RESOLVING NEW KEYNESIAN ANOMALIES WITH WEALTH IN THE UTILITY FUNCTION

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ANOMALIES IN NK MODEL AT ZLB

1. collapse of output & inflation
   - Eggertsson, Woodford [2004]
   - Werning [2011]
2. implausibly large effects of forward guidance
   - del Negro, Giannoni, Patterson [2015]
   - Cochrane [2017]
3. implausibly large effects of government spending
   - Christiano, Eichenbaum, Rebello [2011]
   - Cochrane [2017]

EXISTING REMEDIES TO ZLB ANOMALIES

- Cochrane [2018]: fiscal theory of price level
- Bilbiie [2018] & Acharya, Dogra [2020]: heterogeneous agents
- Gabaix [2020]: bounded rationality
- Diba, Loisel [2021]: interest on bank reserves
- but these remedies complicate the textbook model
  - sometimes equilibrium system becomes 3-dimensional
  - sometimes derivations are complicated by heterogeneity or bounded rationality

THIS PAPER: MINIMAL DEVIATION FROM TEXTBOOK

- New Keynesian model with relative wealth in the utility function
- only one additional parameter
  - marginal utility of wealth in Euler equation

⇝ equilibrium system remains 2-dimensional
  - 2 variables: output & inflation
  - 2 differential equations: Euler equation & Phillips curve

⇝ derivations remain exactly the same

WHY WOULD PEOPLE VALUE WEALTH IN ITSELF?

- Keynes [1919]: "The duty of saving became nine-tenths of virtue and the growth of the cake the object of true religion. . . . Saving was for old age or for your children; but this was only in theory—the virtue of the cake was that it was never to be consumed, neither by you nor by your children after you."
- Irving Fisher [1930]: "A man may include in the benefits of his wealth. . . the social standing he thinks it gives him, or political power and influence, or the mere miserly sense of possession, or the satisfaction in the mere process of further accumulation."

WHY WOULD PEOPLE VALUE WEALTH IN ITSELF?

- Camerer, Loewenstein, Prelec [2005]: “brain-scans conducted while people win or lose money suggest that money activates similar reward areas as do other primary reinforcers like food and drugs, which implies that money confers direct utility, rather than simply being valued only for what it can buy.”
- evidence from economics, social psychology, sociology, social neuroscience: wealth is a marker of social status, and people value high social status

NK MODEL WITH WEALTH IN THE UTILITY

- self-employed household $j \in [0,1]$ maximizes utility

$$\int_0^\infty e^{-\delta t}\left[\ln\Big(c_j(t)\Big) + u\left(\frac{b_j(t)}{p(t)} - \frac{b(t)}{p(t)}\right) - \kappa h_j(t) - \frac{\gamma}{2}\pi_j(t)^2\right] dt$$

  - consumption index: $c_j(t) = \left[\int_0^1 c_{jk}(t)^{(\epsilon-1)/\epsilon}\, dk\right]^{\epsilon/(\epsilon-1)}$
  - aggregate wealth: $b(t) = \int_0^1 b_j(t)\, dj$
  - inflation: $\pi_j(t) = \dot{p}_j(t)/p_j(t)$
- subject to budget constraint:

$$\dot{b}_j(t) = i(t)b_j(t) + p_j(t)y_j(t) - \int_0^1 p_k(t)c_{jk}(t)\, dk$$

- to production function: $y_j(t) = ah_j(t)$
- to demand for good i: $y_j(t) = \left[p_j(t)/p(t)\right]^{-\epsilon} c(t)$

EQUILIBRIUM: EULER-PHILLIPS SYSTEM

- Phillips curve: standard

$$\dot{\pi} = \delta\pi - \frac{\epsilon\kappa}{\gamma a}\left(y - y^n\right) \quad \text{with} \quad y^n = \frac{\epsilon - 1}{\epsilon} \cdot \frac{a}{\kappa}$$

- Euler equation: “discounted”

$$\frac{\dot{y}}{y} = r(\pi) + u'(0)y - \delta$$

  – financial returns: real interest rate $= r(\pi) = i(\pi) - \pi$

  – hedonic returns: MRS(wealth, consumption) $= u'(0)y^n$

so $\quad \dfrac{\dot{y}}{y} = r(\pi) - r^n + u'(0)(y - y^n) \quad$ with $\quad r^n = \delta - u'(0)y^n$

