

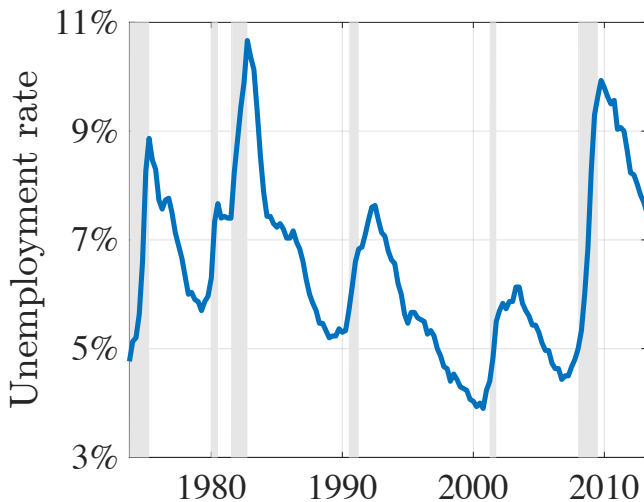
AGGREGATE DEMAND, IDLE TIME, AND UNEMPLOYMENT

Pascal Michailat, Emmanuel Saez

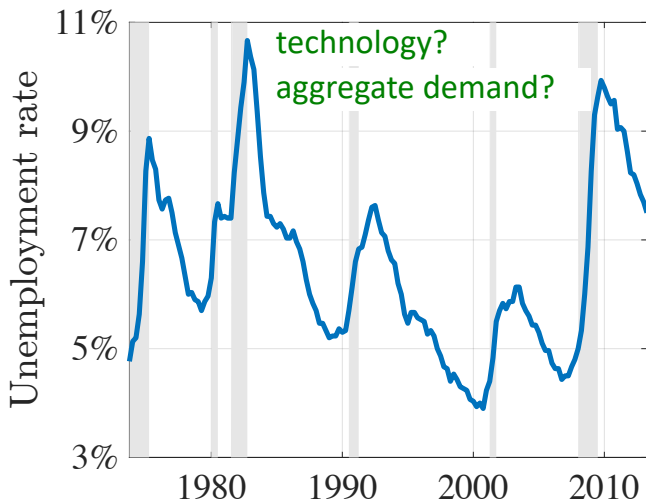
Quarterly Journal of Economics, 2015

Paper available at <https://pascalmichailat.org/3/>

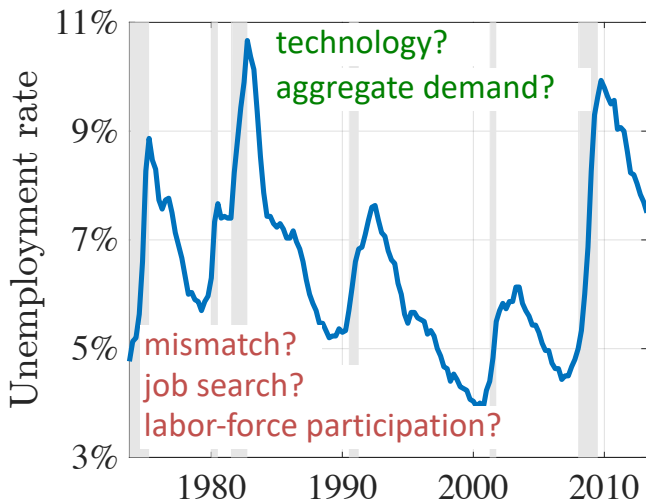
UNEMPLOYMENT FLUCTUATIONS REMAIN INSUFFICIENTLY UNDERSTOOD



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MODERN MODELS

- matching model of the labor market
 - tractable
 - but no aggregate demand
- New Keynesian model with matching frictions on the labor market
 - many shocks, including aggregate demand
 - but complex

GENERAL-DISEQUILIBRIUM MODEL

- vast literature after Barro & Grossman [1971]
 - revival after the Great Recession
- captures effect of aggregate demand on unemployment
- but supply-side factors are irrelevant in demand-determined regimes
- and difficult to analyze because of multiple regimes

THIS PAPER'S MODEL

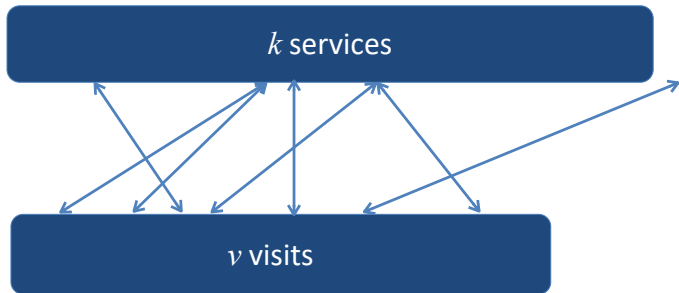
- Barro-Grossman architecture
- matching structure on product market & labor market
 - instead of disequilibrium structure
 - markets can be too slack or too tight but remain in equilibrium
- aggregate demand affects unemployment
 - as do labor productivity, mismatch, job search, and labor-force participation
- simple: graphical representation of equilibrium

BASIC MODEL: PRODUCT MARKET

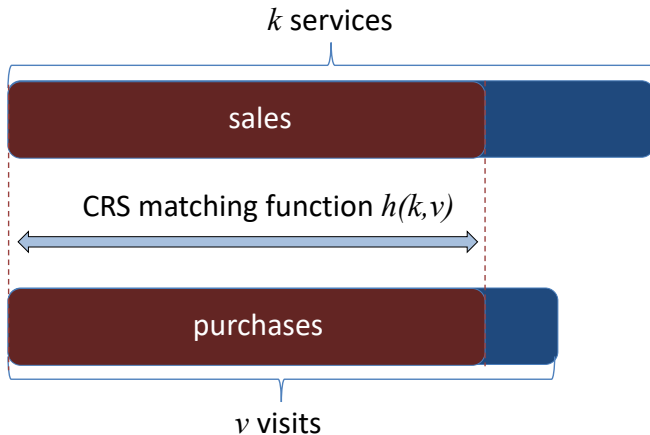
STRUCTURE

- static model
- measure 1 of identical households
- households produce and consume services
 - no firms: services produced within households
 - households cannot consume their own services
- services are traded on matching market
- households visit other households to buy services

