

Session 4: Labor market - unemployment modelling

Karl Walentin

Sveriges Riksbank

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Concluding the heterogeneity part

- Facts: increasing inequality, especially earnings
- Aiyagari/Bewley model
- Treated earnings/wealth inequality
- Many other interesting dimensions remain:
 - jobs (today!)
 - human capital (with dynamics)
- Need for more and better theories/models: Many unanswered questions
 - Understanding main drivers of earnings and wealth inequality
 - ... and what has caused recent increase in inequality

Today's session

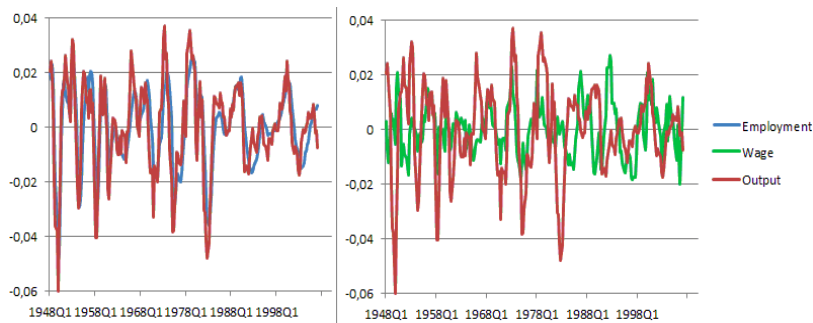
- ① Cyclical facts about labor market and unemployment
- ② Overview of models
- ③ Simple search-and-matching model

- Unemployed people are:
 - 1 out of work
 - 2 available for work
 - 3 looking for work
- Labor force = Employed + Unemployed
- Unemployment rate = $\text{Unemployed} / \text{Labor force}$
- Labor force participation rate = $\text{Labor force} / \text{Population}$
- Employment rate = $\text{Employed} / \text{Population}$

Facts

- Stylized facts (US):

- employment covaries strongly with gdp
- wages less so

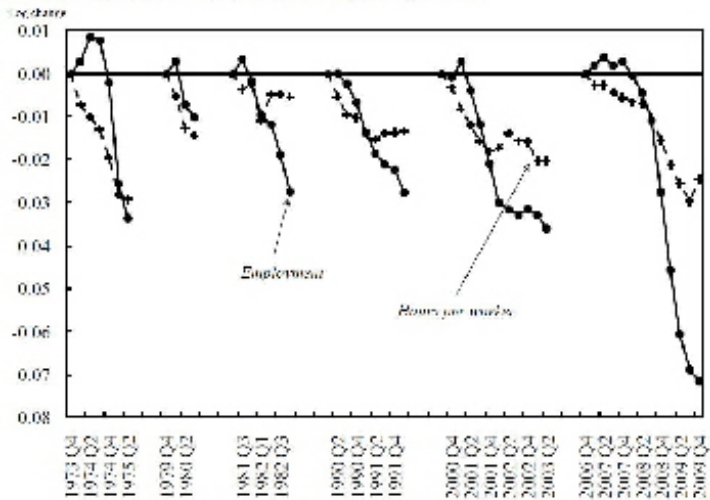


- Correlation between output and employment (wage): 0.82 (0.18)
- Standard deviation of employment (wage) relative to output: 0.86 (0.57)

Cyclical variation: Employment vs. hours per worker

Figure 4. Hours vs. Bodies by Recession, 1973-2009

Cumulative log decline in employment and weekly hours per worker



Source: Bureau of Labor Statistics, Labor Productivity and Costs, employment and weekly hours series

Stylized unemployment facts

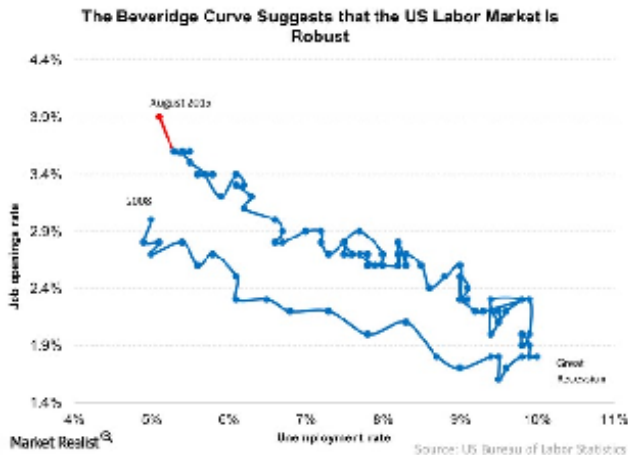
- Extensive margin (employment) explain 2/3 of variation in total hours worked
 - Employment falls later in a recession, but more than hours per worker