TWO MODELS

- NK: standard New Keynesian model

$$u'(0) = 0$$

- WUNK: wealth-in-the-utility New Keynesian model

$$u'(0) > \frac{\epsilon\kappa}{\delta\gamma a}$$

OUTPUT & INFLATION COLLAPSE

SCENARIO: ZLB

ZLB

back to natural steady state

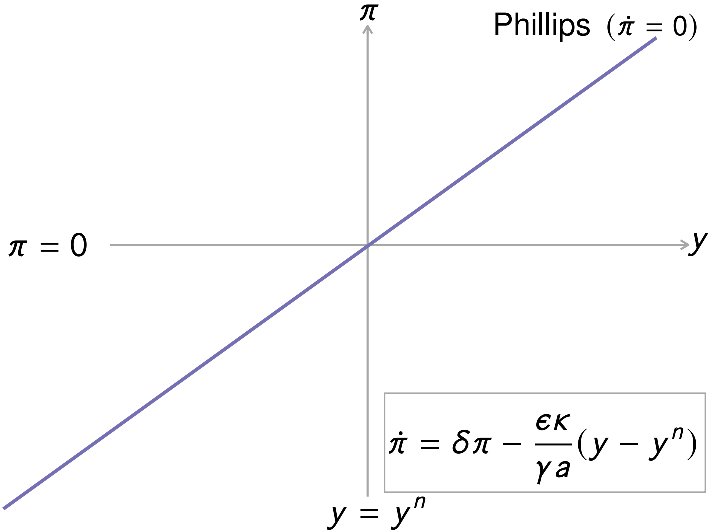
- $r^n < 0$
- $i(\pi) = 0$

- $r^n > 0$
- $i(\pi) = r^n + \phi\pi$
  $\phi > 1$

$t = 0$

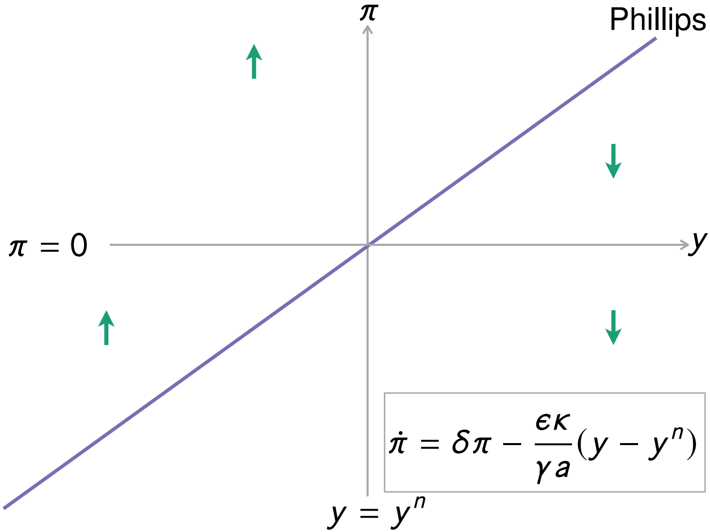
$t = \mathrm{T}$

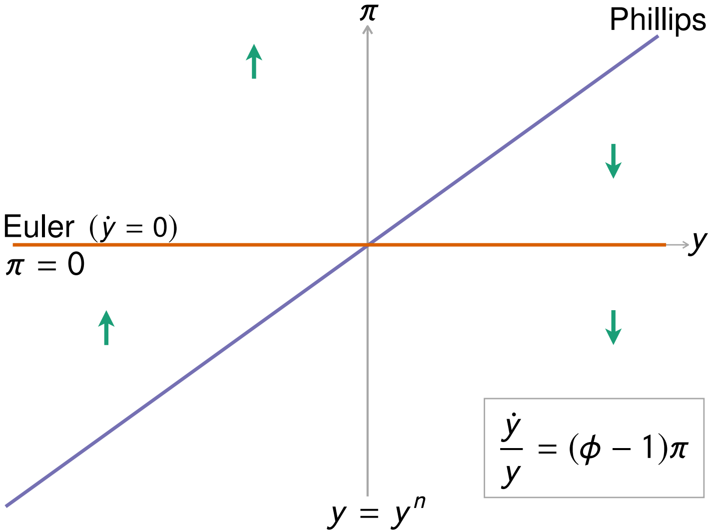
NK | PHASE DIAGRAM IN NORMAL TIMES



$$\dot{\pi} = \delta\pi - \frac{\epsilon\kappa}{\gamma a}(y - y^n)$$

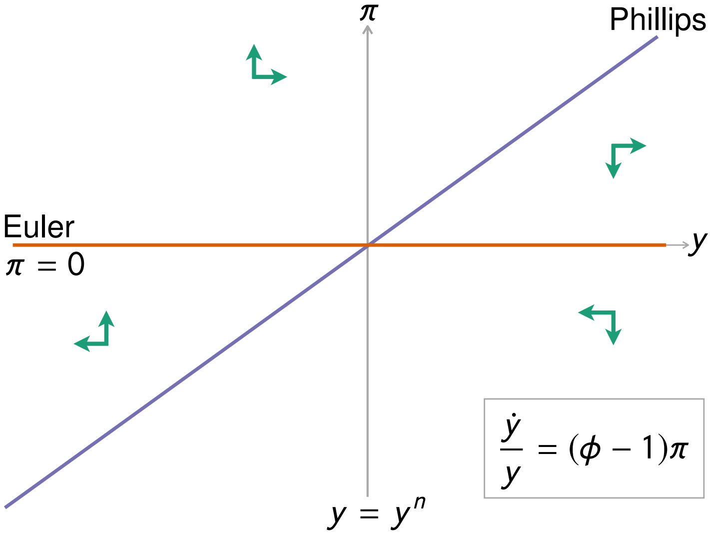
NK | PHASE DIAGRAM IN NORMAL TIMES



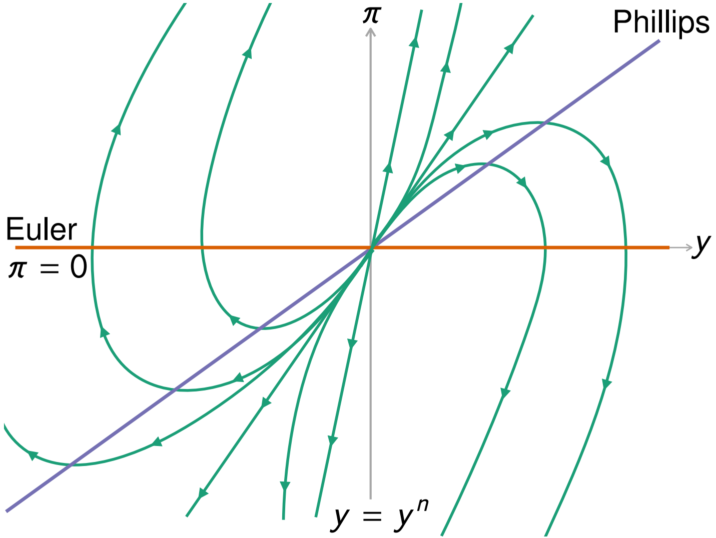


$$\frac{\dot{y}}{y} = (\phi - 1)\pi$$

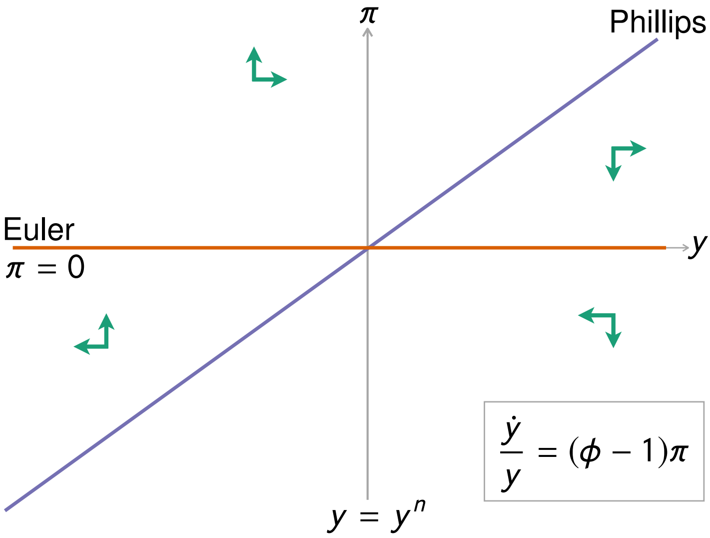
NK | PHASE DIAGRAM IN NORMAL TIMES



NK | PHASE DIAGRAM IN NORMAL TIMES: SOURCE



NK | PHASE DIAGRAM AT ZLB



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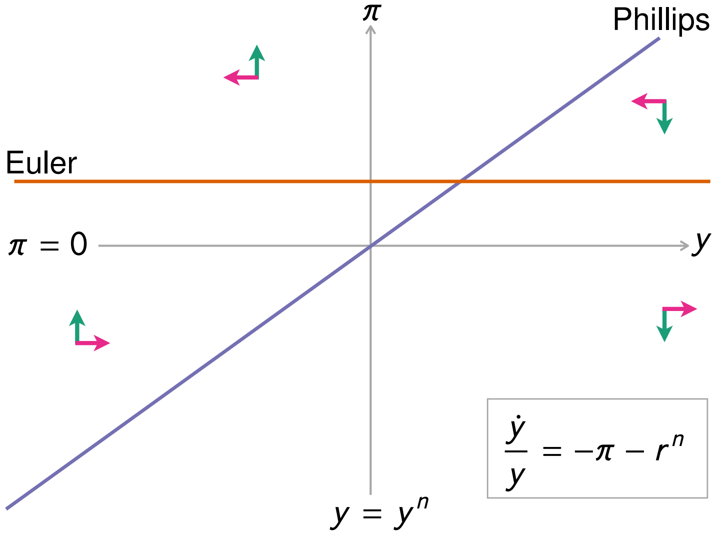
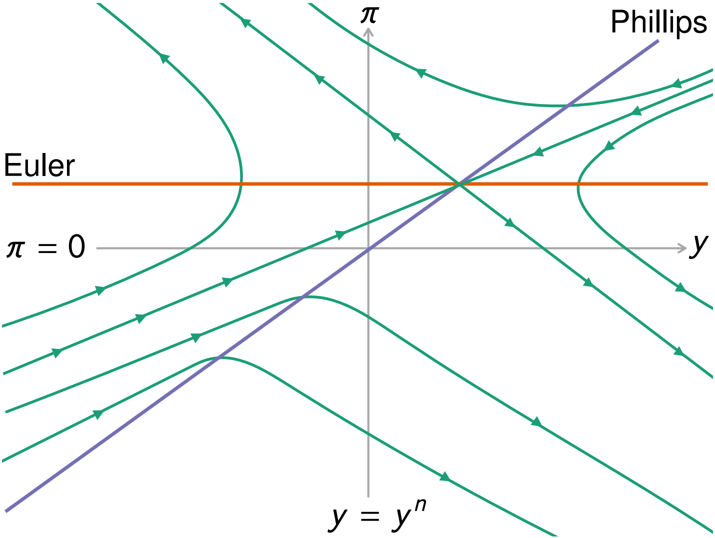
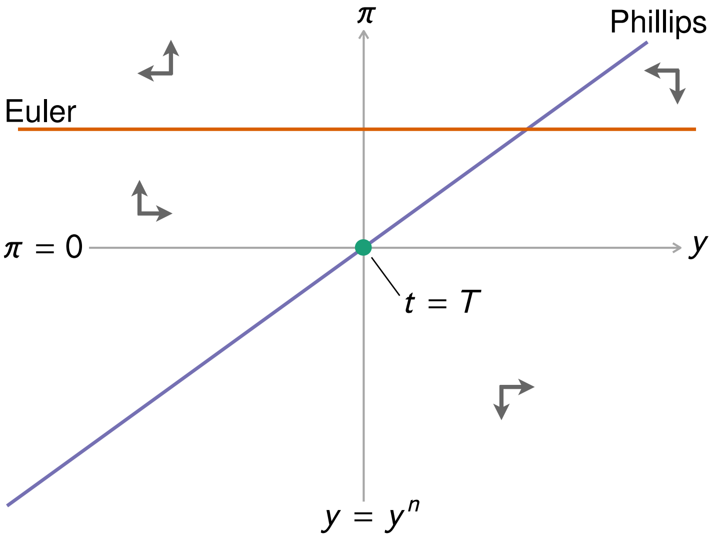
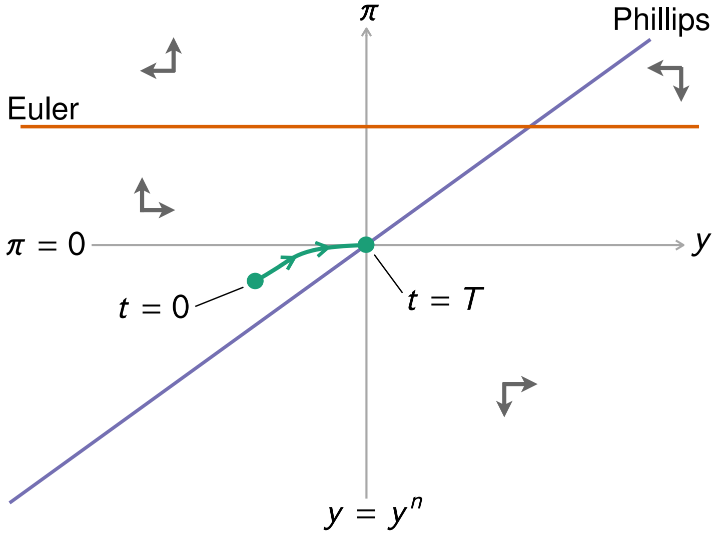