MATCHING FUNCTION & TIGHTNESS

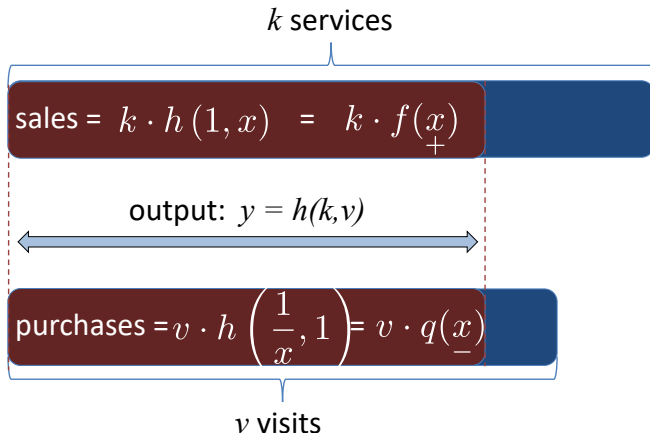


MATCHING FUNCTION & TIGHTNESS



MATCHING FUNCTION & TIGHTNESS

$$\text{tightness: } x = v / k$$



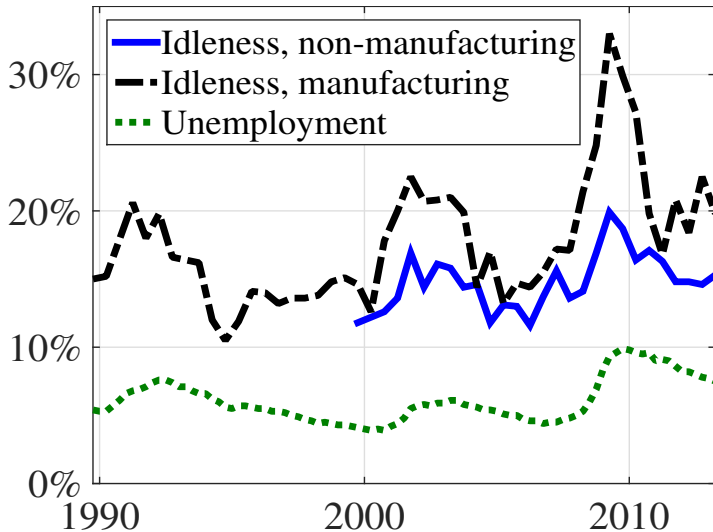
LOW PRODUCT MARKET TIGHTNESS



HIGH PRODUCT MARKET TIGHTNESS



EVIDENCE OF UNSOLD CAPACITY

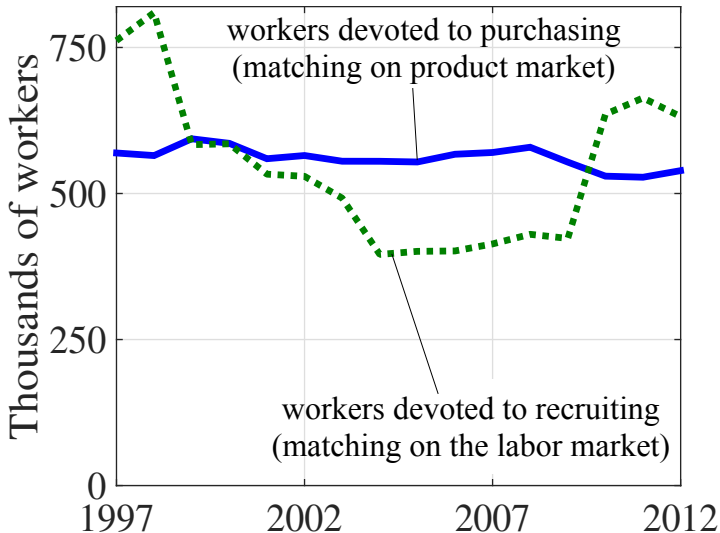


MATCHING COST: $\rho \in (0, 1)$ SERVICE PER VISIT

- consumption \equiv output net of matching services
 - consumption, not output, yields utility
- key relationship: output = $[1 + \tau(x)] \cdot$ consumption
- matching wedge $\tau(x)$ summarizes matching costs:

$$\underbrace{y}_{\text{output}} = \underbrace{c}_{\text{consumption}} + \underbrace{\rho \cdot v}_{\text{matching services}} = c + \rho \cdot \frac{y}{q(x)}$$
$$\Rightarrow y = \left[1 + \frac{\rho}{q(x) - \rho} \right] \cdot c \equiv \left[1 + \tau(x) \right] \cdot c$$

EVIDENCE OF MATCHING COSTS



CONSUMPTION < OUTPUT < CAPACITY

- output $y < \text{capacity } k$ because the matching function prevents all services from being sold
 - selling probability $f(x) < 1$
- consumption $c < \text{output } y$ because some services are devoted to matching so cannot provide utility
 - matching wedge $\tau(x) > 0$
- consumption is directly relevant for welfare

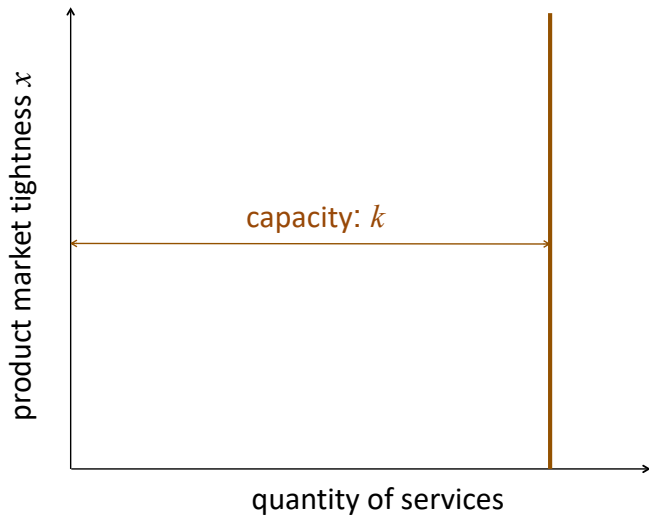
AGGREGATE SUPPLY

- aggregate supply \equiv number of services consumed at tightness x , given the supply of services k and matching process

