

# RESOLVING NEW KEYNESIAN ANOMALIES WITH WEALTH IN THE UTILITY FUNCTION

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Paper available at <https://pascalmichailat.org/11/>

# 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, Rebelo [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

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

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

- 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

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

- 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:  $\text{MRS}(\text{wealth, consumption}) = u'(0)y^n$

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

## TWO MODELS

- NK: standard New Keynesian model

$$u'(0) = 0$$

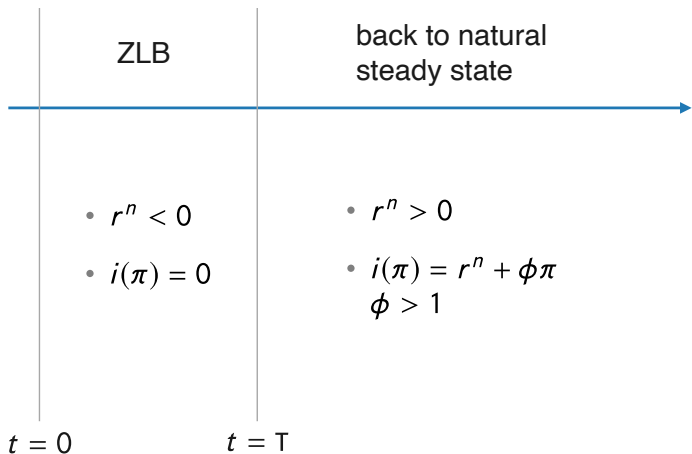
- WUNK: wealth-in-the-utility New Keynesian model

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

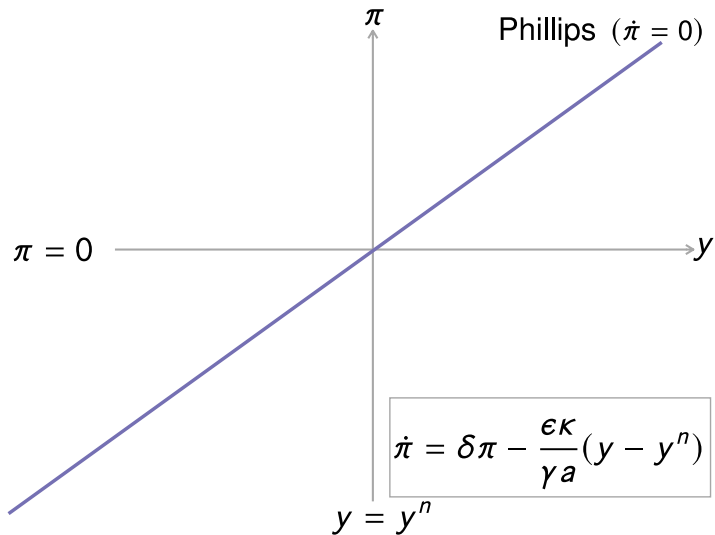
# OUTPUT & INFLATION COLLAPSE

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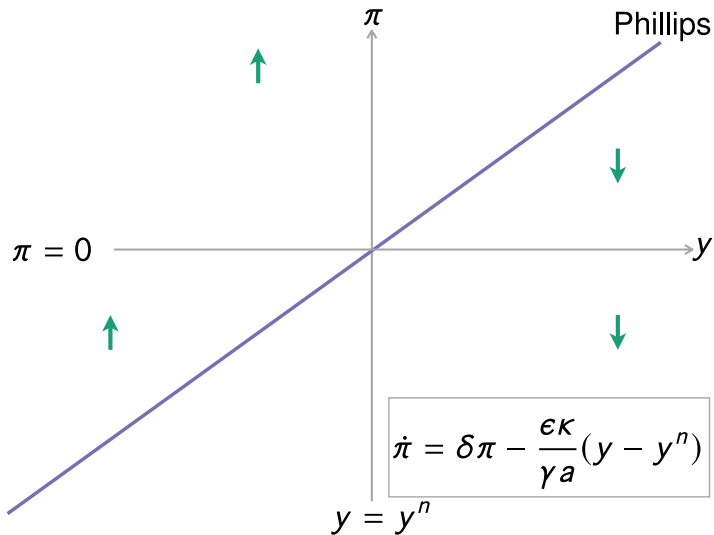
## SCENARIO: ZLB



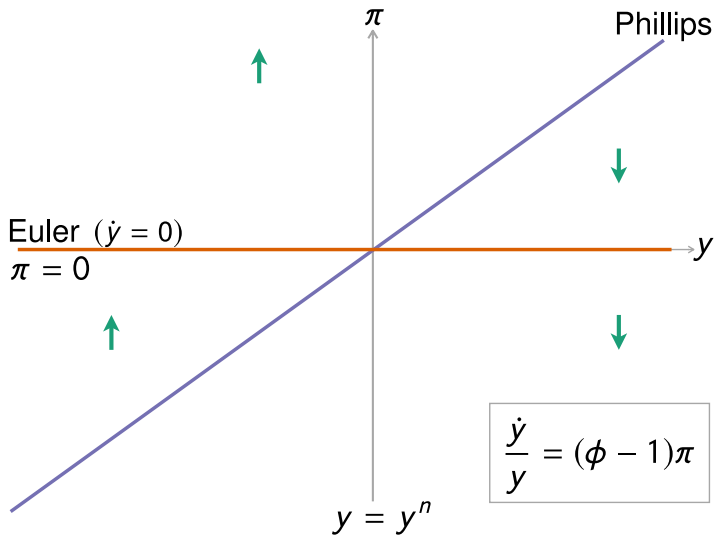
# NK | PHASE DIAGRAM IN NORMAL TIMES



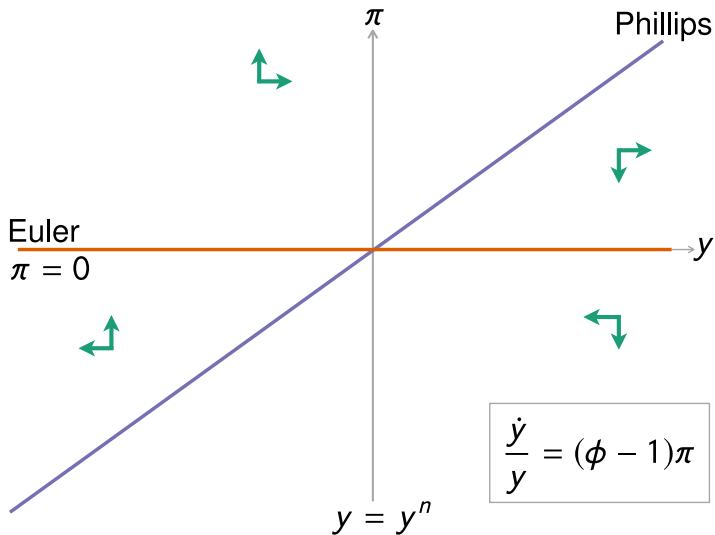
# NK | PHASE DIAGRAM IN NORMAL TIMES



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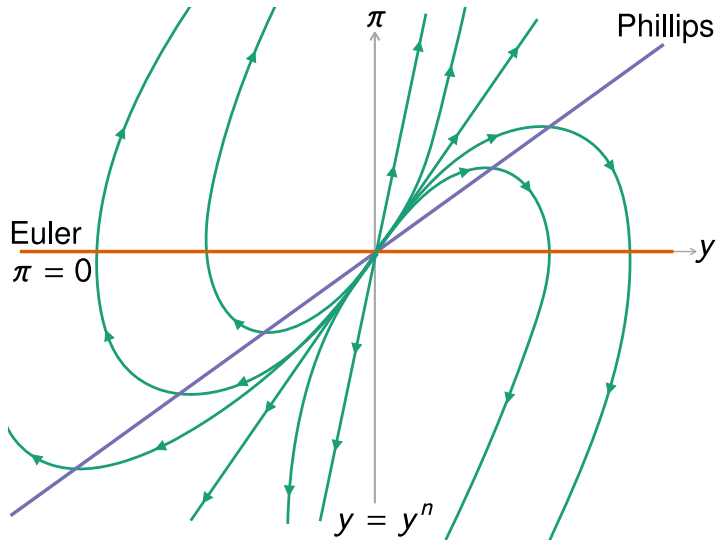


