TAMING BUSINESS CYCLES WITH MONETARY AND FISCAL POLICY

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Course material available at https://pascalmichaillat.org/c5/

OUTLINE

- develop Beveridgean framework to think about productive efficiency, based on Michaillat, Saez (2021)
  - compute efficient labor market tightness
  - compute efficient unemployment rate
- derive formula for optimal monetary policy, based on Michaillat, Saez (2022)
- derive formula for optimal government spending, based on Michaillat, Saez (2019)

BEVERIDGEAN FRAMEWORK FOR PRODUCTIVE EFFICIENCY

COMPOSITION OF LABOR FORCE

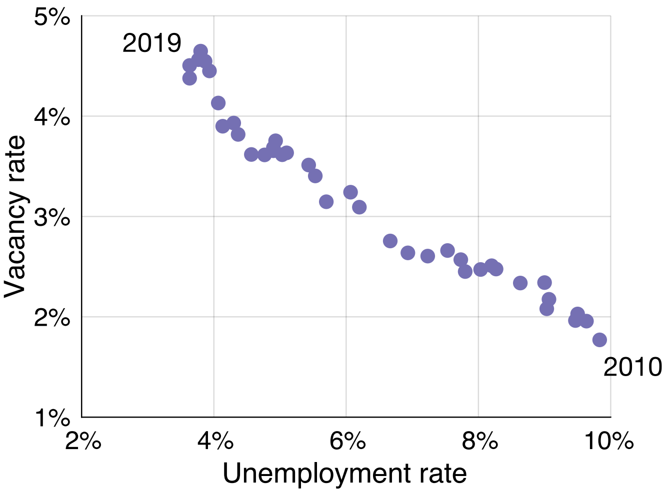
- share u of labor force is unemployed
  - home production is fraction $\zeta \in (0, 1)$ for market production
- share $\kappa \cdot v$ of labor force is employed recruiting
  - κ recruiter per vacancy
- share $1 - u - \kappa v$ of labor force is employed producing
- social welfare is determined by home production + market production:

$$SW \propto 1 - u - \kappa \cdot v + \zeta \cdot u = 1 - \kappa \cdot v - (1 - \zeta) \cdot u$$

BEVERIDGEAN MODEL OF THE ECONOMY

- maximize social welfare $\Leftrightarrow$ minimize $\kappa v + (1 - \zeta)u$
  - special case with $\kappa = 1$ and $\zeta = 0$: minimize $u + v$ (Michaillat, Saez (2023))
- of course, cannot set $u = v = 0$
- Beveridge curve: $v(u)$
  - v: vacancy rate
  - u: unemployment rate
  - $v(u)$: decreasing in u, convex

US BEVERIDGE CURVE



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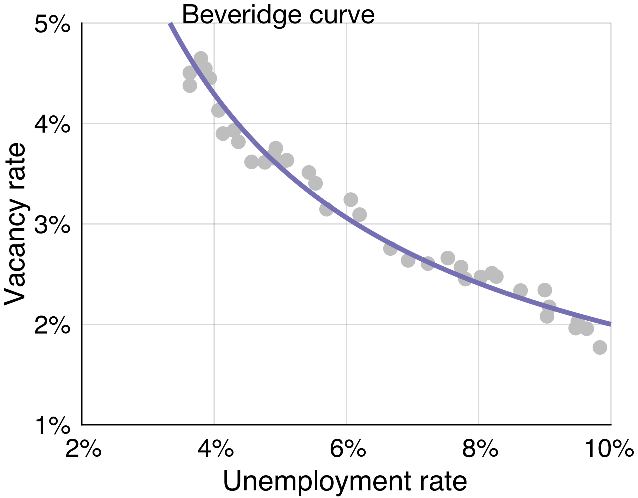

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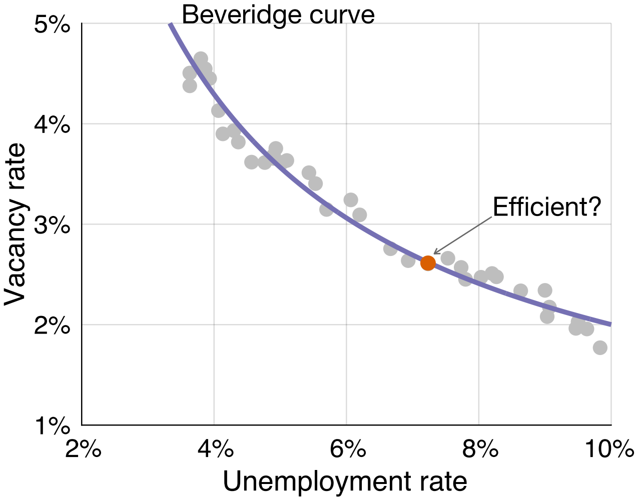
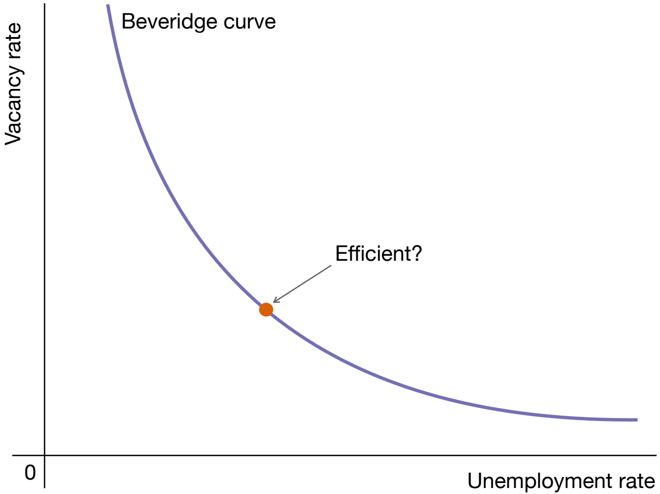


