AGGREGATE DEMAND, IDLE TIME, AND UNEMPLOYMENT

Pascal Michaillat, Emmanuel Saez

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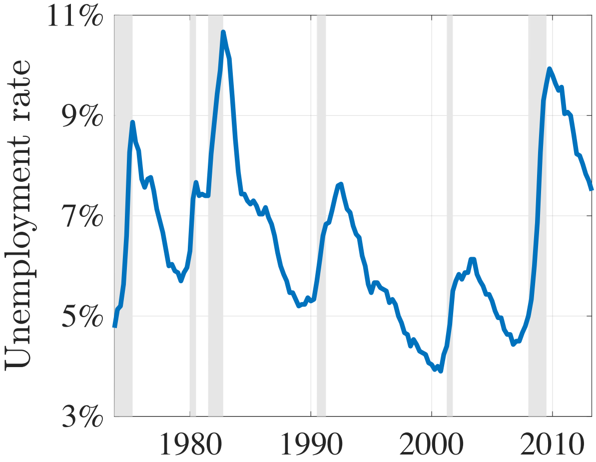
UNEMPLOYMENT FLUCTUATIONS REMAIN INSUFFICIENTLY UNDERSTOOD



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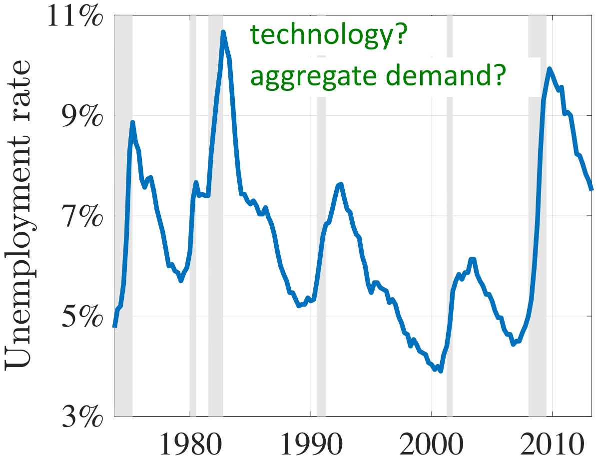

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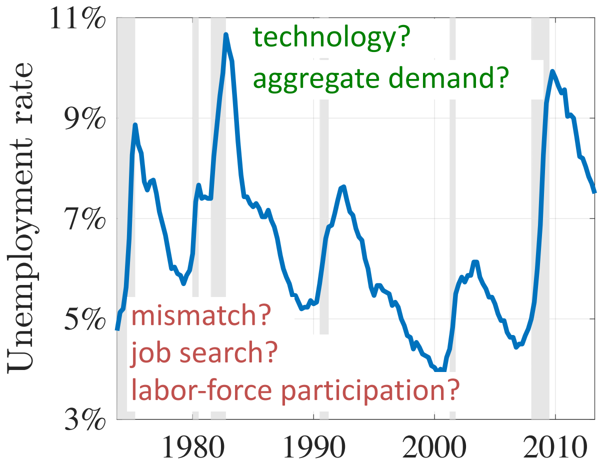


MODERN MODELS

- 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

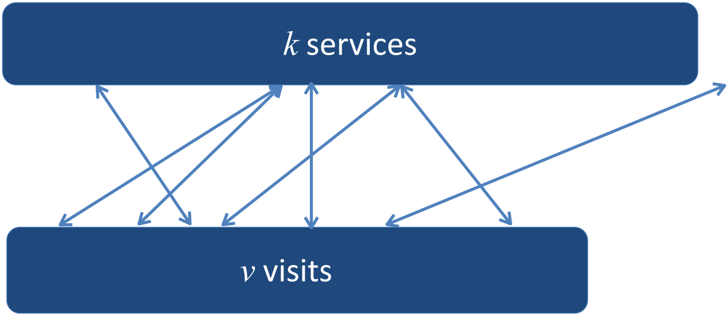
- Barro-Grossman architecture
- matching structure on product market & labor market
  - instead of disequilibrium structure
  - markets can be too slack or too tight but remain in equilibrium
- aggregate demand affects unemployment
  - as do labor productivity, mismatch, job search, and labor-force participation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



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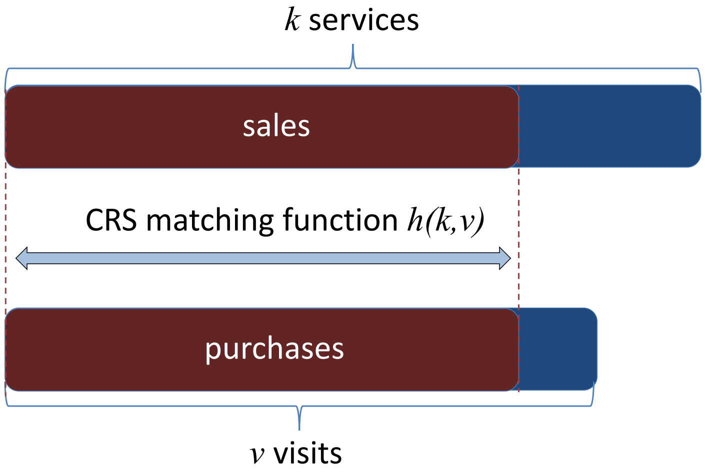