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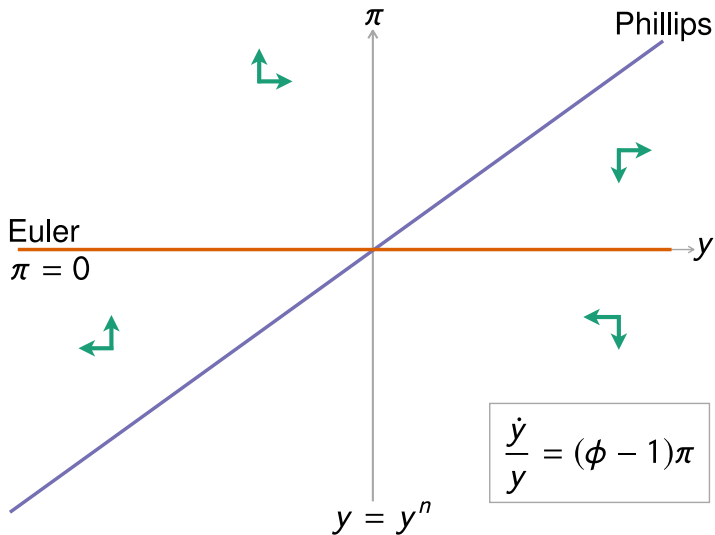




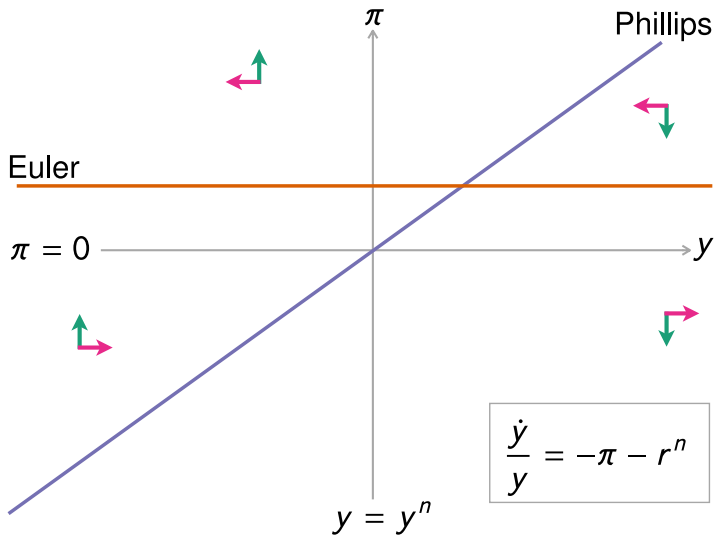
# NK | PHASE DIAGRAM IN NORMAL TIMES: SOURCE