CONDITION FOR LABOR-MARKET EFFICIENCY



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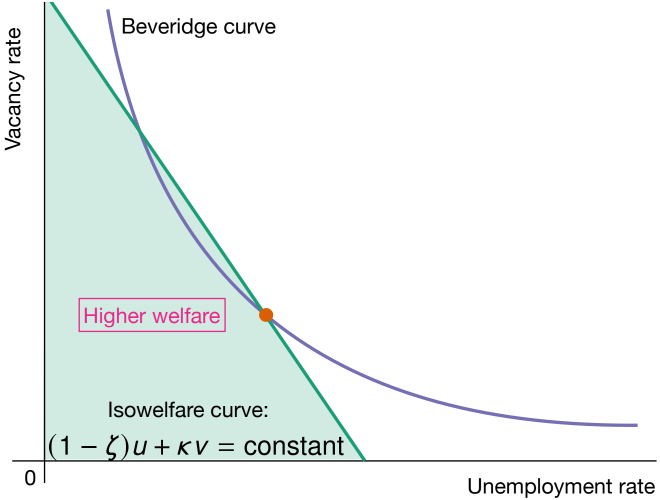

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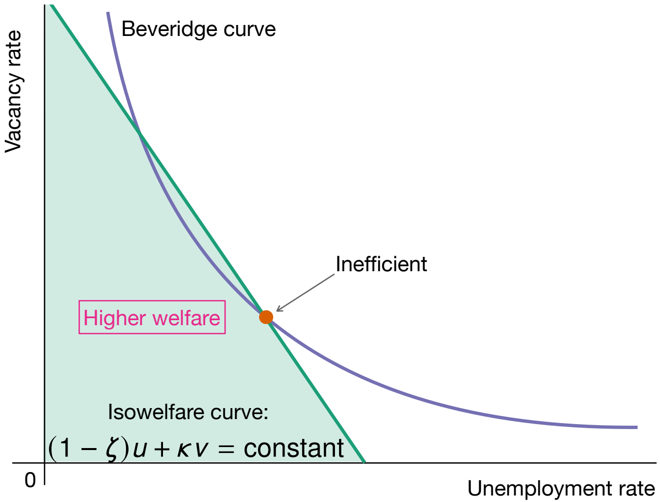

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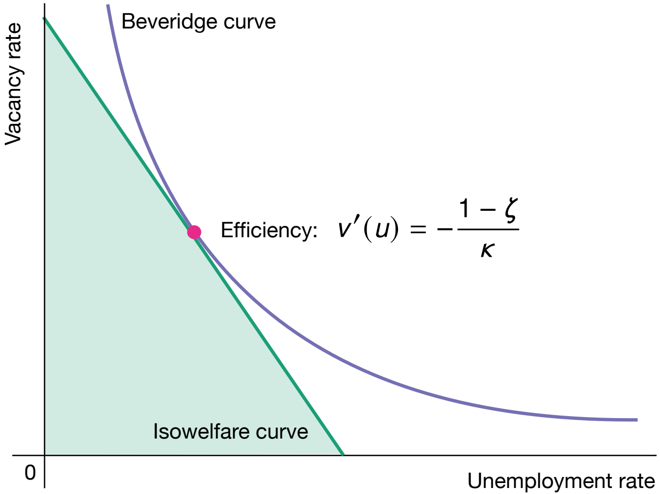
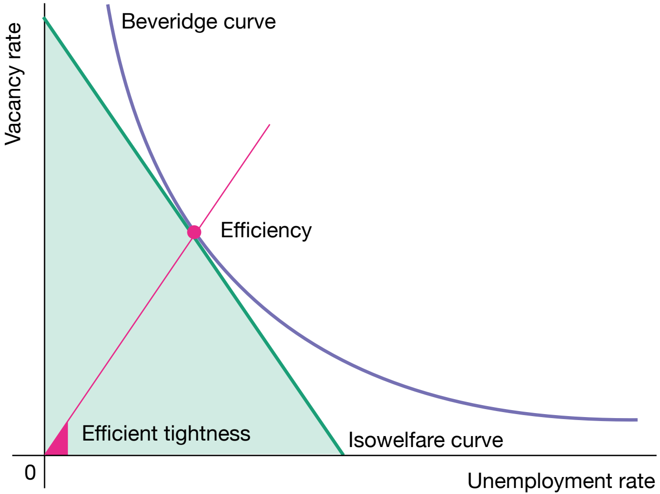


TIGHTNESS GAP AND UNEMPLOYMENT GAP



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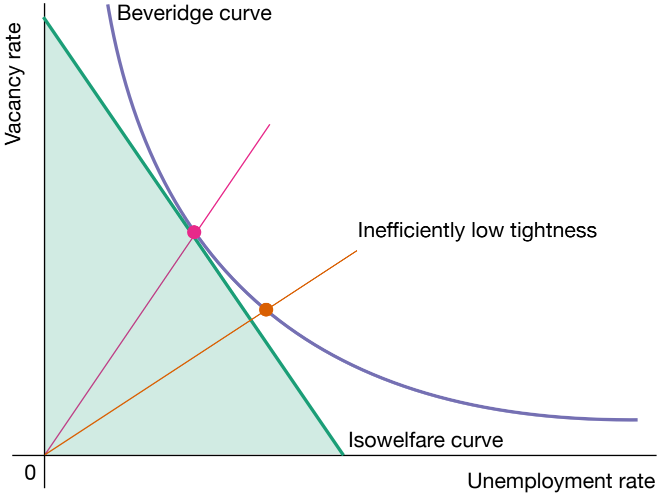