NK | PHASE DIAGRAM AT ZLB: SADDLE

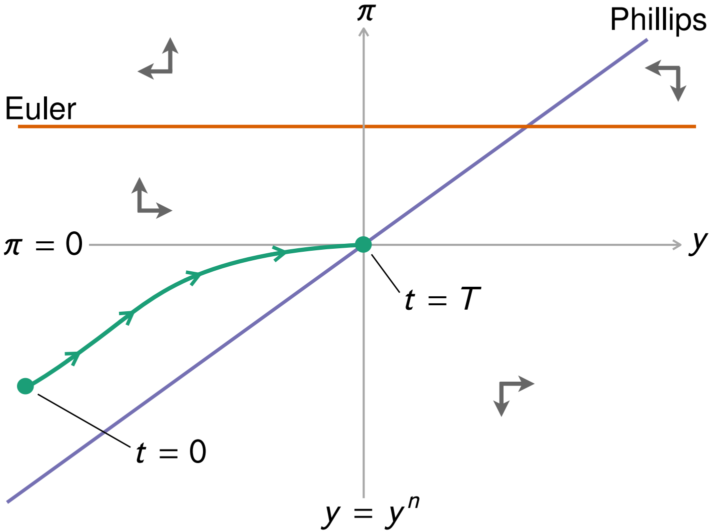


NK | ZLB EPISODE

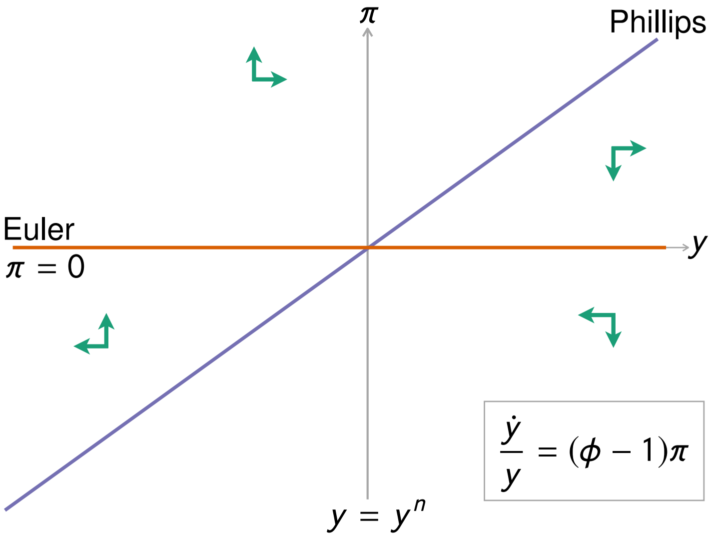



π
Phillips
Euler
$\pi = 0$
y
$t = 0$
$t = T$
$y = y^n$

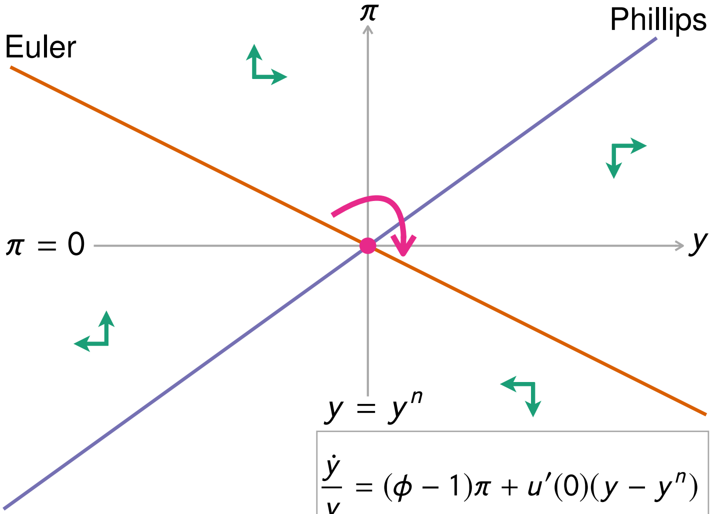
NK | LONGER ZLB: OUTPUT & INFLATION COLLAPSE



WUNK | PHASE DIAGRAM IN NORMAL TIMES

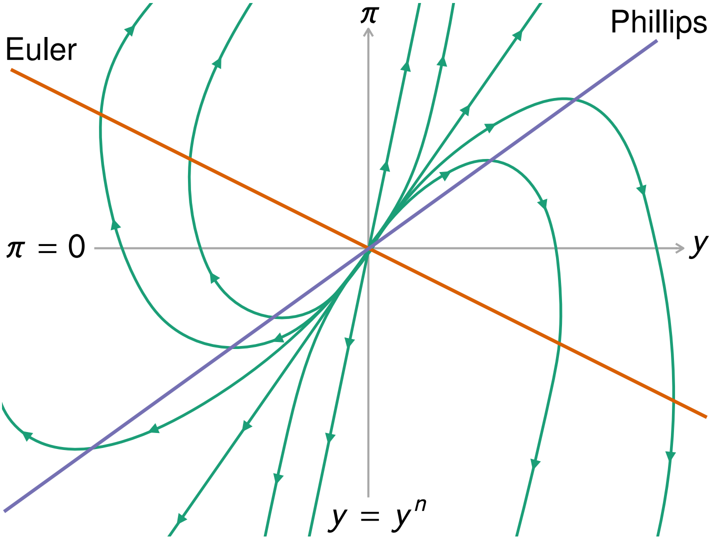


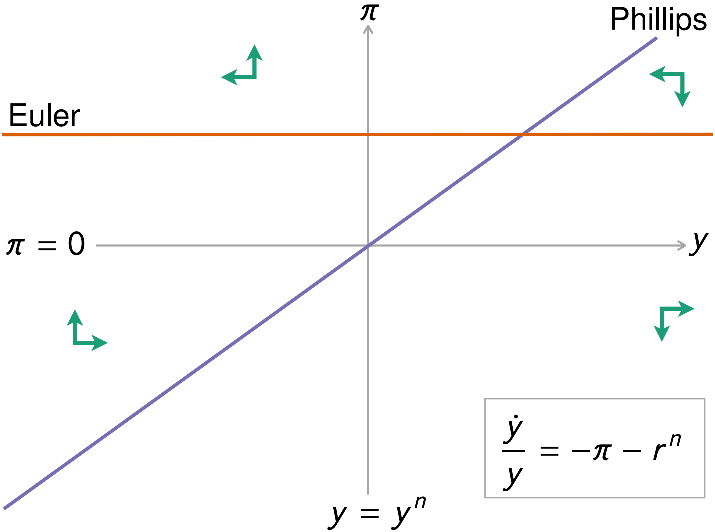
WUNK | PHASE DIAGRAM IN NORMAL TIMES



$$\frac{\dot{y}}{y} = (\phi - 1)\pi + u'(0)(y - y^n)$$

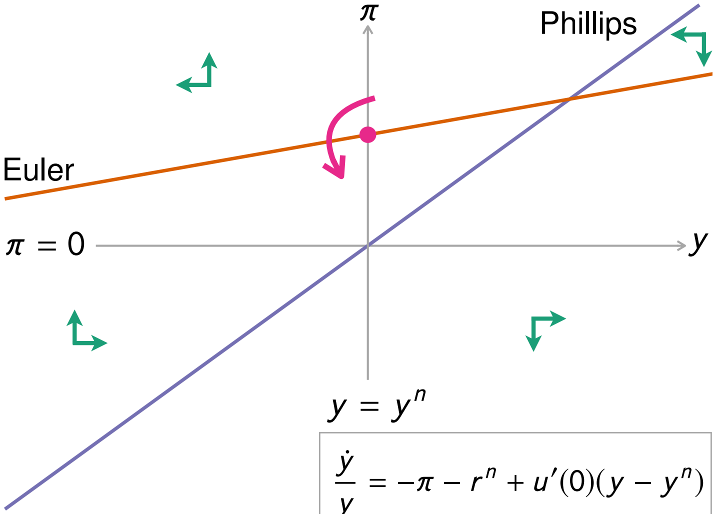
WUNK | PHASE DIAGRAM IN NORMAL TIMES: SOURCE





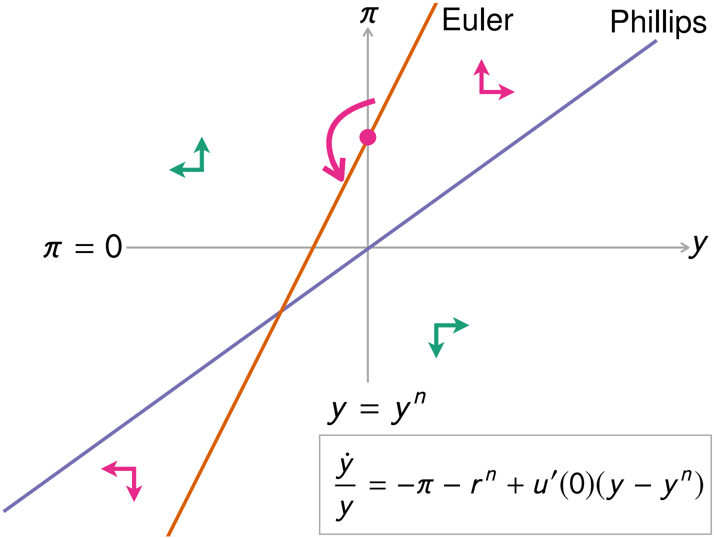
π
Phillips
Euler
$\pi = 0$
y
$y = y^n$
$\frac{\dot{y}}{y} = -\pi - r^n$

