DO MATCHING FRICTIONS EXPLAIN UNEMPLOYMENT? NOT IN BAD TIMES

Pascal Michaillat

WORKERS QUEUE FOR JOBS IN BAD TIMES

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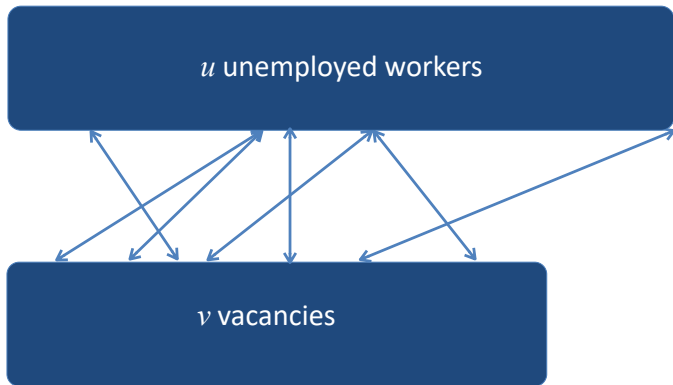
EXISTING MATCHING MODELS: NO QUEUES

- a queue is a situation where workers desperately want a job but cannot find one
- in existing models, unemployment vanishes when workers desperately want a job $\rightsquigarrow$ queues cannot exist
  - formally: unemployment vanishes when workers' job-search effort becomes infinite
- problem with existing models: firms hire everybody when recruiting is costless
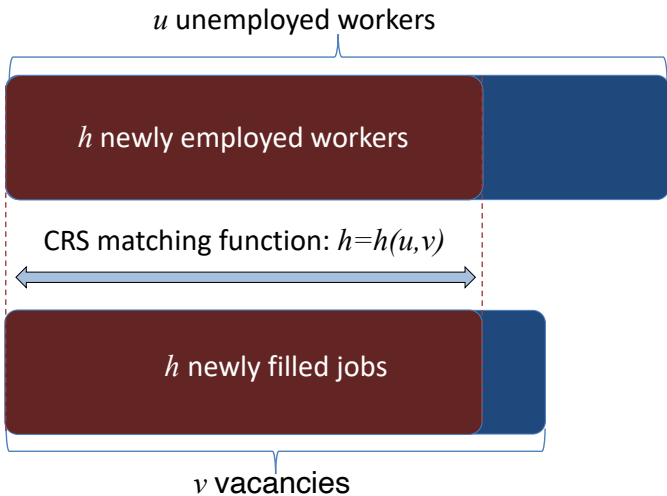
THIS PAPER: MATCHING MODEL WITH QUEUES

- firms may not hire everybody when recruiting is costless
- based on two assumptions:
  - diminishing marginal returns to labor
  - wage rigidity
- in bad times, jobs are rationed:
  - unemployment would not disappear if recruiting costs vanished
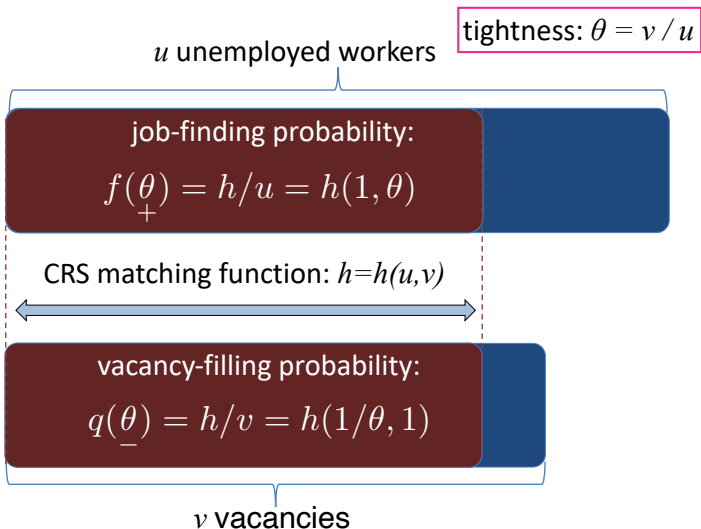 - queues could appear

# GENERIC MATCHING MODEL

MATCHING FUNCTION

MATCHING FUNCTION

u unemployed workers

h newly employed workers

CRS matching function: $h=h(u,v)$

h newly filled jobs

v vacancies

MATCHING FUNCTION

tightness: $\theta = v\,/\,u$

u unemployed workers

job-finding probability:

$$f(\underset{+}{\theta}) = h/u = h(1,\theta)$$

CRS matching function: $h=h(u,v)$

vacancy-filling probability:

$$q(\underset{-}{\theta}) = h/v = h(1/\theta,1)$$

v vacancies

WORKER FLOWS: JOB CREATION & DESTRUCTION

$$f(\theta_t) \times u_t$$

n_t employed workers

u_t unemployed workers
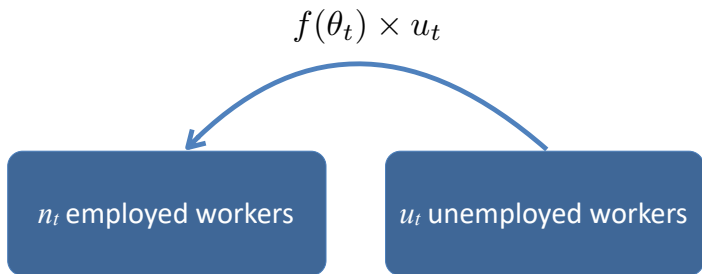
WORKER FLOWS: JOB CREATION & DESTRUCTION
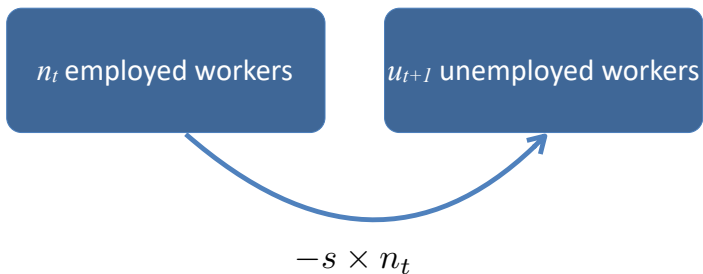
BEVERIDGE CURVE

