Aggregate Demand, Idle Time, and Unemployment

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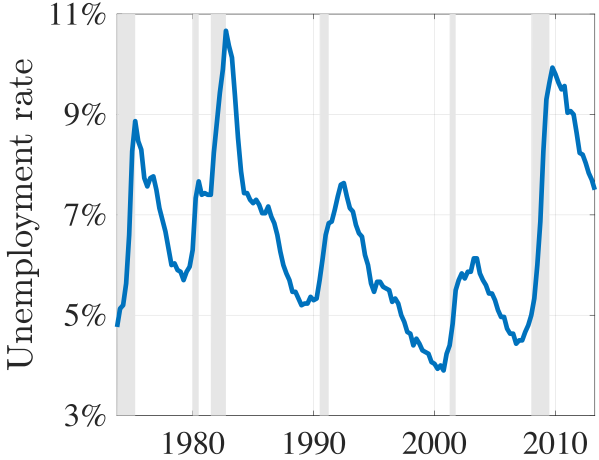
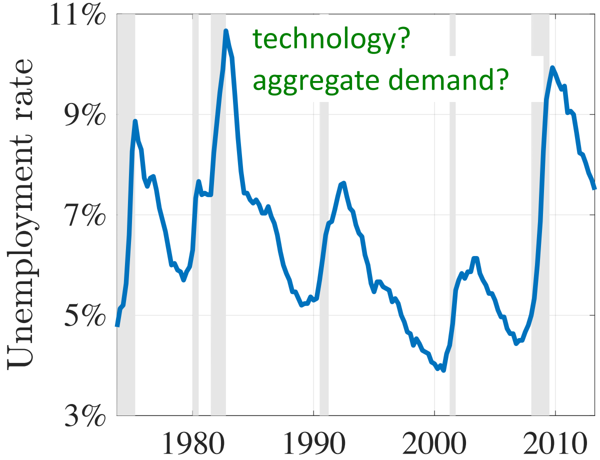
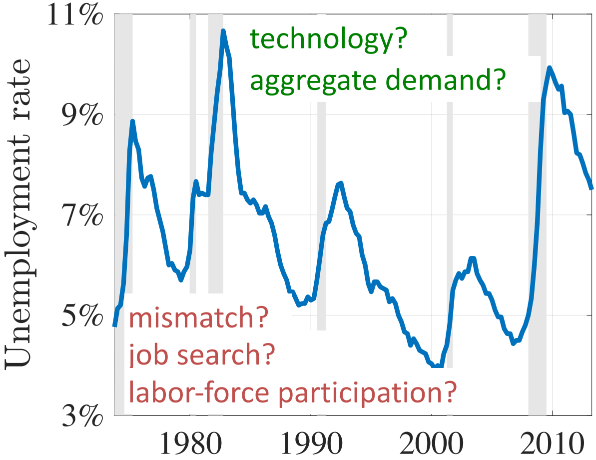
unemployment fluctuations remain insufficiently understood



unemployment fluctuations remain insufficiently understood



unemployment fluctuations remain insufficiently understood



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 fairly complex

general-disequilibrium model

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

the model in this paper

- Barro-Grossman architecture
- but matching structure on product + labor markets
  - instead of disequilibrium structure
  - advantage: markets can be too slack or too tight but remain in equilibrium
- aggregate demand, technology, mismatch, and labor supply (search / participation) affect unemployment
- simple: graphical representation of equilibrium

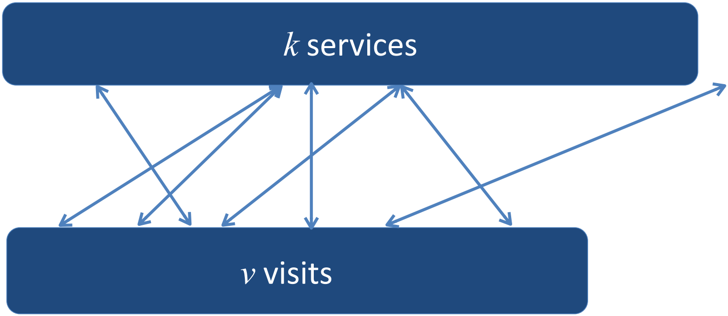
basic model:

only 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 and tightness



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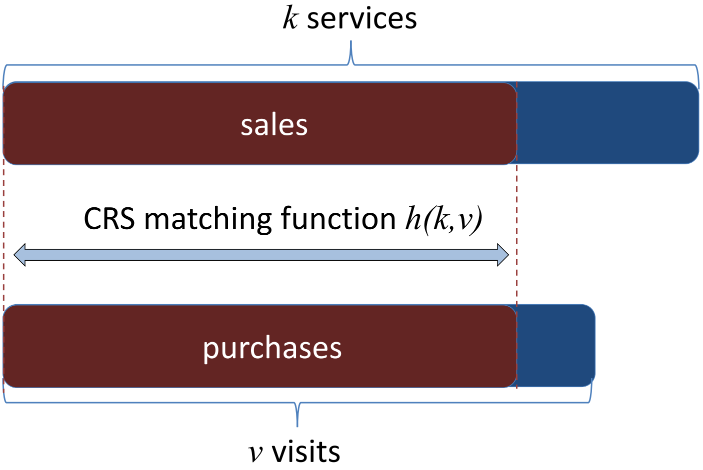

