A Life-Cycle Model of
Trans-Atlantic Employment Experiences

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Stockholm School of Economics and New York University

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New York University and Hoover Institution
Extension of turbulence theory by Ljungqvist and Sargent (1998)

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*age-dependent increases in autocovariances of income shocks*

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Now we discover Moffitt and Gottschalk (1995) age-dependent increases in autocovariances of income shocks

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<thead>
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<tbody>
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<td>[ h_{t+1} = h_t + A_i(h_t, t)^{0.8} ]</td>
</tr>
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Source: OECD via Shimer

Benefit dependency rates

<table>
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<tr>
<th></th>
<th>1980</th>
<th>1990</th>
<th>1999</th>
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<tbody>
<tr>
<td>France</td>
<td>13.9</td>
<td>20.2</td>
<td>24.2</td>
</tr>
<tr>
<td>Germany</td>
<td>15.2</td>
<td>18.1</td>
<td>22.4</td>
</tr>
<tr>
<td>United States</td>
<td>16.8</td>
<td>15.6</td>
<td>13.7</td>
</tr>
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</table>

Source: OECD Employment Outlook 2003
Source: OECD via Shimer

1970

2004

Tranquil times

Turbulent times
OLG search-island model with indivisible labor

**Ex ante heterogeneity:** 2 types (L and H) distinguished by parameters of

- McCall productivity distribution in a phase of ‘inexperience’ (high job destruction probability)
- Ben-Porath human capital technology in a phase of ‘experience’ (lower job destruction probability)

**Ex post heterogeneity:**

- Time to become experienced
- Job search luck
- Job destruction luck
- i.i.d. earnings shocks
- Human capital investments
- … and depreciation at job destructions (‘turbulence’)
- Financial savings

**Government**

- Labor and capital taxes
- Layoff tax
- UI benefits
- Social security
- (Minimum wage)

**Ways to smooth consumption:**

- Trade a risk-free asset
- Invest in human capital
- Career planning
- Social safety net (UI)
- Social security

**Mandatory retirement**

$T^*$, $T$
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Agents  2 types;  \( i = L, H \)  [ low type (high school) ,  high type (college) ]

Preferences  \[
E_0 \sum_{t=0}^{T} \beta^t [\log c_t - B_t]
\]

- \( B_t = B \)  employed (indivisible labor)
- \( B_t = B^u(s_t) \)  unemployed (search intensity \( s_t \))
- \( B_t = 0 \)  inactive (incl. retirement)
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Career path working age 20-65, mandatory retirement 66-90 \{ survival prob. \( m_t \} \)

(1) ‘Inexperienced’:

\[ \text{transition probability } \pi \]

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(1) ‘Inexperienced’: for each employment spell, efficiency units are drawn from \( G_i(n) \)

\[ \text{transition probability } \pi \]

(2) ‘Experienced’: efficiency units \( h_t(1 - l_t) \), \{ human capital \( h_t \), investment \( l_t \in [0, 1] \) \}

Ben-Porath technology \( h_{t+1} = h_t + A_i(h_t l_t)^\nu \) (no depreciation)

convert into bimonthly transition probabilities \( H_i^n(h, h'; l) \)
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Turbulence  
transition probability at an exogenous job termination  
\( H^\lambda_i(h', h'') \)
Firms  each firm creates a single job

Production function  \[ F(z, k, n) = z k^\alpha n^{1-\alpha} \]

\( z \)  job-specific productivity level  Markov transition kernel  \( Z(z, z') \)

\( k \)  physical capital (depreciation rate  \( \delta \))

\( \mu \)  cost of creating a new job (with productivity level  \( z_{\text{initial}} \))
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Search-island model (Alvarez and Veracierto, 2001)

- \( B^u(s_t) \) disutility of search
- \( S(s_t) \) prob. of finding labor market next period

- workers and firms are randomly matched each period
- after observing worker, firm hires profit-maximizing capital
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Endogenous and exogenous separations:

- \( q \): prob. firm destroys job endogenously
- \( \lambda \): exogenous destruction
- \( \tilde{\lambda} - \lambda \): additional exog. breakups for inexperienced
### Value functions