- the Beveridge curve relates employment n to tightness θ when labor market flows are balanced
  - $E \rightarrow U = U \rightarrow E$
  - $s \cdot n = f(\theta) \cdot u = f(\theta) \cdot [1 - n + s \cdot n]$
- equation of the Beveridge curve:

$$n = \frac{f(\theta)}{s + (1 - s) \cdot f(\theta)}$$

GENERIC WAGE SCHEDULE

- there are mutual gains from matching

- many wage schedules are consistent with equilibrium

- generic wage schedule: $w_t = w(n_t, \theta_t, x_t)$

  - n_t: level of employment in the firm

  - θ_t: aggregate level of tightness

  - x_t: state of the economy

- w nests various types of bargaining and wage rigidity

REPRESENTATIVE FIRM

- employs n_t workers paid w_t
- produces $y_t = g(n_t, a_t)$
  - g: production function
  - a_t: productivity (random variable)
- hires $n_t - (1 - s) \cdot n_{t-1}$ new workers
  - cost per vacancy: $c \cdot a_t$
  - probability to fill a vacancy: $q(\theta_t)$

FIRM PROBLEM

- given productivity $\{a_t\}$, tightness $\{\theta_t\}$, and the wage schedule w, the firm chooses employment $\{n_t\}$ to maximize expected profits

$$\mathbb{E}_0 \sum_{t=0}^{+\infty} \delta^t \left[\underbrace{g(n_t, a_t)}_{\text{production}} - \underbrace{w(n_t, \theta_t, x_t) \cdot n_t}_{\text{wage bill}} \right.$$

$$\left. - \underbrace{\frac{c \cdot a_t}{q(\theta_t)} \cdot (n_t - (1-s) \cdot n_{t-1})}_{\text{recruiting expenses}} \right]$$

PROFIT MAXIMIZATION

$$\frac{\partial g(n, a)}{\partial n} - w - n \cdot \frac{\partial w(n, \theta, x)}{\partial n} - \left[1 - \delta \cdot (1 - s)\right] \cdot \frac{c \cdot a}{q(\theta)} = 0$$

- the condition says that marginal profit = 0
- the marginal profit is the sum of
  - gross marginal profit: independent of c
  - marginal recruiting expenses: dependent on c
- (this is the steady-state expression of the condition)

ABSENCE OR PRESENCE OF JOB RATIONING

IN SEVERAL MODELS

DEFINITION OF JOB RATIONING

- jobs are rationed if the employment rate remains strictly below 1 when recruiting is costless

- equivalently, jobs are rationed if the employment rate remains strictly below 1 when the recruiting cost $c \to 0$

- when jobs are rationed, queues could exist

  - employment is the same when job-search effort $\to \infty$ and when $c \to 0$

FOUR MATCHING MODELS

model	production function	wage setting
Pissarides [2000]	constant returns to labor	Nash bargaining
Cahuc & Wasmer [2001]	diminishing marginal returns to labor	Stole-Zwiebel bargaining
Hall [2005]	constant returns to labor	rigid wage
this paper	diminishing marginal returns to labor	rigid wage

THE MODEL OF PISSARIDES [2000]

- linear production function: $g(n, a) = a \cdot n$
- wage from Nash bargaining:

$$w = a \cdot c \cdot \frac{\beta}{1 - \beta} \left[\frac{1 - \delta \cdot (1 - s)}{q(\theta)} + \delta \cdot (1 - s) \cdot \theta \right]$$

- $\beta \in (0, 1)$: workers' bargaining power
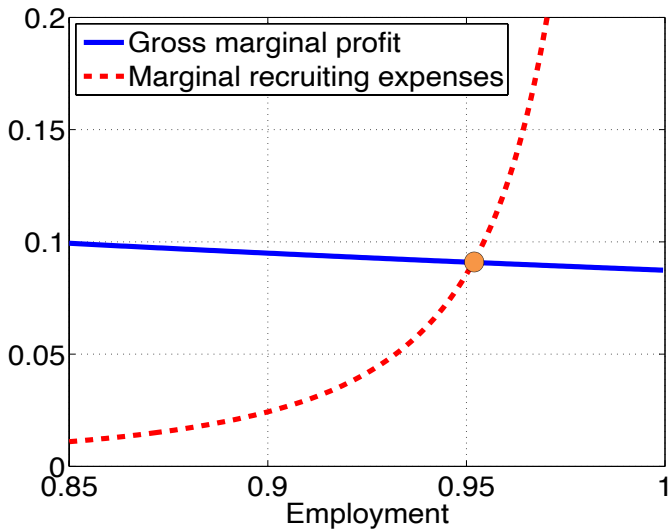- (this is the steady-state expression of the wage)