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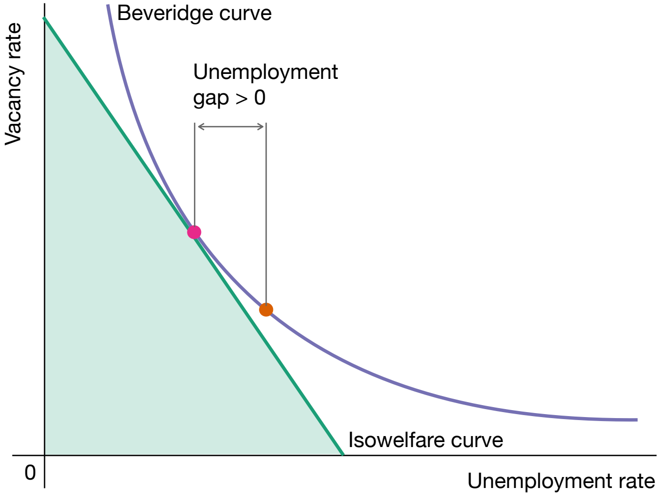

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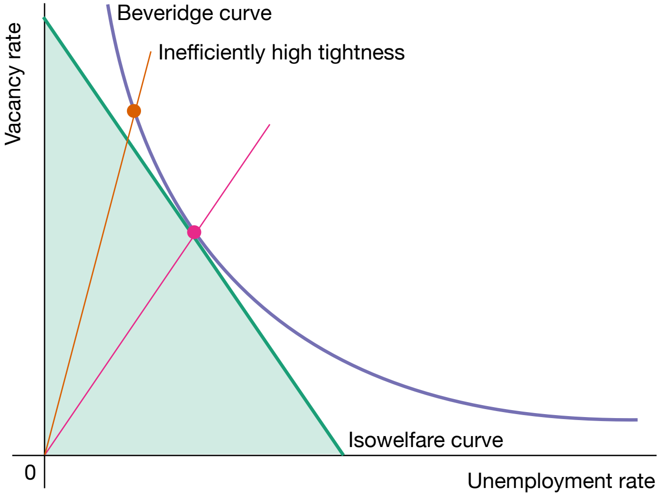

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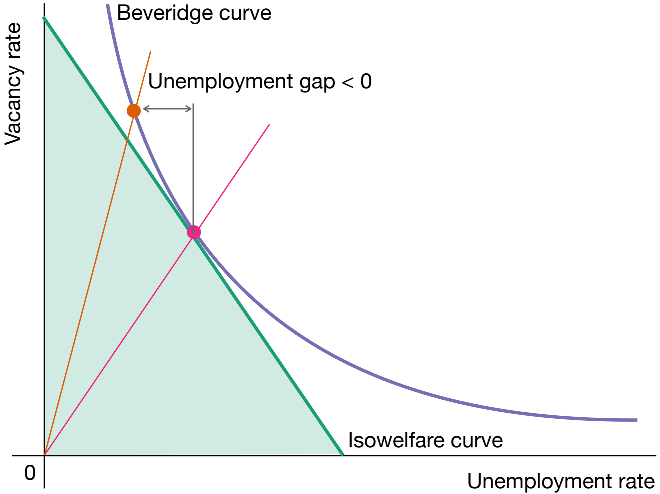


GRAPHICAL CHARACTERIZATION OF EFFICIENCY

- efficiency at tangency point: $v'(u) = MRS_{uv}$
- computing the social marginal rate of substitution:

$$MRS_{uv} = -\frac{\partial SW/\partial u}{\partial SW/\partial v} = -\frac{1-\zeta}{\kappa}$$

- efficiency condition:

$$v'(u) = -\frac{1-\zeta}{\kappa}$$

ANALYTICAL CHARACTERIZATION OF EFFICIENCY

- efficiency $\Leftrightarrow$ minimize $\kappa v(u) + (1 - \zeta)u$
- first-order condition is necessary and sufficient for this convex problem:

$$\kappa v'(u) + (1 - \zeta) = 0$$

- efficiency condition:

$$v'(u) = -\frac{1 - \zeta}{\kappa}$$

SUFFICIENT-STATISTIC FORMULA FOR EFFICIENT TIGHTNESS

- labor market tightness: $\theta = v/u$
- Beveridge elasticity:

$$\epsilon = -\frac{d\ln(v)}{d\ln(u)} = -\frac{u}{v} \cdot \frac{dv}{du} = -\frac{v'(u)}{\theta} > 0$$

- condition for efficiency:

$$\begin{aligned} v'(u) &= -\frac{1-\zeta}{\kappa} \\ -\frac{v'(u)}{\theta} \cdot \theta &= \frac{1-\zeta}{\kappa} \\ \theta &= \frac{1-\zeta}{\kappa \cdot \epsilon} \end{aligned}$$