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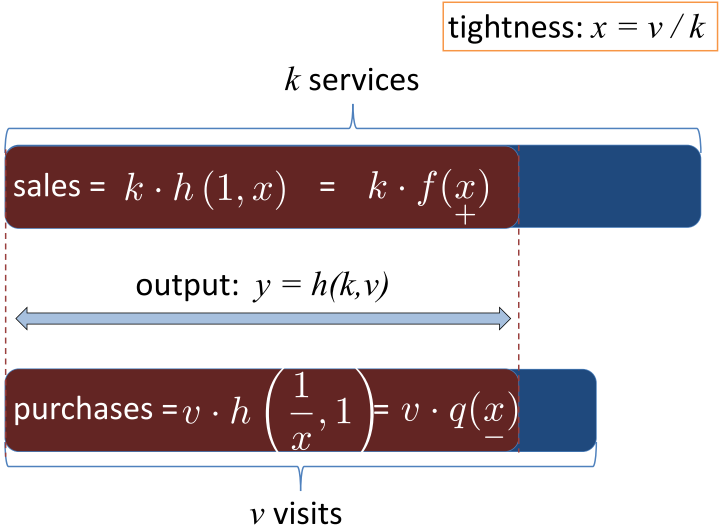
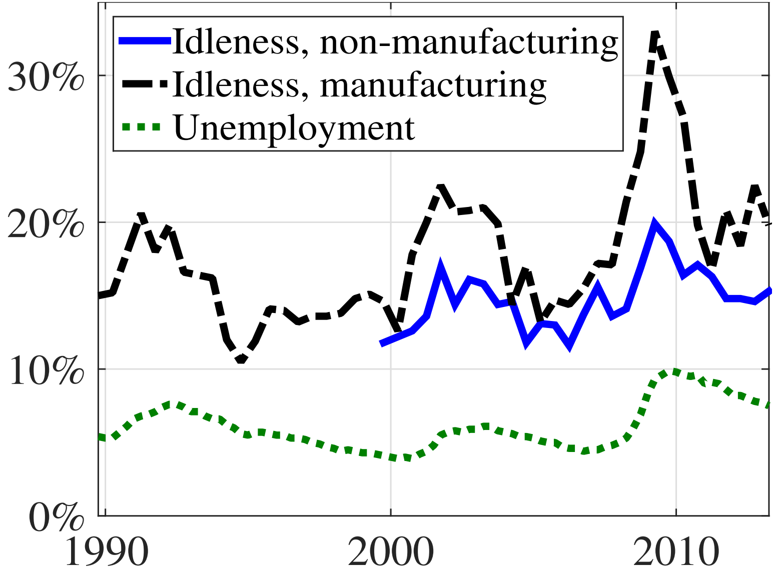


LOW PRODUCT MARKET TIGHTNESS

HIGH PRODUCT MARKET TIGHTNESS

EVIDENCE OF UNSOLD CAPACITY



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

- consumption ≡ 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:

$$\underbrace{y}_{\text{output}} = \underbrace{c}_{\text{consumption}} + \underbrace{\rho \cdot v}_{\text{matching services}} = c + \rho \cdot \frac{y}{q(x)}$$

$$\Rightarrow y = \left[1 + \frac{\rho}{q(\underset{-}{x}) - \rho}\right] \cdot c \equiv \left[1 + \tau(\underset{+}{x})\right] \cdot c$$

EVIDENCE OF MATCHING COSTS

CONSUMPTION $<$ OUTPUT $<$ CAPACITY

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

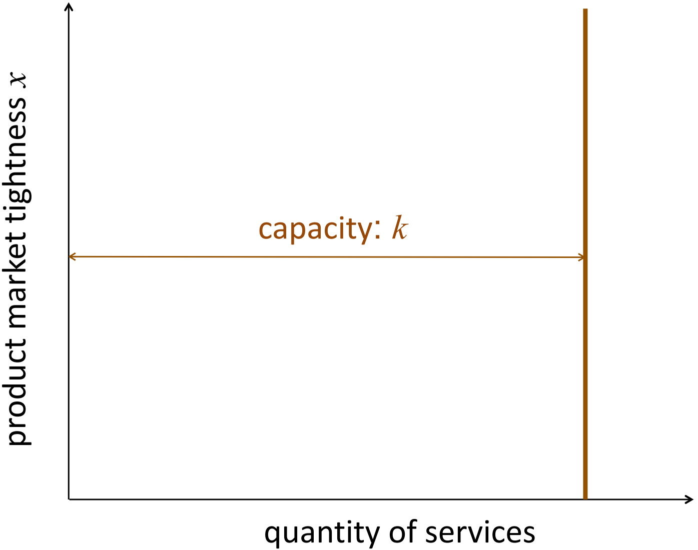
AGGREGATE SUPPLY

- aggregate supply ≡ 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



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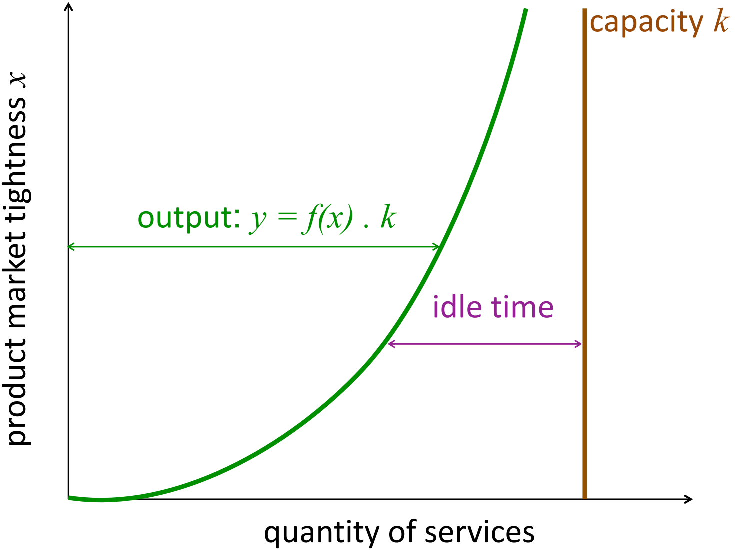

