The Dark Corners of the Labor Market

Vincent Sterk (UCL)

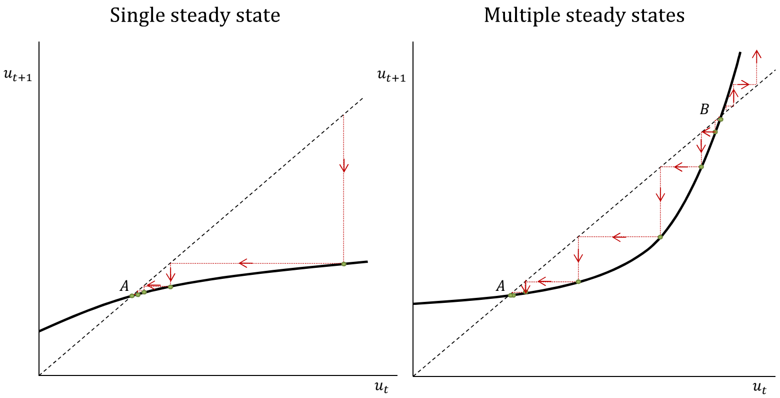
EUI/CEPR/IMF conference on Secular Stagnation, Growth and Real Interest Rates

Florence, June 2015

Dark Corners

The main lesson of the crisis is that we were much closer to those dark corners than we thought—and the corners were even darker than we had thought too. – Olivier Blanchard (2014), in "Where Danger Lurks".

Single vs multiple steady states



Models with multiple steady-state rates of unemployment

Diamond (1982), Blanchard and Summers (1986,1987), Pissarides (1992), Saint-Paul (1992), Rochetau (1999), Den Haan (2007), Ellison, Keller, Roberts and Stevens (2014), Kaplan and Menzio (2014).

This paper

1. Reduced-form model

- Focus on labor market stocks and flows for the United States.

This paper

1. Reduced-form model

- Focus on labor market stocks and flows for the United States.
- Estimate reduced-form model and compute implied steady states.

This paper

1. Reduced-form model

- Focus on labor market stocks and flows for the United States.
- Estimate reduced-form model and compute implied steady states.
- Preview of findings: at least 3 steady states with different unemployment rates:

This paper

1. Reduced-form model

- Focus on labor market stocks and flows for the United States.
- Estimate reduced-form model and compute implied steady states.
- Preview of findings: at least 3 steady states with different unemployment rates:
  - $A : \pm$ **5%** (stable)

This paper

1. Reduced-form model

- Focus on labor market stocks and flows for the United States.
- Estimate reduced-form model and compute implied steady states.
- Preview of findings: at least 3 steady states with different unemployment rates:
  - A : $\pm$ **5%** (stable)
  - B : $\pm$ **10%** (unstable)

This paper

1. Reduced-form model

- Focus on labor market stocks and flows for the United States.
- Estimate reduced-form model and compute implied steady states.
- Preview of findings: at least 3 steady states with different unemployment rates:
  - $A : \pm$ **5%** (stable)
  - $B : \pm$ **10%** (unstable)
  - $C : >$ **10%** (stable)

This paper

2. Search and matching models

- Basic Diamond-Mortensen-Pissarides (DMP) model + extension with skill losses à la Pissarides (1992)

This paper

2. Search and matching models

- Basic Diamond-Mortensen-Pissarides (DMP) model + extension with skill losses à la Pissarides (1992)
- Feed in observed rates of job loss as (only) exogenous shock.

This paper

2. Search and matching models

- Basic Diamond-Mortensen-Pissarides (DMP) model + extension with skill losses à la Pissarides (1992)
- Feed in observed rates of job loss as (only) exogenous shock.
  - ask models to explain job finding rate and unemployment rate.

This paper

2. Search and matching models

- Basic Diamond-Mortensen-Pissarides (DMP) model + extension with skill losses à la Pissarides (1992)
- Feed in observed rates of job loss as (only) exogenous shock.
  - ask models to explain job finding rate and unemployment rate.
- Preview of findings:

This paper

2. Search and matching models

- Basic Diamond-Mortensen-Pissarides (DMP) model + extension with skill losses à la Pissarides (1992)
- Feed in observed rates of job loss as (only) exogenous shock.
  - ask models to explain job finding rate and unemployment rate.
- Preview of findings:
  - basic DMP model fails to explain data by a wide margin.