WUNK | PHASE DIAGRAM AT ZLB



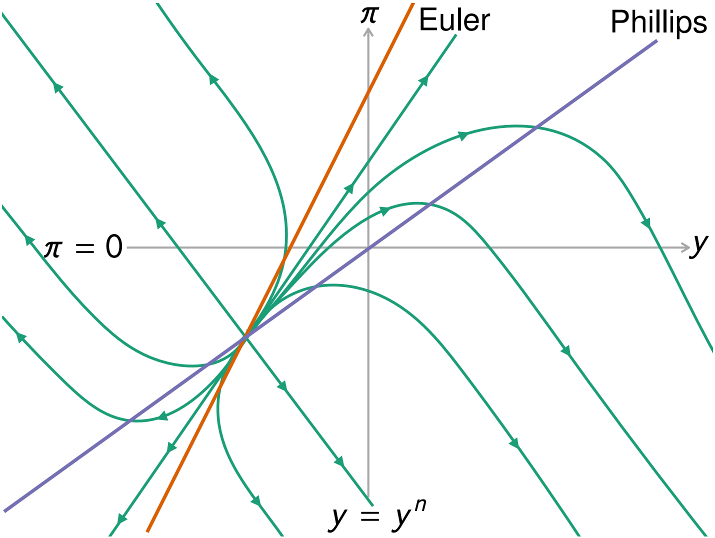
$$\frac{\dot{y}}{y} = -\pi - r^n + u'(0)(y - y^n)$$

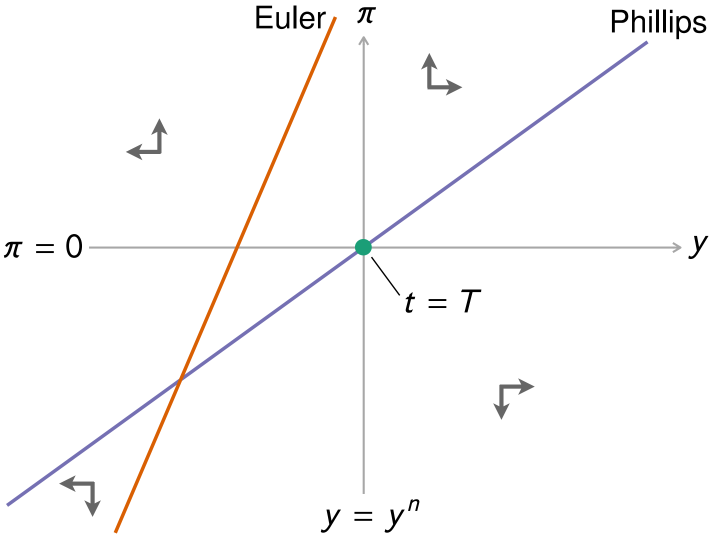
WUNK | PHASE DIAGRAM AT ZLB



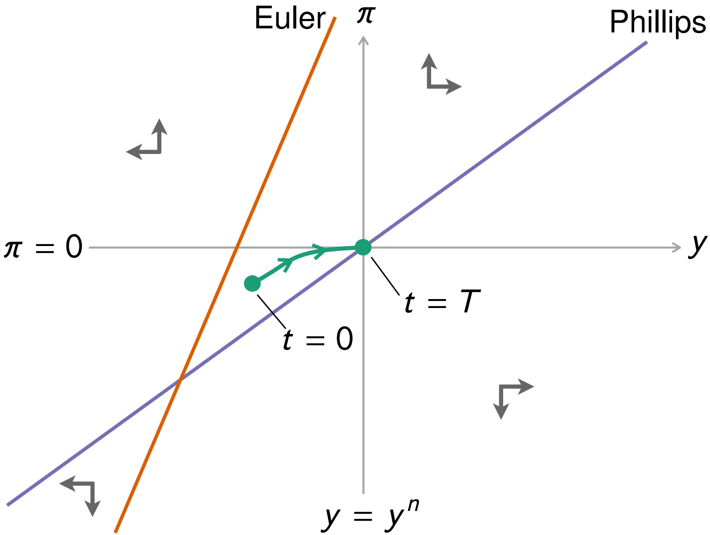
$$\frac{\dot{y}}{y} = -\pi - r^n + u'(0)(y - y^n)$$

WUNK | PHASE DIAGRAM AT ZLB: SOURCE

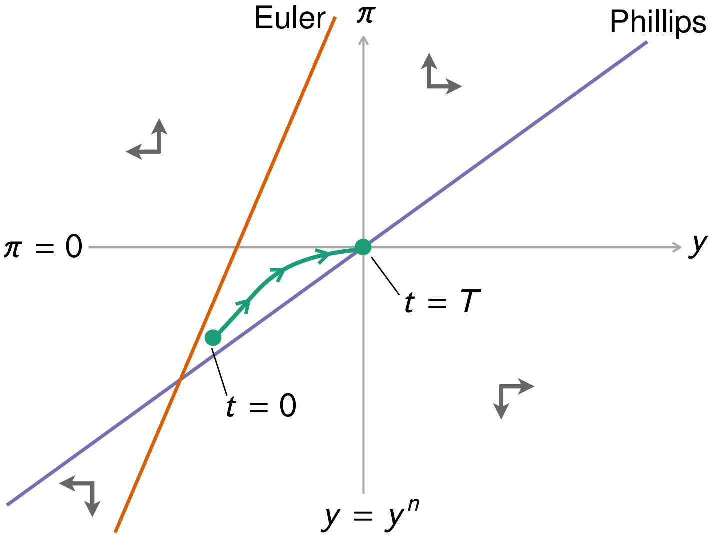



Euler
π
Phillips
$\pi = 0$
y
$t = T$
$y = y^n$

WUNK | ZLB EPISODE



WUNK | LONGER ZLB CONVERGES TO STEADY STATE



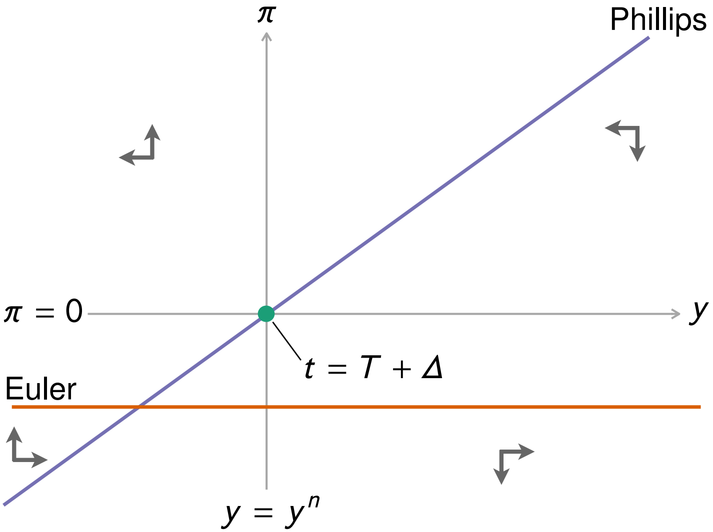
FORWARD GUIDANCE

SCENARIO: ZLB + FORWARD GUIDANCE

ZLB	forward guidance	back to natural steady state
• $r^n < 0$	• $r^n > 0$	• $r^n > 0$
• $i(\pi) = 0$	• $i(\pi) = 0$	• $i(\pi) = r^n + \phi\pi$ $\phi > 1$

$t = 0$ $\qquad$ $t = \mathrm{T}$ $\qquad$ $t = T + \Delta$

NK | ZLB + **FORWARD GUIDANCE**



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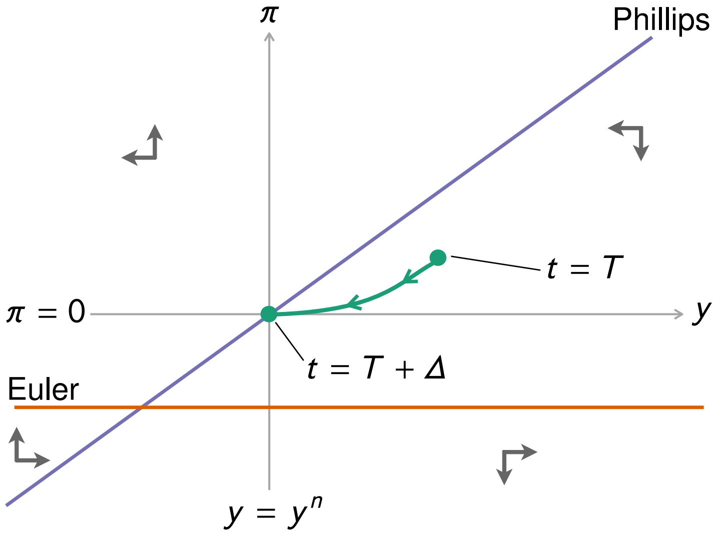