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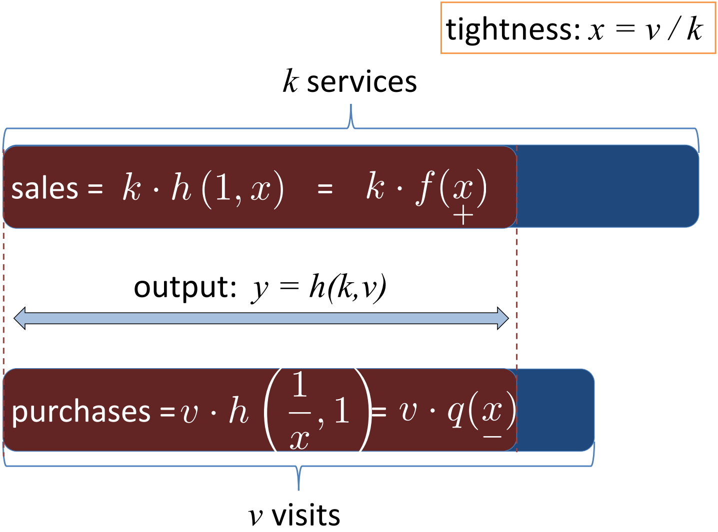
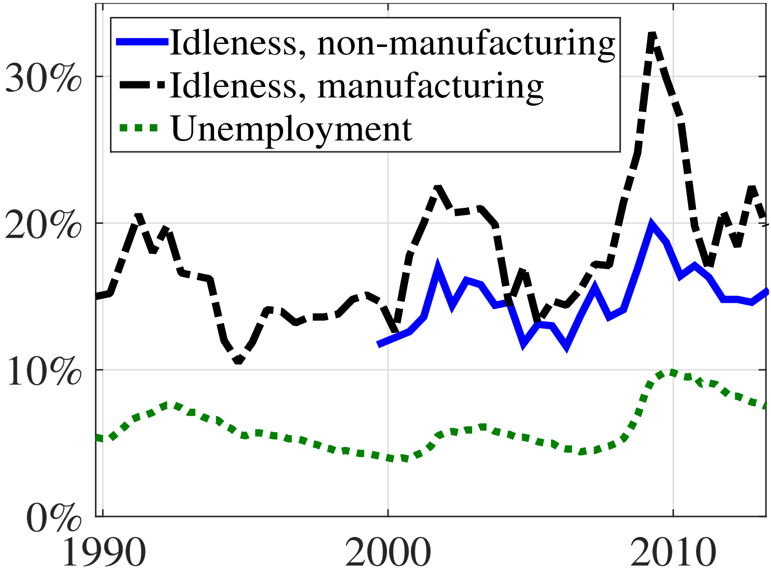


low product market tightness

high product market tightness

evidence of unsold capacity



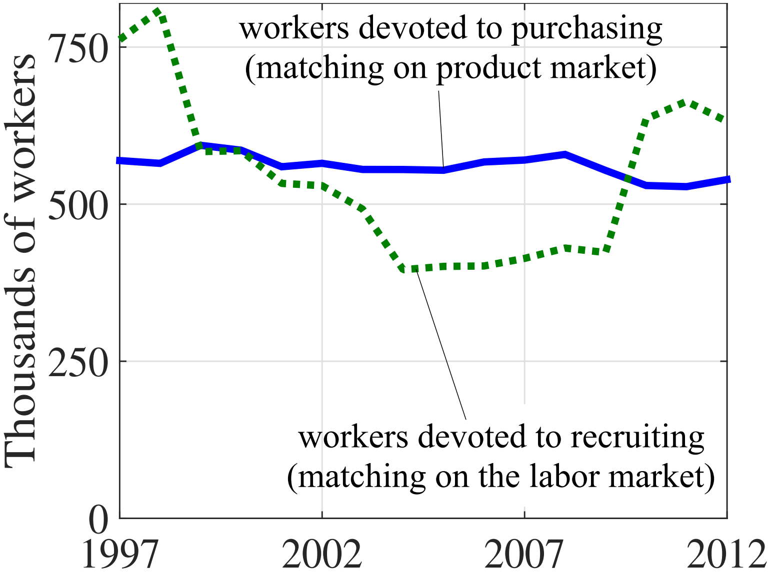
matching cost: $\rho \in (0,1)$ service per visit