EFFICIENT TIGHTNESS

- formula in sufficient statistics (valid in any Beveridgean model):

$$\theta^* = \frac{1 - \zeta}{\kappa \cdot \epsilon}$$

- in the US, in aggregate, $\zeta \approx 0$, $\kappa \approx 1$, and $\epsilon \approx 1$ so $\theta^* \approx 1$ (Michaillat, Saez 2023)
  - ϵ: Beveridge elasticity
  - κ: recruiting cost
  - ζ: social value of nonwork (does not include benefits and transfers)
- but these statistics might take different values in other countries or in specific industries

SUFFICIENT-STATISTIC FORMULA FOR EFFICIENT UNEMPLOYMENT RATE

- with isoelastic Beveridge curve:

$$v = A \cdot u^{-\epsilon}$$

$$\theta = \frac{v}{u} = A \cdot u^{-(\epsilon+1)}$$

$$u = (\theta/A)^{-1/(\epsilon+1)}$$

$$u^* = (\theta^*/A)^{-1/(\epsilon+1)}$$

- u^* obtained from θ^* through Beveridge curve:

$$\frac{u}{u^*} = \left(\frac{\theta}{\theta^*}\right)^{-1/(1+\epsilon)}$$

EFFICIENT UNEMPLOYMENT RATE

- reshuffling the terms in the previous expression gives the efficient unemployment rate:

$$u^* = \left(\frac{\kappa \cdot \epsilon}{1 - \zeta} \cdot v \cdot u^{\epsilon}\right)^{1/(1+\epsilon)}$$

- in the US, in aggregate, $\zeta \approx 0$, $\kappa \approx 1$, and $\epsilon \approx 1$ so $u^* \approx \sqrt{uv}$ (Michaillat, Saez 2023)
- taking logs in the previous expression, we can also link log unemployment and log tightness gaps, which is useful to move between unemployment and tightness:

$$\log(u) - \log(u^*) = -\frac{1}{1 + \epsilon} \cdot [\log(\theta) - \log(\theta^*)]$$

MATCHING MODELS ARE BEVERIDGEAN MODELS

DYNAMIC BUSINESS-CYCLE MODEL

- unemployment is a function of tightness when flows are balanced:

$$u = \frac{\lambda}{\lambda + f(\theta)}$$

- we can express relationship as a Beveridge curve:

$$u = \frac{\lambda}{\lambda + \omega \cdot \theta^{1-\eta}}$$

$$\lambda = \lambda \cdot u + \omega \cdot \frac{v^{1-\eta}}{u^{1-\eta}} \cdot u$$

$$\lambda \cdot (1 - u) = \omega \cdot v^{1-\eta} \cdot u^{\eta}$$

- this yields the Beveridge curve—a negative relationship between v and u:

$$v(u) = \left[\frac{\lambda \cdot (1 - u)}{\omega \cdot u^{\eta}}\right]^{1/(1-\eta)}$$

BEVERIDGE ELASTICITY IN DYNAMIC BUSINESS-CYCLE MODEL

- for a refresher on how to compute elasticities, see https://youtu.be/tU0dtS9iiOk
- Beveridge elasticity in dynamic model:

$$\epsilon = -\frac{d\ln(v)}{d\ln(u)} = -\frac{1}{1-\eta}\cdot\left[\frac{d\ln(\lambda\cdot(1-u))}{d\ln(u)} - \eta\right]$$

$$\epsilon = \frac{1}{1-\eta}\cdot\left[\eta - \frac{d\ln(1-u)}{d\ln(u)}\right]$$

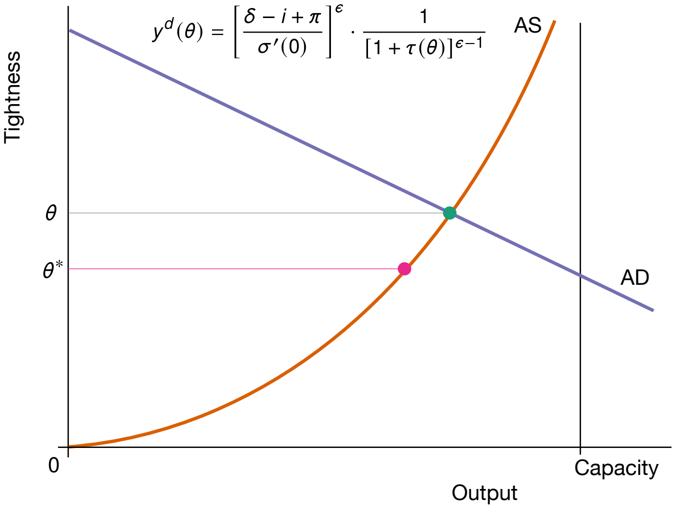
$$\epsilon = \frac{1}{1-\eta}\left[\eta + \frac{u}{1-u}\right]$$

- since $u/(1-u)$ is small, because u is small, ϵ is almost constant:

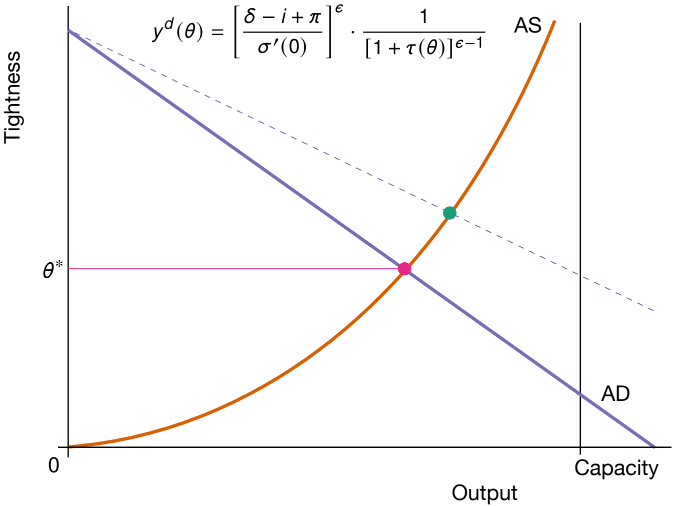
$$\epsilon \approx \frac{\eta}{1-\eta}$$