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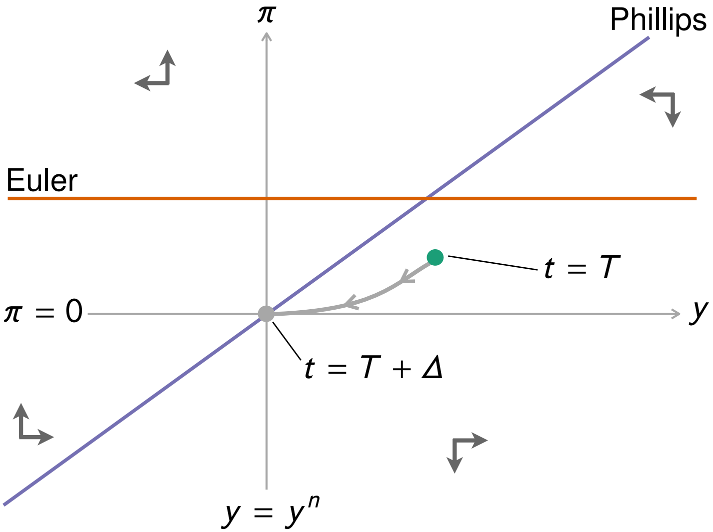
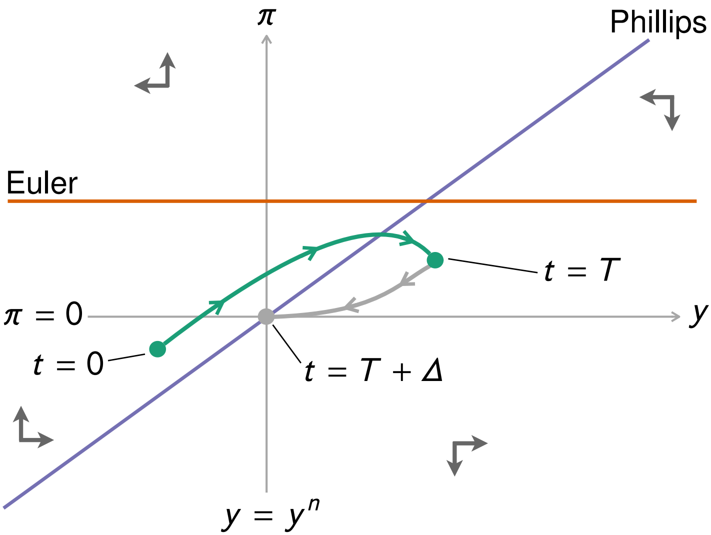
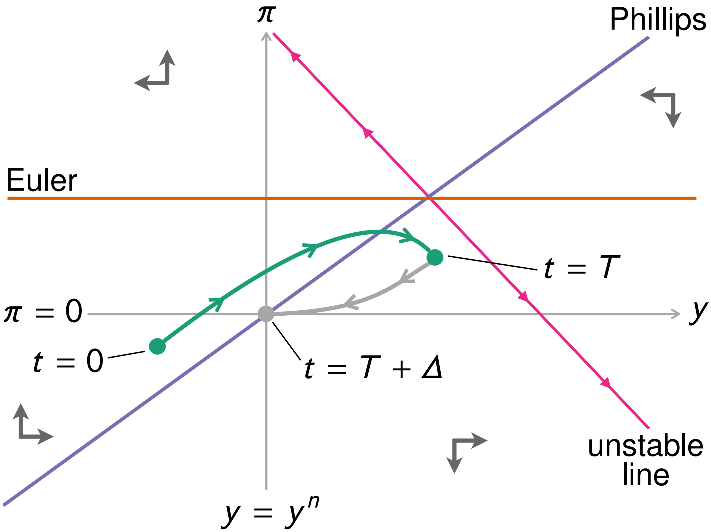


