A Life-Cycle Model of Trans-Atlantic Employment Experiences

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Lars Ljungqvist

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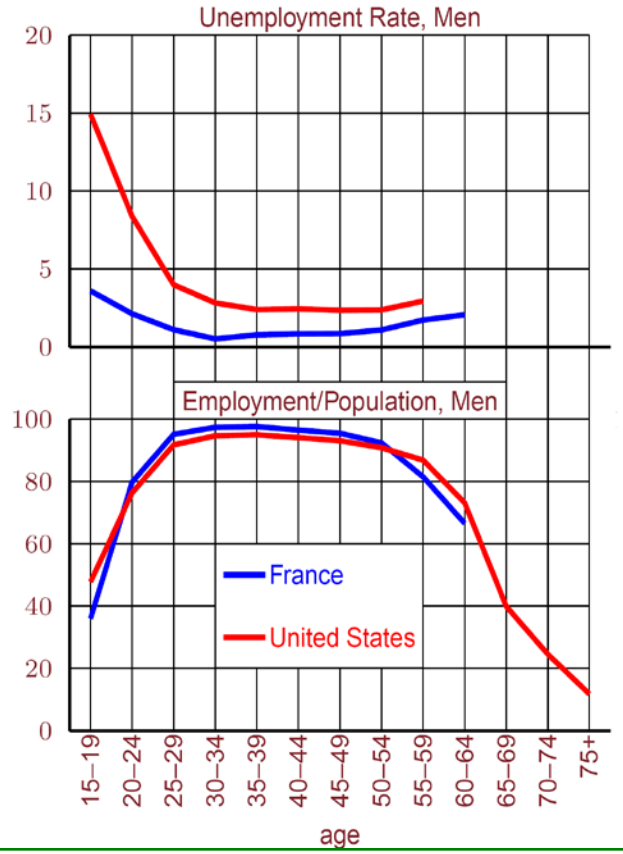
Thomas J. Sargent

New York University and Hoover Institution

1970



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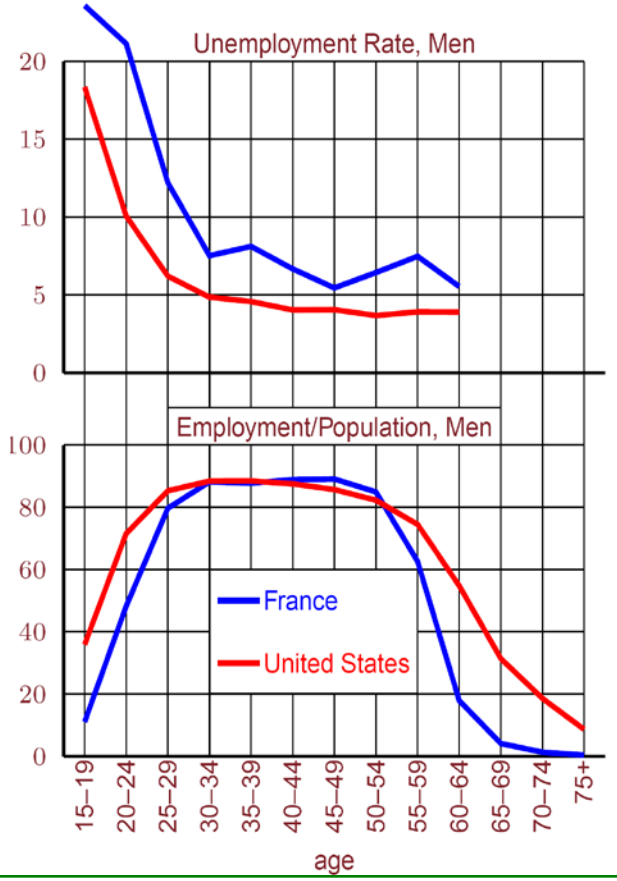

Source:
OECD
via Shimer

Extension of turbulence theory by

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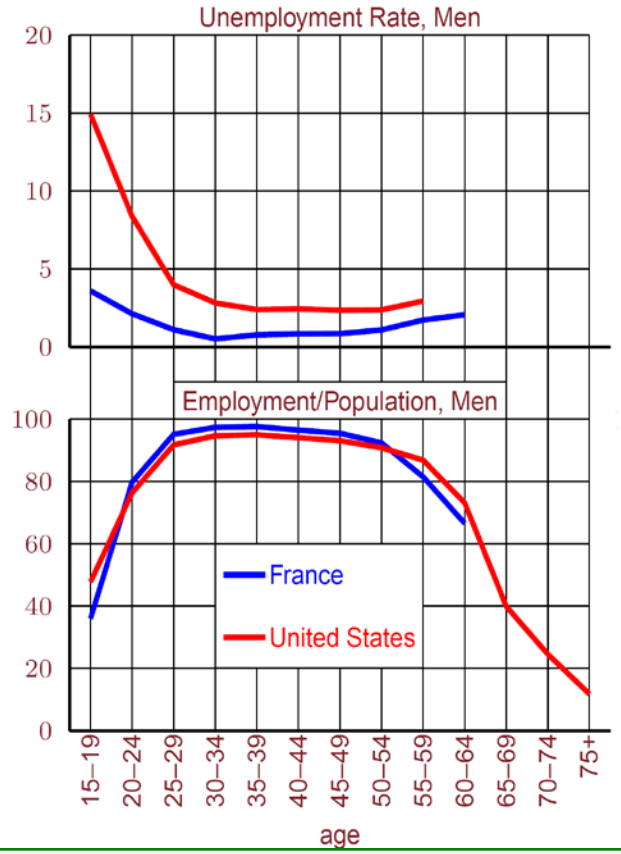

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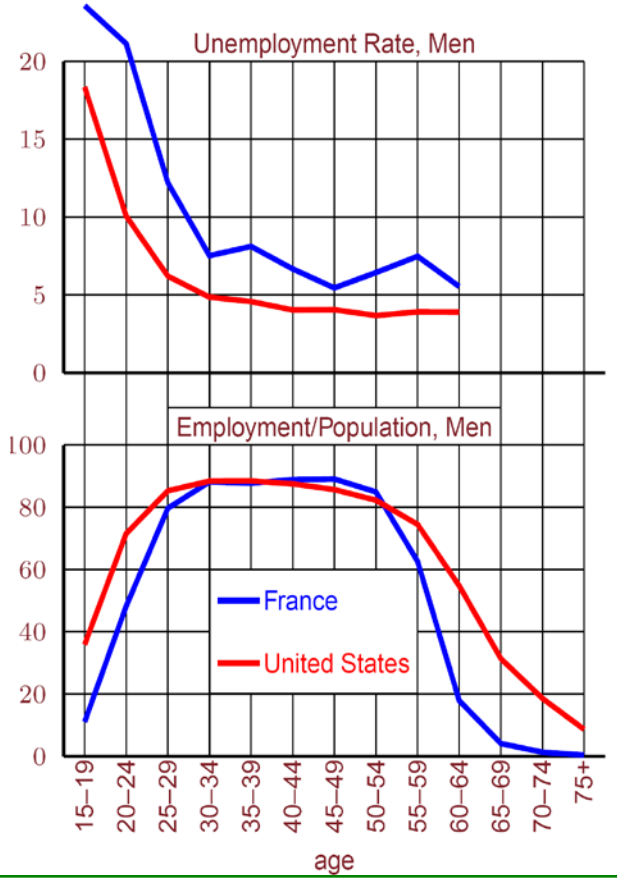

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Benefit dependency rates[c]

	1980	1990	1999
France	13.9	20.2	24.2
Germany	15.2	18.1	22.4
United States	16.8	15.6	13.7

Source: OECD Employment Outlook 2003

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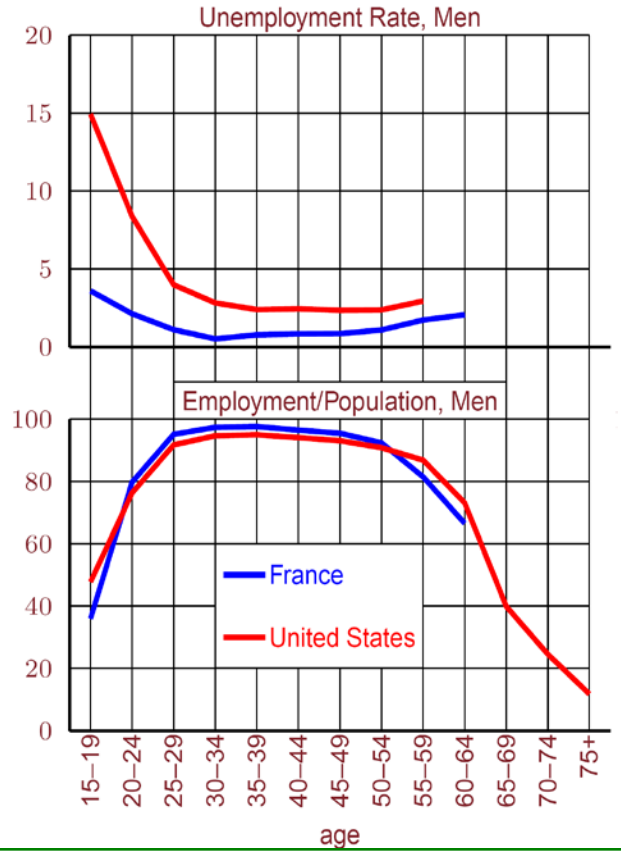

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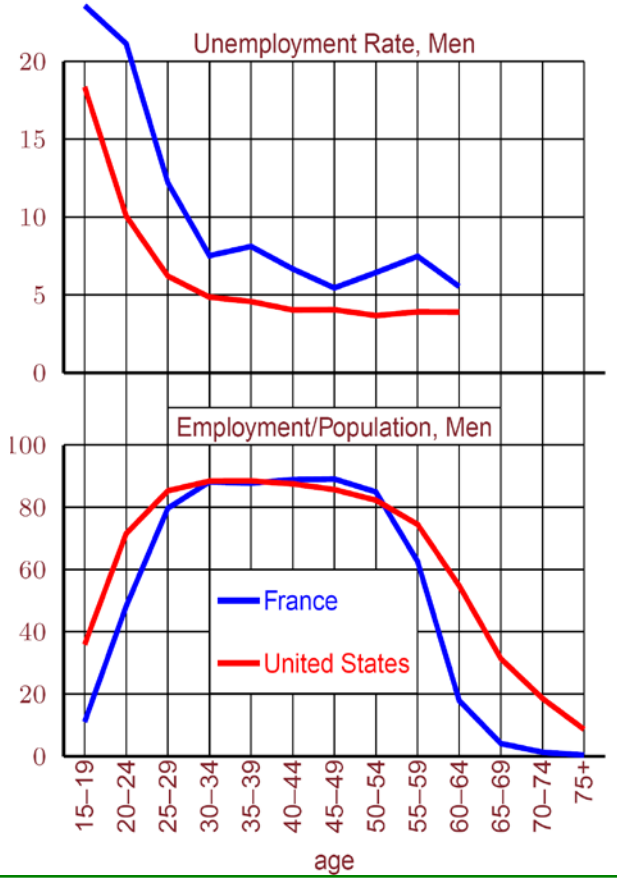