OPTIMAL MONETARY POLICY IN DYNAMIC BUSINESS-CYCLE MODEL

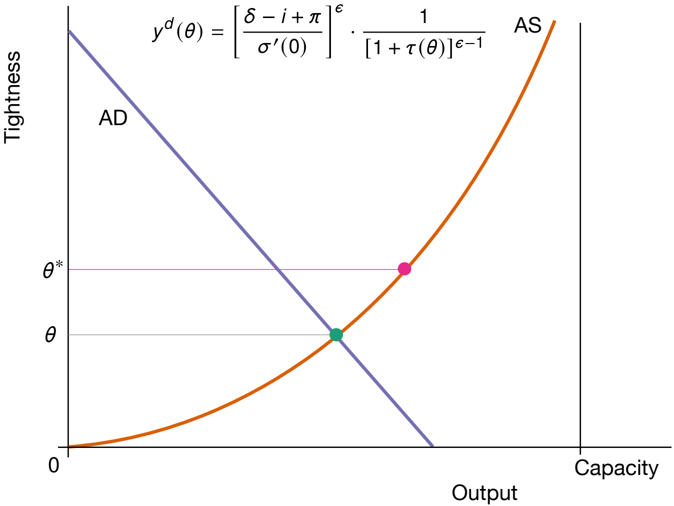
RESPONSE TO EXCESSIVE TIGHTNESS



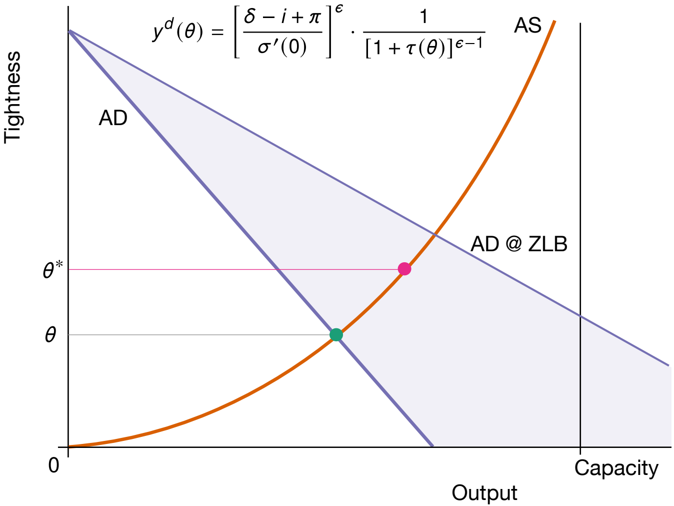
RESPONSE TO EXCESSIVE TIGHTNESS



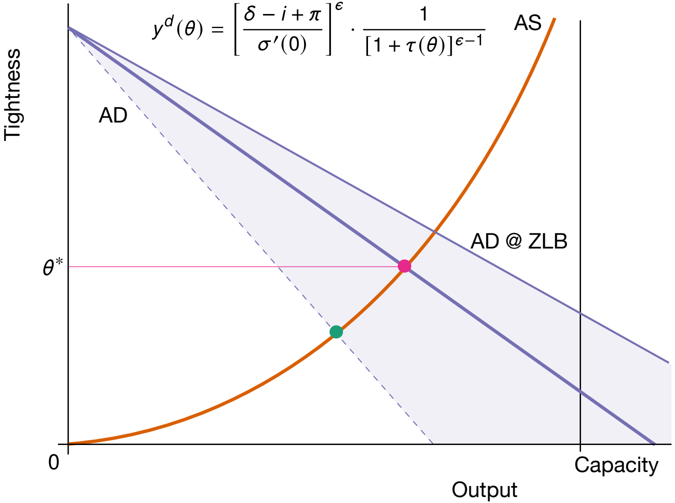
RESPONSE TO INSUFFICIENT TIGHTNESS



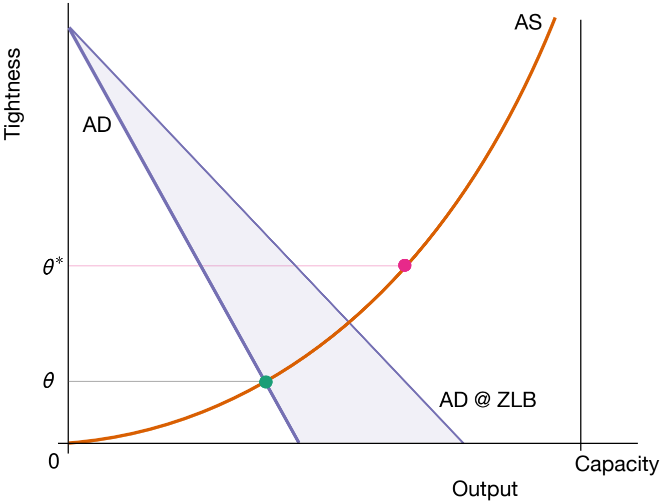
RESPONSE TO INSUFFICIENT TIGHTNESS



RESPONSE TO INSUFFICIENT TIGHTNESS



ZLB CONSTRAINT



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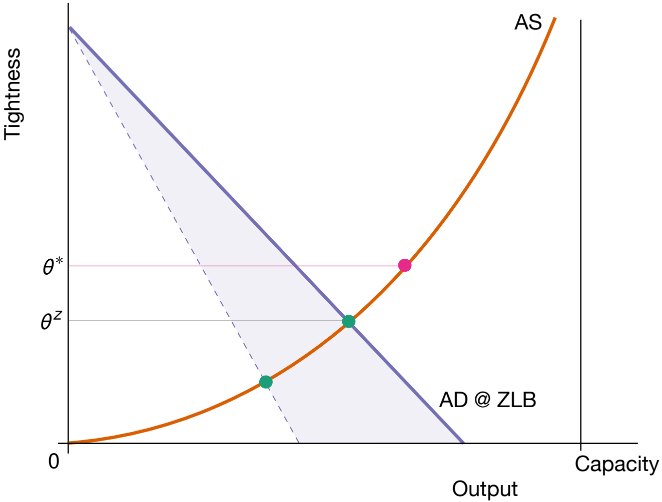
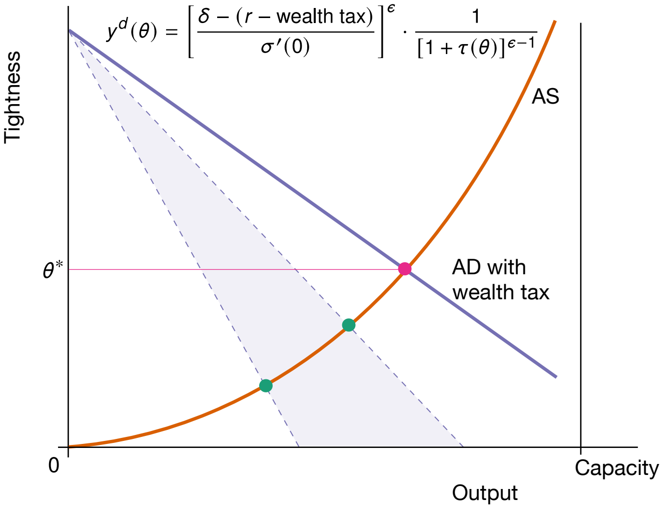


WEALTH TAX UNDOES ZLB



SUFFICIENT-STATISTIC FORMULA FOR OPTIMAL MONETARY POLICY

OPTIMAL MONETARY POLICY FORMULA

- unemployment rate is function $u(i)$ of interest rate
- linear expansion of $u(i)$ around suboptimal $[i, u]$, assessed at efficient $\left[i^*, u^*\right]$:

$$u^* \approx u + \frac{du}{di} \cdot (i^* - i)$$

- reshuffling terms yields sufficient-statistic formula:

$$i - i^* \approx \frac{u - u^*}{du/di}$$

- two sufficient statistics required:
  - unemployment gap: $u - u^*$
  - monetary multiplier: du/di

MONETARY MULTIPLIER IN THE US: $du/di \approx 0.5$

study	du/di	method
Bernanke, Blinder (1992)	0.6	VAR