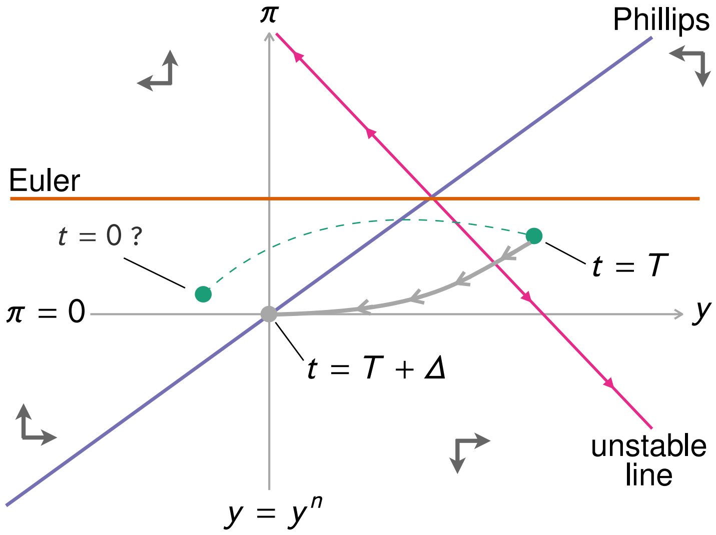


π
Phillips
Euler
$t = T$
$\pi = 0$
y
$t = 0$
$t = T + \Delta$
$y = y^n$

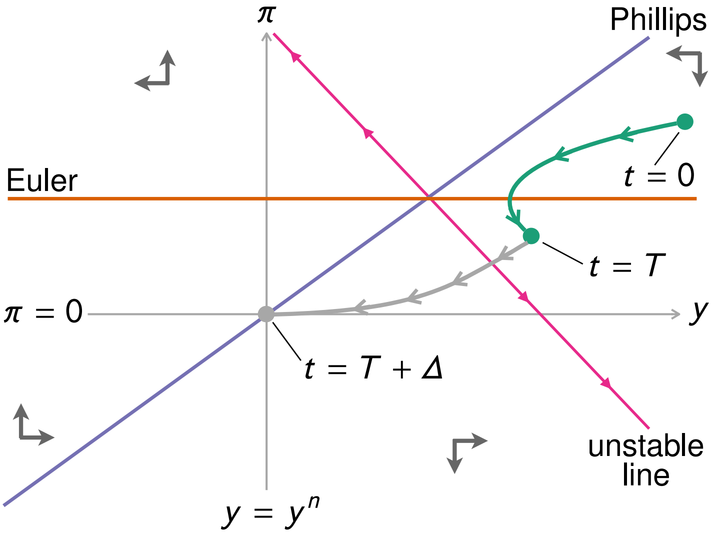
NK | LONGER GUIDANCE: BOOM AT ZLB

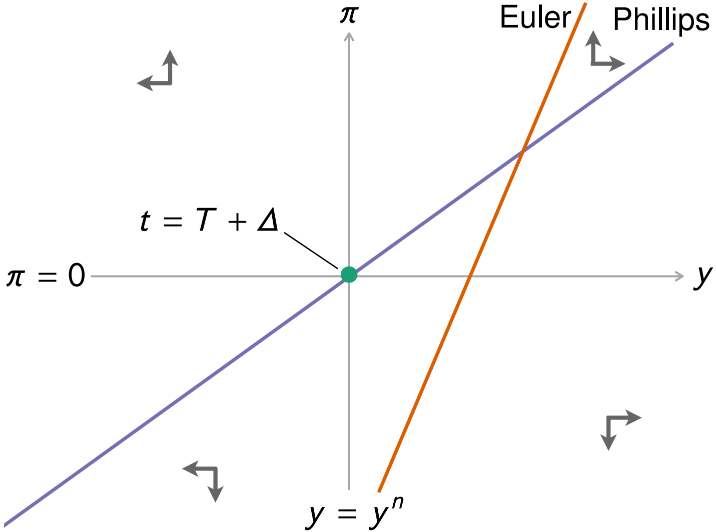


NK | LONGER GUIDANCE: BOOM AT ZLB

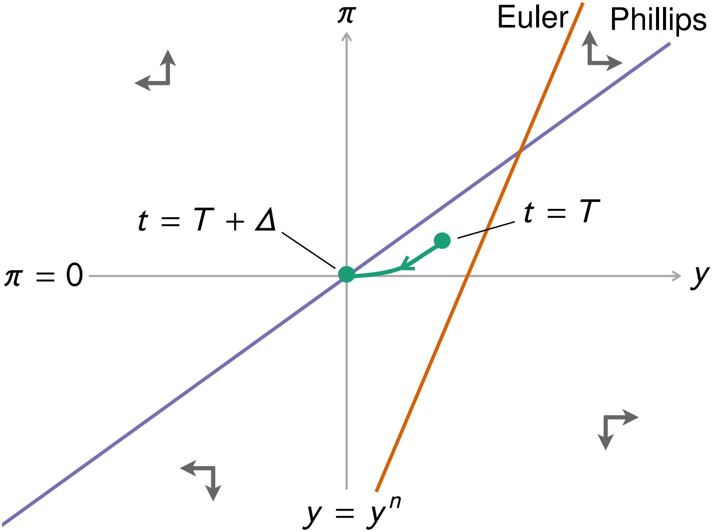


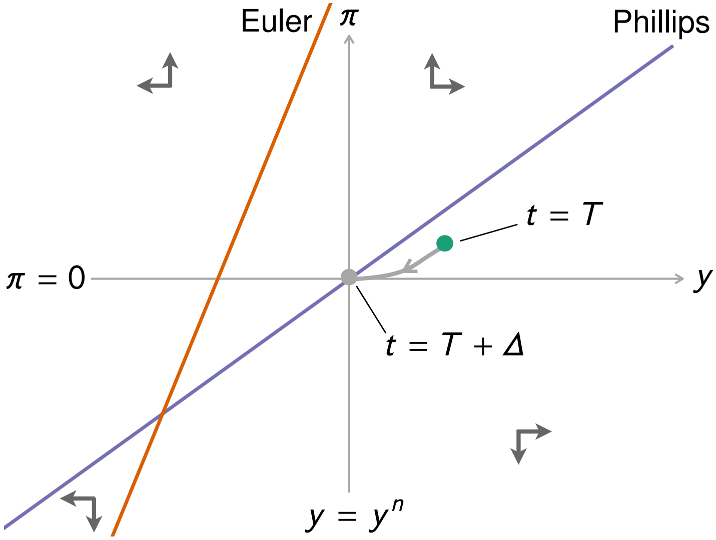
NK | LONGER GUIDANCE: BOOM AT ZLB

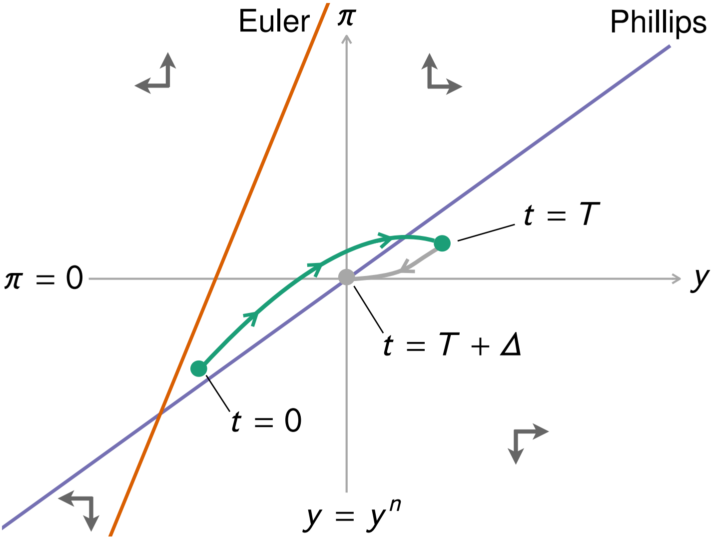



π
Euler
Phillips
t = T + Δ
π = 0
y
y = y^n

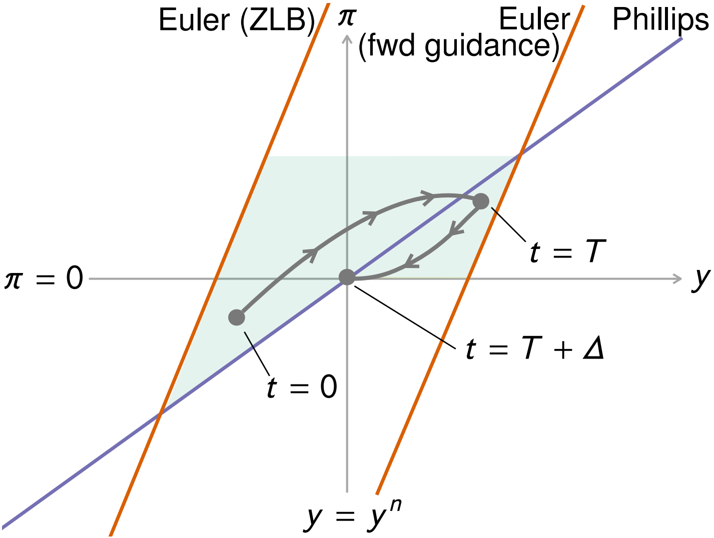
WUNK | ZLB + **FORWARD GUIDANCE**




Euler
π
Phillips
$t = T$
$\pi = 0$
y
$t = T + \Delta$
$y = y^n$


Euler
π
Phillips
$t = T$
$\pi = 0$
y
$t = T + \Delta$
$t = 0$
$y = y^n$

WUNK | LONGER GUIDANCE: LIMITED EFFECT



GOVERNMENT SPENDING

SCENARIO: ZLB + GOVERNMENT SPENDING g

ZLB

- $r^n < 0$
- $i(\pi) = 0$
- $g > 0$

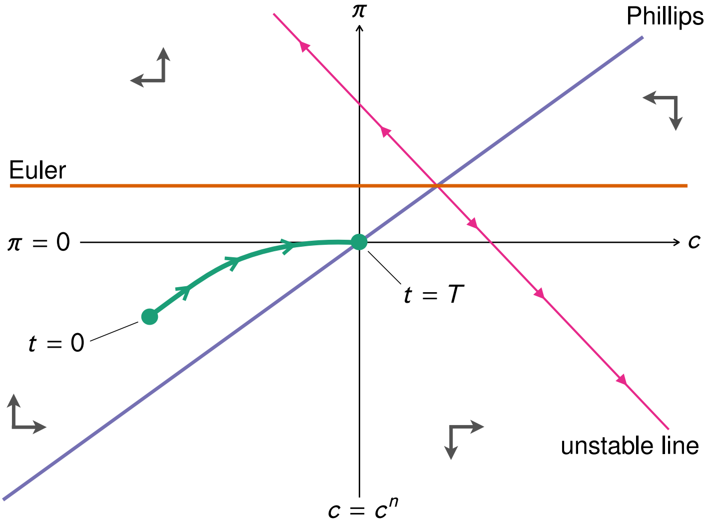
back to natural steady state

- $r^n > 0$
- $i(\pi) = r^n + \phi\pi$
  $\phi > 1$
- $g = 0$

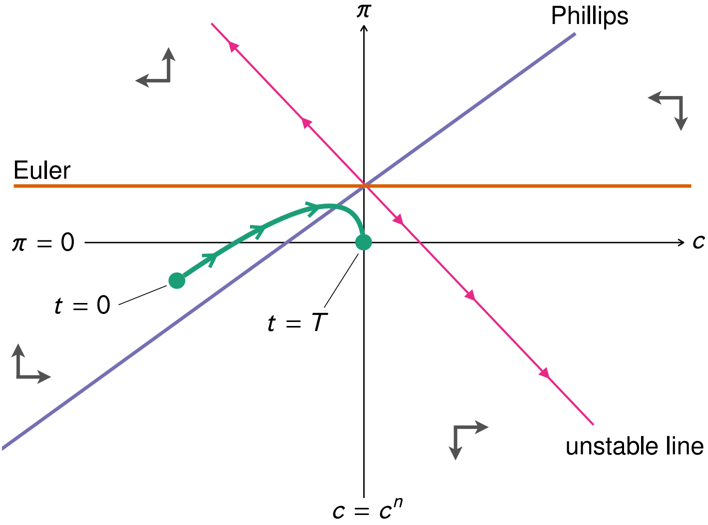