- consumption $\equiv$ 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

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

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

evidence of matching costs



consumption $<$ output $<$ capacity

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

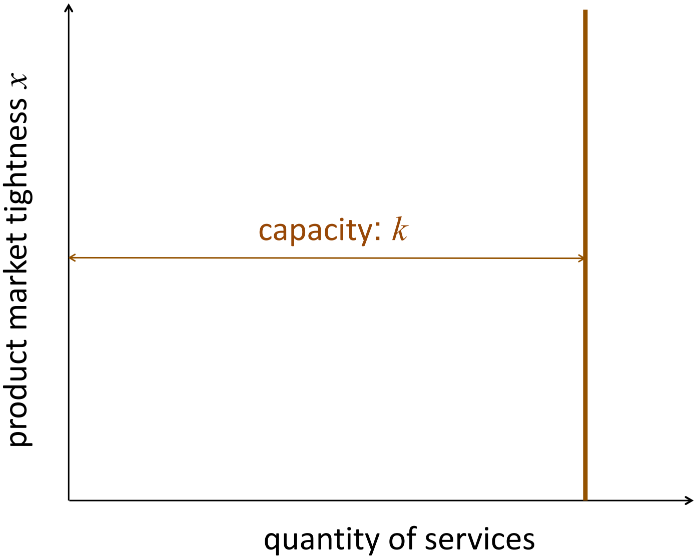
aggregate supply

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

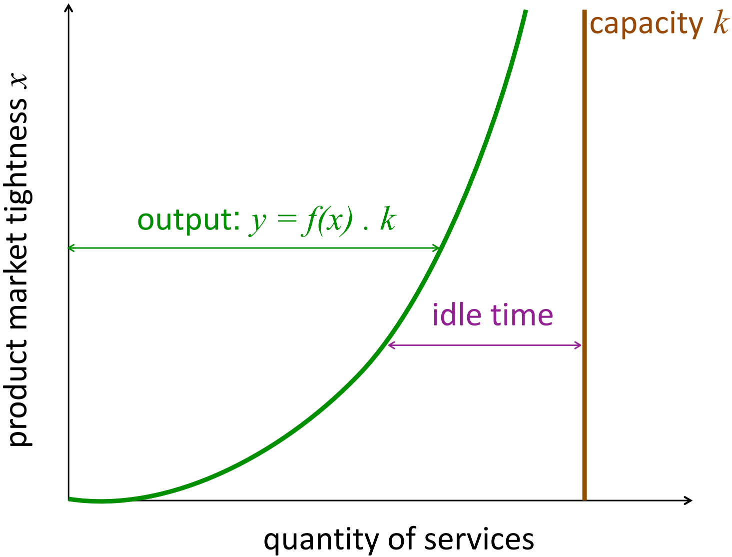
$$c^s(x) = \frac{f(x)}{1+\tau(x)} \cdot k = [f(x) - \rho \cdot x] \cdot k$$

- it is equivalent to represent aggregate supply (and demand) in terms of output instead of consumption
- but consumption representation is linked to welfare

tightness and aggregate supply



tightness and aggregate supply



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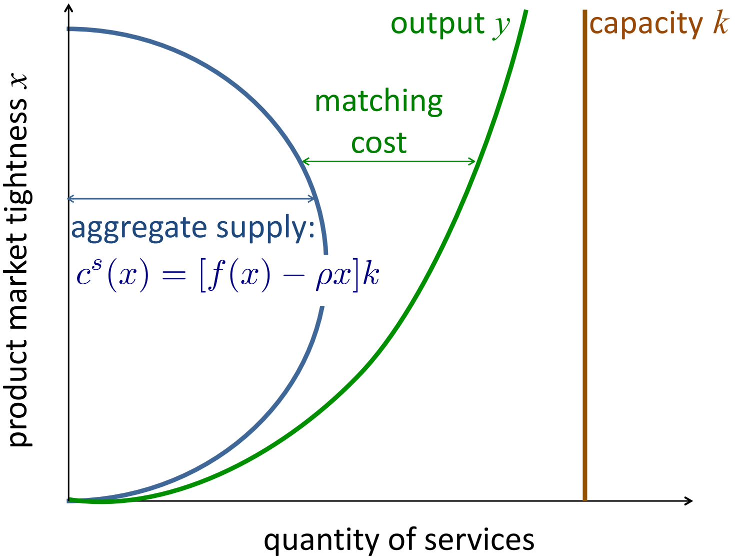

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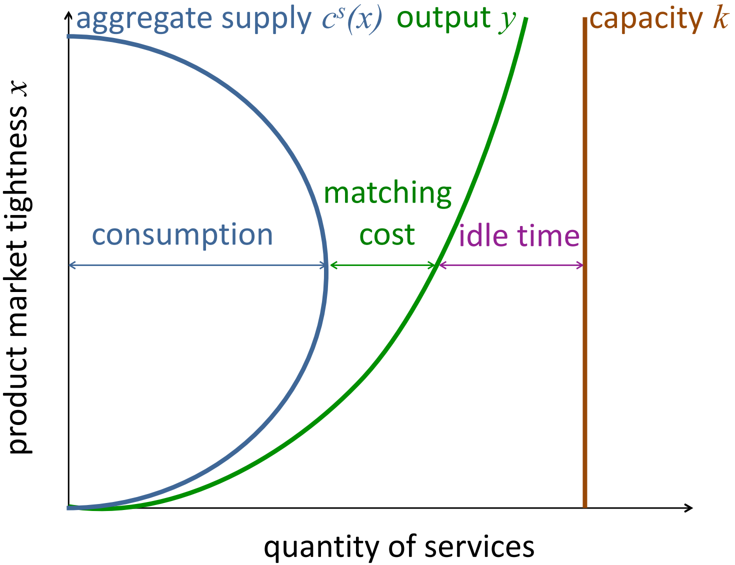


money

- 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

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

- 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:

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

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

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

linking aggregate demand and visits

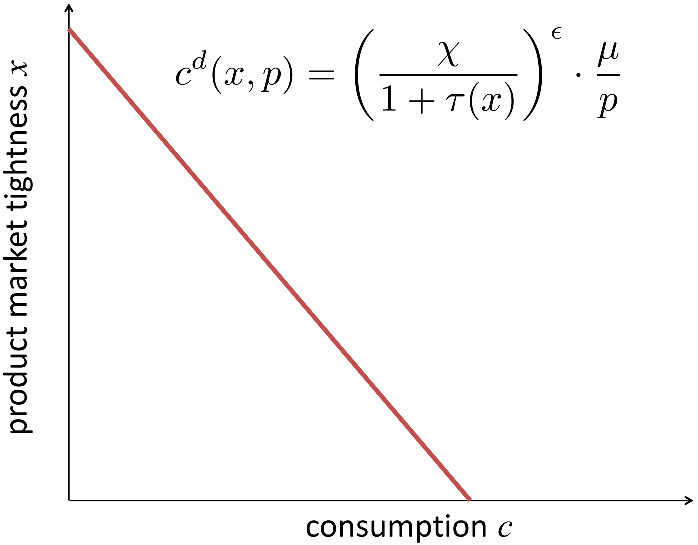
- there is a direct link between consumption of services, purchase of services, and visits
- if the desired consumption is $c^d(x,p)$
- the desired number of purchases is