This paper

2. Search and matching models

- Basic Diamond-Mortensen-Pissarides (DMP) model + extension with skill losses à la Pissarides (1992)
- Feed in observed rates of job loss as (only) exogenous shock.
  - ask models to explain job finding rate and unemployment rate.
- Preview of findings:
  - basic DMP model fails to explain data by a wide margin.
  - extension with quantitatively moderate skill losses generates multiple steady states.

Part 1: reduced-form model

Reduced-form model

$$u_t = \underbrace{\left(1-\rho_{f,t}\right)u_{t-1}}_{\text{previously unemployed}} + \underbrace{\rho_{x,t}\left(1-\rho_{f,t}\right)\left(1-u_{t-1}\right)}_{\text{newly unemployed}}$$

$$\rho_{x,t} = \rho_x\left(\mathcal{S}_t\right)$$

$$\rho_{f,t} = \rho_f\left(\mathcal{S}_t\right)$$

u_t: unemployment rate
$\rho_{f,t}$: job finding rate
$\rho_{x,t}$: job loss rate
$\mathcal{S}_t$: aggregate state

Steady states

Example 1: $\rho_x(\mathcal{S}_t) = \overline{\rho}_x, \qquad \rho_f(\mathcal{S}_t) = \gamma_0 + \gamma_1 u_{t-1}$

$\Longrightarrow$

$$\overline{u} = (1 - \gamma_0 - \gamma_1 \overline{u})\,\overline{u} + \overline{\rho}_x (1 - \gamma_0 - \gamma_1 \overline{u})(1 - \overline{u})$$

quadratic equation, two solutions for $\overline{u}$.

Example 2: $\rho_x(\mathcal{S}_t) = \overline{\rho}_x, \qquad \rho_f(\mathcal{S}_t) = \gamma_0$

$\Longrightarrow$

$$\overline{u} = (1 - \gamma_0)\,\overline{u} + \overline{\rho}_x (1 - \gamma_0)(1 - \overline{u})$$

linear equation, one solution for $\overline{u}$.

Estimating steady states

- Estimate *forecasting* equations:

$$\mathbb{E}_t \rho_{r,t+k} \equiv \mathbb{E}\left[\rho_r\left(\mathcal{S}_{t+k}\right)\middle|\, \mathcal{S}_t\right]$$

for $r = x, f$ and for some forecast horizon $k \geq 1$.

Estimating steady states

- Estimate *forecasting* equations:

$$\mathbb{E}_t \rho_{r,t+k} \equiv \mathbb{E}\left[\rho_r\left(\mathcal{S}_{t+k}\right)\middle|\,\mathcal{S}_t\right]$$

for $r = x, f$ and for some forecast horizon $k \geq 1$.

- Combine estimated equations with transition to compute implied steady state(s).

Estimating steady states

- Estimate *forecasting* equations:

$$\mathbb{E}_t \rho_{r,t+k} \equiv \mathbb{E}\left[\rho_r\left(\mathcal{S}_{t+k}\right) \middle| \mathcal{S}_t\right]$$

  for $r = x, f$ and for some forecast horizon $k \geq 1$.

- Combine estimated equations with transition to compute implied steady state(s).

- Issue: $\mathcal{S}_t$ may not be entirely observable.

Estimating steady states

- Estimate *forecasting* equations:

$$\mathbb{E}_t \rho_{r,t+k} \equiv \mathbb{E}\left[\rho_r\left(\mathcal{S}_{t+k}\right) \middle| \mathcal{S}_t\right]$$

  for $r = x, f$ and for some forecast horizon $k \geq 1$.

- Combine estimated equations with transition to compute implied steady state(s).

- Issue: $\mathcal{S}_t$ may not be entirely observable.
  - Exploit that information in $\mathcal{S}_t$ is implicitly revealed by observed outcomes.

Estimating steady states

- Partition $\mathcal{S}_t = \{\mathbf{s}_{1,t}, \mathbf{s}_{2,t}\}$, where $\mathbf{s}_{1,t}$ contains lags of $\rho_{x,t}$, $\rho_{f,t}$ and u_t. Assume $\mathbf{s}_{2,t}$ contains two additional state variables (may be unobserved).