<table>
<thead>
<tr>
<th>Value function</th>
<th>phase of life</th>
<th>decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tilde{V}_i^u(a, \gamma, d, t)$</td>
<td>inexperienced, unemployed</td>
<td>$c, a', s$</td>
</tr>
<tr>
<td>$\tilde{V}_i^n(a, n, t)$</td>
<td>inexperienced, employed</td>
<td>$c, a'$</td>
</tr>
<tr>
<td>$V_i^u(a, h, \gamma, d, t)$</td>
<td>experienced, unemployed</td>
<td>$c, a', s$</td>
</tr>
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<td>experienced, employed</td>
<td>$c, a', l$</td>
</tr>
<tr>
<td>$V(a, t)$</td>
<td>old, retired</td>
<td>$c, a'$</td>
</tr>
<tr>
<td>$V^f(z)$</td>
<td>firm</td>
<td>{stay, exit}, $k$</td>
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<td>$a$</td>
<td>assets</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>UI benefits</td>
</tr>
<tr>
<td>$d$</td>
<td>elapsed duration</td>
</tr>
<tr>
<td>$t$</td>
<td>age</td>
</tr>
<tr>
<td>$n$</td>
<td>inexperienced efficiency units</td>
</tr>
<tr>
<td>$h$</td>
<td>human capital</td>
</tr>
<tr>
<td>$i$</td>
<td>skill type</td>
</tr>
<tr>
<td>$c$</td>
<td>consumption</td>
</tr>
<tr>
<td>$s$</td>
<td>search intensity</td>
</tr>
<tr>
<td>$l$</td>
<td>investment in skills</td>
</tr>
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Parameters set outside the model

(a) government policies (public expenditures clear the government b.c.)
(b) aggregate production technology
(c) real interest rate, 4% (do not model top 5% of the population)
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(public expenditures clear the government b.c.)

(b) aggregate production technology

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### Parameters estimated/calibrated within the model to U.S. data

1. Subjective discount factor  
2. Ben-Porath technology  
3. Search technology  
4. Idiosyncratic firm productivity  
5. Disutility of work

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<th>Parameter</th>
<th>Implications</th>
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<td>Earnings profiles (college and non-college)</td>
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<td>Average unemployment duration</td>
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<td>and ‘equilibrium response’ to layoff taxes</td>
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<td>Cross-time and cross-continent unemployment</td>
<td>and permanent earnings volatility</td>
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- Fraction of wealth held by 95% of population
- Earnings profiles (college and non-college)
- Average unemployment duration
- Average number of jobs held over a lifetime and ‘equilibrium response’ to layoff taxes
- Cross-time and cross-continent unemployment and permanent earnings volatility

Check auxiliary implications

(i) life-cycle profiles of asset holdings and consumption
(ii) unemployment duration and long-term unemployment by age group
(iii) autocorrelations of individual earnings at different lag orders and by age group
<table>
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<tbody>
<tr>
<td>$\Gamma(e)$</td>
<td>UI, last labor earnings $e$</td>
</tr>
<tr>
<td>$d_{\text{max}}$</td>
<td>UI duration</td>
</tr>
<tr>
<td>$\Omega$</td>
<td>job destruction tax</td>
</tr>
<tr>
<td>$e_{\text{min}}$</td>
<td>minimum wage</td>
</tr>
<tr>
<td>$\tau_n$</td>
<td>labor tax rate</td>
</tr>
<tr>
<td>$\tau_p$</td>
<td>social security tax rate</td>
</tr>
<tr>
<td>$\tau_k$</td>
<td>capital tax rate</td>
</tr>
<tr>
<td>$\hat{c}$</td>
<td>retirement benefit</td>
</tr>
<tr>
<td>$X$</td>
<td>public consumption</td>
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</tbody>
</table>
### OECD Economic Studies (1996):
Net unemployment benefit replacement rates in 1994 for single-earner households, in percent