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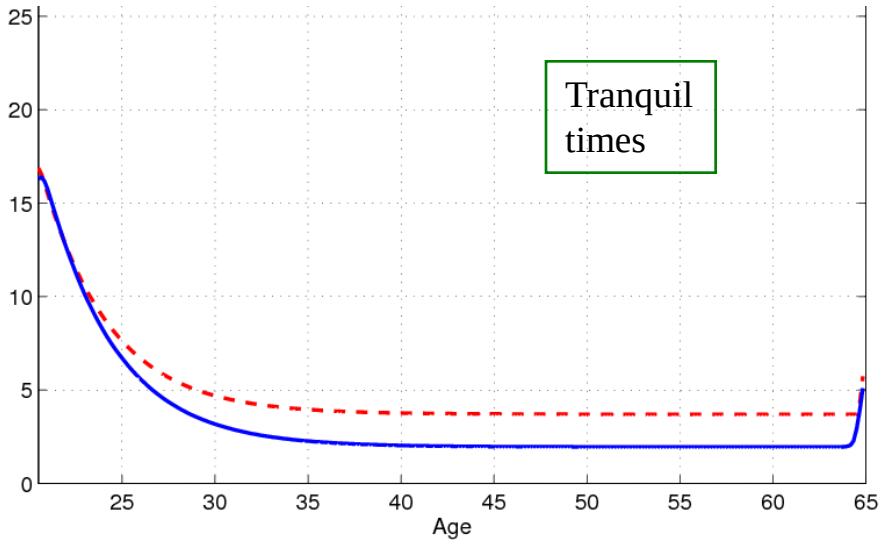
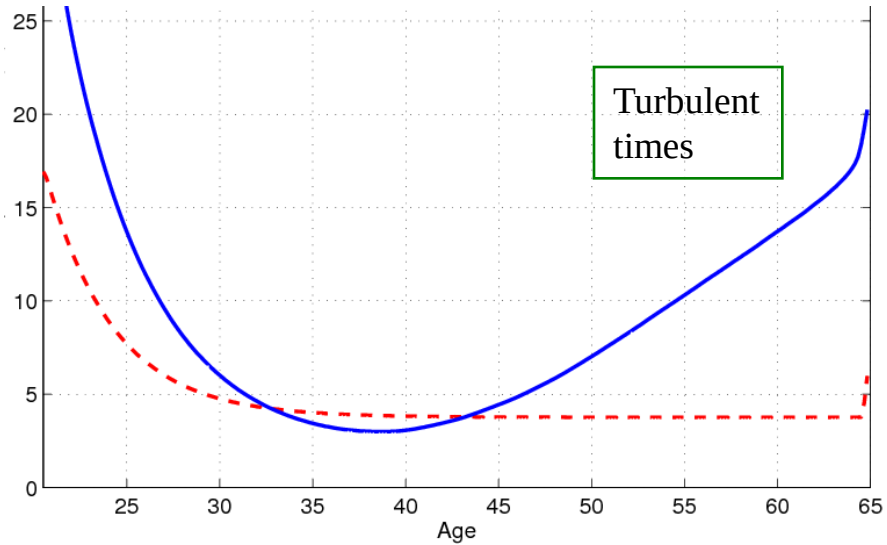




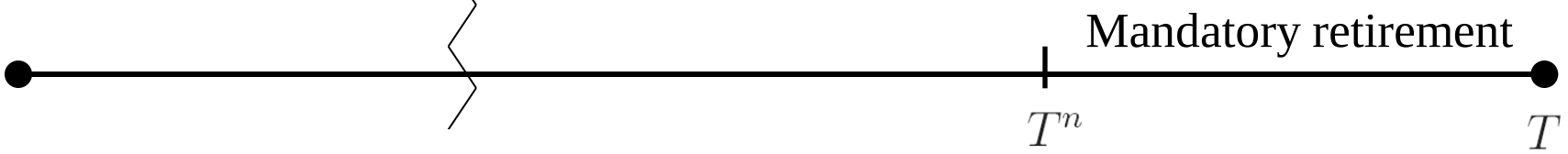
OLG search-island model with indivisible labor

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:



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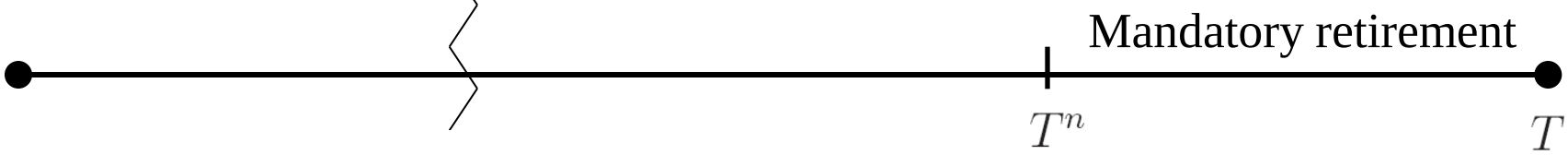
Ex post heterogeneity:

- 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



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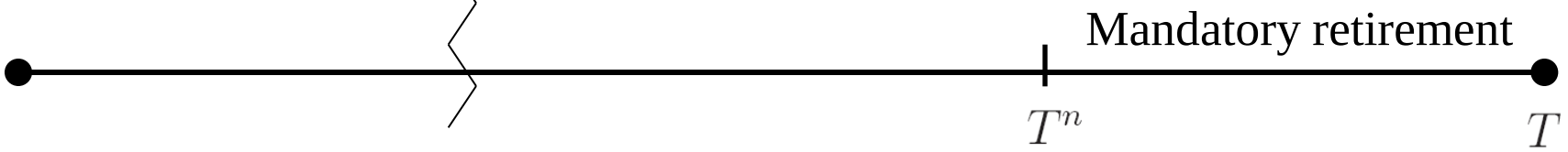

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- labor and capital taxes
- layoff tax
- UI benefits
- social security
- (minimum wage)

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Ways to smooth consumption:

- trade a risk-free asset
- invest in human capital
- career planning
- social safety net (UI)
- social security

Agents

2 types; i = L, H [low type (high school) , high type (college)]

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

$B_t = B$ 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':

⇩ transition probability π

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

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 δ)
- μ cost of creating a new job (with productivity level z_{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
- anonymous labor market with a market-clearing wage rate per efficiency unit of labor

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Endogenous and exogenous separations:

q prob. firm destroys job endogenously

λ exogenous destruction

$\tilde{\lambda} - \lambda$ additional exog. breakups for inexperienced

Value functions

Value function	phase of life	decisions
$\tilde{V}_i^u(a, \gamma, d, t)$	inexperienced, unemployed	c, a', s
$\tilde{V}_i^n(a, n, t)$	inexperienced, employed	c, a'
$V_i^u(a, h, \gamma, d, t)$	experienced, unemployed	c, a', s
$V_i^n(a, h, t)$	experienced, employed	c, a', l
$\hat{V}(a, t)$	old, retired	c, a'
$V^f(z)$	firm	{stay, exit}, k

a	assets	h	human capital
γ	UI benefits	i	skill type
d	elapsed duration	c	consumption
t	age	s	search intensity
n	inexperienced efficiency units	l	investment in skills

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

(1) Subjective discount factor	Fraction of wealth held by 95% of population
(2) Ben-Porath technology	Earnings profiles (college and non-college)
(3) Search technology	Average unemployment duration
(4) Idiosyncratic firm productivity	Average number of jobs held over a lifetime and 'equilibrium response' to layoff taxes
(5) Disutility of work	Cross-time and cross-continent unemployment and permanent earnings volatility

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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

Government

$\Gamma(e)$	UI, last labor earnings e
$d_{\max}$	UI duration
Ω	job destruction tax
$e_{\min}$	minimum wage
τ_n	labor tax rate
τ_p	social security tax rate
τ_k	capital tax rate
$\hat{\epsilon}$	retirement benefit
X	public consumption

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	U.S.	Europe
	60 % replacement rate	
	6 months	unlimited duration

OECD Economic Studies (1996):

Net unemployment benefit replacement rates in 1994 for single-earner households, in percent

	U.S.	France	Germany
first year	34 (38)	79 (80)	66 (74)
second and third year	9 (14)	63 (62)	63 (72)
fourth and fifth year	9 (14)	61 (60)	63 (72)

without (with) dependent spouse

Government

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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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	U.S.	Europe
	60 % replacement rate	
$d_{\max}$	6 months	unlimited duration
Ω	0	3 months of low-type earnings
$e_{\min}$	no	yes, in turbulent times

Government

		U.S.	Europe
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$d_{\max}$	UI duration	6 months	unlimited duration
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$e_{\min}$	minimum wage	no	yes, in turbulent times
τ_n	labor tax rate	15%	30%
τ_p	social security tax rate	10%	10%
τ_k	capital tax rate	15%	15%
$\hat{\epsilon}$	retirement benefit		
X	public consumption		

Mendoza et al. (JME, 1994) and
http://www.econ.umd.edu/~mendoza/pp/newtaxdata.pdf

Tax on labor income U.S. 28% France 46%
Germany 41%

Government

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τ_k	capital tax rate	15%	15%
$\hat{\epsilon}$	retirement benefit	Based on replacement rate of average earnings	
		40%	50%
X	public consumption		

OECD study (2006): Gross replacement rate of average earnings	U.S.	France	Germany
	38.6%	52.9%	45.8%

Government

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Residual

	U.S.	Europe
	60 % replacement rate	
	6 months	unlimited duration
	0	3 months of low-type earnings
	no	yes, in turbulent times
	15%	30%
	10%	10%
	15%	15%
	Based on replacement rate of average earnings	
	40%	50%

Ben-Porath technology

Earnings profile
(in $10,000 dollars)

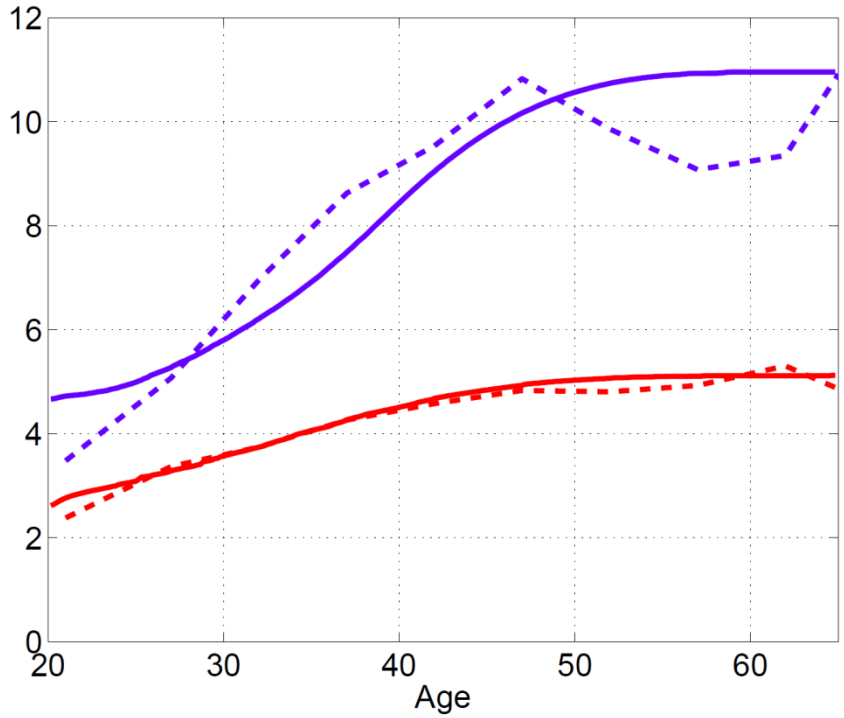
Target:

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

Model:

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

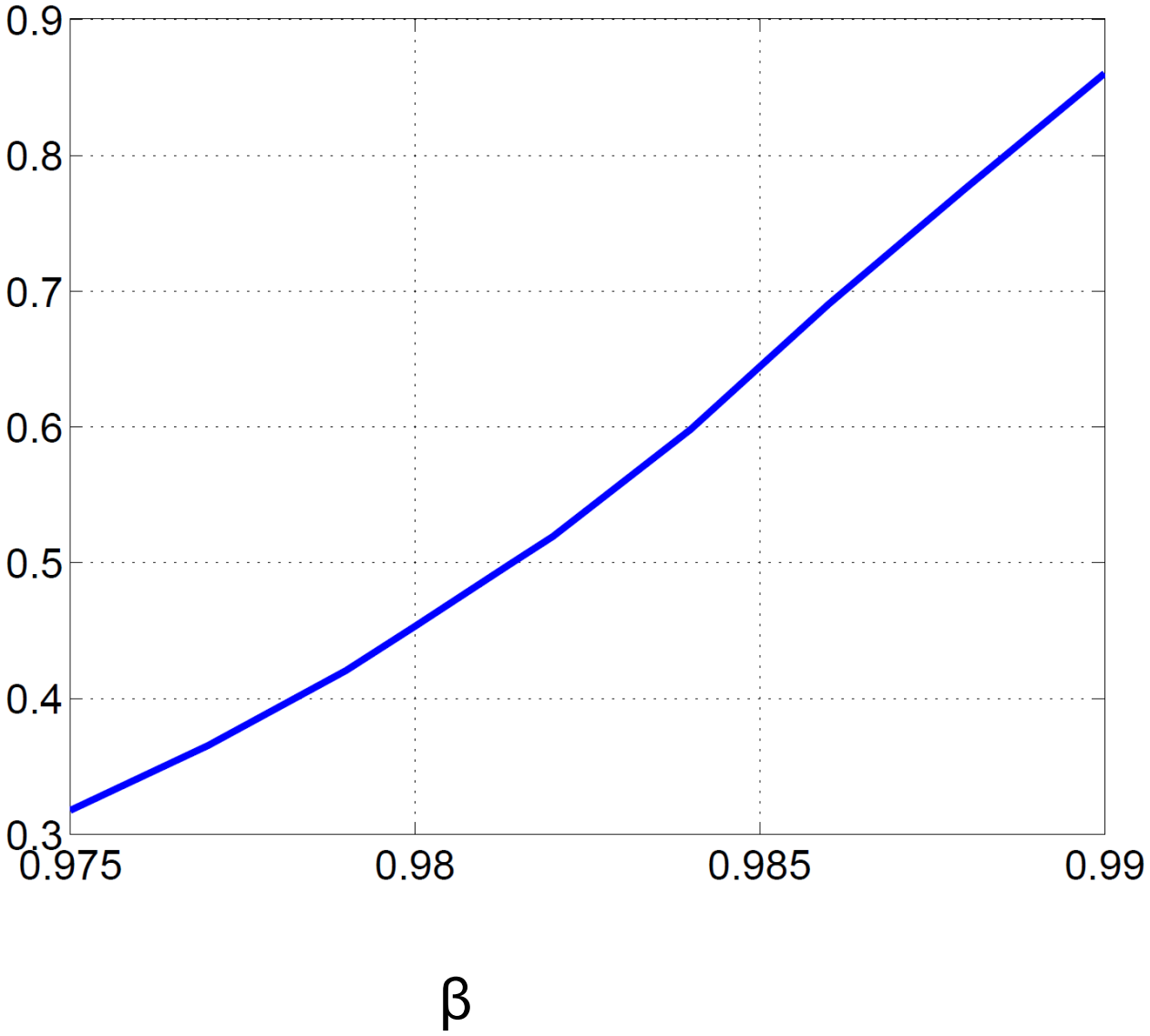
Inexperienced workers $G_i(n)$
normal dist. on $[0,\ \rho\, h_{o,i}]$



Solid line – model
Dashed line – data

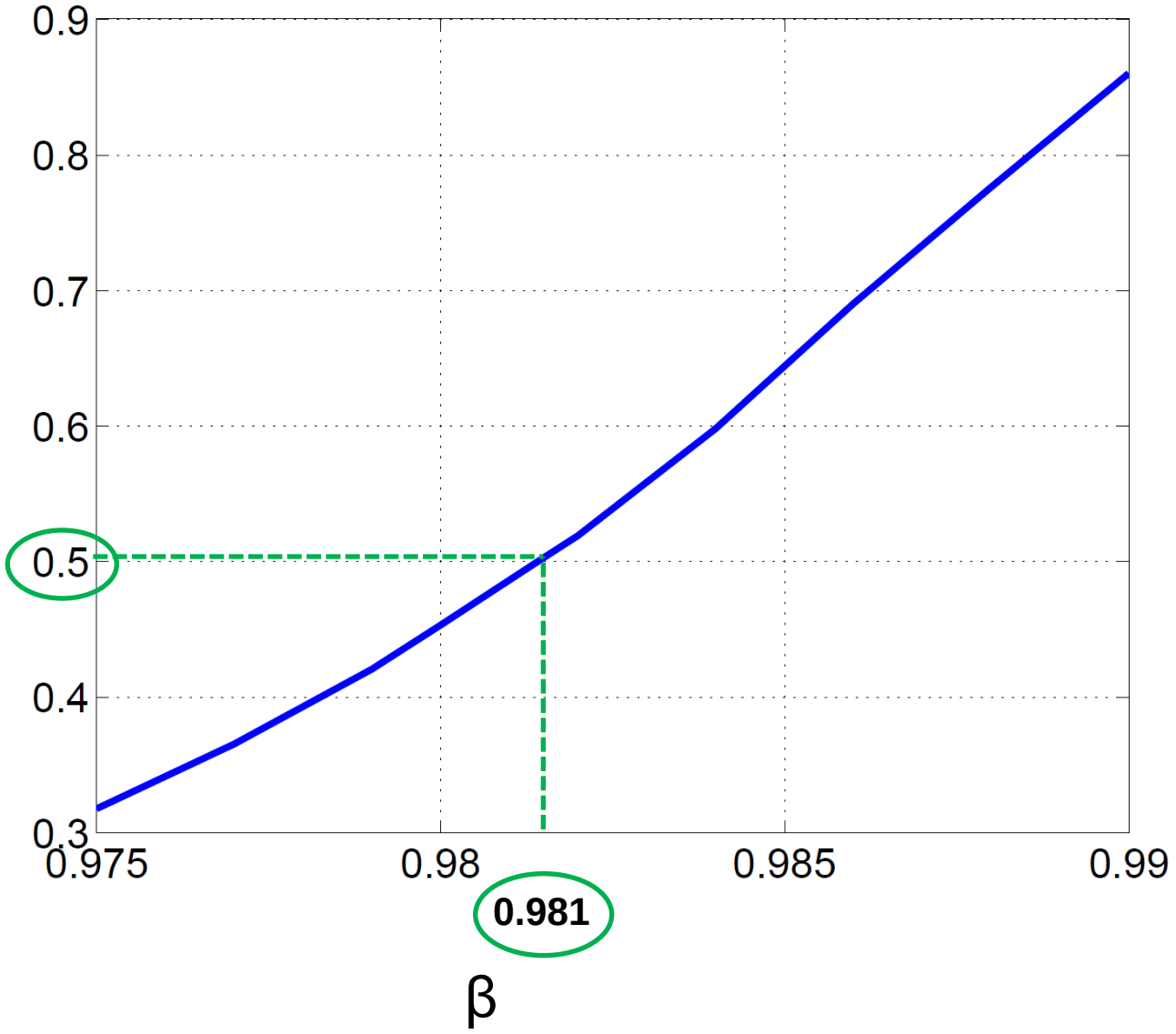
Subjective discount factor

Fraction of wealth held by 95% of population



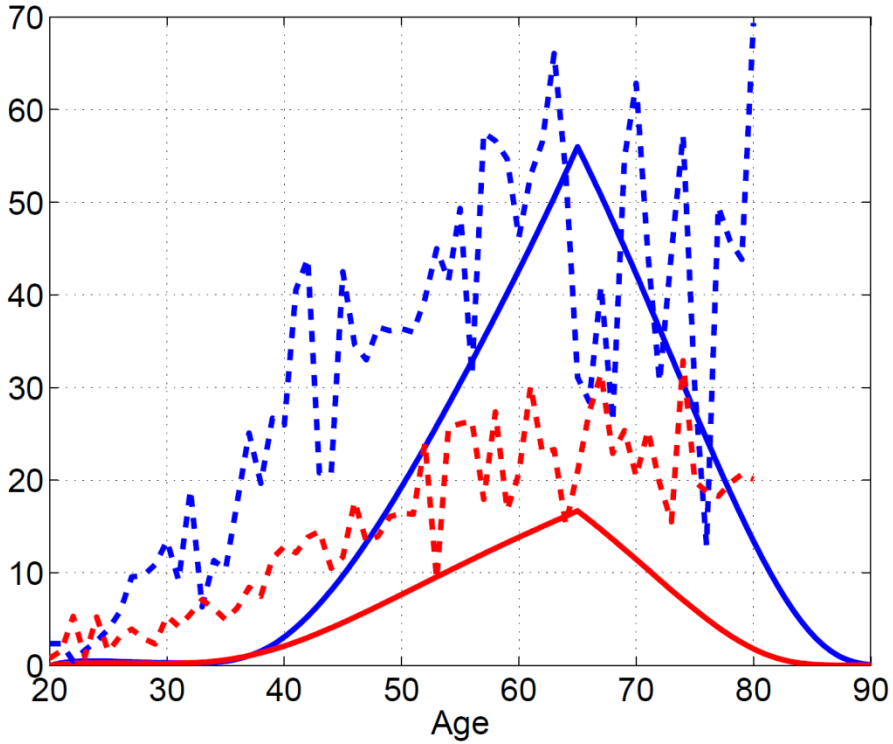
Subjective discount factor

Fraction of wealth held by 95% of population



Asset profile
(in $10,000 dollars)

Solid line – model
Dashed line – data



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…"