Estimating steady states

- Partition $\mathcal{S}_t = \{\mathbf{s}_{1,t}, \mathbf{s}_{2,t}\}$, where $\mathbf{s}_{1,t}$ contains lags of $\rho_{x,t}$, $\rho_{f,t}$ and u_t. Assume $\mathbf{s}_{2,t}$ contains two additional state variables (may be unobserved).
- $\mathbf{s}_{2,t}$ uniquely pinned down by observed outcomes $\rho_{f,t} = \rho_f\left(\{\mathbf{s}_{1,t}, \mathbf{s}_{2,t}\}\right)$ and $\rho_{x,t} = \rho_x\left(\{\mathbf{s}_{1,t}, \mathbf{s}_{2,t}\}\right)$ .Forecast becomes:

$$\begin{aligned} \mathbb{E}_t \rho_{r,t+k} &\equiv \mathbb{E}\left[\rho_r\left(\mathcal{S}_{t+k}\right) \middle| \mathcal{S}_t\right], \\ &= \mathbb{E}\left[\rho_r\left(\mathcal{S}_{t+k}\right) \middle| \mathbf{s}_{1,t}, \rho_{f,t}, \rho_{x,t}\right]. \end{aligned}$$

Model specifications

Compare three specifications for job finding rate:

$$\text{(I)}\quad \mathbb{E}_t\rho_{f,t+k} = \gamma_0 + \gamma_1\rho_{x,t} + \gamma_2\rho_{f,t} + \varepsilon_{t+k}$$

$$\text{(II)}\quad \mathbb{E}_t\rho_{f,t+k} = \gamma_0 + \gamma_1\rho_{x,t} + \gamma_2\rho_{f,t} + \gamma_3 u_t + \varepsilon_{t+k}$$

$$\text{(III)}\quad \mathbb{E}_t\rho_{f,t+k} = \gamma_0 + \gamma_1\rho_{x,t} + \gamma_2\rho_{f,t} + \gamma_3 u_t + \gamma_3 u_t^2 + \varepsilon_{t+k}$$

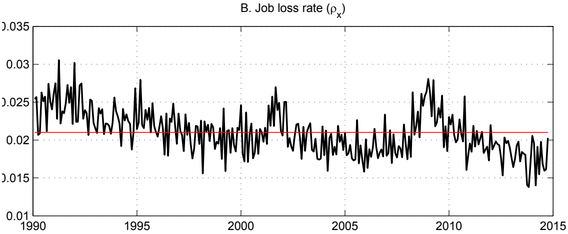
Specify AR(1) process for job loss rate $\rho_{x,t}$.

Data

- Monthly data from February 1990 until November 2014.
- CPS data on unemployment rate and flow rate from U to E (gross-flows).
  - similar results with duration-based flow data
- Construct job loss rate to be consistent with transition identity.
- IV estimator to account for noise in observations, using lagged values as instruments.

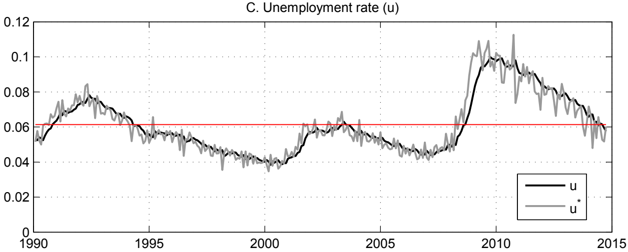
Data

A. Job finding rate (ρ_f)
0.4
0.3
0.2
0.1
0
1990
1995
2000
2005
2010
2015



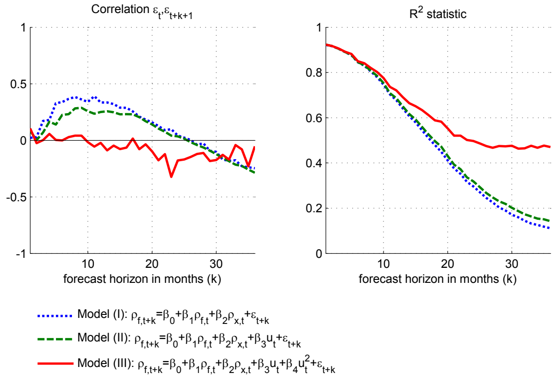
B. Job loss rate (ρ_x)
0.03
0.02
0.01
1990
1995
2000
2005
2010
2015