Unemployment

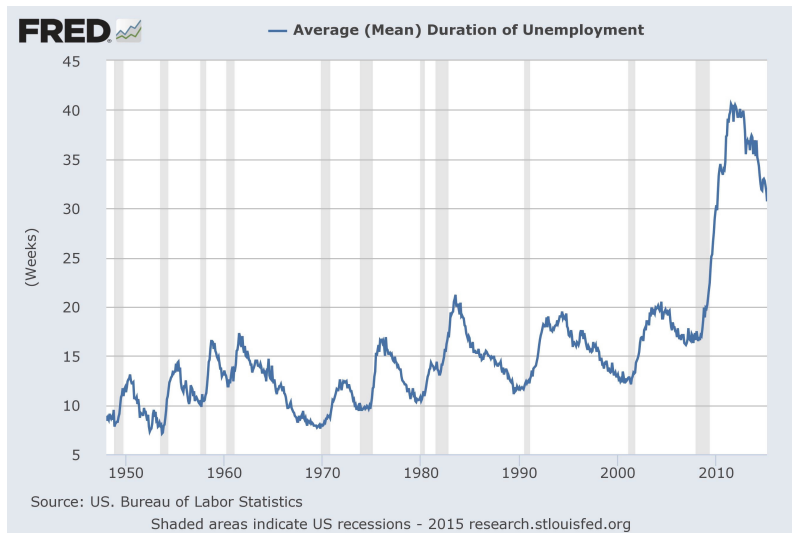


Beveridge curve - relationship between unemployment and vacancies

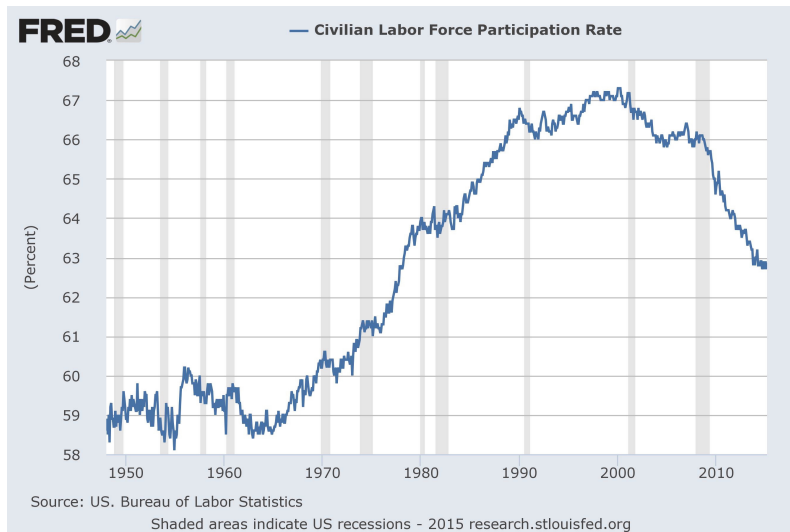
- Unemployment is countercyclical while vacancies procyclical
 - Relationship U vs V is strongly negative: The Beveridge curve:



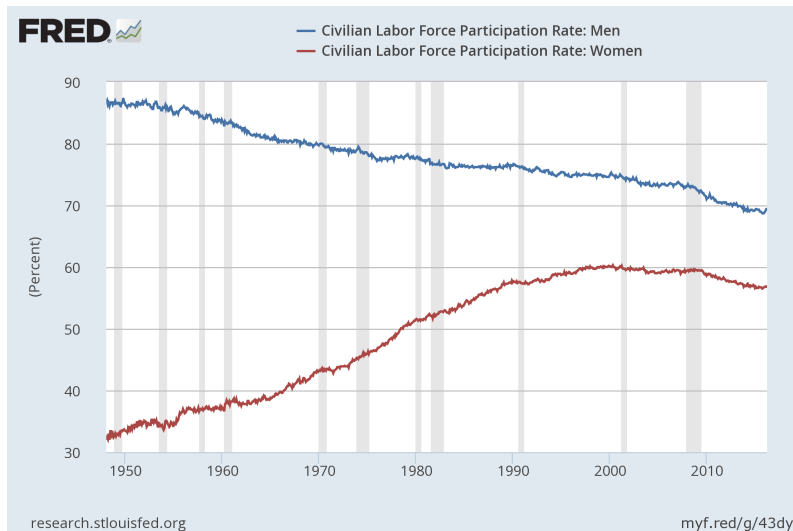
Unemployment duration



Labor force participation



Labor force participation, by gender



Flows are large

US Rates 1951-2006

Unemployment \Rightarrow Employment: 42% per month
“job finding rate”, f

Employment \Rightarrow Unemployment: 2.6% per month
“separation rate”, σ

Employment \Rightarrow Employment: 2.9% month

TABLE 1
SUMMARY STATISTICS, QUARTERLY U.S. DATA

x	u	v	h^{ue}	h^{eu}	h^{ee}	π
$SD(x)/SD(\pi)$	9.56	10.9	5.96	5.48	5.98	1
$Autocorr(x)$	.872	.909	.822	.698	.597	.760
$Corr(\cdot, x)$:						
u	1	-.902	-.916	.778	-.634	-.283
v	...	1	.902	-.778	.607	.423
h^{ue}	...	...	1	-.677	.669	.299
h^{eu}	...	...	...	1	-.301	-.528
h^{ee}	...	...	...	...	1	.208
π	...	...	...	...	...	1

Source: Menzio and Shi (JPE, 2011)

where π denotes output/worker

- Why does the labor market matter for macro?
 - Seemingly important for:
 - 1 Earnings dispersion
 - 2 Business cycles
 - 3 General "economic dynamism"
- Challenges for models
 - Existence of unemployment - seemingly involuntary
 - But why doesn't the labor market clear?
 - Volatility of (un)employment (e.g. Shimer puzzle)

1 Search and Matching

- **random search** (the simple text book case)
- directed search

2 Various theories why wages $>$ market clearing level

- Efficiency wages
- Unions
- Over the cycle: wage rigidities
- ...

Frictional unemployment - search and matching

- Standard search and matching model: A.k.a. Diamond-Mortenssen-Pissarides (DMP) model
- Main strength: Has implications for labor market **flows**
- Can be used to analyze many things:
 - Unemployment
 - Wage dispersion
 - Optimal unemployment benefits
 - Business cycles
 - One way to make employment inertial

Simple (business cycle) search model

- Risk-neutrality (!)
- (ex ante) Homogenous workers
- Homogenous firms
- A match produces output, z_t
- Wages determined by Nash bargaining
 - Flexible wages, re-bargained every period
- Cost of creating a vacancy, c
- Free entry for firms
- Unemployment benefit, b
- Exogenous break-up rate, σ
- Constant labor force participation
- No intensive margin (hours/worker)

Key implication: the centrality of tightness $\theta_t \equiv V_t / U_t$

Assume Cobb-Douglas matching function:

$$M_t = V_t^{1-\lambda} U_t^\lambda, \quad 0 < \lambda < 1$$

Yields

$$\text{job finding probability} : f_t = \frac{M_t}{U_t} = \theta_t^{1-\lambda}$$

$$\text{vacancy filling probability} : q_t = \frac{M_t}{V_t} = \theta_t^{-\lambda}$$

High θ (tight market from employer point of view) \Rightarrow high f and low q

- Ex post (after vacancy cost is sunk), a match represents a surplus
- Need add'l assumption to determine how surplus divided (i.e. wage)
- Most common assumption: Flexible wages and Nash bargaining:
 - $Max_w \Omega = H_t^\varphi J_t^{1-\varphi}$
 - $\Rightarrow H_t = \varphi (H_t + J_t)$
 - Worker bargaining strength φ
- Value to a firm of having an employee:
 - $J_t = z_t - w_t + \beta (1 - \sigma) E_t J_{t+1}$
- Value to worker of being employed (above unemployed)
 - $H_t = w_t - b + \beta [(1 - \sigma) - f(\theta_t)] E_t H_{t+1}$
 - Discuss: Workers outside option is to be unemployed

