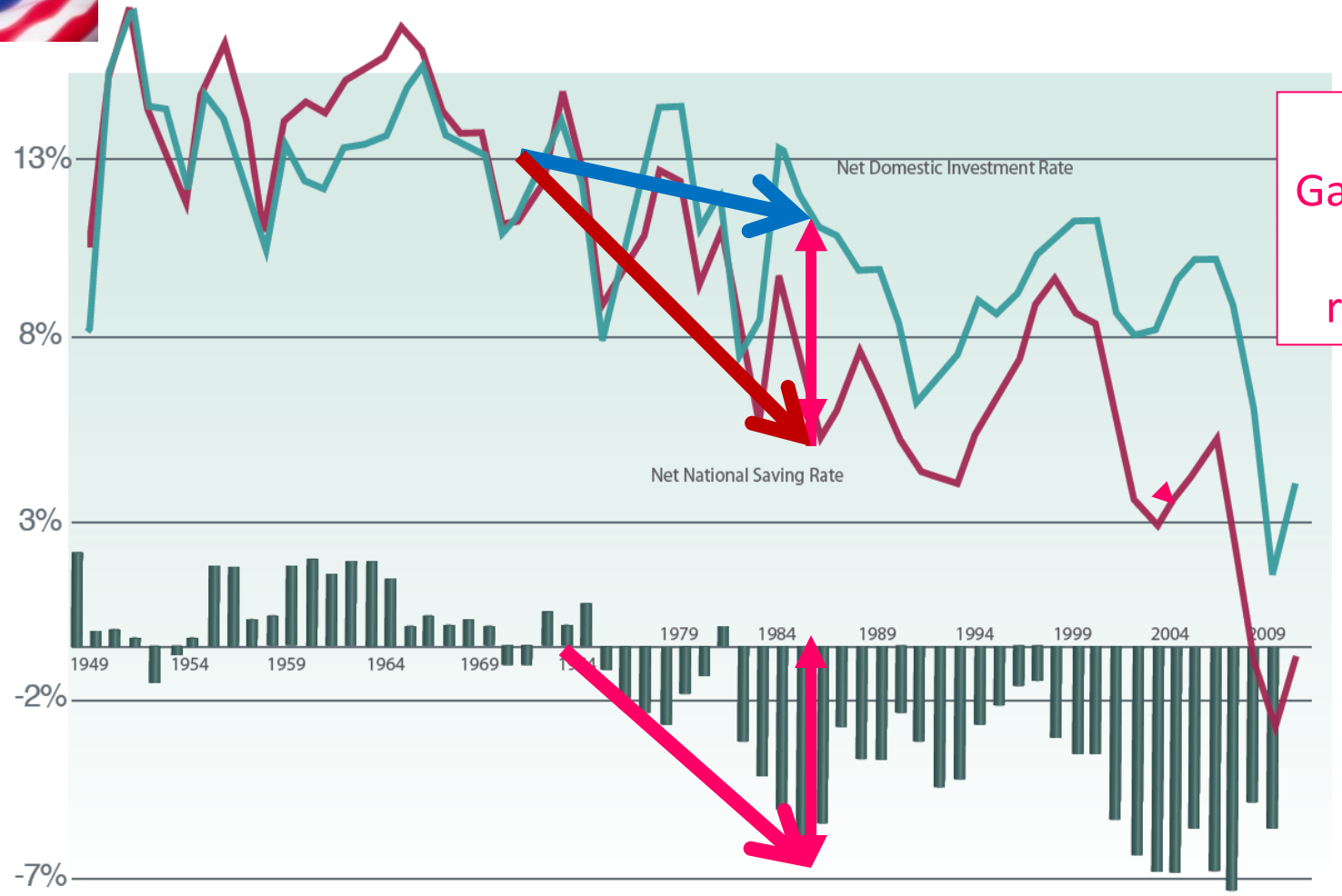
from low real interest rate & low $ in the late 1970s,

to high real interest rate & high $ in the mid-1980s.

GDP composition shifts to *G* & *C*, away from *I* & *X-M*.