$t = 0$

$t = \mathrm{T}$

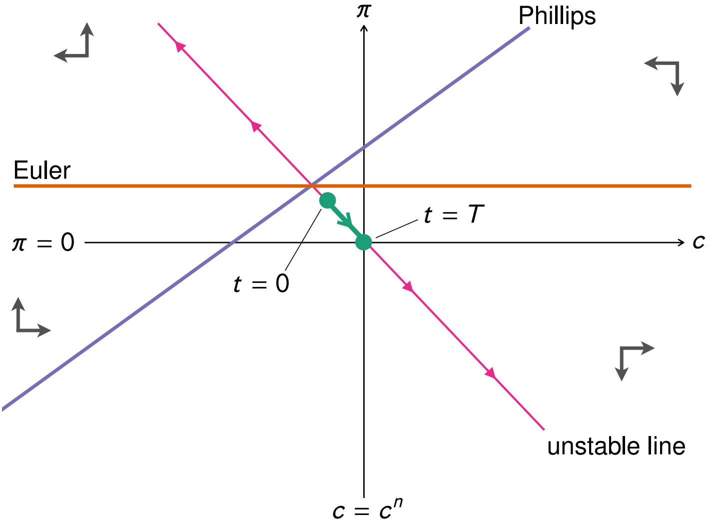
NK | ZLB + NO SPENDING



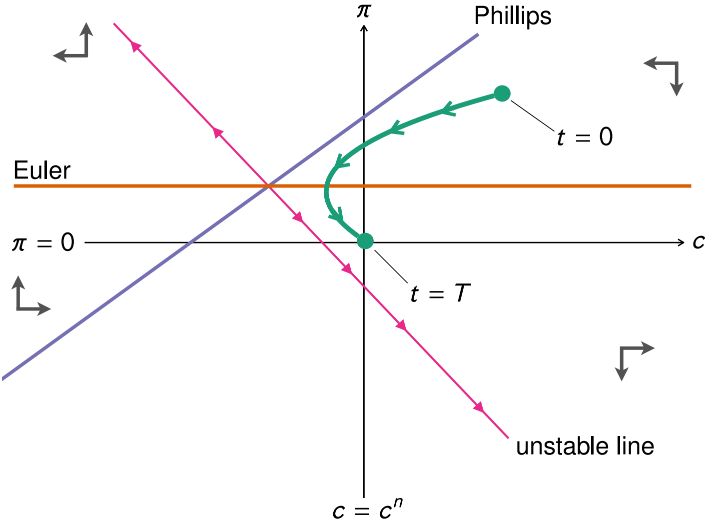
NK | ZLB + SMALL SPENDING



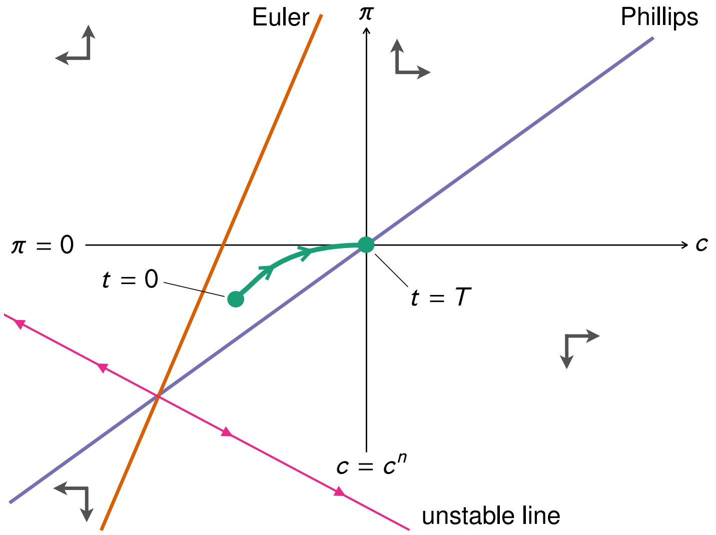
NK | ZLB + MEDIUM SPENDING



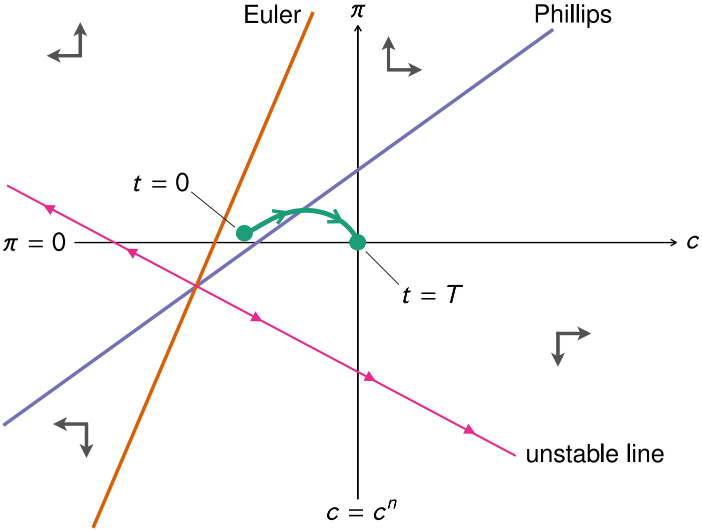
NK | ZLB + LARGE SPENDING: BOOM AT ZLB



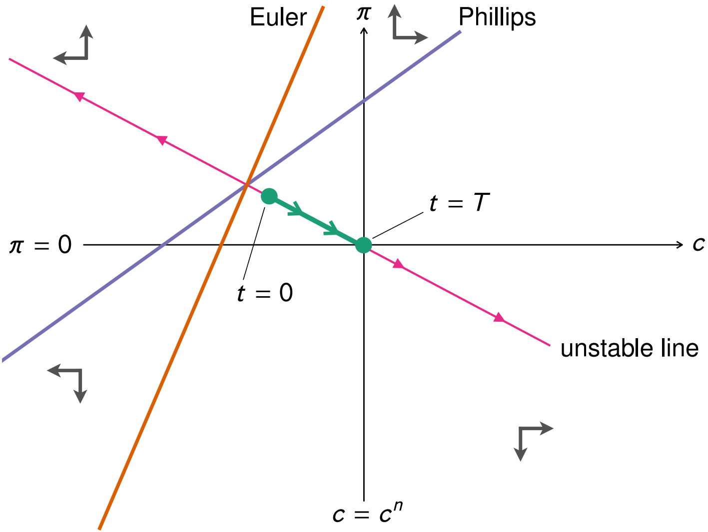
WUNK | ZLB + NO SPENDING



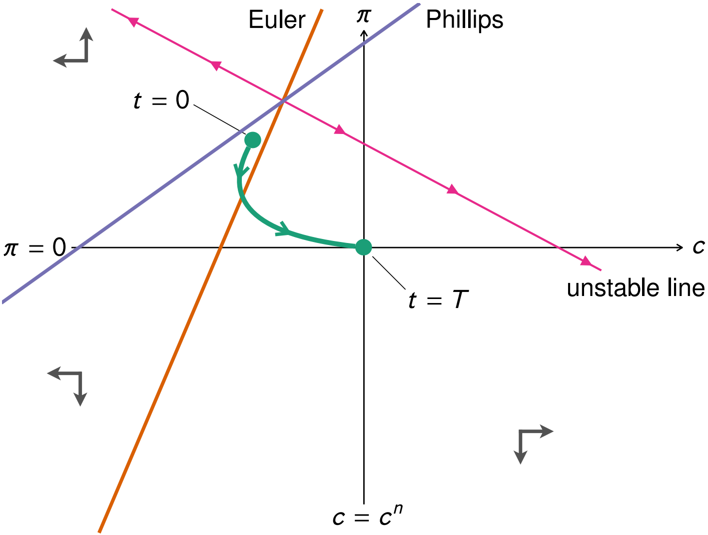
WUNK | ZLB + SMALL SPENDING



WUNK | ZLB + MEDIUM SPENDING

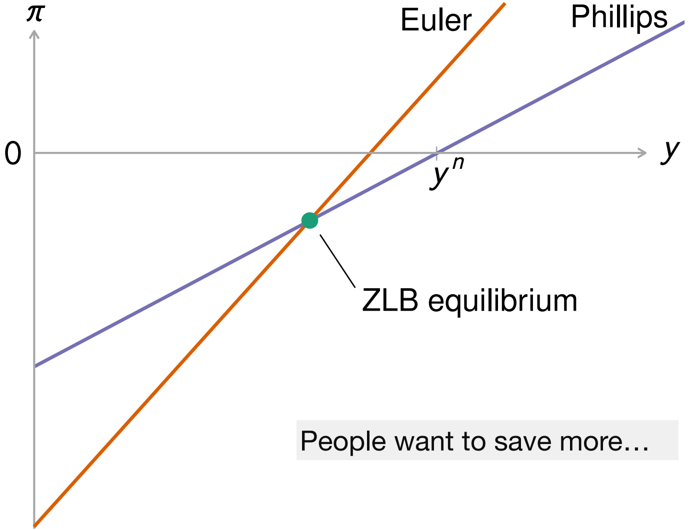


WUNK | ZLB + LARGE SPENDING: LIMITED EFFECT



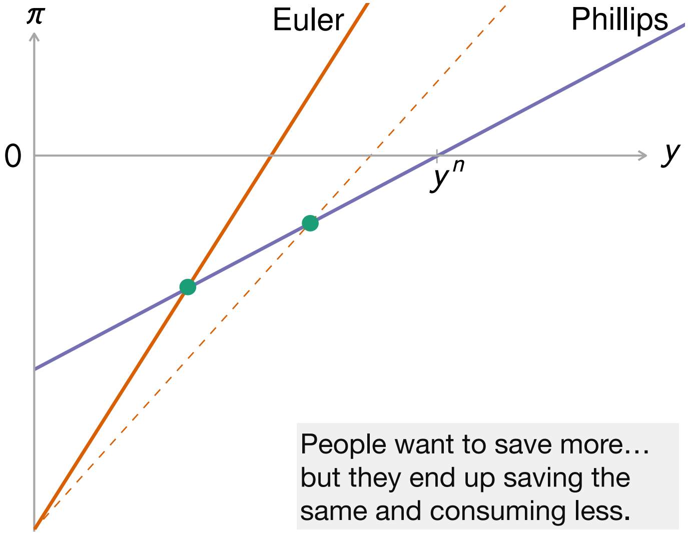
OTHER ZLB PROPERTIES IN WUNK

PARADOX OF THRIFT: HIGHER MU OF WEALTH



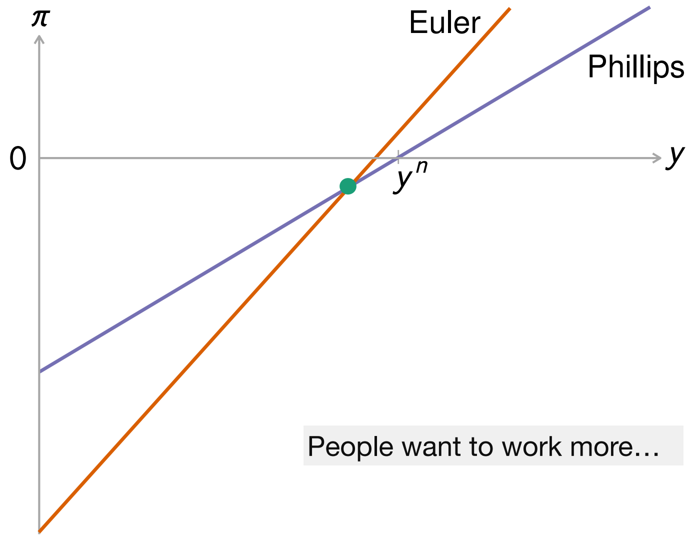
People want to save more…

PARADOX OF THRIFT: HIGHER MU OF WEALTH

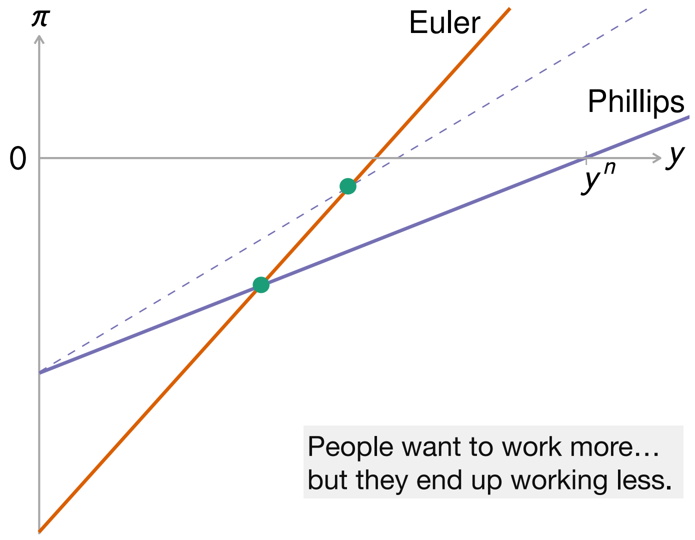


People want to save more…
but they end up saving the same and consuming less.

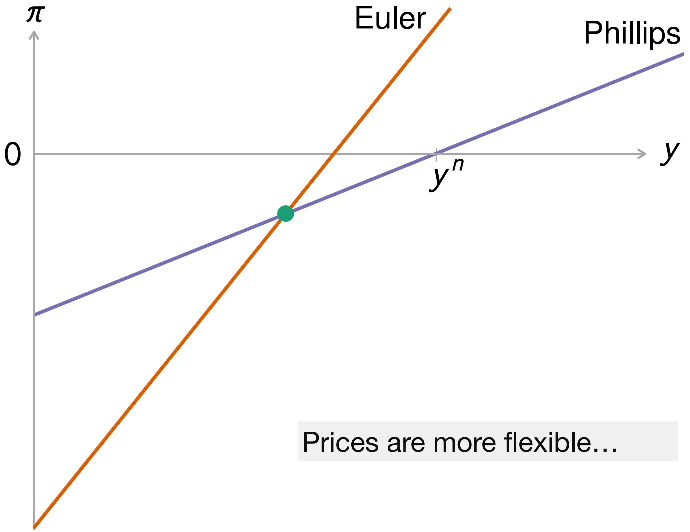