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<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>France</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>first year</td>
<td>34 (38)</td>
<td>79 (80)</td>
<td>66 (74)</td>
</tr>
<tr>
<td>second and third year</td>
<td>9 (14)</td>
<td>63 (62)</td>
<td>63 (72)</td>
</tr>
<tr>
<td>fourth and fifth year</td>
<td>9 (14)</td>
<td>61 (60)</td>
<td>63 (72)</td>
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<tr>
<td>without (with) dependent spouse</td>
<td></td>
<td></td>
<td></td>
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### Symbols and Definitions
- $\Gamma(e)$: UI, last labor earnings $e$
- $d_{\text{max}}$: UI duration
- $\Omega$: job destruction tax
- $e_{\text{min}}$: minimum wage
- $\tau_n$: labor tax rate
- $\tau_p$: social security tax rate
- $\tau_k$: capital tax rate
- $\hat{\epsilon}$: retirement benefit
- $X$: public consumption

- **U.S.**
  - 60% replacement rate
  - 6 months

- **Europe**
  - unlimited duration
Hunt (J. of Labor Economics, 1995):

German unemployment benefits in 1983
First 12 months ‘Arbeitslosengeld’ 68% replacement rate
Thereafter, ‘Arbeitslosenhilfe’ 58% replacement rate
unlimited duration, means tested
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<th>Europe</th>
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<tr>
<td>$\Omega$</td>
<td>job destruction tax</td>
<td>0</td>
<td>3 months of low-type earnings</td>
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<tr>
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<td>minimum wage</td>
<td>no</td>
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<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>$\tau_k$</td>
<td>capital tax rate</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>$\hat{e}$</td>
<td>retirement benefit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X$</td>
<td>public consumption</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Tax on labor income: U.S. 28% France 46% Germany 41%
| \( \Gamma(e) \) | UI, last labor earnings \( e \) |
| \( d_{\text{max}} \) | UI duration |
| \( \Omega \) | job destruction tax |
| \( e_{\text{min}} \) | minimum wage |
| \( \tau_n \) | labor tax rate |
| \( \tau_p \) | social security tax rate |
| \( \tau_k \) | capital tax rate |
| \( \hat{e} \) | retirement benefit |
| \( X \) | public consumption |

<table>
<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 % replacement rate</td>
<td>60 %</td>
<td>unlimited duration</td>
</tr>
<tr>
<td>6 months</td>
<td>3 months</td>
<td>3 months of low-type earnings</td>
</tr>
<tr>
<td>no</td>
<td>yes, in turbulent times</td>
<td></td>
</tr>
<tr>
<td>15%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>15%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Based on replacement rate of average earnings</td>
<td>40%</td>
<td>50%</td>
</tr>
</tbody>
</table>

OECD study (2006):

<table>
<thead>
<tr>
<th>Gross replacement rate of average earnings</th>
<th>U.S.</th>
<th>France</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.6%</td>
<td>52.9%</td>
<td>45.8%</td>
<td></td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td><strong>U.S.</strong></td>
<td><strong>Europe</strong></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>$\Gamma(e)$</td>
<td>UI, last labor earnings $e$</td>
<td>60% replacement rate</td>
<td></td>
</tr>
<tr>
<td>$d_{\text{max}}$</td>
<td>UI duration</td>
<td>6 months</td>
<td></td>
</tr>
<tr>
<td>$\Omega$</td>
<td>job destruction tax</td>
<td>unlimited duration</td>
<td></td>
</tr>
<tr>
<td>$e_{\text{min}}$</td>
<td>minimum wage</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$\tau_n$</td>
<td>labor tax rate</td>
<td>3 months of low-type earnings</td>
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<td>$X$</td>
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<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

Based on replacement rate of average earnings:

- **U.S.**: 40%
- **Europe**: 50%

OECD study (2006):

- **Gross replacement rate**
  - U.S.: 38.6%
  - France: 52.9%
  - Germany: 45.8%

**Residual**
Ben-Porath technology

Target:
U.S. Census 2006
non-college and college graduates

Model:
Experienced workers \( h' = h + A_i(h)\nu \)
with type-specific \( A_i, \ h_{o,i} \)

Inexperienced workers \( G_i(n) \)
normal dist. on \([0, \ \rho h_{o,i}]\)

Earnings profile
(in $10,000 dollars)