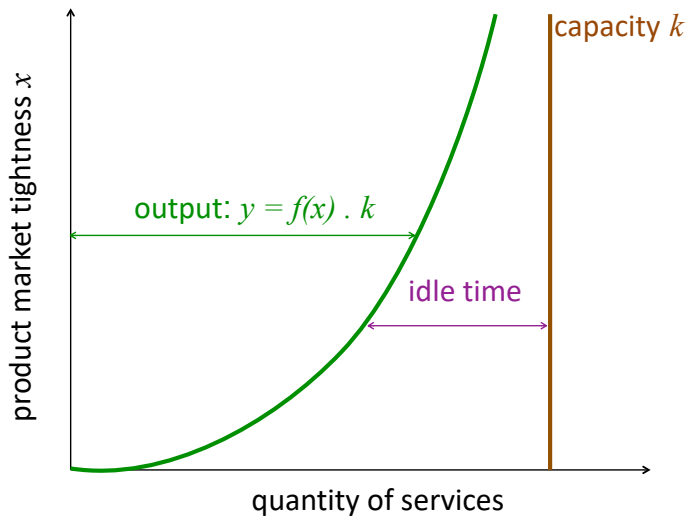
$$c^S(x) = \frac{f(x)}{1 + \tau(x)} \cdot k = [f(x) - \rho \cdot x] \cdot k$$

- could represent aggregate supply in terms of output instead of consumption, but consumption is linked to welfare

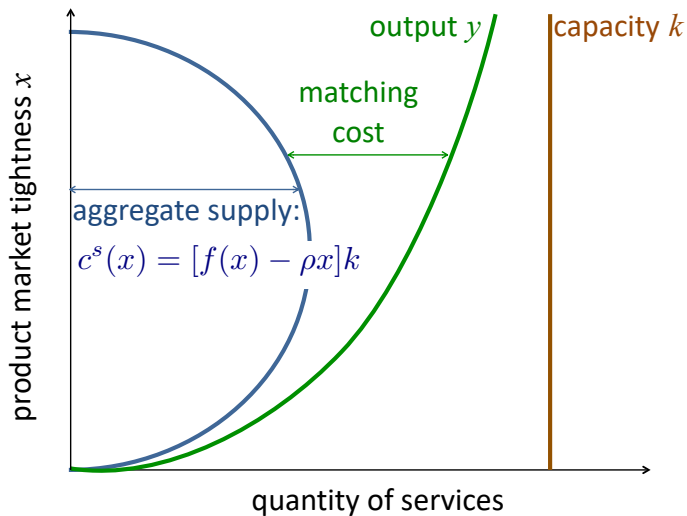
TIGHTNESS & AGGREGATE SUPPLY



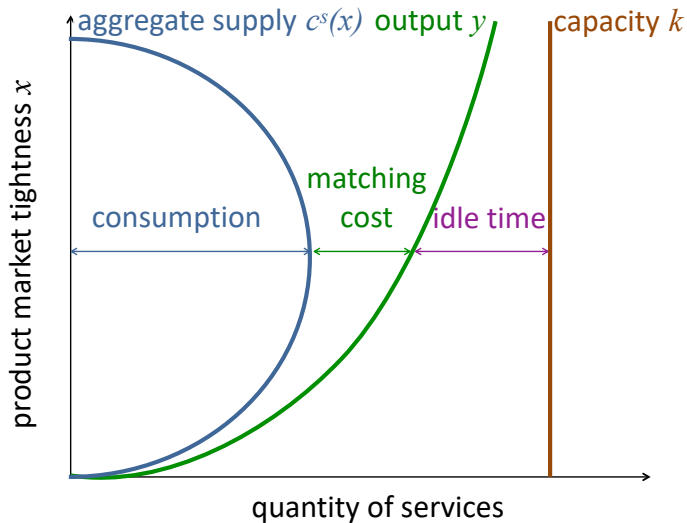
TIGHTNESS & AGGREGATE SUPPLY



TIGHTNESS & AGGREGATE SUPPLY



TIGHTNESS & AGGREGATE SUPPLY



MONEY

- money is in fixed supply μ
- households hold m units of money
- the price of services in terms of money is p
- real money balances enter the utility function
 - Barro & Grossman [1971]
 - Blanchard & Kiyotaki [1987]

HOUSEHOLDS

- take price p and tightness x as given
- choose c , m to maximize utility

$$\underbrace{\frac{\chi}{1+\chi} \cdot c^{\frac{\epsilon-1}{\epsilon}}}_{\text{services}} + \underbrace{\frac{1}{1+\chi} \cdot \left(\frac{m}{p}\right)^{\frac{\epsilon-1}{\epsilon}}}_{\text{real money balances}}$$

- subject to budget constraint

$$\underbrace{m}_{\text{money}} + \underbrace{p \cdot (1 + \tau(x)) \cdot c}_{\text{expenditure on services}} = \underbrace{\mu}_{\text{endowment}} + \underbrace{f(x) \cdot p \cdot k}_{\text{labor income}}$$

AGGREGATE DEMAND

- optimal consumption decision:

$$\underbrace{(1 + \tau(x))}_{\text{relative price}} \cdot \underbrace{\frac{1}{1 + \chi} \cdot \left(\frac{m}{p}\right)^{-\frac{1}{\epsilon}}}_{\text{MU of real money}} = \underbrace{\frac{\chi}{1 + \chi} \cdot c^{-\frac{1}{\epsilon}}}_{\text{MU of services}}$$

- money market clears: $m = \mu$
- aggregate demand gives desired consumption of services given price p and tightness x :

$$c^d(x, p) = \left(\frac{\chi}{1 + \tau(x)}\right)^{\epsilon} \cdot \frac{\mu}{p}$$