PISSARIDES [2000]: EQUILIBRIUM

- steady-state equilibrium: pair (n, θ) that satisfies

  – Beveridge curve

  – firm's profit-maximization condition
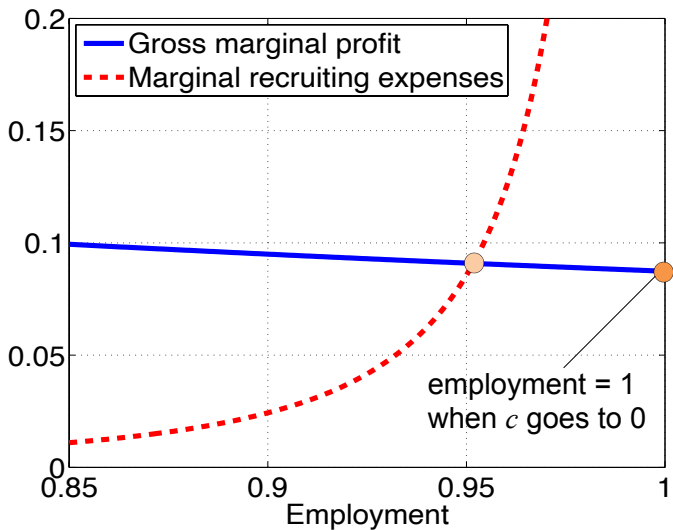
- equilibrium condition:

$$\underbrace{1 - \beta}_{\text{gross marginal profit}} = \underbrace{c \cdot \left[\frac{1 - \delta \cdot (1 - s)}{q(\theta(n))} + \delta \cdot (1 - s) \cdot \beta \cdot \theta(n) \right]}_{\text{marginal recruiting expenses}}$$

  – where $\theta(n)$ is implicitly defined by Beveridge curve

PISSARIDES [2000]: EQUILIBRIUM AS $c \to 0$

Gross marginal profit
Marginal recruiting expenses

employment = 1
when c goes to 0

Employment
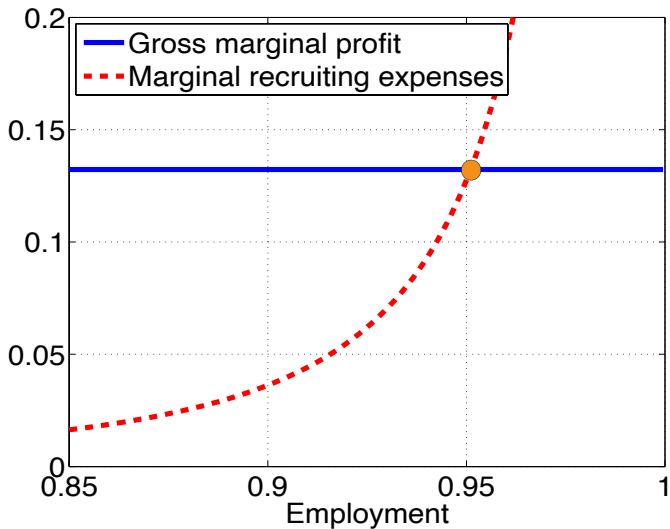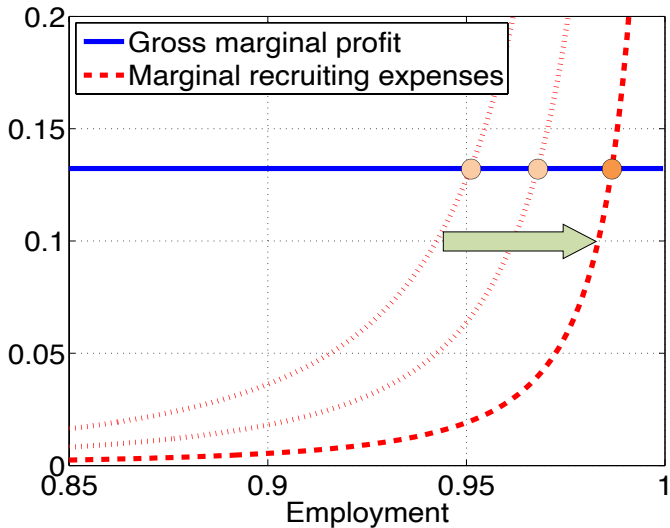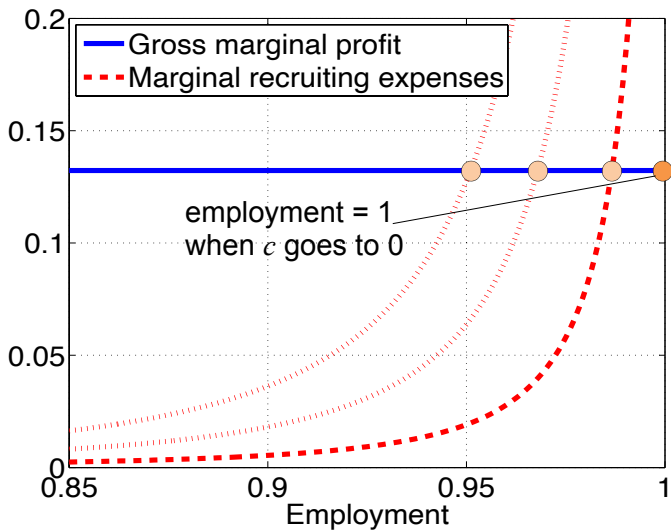
THE MODEL OF CAHUC & WASMER [2001]

- concave production function: $g(n, a) = a \cdot n^{\alpha}$

  - $\alpha < 1$: diminishing marginal returns to labor

- wage from Stole-Zwiebel bargaining:

$$w = a \cdot \left[\frac{\beta \cdot \alpha}{1 - \beta \cdot (1 - \alpha)} \cdot n^{\alpha - 1} + c \cdot (1 - s) \cdot \delta \cdot \beta \cdot \theta \right]$$