Solid line – model
Dashed line – data
Subjective discount factor

Fraction of wealth held by 95% of population
Subjective discount factor

Fraction of wealth held by 95% of population

\[ \beta = 0.981 \]
Predictions versus data:
SCF (Survey of Consumer Finance) in 2004, excluding the 5% wealthiest

Gourinchas and Parker (2002):
“Young consumers behave as buffer-stock agents
Around age 40, the typical household starts accumulating liquid assets for retirement…”
Predictions versus data:
SCF (Survey of Consumer Finance) in 2004, excluding the 5% wealthiest

Gourinchas and Parker (2002):
“Young consumers behave as buffer-stock agents. Around age 40, the typical household starts accumulating liquid assets for retirement…”

Key parameters: \( \beta = 0.981 \)
and survival probabilities \( \{m_t\} \)
[source: Social Security Adm.]

Gourinchas and Parker (2002):
“…the profiles are very sensitive to small variations in the discount factor”
**Job tenures of inexperienced and experienced workers**

**Observations**

Hall (AER, 1982):
“by age 24, the average worker has held four jobs out of the ten he or she will hold in an entire career.”

Davis and Haltiwanger (NBER Macro, 1990):
“March-to-March establishment-level employment changes, we calculate that manufacturing’s rates of … destruction averaged 11.3% per year … quarter-to-quarter rates are larger yet … 5.62% on a quarterly basis.”

**Calibration outcomes**

Average number of jobs held

... annual job destruction rate for experienced worker in the U.S. model economy is 14.4%
Productivity process of firms

The productivity will remain the same at $z$ with probability $1-p_z$. With probability $p_z$, the new productivity is a random draw from a normal distribution having mean $0.5$ and standard deviation $\sigma_z$ that has been truncated to the unit interval $[0, 1]$. 

Parameters that attain U.S. job turnover data
Productivity process of firms

The productivity will remain the same at \( z \) with probability \( 1 - p_z \). With probability \( p_z \), the new productivity is a random draw from a normal distribution having mean 0.5 and standard deviation \( \sigma_z \) that has been truncated to the unit interval \([0, 1]\).

Parameters that suppress European unemployment in tranquil times by 1.5 percentage points, given the above layoff tax (months of low-type’s average earnings)
Tranquil times: Layoff tax suppresses European unemployment
Skill loss upon exogenous job destruction:

<table>
<thead>
<tr>
<th>Tranquil times</th>
<th>Turbulent times</th>
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<tbody>
<tr>
<td>none</td>
<td>governed by transition probability $H_i^x(h', h'')$</td>
</tr>
</tbody>
</table>

A worker with skill level $h'$ whose job is exogenously terminated, her new skill level $h''$ is distributed as...
Tranquil times | Turbulent times

Skill loss upon exogenous job destruction:

- None
- Governed by transition probability $H_i^*(h', h'')$

A worker with skill level $h'$ whose job is exogenously terminated, her new skill level $h''$ is distributed as

More turbulence
| Skill loss upon exogenous job destruction: | none | governed by transition probability $H_i^\lambda (h', h'')$
| Europe-specific labor market institutions: | layoff tax and unlimited duration of benefits | same as before and a minimum wage

A worker with skill level $h'$ whose job is exogenously terminated, her new skill level $h''$ is distributed as

More turbulence
European unemployment by type: turbulence and minimum wage

Tranquil times
European unemployment by type: turbulence and minimum wage

Turbulent times without a minimum wage
European unemployment by type: turbulence and minimum wage

Turbulent times with a minimum wage

Age
Turbulent times: U.S. earnings volatility and European unemployment 10%

Distribution of permanent earnings

Distribution of transitory earnings

Data
Turbulent times: U.S. earnings volatility and European unemployment 10%

Data

Distribution of permanent earnings

- 1970–78
- 1979–87

Distribution of transitory earnings

- 1970–78
- 1979–87

Model (high-type workers)
Turbulent times: U.S. earnings volatility and European unemployment 10%

Distribution of permanent earnings

Data

B = 0.22
**Turbulent times:** U.S. earnings volatility and European unemployment 10%

**Distribution of permanent earnings**

Data

![Bar chart showing distribution of permanent earnings with two periods, 1970–78 and 1979–87.]