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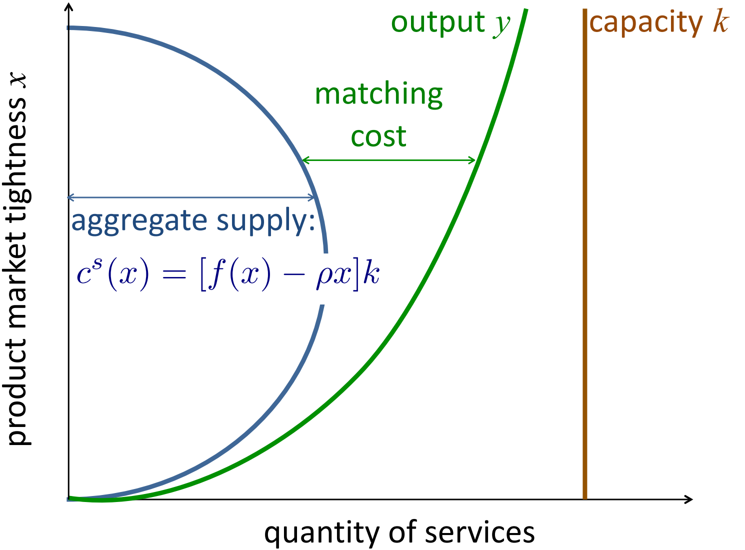

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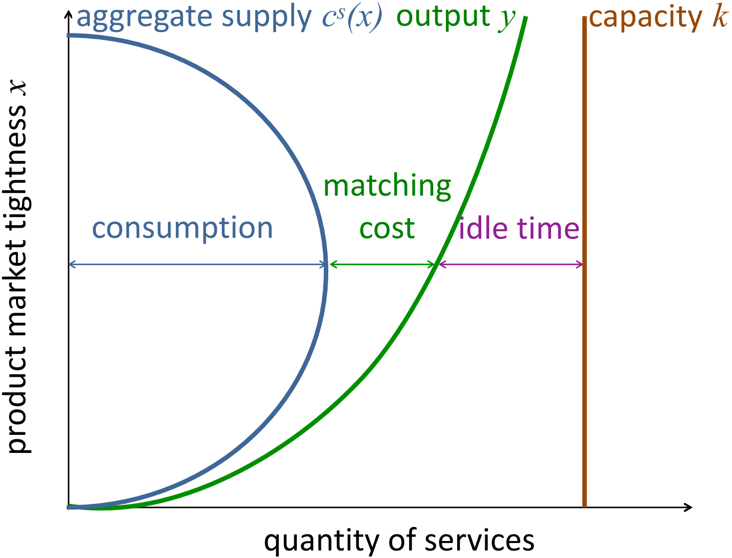


MONEY

- 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

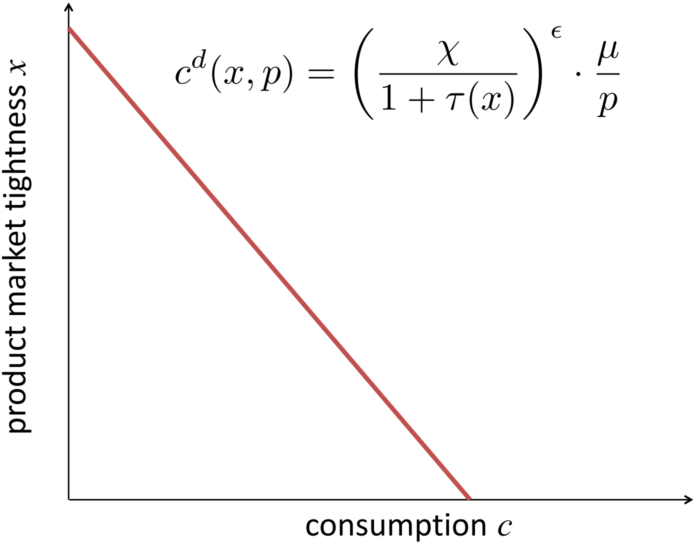
- there is a direct link between consumption of services, purchase of services, and visits
- if the desired consumption is $c^d(x, p)$
- the desired number of purchases is

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

- and the required number of visits is

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

TIGHTNESS & AGGREGATE DEMAND



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

EQUILIBRIUM

- price p + tightness x equilibrate supply and demand:

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

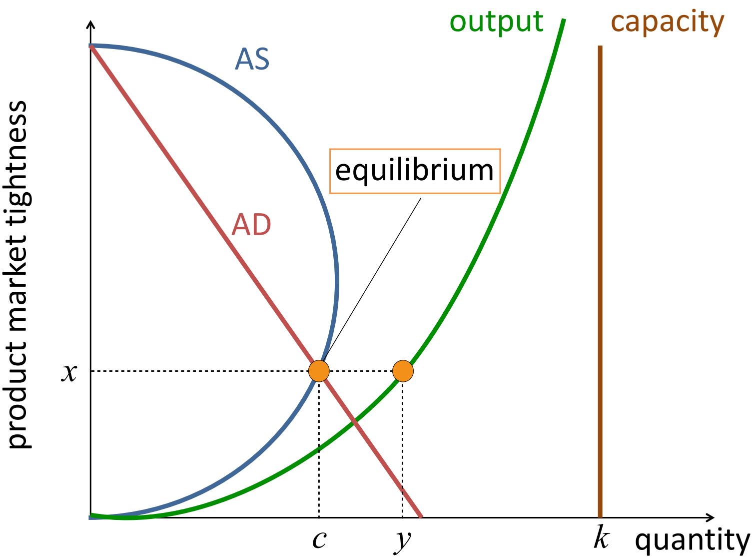
- the matching equilibrium is richer than the Walrasian equilibrium—where only price equilibrates supply and demand
  - can describe "Walrasian situations" where price responds to shocks and tightness is constant
  - but can also describe "Keynesian situations" where price is constant and tightness responds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

PRICE MECHANISM

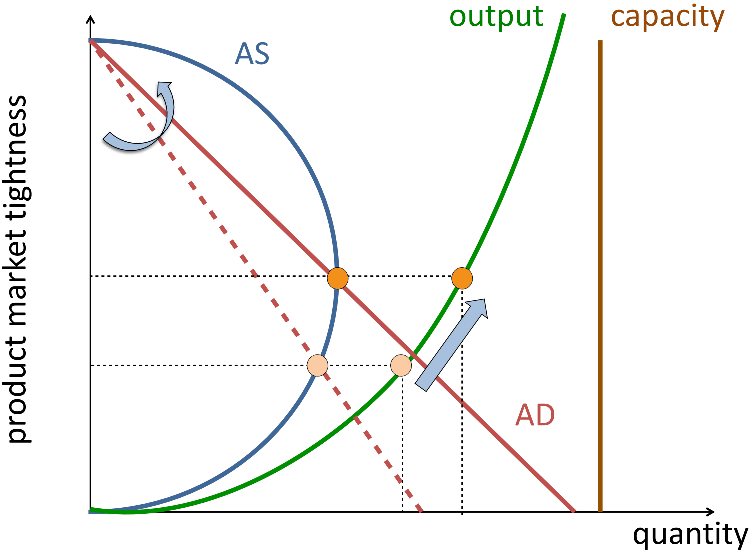
- we need a price mechanism to completely describe the equilibrium
- here we consider two polar cases:
  - fixed price [Barro & Grossman 1971]
  - competitive price [Moen 1997]
- in the paper we also consider:
  - bargaining (typical in the matching literature)
  - partially rigid price [Blanchard &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

COMPARATIVE STATICS

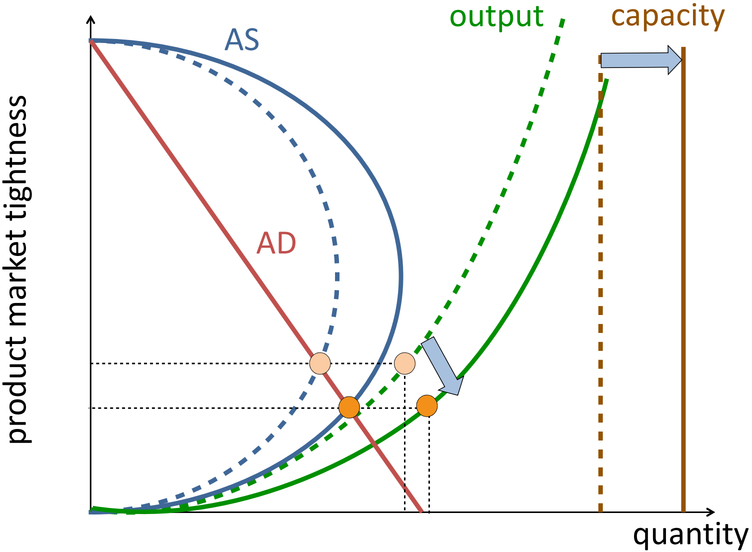
INCREASE IN AD WITH FIXED PRICE $(\chi \uparrow)$



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



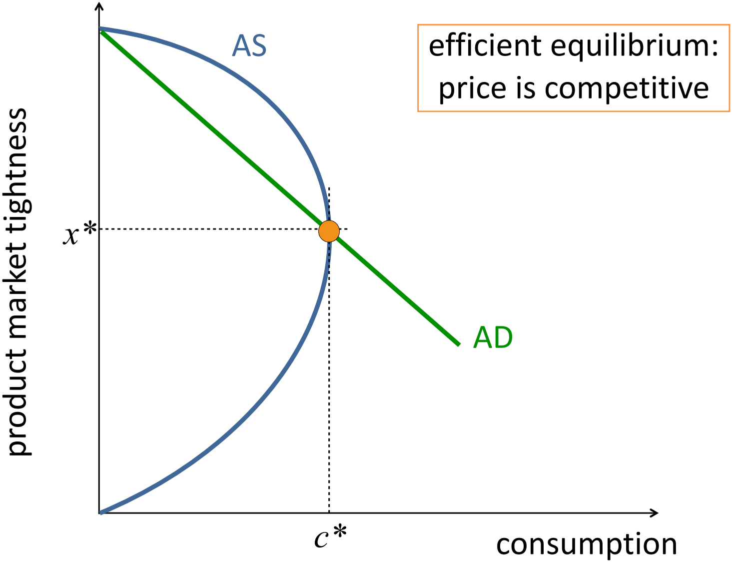
INCREASE IN AS WITH FIXED PRICE $(k\uparrow)$