Leeper, Sims, Zha (1996)	0.1	VAR
Christiano, Eichenbaum, Evans (1996)	0.1	VAR
Romer, Romer (2003)	0.9	narrative
Bernanke, Boivin, Eliasz (2005)	0.2	FAVAR
Coibion (2012)	0.5	narrative & VAR
median	0.5	

PRACTICAL RULE FOR MONETARY POLICY

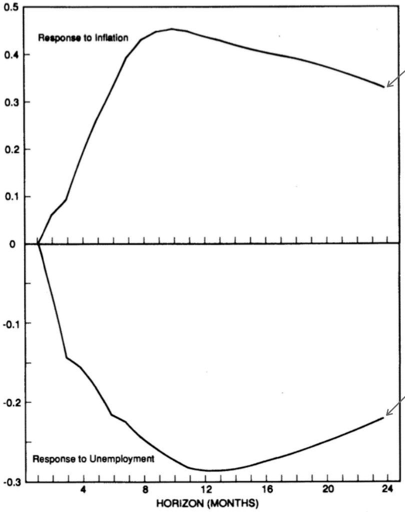
- using US evidence on the monetary multiplier, optimal monetary policy becomes:

$$i - i^* \approx \frac{u - u^*}{0.5} = 2 \times (u - u^*)$$

⇝ Fed should reduce interest rate by 2 percentage points for each positive percentage point of unemployment gap

⇝ Fed should raise interest rate by 2 percentage points for each negative percentage point of unemployment gap

REPONSE OF FED TO UNEMPLOYMENT RATE (BERNANKE, BLINDER 1992)

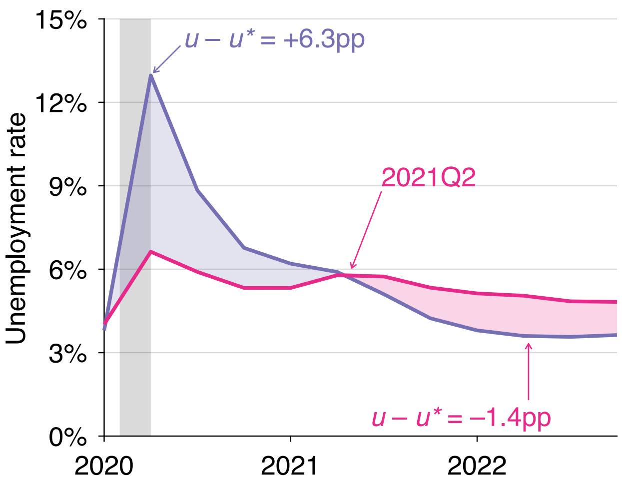


Response of FFR to increase in inflation by 2.15pp

Response of FFR to increase in unemployment by 0.18pp

- fed funds rate (FFR) drops by 0.28pp when unemployment increases by 0.18pp
- since u^* is very stable, FFR drops by 0.28pp when unemployment gap increases by $\approx$ 0.18pp
- FFR drops by 0.28/0.18 = 1.6pp when unemployment gap increases by 1pp
- close to the 2pp response suggested by optimal formula

