

# THE FOUR R-STARS: FROM INTEREST RATES TO INFLATION, AND BACK

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# Where are interest rate going?

Important question to answer, even if very hard:

- for monetary policy in 2025: when will central bank stop easing?
- for fiscal policy: will  $r < g$  keep sustaining high public debt?
- for macroeconomists: has the savings-investment balance changed?
- for intertemporal tradeoffs in economics: how is future being discounted?

# Current approach and its difficulties

- (1) Steady-state or long-run value component of realized returns.  
*Measured with long time series, separating trends from cycles.*
- (2) Counterfactual interest rate where investment equals savings  
*Measured using models of capital markets and investment.*
- (3) Benchmark for policy rate, if above (below) it, the inflation will fall (rise)  
*Measured using models and data on expectations, financial conditions, inflation*
- (4) Risk-free rate in  $r_i = r^* + \text{premium}_i$ ,  
*Measured as return on safest, most liquid, short-term asset... (policy rate!?)*

*Four approaches because not really the same object, or the same use...*



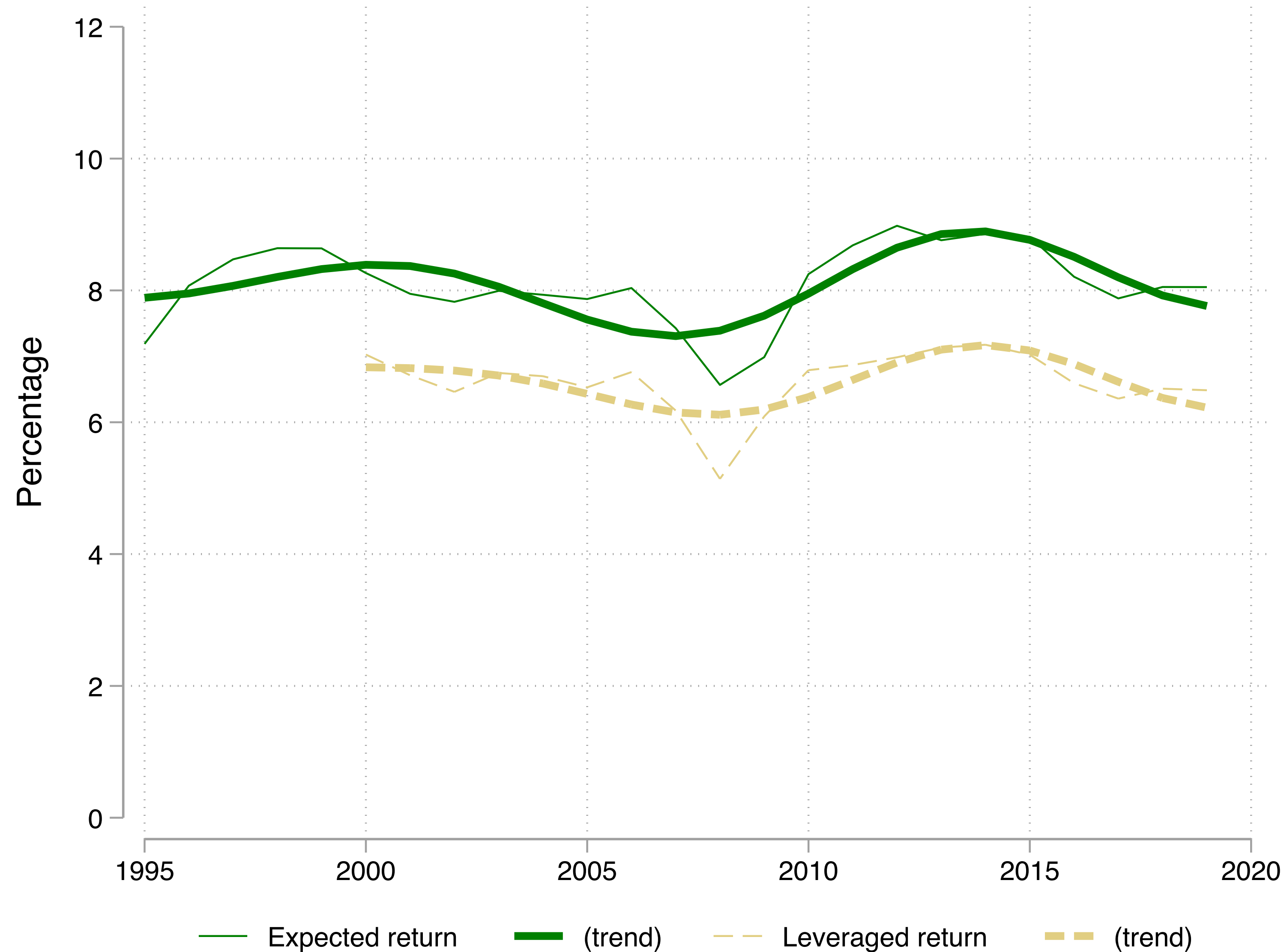


- The econometrician chasing four hares
- While thinking there is only one, and so missing
- **This talk:** Identify four separate R-stars, conceptually show they are different, look at data of the past, guess where they are going

# **CONCEPTS AND TRENDS FROM 1995-2019**

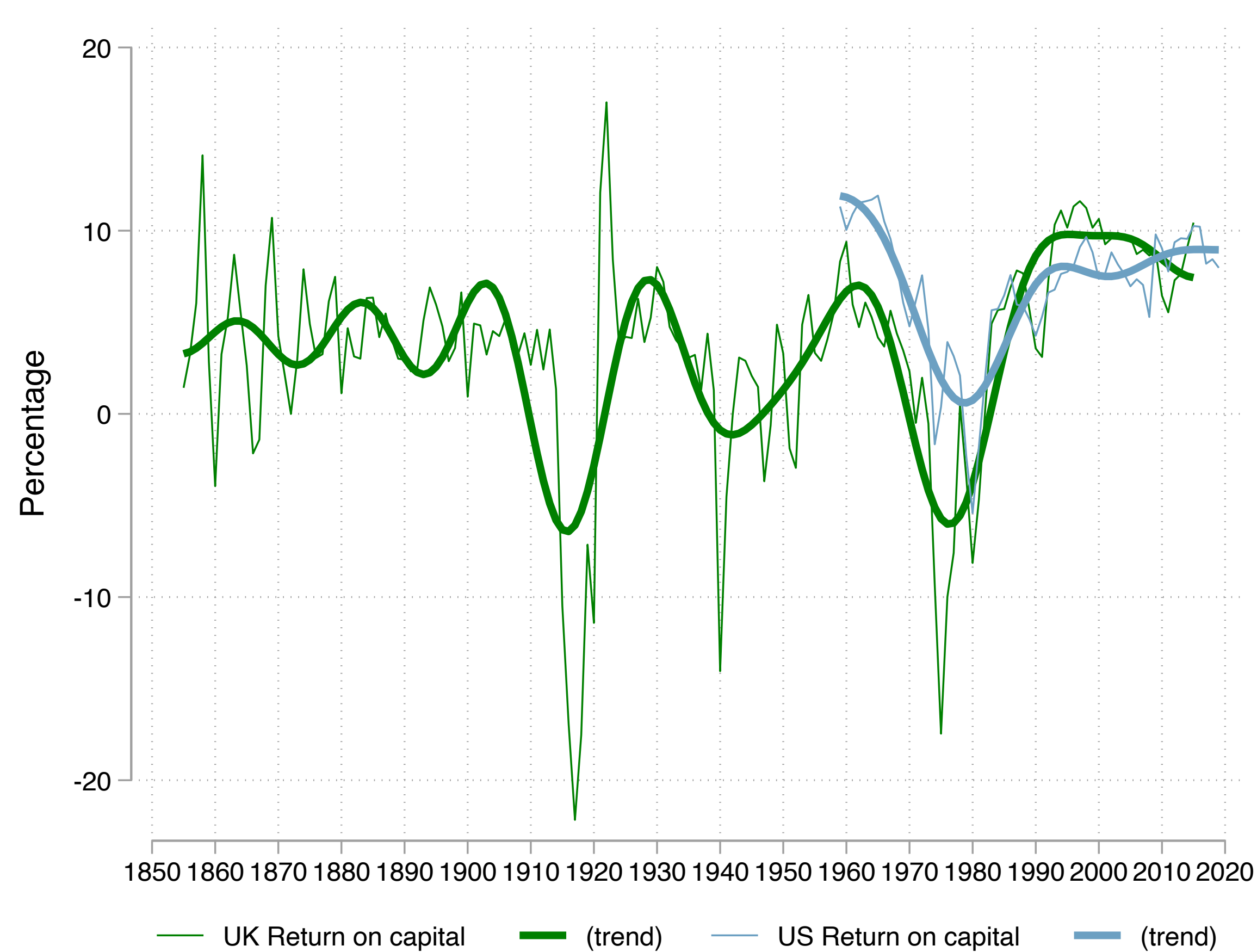


# The four r-stars... (I) investment, $m$

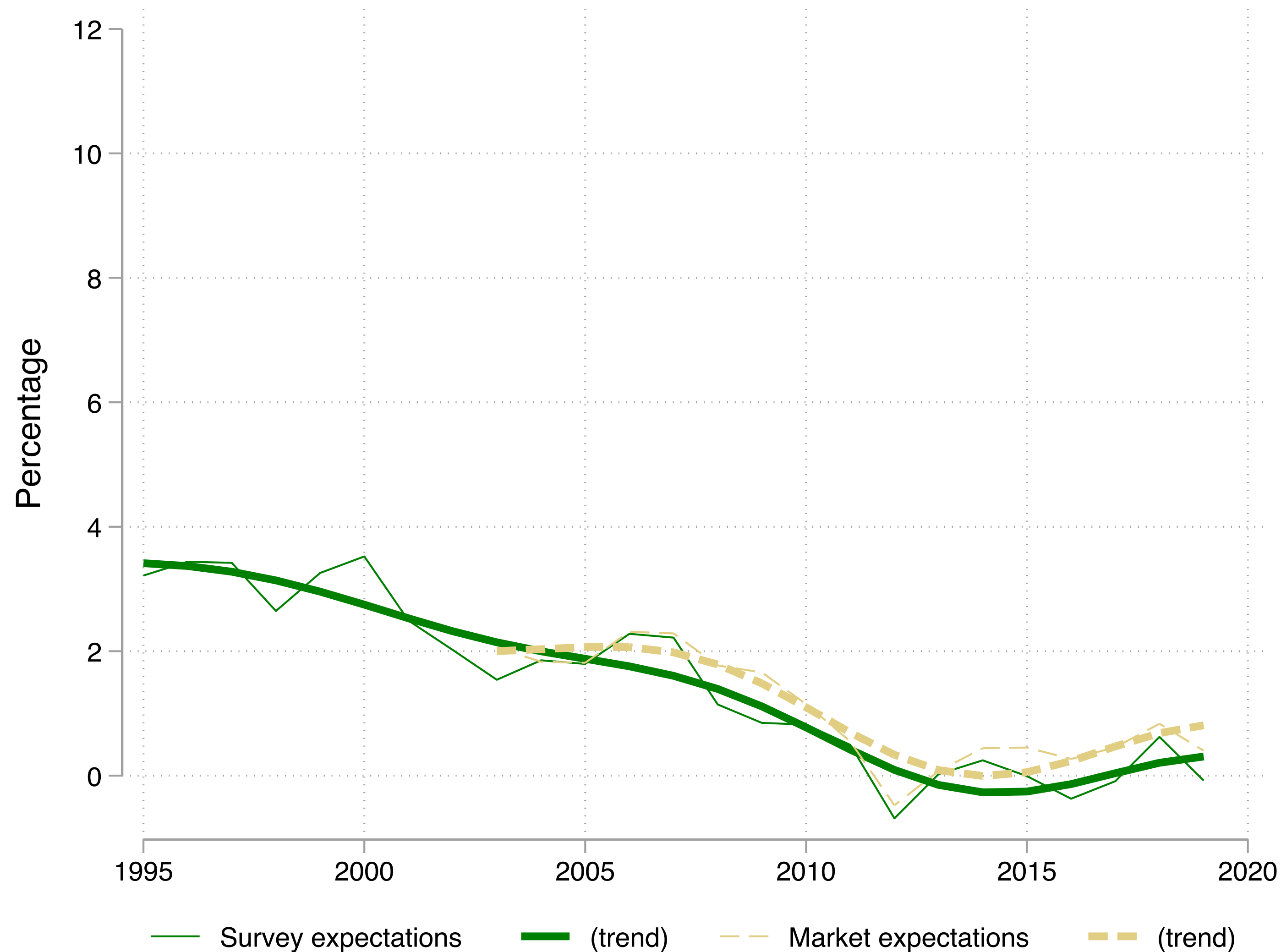


- Expected return on productive investment
- Matches models of savings and investment
- Ramsey-Solow
- Wicksell

# The four r-stars... (I) investment, $m$



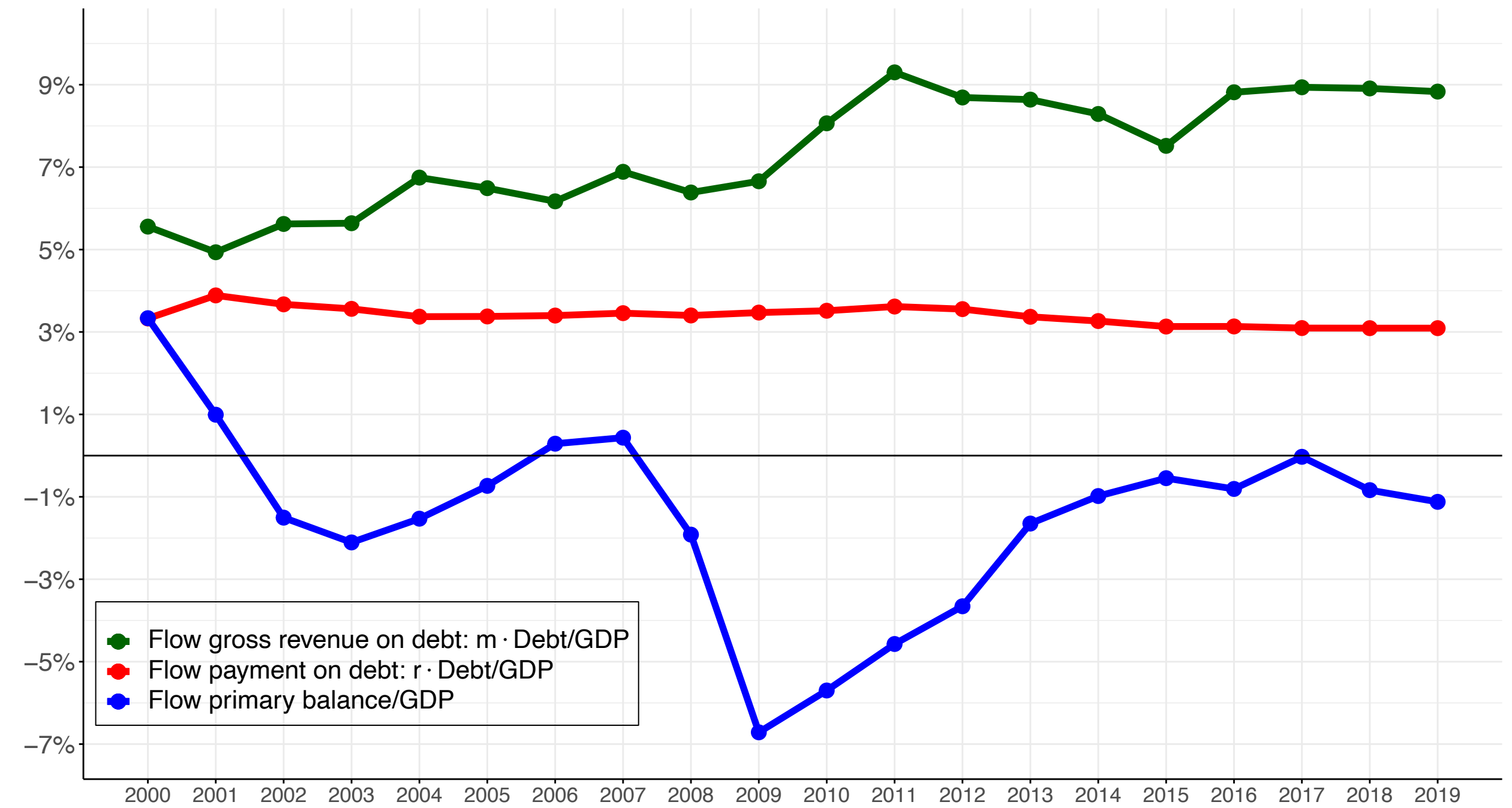
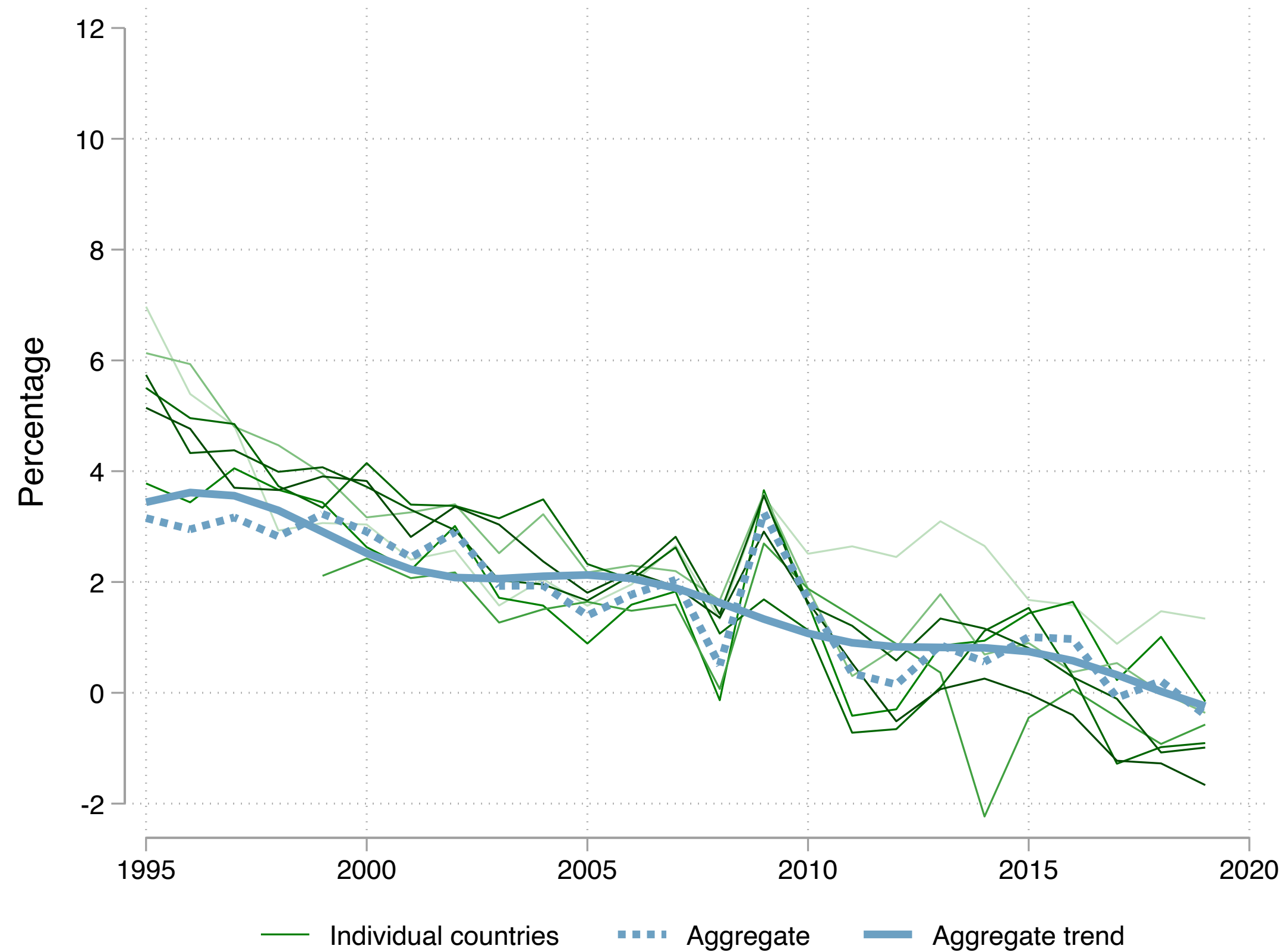
# The four r-stars... (2) government bonds, $y$



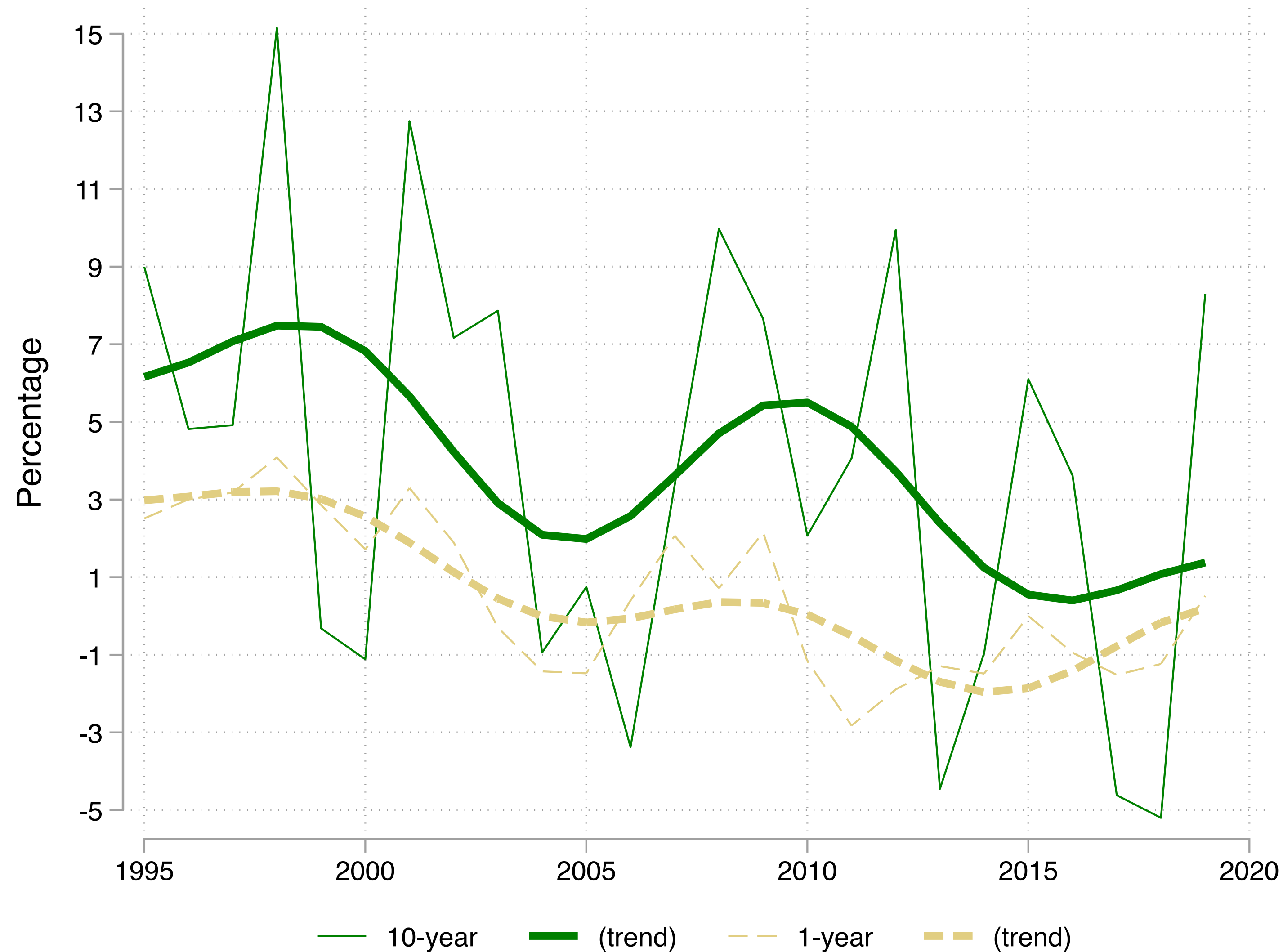
- Real yield on government bonds
- Matches finance models of safe returns
- Diamond's unproductive storage