  - $\beta \in (0, 1)$: workers' bargaining power
  - (this is the steady-state expression of the wage)
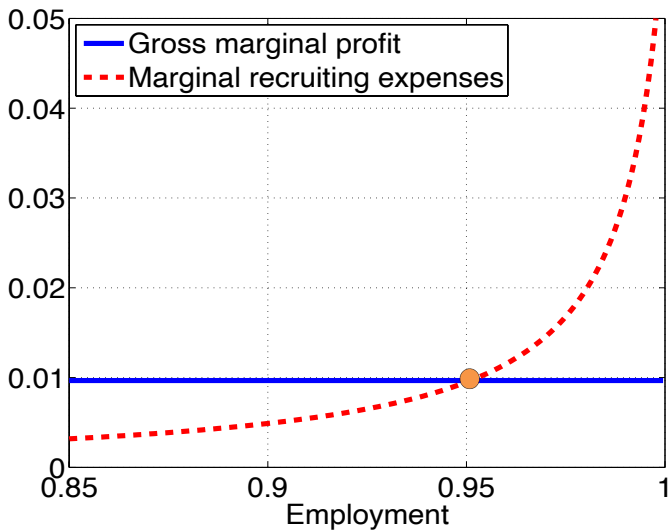
- steady-state equilibrium: pair (n, θ) that satisfies

  - Beveridge curve

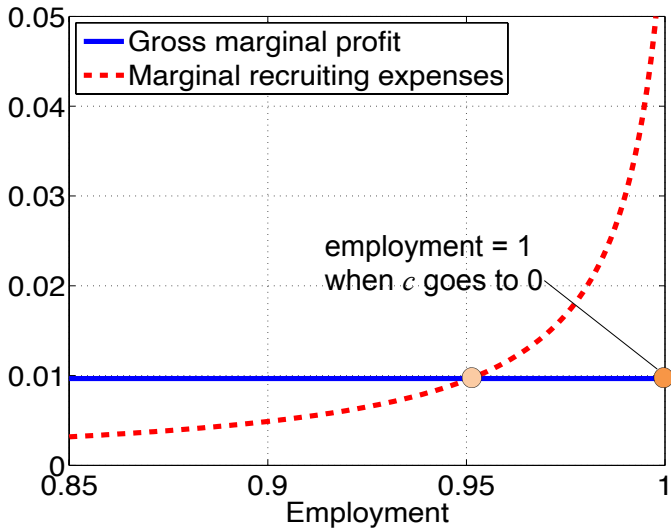 - firm's profit-maximization condition

- equilibrium condition:

$$\underbrace{\frac{\alpha \cdot (1 - \beta)}{1 - \beta \cdot (1 - \alpha)} \cdot n^{\alpha - 1}}_{\text{gross marginal profit}} = c \cdot \underbrace{\left[\frac{1 - \delta(1 - s)}{q(\theta(n))} + \delta(1 - s) \cdot \beta \cdot \theta(n) \right]}_{\text{marginal recruiting expenses}}$$

  - where $\theta(n)$ is implicitly defined by Beveridge curve

THE MODEL OF HALL [2005]

- linear production function: $g(n, a) = a \cdot n$
- rigid wage: $w = \omega \cdot a^{\gamma}$
  - $\omega > 0$: level of the real wage
  - $\gamma < 1$: partially rigid real wage
  - if $\gamma = 0$: fixed wage
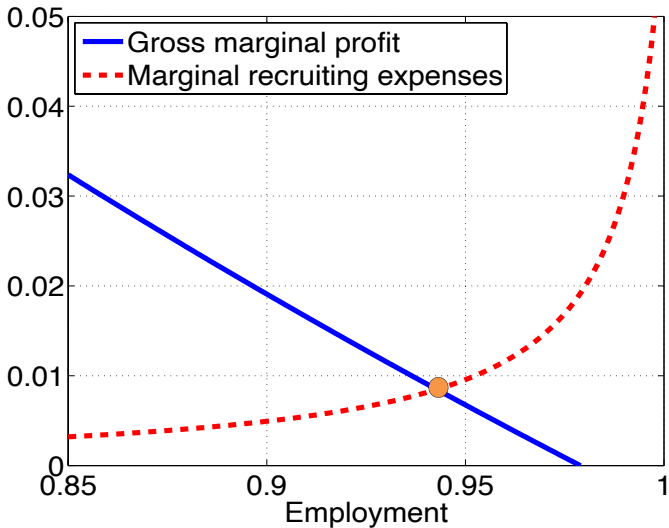 - specification from Blanchard & Gali [2010]

- steady-state equilibrium: pair (n, θ) that satisfies
  - Beveridge curve
 - firm's profit-maximization condition
- equilibrium condition:

$$\underbrace{1 - \omega \cdot a^{\gamma - 1}}_{\text{gross marginal profit}} = \underbrace{c \cdot \frac{1 - \delta \cdot (1 - s)}{q(\theta(n))}}_{\text{marginal recruiting expenses}}$$

 - where $\theta(n)$ is implicitly defined by Beveridge curve

THIS PAPER'S MODEL

- concave production function: $g(n, a) = a \cdot n^{\alpha}$
  - $\alpha < 1$: diminishing marginal returns to labor
- rigid wage: $w = \omega \cdot a^{\gamma}$
  - $\omega > 0$: level of the real wage
  - $\gamma < 1$: partially rigid real wage
  - if $\gamma = 0$: fixed wage
  - specification from Blanchard & Gali [2010]