Asset profile
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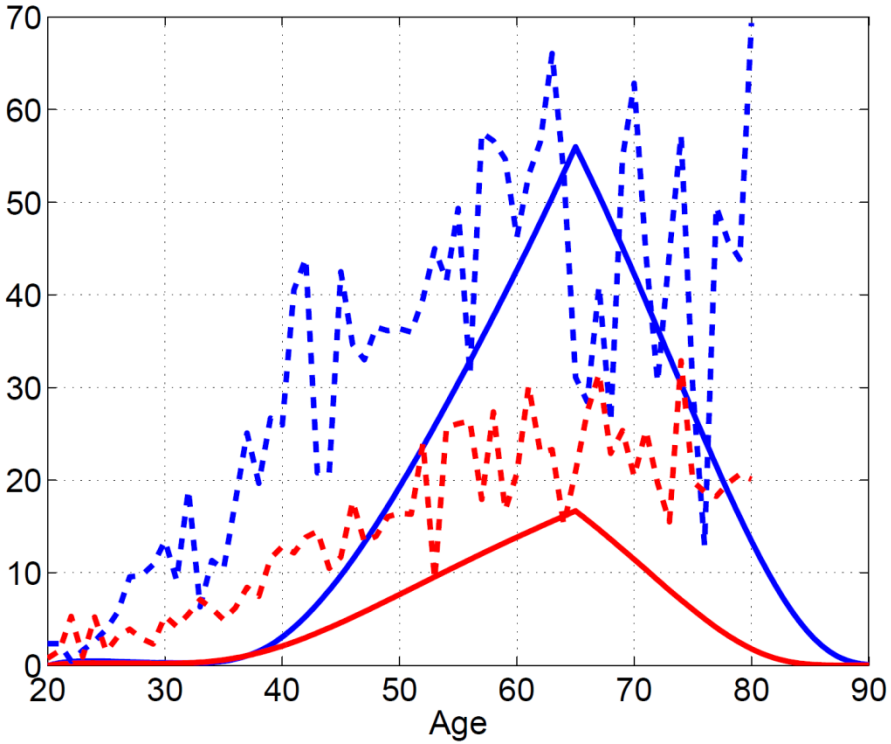
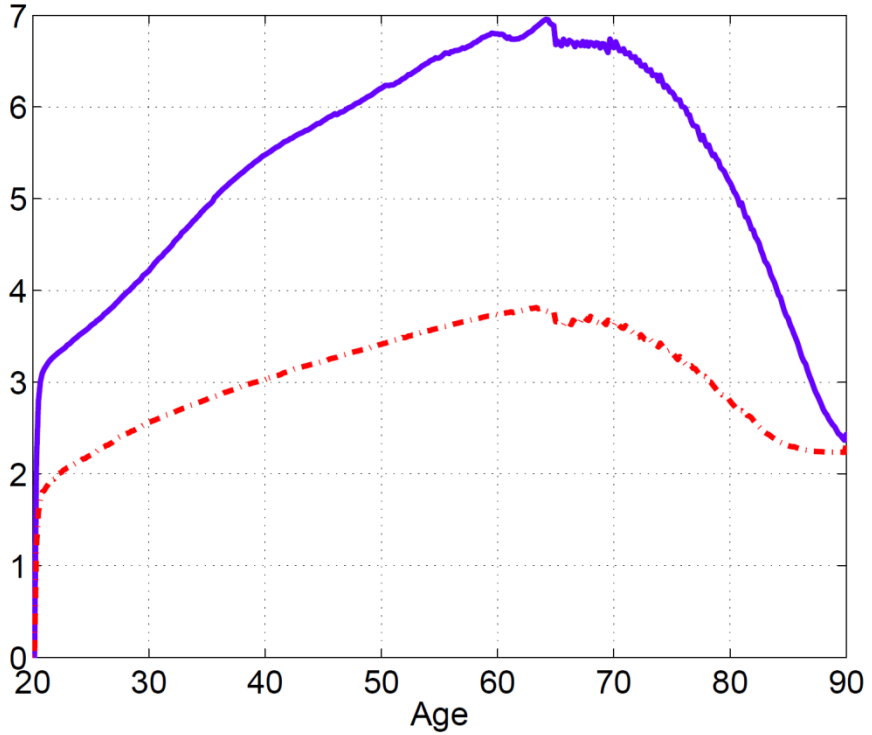


Consumption profile
(in $10,000 dollars)



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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

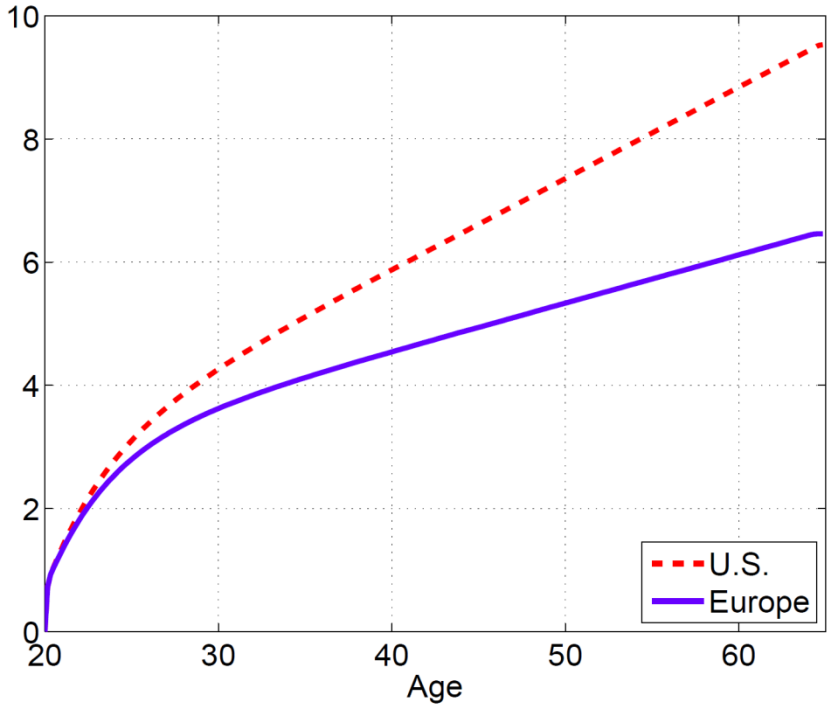
Observations

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

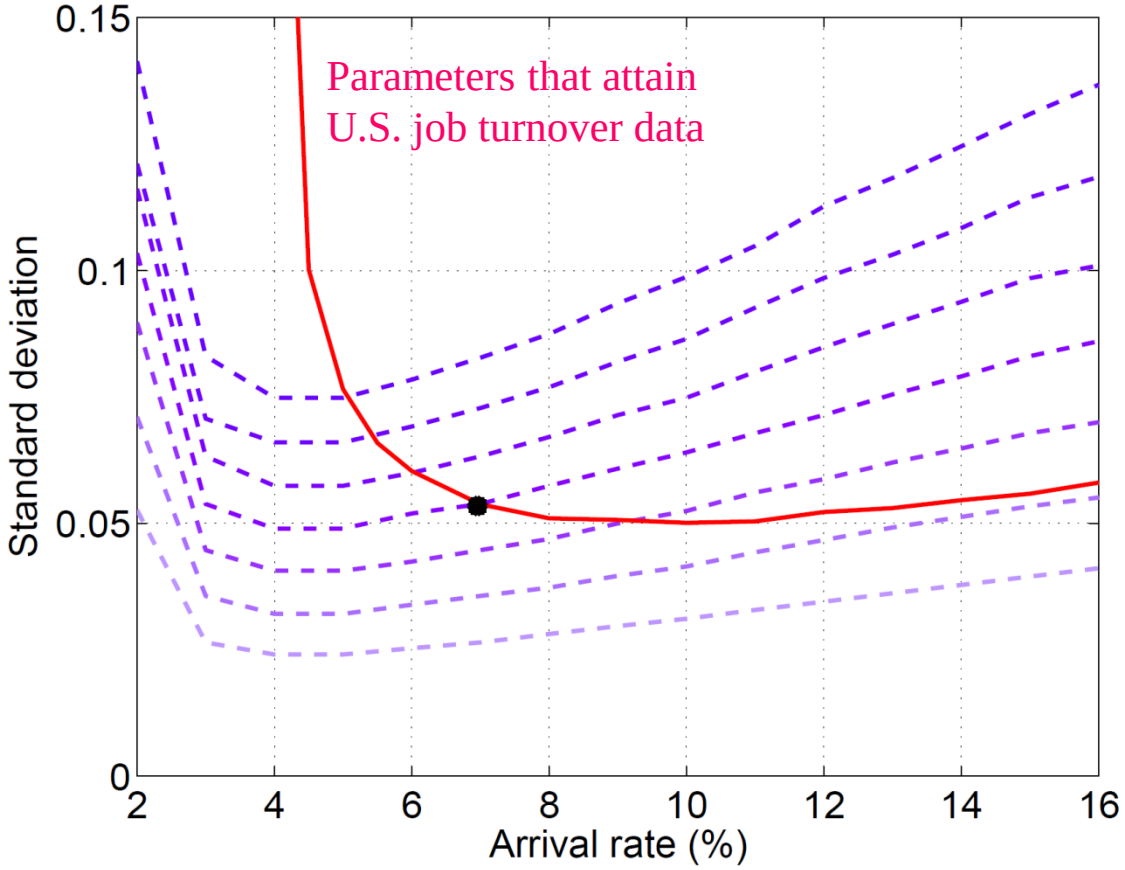
Average number of jobs held



… 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 σ_z that has been truncated to the unit interval [0, 1].