# The four r-stars... (2) government bonds, $y$

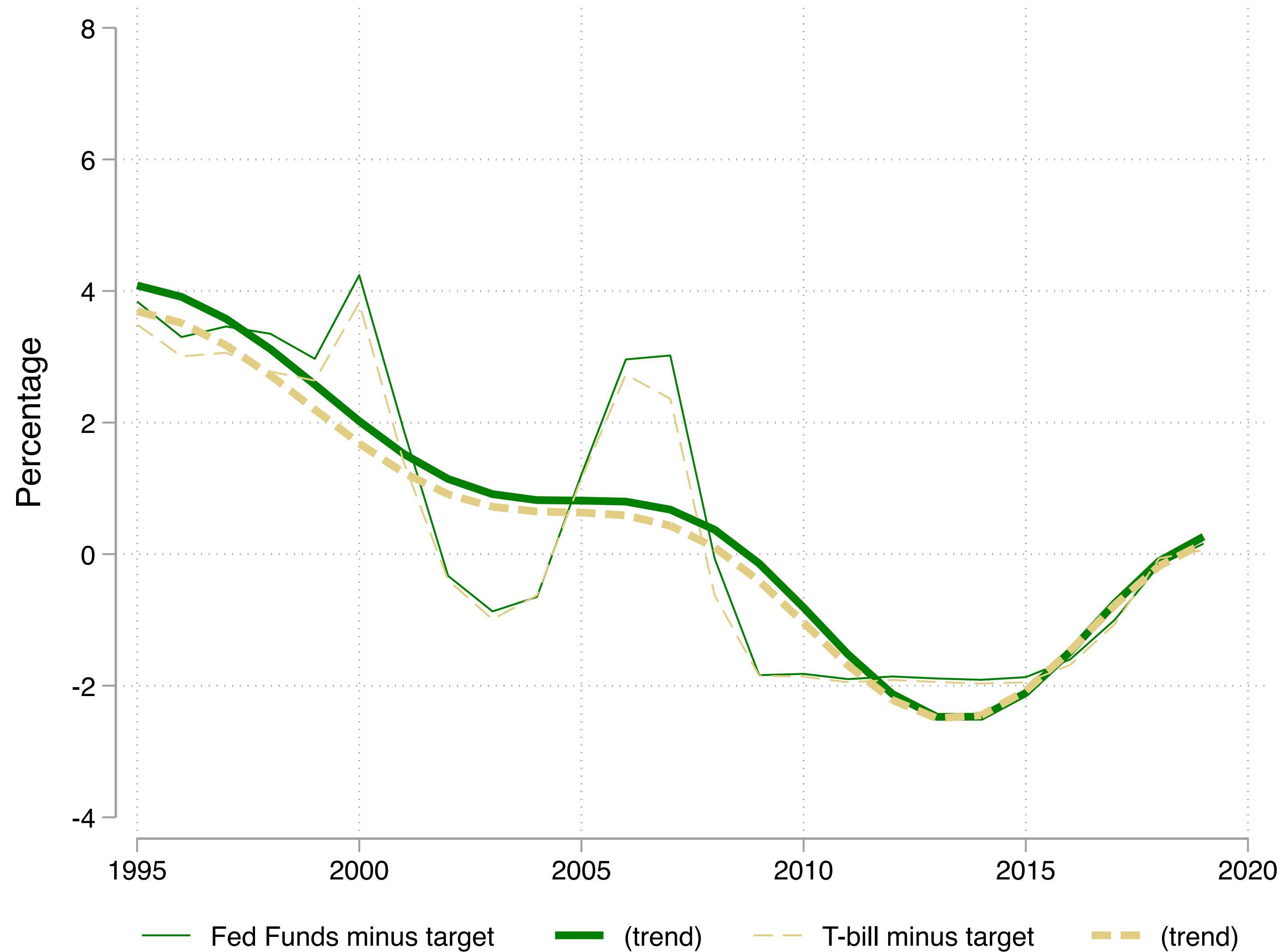


# The four r-stars... (3) realized return $\rho$



- Realized return on government bonds
- Relevant for debt sustainability and fiscal policy
- Time-series average of returns over long samples

# The four r-stars... (4) policy rate, $i$



- Policy rate
- Captures role of monetary policy
- Connection to inflation



# Conclusions for 1995-2019

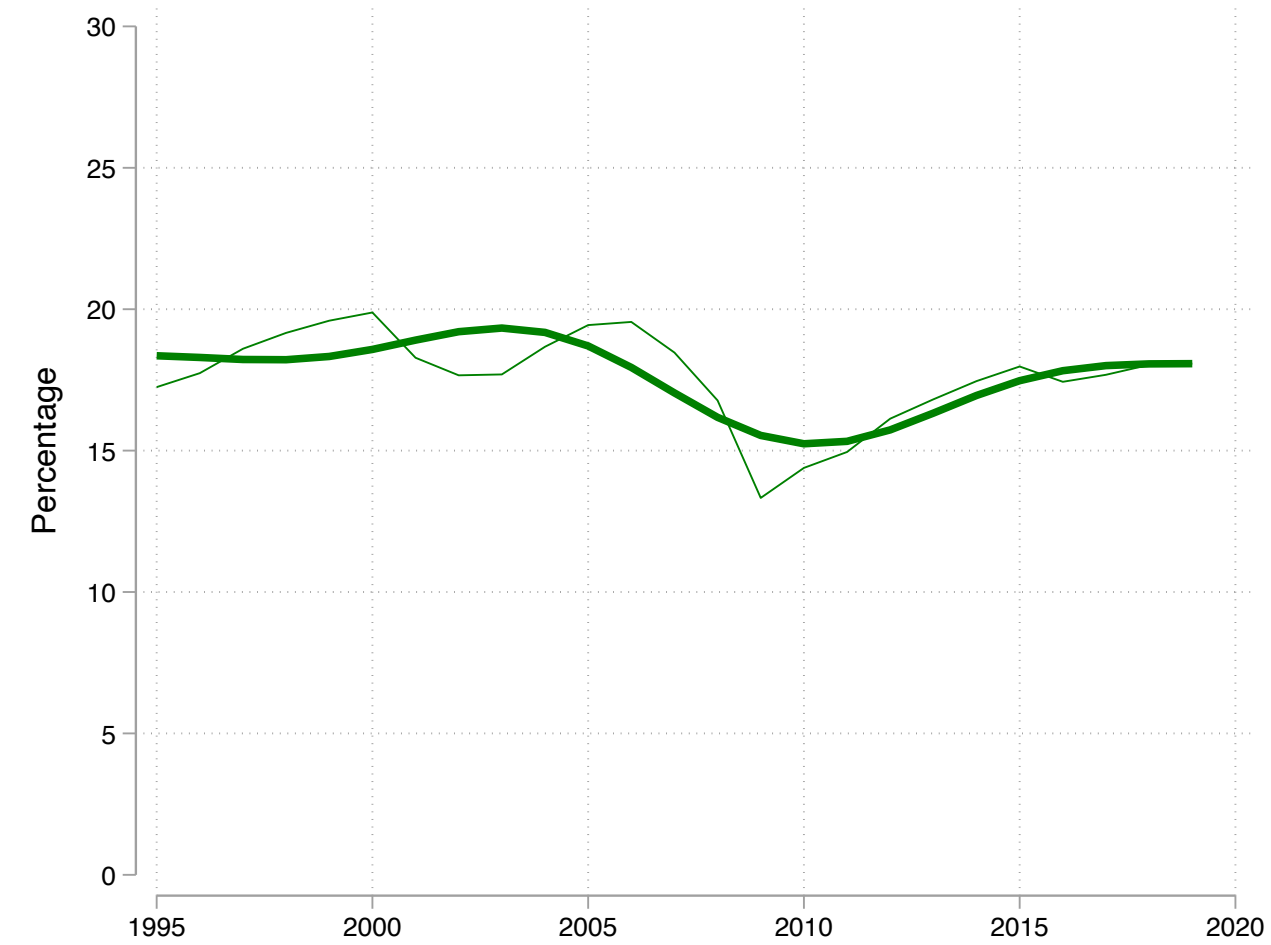
## The four $r^*$

- **m**: Expected return on productive investment was **roughly stable throughout**.  
*The  $r^*$  that matches long-run macro models of savings and investment*
- **y**: Real yield on government bonds **declined throughout**  
*The  $r^*$  that matches finance models of safe returns*
- **$\rho$** : Realized return on government bonds **mirror yields until 2010-15, then up**  
*The  $r^*$  that captures time-series role of unexpected inflation in business cycle*
- **i**: Policy rate **fell even faster until 2010-15, but then rose**  
*The  $r^*$  that captures role of monetary policy in inflation*

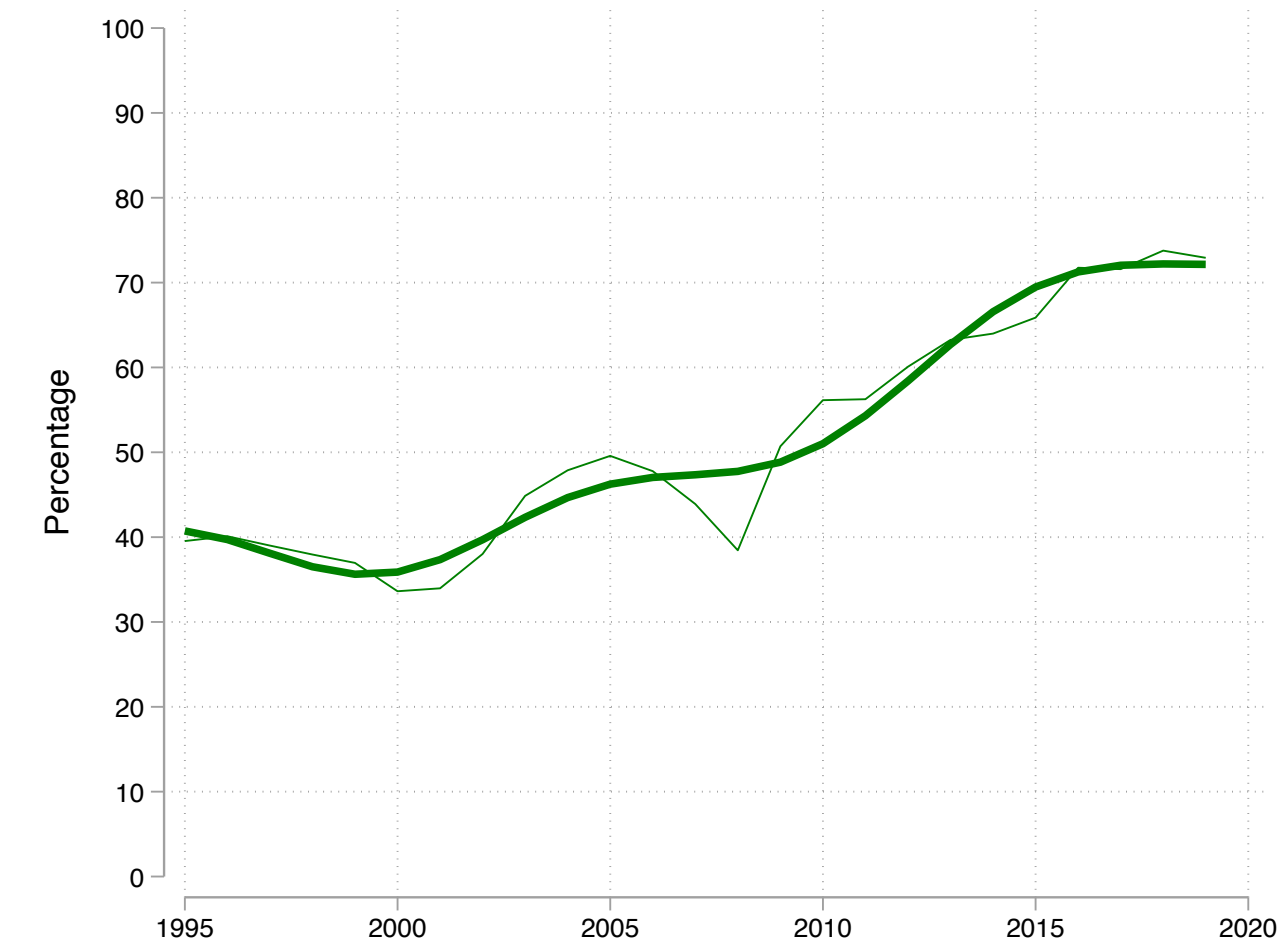


# Other indicators

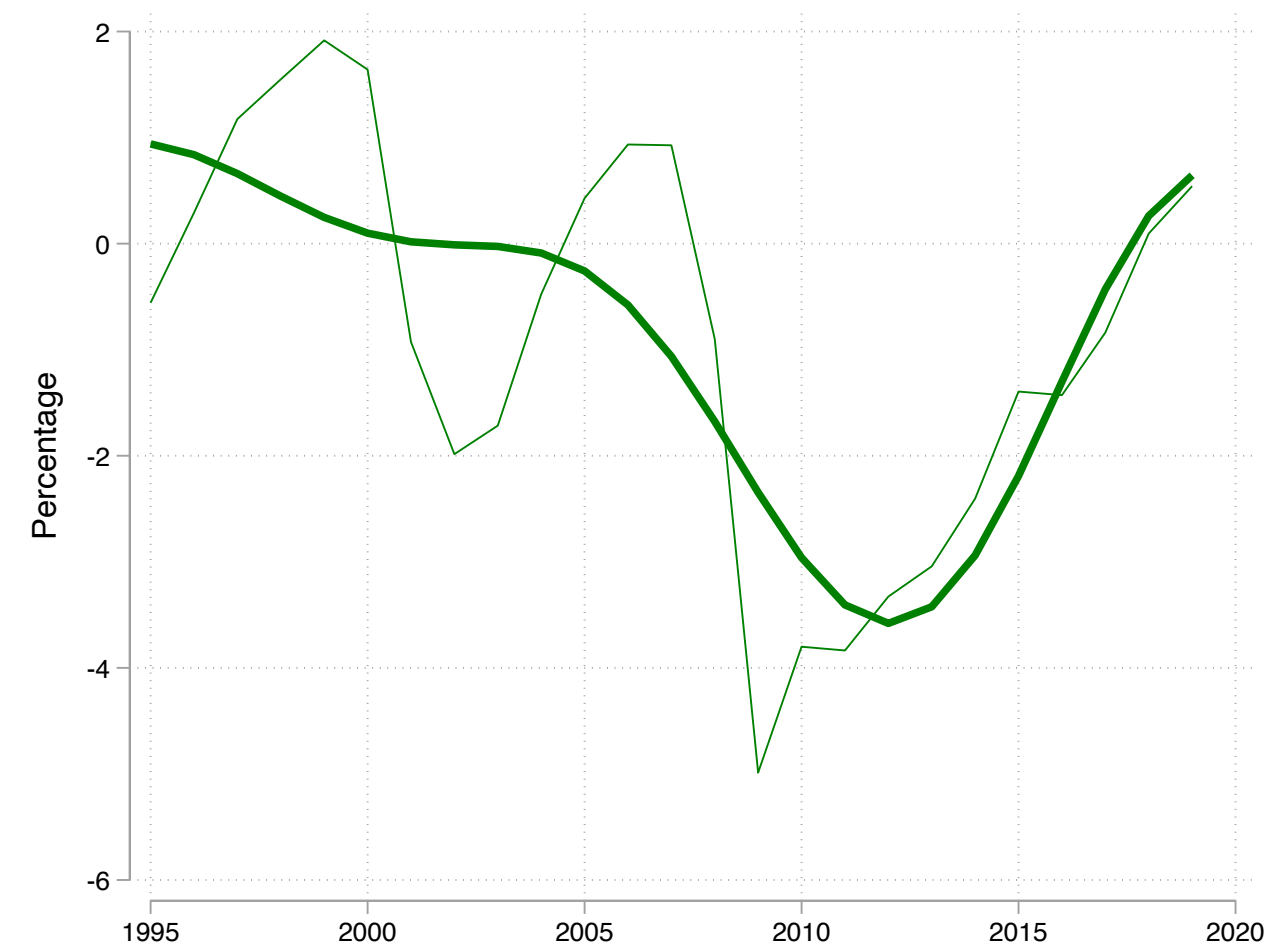
(a)  $k$ : investment over output



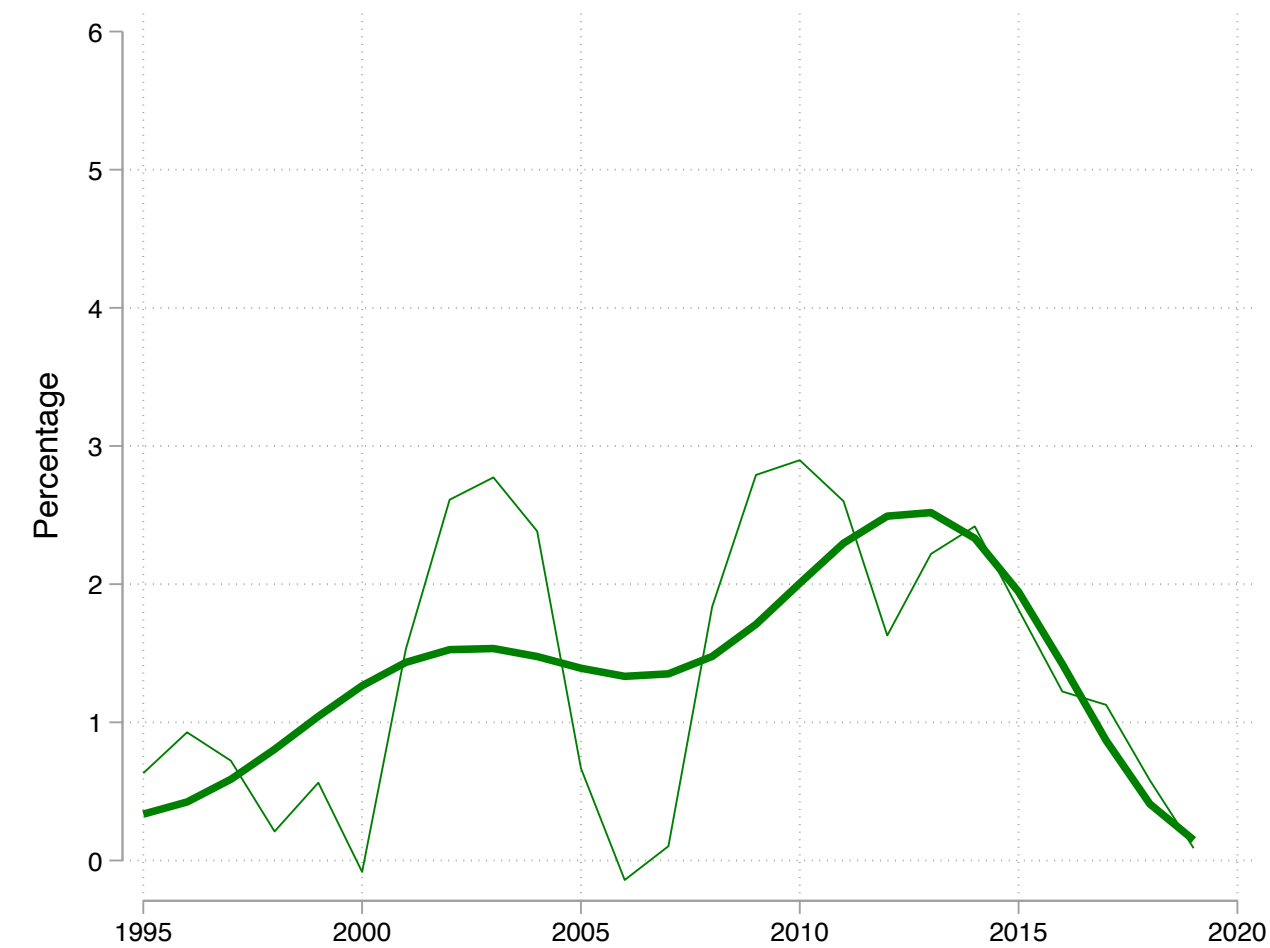
(b)  $b/k$ : ratio of unproductive to productive assets



(c)  $x/x^p$ : output relative to potential

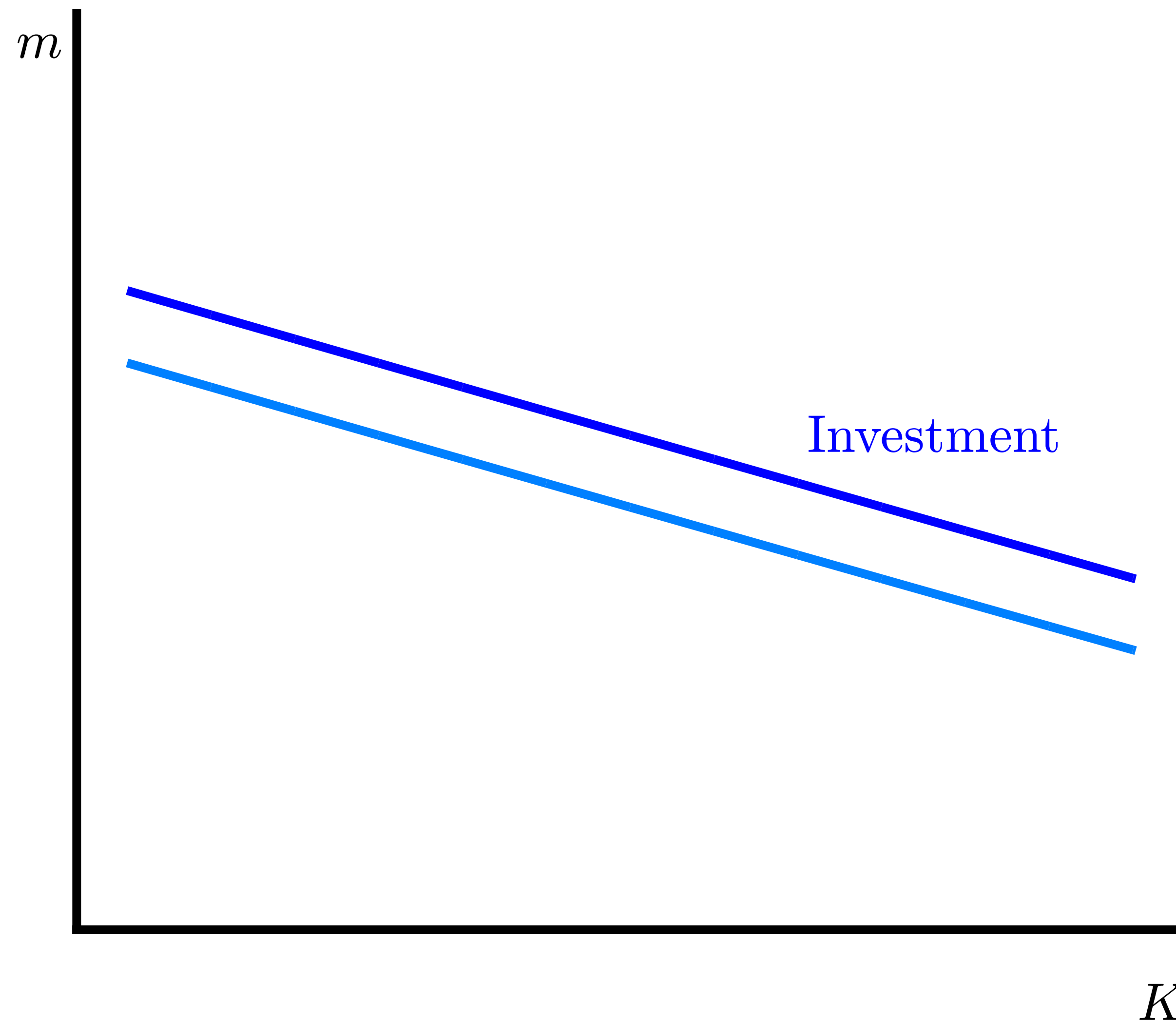


(d)  $t$ : term premium



# **AN EXTENDED I-S FRAMEWORK**

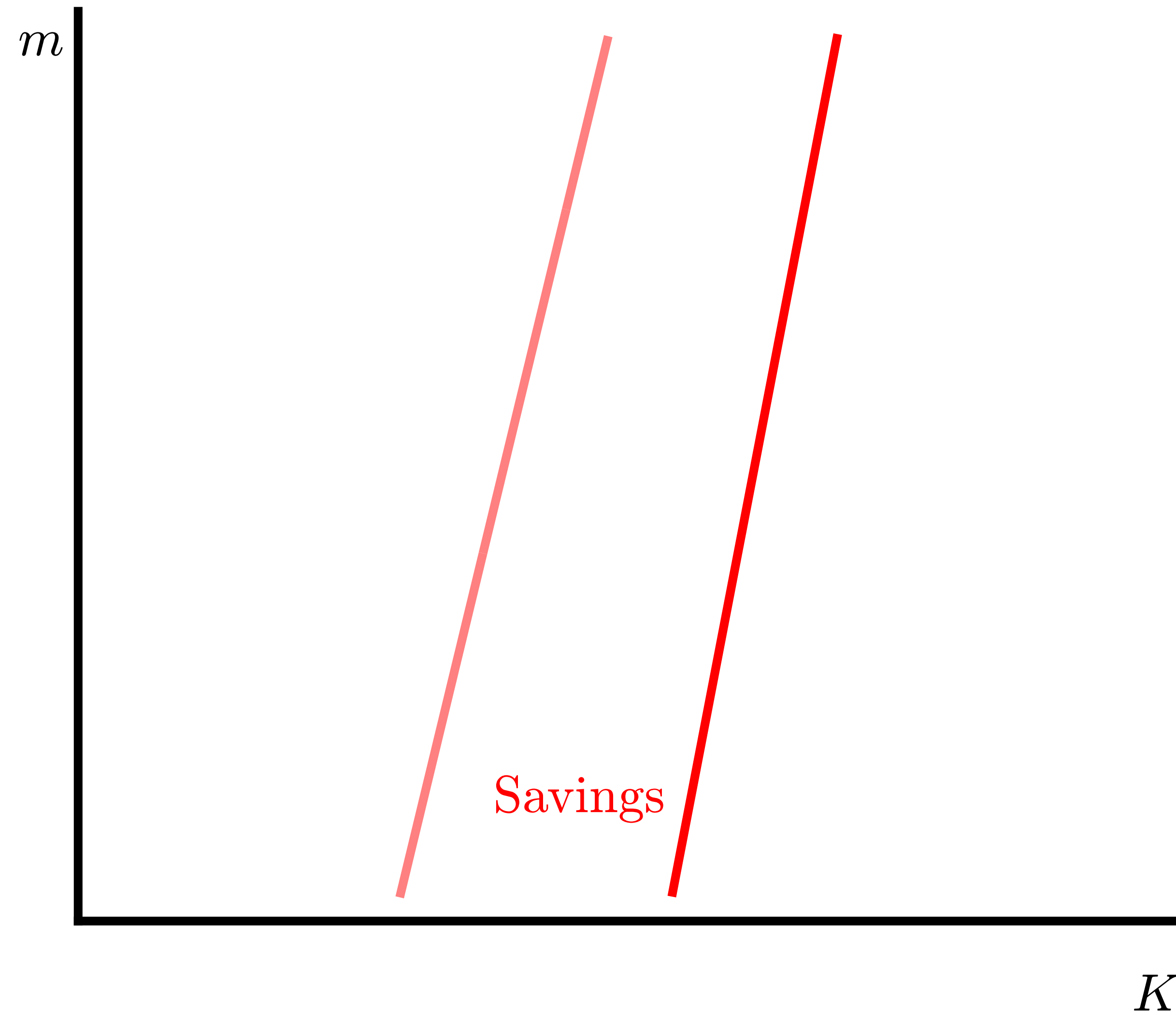
# I. Productive savings and investment



- $m$  marginal product of capital
- Productive investment is lower the higher is the return it gives, diminishing returns
- Shifts left-down when:
  - TFP falls, depreciation rises
  - Price of capital goods falls
  - Less competition, more regulation, higher taxes
  - Public investment falls