THIS PAPER'S MODEL: EQUILIBRIUM

- steady-state equilibrium: pair (n, θ) that satisfies
  - Beveridge curve
  - firm's profit-maximization condition
- equilibrium condition:

$$\underbrace{\alpha \cdot n^{\alpha-1} - \omega \cdot a^{\gamma-1}}_{\text{gross marginal profit}} = \underbrace{c \cdot \frac{1 - \delta \cdot (1 - s)}{q(\theta(n))}}_{\text{marginal recruiting expenses}}$$

  - where $\theta(n)$ is implicitly defined by Beveridge curve
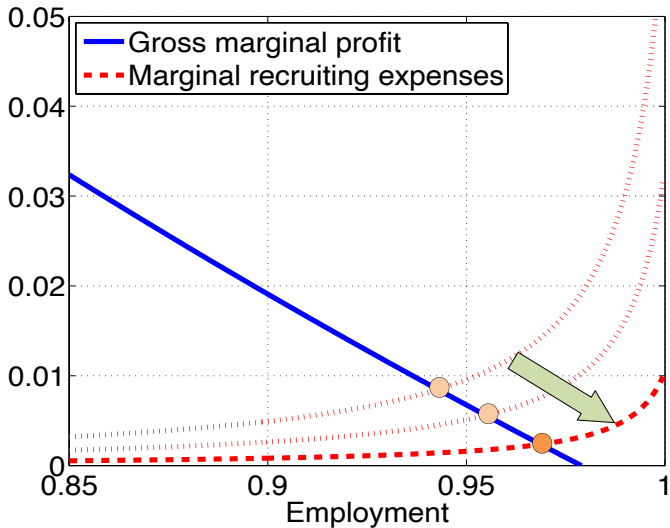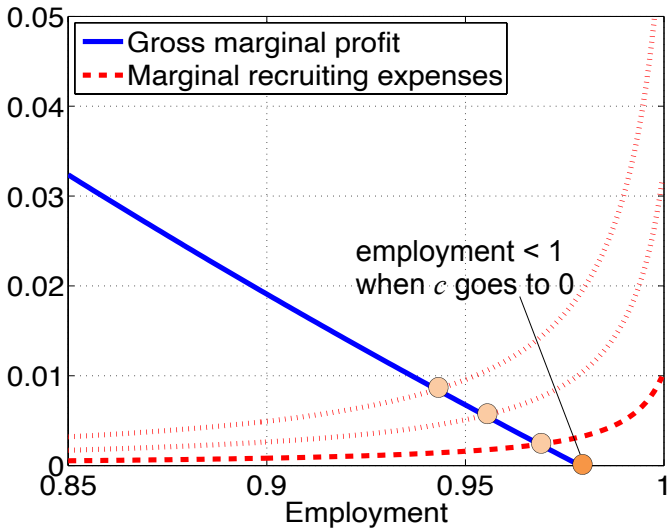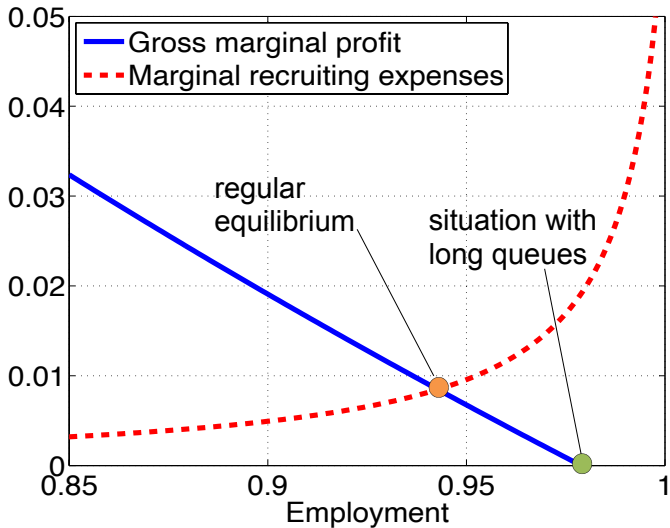
FRICTIONAL & RATIONING UNEMPLOYMENT
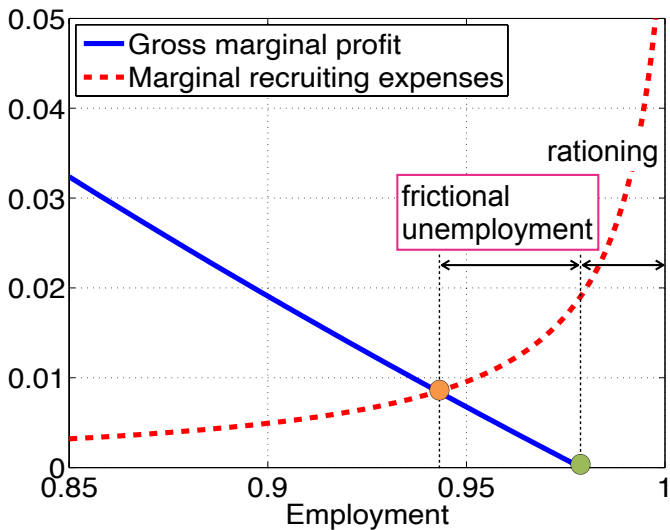
SUMMARY

model	assumptions	job rationing?
Pissarides [2000]	bargaining linear production	no
Cahuc & Wasmer [2001]	bargaining concave production	no
Hall [2005]	rigid wage linear production	no
this paper	rigid wage concave production	yes