Data

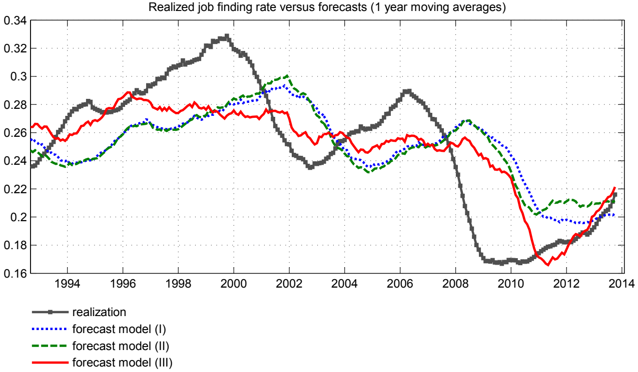


$$u_t^* \equiv \frac{\rho_{x,t}\left(1-\rho_{f,t}\right)}{\rho_{x,t}\left(1-\rho_{f,t}\right)+\rho_{f,t}}$$

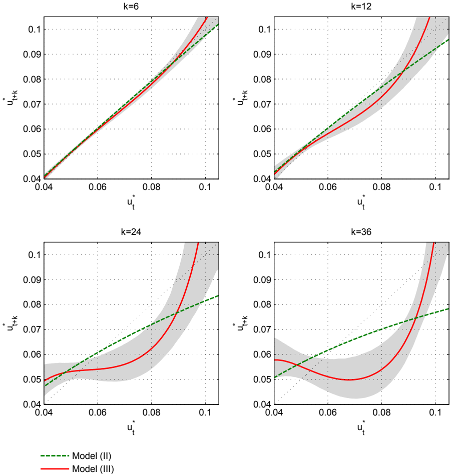
Model diagnostics



Two year ahead forecasts

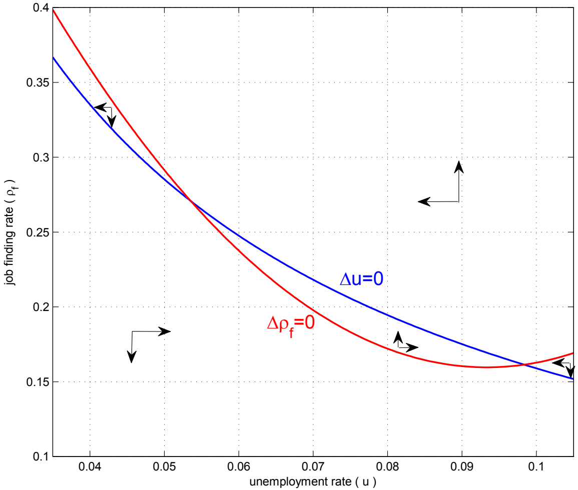


Implied steady states

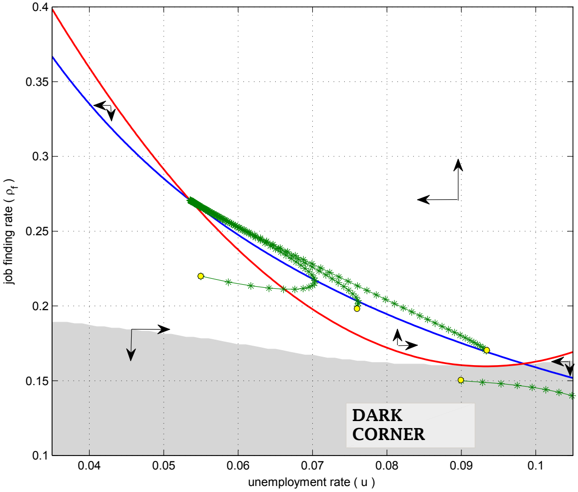


Steady state curve for $\rho^*_{x,t} = \rho_x$. Shaded area's denote 90 percent (bootstrapped) confidence bands.

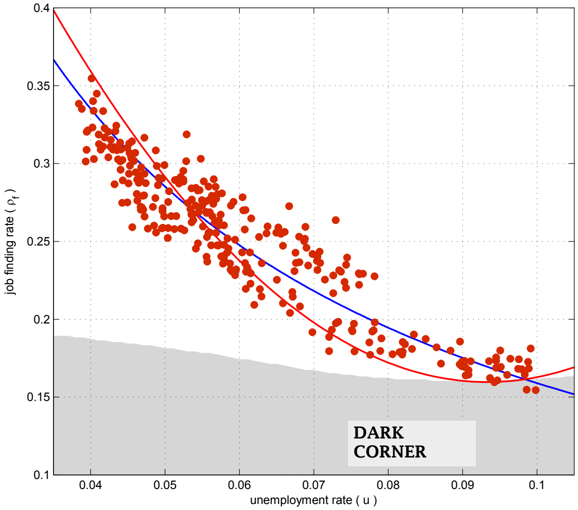
Phase diagram



Phase diagram



Phase diagram



Part 2: search and matching models

Model: general setup

- Random search and matching model in tradition of Diamond, Mortensen and Pissarides.