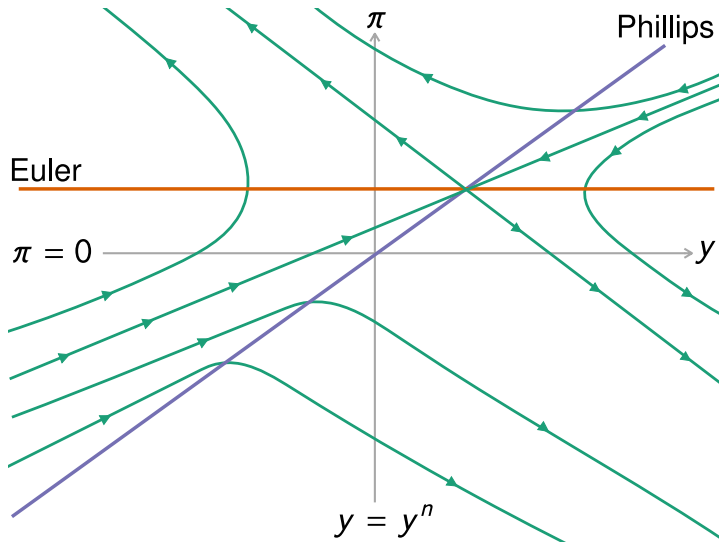
# NK | PHASE DIAGRAM AT ZLB



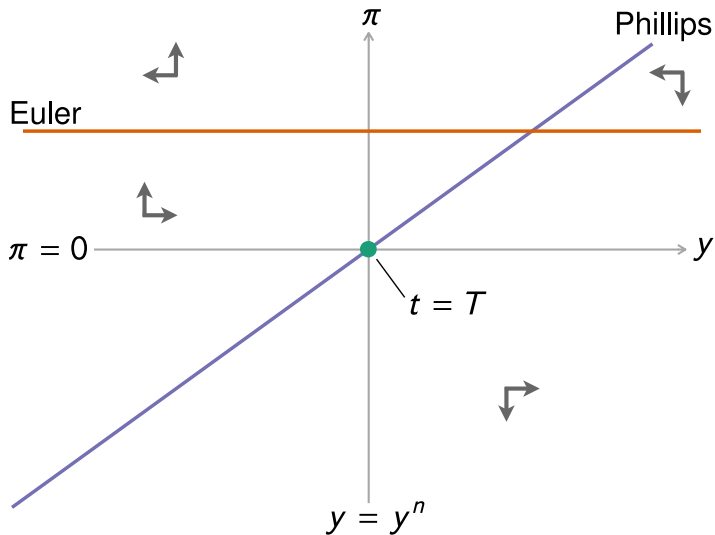
# NK | PHASE DIAGRAM AT ZLB



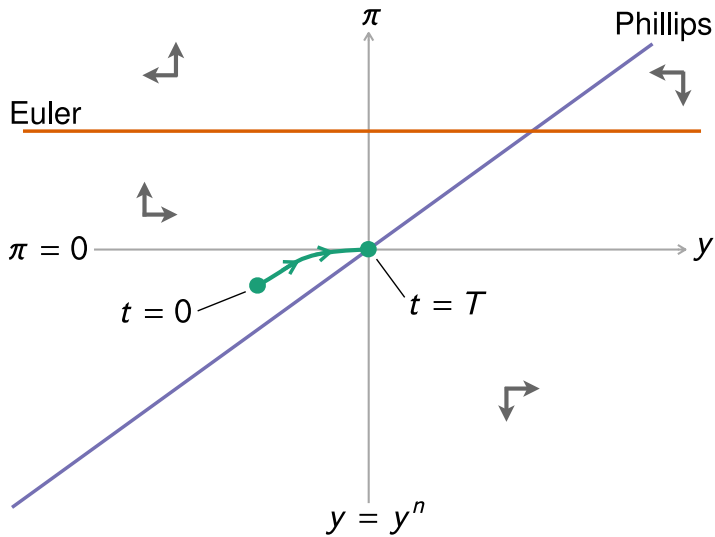
# NK | PHASE DIAGRAM AT ZLB: SADDLE



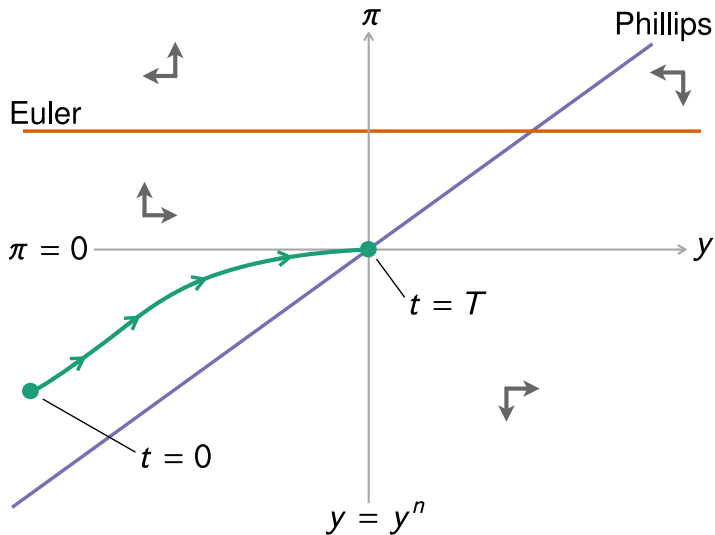
# NK | ZLB EPISODE



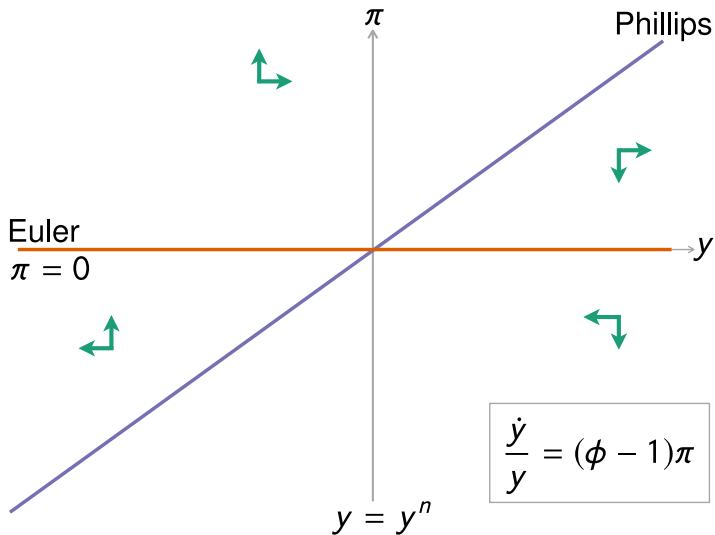
# NK | ZLB EPISODE



# NK | LONGER ZLB: OUTPUT & INFLATION COLLAPSE

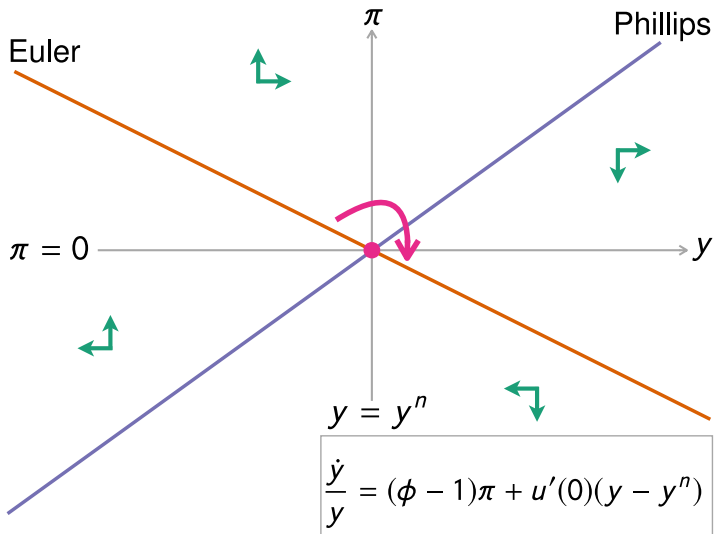


# WUNK | PHASE DIAGRAM IN NORMAL TIMES

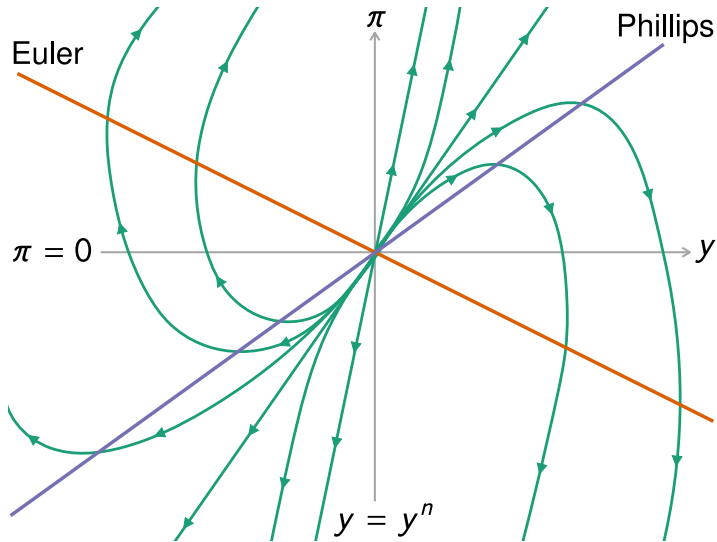




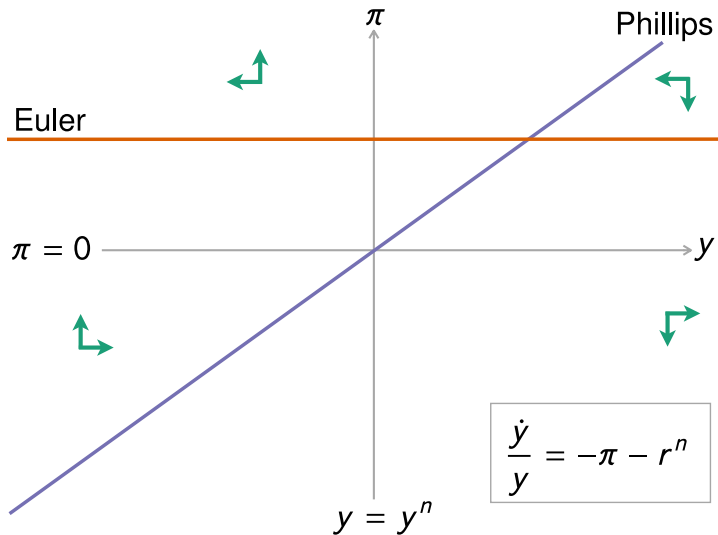
# WUNK | PHASE DIAGRAM IN NORMAL TIMES



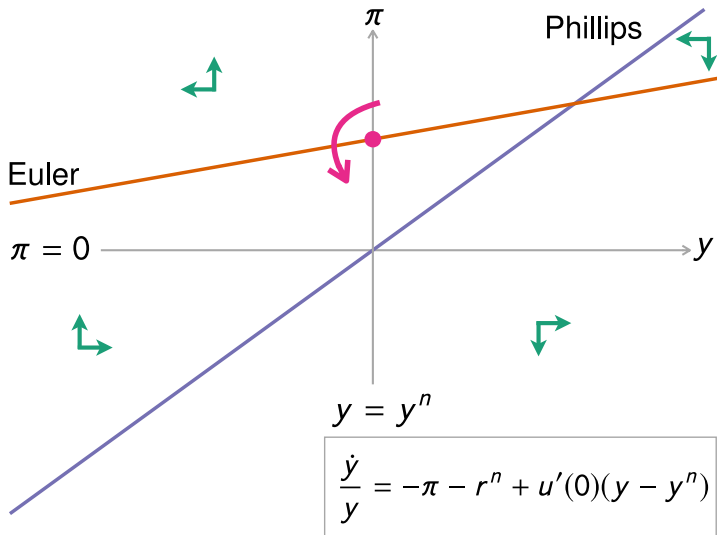
# WUNK | PHASE DIAGRAM IN NORMAL TIMES: SOURCE