PARADOX OF TOIL: LOWER DISUTILITY OF LABOR



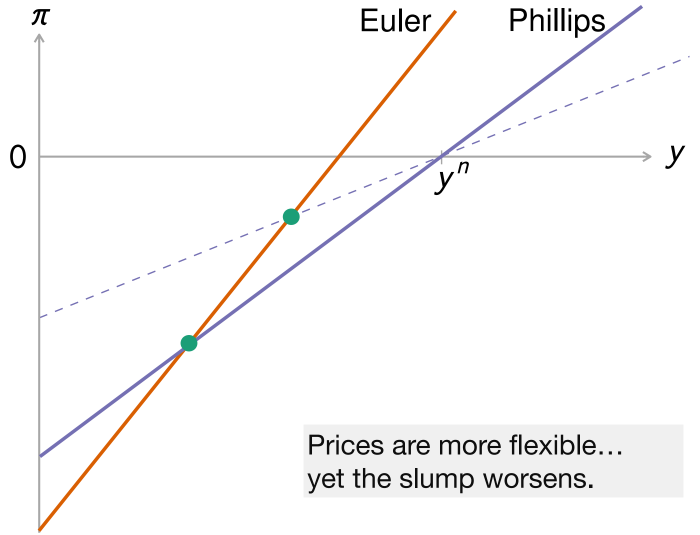
PARADOX OF TOIL: LOWER DISUTILITY OF LABOR



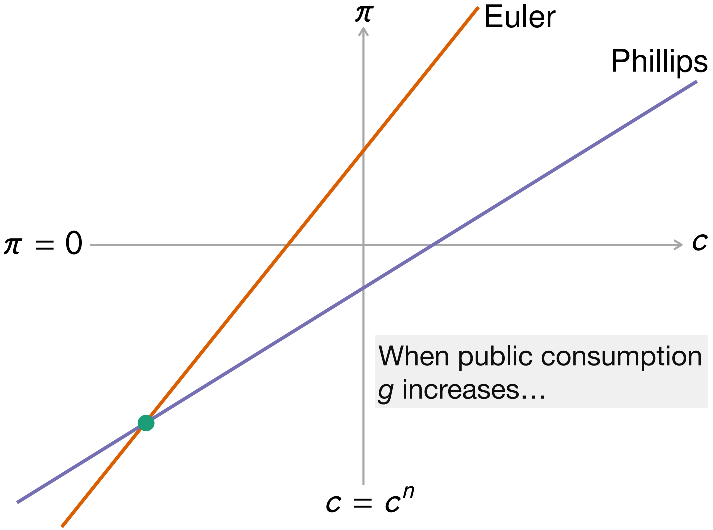
PARADOX OF FLEXIBILITY: LOWER PRICE-ADJUSTMENT COST



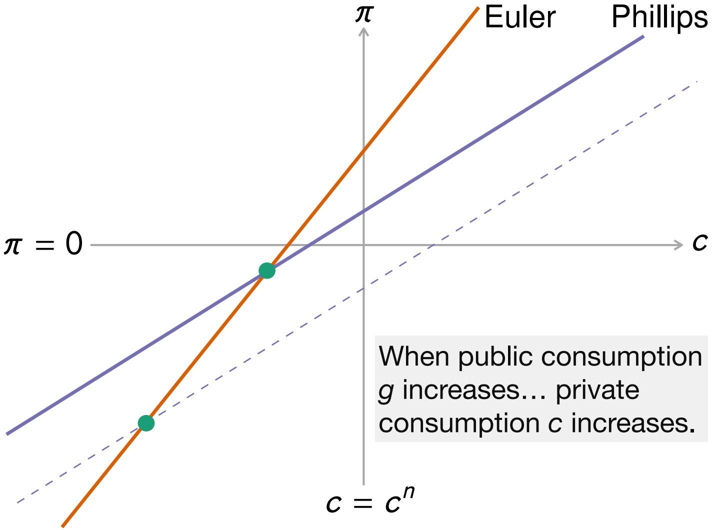
PARADOX OF FLEXIBILITY: LOWER PRICE-ADJUSTMENT COST



ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER



ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER



ASSESSMENT OF WUNK ASSUMPTION

- WUNK assumption in measurable statistics:

$$\delta - r^n > \frac{\lambda}{\delta}$$

- δ = annual time discount rate $\approx 43\%$
  - Frederick, Loewenstein, O'Donoghue [2002]
  - Andersen, Harrison, Lau, Rutstrom [2014]
- r^n = natural rate of interest $\approx 2\%$
- λ = output-gap coefficient in Phillips curve $\approx 1.6\%$
  - Mavroeidis, Plagborg-Moller, Stock [2014]
- assumption holds: $43\% - 2\% = 0.41 > 0.037 = 1.6\%/43\%$
  - lowest acceptable household discount rate: 27%
  - lowest acceptable firm discount rate: 16%