Model: general setup

- Random search and matching model in tradition of Diamond, Mortensen and Pissarides.
- Economy populated by measure of risk-neutral households who transition between employment and unemployment and who own firms.

Model: general setup

- Random search and matching model in tradition of Diamond, Mortensen and Pissarides.
- Economy populated by measure of risk-neutral households who transition between employment and unemployment and who own firms.
- Unemployment creates a loss of human capital (Pissarides (1992)).

Model: general setup

- Random search and matching model in tradition of Diamond, Mortensen and Pissarides.
- Economy populated by measure of risk-neutral households who transition between employment and unemployment and who own firms.
- Unemployment creates a loss of human capital (Pissarides (1992)).
- Only source of aggregate uncertainty is exogenously varying probability of job loss $\rho_{x,t}$.

Model: timing within period

1. Rate of job loss is revealed and job losses take place.

2. Job losers and previously unemployed workers find a job with an endogenous probability $\rho_{f,t}$. Vacancies ($v_t \geq 0$) are posted at a cost $\kappa > 0$ per unit and filled with an endogenous probability q_t.

3. Production and consumption take place. Employed workers produce $\overline{A}$ units of goods and receive a wage. Unemployed workers receive $b < \overline{A}$ units of goods.

Model: skill losses

- Job losers who immediately find a new job retain their productivity.
- Job losers who become unemployed need to be re-trained upon re-employment, at a cost $\chi \geq 0$ to the employer. Basic DMP model is obtained by setting $\chi = 0$.
- The fraction of job searchers with reduced skills, p_t, is given by:

$$p_t = \frac{u_{t-1}}{u_{t-1} + \rho_{x,t}\left(1 - u_{t-1}\right)}.$$

Vacancy posting (free-entry) condition

$$\underbrace{\frac{\kappa}{q_t} + p_t \chi}_{\text{exp. hiring cost}} = \underbrace{\mathbb{E}_t \sum_{k=0}^{\infty} \beta^t s_{t,t+k} \left(\overline{A} - w_{t+j}\right)}_{\text{exp. present value profits}} + \xi_t$$

where

- $s_{t,t+k} \equiv \prod_{j=1}^{k} (1 - \rho_{x,t+j})$ is the probability that the match survives until period $t + k$
- ξ_t is the Lagrange multiplier on the constraint $v_t \geq 0$.

Labor market

- Matching function:

$$m_t = s_t^{\alpha} v_t^{1-\alpha},$$

where $s_t \equiv u_{t-1} + \rho_{x,t}(1 - u_{t-1})$ is the number of searchers $\Rightarrow \rho_{f,t} = \frac{m_t}{s_t}$ and $q_t = \frac{m_t}{v_t} = \rho_{f,t}^{\frac{\alpha}{\alpha-1}}$.

- Assume firms have all bargaining power $\Rightarrow w_t = \overline{w} = b$ (rigid real wage). Could be relaxed.

Model summary

$$u_t = \left(1 - \rho_{f,t}\right) u_{t-1} + \rho_{x,t} \left(1 - \rho_{f,t}\right) (1 - u_{t-1}) \tag{1}$$

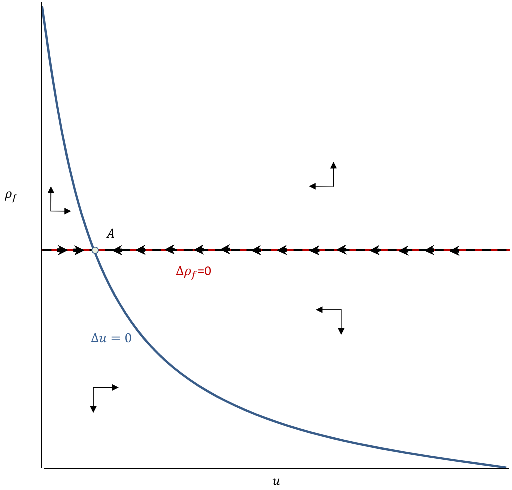
$$p_t = \frac{u_{t-1}}{u_{t-1} + \rho_{x,t} (1 - u_{t-1})} \tag{2}$$

$$\rho_{x,t} = (1 - \lambda_x) \overline{\rho}_x + \lambda_x \rho_{x,t-1} + \varepsilon_{x,t} \tag{3}$$