**Mean of log annual earnings**

- **B = 0.22**

![Bar chart showing distribution of permanent earnings with two periods, 1970–78 and 1979–87.]

**Mean of log annual earnings**

- **B = 0.30**

- Graphs depict the distribution of earnings volatility with data points indicating the mean of log annual earnings.
Turbulent times: U.S. earnings volatility and European unemployment 10%

Distribution of permanent earnings

Data

Distribution of transitory earnings

B = 0.22

B = 0.15

B = 0.30
6. Disutility of work

Gottschalk and Moffitt (1994): All workers
- 41%
  - Years of education fewer than 12: 55%
  - 12 or more: 34%

European unemployment
- in turbulent times
- exceeds calibration target in tranquil times
6. Disutility of work

Gottschalk and Moffitt (1994): All workers: 41%
Years of education:
- fewer than 12: 55%
- 12 or more: 34%

European unemployment exceeds calibration target in tranquil times.

European unemployment in turbulent times.

The graph depicts the disutility of work with varying levels of educational attainment and their corresponding changes in permanent earnings. The diagram highlights the percentage changes in variance for different levels of education.
6. Disutility of work

Gottschalk and Moffitt (1994): All workers: 41%
- Years of education fewer than 12: 55%
- 12 or more: 34%

European unemployment exceeds calibration target in tranquil times.
6. Disutility of work

European unemployment exceeds calibration target in tranquil times

European unemployment in turbulent times

Average loss of skills (%) vs. disutility B

0  0.05  0.1  0.15  0.2  0.25  0.3  0.35

0  20  40  60  80  100

Percent change in variance of permanent earnings

Gottschalk and Moffitt (1994):

<table>
<thead>
<tr>
<th>Years of education</th>
<th>Percent change in variance of permanent earnings</th>
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</thead>
<tbody>
<tr>
<td>fewer than 12</td>
<td>55%</td>
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<tr>
<td>12 or more</td>
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All workers: 41%
Unemployment in Europe and in the U.S.

Unemployment (percent)

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<tr>
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<th>U.S.</th>
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<tbody>
<tr>
<td></td>
<td>Tranquil</td>
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</tr>
<tr>
<td>Low type</td>
<td>3.93</td>
<td>11.73</td>
</tr>
<tr>
<td>High type</td>
<td>3.83</td>
<td>5.91</td>
</tr>
<tr>
<td>All</td>
<td>3.90</td>
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</table>
Unemployment in Europe and in the U.S.

Flow rates into and out of unemployment (in bi-monthly model frequency)

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<tr>
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<tr>
<td></td>
<td>Tranquil</td>
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<tr>
<td>Inflow rate</td>
<td>2.16</td>
<td>2.22</td>
</tr>
<tr>
<td>Outflow rate</td>
<td>62.85</td>
<td>23.24</td>
</tr>
</tbody>
</table>
Unemployment in Europe and in the U.S.

Europeans by age groups

<table>
<thead>
<tr>
<th>Age</th>
<th>Unempl. duration (months)</th>
<th>Long-term unempl. (percent of unempl.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tranquil</td>
<td>Turbulent</td>
</tr>
<tr>
<td>20-29</td>
<td>3.29</td>
<td>7.51</td>
</tr>
<tr>
<td>30-39</td>
<td>3.17</td>
<td>6.20</td>
</tr>
<tr>
<td>40-49</td>
<td>3.01</td>
<td>7.58</td>
</tr>
<tr>
<td>50-59</td>
<td>2.99</td>
<td>17.34</td>
</tr>
<tr>
<td>60+</td>
<td>3.35</td>
<td>26.36</td>
</tr>
<tr>
<td>All</td>
<td>3.21</td>
<td>12.93</td>
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Unemployment (percent)

<table>
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Search intensity of low-type workers in Europe in tranquil times

Optimal search intensity of the average low-type worker in Europe in tranquil times, as a function of age and ‘human capital loss’. The agent is assumed to hold the average wealth level and to be entitled to benefits based on average earnings in her age group. The search intensity is plotted for different levels of human capital below the average level in her age group, where the difference between these numbers is interpreted as her ‘human capital loss’. The solid (dashed) line is the contour curve for full (zero) search intensity.
Search intensity of high-type workers in Europe in tranquil times
High-type workers loss of earnings relative to the age-earnings profile, after an ‘earnings shock’ of 10%, in the U.S.
High-type workers loss of earnings relative to the age-earnings profile, after an ‘earnings shock’ of 10%, in the U.S.