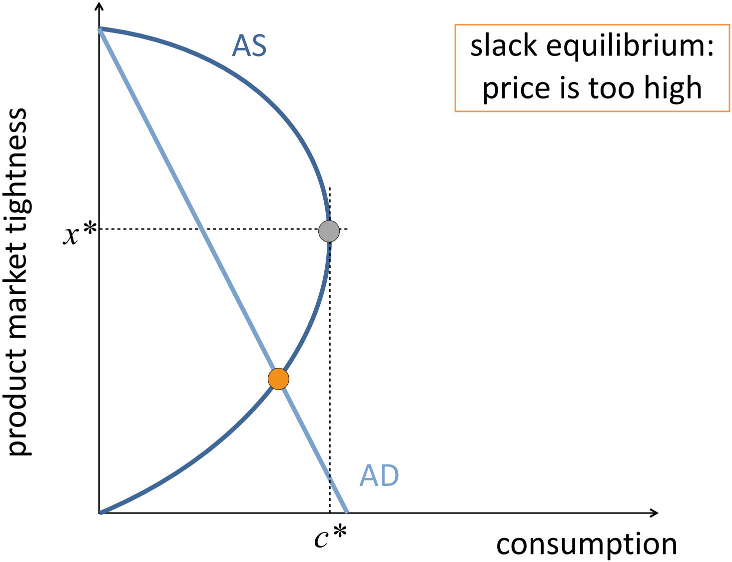
COMPARATIVE STATICS WITH FIXED PRICE

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

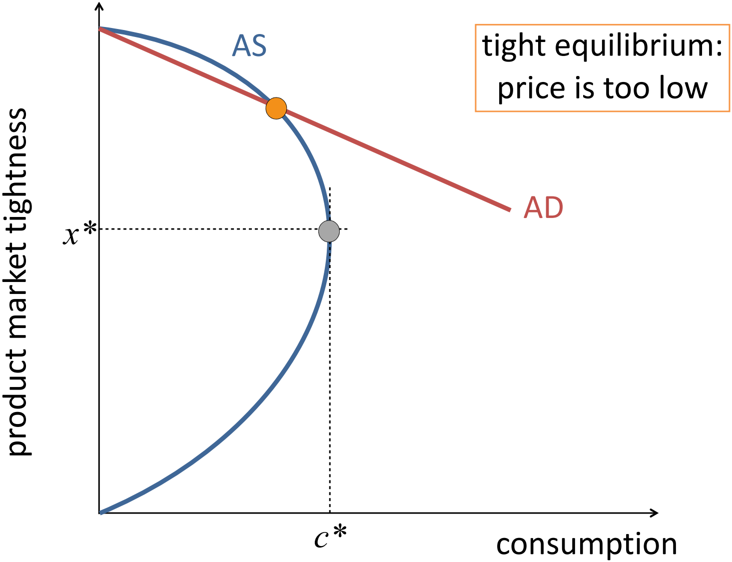
EFFICIENT EQUILIBRIUM: CONSUMPTION IS MAXIMUM



SLACK EQUILIBRIUM: CONSUMPTION IS TOO LOW



TIGHT EQUILIBRIUM: CONSUMPTION IS TOO LOW

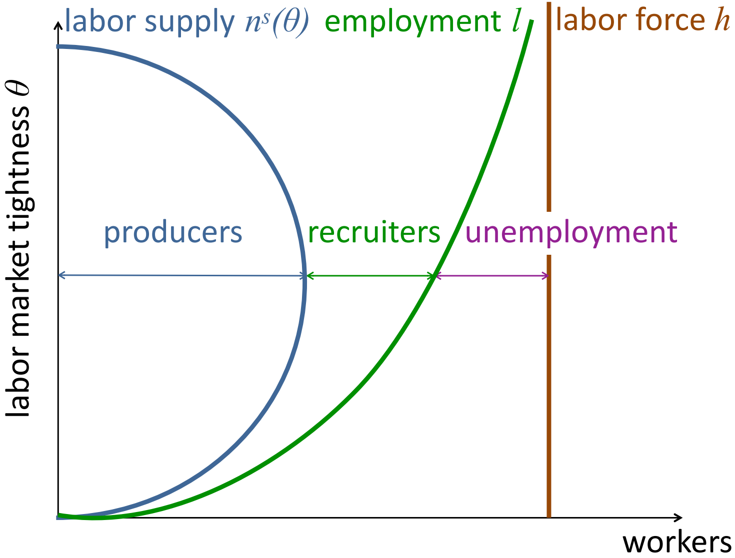


COMPARATIVE STATICS WITH COMPETITIVE PRICE

	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

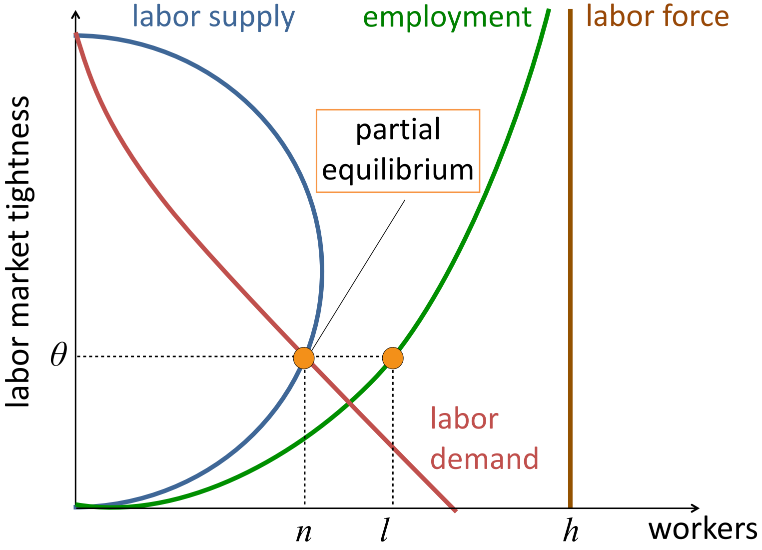
- optimal employment decision:

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

- 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

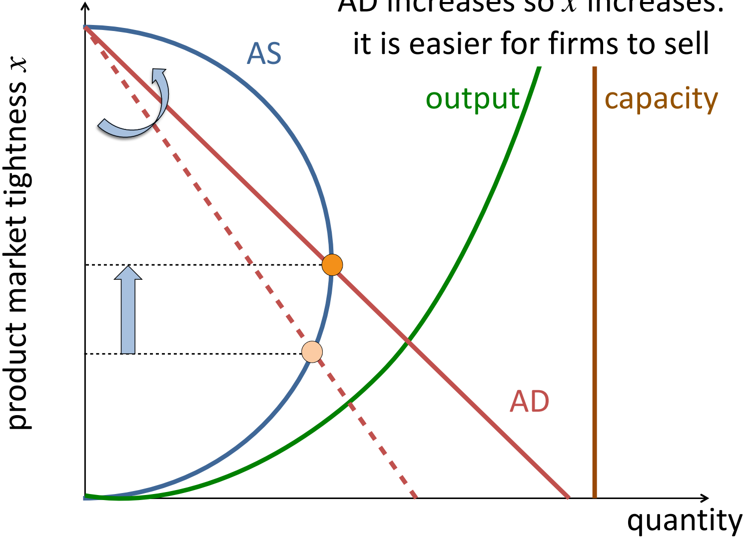
- prices (p, w) and tightnesses (x, θ) equilibrate supply and demand on product and labor markets:

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

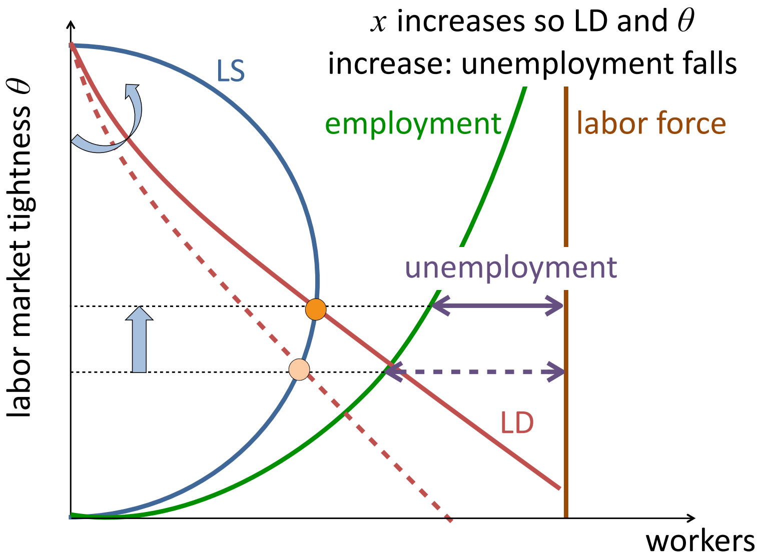
- need to specify price and wage mechanisms
  - fixed price and fixed wage
  - competitive price and competitive wage

EFFECT OF AD WITH FIXED PRICES

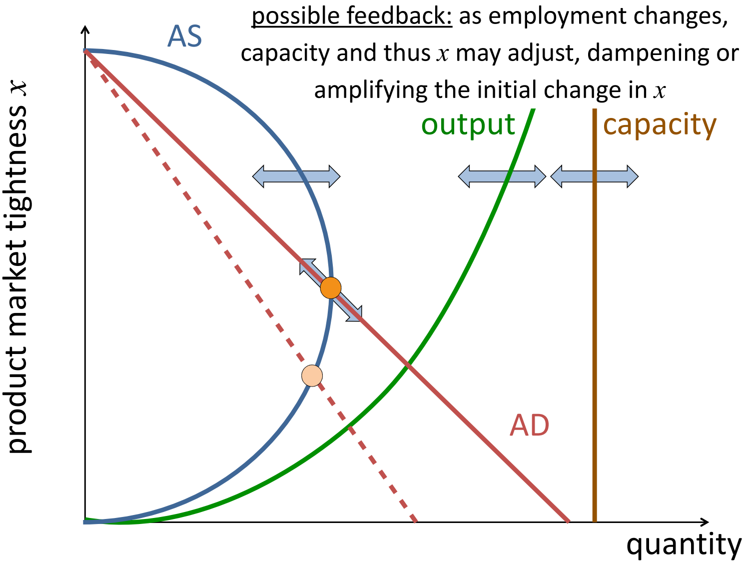
AD increases so x increases:
it is easier for firms to sell