We now have a causal interpretation of the twin deficits

US National Saving, Investment, & Current Account as Shares of GDP, 1949-2009



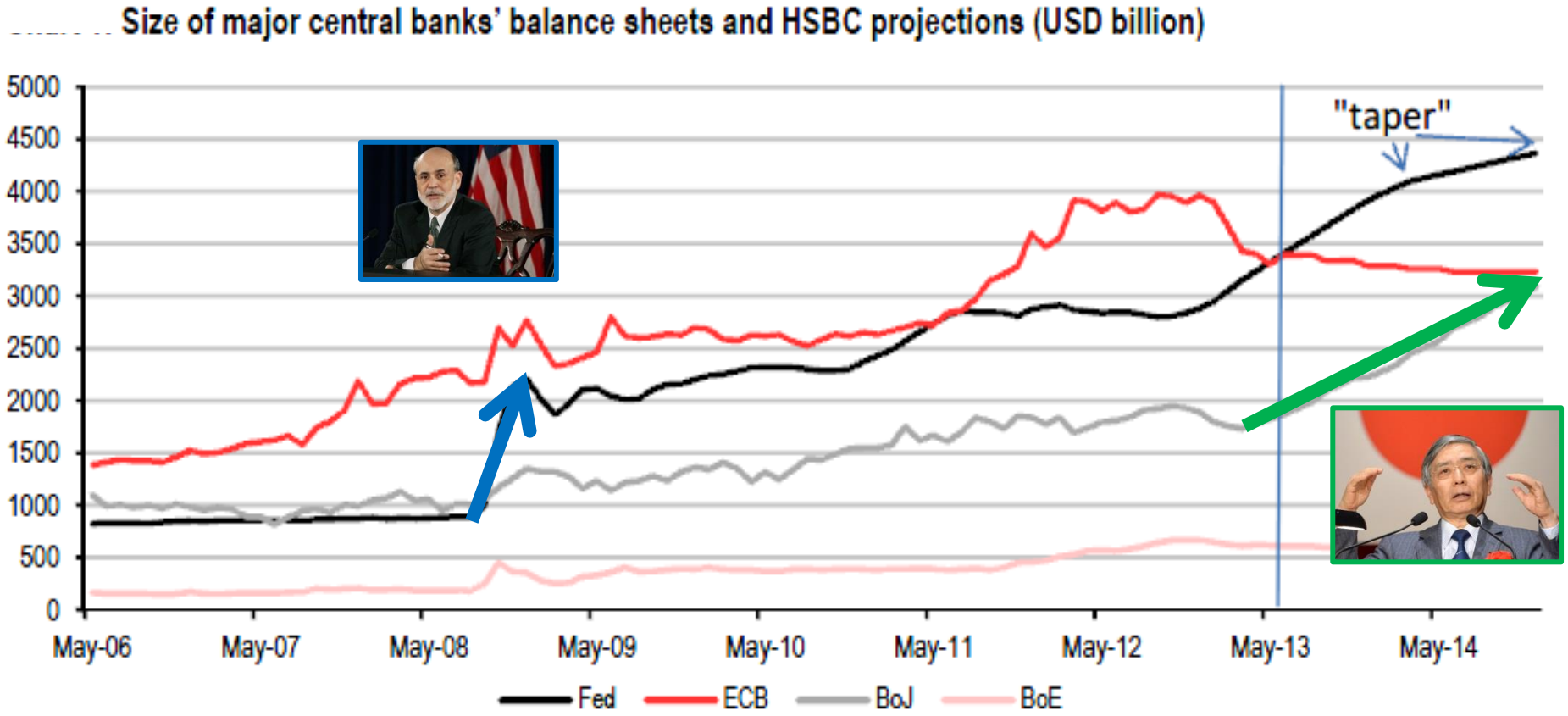
Trend:
Gap widened, as NS fell relative to I

Appendix: Japanese monetary expansion and yen depreciation 2012-15

"Abenomics"

QE: The Fed doubled the monetary base in 2008.