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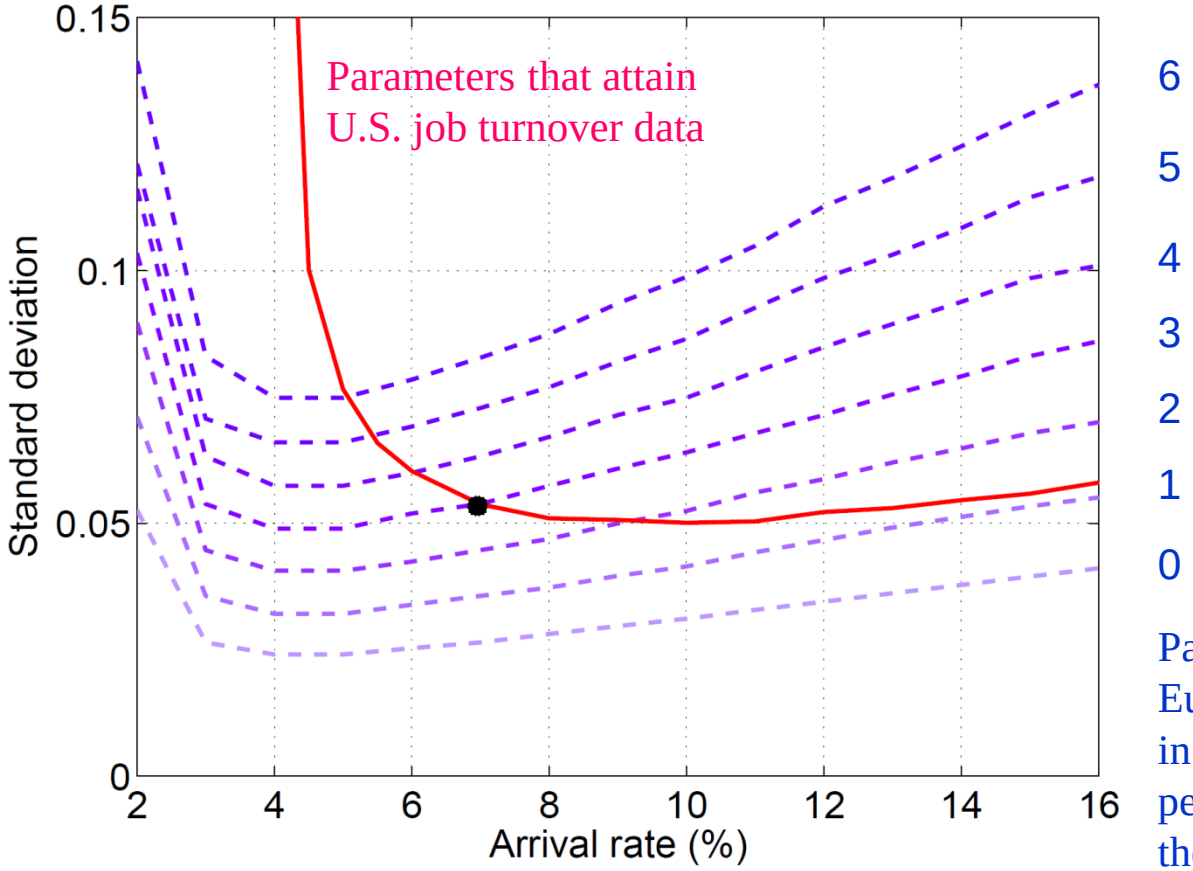
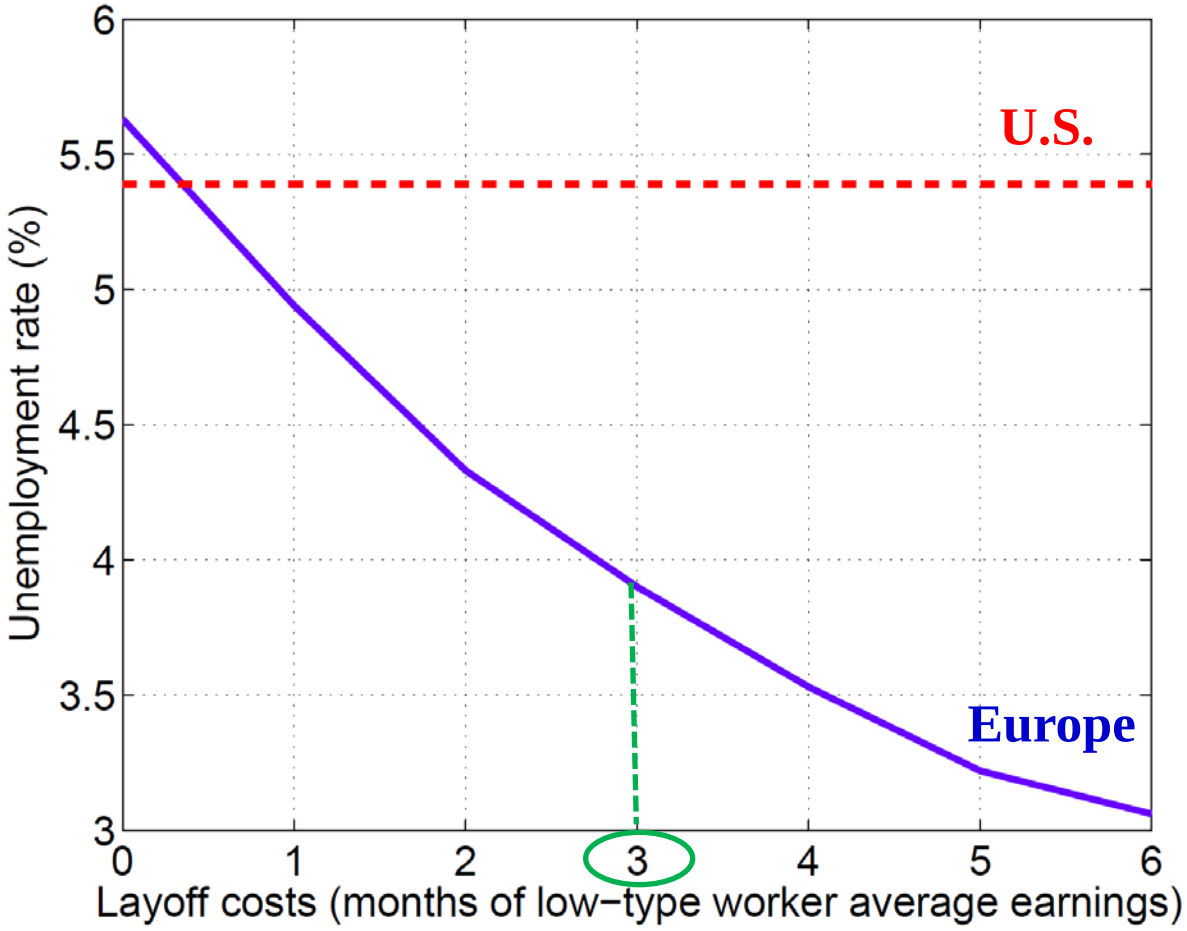


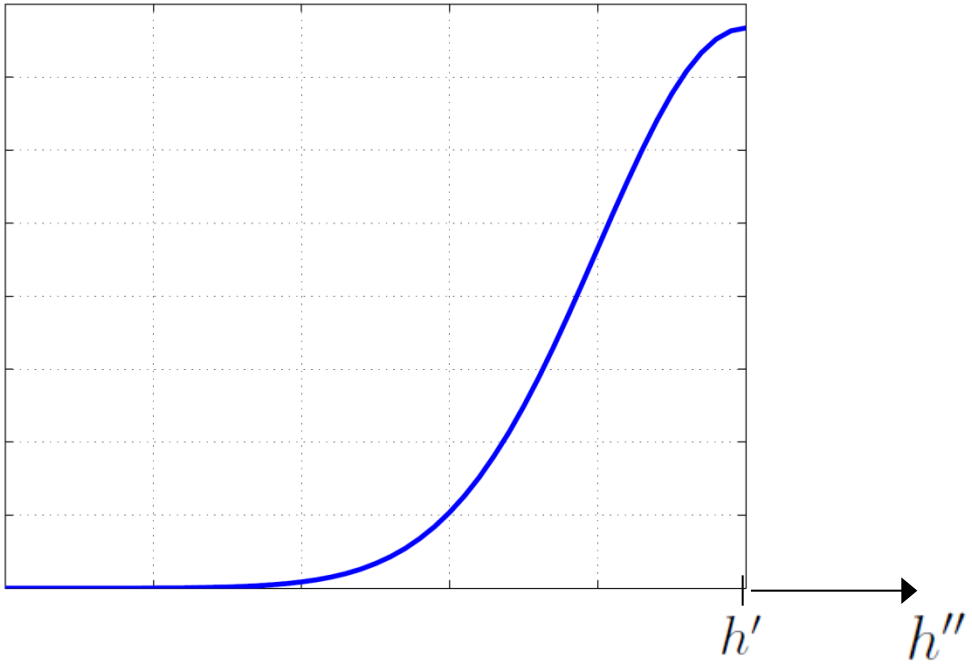
Parameters that suppress European unemployment in tranquil times by 1.5 percentage points, given the above layoff tax (months of low-type's average earnings)

Tranquil times: Layoff tax suppresses European unemployment



	Tranquil times	Turbulent times
Skill loss upon exogenous job destruction:	none	governed by transition probability $H_i^{\lambda}(h', h'')$