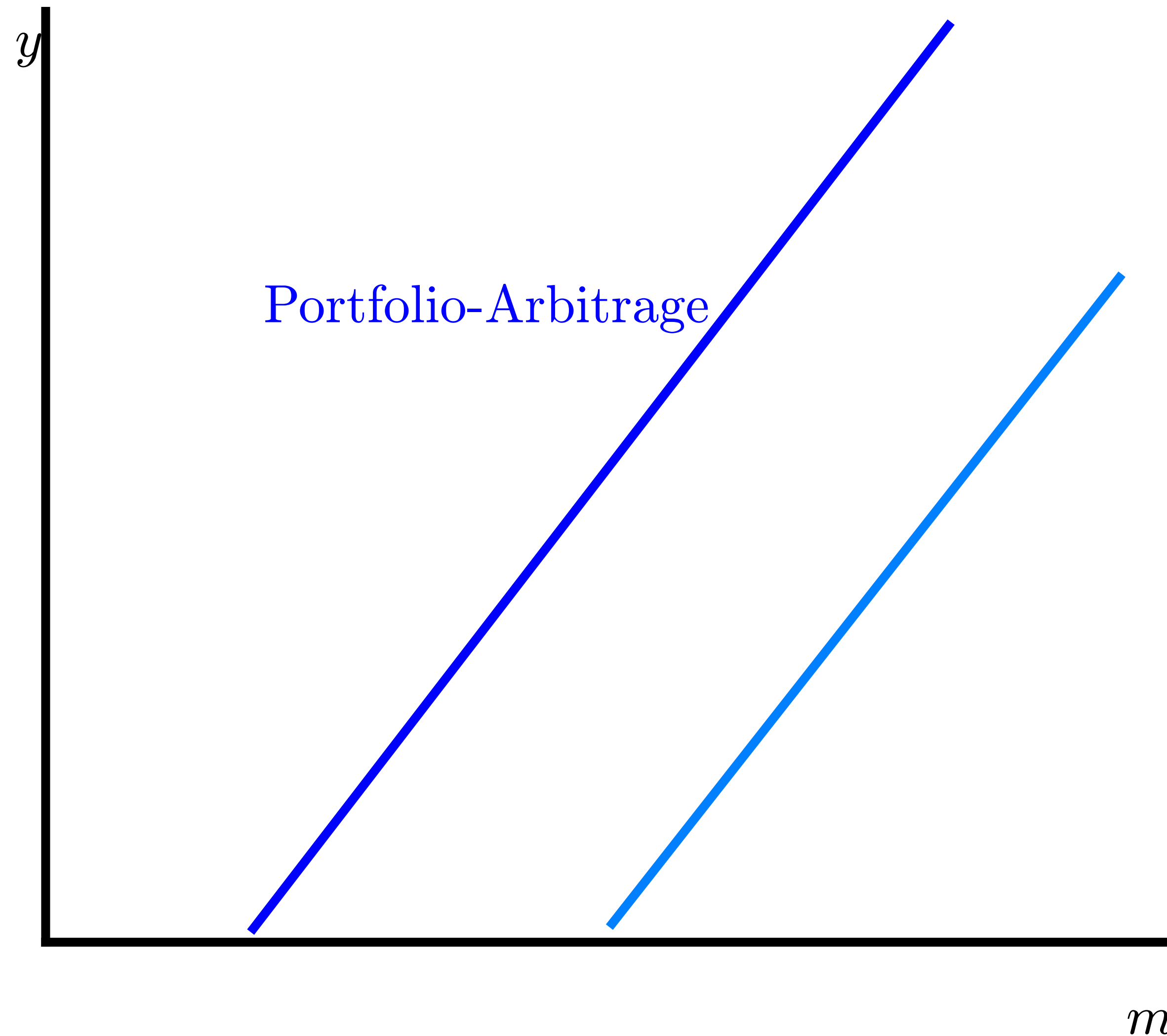


# I. Productive savings and investment



- In Ramsey model, supply of savings is horizontal at the discount rate.
- Upward sloping with incomplete markets.
- Unpack it...

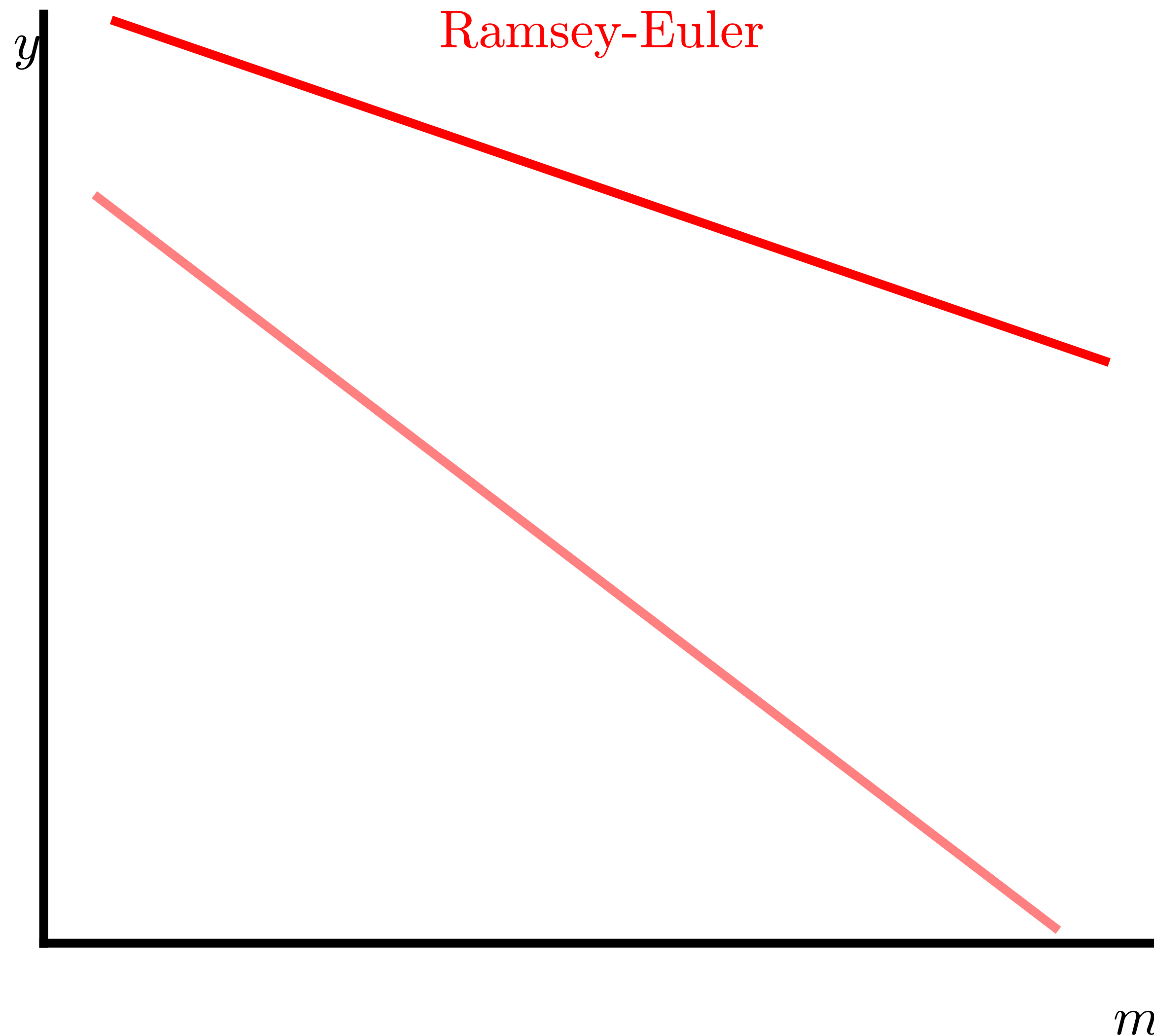
## 2. Productive versus storage savings



- Productive capital stock vs storage (gov debt + housing + rents)
- Not 45 degree line because differ in their non-return features
- Shifts right-down when:
  - Productive investments are perceived as riskier or less liquid
  - Financial frictions preventing productive investment

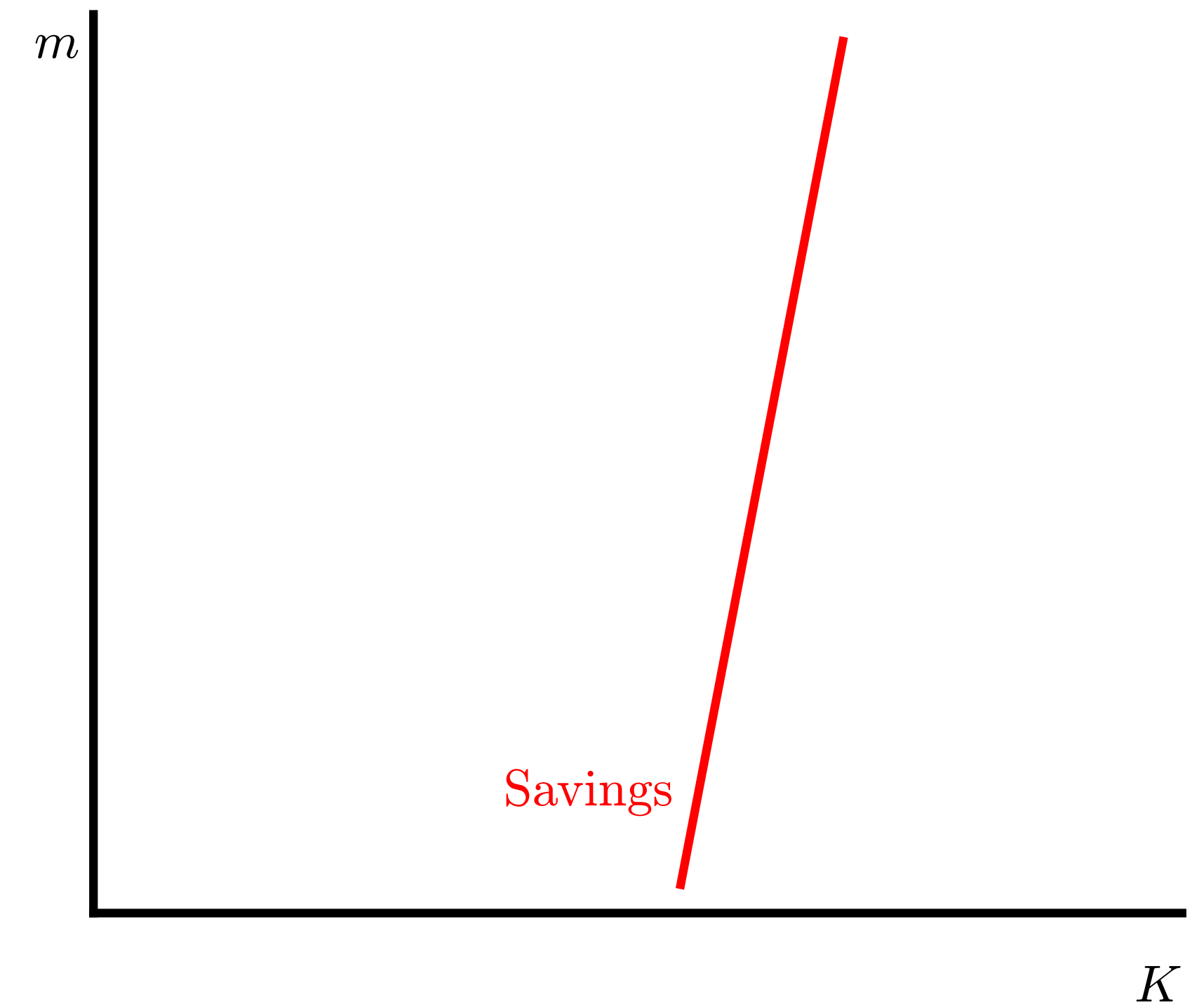
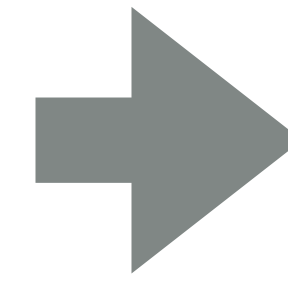
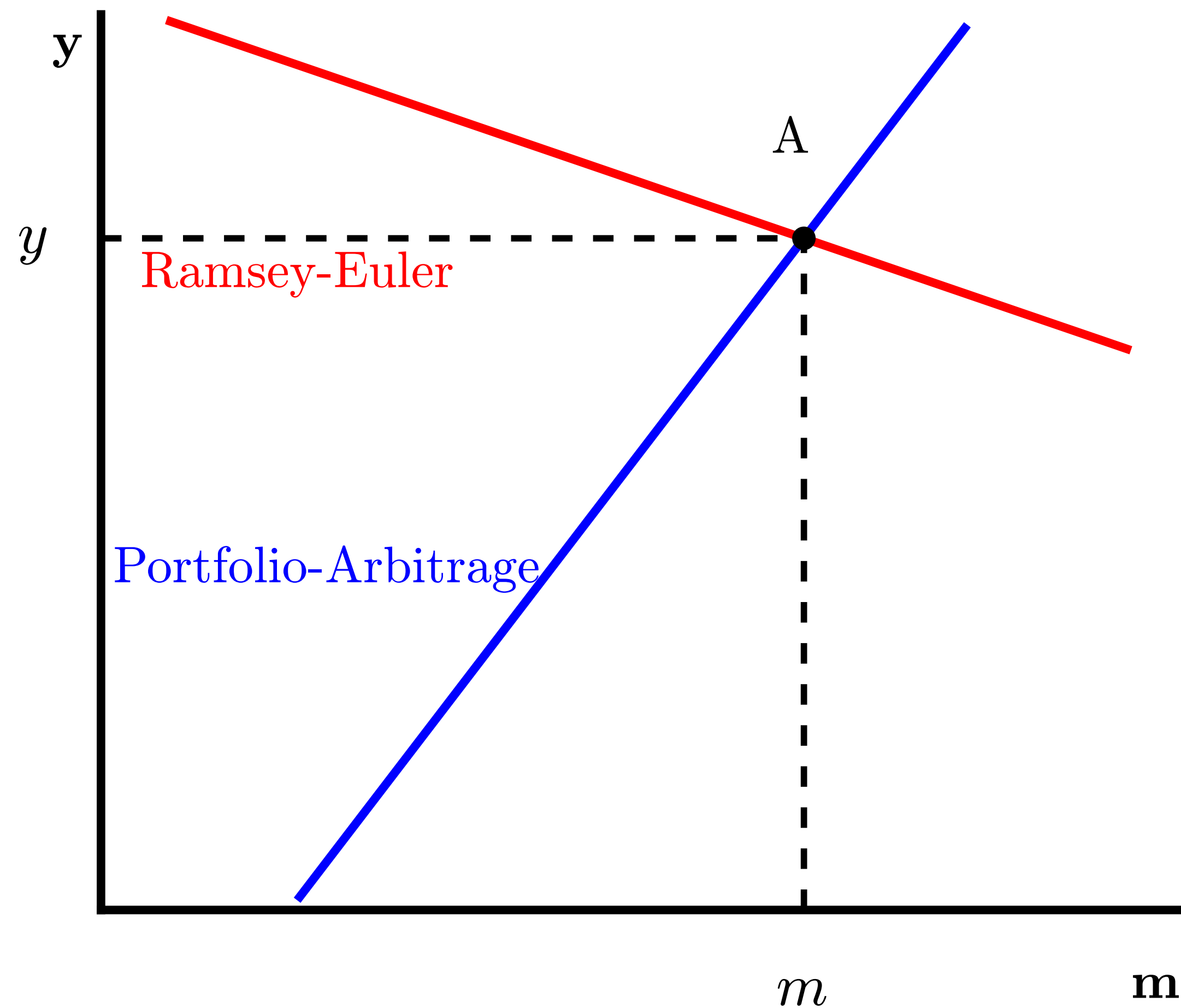


## 2. Productive versus storage savings



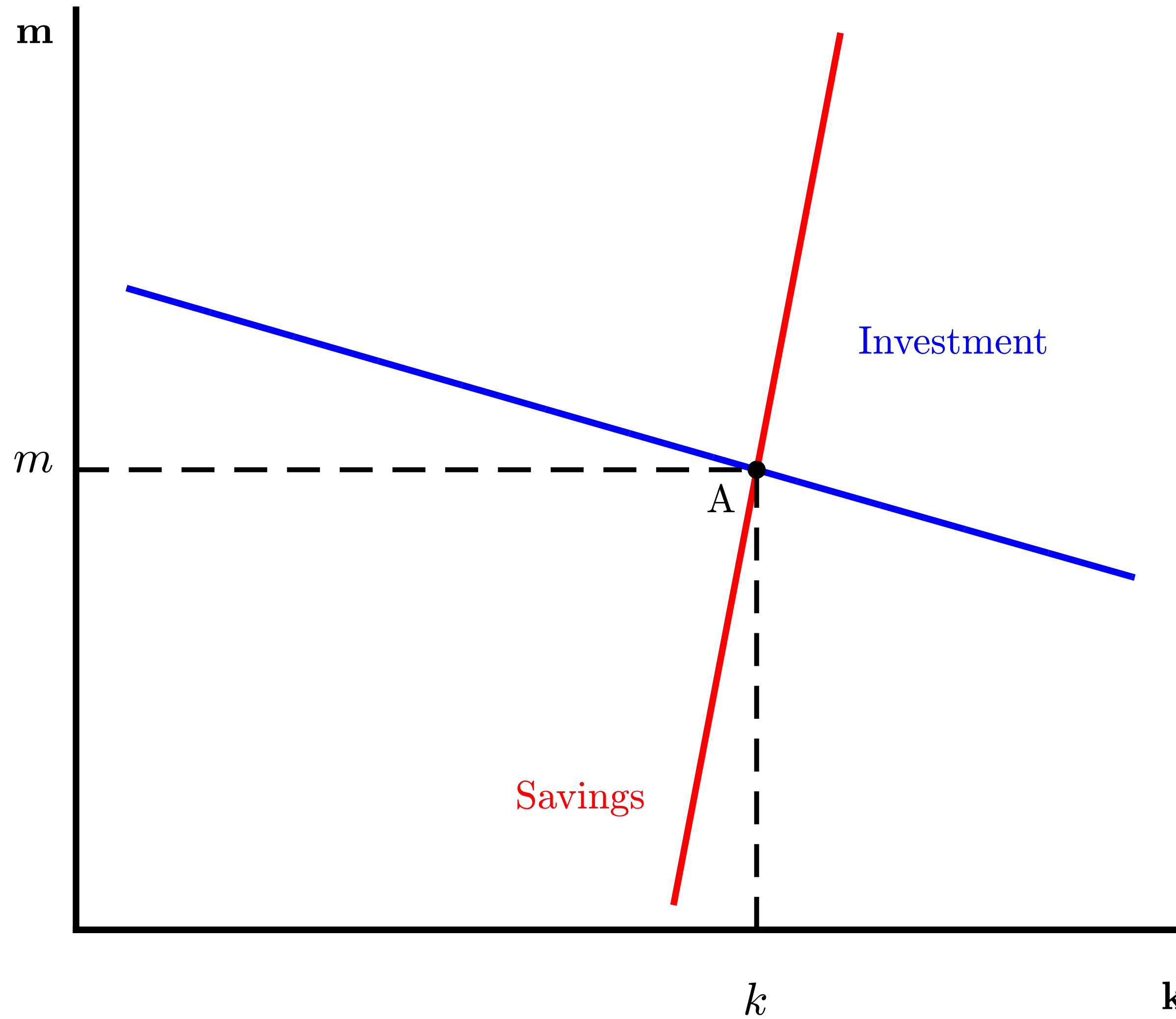
- Average return on savings = discount rate plus growth (times inverse IES).
- Average of returns on the two forms of savings: downward sloping between the two returns.
- Shifts left-down:
  - Growth falls
  - Inequality rises
  - Demography so discount less