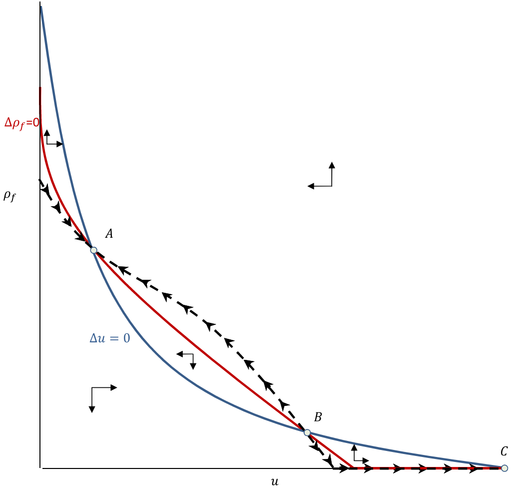
$$\beta \mathbb{E}_t \left(1 - \rho_{x,t+1}\right) (\chi p_{t+1} - \xi_{t+1} + \kappa \rho_{f,t+1}^{\frac{\alpha}{1-\alpha}}) = \chi p_t - \xi_t + \kappa \rho_{f,t}^{\frac{\alpha}{1-\alpha}} - \overline{A} + \overline{w} \tag{4}$$

An equilibrium is characterized by laws of motion for $u_t, \rho_{f,t}, \rho_{f,t}, p_t$ and ξ_t that satisfy the above four equations, and the complementary slackness condition $\rho_{f,t}\xi_t = 0$. The state of the aggregate economy can be summarized as $S_t = \left\{\rho_{x,t}, u_{t-1}\right\}$.

Phase diagram: no skill losses



Phase diagram: skill losses



Parameter values

- Model period: 1 month
- Steady-state targets:

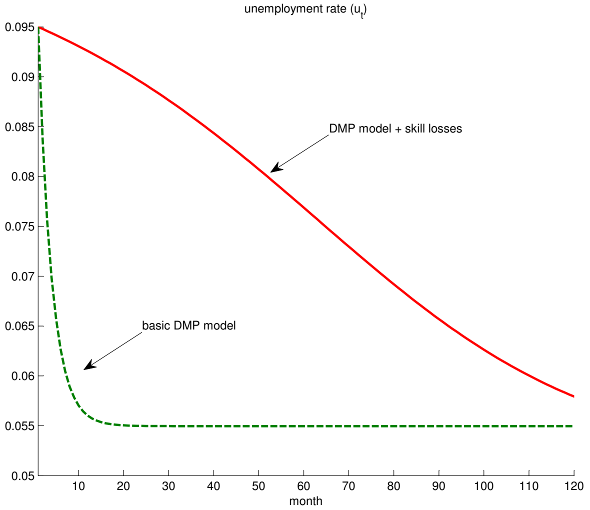
target	**no skill losses**	**skill losses**
$\overline{u}^A$	0.055	0.055
$\overline{u}^B$	—	0.095

Parameter values

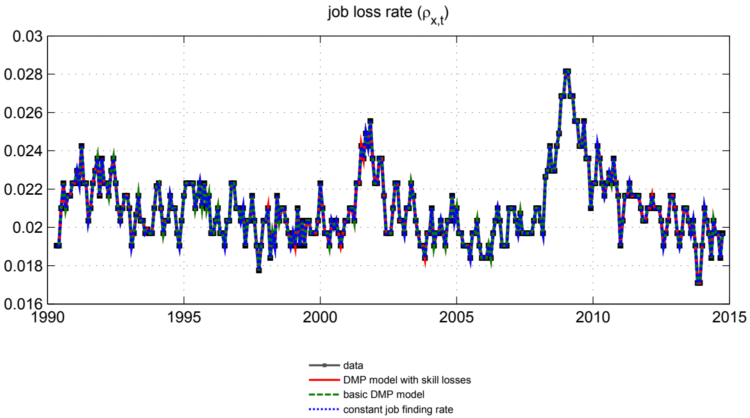
parameter	description	no skill losses	skill losses
β	discount factor	$1.04^{-\frac{1}{12}}$	$1.04^{-\frac{1}{12}}$
α	matching function elast.	0.6	0.6
κ	vacancy cost	0.989	0.989
$\overline{A}$	worker productivity	1	1
$\overline{\rho}_x$	s.s. job loss rate	0.021	0.021
λ_x	persistence job loss rate shocks	0.896	0.896
$\overline{\sigma}_x$	s.t. deviation job loss shocks	$7.91e^{-4}$	$7.91e^{-4}$
χ	re-training cost	0	0.688
b	flow from unemployment	0.997	0.985