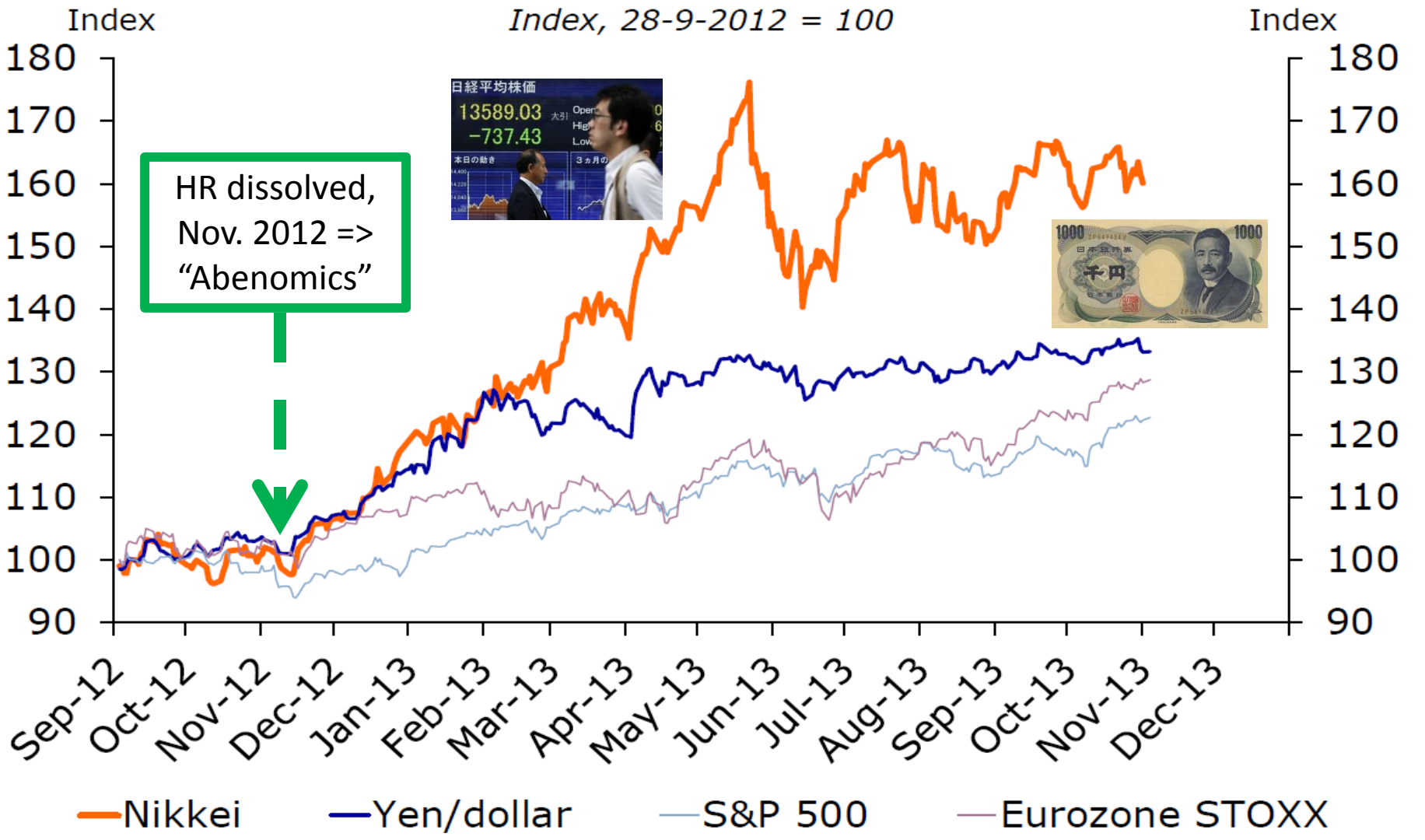
Kuroda in Apr. 2013 announced BoJ would double over 2 years.