LINKING AGGREGATE DEMAND & VISITS

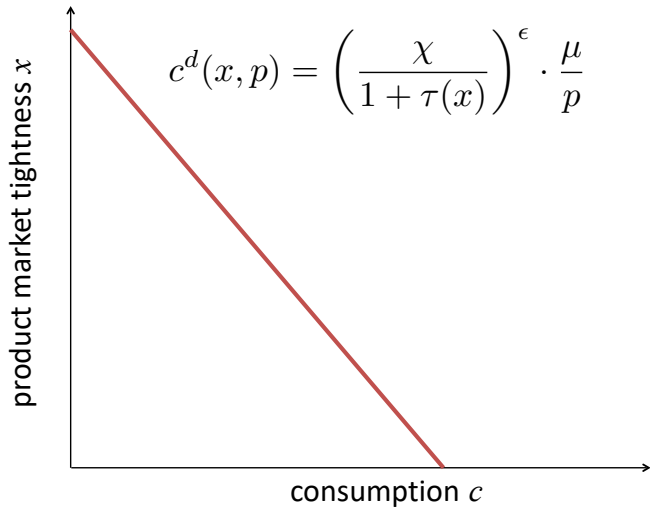
- there is a direct link between consumption of services, purchase of services, and visits
- if the desired consumption is $c^d(x, p)$
- the desired number of purchases is

$$(1 + \tau(x)) \cdot c^d(x, p)$$

- and the required number of visits is

$$v = \frac{(1 + \tau(x)) \cdot c^d(x, p)}{q(x)}$$

TIGHTNESS & AGGREGATE DEMAND



EQUILIBRIUM

- price p + tightness x equilibrate supply and demand:

$$c^s(x) = c^d(x, p)$$

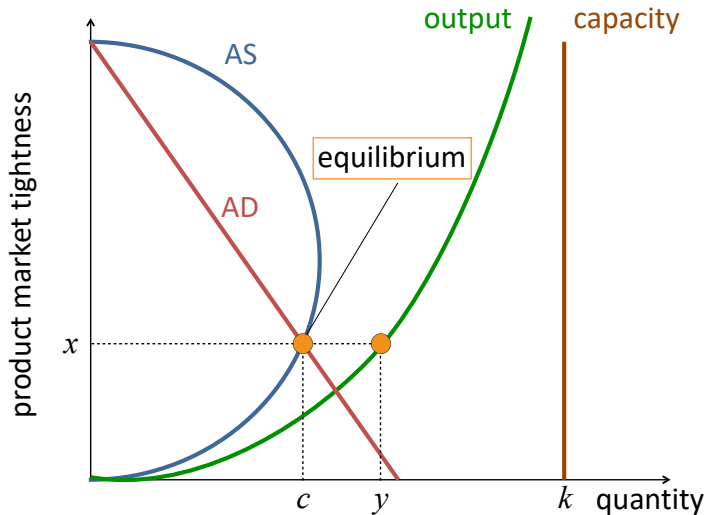
- the matching equilibrium is richer than the Walrasian equilibrium—where only price equilibrates supply and demand
 - can describe “Walrasian situations” where price responds to shocks and tightness is constant
 - but can also describe “Keynesian situations” where price is constant and tightness responds to shocks

PRICE MECHANISM

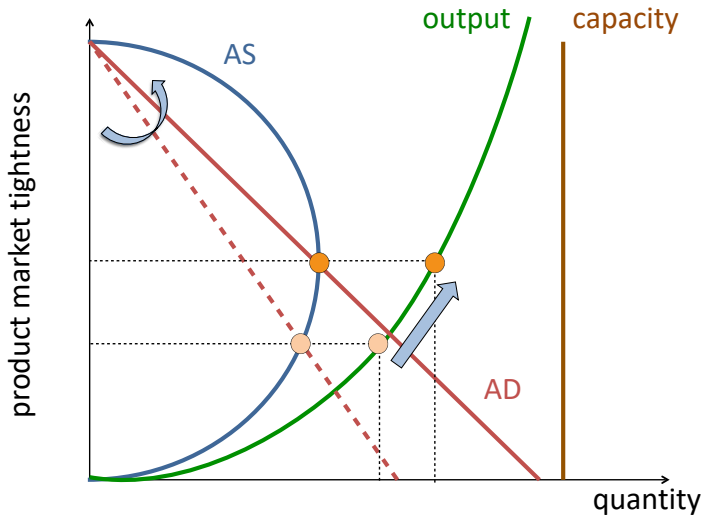
- we need a price mechanism to completely describe the equilibrium
- here we consider two polar cases:
 - fixed price [Barro & Grossman 1971]
 - competitive price [Moen 1997]
- in the paper we also consider:
 - bargaining (typical in the matching literature)
 - partially rigid price [Blanchard & Gali 2010]

COMPARATIVE STATICS

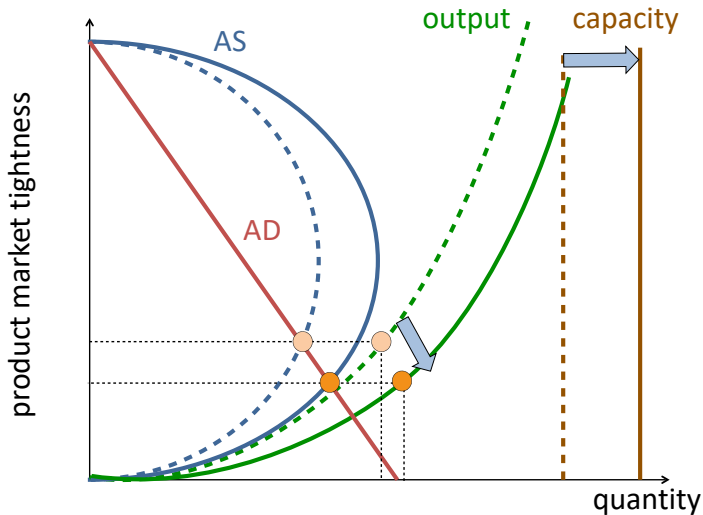
INCREASE IN AD WITH FIXED PRICE ($\chi \uparrow$)



INCREASE IN AD WITH FIXED PRICE ($\chi \uparrow$)