Propagation

deterministic simulation

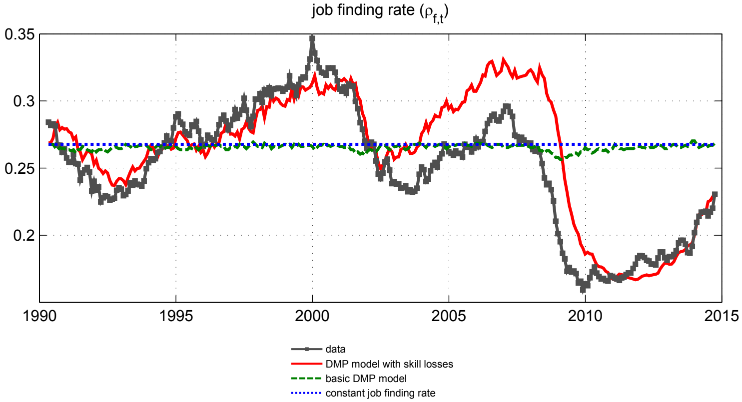


Simulation



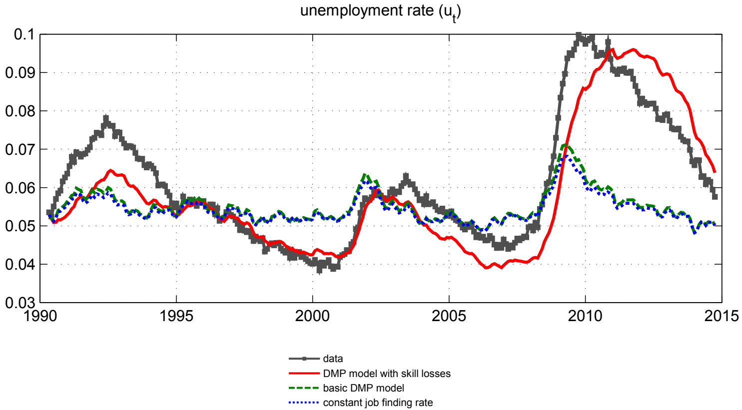
job loss rate ($\rho_{x,t}$)
0.03
0.028
0.026
0.024
0.022
0.02
0.018
0.016
1990
1995
2000
2005
2010
2015
data
DMP model with skill losses
basic DMP model
constant job finding rate

Simulation



job finding rate ($\rho_{f,t}$)
0.35
0.3
0.25
0.2
1990
1995
2000
2005
2010
2015
data
DMP model with skill losses
basic DMP model
constant job finding rate

Simulation


unemployment rate (u_t)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
1990
1995
2000
2005
2010
2015
data
DMP model with skill losses
basic DMP model
constant job finding rate

Conclusion

- Multiple-steady state model provides superior description of data.
- Threshold at around 10% unemployment.
- Possibly large and non-linear policy implications.

Appendix: firm decision problem

Large firms with constant returns-to-scale technologies decide on number of vacancies (v_t), hires (h_t) and employment (n_t). Decision problem:

$$V(n_{t-1}, \mathcal{S}_t) = \max_{h_t, n_t, v_t} \left(\overline{A} - w_t\right) n_t - \left((\chi - d_t) \, p_t + \frac{\kappa}{q_t} \right) h_t$$
$$+ \beta \mathbb{E}_t V(n_t, \mathcal{S}_{t+1}),$$

subject to

$$n_t = \left(1 - \rho_{x,t}\right) n_{t-1} + h_t,$$
$$h_t = q_t v_t,$$
$$h_t \geq 0,$$

where w_t is the wage and d_t is a possible wage deduction for newly hired workers with reduced skills.