FRICTIONAL UNEMPLOYMENT OVER THE BUSINESS CYCLE: COMPARATIVE STATICS

FRICTIONAL UNEMPLOYMENT IS HIGH IN BOOMS
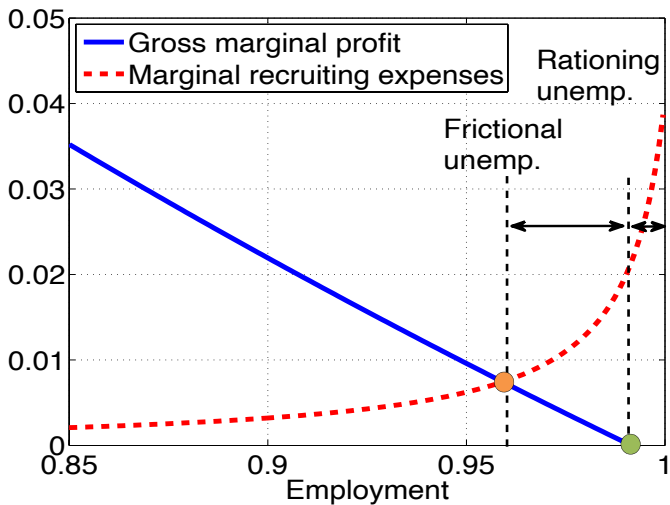
FRICTIONAL UNEMPLOYMENT IS LOW IN SLUMPS
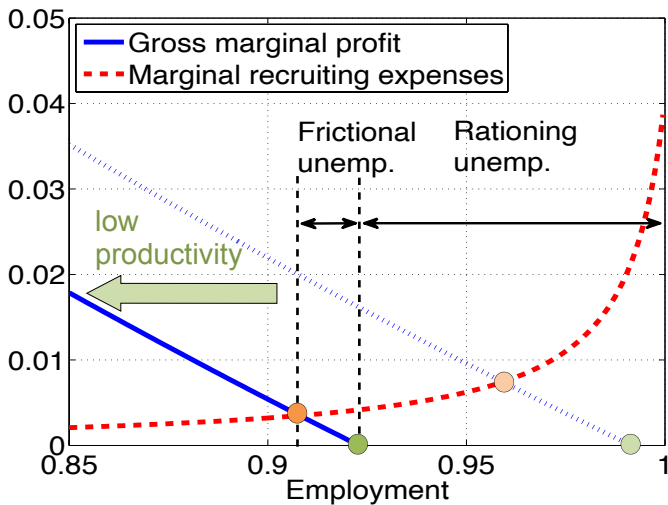
SUMMARY

- with low productivity, gross marginal profits are low
    - because of wage rigidity
⤳ labor demand is depressed
⤳ total unemployment & rationing unemployment are high
- but it is easy for firms to recruit workers
⤳ frictional unemployment is low

FRICTIONAL UNEMPLOYMENT OVER THE BUSINESS CYCLE: SIMULATIONS

CALIBRATION (WEEKLY FREQUENCY)

	interpretation	value	source
η	elasticity of matching	0.5	Petrongolo & Pissarides [2001]
γ	real wage flexibility	0.7	Haefke et al [2008]
c	recruiting cost	0.22	Barron et al [1997]
			Silva & Toledo [2009]
s	separation rate	0.95%	JOLTS, 2000–2009
μ	effectiveness of matching	0.23	JOLTS, 2000–2009
α	marginal returns to labor	0.67	matches labor share = 0.66
ω	steady-state real wage	0.67	matches unemployment = 5.8%
ρ	autocorrelation of productivity	0.992	MSPC, 1964–2009
ω	standard deviation of shocks	0.0027	MSPC, 1964–2009

IMPULSE RESPONSES TO NEGATIVE SHOCK
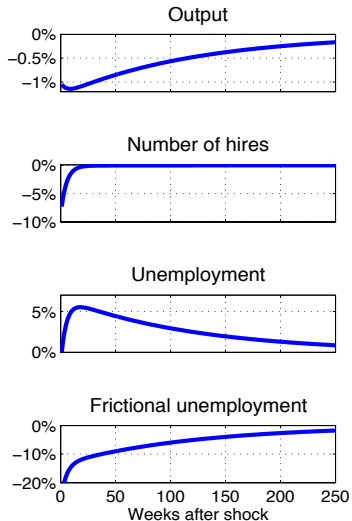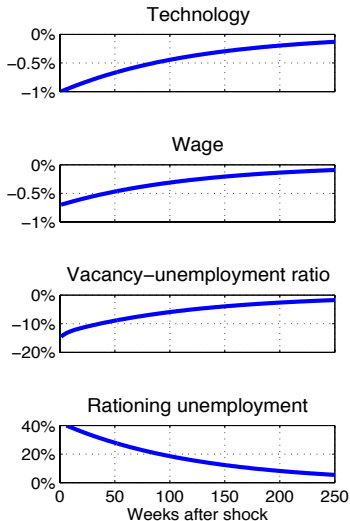
SIMULATED & EMPIRICAL MOMENTS

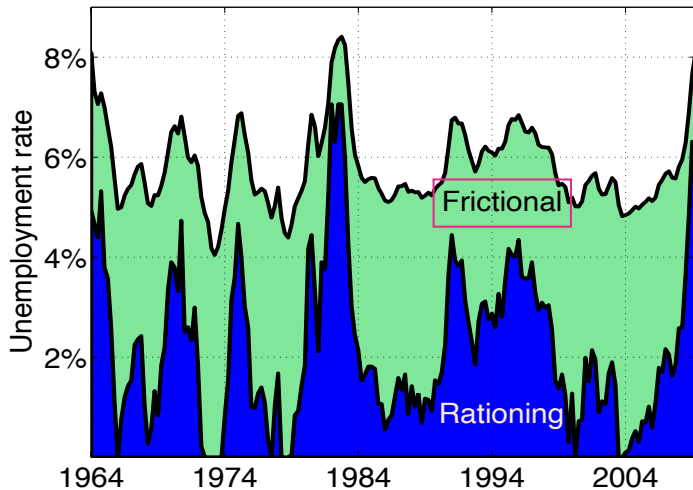| moment	model	US data
elasticity of u wrt a	5.9	4.2
elasticity of v wrt a	6.8	4.3
elasticity of w wrt a	0.7	0.7
autocorrelation(u)	0.90	0.91
autocorrelation(v)	0.76	0.93
correlation(u, v)	−0.89	−0.89