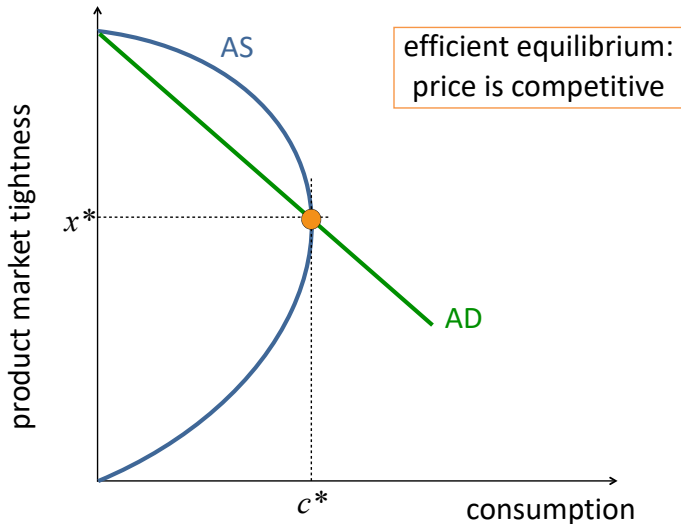
INCREASE IN AS WITH FIXED PRICE ($k \uparrow$)



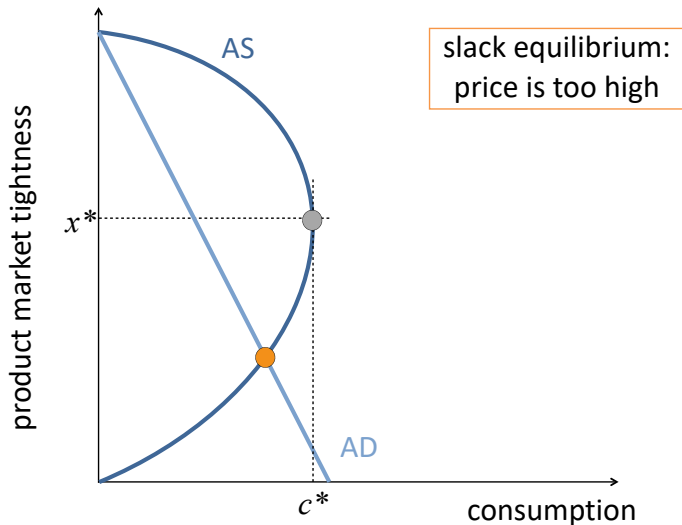
COMPARATIVE STATICS WITH FIXED PRICE

	output	tightness
increase in:	y	x
aggregate demand χ	+	+
aggregate supply k	+	-

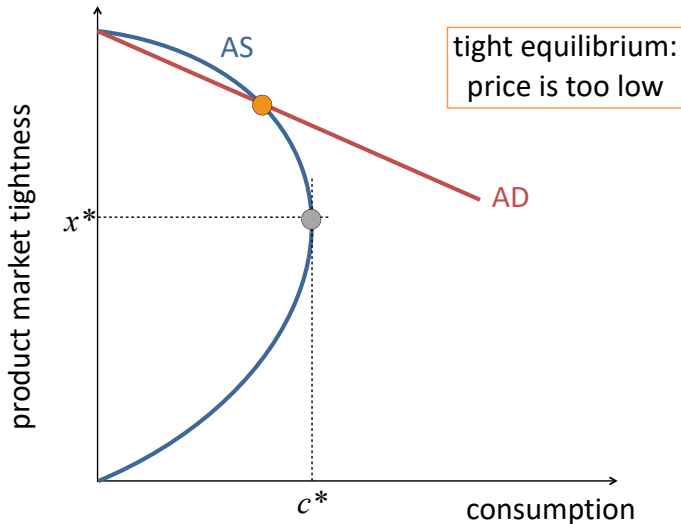
EFFICIENT EQUILIBRIUM: MAXIMUM CONSUMPTION



SLACK EQUILIBRIUM: CONSUMPTION IS TOO LOW



TIGHT EQUILIBRIUM: CONSUMPTION IS TOO LOW

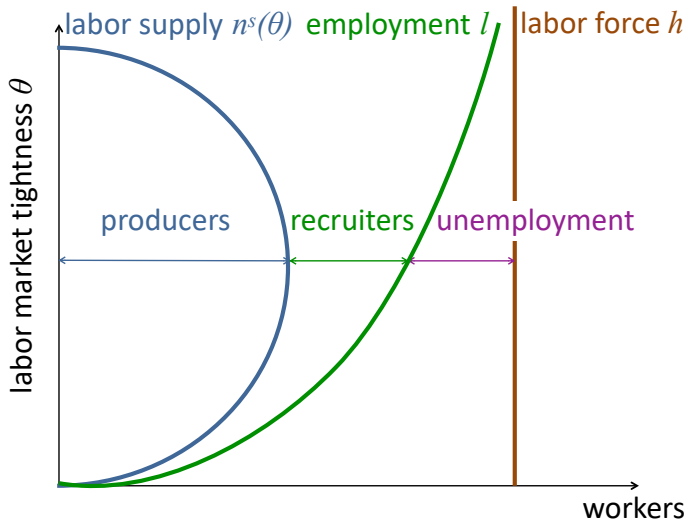


COMPARATIVE STATICS WITH COMPETITIVE PRICE

	output	tightness
increase in:	y	x
aggregate demand χ	0	0
aggregate supply k	+	0

COMPLETE MODEL: PRODUCT MARKET & LABOR MARKET

LABOR MARKET & UNEMPLOYMENT



FIRMS

- workers are hired on matching labor market
- production is sold on matching product market
- firms employ producers and recruiters
 - number of recruiters = $\hat{\tau}(\theta) \times$ producers
 - number of employees = $[1 + \hat{\tau}(\theta)] \times$ producers
- take real wage w and tightnesses x and θ as given
- choose number of producers n to maximize profits

$$\underbrace{f(x)}_{\text{selling probability}} \cdot \underbrace{a \cdot n^\alpha}_{\text{production}} - \underbrace{[1 + \hat{\tau}(\theta)] \cdot w \cdot n}_{\text{wage of producers + recruiters}}$$