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



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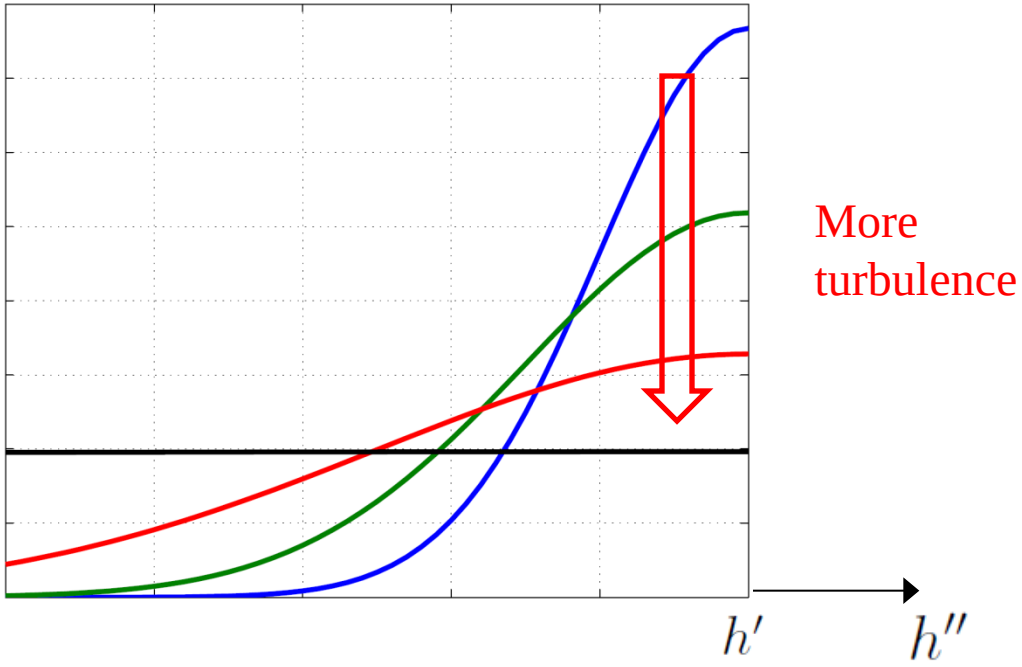
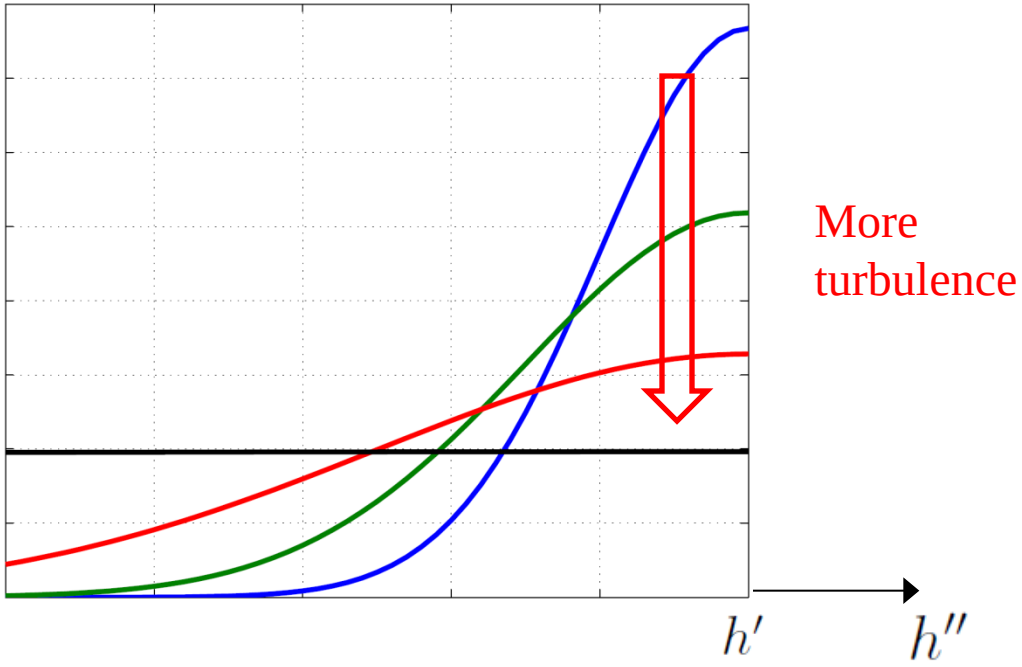
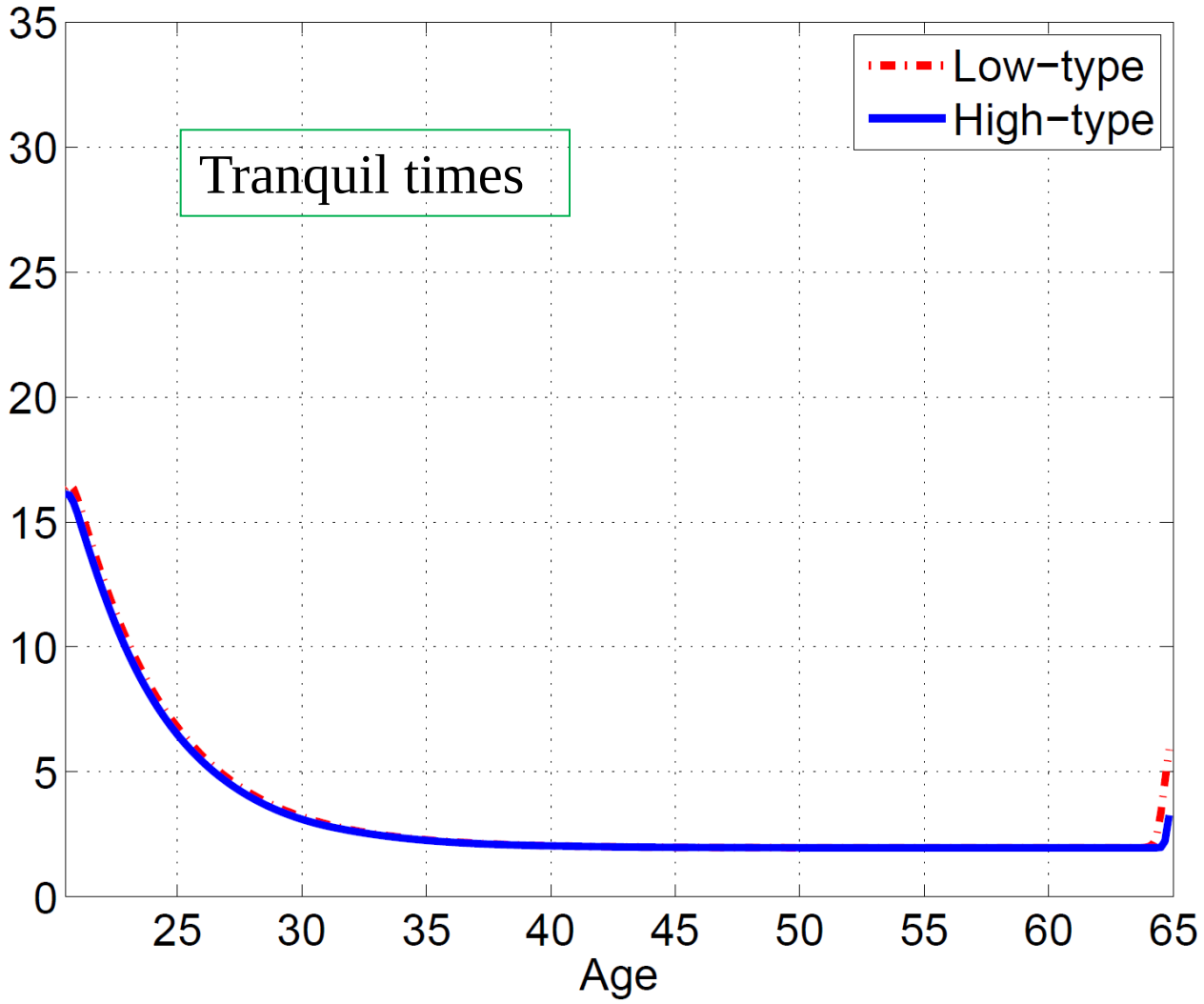


	Tranquil times	Turbulent times
Skill loss upon exogenous job destruction:	none	governed by transition probability $H_i^{\lambda}(h', h'')$
Europe-specific labor market institutions:	layoff tax and unlimited duration of benefits	same as before and a minimum wage

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



European unemployment by type: turbulence and minimum wage



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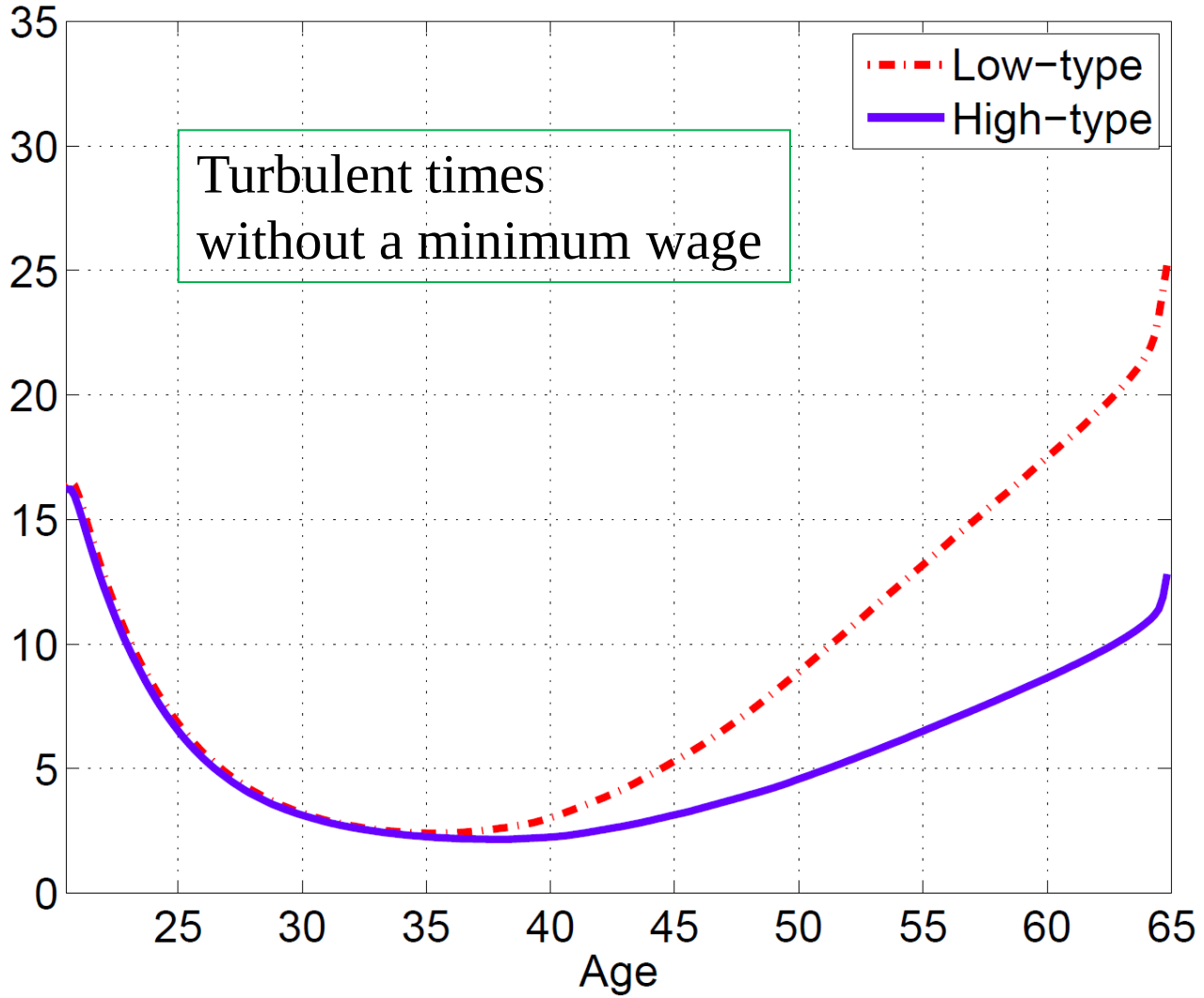