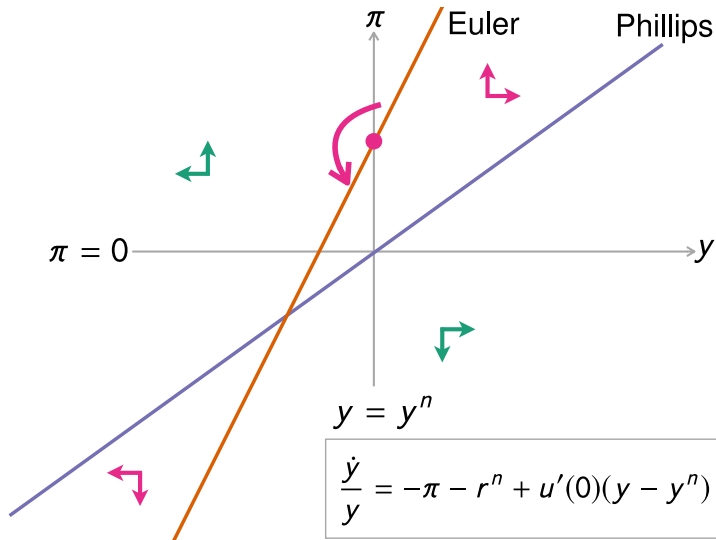
# WUNK | PHASE DIAGRAM AT ZLB



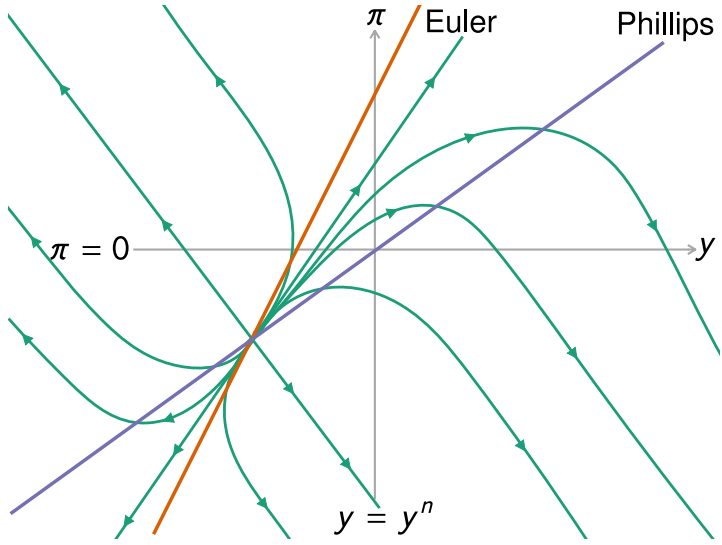
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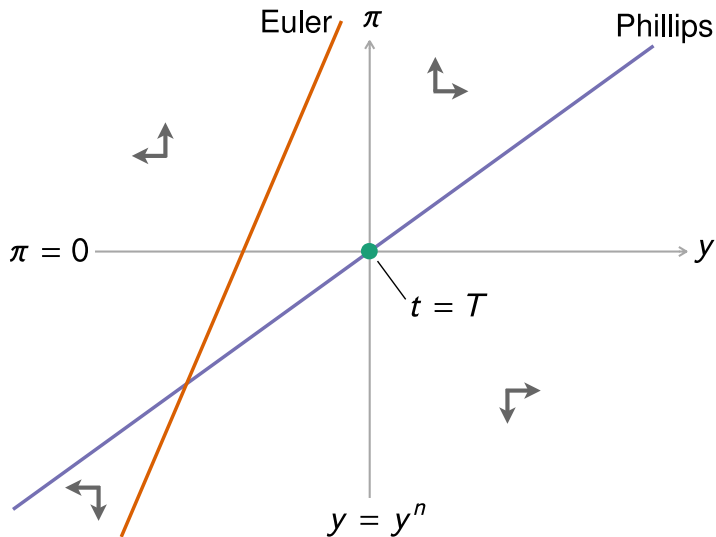
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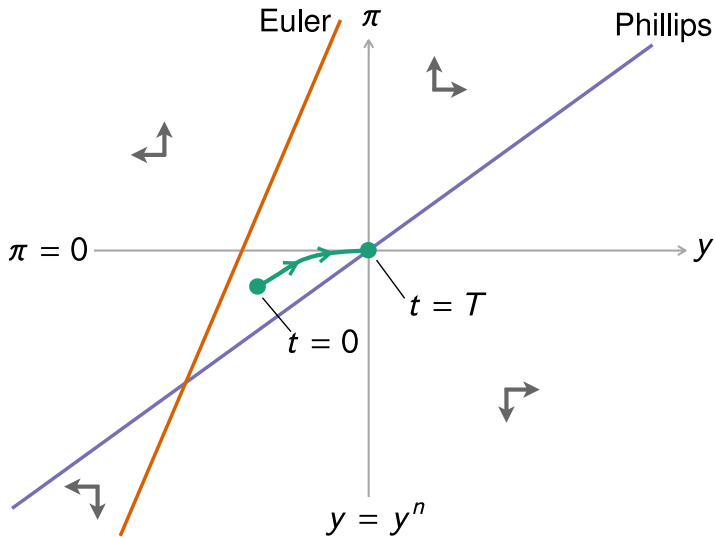
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# WUNK | ZLB EPISODE

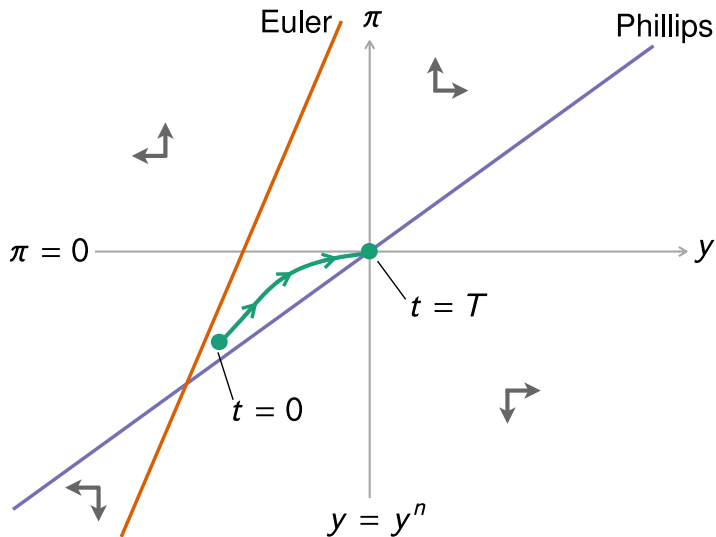


# WUNK | ZLB EPISODE





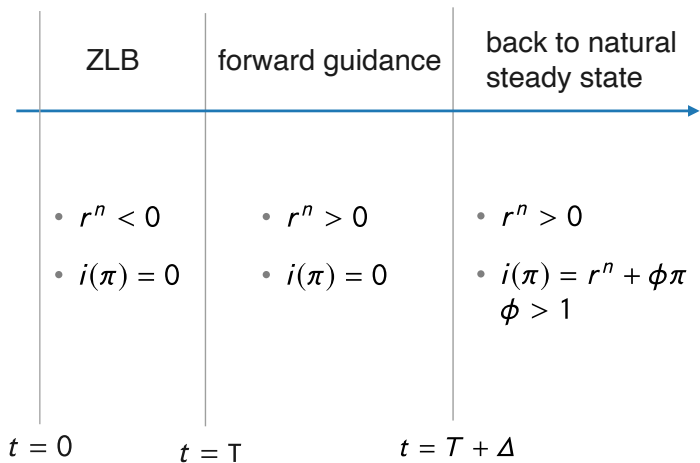
# WUNK | LONGER ZLB CONVERGES TO STEADY STATE



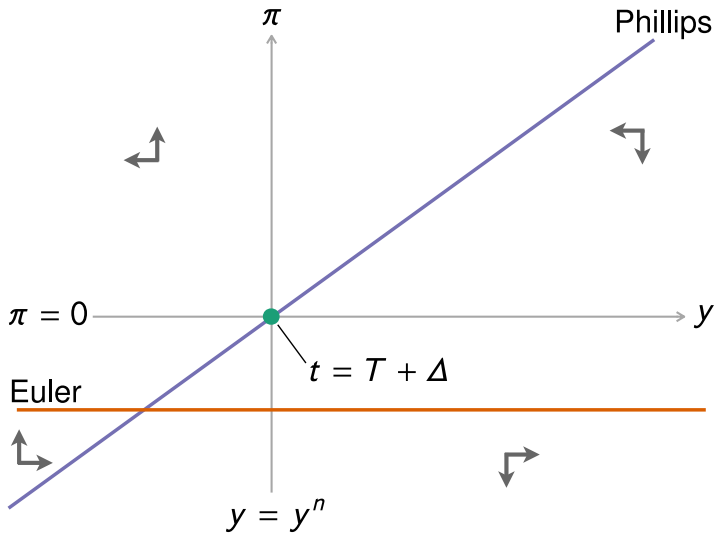
# FORWARD GUIDANCE

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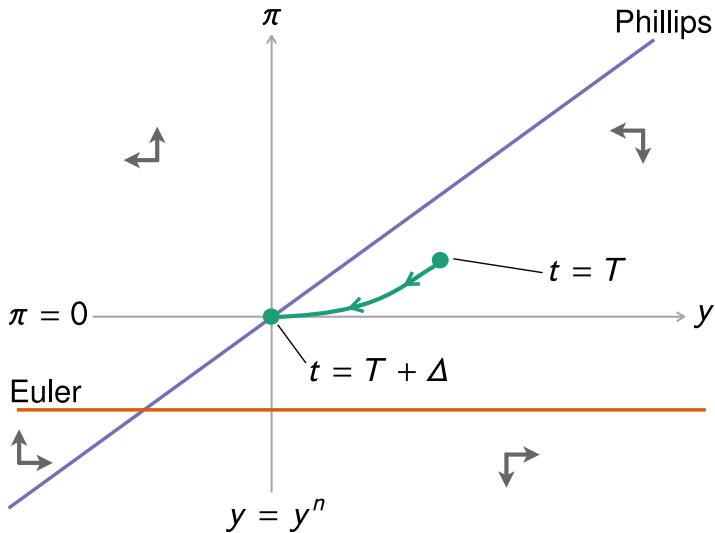
## SCENARIO: ZLB + FORWARD GUIDANCE