LABOR DEMAND

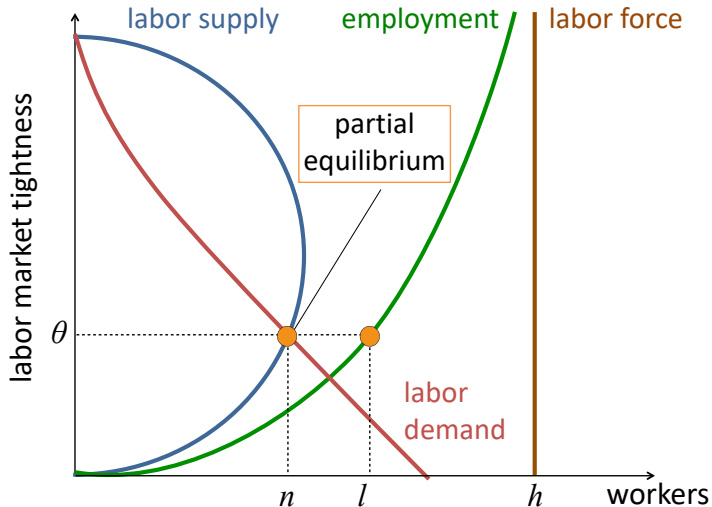
- optimal employment decision:

$$\underbrace{f(x)}_{\text{selling probability}} \cdot \underbrace{\alpha \cdot a \cdot n^{\alpha-1}}_{\text{MPL}} = (1 + \underbrace{\hat{\tau}(\theta)}_{\text{matching wedge}}) \cdot \underbrace{w}_{\text{real wage}}$$

- same as Walrasian first-order condition, except for selling probability < 1 and matching wedge > 0
- labor demand gives the desired number of producers:

$$n^d(\theta, x, w) = \left[\frac{f(x) \cdot a \cdot \alpha}{(1 + \hat{\tau}(\theta)) \cdot w} \right]^{\frac{1}{1-\alpha}}$$

PARTIAL EQUILIBRIUM ON LABOR MARKET



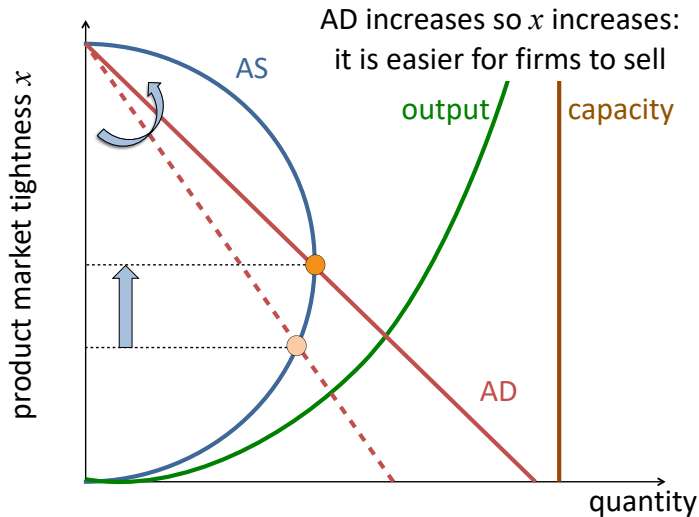
GENERAL EQUILIBRIUM

- prices (p, w) and tightnesses (x, θ) equilibrate supply and demand on product and labor markets:

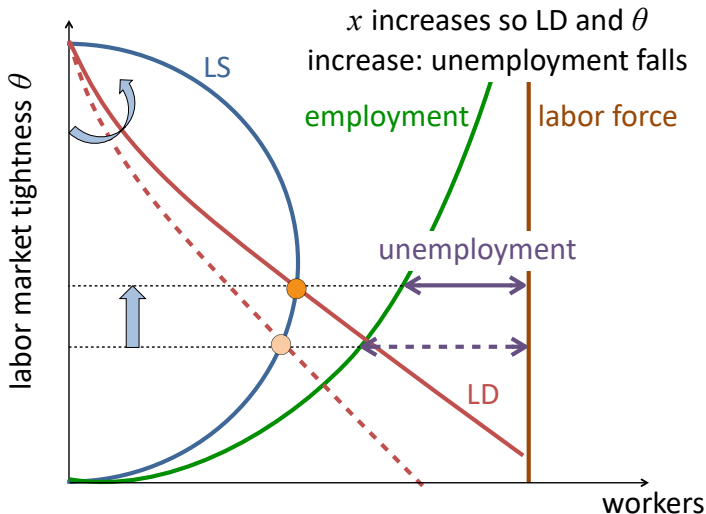
$$\begin{cases} c^s(x, \theta) &= c^d(x, p) \\ n^s(\theta) &= n^d(\theta, x, w) \end{cases}$$

- need to specify price and wage mechanisms
 - fixed price and fixed wage
 - competitive price and competitive wage

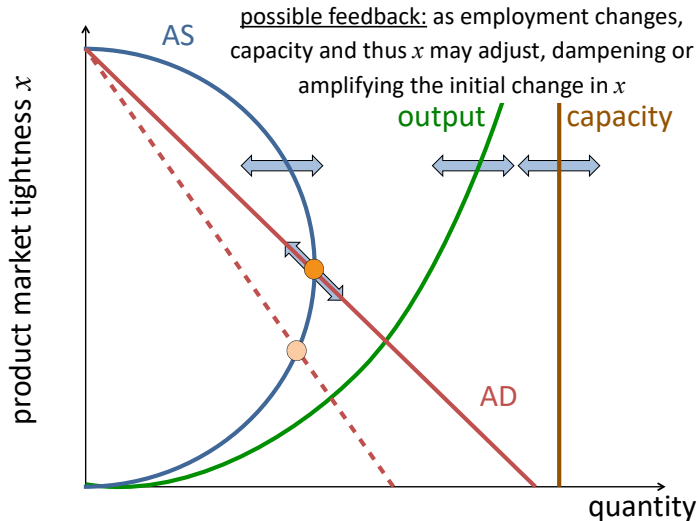
EFFECT OF AD WITH FIXED PRICES



EFFECT OF AD WITH FIXED PRICES



EFFECT OF AD WITH FIXED PRICES



KEYNESIAN, CLASSICAL, & FRICTIONAL UNEMPLOYMENT

- equilibrium unemployment rate:

$$u = 1 - \frac{1}{h} \cdot \left(\frac{f(x) \cdot a \cdot \alpha}{w} \right)^{\frac{1}{1-\alpha}} \cdot \left(\frac{1}{1 + \hat{\tau}(\theta)} \right)^{\frac{\alpha}{1-\alpha}}$$