SIMULATED & EMPIRICAL MOMENTS

- the volatility of unemployment and vacancies is as large in the model as in US data
  - ⤳ no Shimer [2005] puzzle
    - although wages are as flexible as in newly created US jobs
- the correlation between unemployment and vacancies is the same in the model as in the data
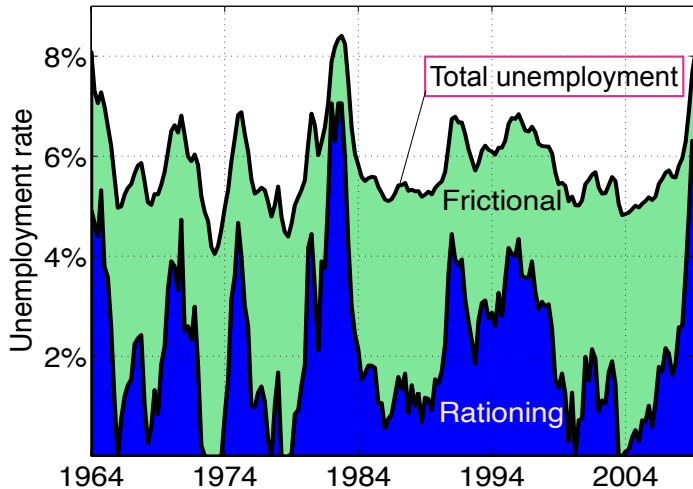 - ⤳ realistic Beveridge curve
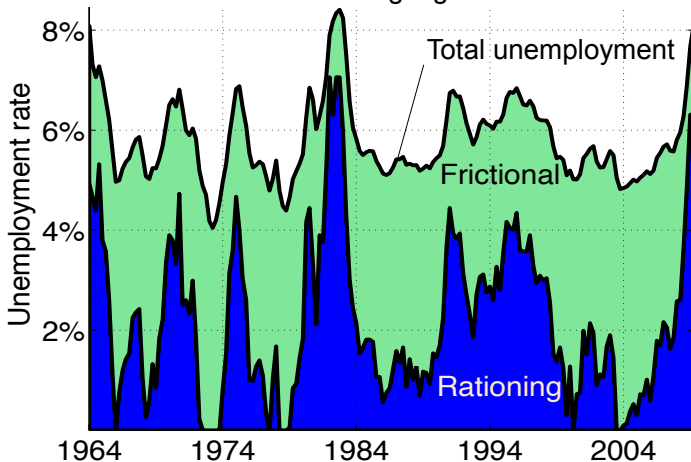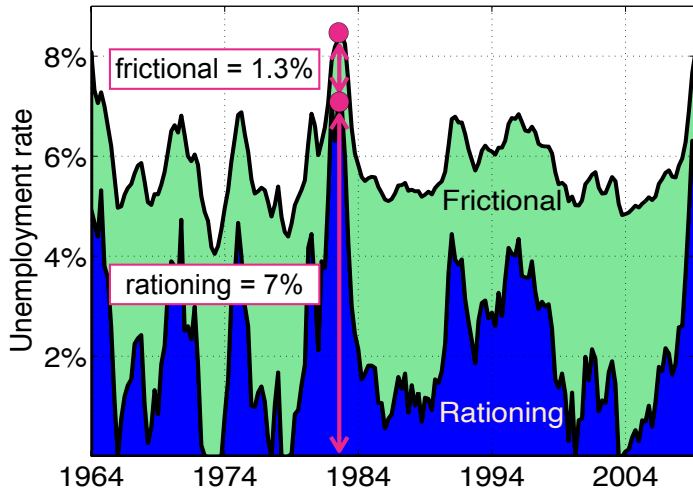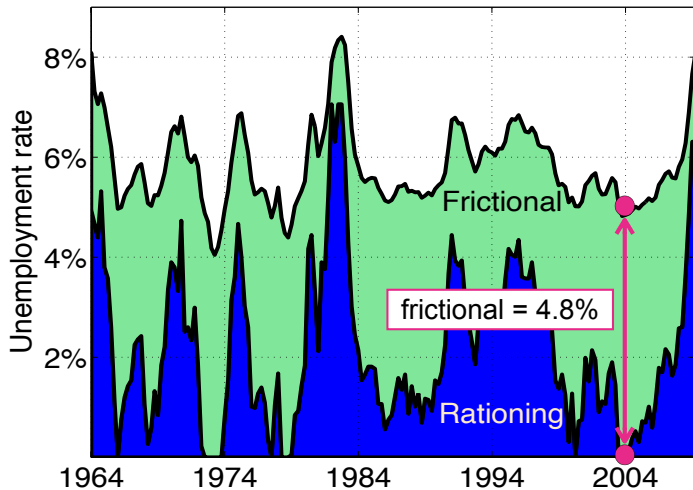
HISTORICAL DECOMPOSITION OF UNEMPLOYMENT