## 2. Equilibrium



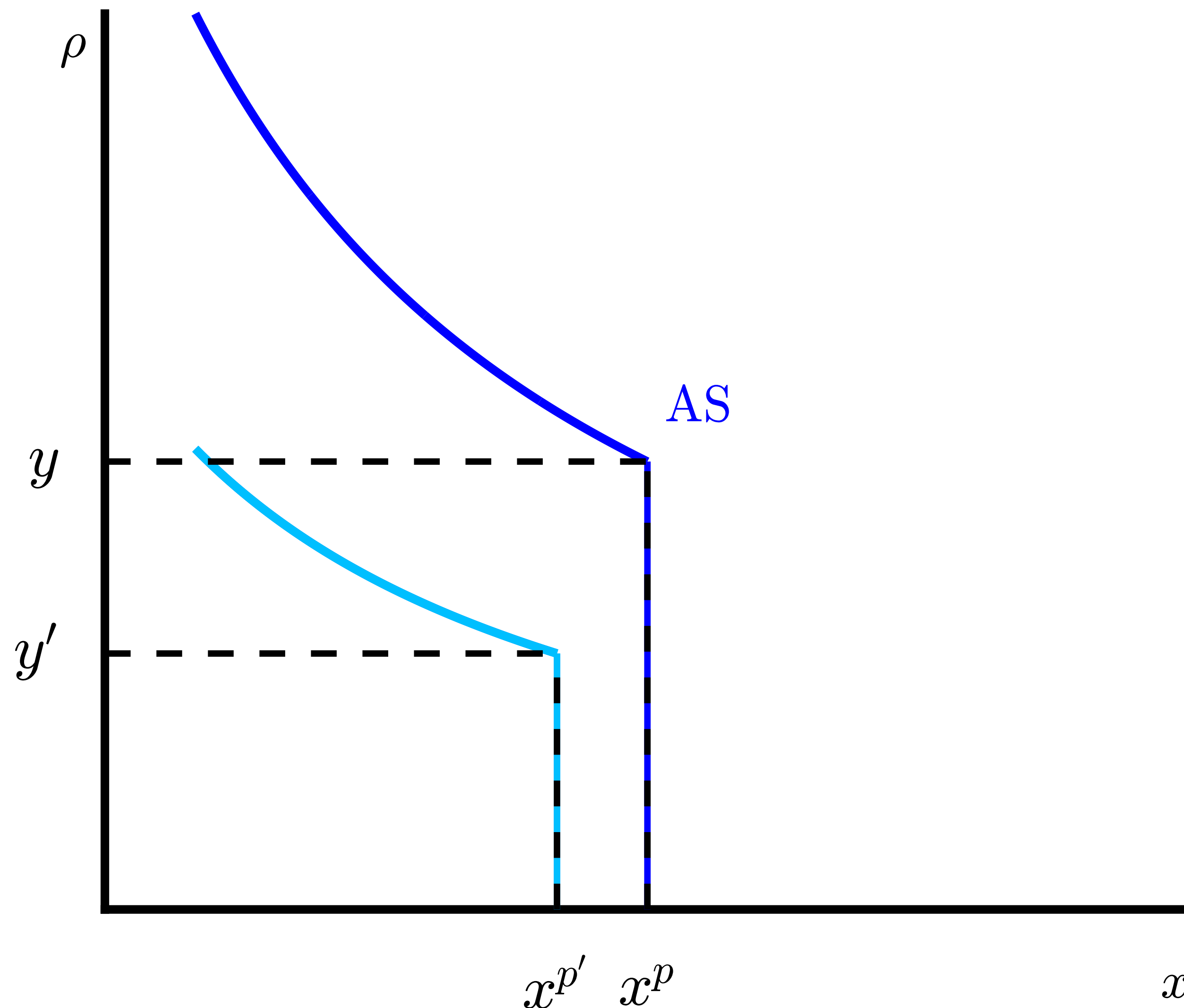
- More investment in productive assets ( $k$ ) shifts P-A right-down, raises  $m$ , Savings upward slope
- Savings shifts left-up if: (i) lower growth, (ii) aging, (iii) more financial frictions

# I and 2. Equilibrium



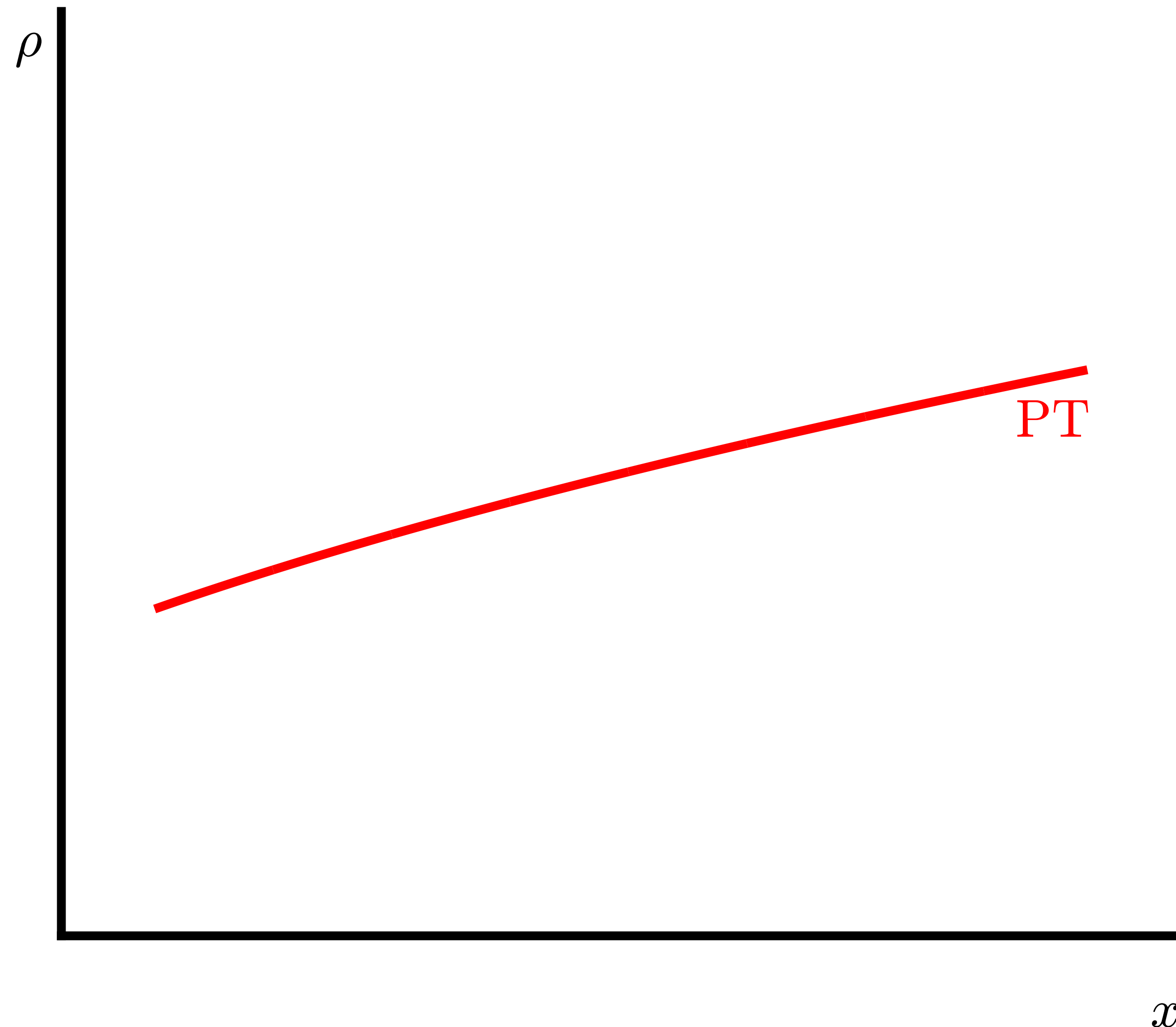


### 3. Realized returns, potential and actual output



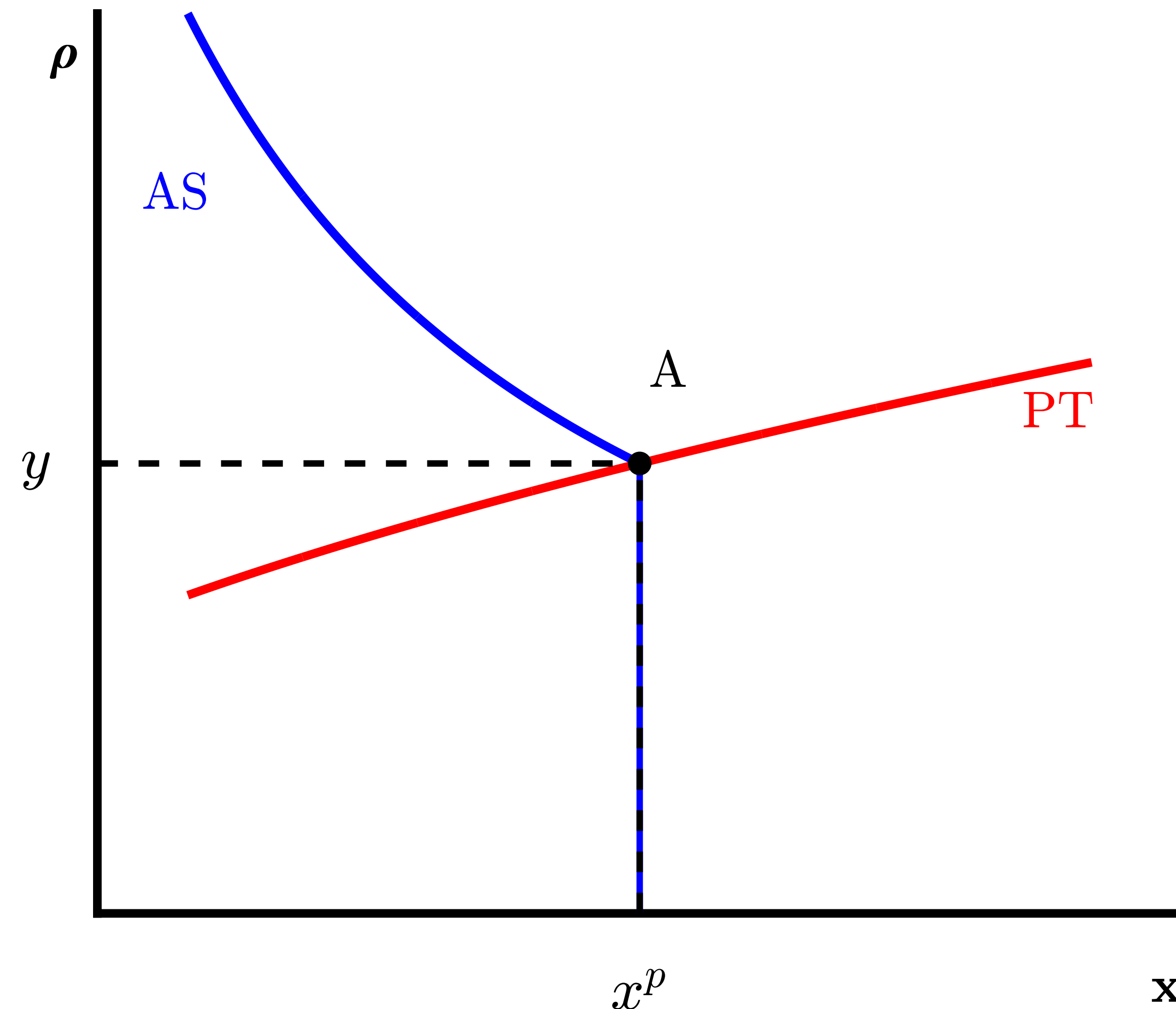
- Given productive capital, output  $x$  equals potential  $x^p$
- Variable inputs require ex post return through a norm.
- Inflation below norm, then  $\rho$  is high, inputs are less used, output is below potential  $x^p$
- Kink where  $\rho = y$
- Shifts left-down if less capital

# 4. Policy target: fiscal and monetary policy



- Aggregate demand management by fiscal and monetary policy
- Policy targets: trade-off costs of inflation versus costs of underemployment.
- Shift right-down when
  - $y$  falls
  - Target higher potential or higher inflation above norm

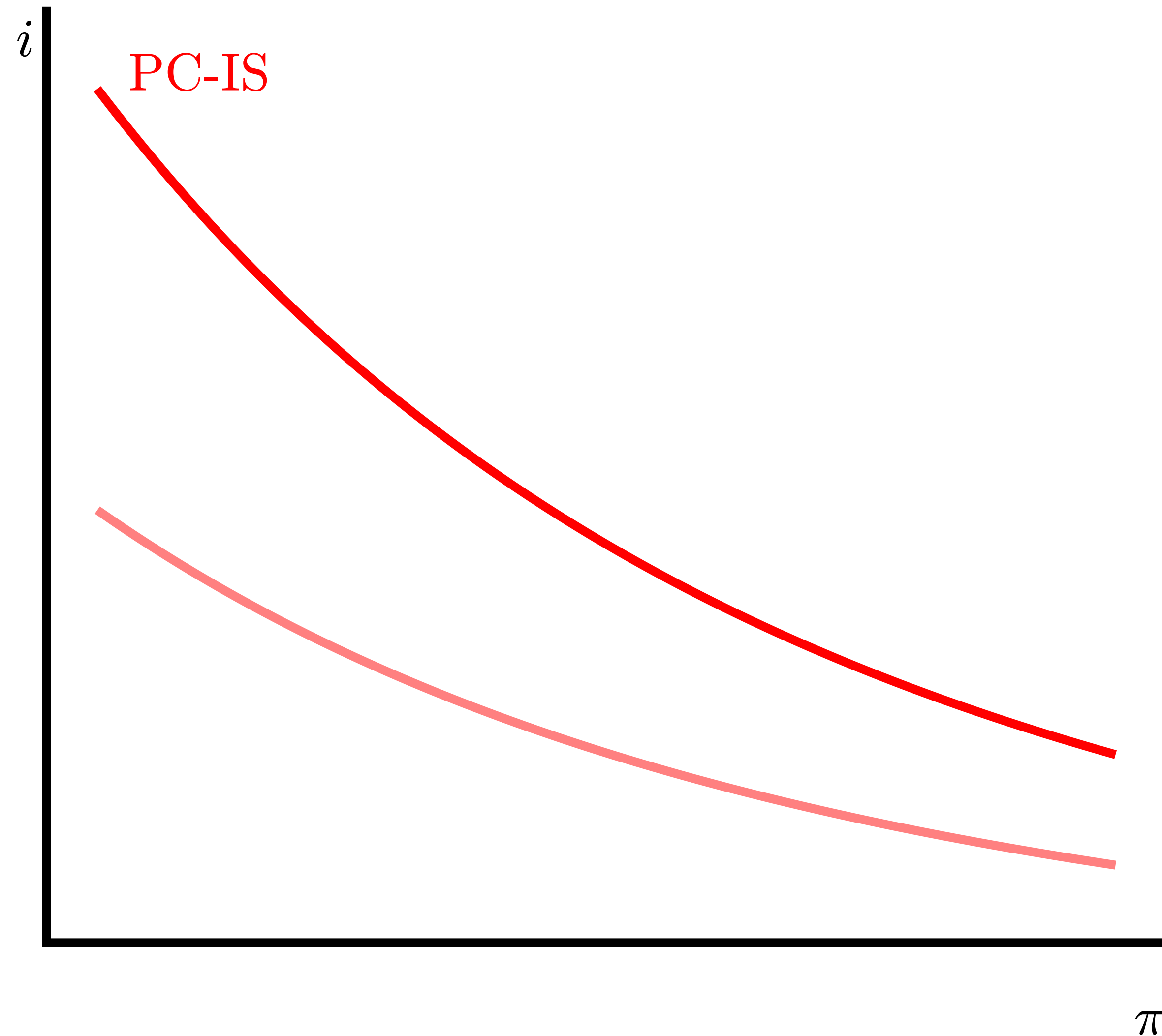
# 4. Equilibrium realized returns and output



- Goal: intersect at the kink
- Policy: target inflation equals inflation norm and target output equals potential output.
- If overdo it, intersect below kink, high inflation, realized returns lower.
- By Rational expectations, then inflation norm rises, shift **PT** left-up towards kink

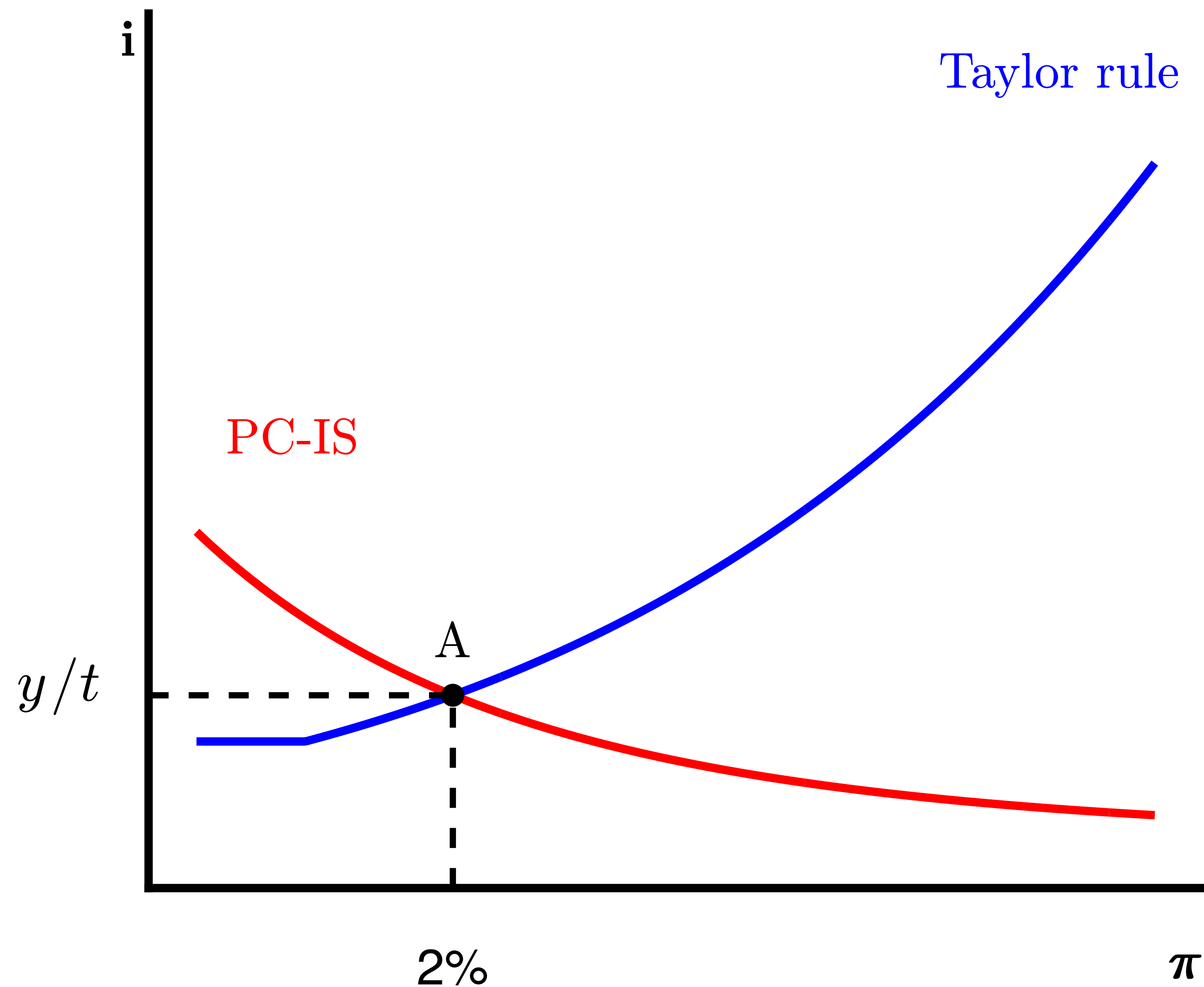


# 5. Policy rate and unexpected inflation



- Lower policy interest rate ( $i$ ) raises aggregate demand by consumers, pushes inflation high from sticky prices by firms
- Neutral/Wickselian rate:  $y/t$
- Shifts left-down if:
  - Yield  $y$  falls
  - Term premia ( $t$ ) rises
  - Expected inflation ( $\pi^e$ ) falls

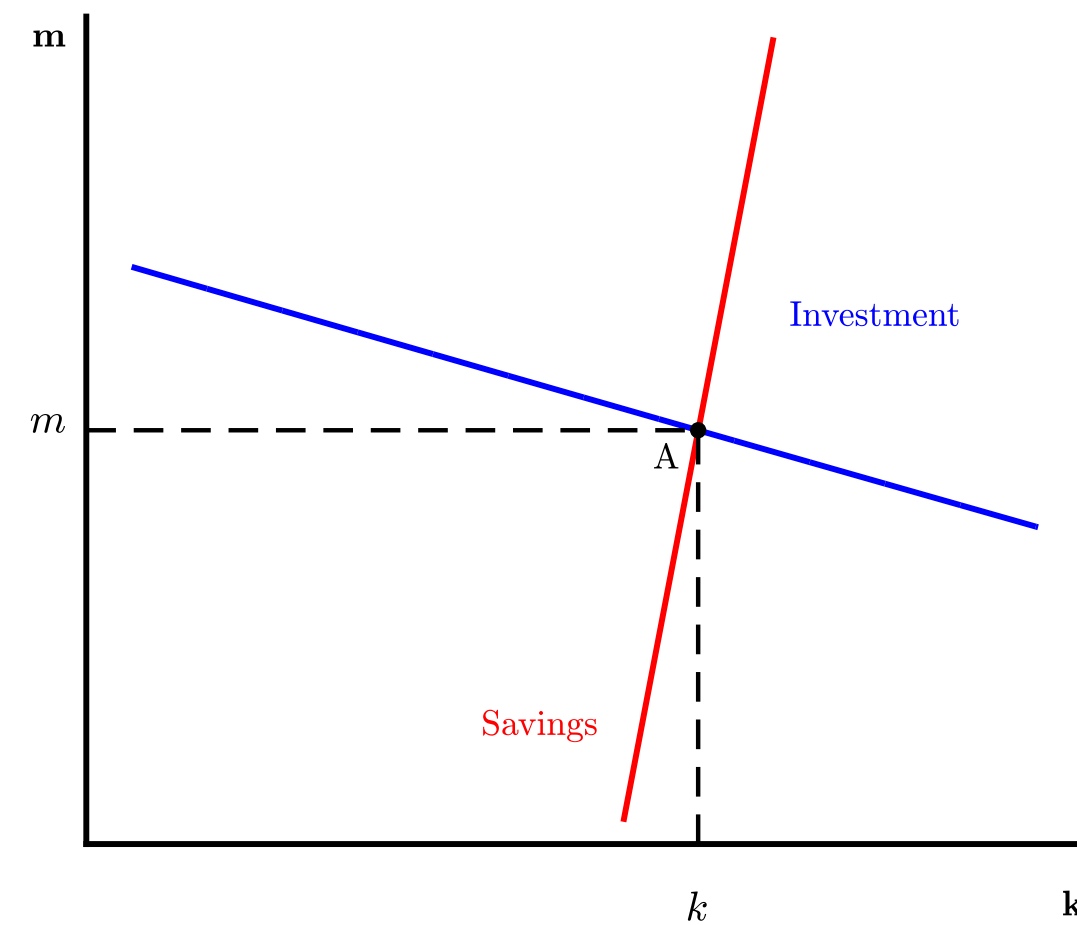
# 5. Policy rate and unexpected inflation



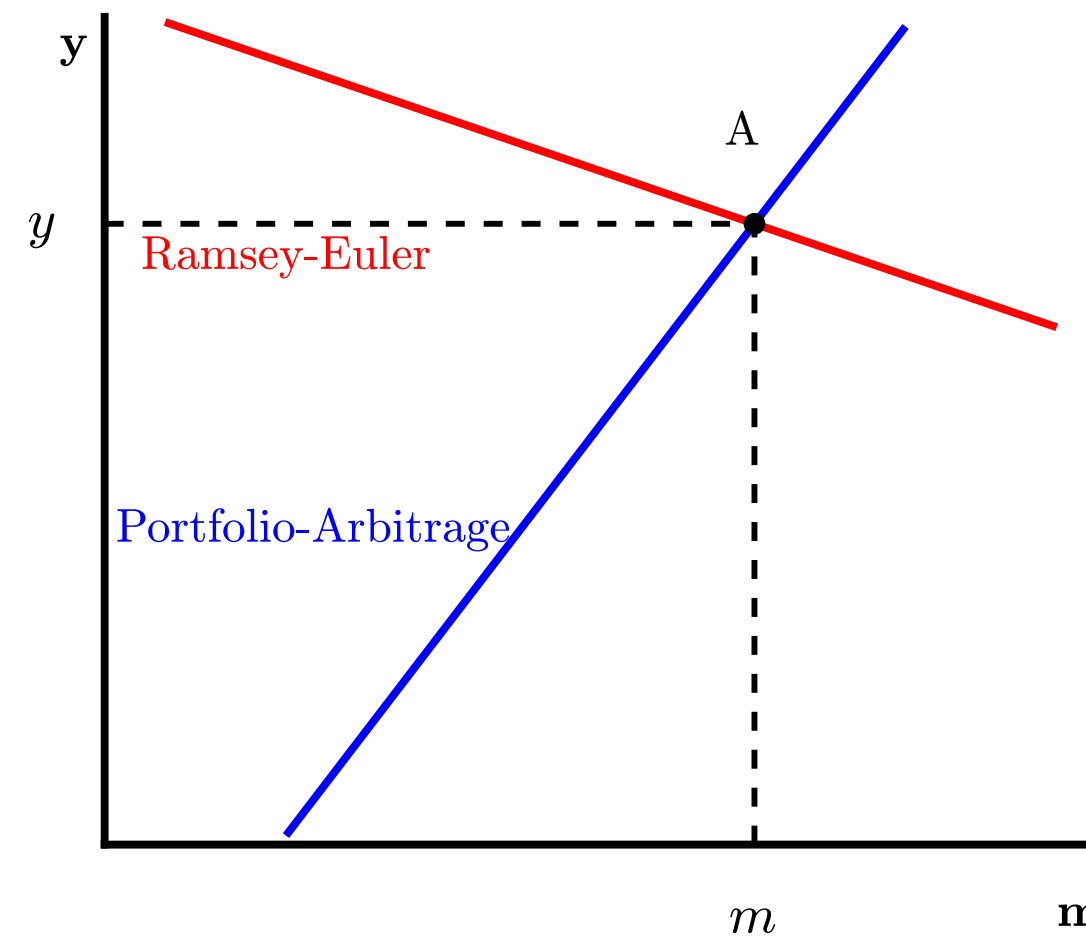
- Taylor rule for policy rate: higher inflation leads to higher policy rate, as usual.
- Shifts right /down when higher target inflation rate
- Policymaker targets the neutral rate, and if gets it right, then inflation is equal to target, as intersects the PC-IS at this level