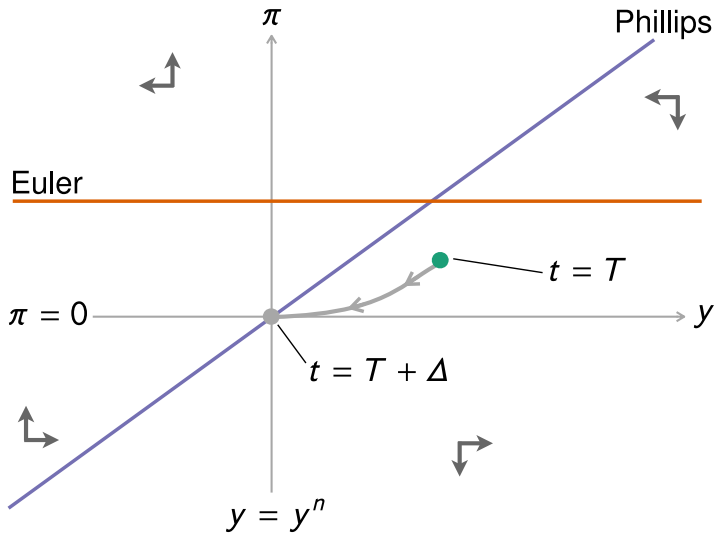
# NK | ZLB + **FORWARD GUIDANCE**



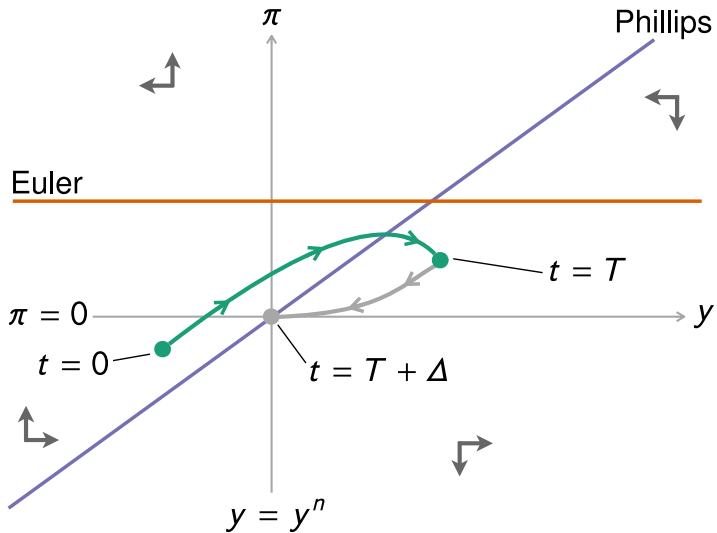
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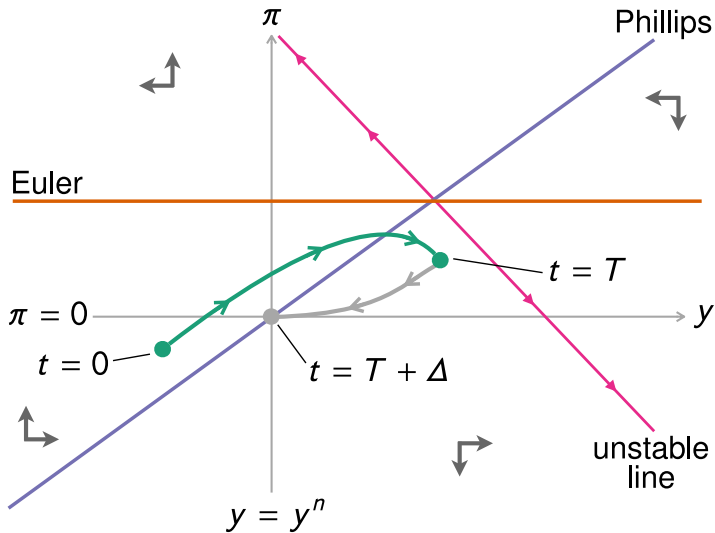
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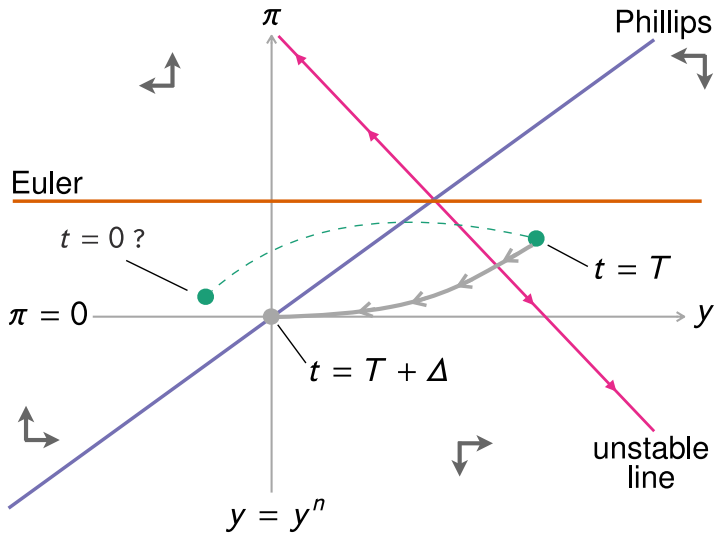