- if $f(x) = 1$, $w = a\alpha h^{\alpha-1}$, and $\hat{\tau}(\theta) = 0$, then $u = 0$
- the factors of unemployment therefore are
 - Keynesian factor: $f(x) < 1$
 - classical factor: $w > a \cdot \alpha \cdot h^{\alpha-1}$
 - frictional factor: $\hat{\tau}(\theta) > 0$

COMPARATIVE STATICS WITH FIXED PRICES

	output	product tightness	employment	labor tightness
increase in:	y	x	l	θ
aggregate demand χ	+	+	+	+
technology a	+	-	+	+
labor supply h	+	-	+	-

COMPARATIVE STATICS WITH FIXED PRICES

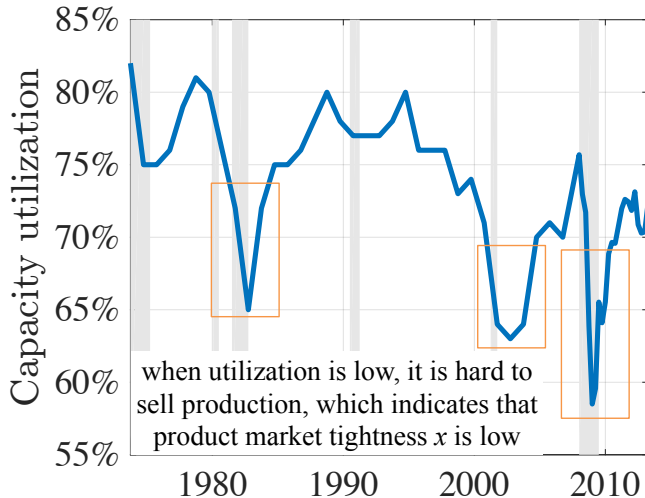
	output	product tightness	employment	labor tightness
increase in:	y	x	l	θ
aggregate demand χ	+	+	+	+
technology a	+	-	+	+
labor supply k	+	-	+	-

COMPARATIVE STATICS WITH COMPETITIVE PRICES

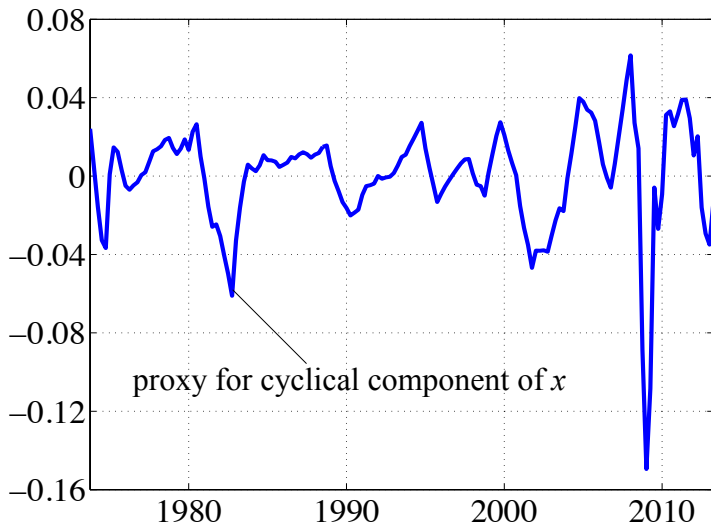
	output	product tightness	employment	labor tightness
increase in:	y	x	l	θ
aggregate demand χ	0	0	0	0
technology a	+	0	0	0
labor supply k	+	0	+	0

RIGID OR FLEXIBLE PRICES?

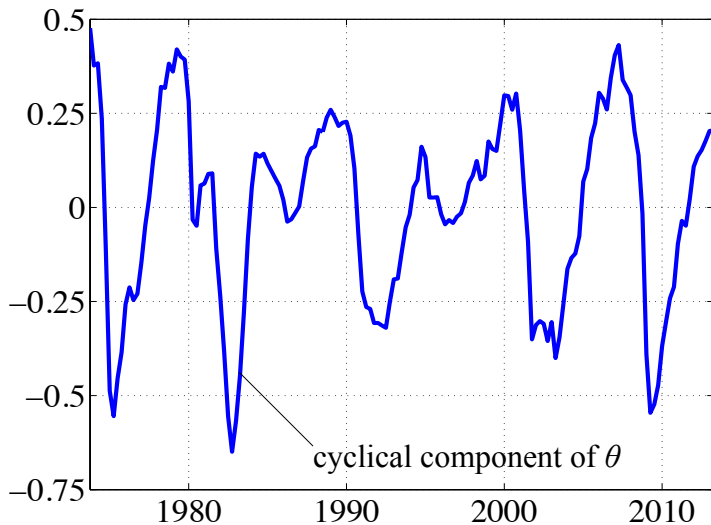
X CONSTRUCTED FROM CAPACITY UTILIZATION IN SPC



FLUCTUATIONS IN $x \Rightarrow$ RIGID PRICE



FLUCTUATIONS IN $\theta \Rightarrow$ RIGID REAL WAGE



LABOR DEMAND

OR LABOR SUPPLY SHOCKS?