# All together: four $r^*$ 's

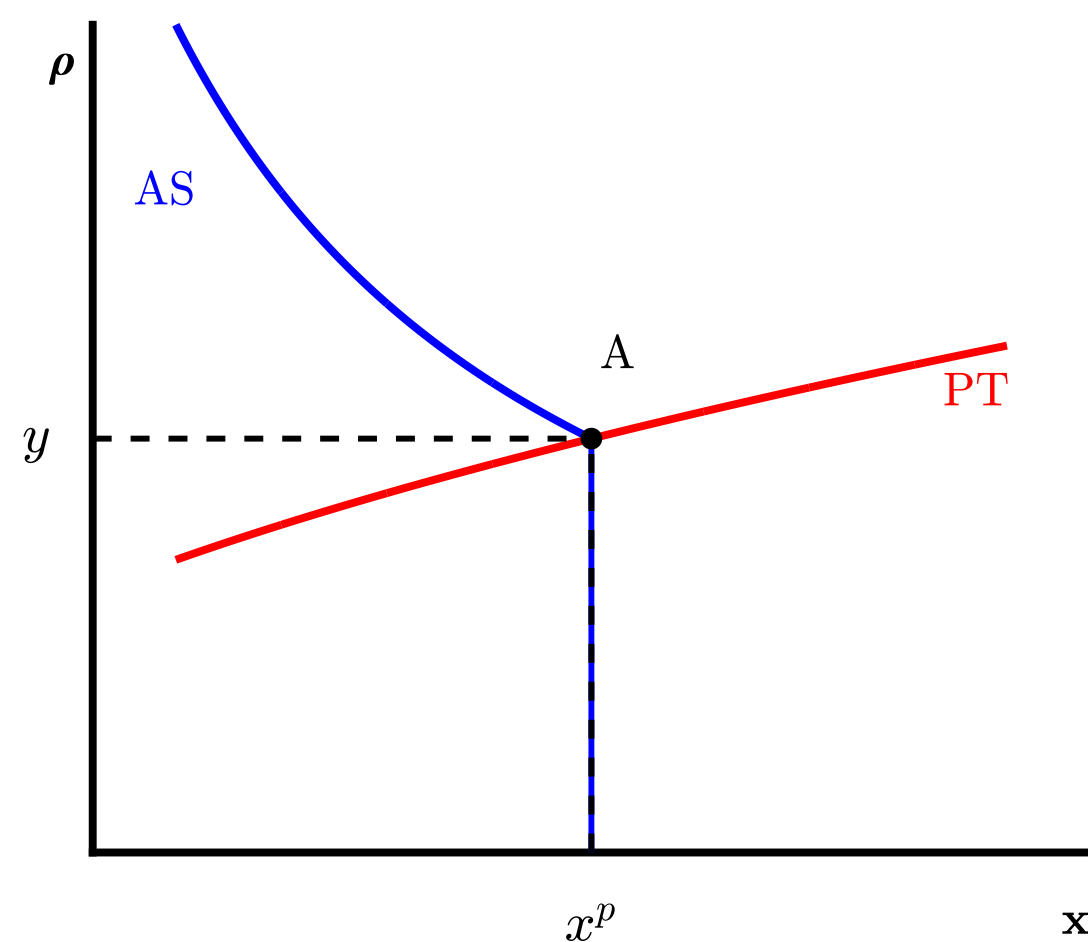
(a) Productive investment and savings



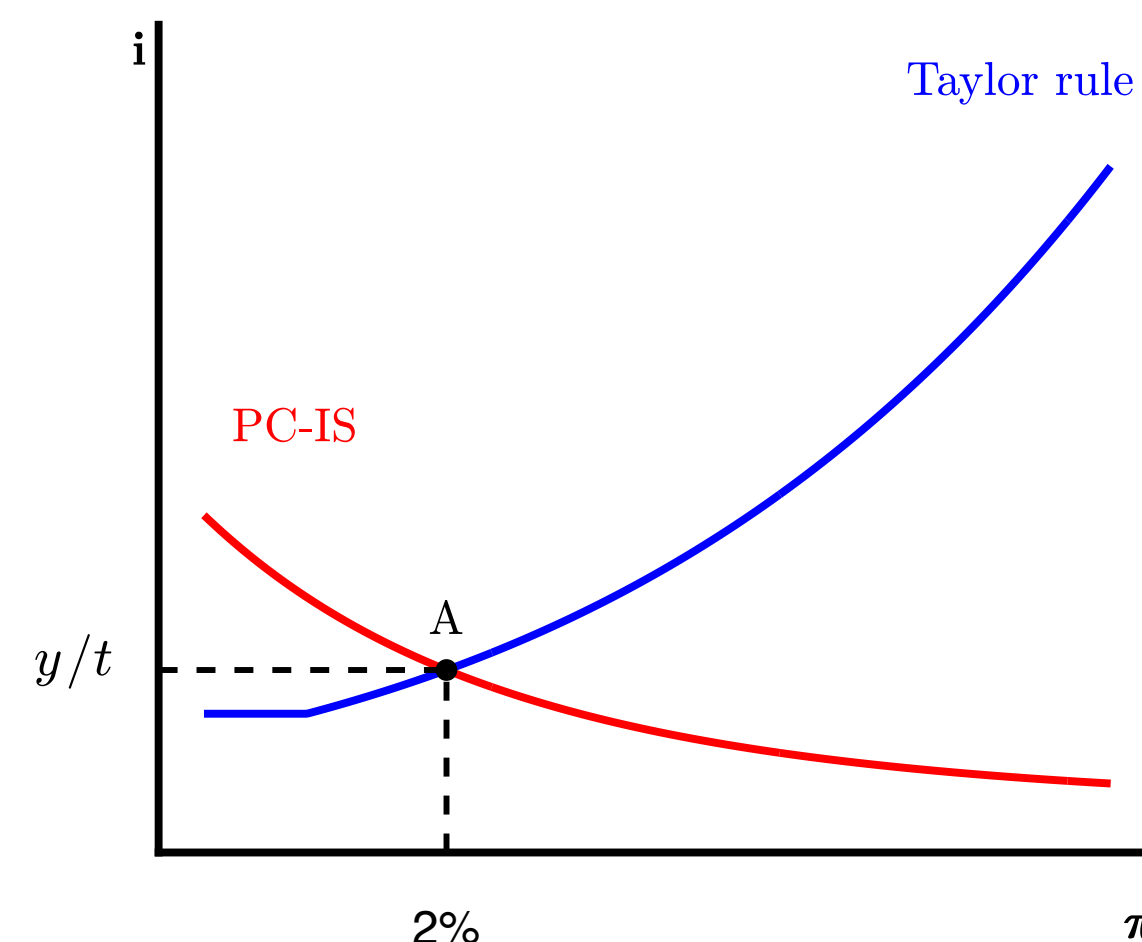
(b) Unproductive or productive savings



(c) Realized returns and policy choices



(d) Monetary policy



## Four R-stars and three macro outcomes

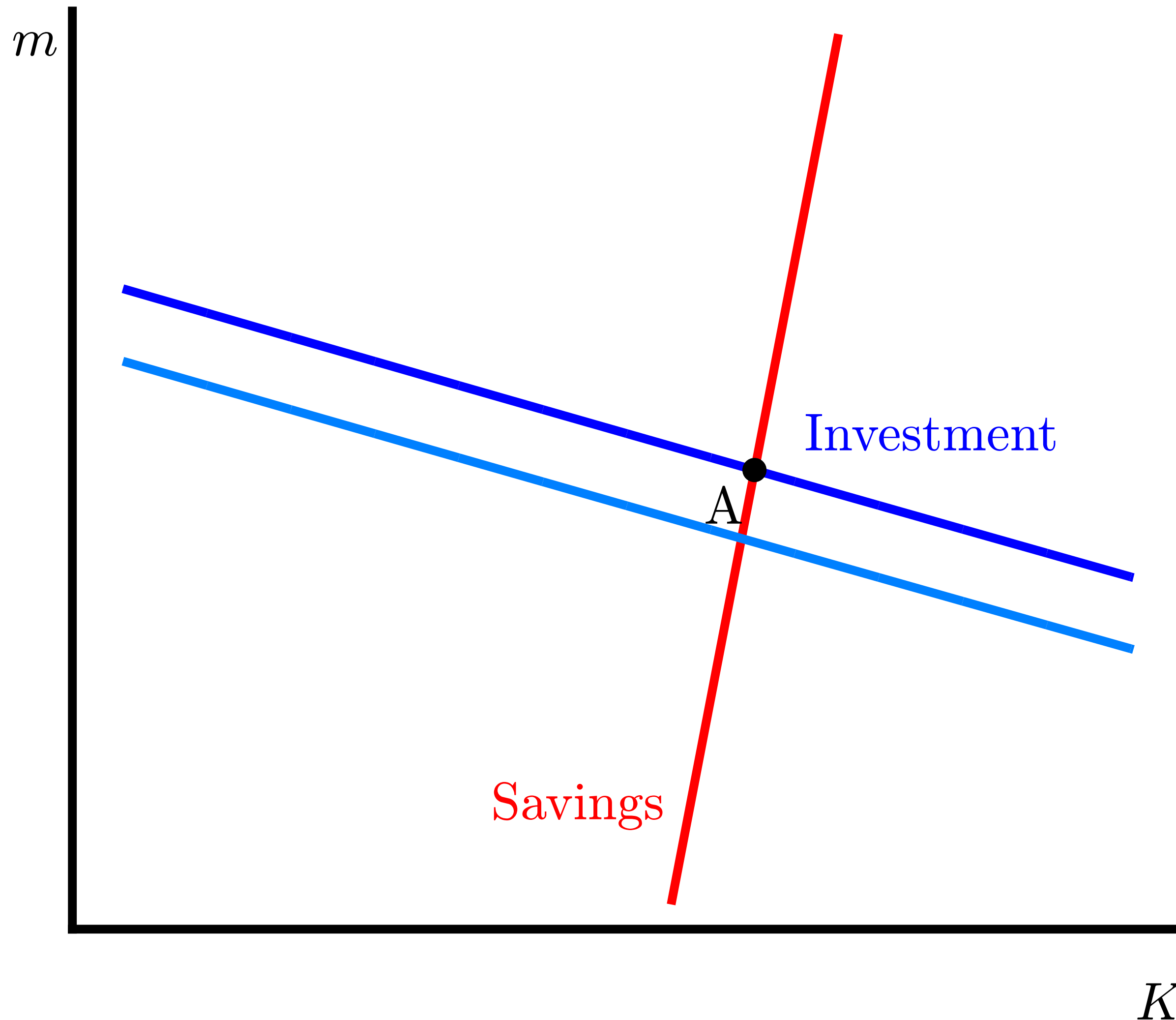
- **Structural determinants:** growth, demographics, productivity, competition, financial frictions
- **Norms, expectations:** compensation, expected inflation, term premium
- **Policy goals / targets:** potential output, inflation target, neutral rate pursued



# **USING THE FRAMEWORK TO ACCOUNT FOR THE 1995-2019 TRENDS**

# Fundamentals from literature on investment

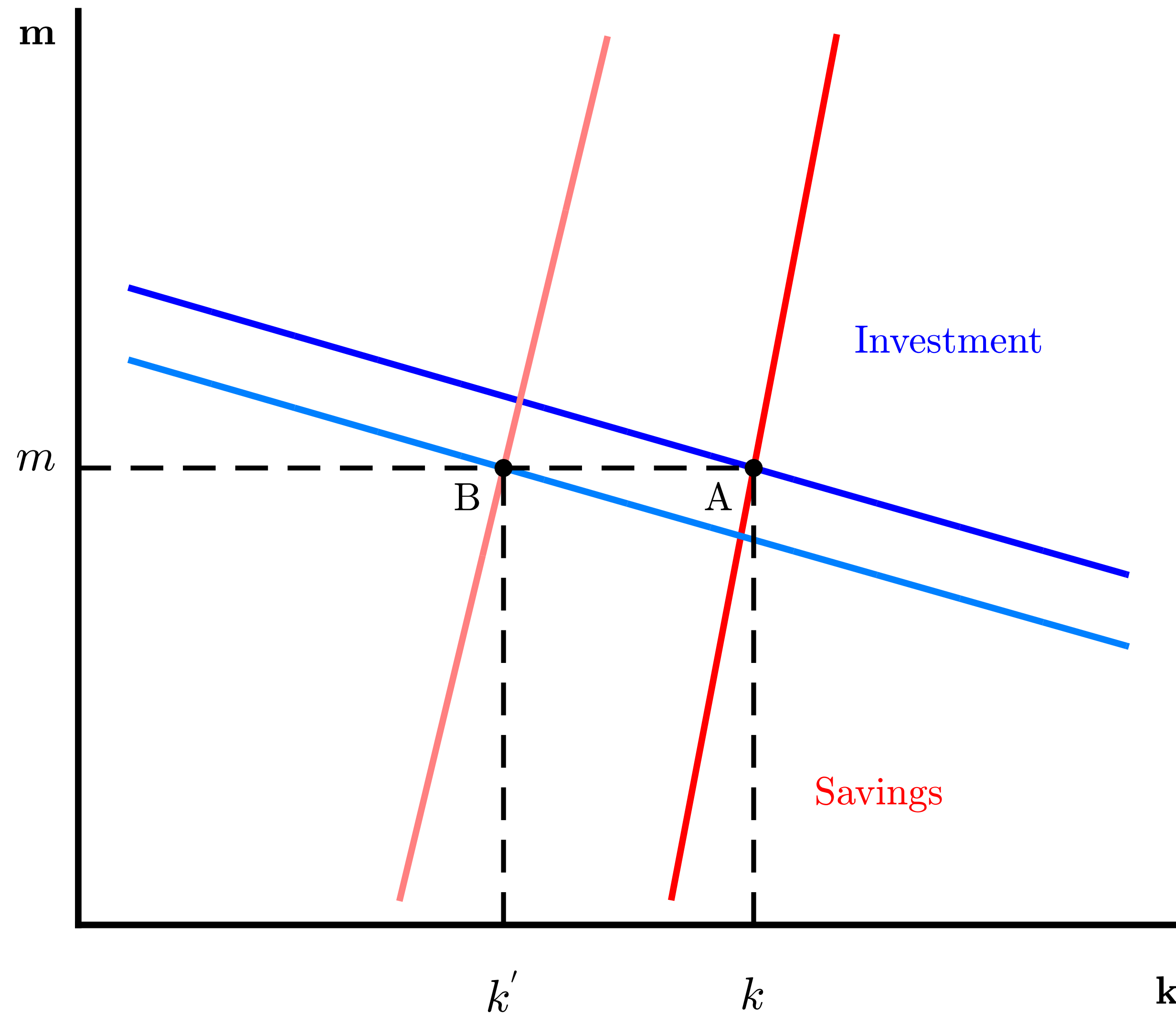
## Investment curve left-down



- Rachel Smith (17), Rachel (23).
  - (1) Fall in relative price of capital
  - (2) Lower economy and population growth rate.
  - (3) Decline in public investment
- I would add:
  - (4) Higher depreciation
  - (5) Higher markups

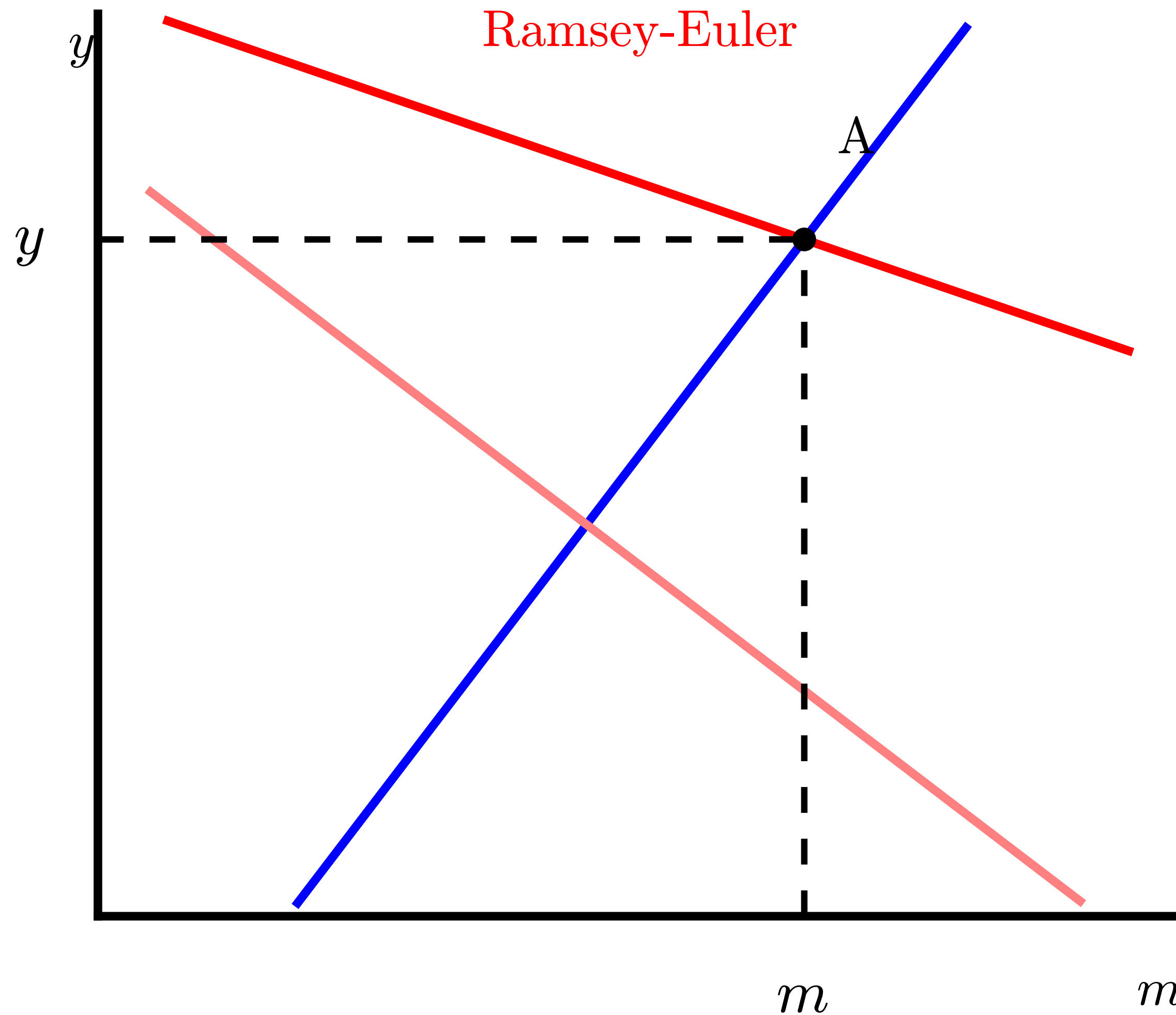
# But data says $m$ constant or barely fell

- Therefore **S**avings curve must have shifted left-up
- Consistent with data on depressed investment
- To see why **S** may have shifted left and what about **y** turn to the next plot...





# Fundamentals from the literature on savings



- Rachel Smith (17), Rachel (23).  
(1) Demographics: ageing  
*RE left-down*  
(2) Productivity and population  
*RE left-down*  
(3) Rising inequality  
*RE left-down*
- But would lead to  **$m$**  falling as much (or more) than  **$y$** .