# NK | LONGER GUIDANCE: BOOM AT ZLB

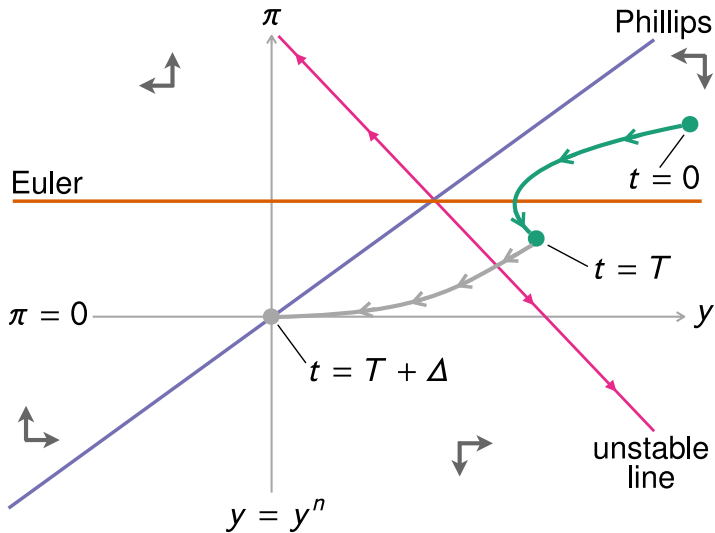




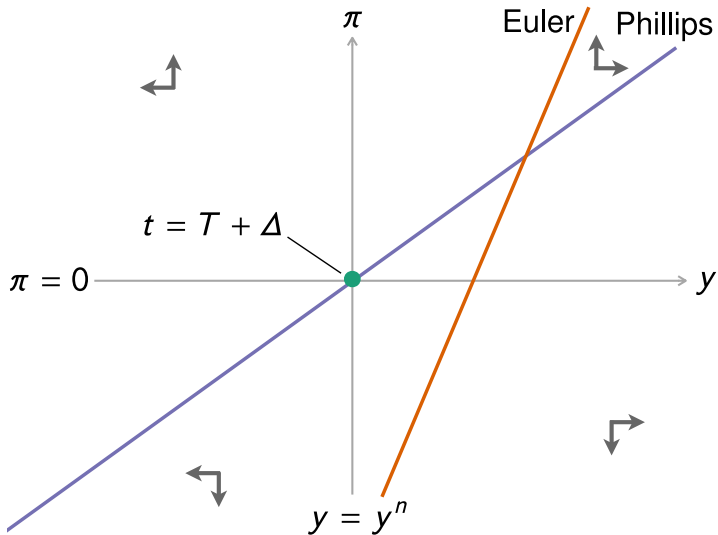
# NK | LONGER GUIDANCE: BOOM AT ZLB



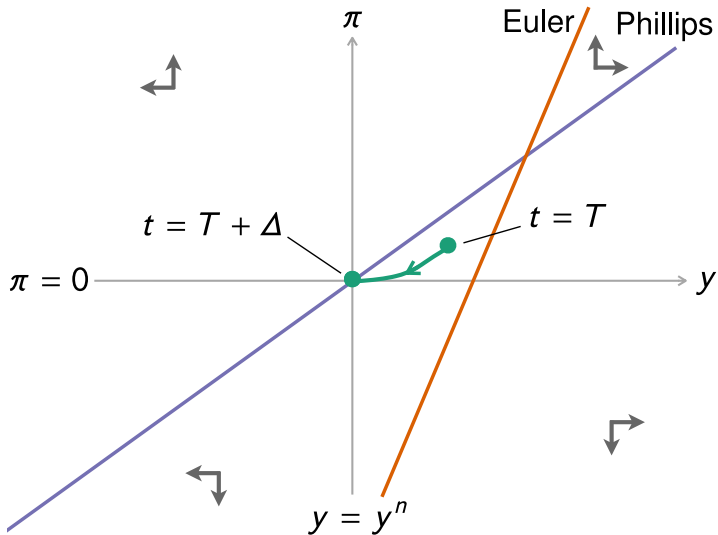
# NK | LONGER GUIDANCE: BOOM AT ZLB



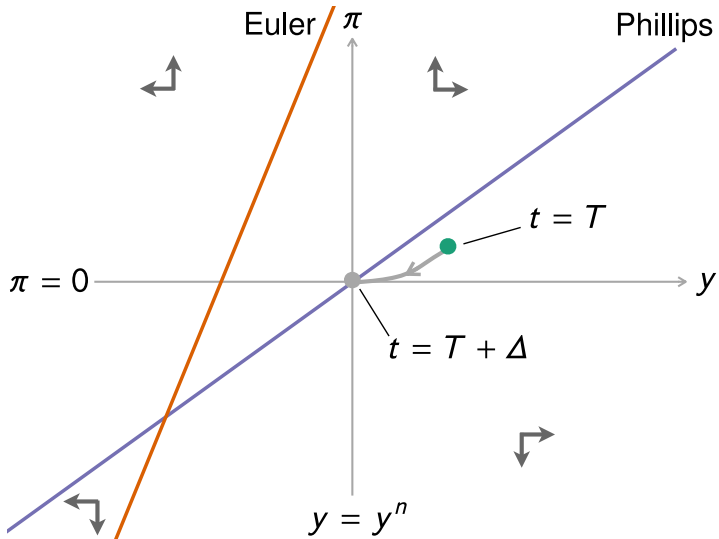
# WUNK | ZLB + **FORWARD GUIDANCE**



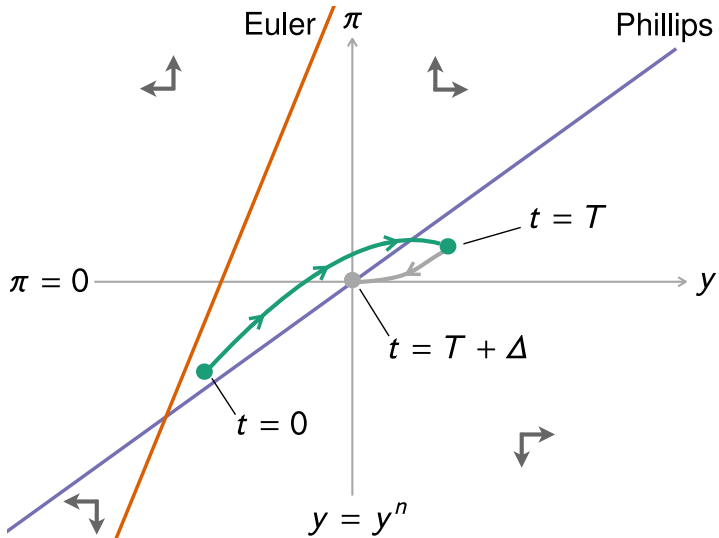
# WUNK | ZLB + FORWARD GUIDANCE



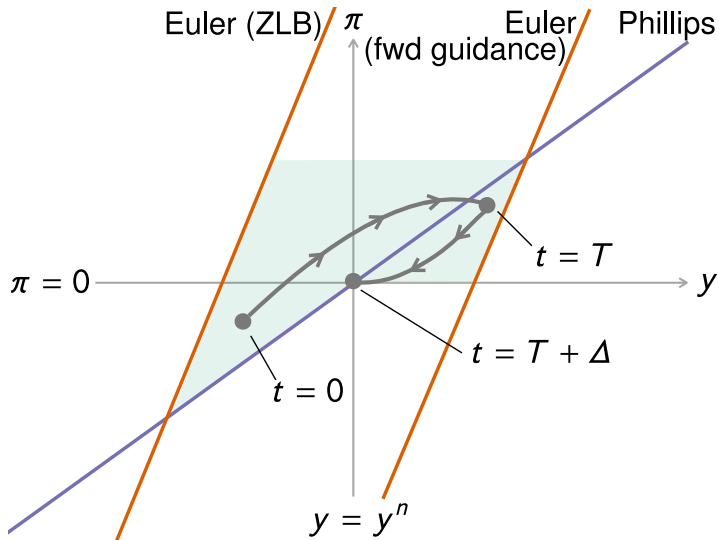
# WUNK | ZLB + FORWARD GUIDANCE



# WUNK | ZLB + FORWARD GUIDANCE



# WUNK | LONGER GUIDANCE: LIMITED EFFECT

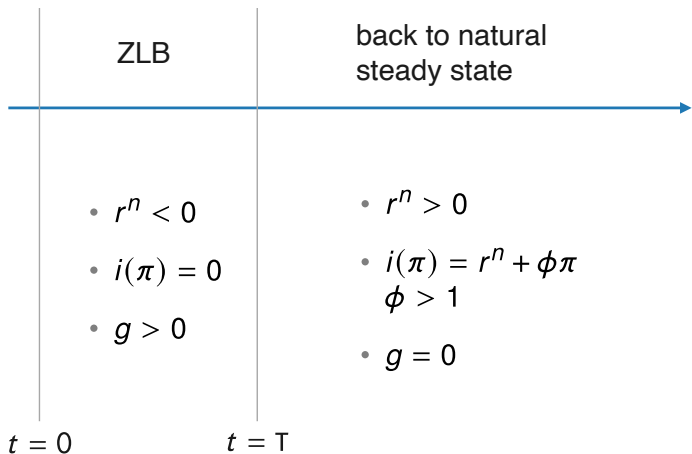


# GOVERNMENT SPENDING

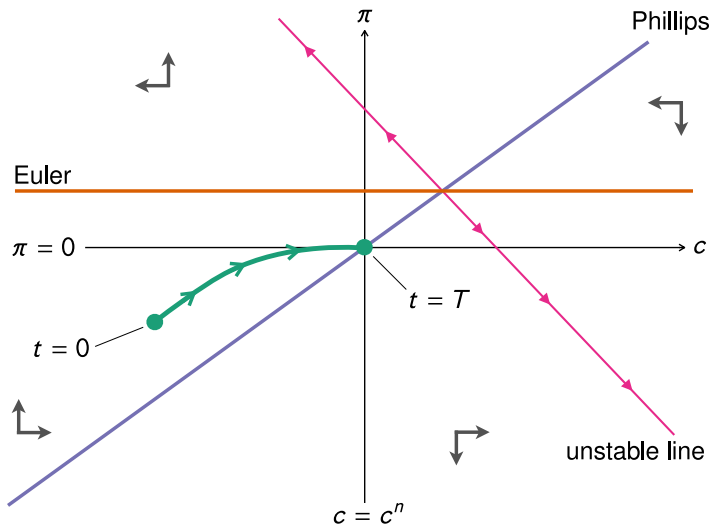
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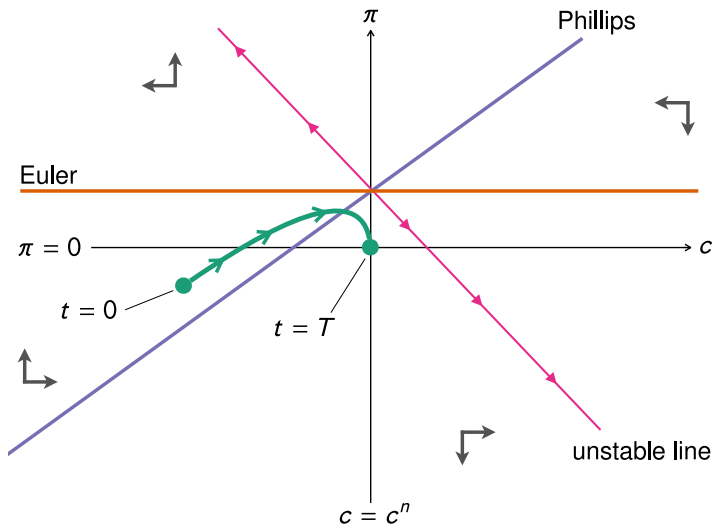
## SCENARIO: ZLB + GOVERNMENT SPENDING $g$