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

- and the required number of visits is

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

tightness and aggregate demand



equilibrium

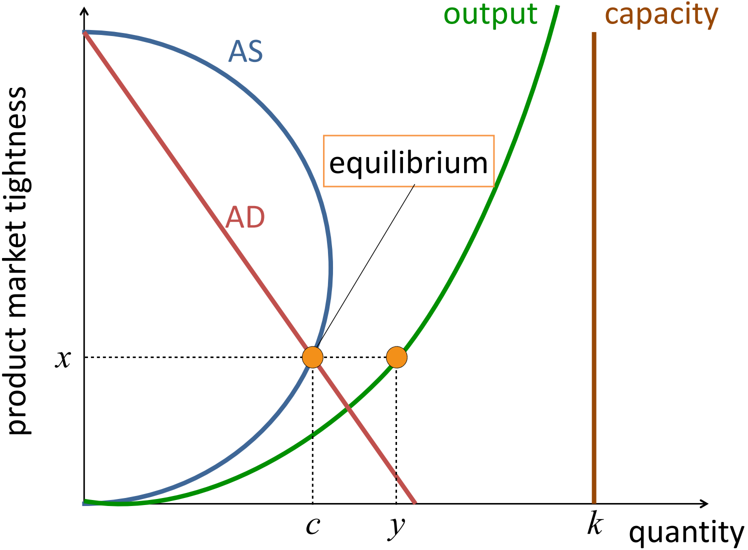
- price p + tightness x equilibrate supply and demand: $c^s(x) = c^d(x,p)$
- the matching equilibrium is much richer than the Walrasian equilibrium—where only the price equilibrates supply and demand
  - can describe "Walrasian situations" where price responds to shocks and tightness is constant
  - but can also describe "Keynesian situations" where price is constant and tightness (slack) responds to shocks

price mechanism

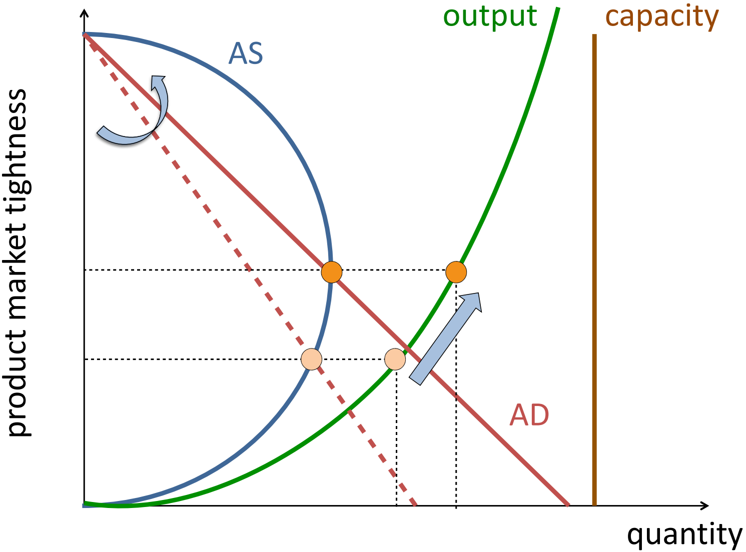
- 1 condition but 2 variables (x, p): we need a price mechanism to completely describe the equilibrium
- here we consider two polar cases:
  - fixed price [Barro & Grossman 1971]
  - competitive price [Moen 1997]
- in the paper we also consider:
  - bargaining (typical in the literature)
  - partially rigid price

comparative statics

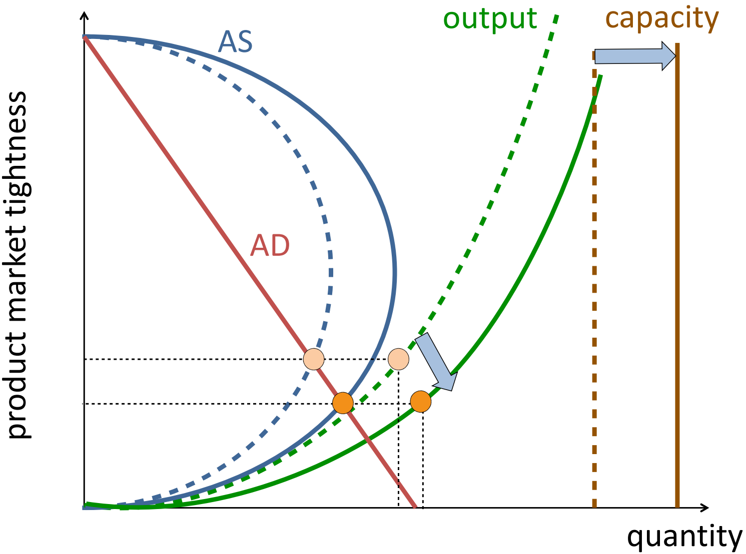
increase in AD with fixed price ($\chi \uparrow$)



increase in AD with fixed price ($\chi \uparrow$)