Job creation - the only active choice

Free entry determines job creation/vacancy posting:

$$c = q(\theta_t) \beta E_t J_{t+1}$$

Stabilizing mechanism: Tight market \Rightarrow low $q \Rightarrow$ fewer vacancies posted

In fact, $E_t J_{t+1}$ fully determines $\theta_t \equiv V_t / U_t$

Flows and stocks

Gross flow into employment: M_t

Gross flow into unemployment: σN_t

$$N_{t+1} = (1 - \sigma) N_t + M_t$$

$$U_{t+1} = 1 - N_{t+1}$$

Steady state (un)employment implies:

$$M = \sigma N$$

$$fU = \sigma N$$

$$f = \sigma \frac{N}{U}$$

- f and σ positively related by factor $\frac{N}{U} \approx 20$ for $U=5\%$
 - $f \approx 20 * \sigma$, $f \gg \sigma$
- Given σ , low U coincide with high f

Cyclicalilty, incl flows (again!)

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Solving the model

Four eq's define the core of the model:

$$\begin{aligned}J_t &= z_t - w_t + \beta (1 - \sigma) E_t J_{t+1} \\H_t &= w_t - b + \beta [(1 - \sigma) - f(\theta_t)] E_t H_{t+1} \\c &= q(\theta_t) \beta E_t J_{t+1} \\H_t &= \varphi(H_t + J_t)\end{aligned}$$

From eq's 1-2 and 4:

$$w_t = \varphi z_t + (1 - \varphi) (b + \beta f(\theta) E_t H_{t+1}),$$

“Algebra fest”

Analytical solution easy in steady state:

$$J = z - w + \beta (1 - \sigma) J$$

$$J = \frac{z - w}{1 - \beta (1 - \sigma)}$$

$$H = w - b + \beta [(1 - \sigma) - f(\theta)] H$$

$$H = \frac{w - b}{1 - \beta [(1 - \sigma) - f(\theta)]}$$

Plugging in for w :

$$J = \frac{z - [\varphi z + (1 - \varphi) (b + \beta f(\theta) H)]}{1 - \beta (1 - \sigma)} = \frac{(1 - \varphi) \{z - b - \beta f(\theta) H\}}{1 - \beta (1 - \sigma)}$$

and

$$H = \frac{[\varphi z + (1 - \varphi) (b + \beta f(\theta) H)] - b}{1 - \beta [(1 - \sigma) - f(\theta)]}$$

....

“Algebra fest” (part II)

Rearranging:

$$\begin{aligned} H \left(1 - \frac{(1-\varphi)\beta f(\theta)}{1-\beta[(1-\sigma)-f(\theta)]} \right) &= \frac{\varphi z + (1-\varphi)b - b}{1-\beta[(1-\sigma)-f(\theta)]} \\ H &= \frac{\frac{\varphi(z-b)}{1-\beta[(1-\sigma)-f(\theta)]}}{1 - \frac{(1-\varphi)\beta f(\theta)}{1-\beta[(1-\sigma)-f(\theta)]}} = \frac{\varphi(z-b)}{1-\beta[(1-\sigma)-f(\theta)] - (1-\varphi)\beta f(\theta)} = \\ &= \frac{\varphi(z-b)}{1-\beta[(1-\sigma)-f(\theta)] - (1-\varphi)\beta f(\theta)} = \frac{\varphi(z-b)}{1-\beta[(1-\sigma)-\varphi f(\theta)]} \end{aligned}$$

Then plug in for H in the expression for J and the resulting J expression in the free-entry condition:

$$c = q(\theta) \beta \frac{(1-\varphi) \left\{ z - b - \beta f(\theta) \frac{\varphi(z-b)}{1-\beta[(1-\sigma)-\varphi f(\theta)]} \right\}}{1-\beta(1-\sigma)}$$

Next steps

- Compute and study dynamics
- Extend model to more business cycle variables
- Endogenous job separation
- Heterogeneity and imperfect unemployment insurance

- Unemployment an important macro phenomenon
- Facts: U is volatile and flows are large
- Worked through prototypical business cycle search and matching model (DMP)