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

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

COMPARATIVE STATICS WITH FIXED PRICES

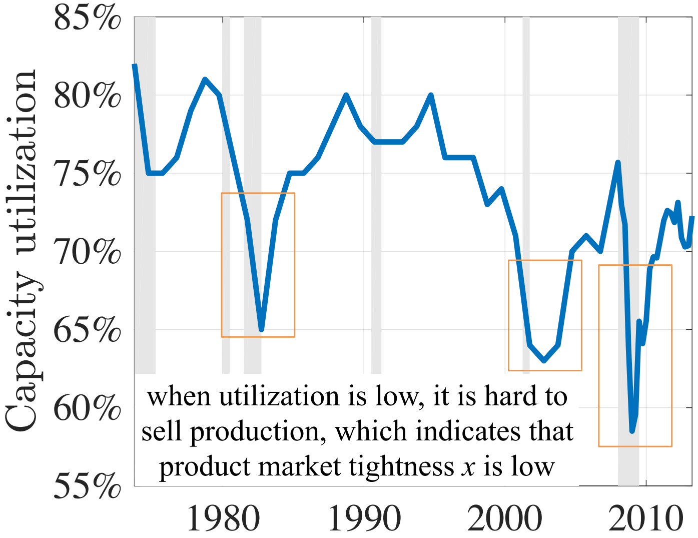
increase in:	output y	product tightness x	employment l	labor tightness θ
aggregate demand χ	+	+	+	+
technology a	+	−	+	+
labor supply k	+	−	+	−

COMPARATIVE STATICS WITH COMPETITIVE PRICES

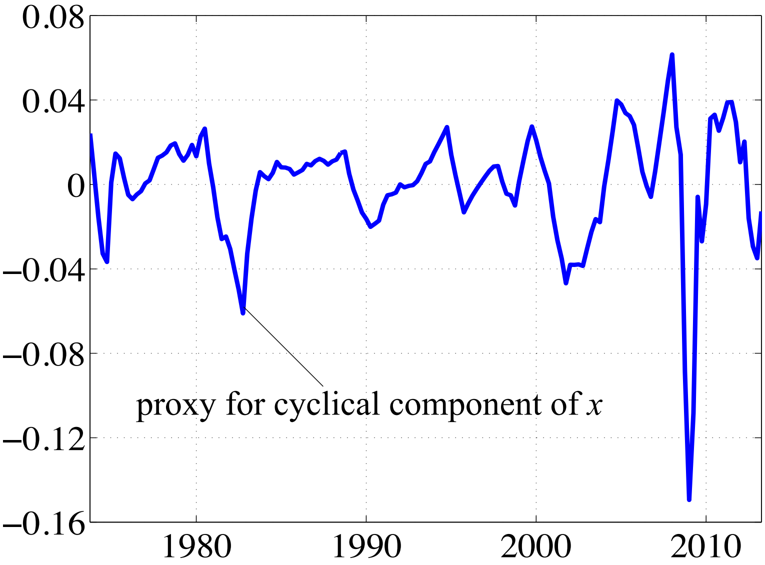
	output	product tightness	employment	labor tightness
increase in:	y	x	l	θ
aggregate demand χ	0	0	0	0
technology a	+	0	0	0
labor supply k	+	0	+	0

RIGID OR FLEXIBLE PRICES?

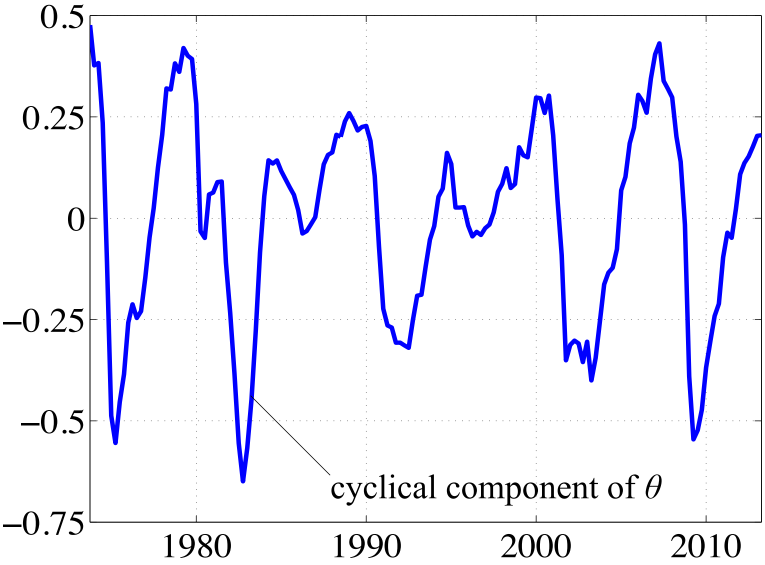
x CONSTRUCTED FROM CAPACITY UTILIZATION IN SPC



FLUCTUATIONS IN $x \Longrightarrow$ RIGID PRICE



FLUCTUATIONS IN $\theta \Longrightarrow$ RIGID REAL WAGE



LABOR DEMAND

OR LABOR SUPPLY SHOCKS?