Source: Bloomberg, national central banks, HSBC; note: balance sheet sizes are projected by HSBC on basis of assumptions, not forecasts

"HSBC: don't worry, BoJ expansion will offset end of QE," *FT,* Jun 14, 2013. http://blogs.ft.com/beyond-brics/2013/06/14/hsbc-dont-worry-boj-expansion-will-offset-end-of-qe/

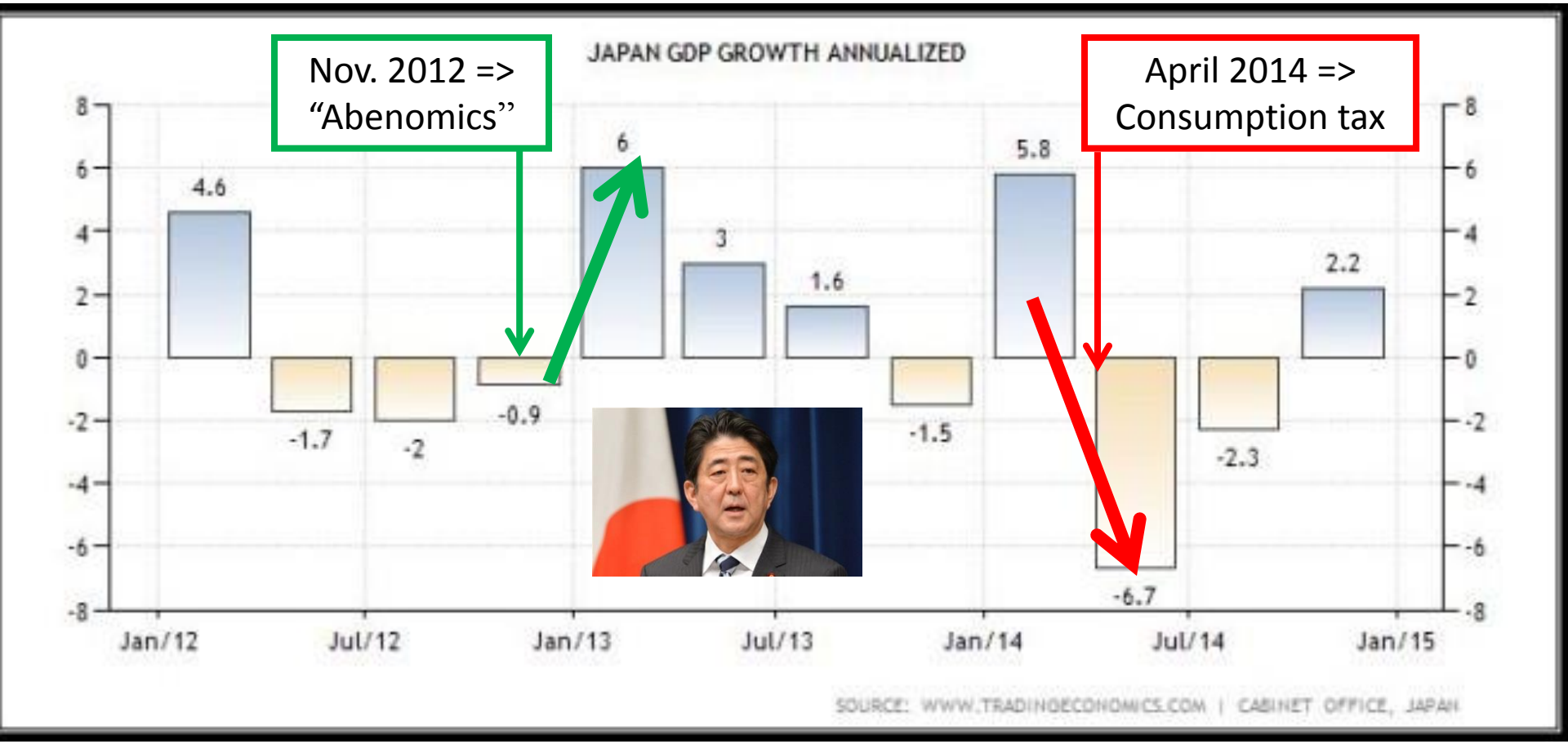
Japan's monetary easing (QQE)
raised the exchange rate (Yen/$) *and* stock market



"Outlook 2014 - Recovery on a shaky footing," Special , Economic Research Dept., Rabobank November 13, 2013, https://economics.rabobank.com/publications/2013/november/outlook-2014-recovery-on-a-shaky-footing/

Abenomics seemed to boost growth, at first.

But Japan went back into recession in 2014 Q2, perhaps because of a big increase in the consumption tax



End of Lecture 16:
Mundell-Fleming model
with a floating exchange rate