# P-A to the right-down is consistent with m-y

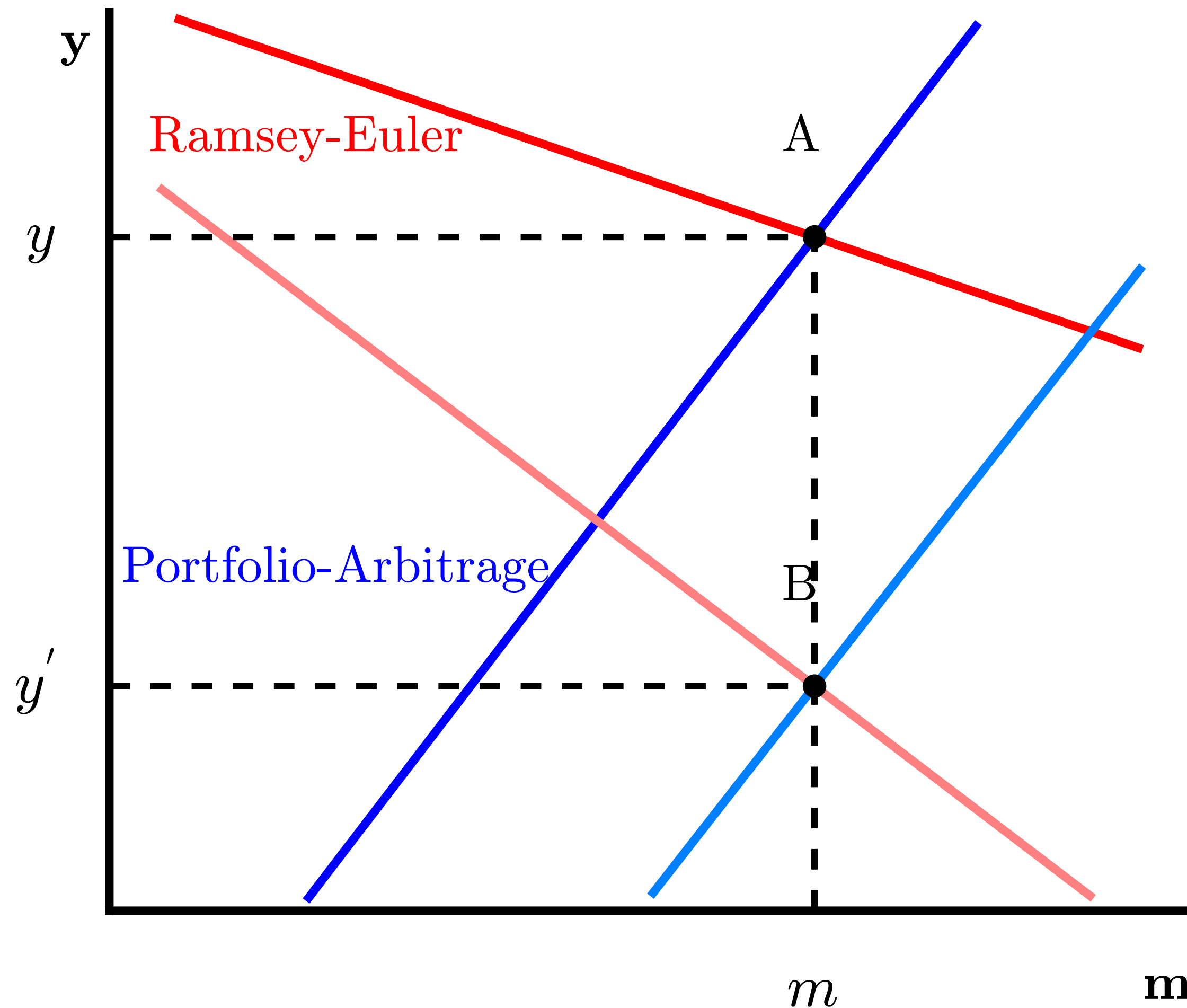
Portfolio-Arbitrage right-up:

(1) Global imbalances

*SE Asia reserve accumulation  
desire liquidity.  
State-controlled foreign investors  
prefer safety.*

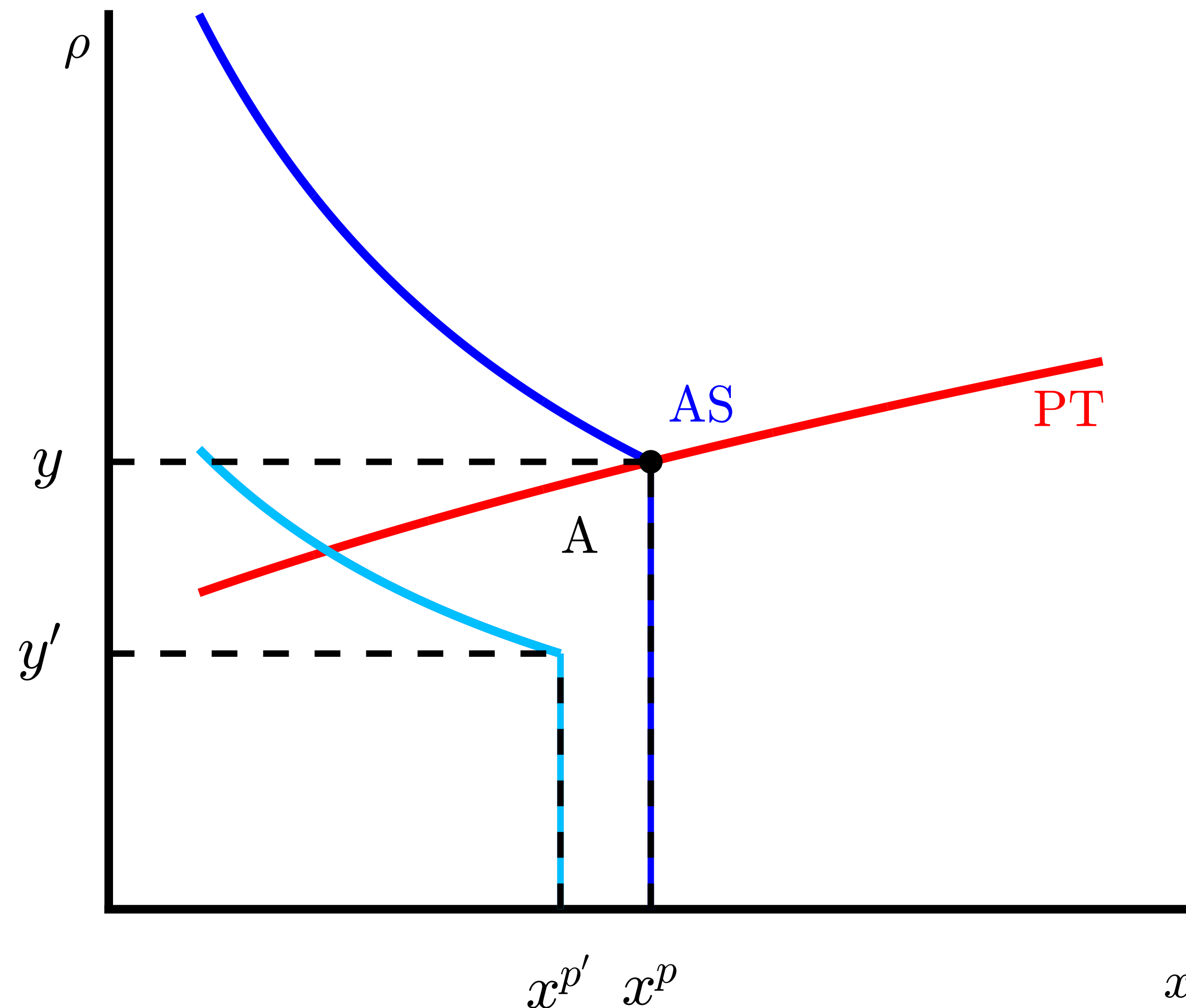
(2) Global financial crisis

*Risk aversion and regulation rise.  
Decrease in private supply of  
storage.*



# Policy challenge from high m-y world

- **AS** shifted left-down
  - (1) less investment means less productive capacity
  - (2) higher markups
  - (3) higher depreciation rate



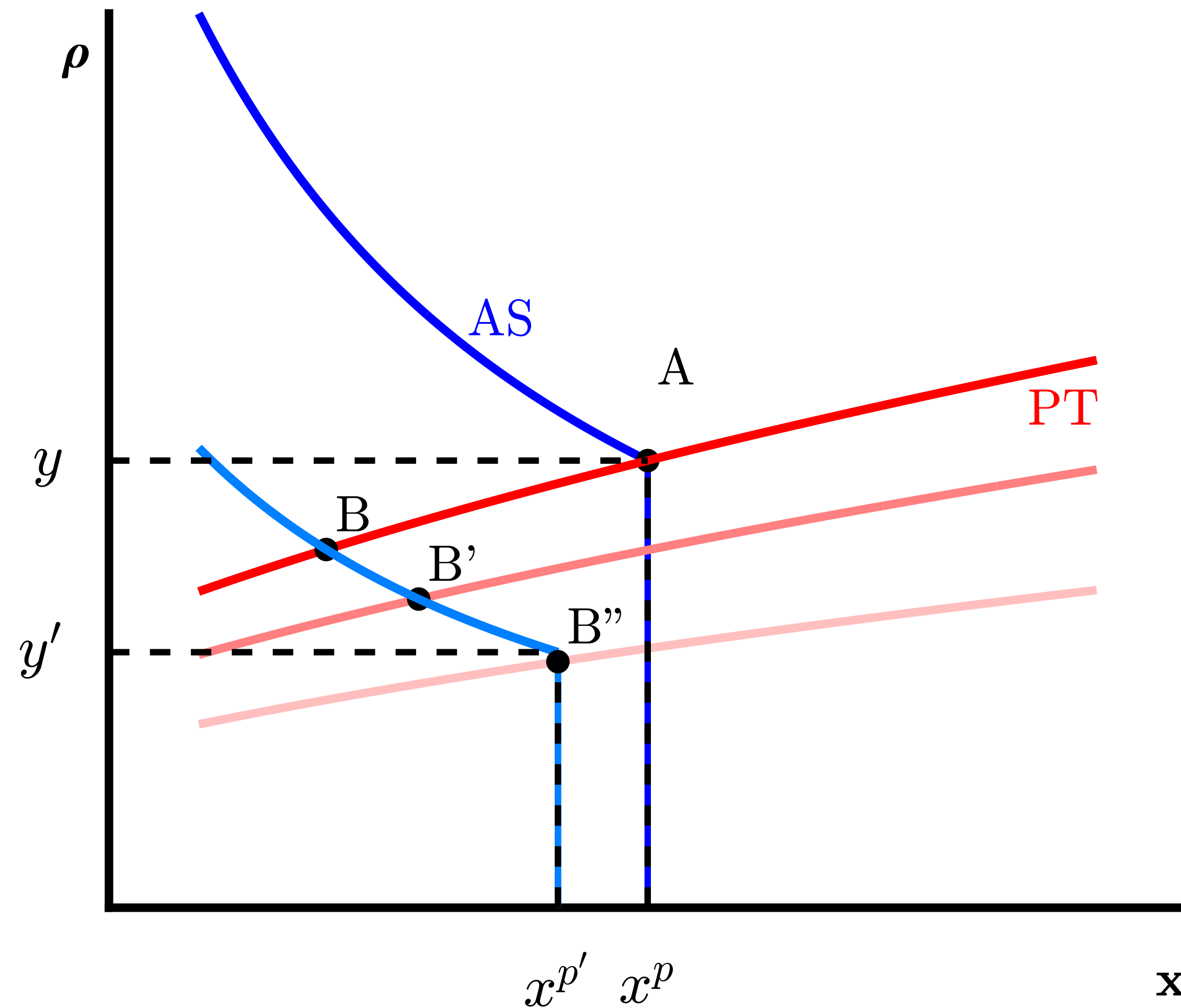
Vertical kink is lower

(1) as  $y'$  is lower

Underemployment with  
unchanged policy: 2008-12

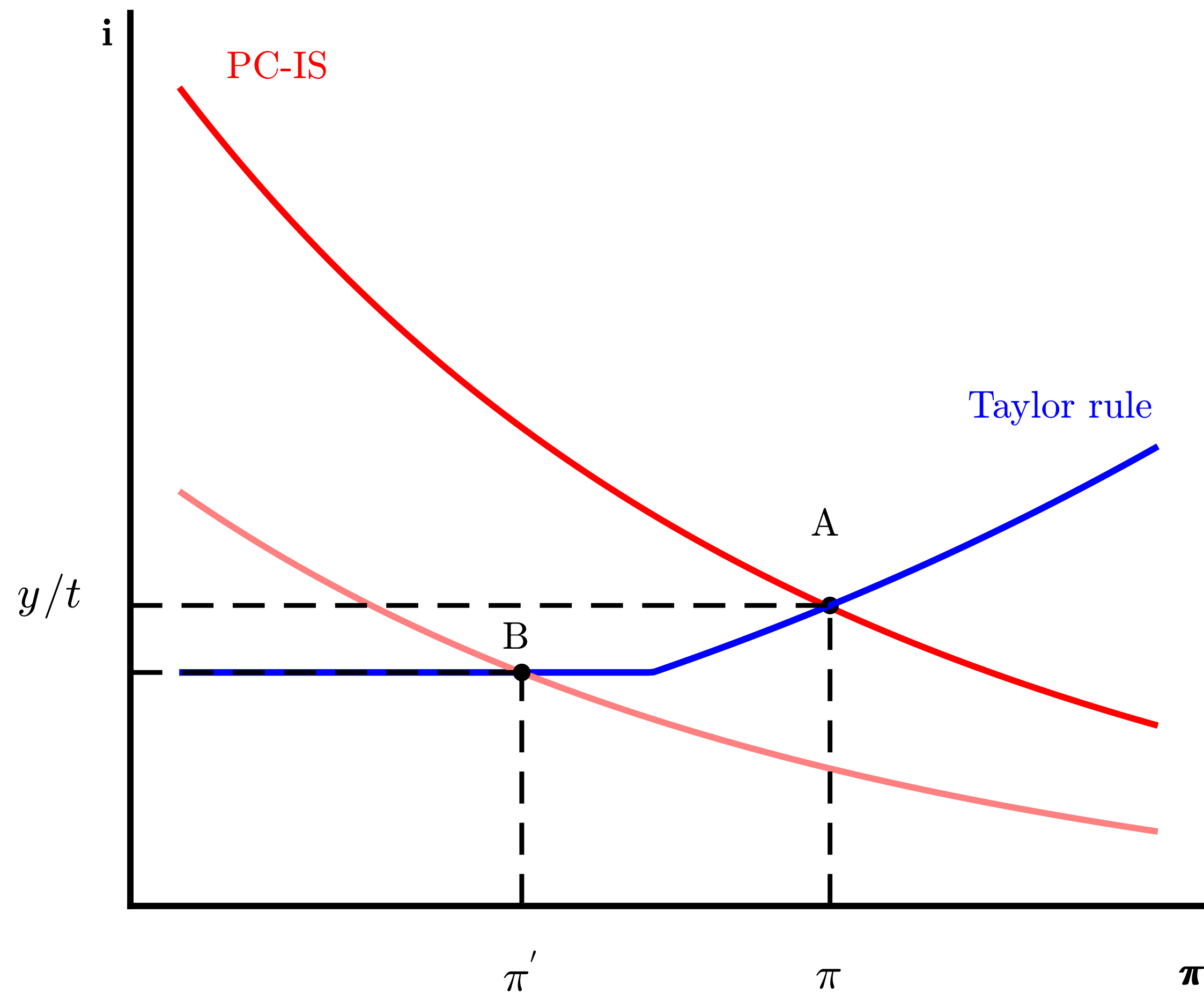


# Policy challenge of low $r$ , high $m$ world



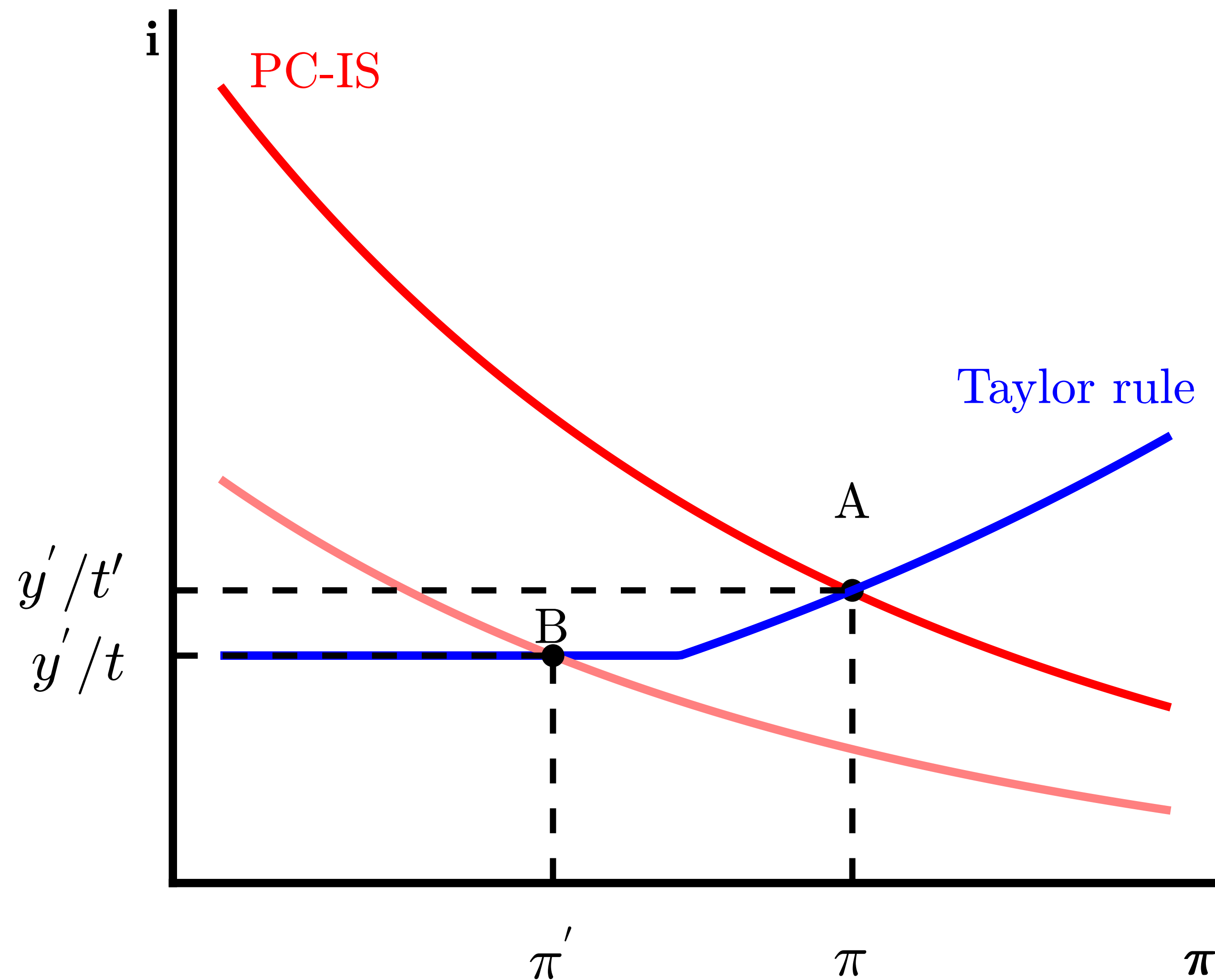
- Policy challenge: shift **PT** right-down from B towards B''
- Fiscal policy large deficits
- Monetary policy kept rates at zero.
- Also, norms adjusted: persistently lower returns, lower inflation norm (less union power, Chinese “deflation” forces)
- 2012-19

# Inflation and the ZLB problem



- With a lower  $y$ , the *PC-IS* shifted left-down
- Policy had to adjust policy to a lower interest rate, but with ZLB, low-inflation trap, point *B*.
- The low inflation delivers the realized returns that led to under-employment, and ZLB explains why *PT* curve not shift enough, need for fiscal

# The term premium to the rescue



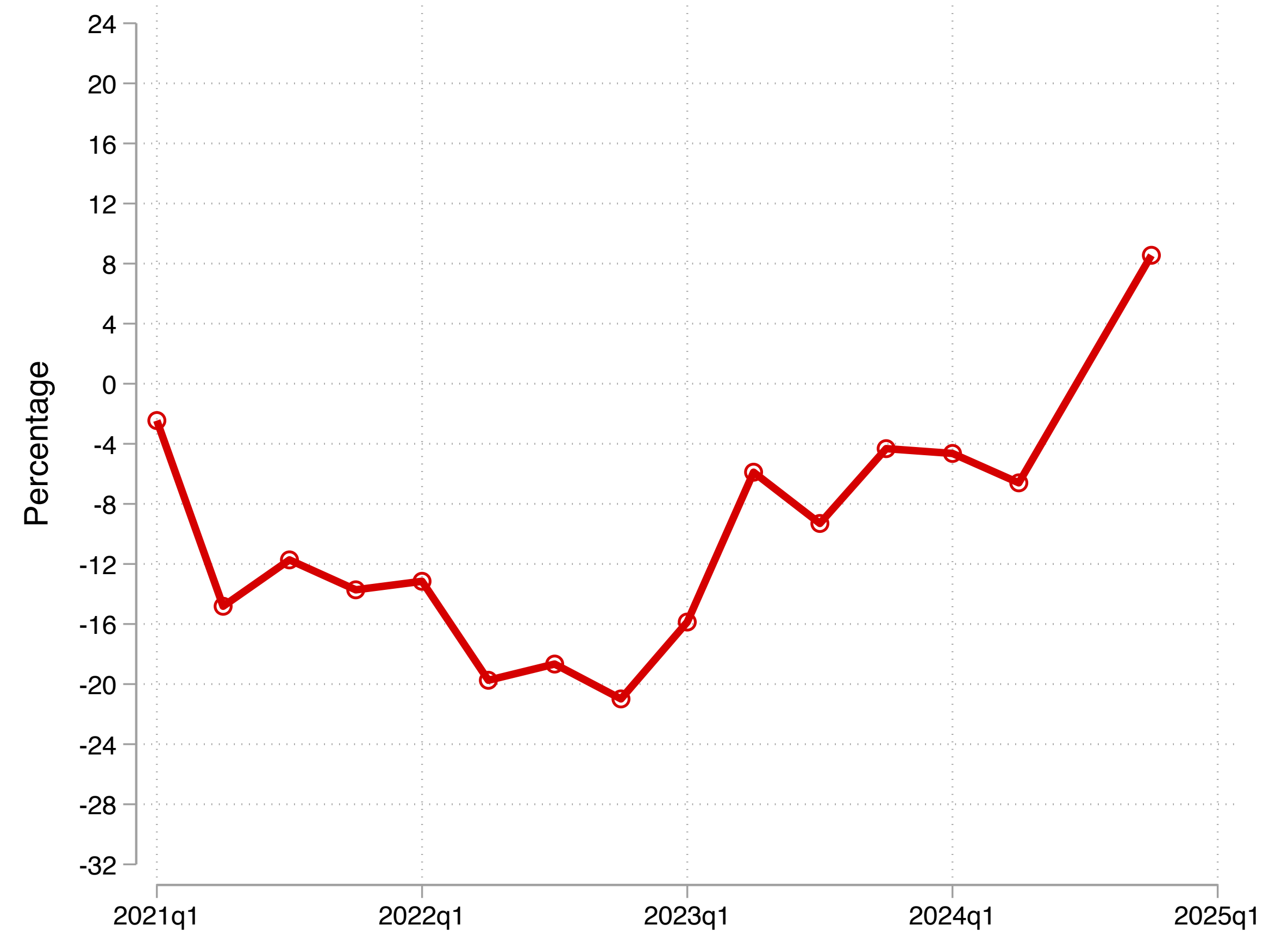
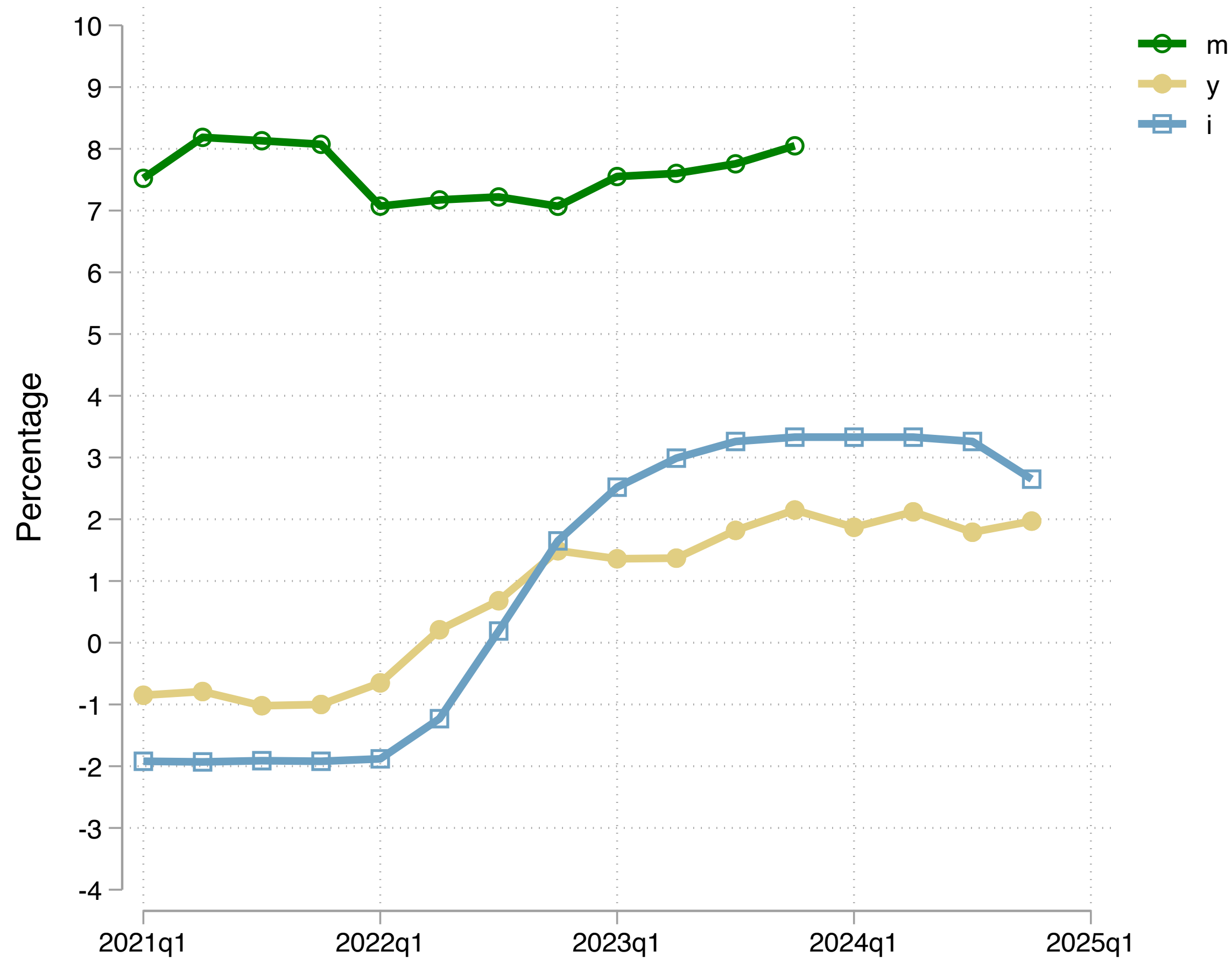
- Unconventional monetary policy (QE and others) lowered term premium to get out of ZLB and raise inflation.
- Get back to **A** by lowering  $t'$
- In EZ, not quite all the way, but towards there.