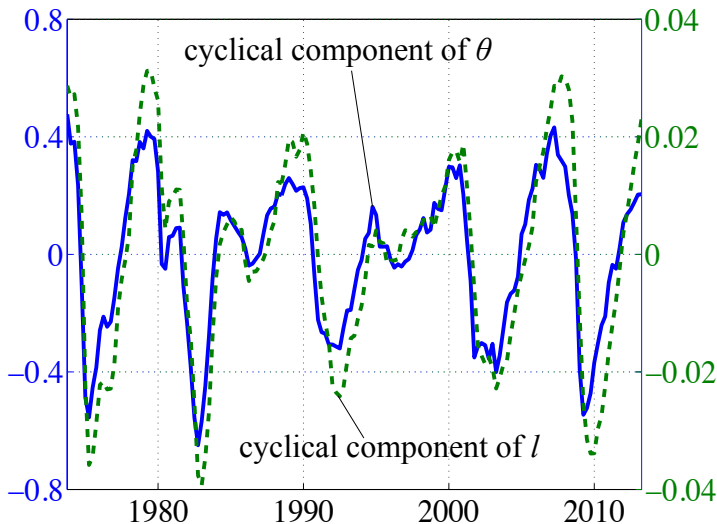
LABOR DEMAND & LABOR SUPPLY SHOCKS

- source of labor demand shocks:
 - aggregate demand χ
 - technology a
- source of labor supply shocks:
 - labor-force participation h
 - h can also be interpreted as job-search effort

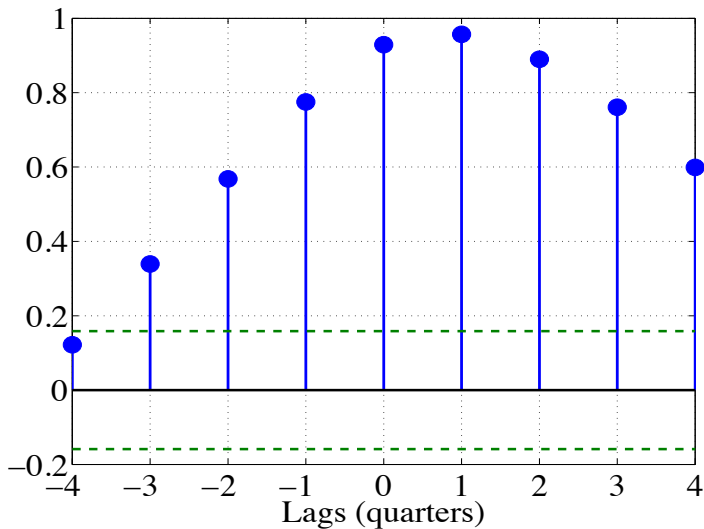
PREDICTED EFFECTS OF SHOCKS

- labor supply shocks:
 - **negative** correlation between employment (l) and labor market tightness (θ)
- labor demand shocks:
 - **positive** correlation between employment (l) and labor market tightness (θ)

$\text{corr}(l, \theta) > 0 \Rightarrow \text{LABOR DEMAND}$



CROSS-CORRELOGRAM: θ (LEADING) & I

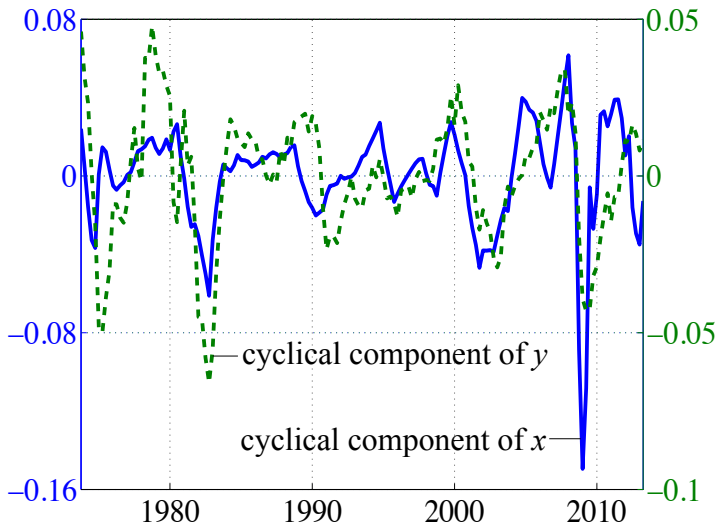


AGGREGATE DEMAND
OR TECHNOLOGY SHOCKS?

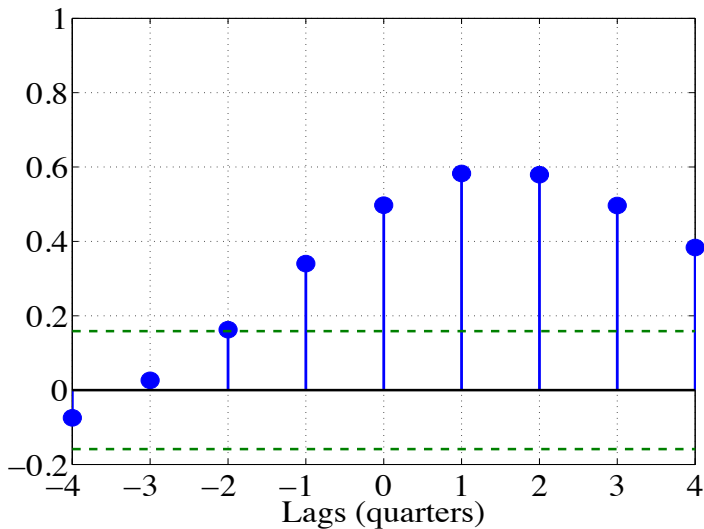
PREDICTED EFFECTS OF SHOCKS

- aggregate demand shocks:
 - **positive** correlation between output (y) and product market tightness (x)
- technology shocks:
 - **negative** correlation between output (y) and product market tightness (x)

$$\text{corr}(y, x) > 0 \Rightarrow \text{AD}$$



CROSS-CORRELOGRAM: x (LEADING) & y



CONCLUSION

SUMMARY

- we develop a tractable, general-equilibrium model of unemployment fluctuations
- we construct empirical series for
 - product market tightness
 - labor market tightness
- we find that unemployment fluctuations stem from
 - price rigidity and real-wage rigidity
 - aggregate demand shocks

APPLICATIONS OF THE MODEL TO POLICY

- optimal unemployment insurance
 - Landais, Michaillat, & Saez [2018]
- optimal public expenditure
 - Michaillat & Saez [2019]
- optimal monetary policy
 - Michaillat & Saez [2021]