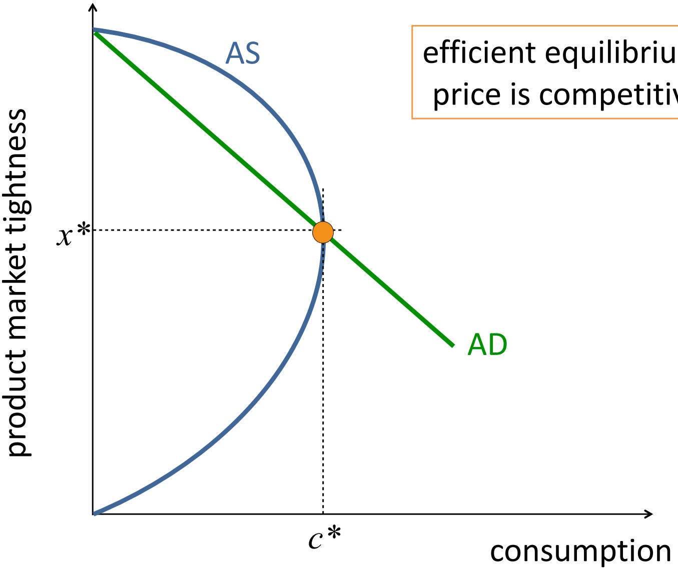
increase in AS with fixed price ($k \uparrow$)



comparative statics with fixed price

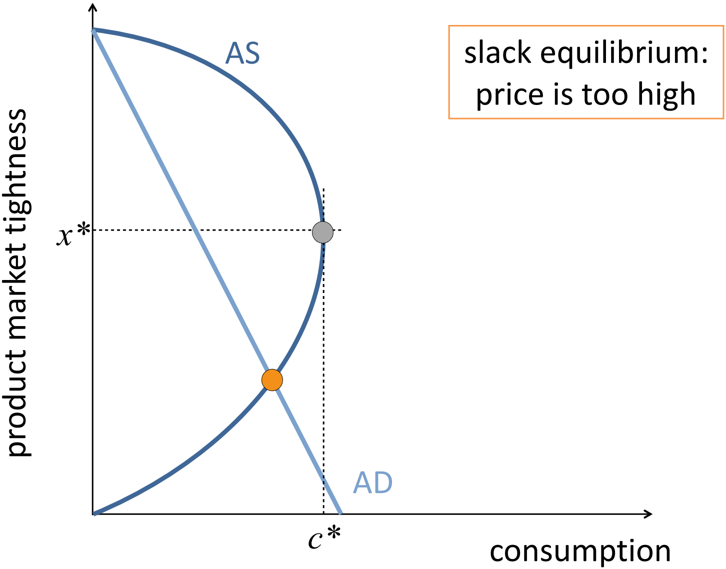
	effect on:	
	output	tightness
increase in:	y	x
aggregate demand χ	$+$	$+$
aggregate supply k	$+$	$-$

efficient equilibrium: consumption is maximum

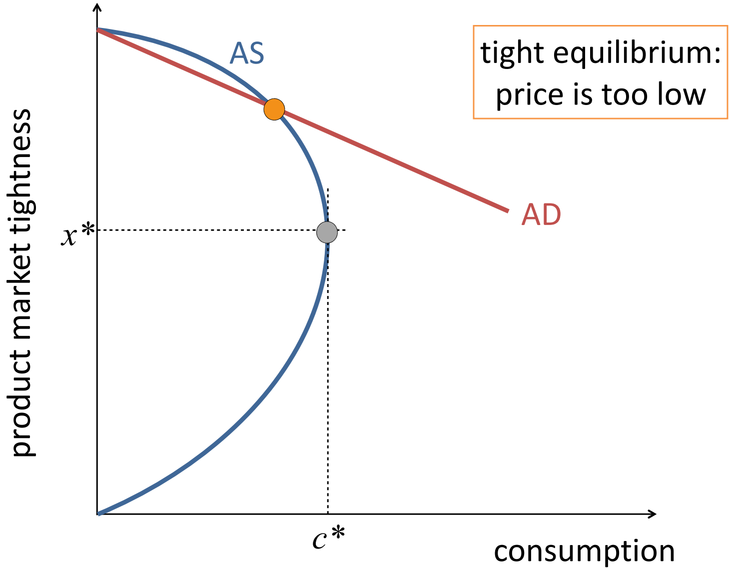


efficient equilibrium:
price is competitive

slack equilibrium: consumption is too low



tight equilibrium: consumption is too low



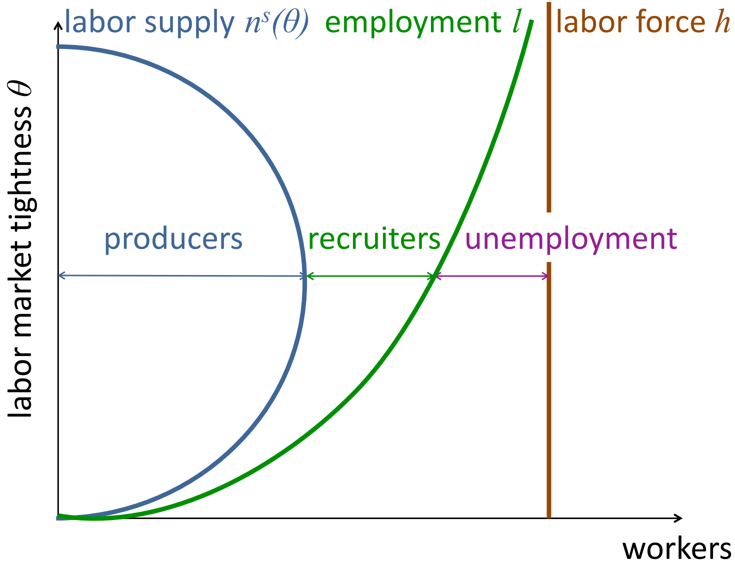
comparative statics with competitive price: price absorbs all shocks so tightness is constant