# THE PRESENT



# What are the data showing? US, 3 years

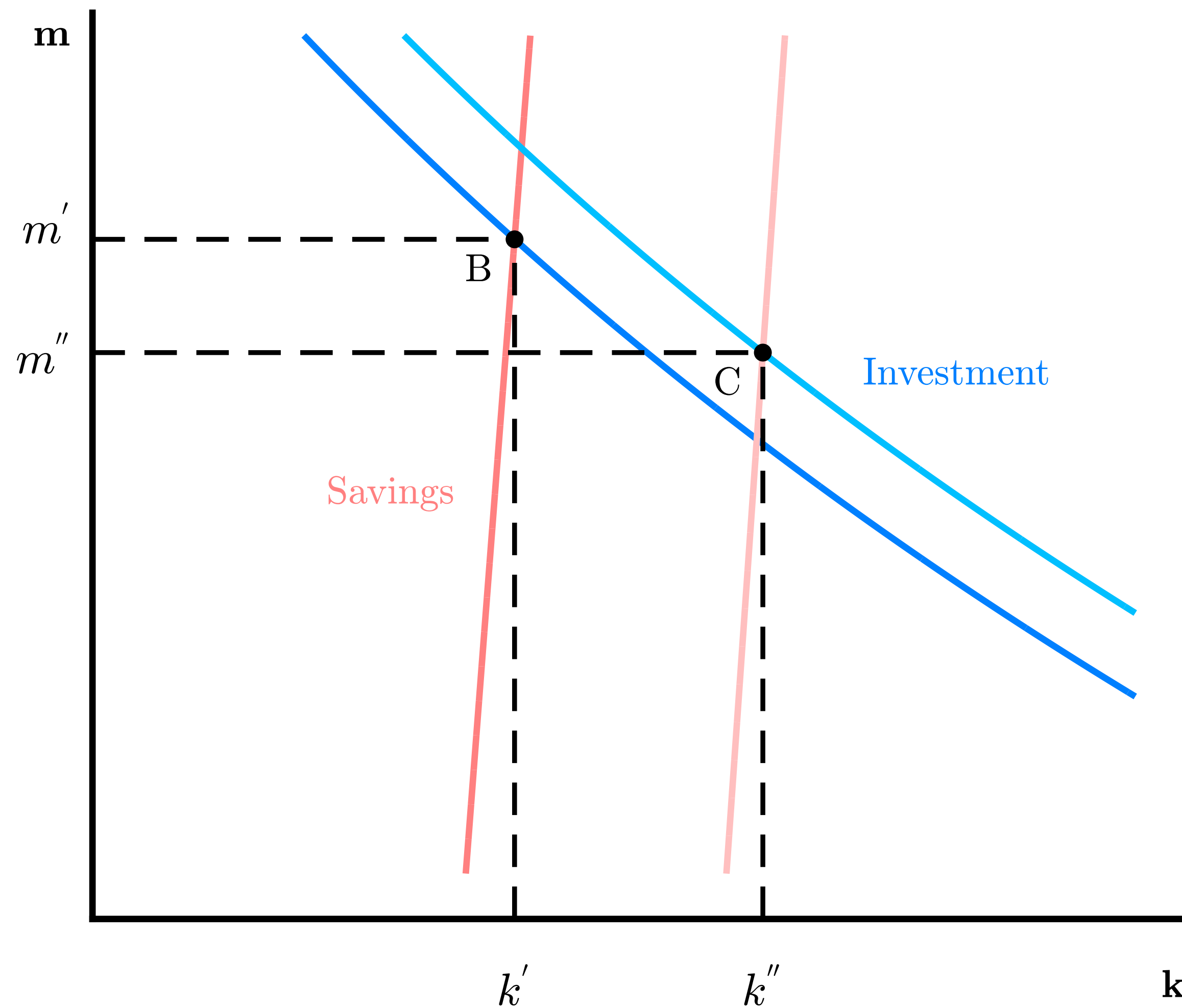


$m$ : slightly lower and investment picked up

$y$ : much higher, with  $i$  lagging

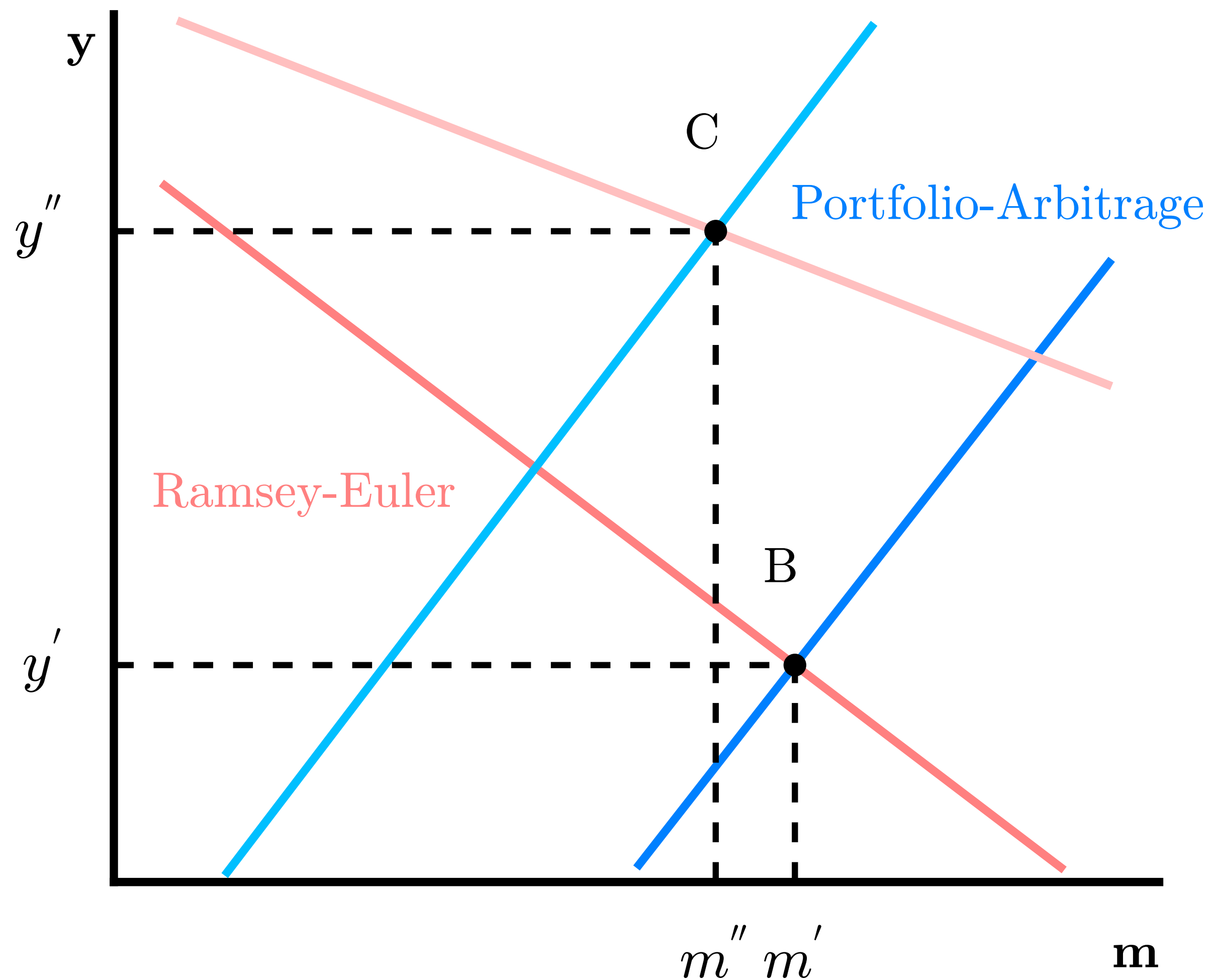
$\rho$ : extremely low, unexpected inflation

# If last few years persist: why higher $y$ ?



- Shift left-up in ***P-A***:
  - (1) Government bonds no longer perceived as safe and liquid
  - (2) Global imbalances reversal
  - (3) Elections and fiscal/monetary mix going forward
- ***R-E*** shift up-right for ***m*** stable:
  - (4) Consumption spree post pandemic,
  - (5) Optimism about AI

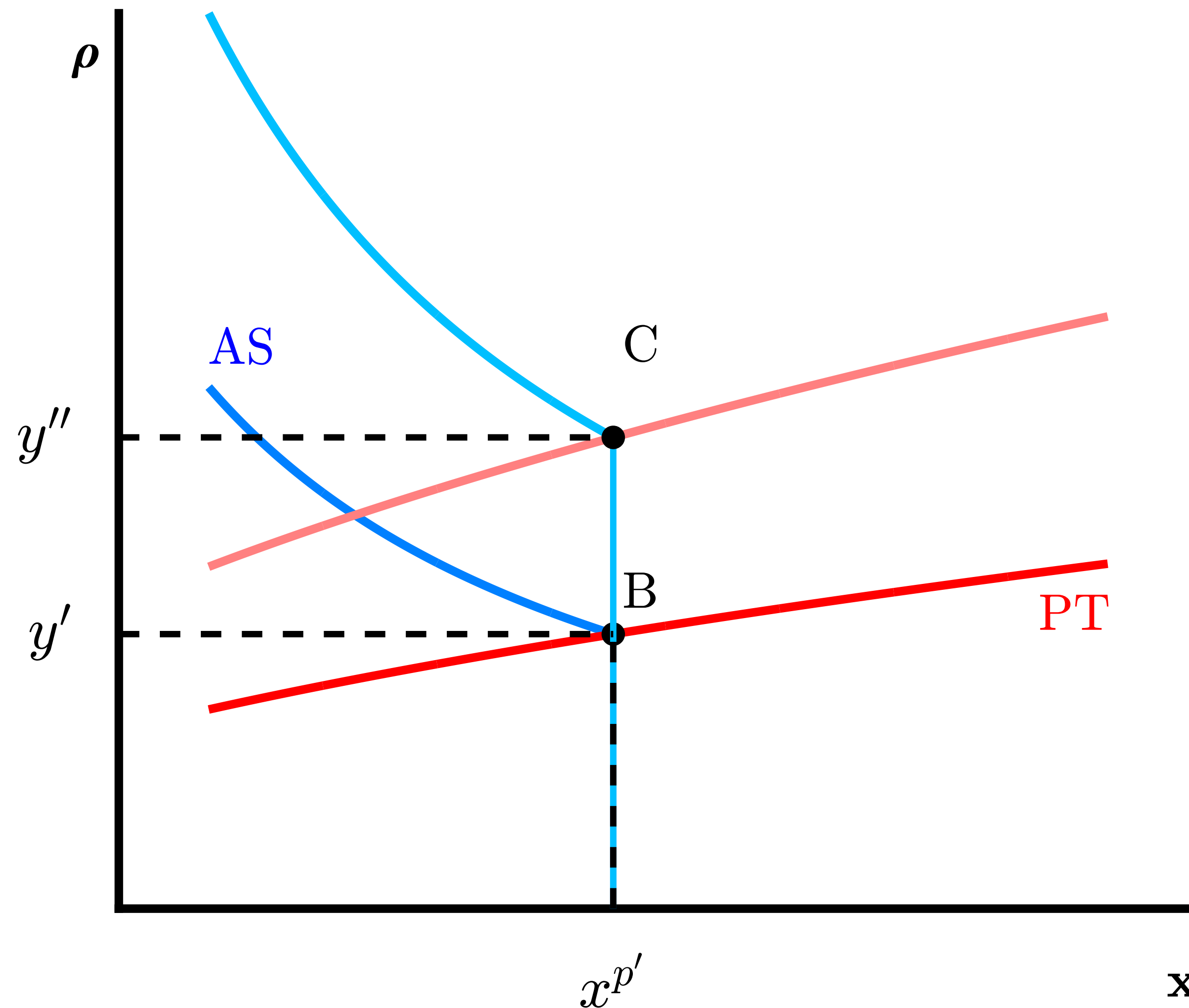
# If last few years persist: $m$



- Shift down/right of **S**avings line from previous slide, brings down  $m$  and  $K$
- Shift up/right in **I**nvestment keeps  $m$  high, as a result of:
  - (i) AI optimism
  - (ii) rise in public investment
- These are small for now, but if keep on picking up, rise in investment and gradually drive down of  $m$

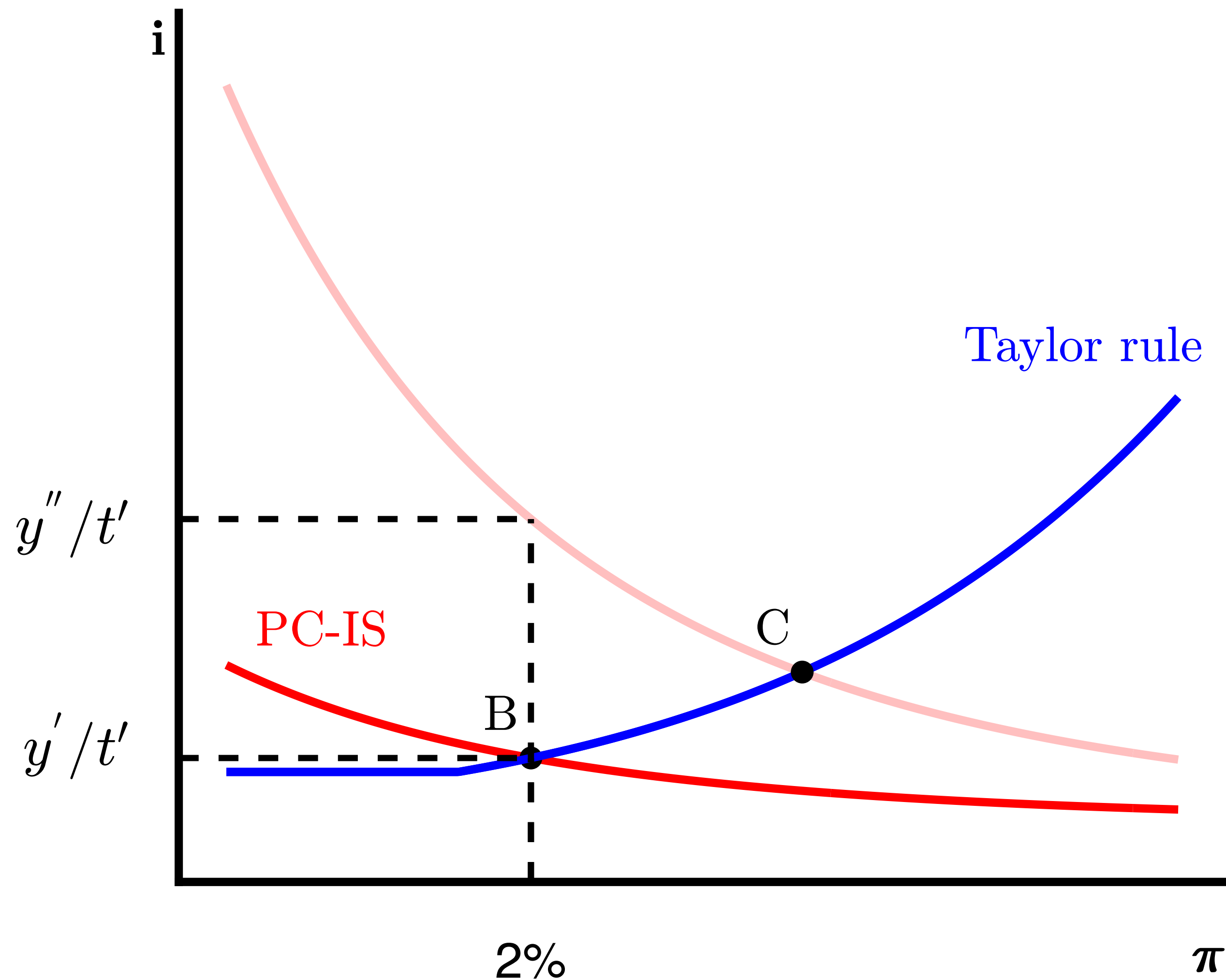


# What happened in last few years: inflation



- With persistently higher  $y$ , then vertical kink becomes higher.
- With unchanged policy: **B** higher inflation, low returns for bondholders
- Why tolerated in 2021-22?
  - (i) to avoid under-employment
  - (ii) pressure to inflate debt.
- Eventually adjust, **PT** shifts up-left, towards point **C**, 2023-24

# Policy in last few years



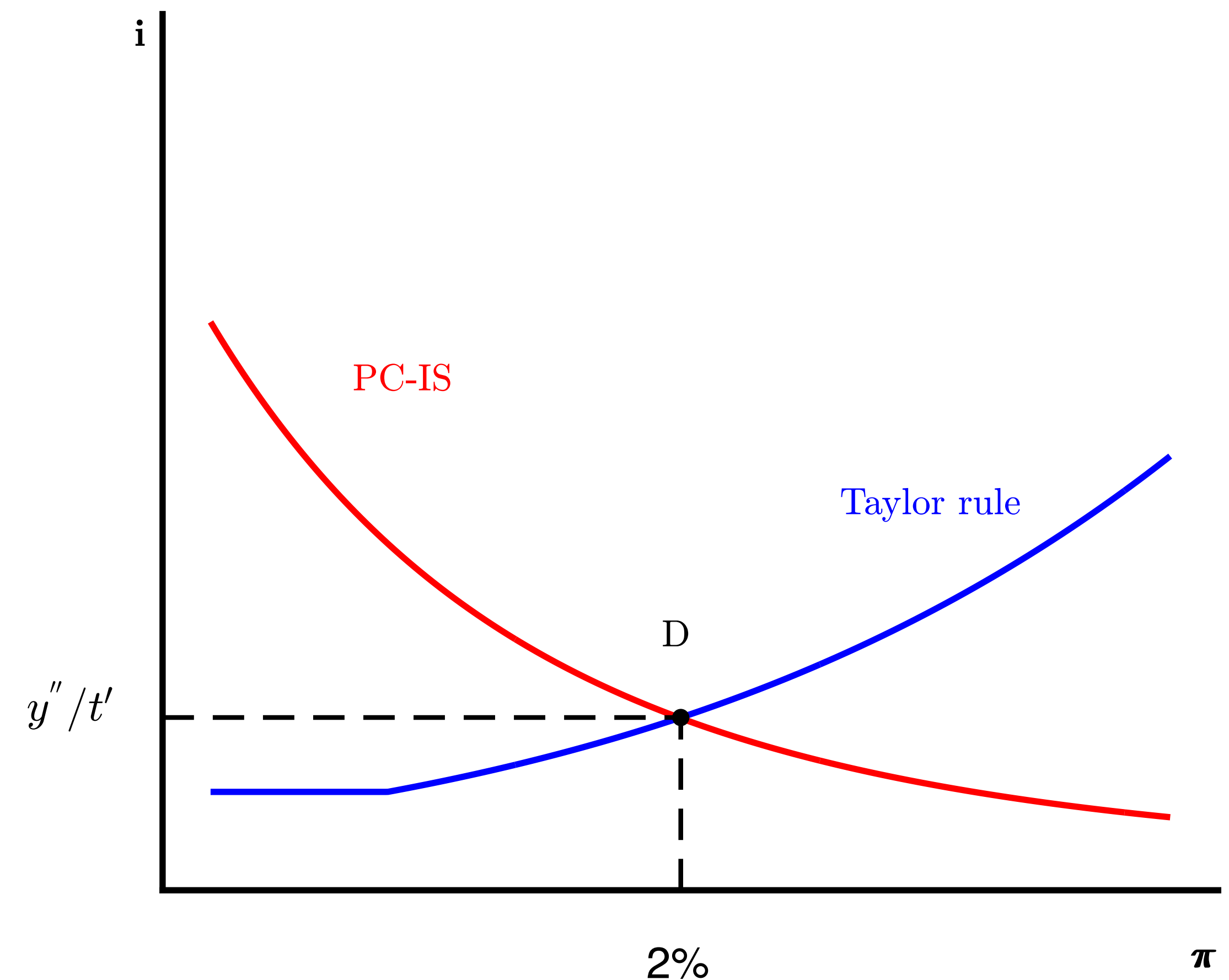
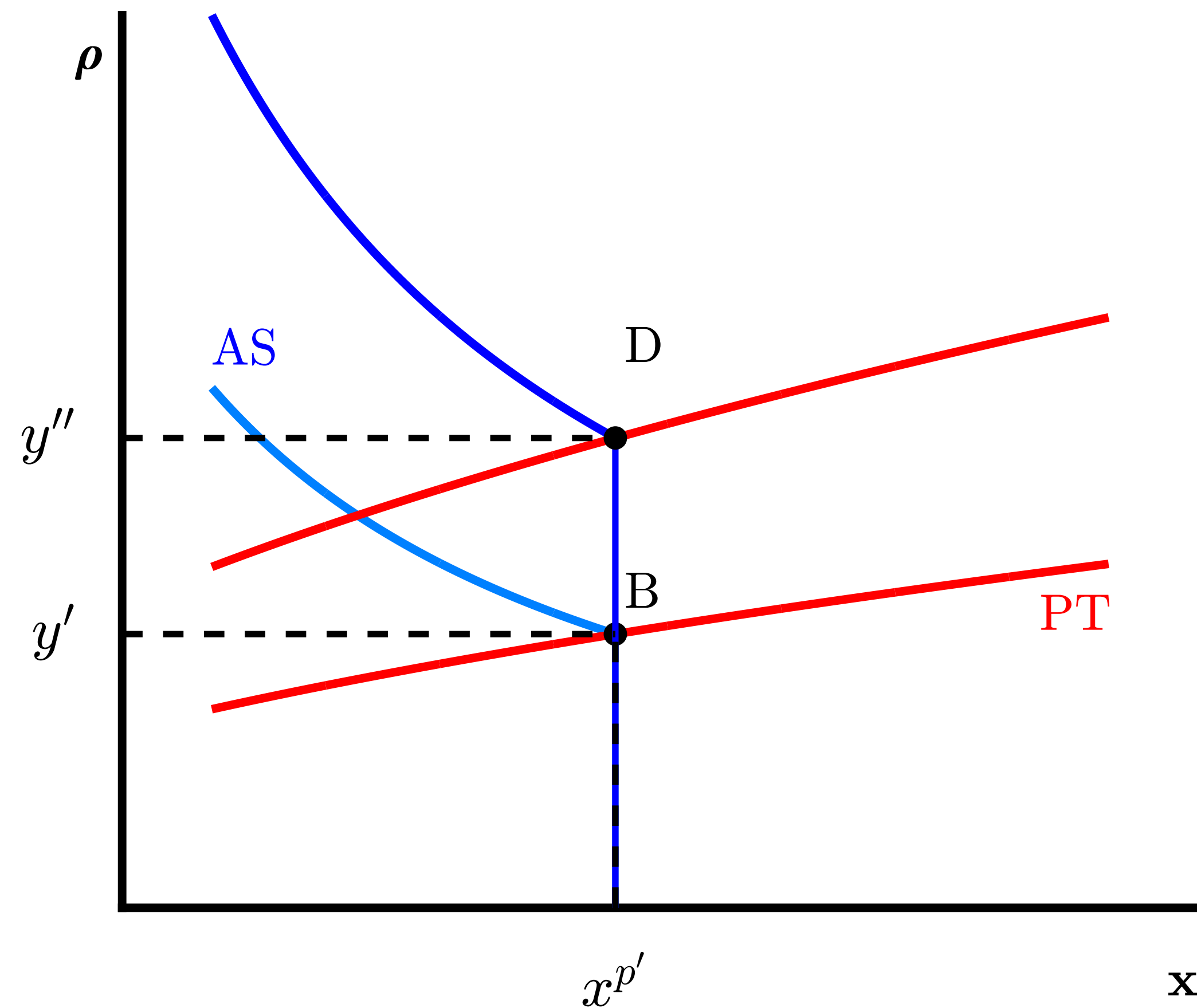
- Higher  $y$  meant that *PC-IS* shifted up/right.
- Economy moved to point **C**
- Keeping inflation on target would have required raising “neutral rate” in the Taylor rule, shifting it up,
- Deliver same inflation through significant higher rates, vertically above point **B**