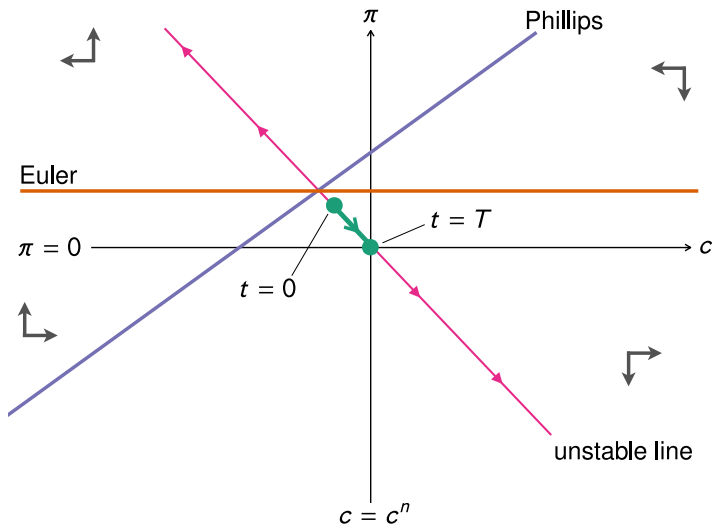
# NK | ZLB + NO SPENDING



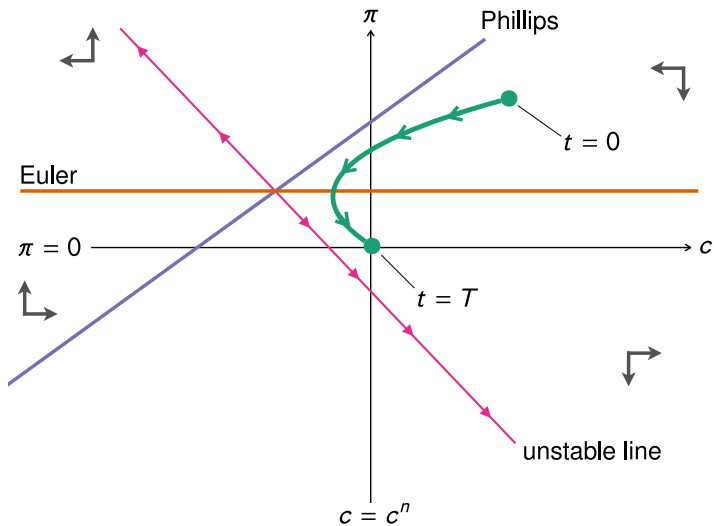
# NK | ZLB + SMALL SPENDING



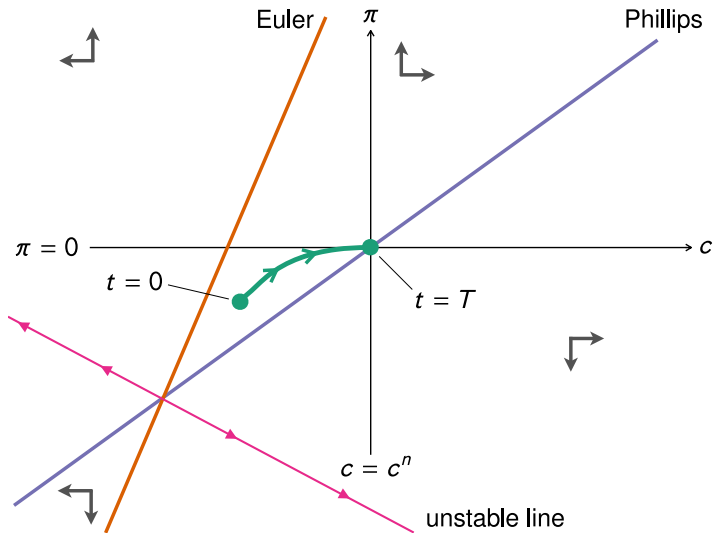
# NK | ZLB + MEDIUM SPENDING



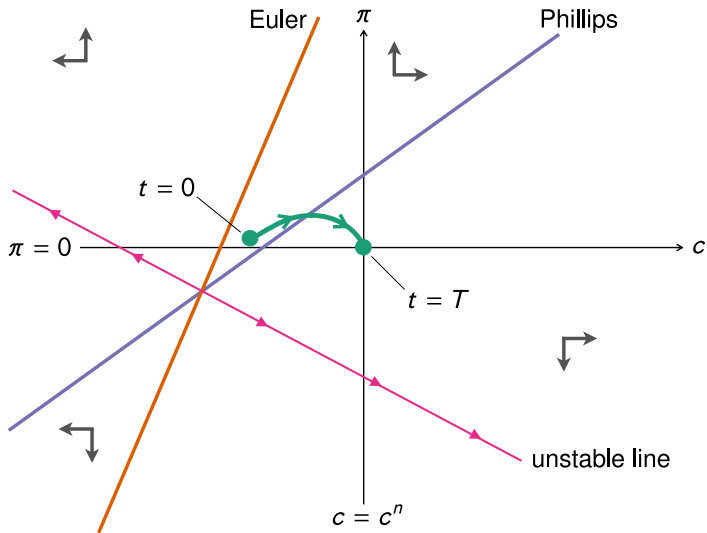
# NK | ZLB + LARGE SPENDING: BOOM AT ZLB



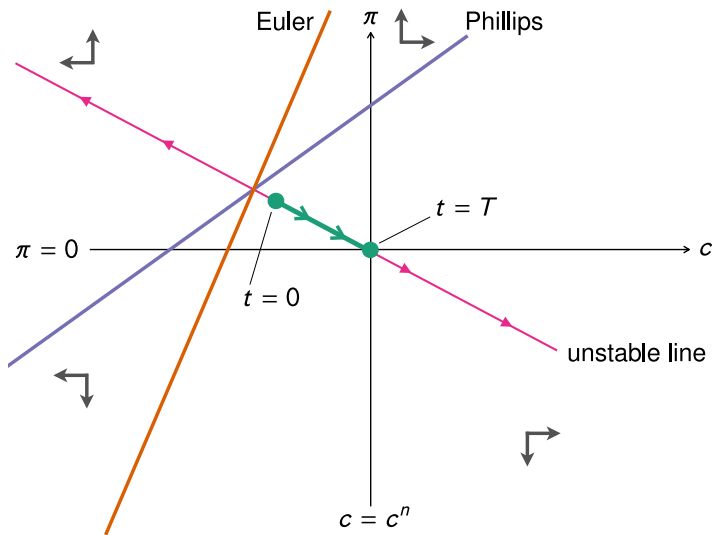
# WUNK | ZLB + NO SPENDING



# WUNK | ZLB + SMALL SPENDING

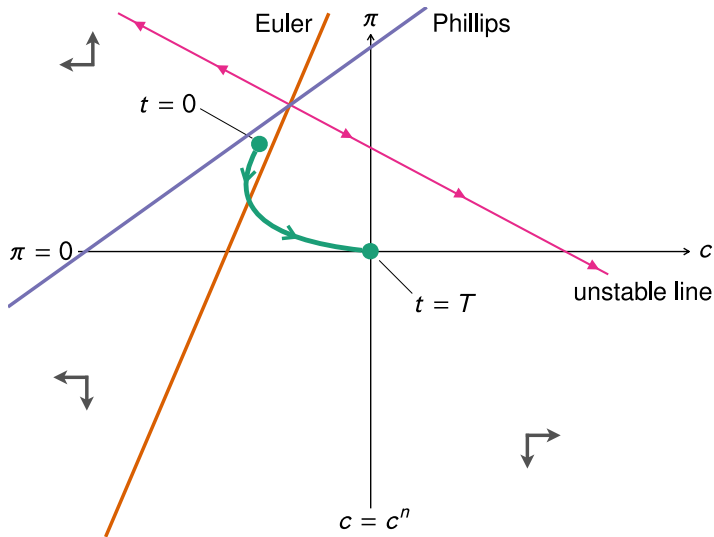


# WUNK | ZLB + MEDIUM SPENDING





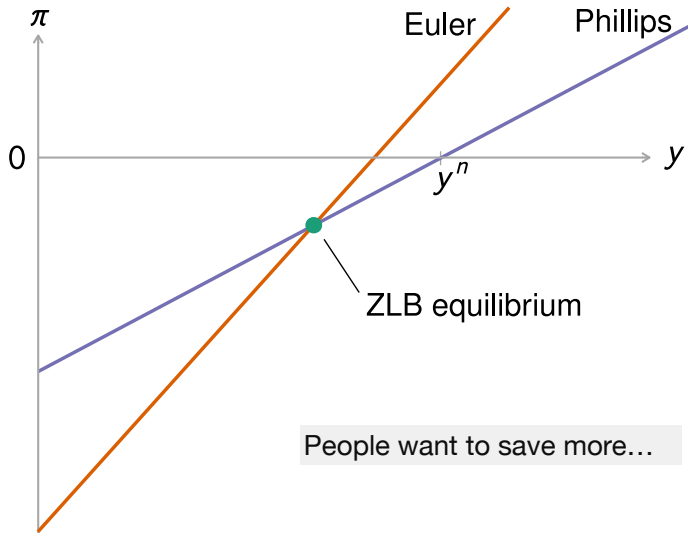
# WUNK | ZLB + LARGE SPENDING: LIMITED EFFECT