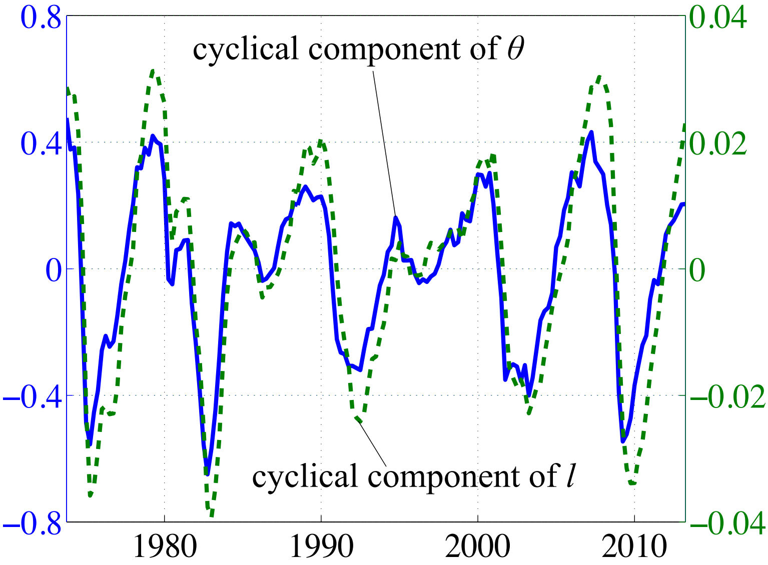
LABOR DEMAND & LABOR SUPPLY SHOCKS

- 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

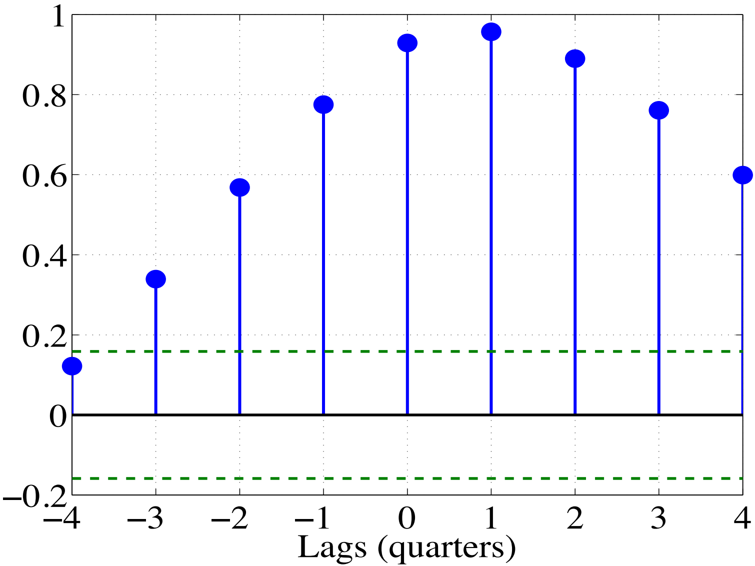
PREDICTED EFFECTS OF SHOCKS

- 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)

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



CROSS-CORRELOGRAM: θ (LEADING) & l



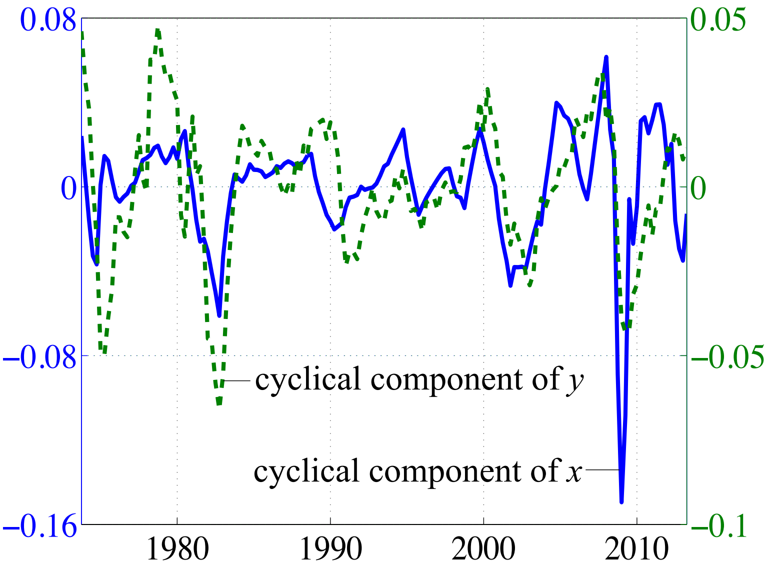
AGGREGATE DEMAND

OR TECHNOLOGY SHOCKS?

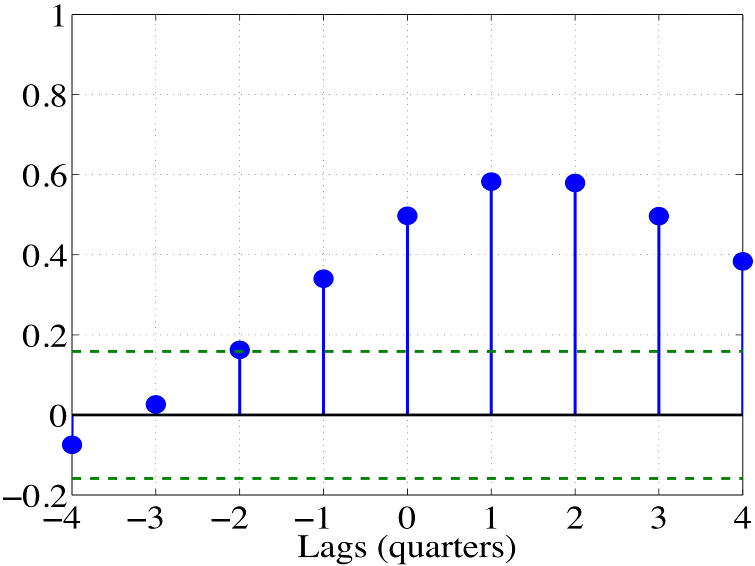
PREDICTED EFFECTS OF SHOCKS

- 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]