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

complete model:

product + labor markets

labor market and 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

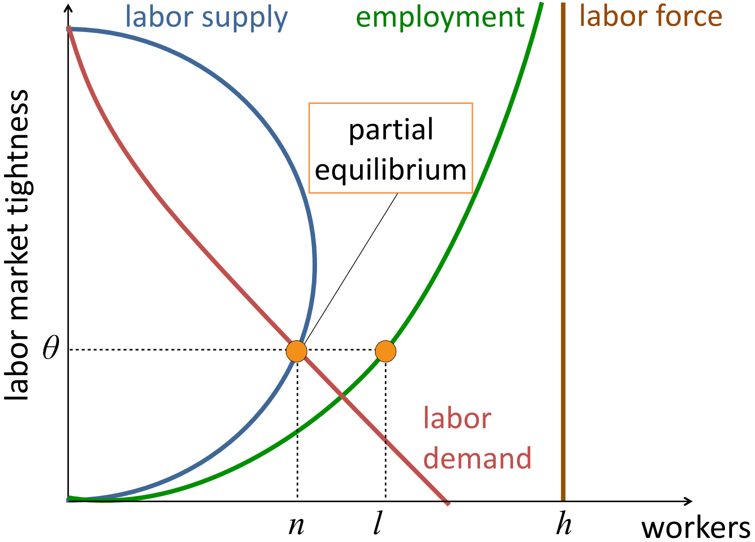
- optimal employment decision:

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

- 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



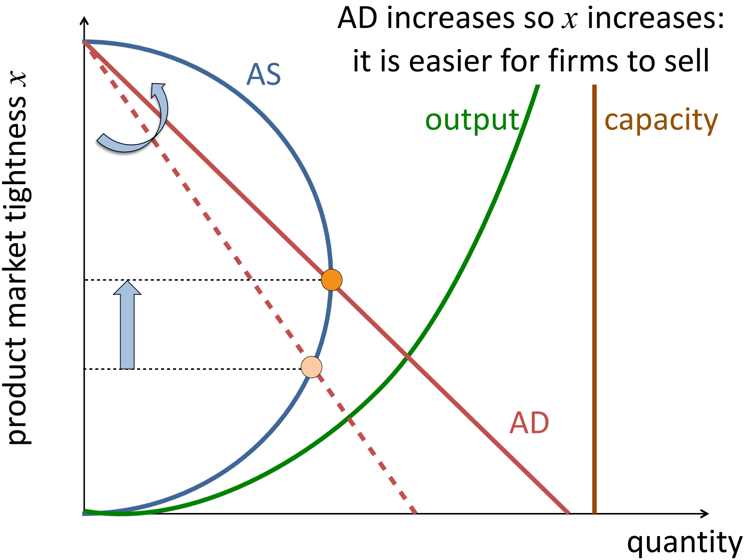
general equilibrium

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

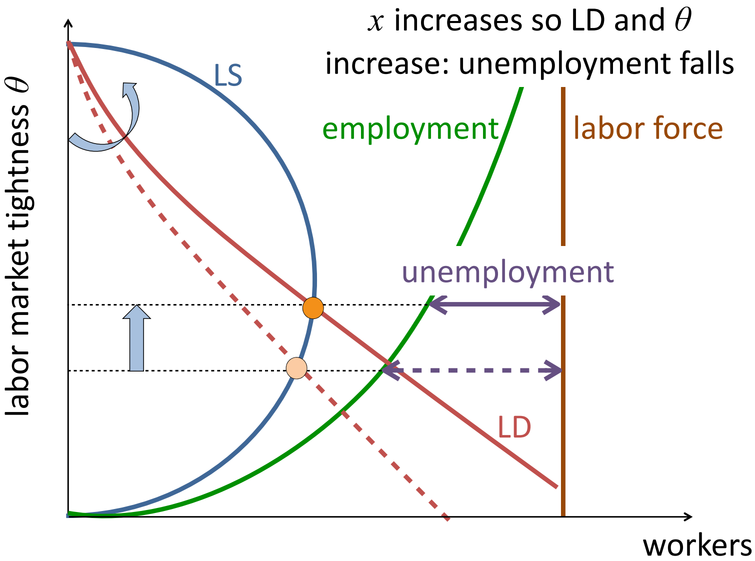
$$\begin{cases} c^s(x, \theta) & = & c^d(x, p) \\ n^s(\theta) & = & n^d(\theta, x, w) \end{cases}$$

- 2 equations, 4 variables: need price + wage mechanisms
  - fixed price and fixed wage
  - competitive price and competitive wage

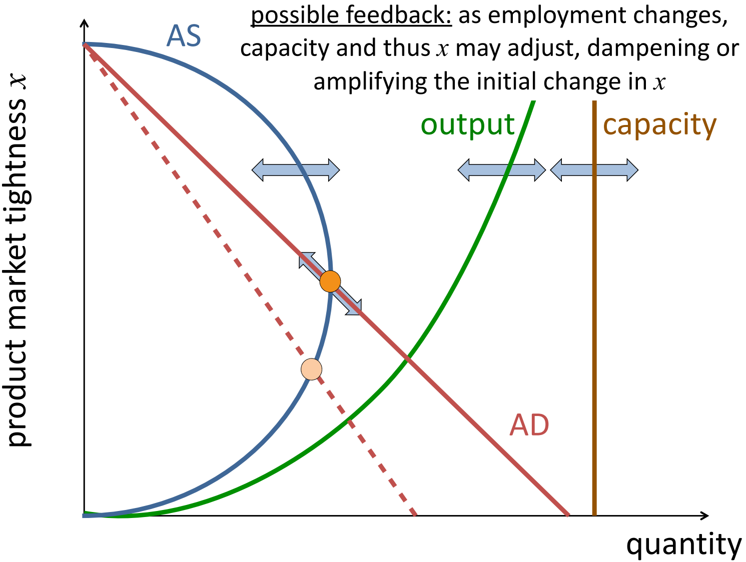
effect of AD on unemployment with fixed prices