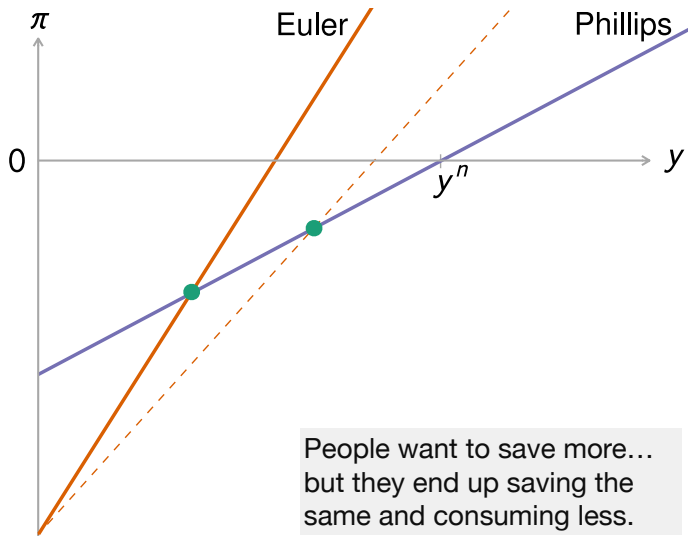
## OTHER ZLB PROPERTIES IN WUNK

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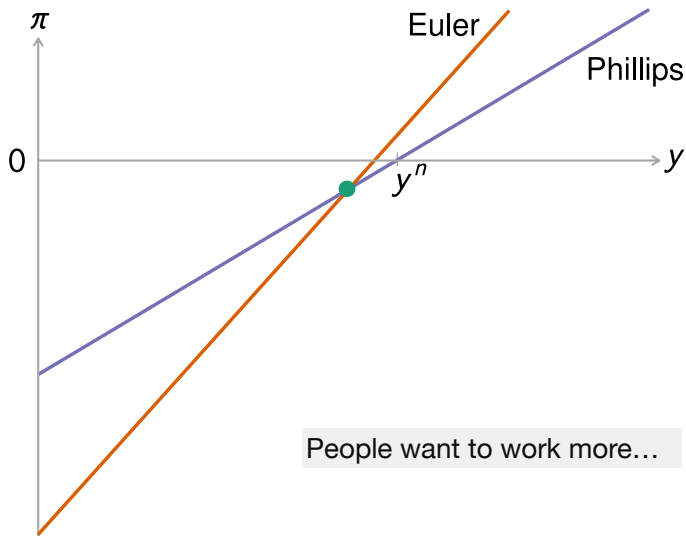
# PARADOX OF THRIFT: HIGHER MU OF WEALTH



## PARADOX OF THRIFT: HIGHER MU OF WEALTH

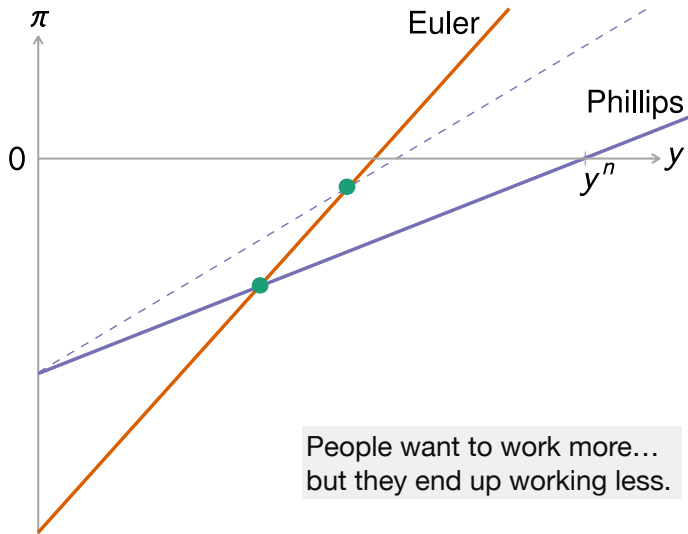


# PARADOX OF TOIL: LOWER DISUTILITY OF LABOR

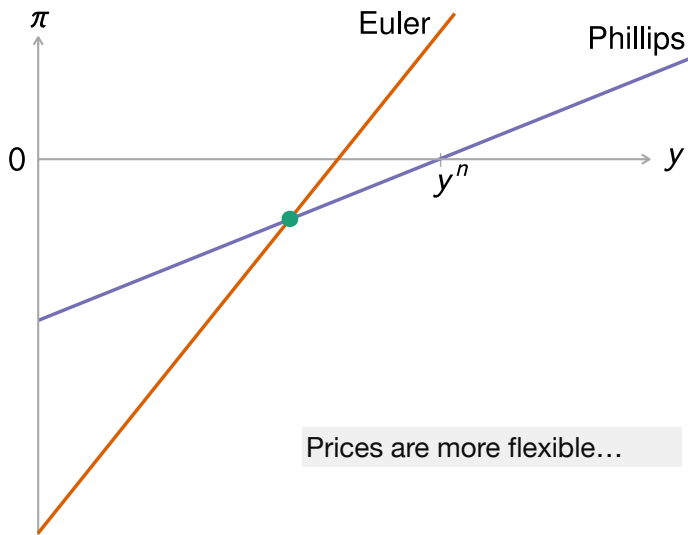


People want to work more...

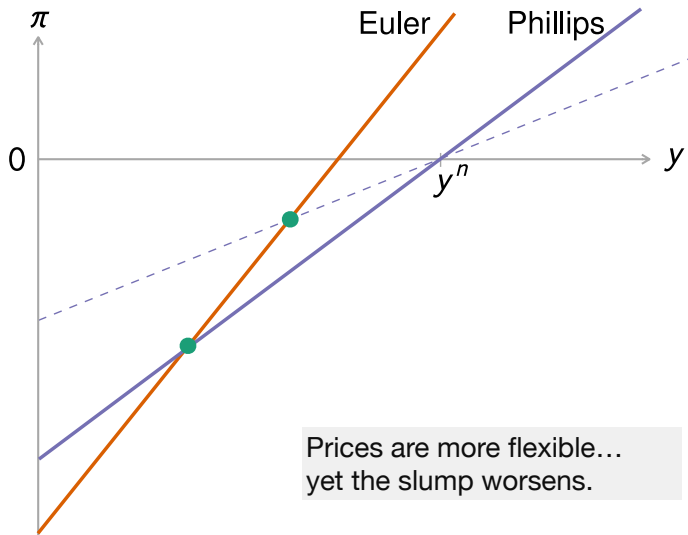
# PARADOX OF TOIL: LOWER DISUTILITY OF LABOR



# PARADOX OF FLEXIBILITY: LOWER PRICE-ADJUSTMENT COST

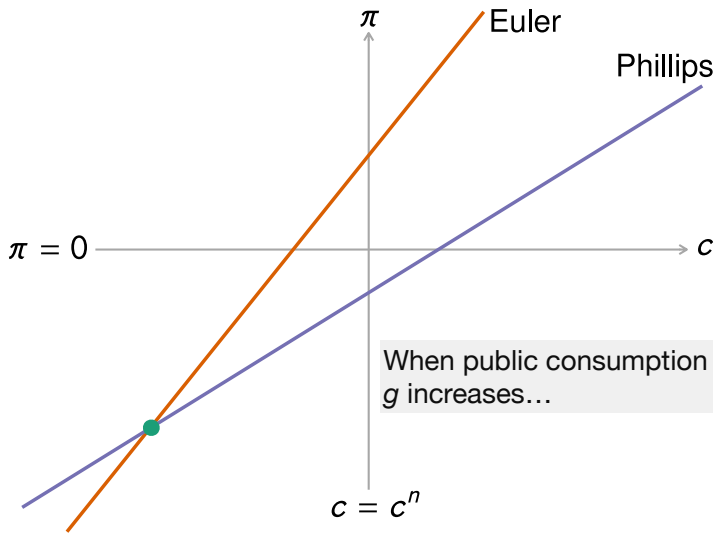


# PARADOX OF FLEXIBILITY: LOWER PRICE-ADJUSTMENT COST

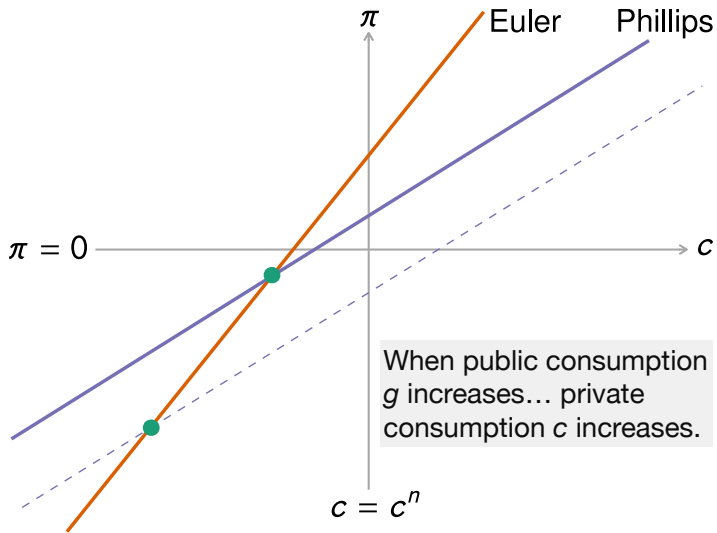




# ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER



# ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER



# ASSESSMENT OF WUNK ASSUMPTION

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- WUNK assumption in measurable statistics:

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

- $\delta$  = annual time discount rate  $\approx 43\%$ 
  - Frederick, Loewenstein, O'Donoghue [2002]
  - Andersen, Harrison, Lau, Rutstrom [2014]
- $r^n$  = natural rate of interest  $\approx 2\%$
- $\lambda$  = 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%