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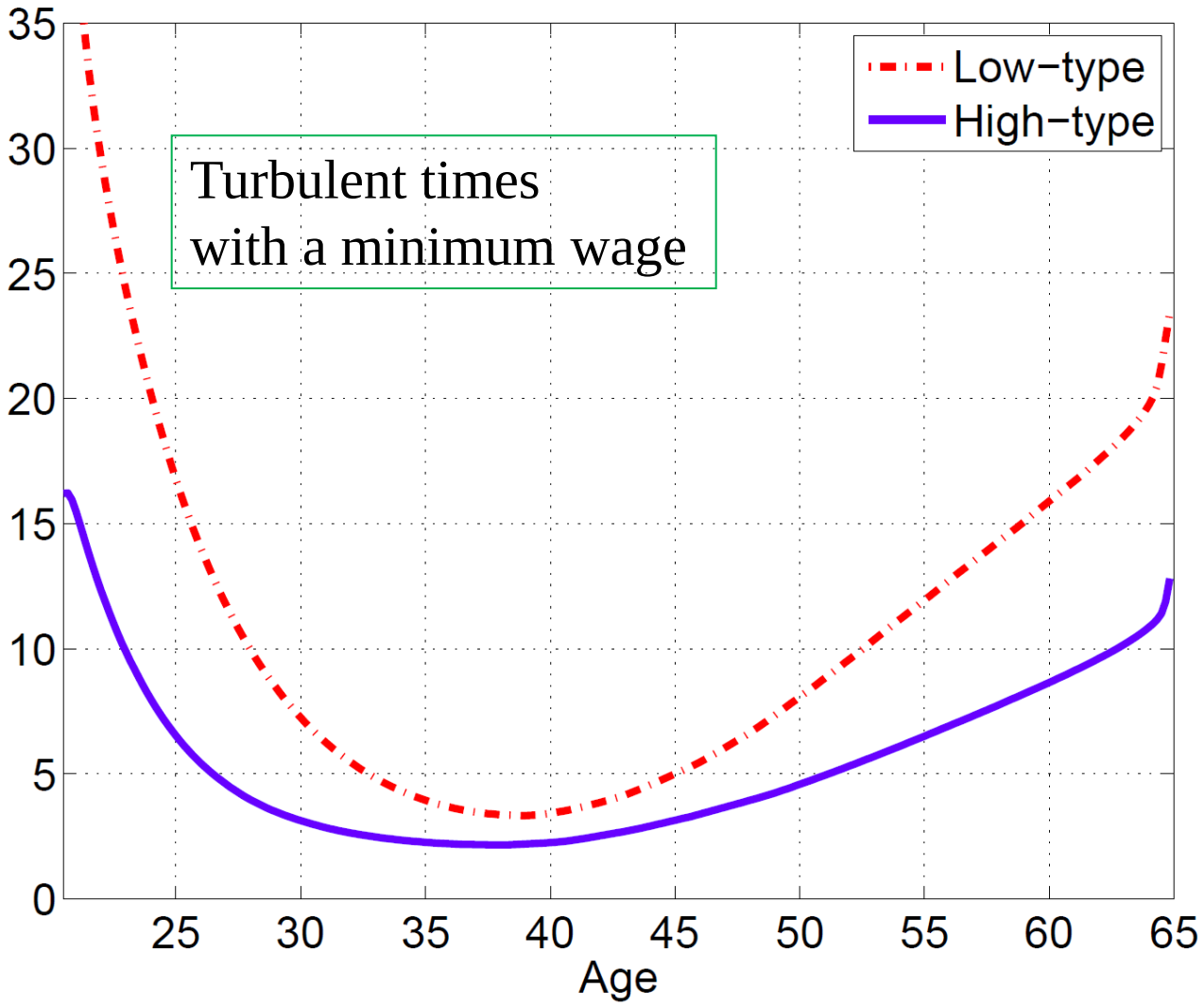
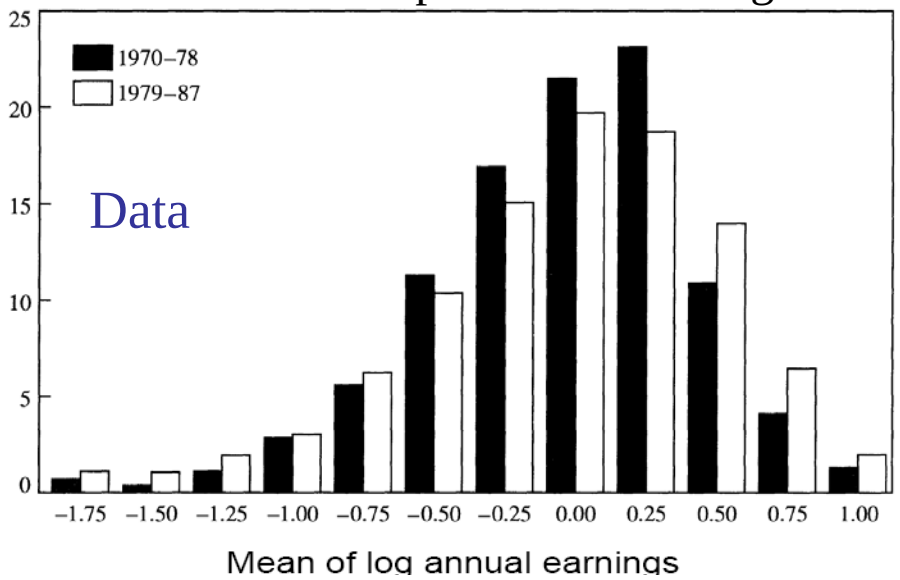
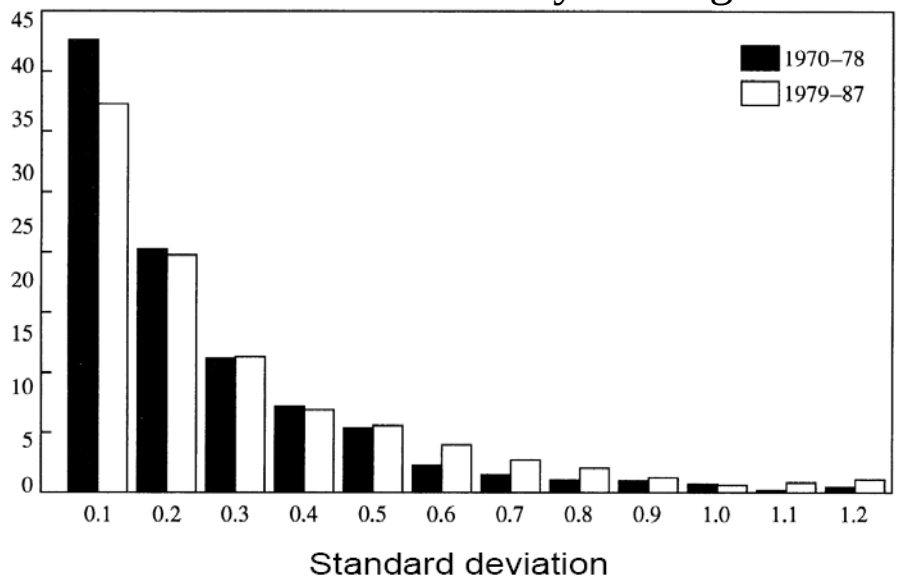


Turbulent times: U.S. earnings volatility and European unemployment 10%

Distribution of permanent earnings



Distribution of transitory earnings



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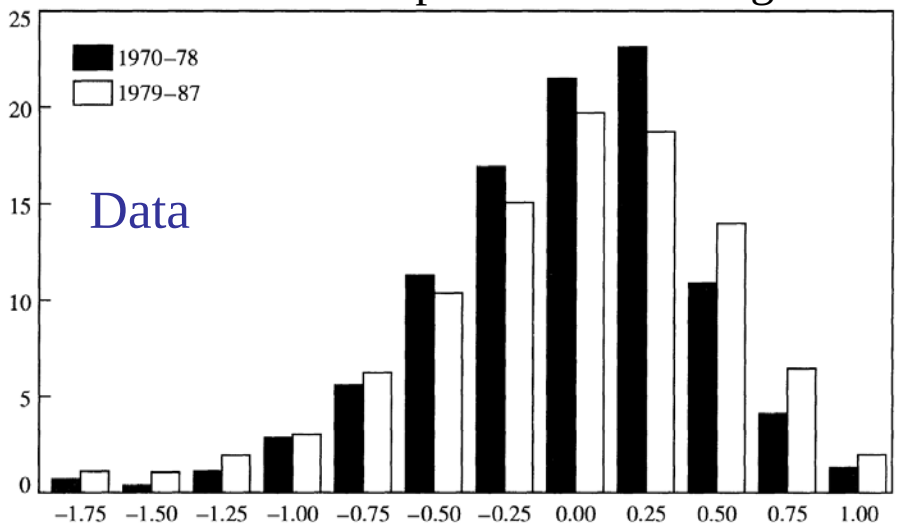

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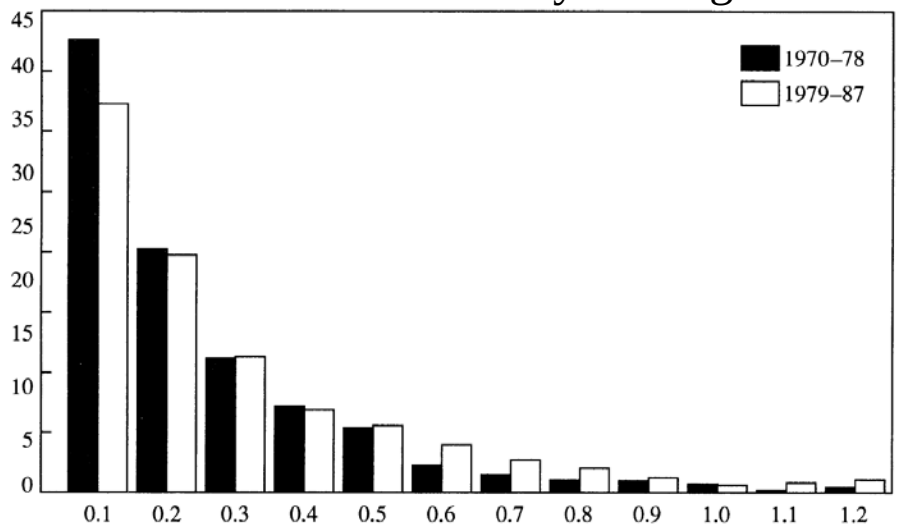
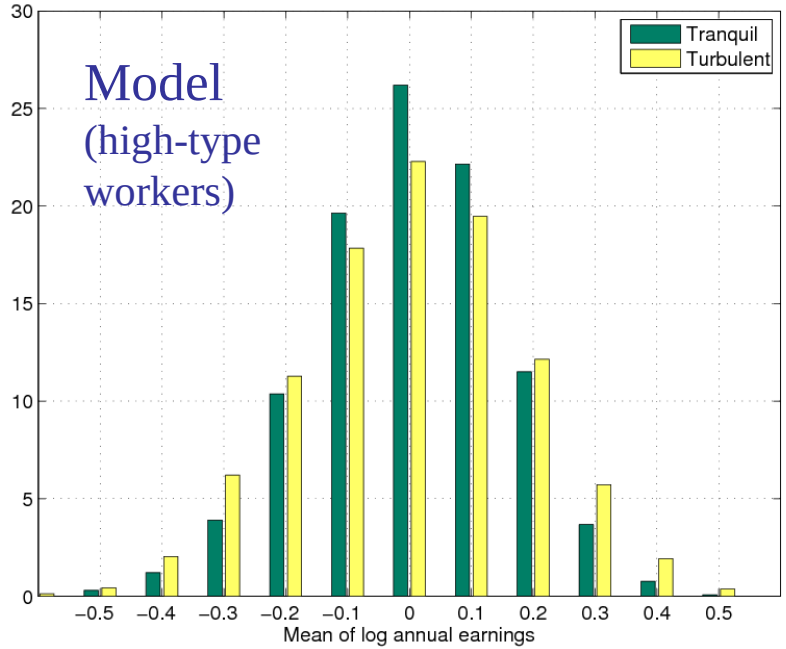
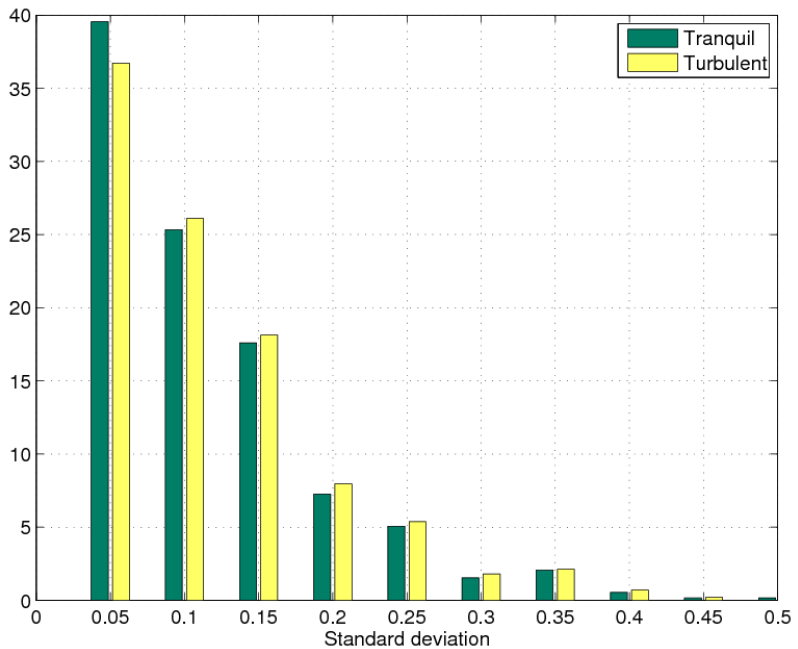