REPONSE OF FED DURING PANDEMIC (MICHAILLAT, SAEZ 2023)



- FFR should drops by $6.3 \times 2 = 12.6$pp at peak of recessions $\rightsquigarrow$ ZLB
- FFR should have started to increase in 2021Q2, when unemployment gap turned negative
- FFR increased by 4.75pp, so we can expect unemployment to increase by $4.75 \times 0.5 = 2.4$pp $\rightsquigarrow$ unemployment gap might turn positive
- lag of 1–1.5 years for full effect

SUFFICIENT-STATISTIC FORMULA FOR OPTIMAL GOVERNMENT SPENDING

GOVERNMENT'S PROBLEM

- households' flow utility over public and private employment: $\mathcal{U}(c, g)$
- to simplify: set up from the paper on $u^* = \sqrt{uv}$
  - no home production, one recruiter per vacancy
- public expenditure is financed by a lump-sum tax to maintain a balanced budget
- private producers: $c = 1 - u - v - g$
- first constraint: Beveridge curve $v(u)$
- second constraint: public spending affects unemployment $u(g)$
- given $v(u)$ and $u(g)$, the government chooses g to maximize

$$\mathcal{U}(1 - [u(g) + v(u(g))] - g, g)$$

CORRECTING THE SAMUELSON FORMULA

- first-order condition of government's problem is

$$0 = \frac{\partial \mathcal{U}}{\partial g} - \frac{\partial \mathcal{U}}{\partial c} - \frac{\partial \mathcal{U}}{\partial c} \cdot u'(g) \cdot \left[1 + v'(u)\right]$$

$$1 = \frac{\partial \mathcal{U}/\partial g}{\partial \mathcal{U}/\partial c} - u'(g) \cdot \left[1 + v'(u)\right]$$

- optimal public expenditure satisfies

$$\underbrace{1 = MRS_{gc}}_{\text{Samuelson formula}} + \underbrace{[1 + v'(u)] \cdot [-u'(g)]}_{\text{correction}}$$

- $MRS_{gc} = [\partial \mathcal{U}/\partial g]/[\partial \mathcal{U}/\partial c]$: marginal rate of substitution between public and private consumption, decreasing in g/c
- $[1 + v'(u)] \cdot [-u'(g)]$: correction to the Samuelson formula in presence of unemployment

INTERPREATION OF THE CORRECTED SAMUELSON FORMULA

$$\underbrace{1 = MRS_{gc}}_{\text{Samuelson formula}} \quad + \quad \underbrace{[1 + v'(u)] \cdot [-u'(g)]}_{\text{correction}}$$

- MRS_{gc}: 1 when public goods g and private goods c are equally valuable, decreasing in g/c
- $1 + v'(u)$: slope of $u + v(u)$, which is minimized at efficiency
  - $1 + v'(u) < 0$ if the economy is inefficiently tight ($u < u^*$)
  - $1 + v'(u) = 0$ if the economy is efficient ($u = u^*$)
  - $1 + v'(u) > 0$ if the economy is inefficiently slack ($u < u^*$)
- $-u'(g) = -du/dg = m$: unemployment multiplier, giving the reduction in # unemployed workers with 1 extra public worker

DEPARTURES FROM SAMUELSON RULE

	multiplier		
state of economy	$-u'(g) < 0$	$-u'(g) = 0$	$-u'(g) > 0$
$1 + v'(u) > 0$	$MRS_{gc} > 1$	$MRS_{gc} = 1$	$MRS_{gc} < 1$
$1 + v'(u) = 0$	$MRS_{gc} = 1$	$MRS_{gc} = 1$	$MRS_{gc} = 1$
$1 + v'(u) < 0$	$MRS_{gc} < 1$	$MRS_{gc} = 1$	$MRS_{gc} > 1$

DEPARTURE OF OPTIMAL SPENDING g/c FROM SAMUELSON SPENDING $(g/c)^*$

	multiplier		
state of economy	$m < 0$	$m = 0$	$m > 0$
$u > u^*$	$g/c < (g/c)^*$	$g/c = (g/c)^*$	$g/c > (g/c)^*$
$u = u^*$	$g/c = (g/c)^*$	$g/c = (g/c)^*$	$g/c = (g/c)^*$
$u < u^*$	$g/c > (g/c)^*$	$g/c = (g/c)^*$	$g/c < (g/c)^*$

INTERPRETATION OF DEPARTURE FROM SAMUELSON SPENDING

- correction to the Samuelson formula appears due to effect of public expenditure on welfare through unemployment
- assume that public employment reduces unemployment ($m > 0$) and the labor market is inefficiently slack ($u > u^*$)
  - then an increase in public employment shifts employment from the private to public sector (shift in the composition of the pie, as in Samuelson)
  - but it also increases the number of producers and therefore the total amout of production (increase in the size of the pie, absent from Samuelson)
  - this extra positive effect from public employment explains why the corrected formula recommends more public employment than Samuelson ($g/c > (g/c^*)$, or $MRS_gc < 1$)