The model is simulated using measured productivity from US data and a shooting algorithm.
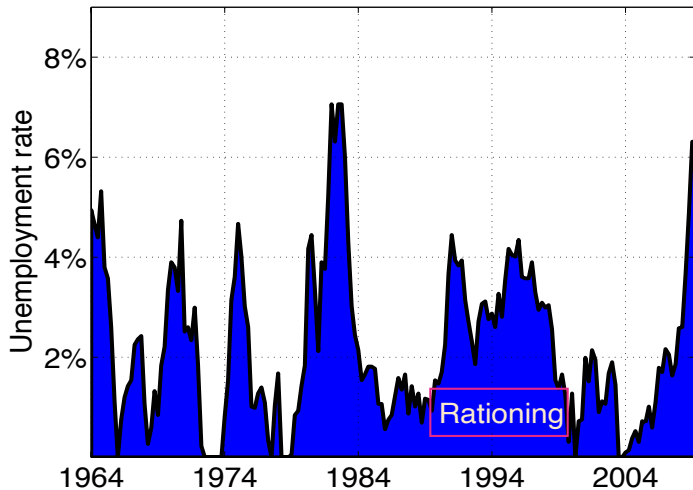
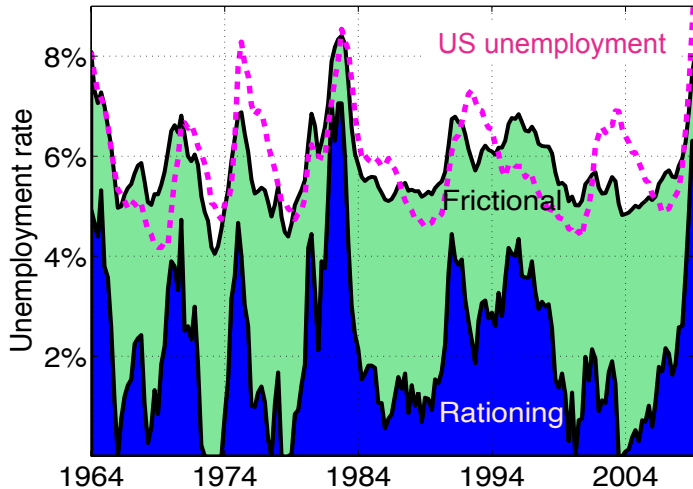# HISTORICAL DECOMPOSITION OF UNEMPLOYMENT

HISTORICAL DECOMPOSITION OF UNEMPLOYMENT
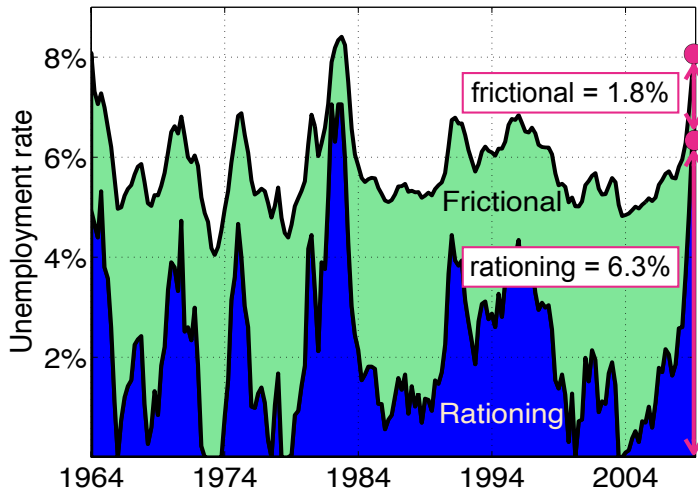
CONCLUSION

SUMMARY

- this paper develops a matching model with job rationing
    - unemployment does not disappear when recruiting costs vanish
- in booms: most of unemployment is frictional
    - there are enough jobs
    - but the matching process and recruiting costs create unemployment

SUMMARY

- in slumps: frictional unemployment is lower and unemployment mostly comes from job rationing
    - there are not enough jobs
    - the matching process and recruiting costs create little additional unemployment
- simulations:
    - as unemployment ↑ from 4.8% to 8.3%
    - rationing unemployment ↑ from 0% to 7%
    - frictional unemployment ↓ from 4.8% to 1.3%

IMPLICATIONS FOR MODELING UNEMPLOYMENT

- the result that frictional unemployment is low in slumps does not mean that the matching framework is inappropriate to describe slumps

- but it means that in slumps, the matching process and recruiting costs create little unemployment

- instead, most unemployment arises from a shortage of jobs—a weak labor demand

IMPLICATIONS FOR POLICY

- in slumps: unemployment comes from job rationing

⤳ to reduce unemployment in slumps, it is necessary to stimulate labor demand

⤳ policies reducing frictional unemployment have limited scope in slumps

   – example #1: creating a placement agency to improve matching

   – example #2: reducing unemployment insurance to stimulate job search

APPLICATION #1: UNEMPLOYMENT INSURANCE

- the model can be combined with a Baily-Chetty model of optimal unemployment insurance (UI)
- this model explains the rat-race effect: higher UI alleviates the rat race for jobs and raises tightness
- policy implication: optimal UI is more generous in slumps than in booms
- see Landais, Michaillat, & Saez [2018]

APPLICATION #2: COUNTERCYCLICAL MULTIPLIERS

- the labor market model can be embedded into a New Keynesian model
- this model explains the countercyclicality of the government multiplier
- the result relies not on the zero lower bound but on the nonlinearity of the labor market
- see Michaillat [2014]

APPLICATION #3: UNEMPLOYMENT FLUCTUATIONS

- the labor market model can be combined to a product market model with a similar structure

- this general-equilibrium model describes how unemployment fluctuations may arise from
    - aggregate demand shocks
    - technology shocks
    - labor supply shocks

- in the US: most unemployment fluctuations come from aggregate demand shocks

- see Michaillat & Saez [2015]