# THE FUTURE



# Scenario I. Benevolent benchmark

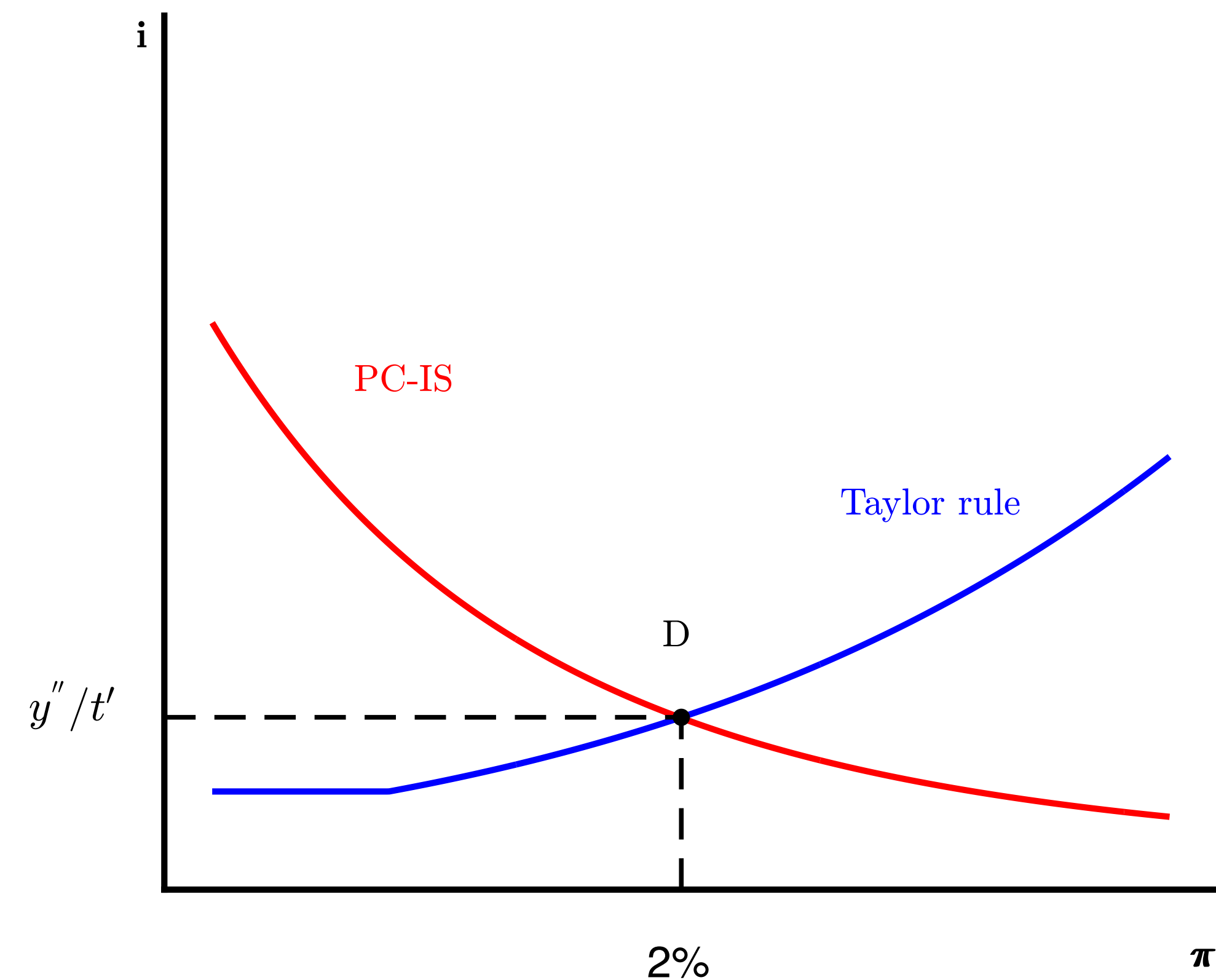
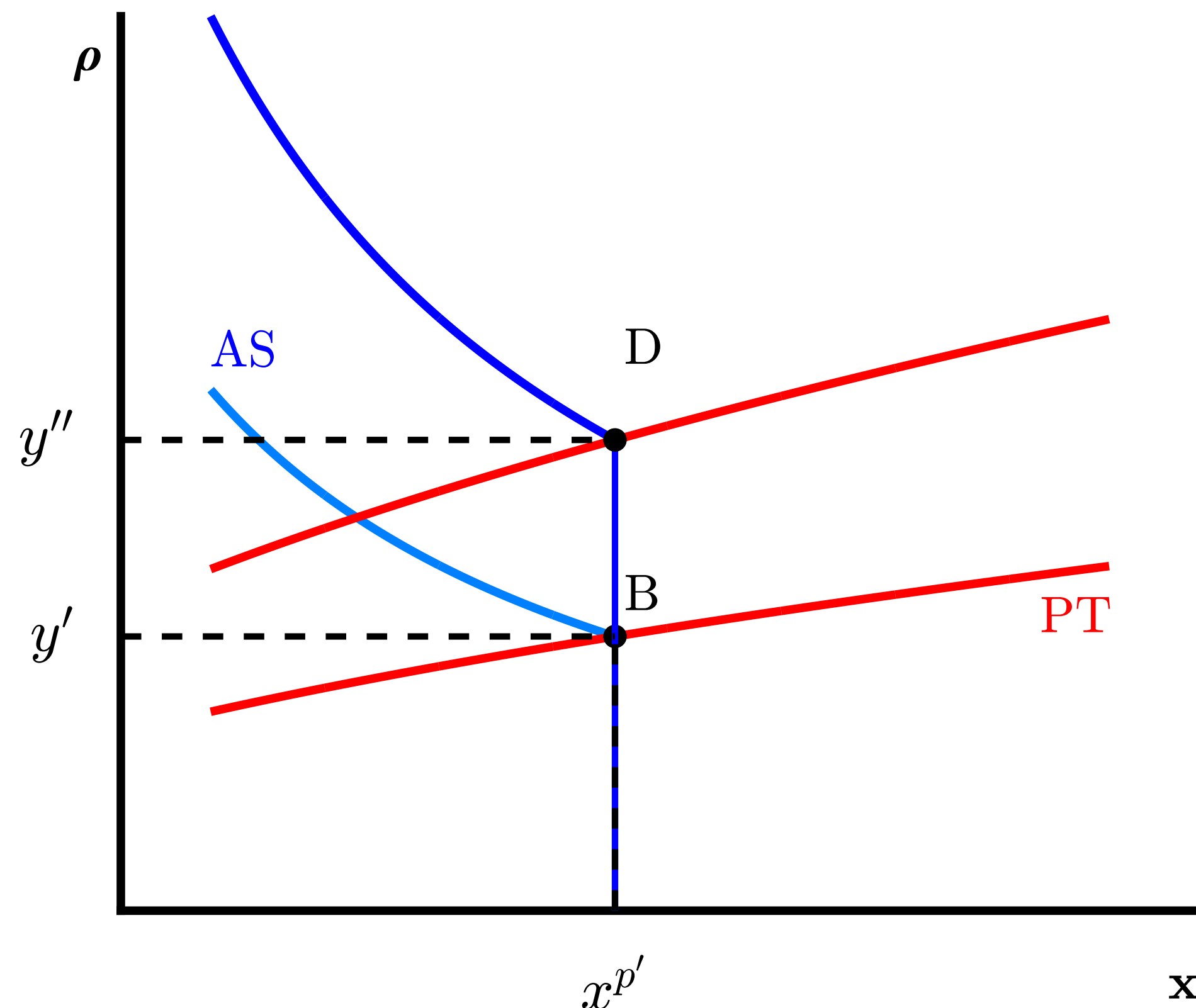
- *TR*: back to inflation target 2% requires higher  $i$  forever to match  $y$ .
- *PT*: back to kink,  $\rho = y$ , higher primary surpluses to pay for interest on debt



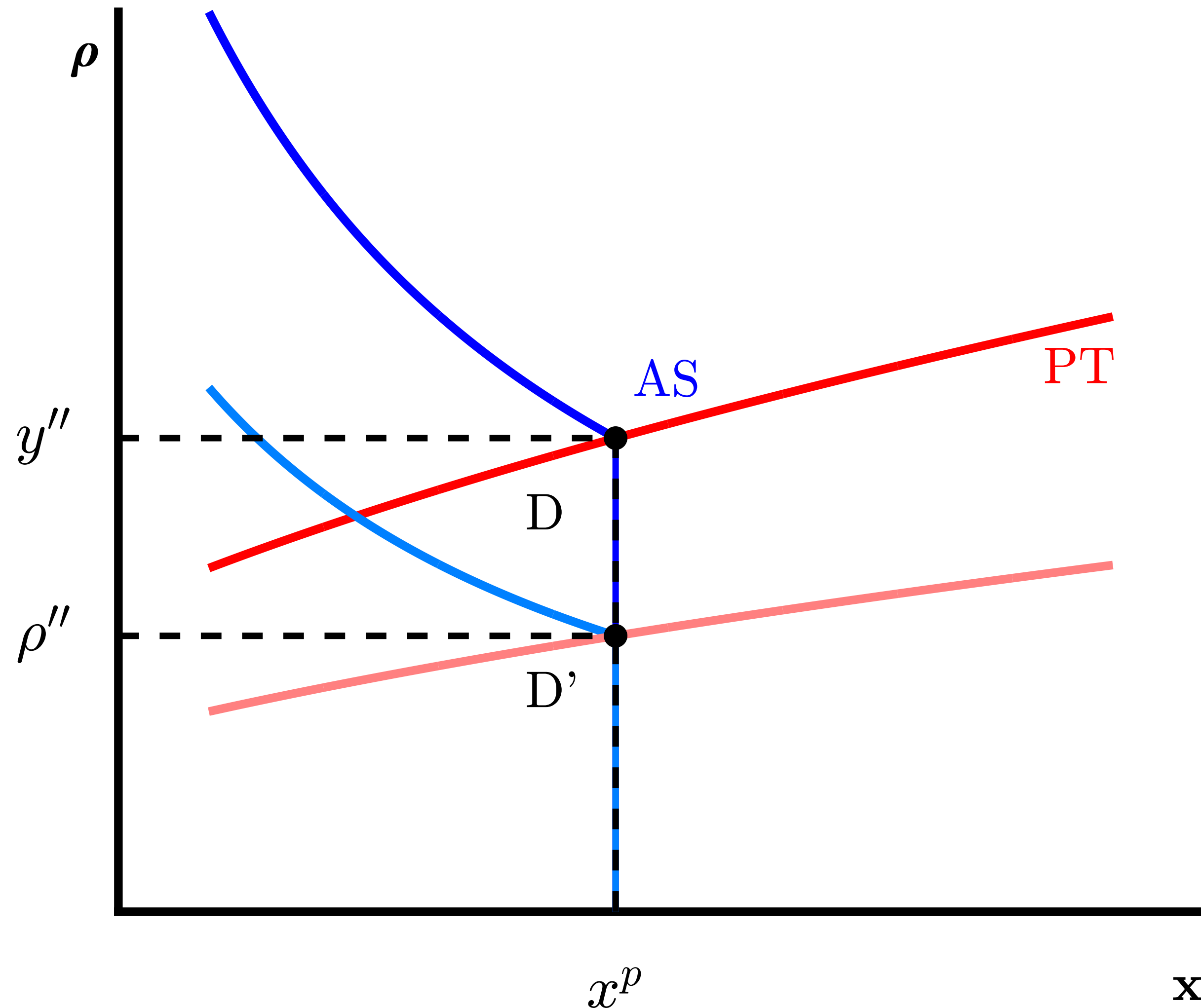


# Scenario I. Benevolent benchmark

- Challenge (i): bumpy road, hard to calibrate
- Challenge (ii): higher  $y$  or lower  $m$ ?
- Challenge (iii): higher interest burden on public debt, pressure on policy

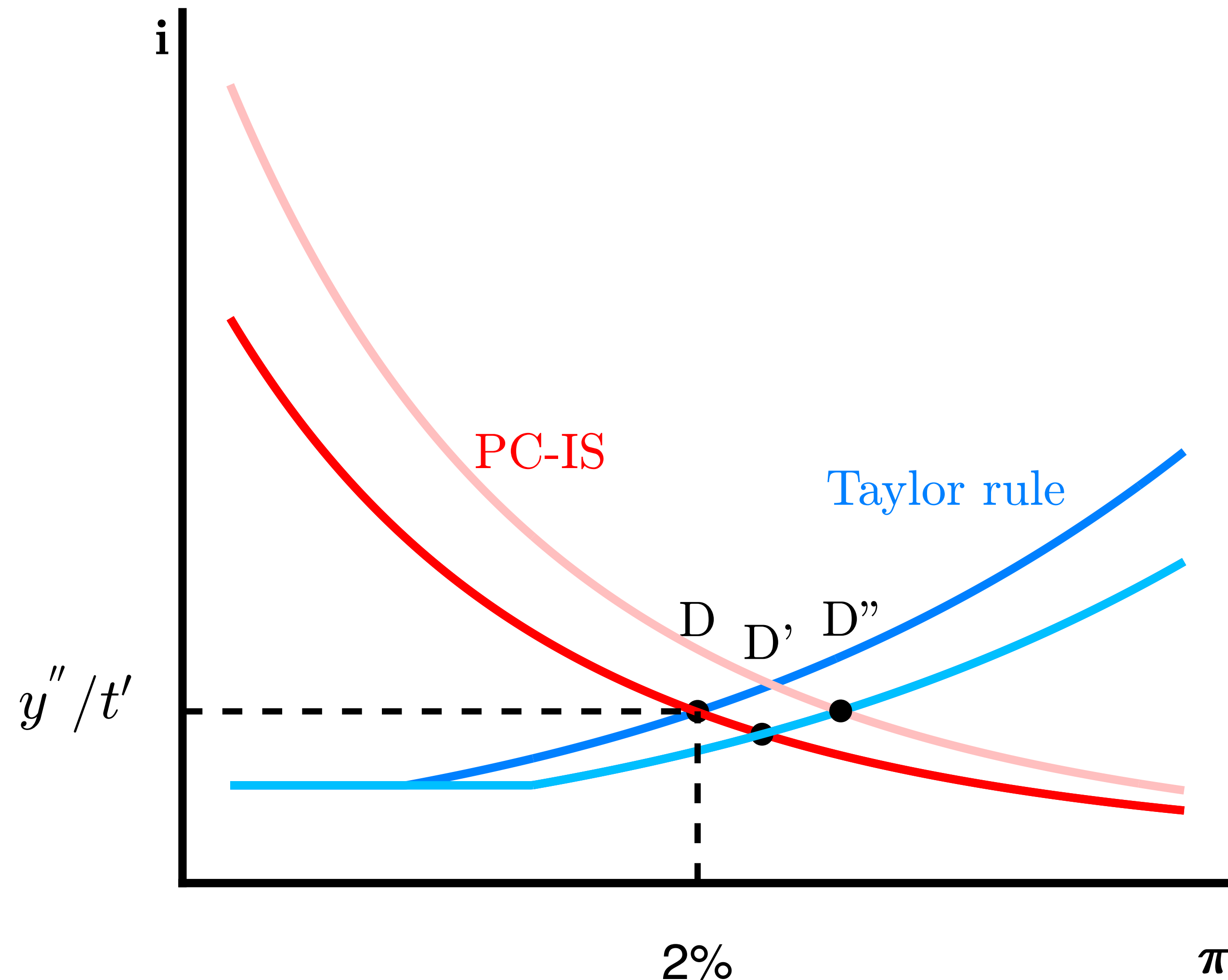


# Scenario 2. Forever-higher inflation



- Give in to fiscal pressure, want to “run economy hot”
- Move  $PT$  right-down, point  $D'$ .
- Forever high inflation, lower returns to bondholders.
- But, norms adjust,  $PT$  goes up-left, policy keeps pushing right-down
- Forever higher inflation, shuffling between  $D$  and  $D'$

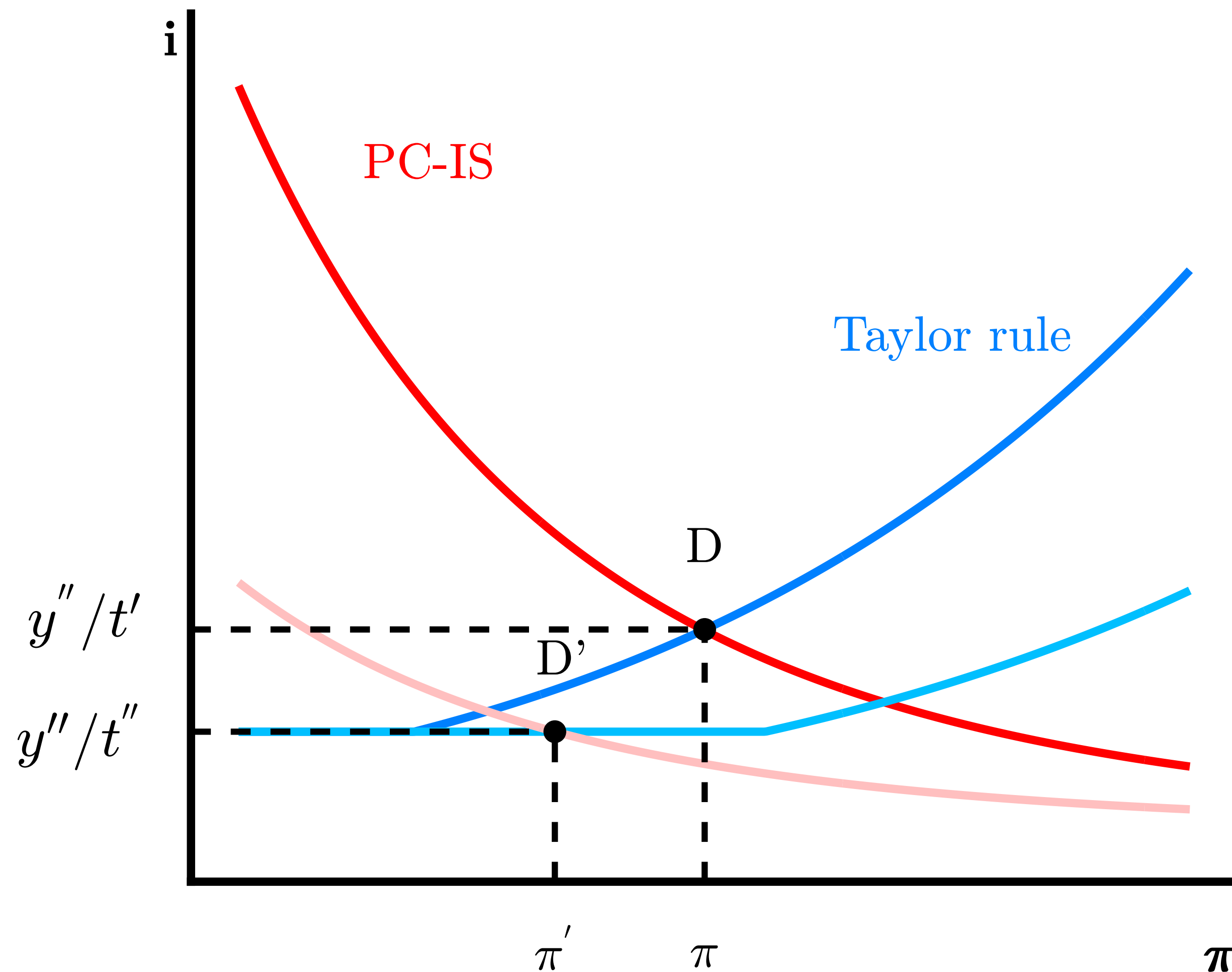
# Scenario 2. Forever-higher inflation



- This is achieved by too low policy rates, *Taylor rule* to the right-down
- First get point **D'**.
- But then **PC-IS** shifts right-up as expected inflation rises,
- Economy moves to **D''**, inflation higher, and so on, both forever shifting right.
- Friedman '68 and the 70s.

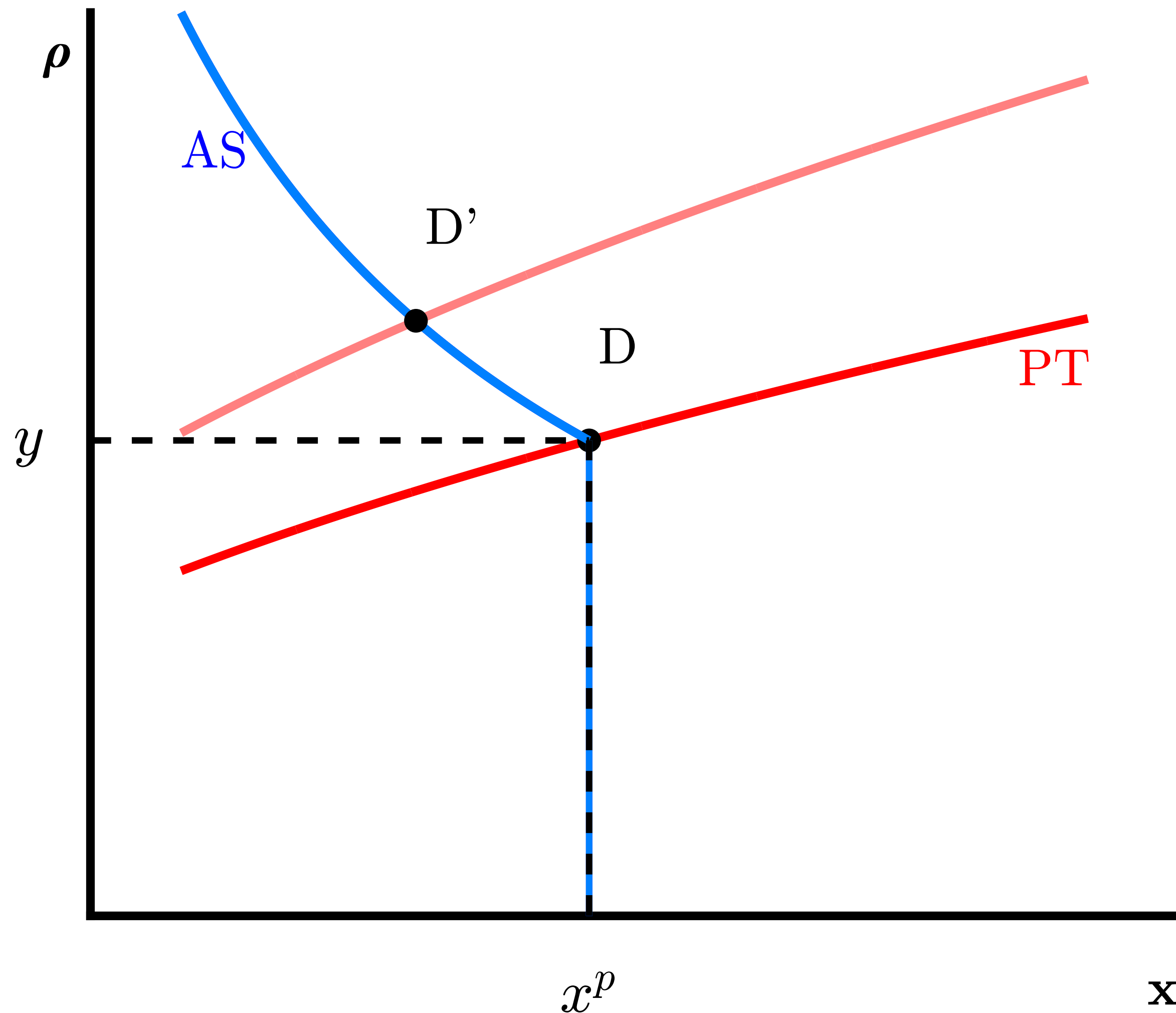


# Scenario 3.A double trap



- Say term premium ( $t$ ) rises:
  - (i) higher inflation risk premia after recent inflation disaster,
  - (ii) financial repression coming
  - (iii) unwinding QE
- *PC-IS* left down, low inflation. Policy responds by forward guidance, but ZLB hits, end up at  $D'$
- The higher term premium offsets the higher long-term interest rate to leave policy rate near zero.

# Scenario 3. A double trap



- Monetary policy cannot move ***PT*** to the right, since constrained by the ZLB.
- Fiscal policy can neither, constrained by fiscal capacity, fear of default.
- Tight AD policy means ***PT*** up-left, economy at ***D'***, recession
- A stagnation trap.

# CONCLUSION



# Where is $r^*$ going?

- Forecasting may be hard, but ignoring the question is foolish
- This talk: distinguished four  $r^*$ 's, proposed a framework, calibrated it with past trends, looked into the future.
- Scenario where  $y$  rises a lot,  $m$  falls some: loss of safety, global imbalances, public investment, AI optimism, (demography and inequality?)
- Three scenarios for  $\rho$  and  $i$  via  $\pi$ 
  - Accept higher policy rates forever, inflation back on target, primary surpluses
  - Persistent higher inflation, low-then-high policy rates, low-then-normal returns
  - Persistent low inflation, stagnation with under-employment, high returns