Moffitt & Gottschalk (1995): Over the 1970s and 1980s, “an increase in covariances … larger for the older age groups and for the low-order covariances”

<table>
<thead>
<tr>
<th>Lag order</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>5.4</td>
<td>25.3</td>
<td>54.1</td>
</tr>
<tr>
<td>5-9</td>
<td>2.6</td>
<td>15.0</td>
<td>39.4</td>
</tr>
<tr>
<td>10-15</td>
<td>3.0</td>
<td>5.3</td>
<td>23.4</td>
</tr>
</tbody>
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Moffitt & Gottschalk (1995):
Over the 1970s and 1980s, “an increase in covariances ... larger for the older age groups and for the low-order covariances”
Connections to Ljungqvist and Sargent’s earlier inquiries

Turbulence and generous European benefits (JPE 1998)
- Turbulence increases European unemployment
- … but leaves U.S. unemployment unchanged.

European layoff costs / stochastic aging (ECMA 2008)
- In tranquil times, European unemp. below that of the U.S.
- In turbulent times, older Europeans suffer long-term unemp.
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This paper

- OLG Bewley growth model
- Ben-Porath human capital technology
- Ex ante heterogeneity (high school / college)

- earlier findings carry over to and are consistent with research on aggregate growth models, life-cycle dynamics and job creation/destruction
- European minimum wage causes youth unemployment
- Low-type workers are more prone to shorten careers
- Endogenous age-dependent earnings persistence (Moffitt and Gottschalk, working paper 1995)
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Framework robustness
- Yes, matching and search-island (JME 2007a)
- No, employment-lottery rep. family (JME 2007b)
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<th>Connections to Ljungqvist and Sargent’s earlier inquiries</th>
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<tr>
<td>This paper OLG Bewley growth model</td>
<td>Probing the “tax story” for European unemployment</td>
</tr>
<tr>
<td>Ben-Porath human capital technology</td>
<td>➢ Complete markets and employment lotteries are not necessary. Given indivisible labor, an agent can instead vary length of labor market career (‘time averaging’) and save for consumption (NBER Macro Annual 2006)</td>
</tr>
<tr>
<td>Ex ante heterogeneity (high school / college)</td>
<td>➢ …. social security can put careers at a corner solution</td>
</tr>
<tr>
<td>➢ earlier findings carry over to and are consistent with research on aggregate growth models, life-cycle dynamics and job creation/destruction</td>
<td>➢ …. permanent neg. earnings shocks can shorten careers</td>
</tr>
<tr>
<td>➢ European minimum wage causes youth unemployment</td>
<td>➢ …. agents with “steeper” earnings profiles choose longer careers (RED 2014)</td>
</tr>
<tr>
<td>➢ Low-type workers are more prone to shorten careers</td>
<td></td>
</tr>
<tr>
<td>➢ Endogenous age-dependent earnings persistence (Moffitt and Gottschalk, working paper 1995)</td>
<td></td>
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</tbody>
</table>
Workers supply labor $\hat{n}$ and invest in human capital

Firms with productivity $z$ demand labor

Earnings shock $\theta$

Realization of stochastic events

Human capital invest. outcome

$H_i^n(h, \bar{h}; \ell)$

Human capital loss

$H_i^\lambda(h, h')$

Firm productivity

$Z(z, z')$

Continuing employed inexperienced workers become experienced with prob. $\pi$

Workers quit voluntarily (but no jobs are destroyed)

Workers consume and make decisions for next period

Firms rent capital and produce $F(z, k, \theta \hat{n})$

Exogenous job destruction rate $\lambda$

(the same fraction of workers must leave the labor market)

Additional forced layoffs of inexperienced workers at rate $\lambda - \tilde{\lambda}$

(but no jobs are destroyed)

Endogenous job destruction by firms at rate $q$

(the same fraction of workers must leave the labor market)