effect of AD on unemployment with fixed prices



effect of AD on unemployment with fixed prices



Keynesian, classical, and 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

	effect on:			
	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

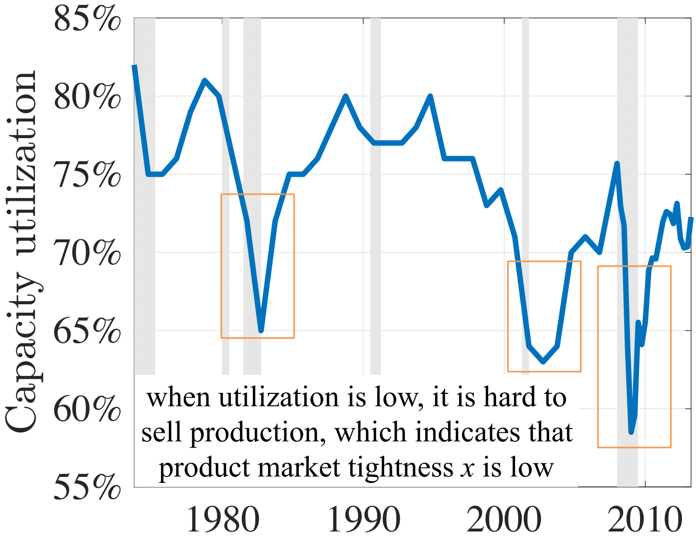
	effect on:			
	output	product tightness	employment	labor tightness
increase in:	y	x	l	θ
aggregate demand χ	$+$	$+$	$+$	$+$
technology a	$+$	$-$	$+$	$+$
labor supply k	$+$	$-$	$+$	$-$

comparative statics with competitive prices: prices absorb all shocks so tightnesses are constant

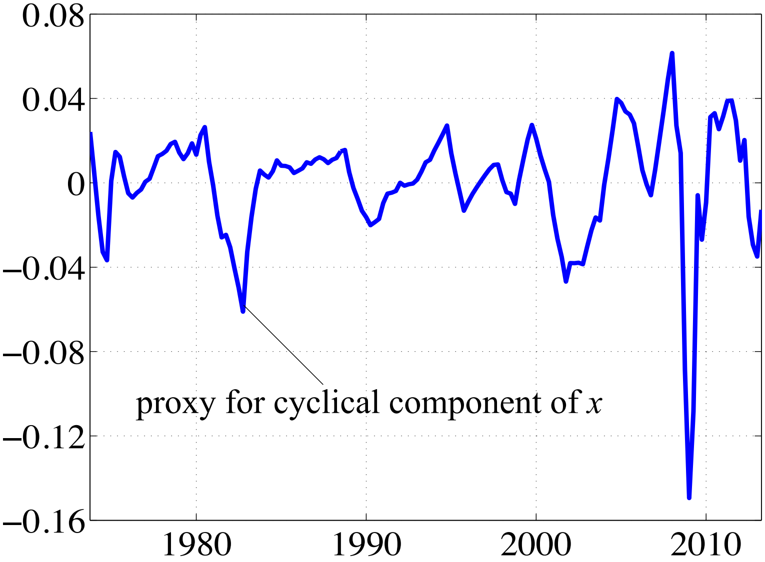
	effect on:			
increase in:	output y	product tightness x	employment l	labor tightness θ
aggregate demand χ	0	0	0	0
technology a	$+$	0	0	0
labor supply k	$+$	0	$+$	0

rigid or flexible prices?

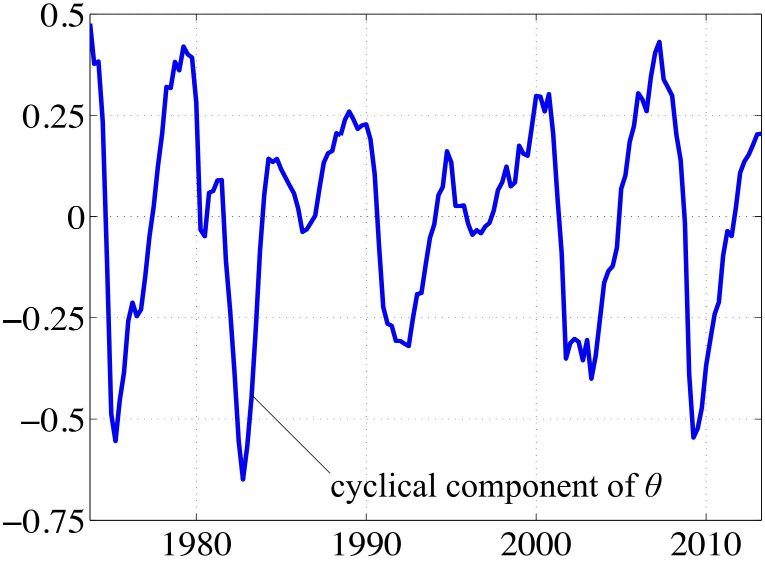
we construct x from capacity utilization in SPC



fluctuations in $x \implies$ rigid price



fluctuations in $\theta \implies$ rigid real wage



labor demand or

labor supply shocks?