EXPLICIT SUFFICIENT-STATISTIC FORMULA

- above formula only implicitly defines the optimal amount of public spending relative to private spending, g/c
- can rework the formula to express optimal g/c as a function of fixed statistics:

$$\frac{g/c - (g/c)^*}{(g/c)^*} \approx \frac{z_0 \xi m}{1 + z_1 z_0 \xi m^2} \cdot \frac{u_0 - u^*}{u^*}$$

- resulting unemployment $u - u^*$ is smaller than $u_0 - u^*$ but positive:

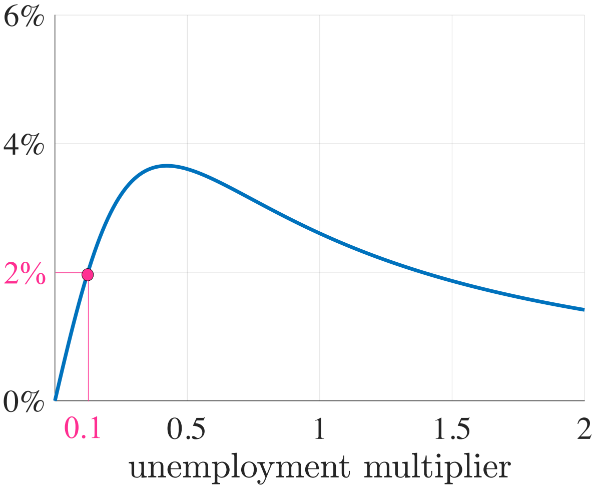
$$u - u^* \approx \frac{u_0 - u^*}{1 + z_1 z_0 \xi m^2} > 0$$

- u_0: initial, inefficient unemployment rate
- ξ: elasticity of substitution between public and private goods
- z_0, z_1: constant of the parameters

ILLUSTRATION: US GREAT RECESSION (MICHAILLAT, SAEZ 2019)

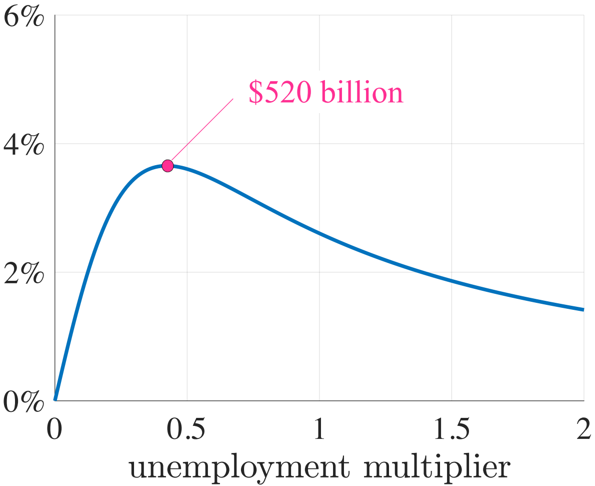
- starting point: winter 2008–2009
- unemployment = 6% and public spending = 16.5% of GDP
  - for illustration: we take these values as efficient so $u^* = 6\%$ and $(g/c)^* = 16.5\%$
- unemployment is forecast to increase to 9%
  - initial unemployment gap $u_0 - u^* = 9\% - 6\% = 3\%$
- we compute optimal stimulus for various unemployment multipliers m
  - ξ, z_0, z_1: calibrated to US values
- the resulting, optimal unemployment gap $u - u^*$ will be smaller than $u_0 - u^*$ but positve

OPTIMAL STIMULUS SPENDING (% OF GDP): SMALL MULTIPLIER



OPTIMAL STIMULUS SPENDING (% OF GDP): MEDIUM MULTIPLIER

OPTIMAL STIMULUS SPENDING (% OF GDP): MEDIUM MULTIPLIER



OPTIMAL STIMULUS SPENDING (% OF GDP): LARGE MULTIPLIER

SUMMARY

UNEMPLOYMENT GAP IN THE UNITED STATES

- socially efficient unemployment rate u^* & unemployment gap $u - u^*$ are determined by 3 sufficient statistics
  - elasticity of Beveridge curve
  - social cost of unemployment
  - cost of recruiting
- in the United States, 1951–2019:
  - u^* averages 4.3% $\rightsquigarrow$ $u - u^*$ averages 1.4pp
  - 3.0% $< u^* <$ 5.4% $\rightsquigarrow$ $u - u^*$ is countercyclical

  $\rightsquigarrow$ labor market is inefficient

  $\rightsquigarrow$ labor market is inefficiently slack in slumps

IMPLICATIONS FOR POLICY DESIGN

- optimal nominal interest rate is procyclical
  - optimal for monetary policy to eliminate the unemployment gap
  - unemployment ↓ when interest rate ↓
- optimal government spending is countercyclical
  - optimal for government spending to reduce—not eliminate—the unemployment gap
  - unemployment ↓ when spending ↑

FURTHER IMPLICATIONS FOR POLICY DESIGN

- optimal unemployment insurance is countercyclical (Landais, Michaillat, Saez 2018)
  - US tightness gap is procyclical
  - optimal for unemployment insurance to reduce—not eliminate—the tightness gap
  - tightness ↑ when unemployment insurance ↑
- optimal immigration policy is procyclical (Michaillat 2023)
  - increase in immigration improves welfare when the labor market is inefficiently tight, and reduces welfare when labor market is inefficiently slack
  - because immigration reduces labor market tightness (positive supply shock)