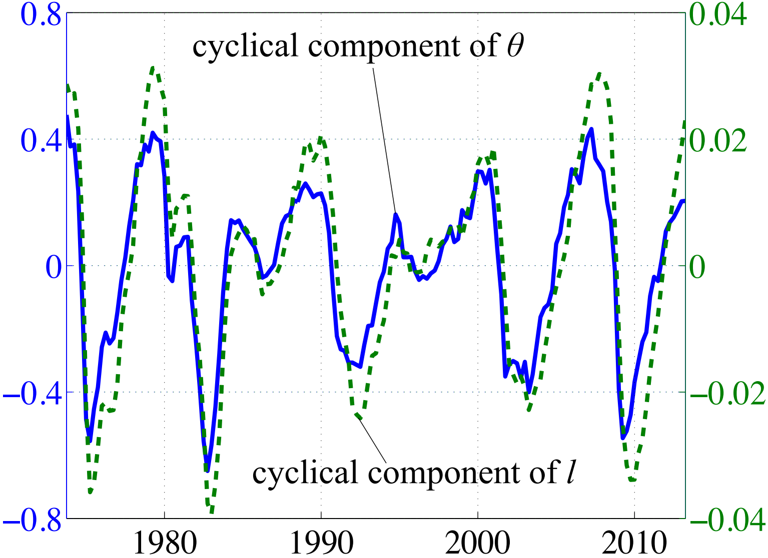
labor demand and labor supply shocks

- 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

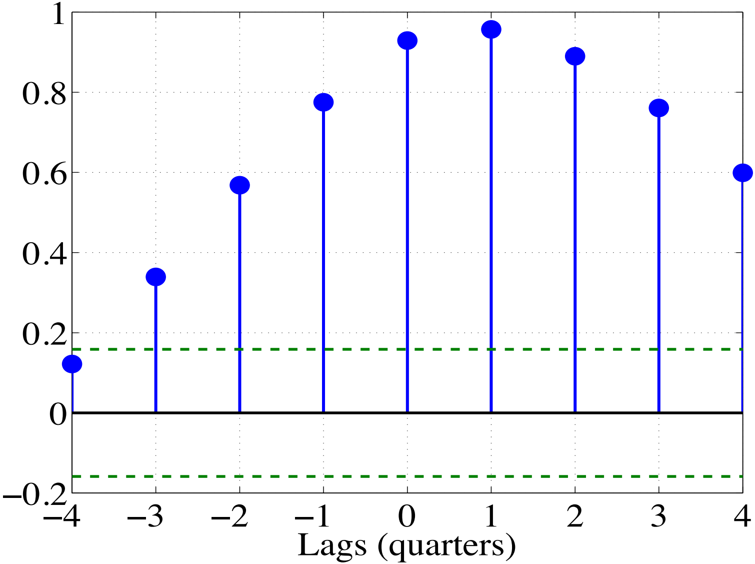
predicted effects of shocks

- 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)

positive correlation between l and θ $\implies$ labor demand



cross-correlogram: θ (leading) and l

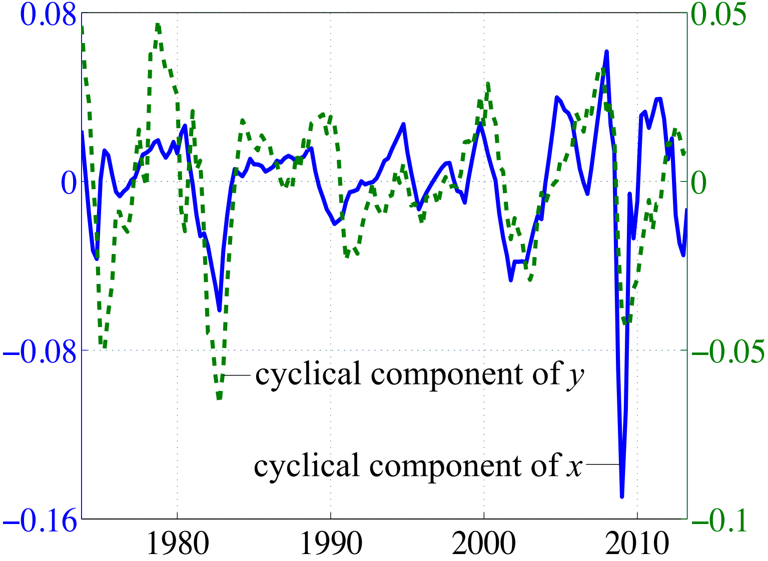


aggregate demand or technology shocks?

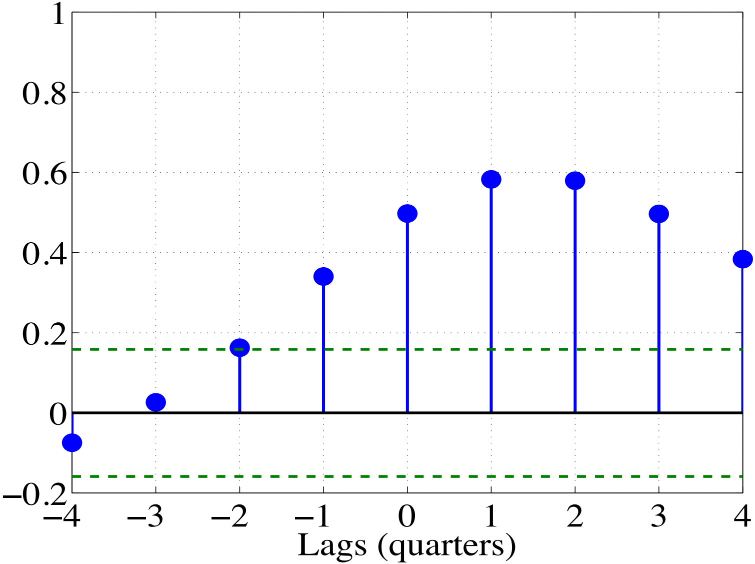
predicted effects of shocks

- 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)

positive correlation between y and $x \implies$ AD



cross-correlogram: x (leading) and 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

- monetary business-cycle model, with liquidity trap
  - Michaillat & Saez [2014]
- optimal unemployment insurance
  - Landais, Michaillat, & Saez [2010]
- optimal public expenditure
  - Michaillat & Saez [2015]
- optimal monetary policy
  - Michaillat & Saez [2016]