Mean of log annual earnings



Standard deviation



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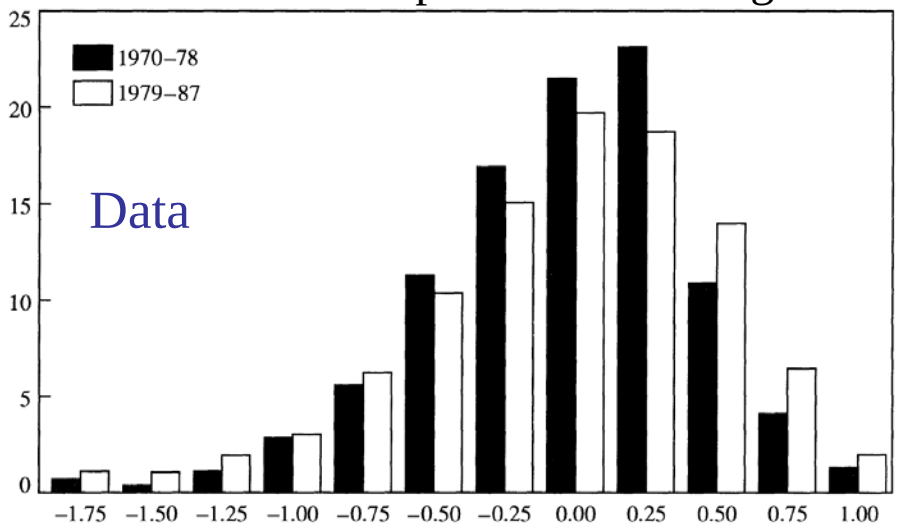

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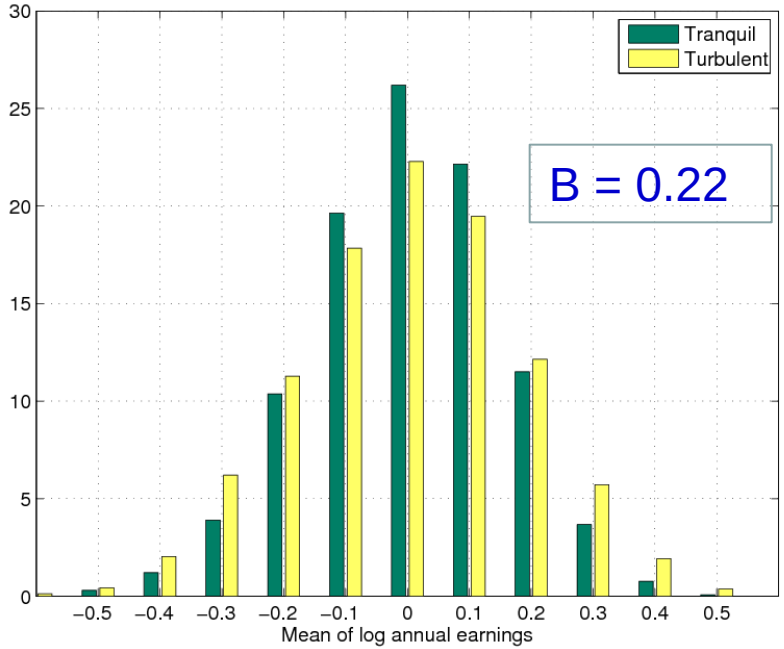

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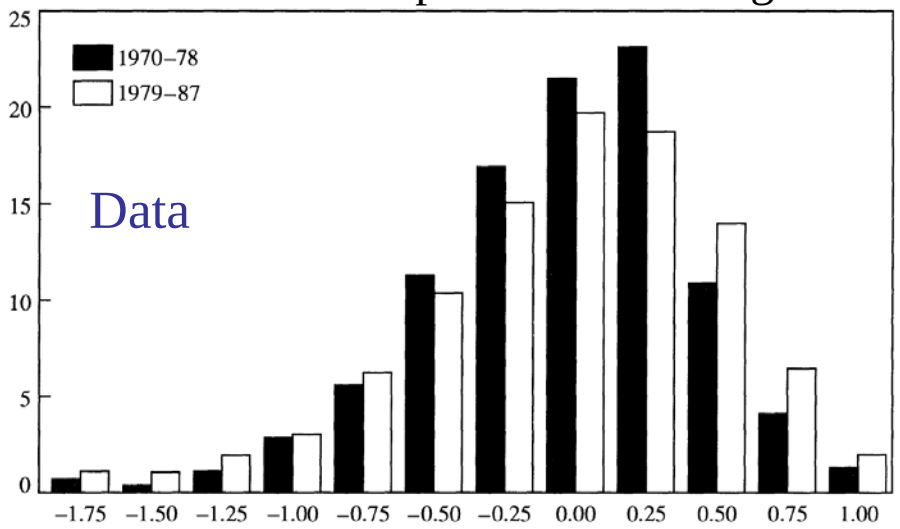

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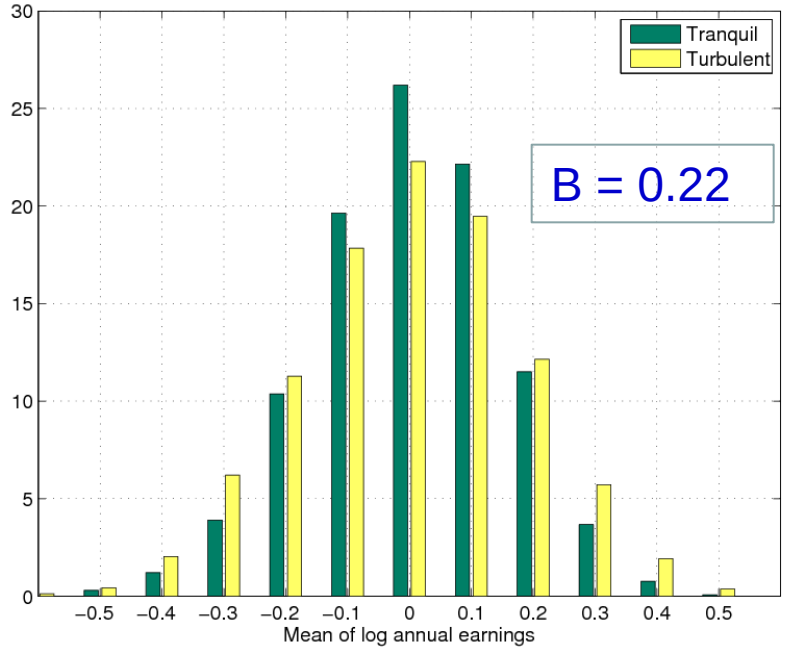

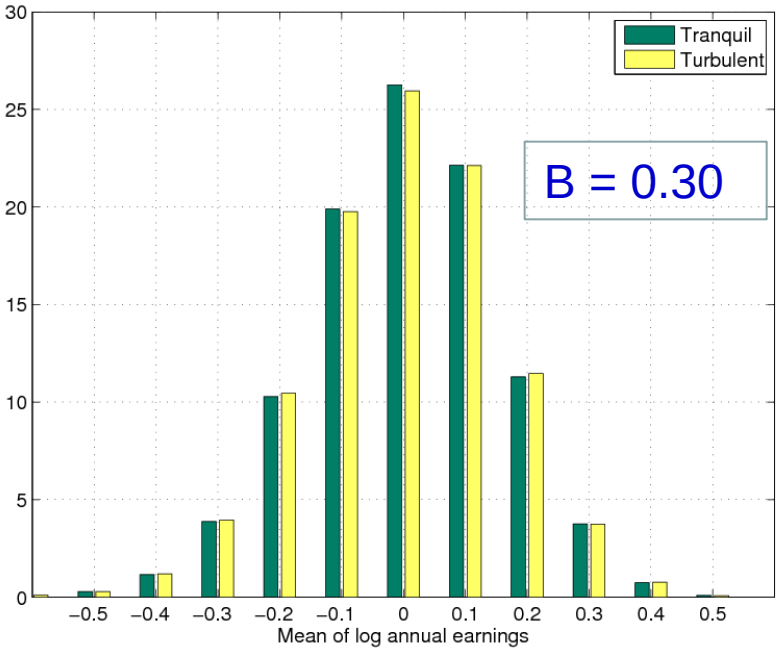

Turbulent times: U.S. earnings volatility and European unemployment 10%

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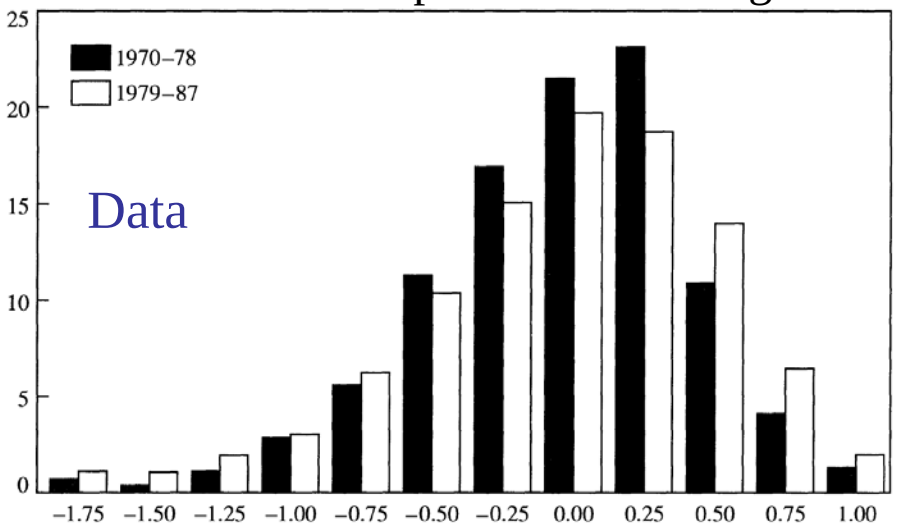

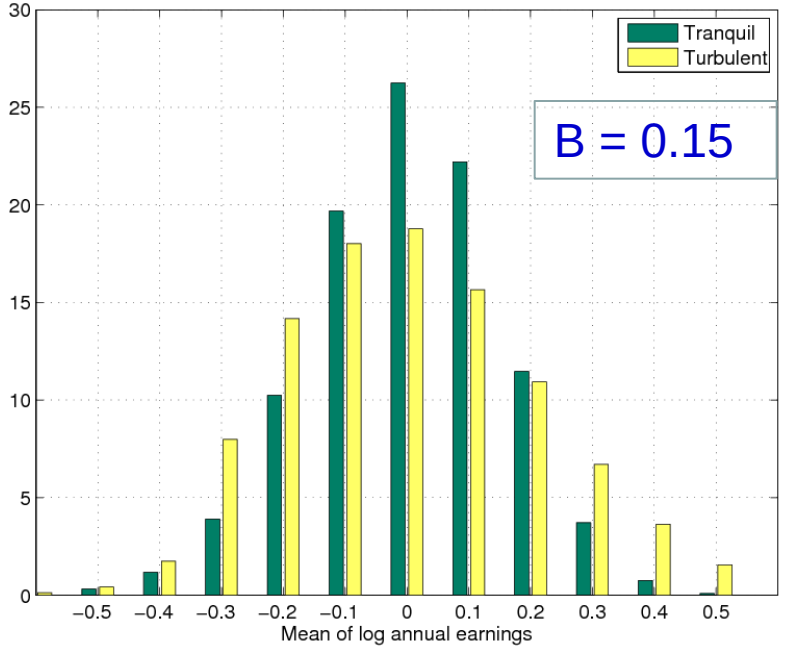

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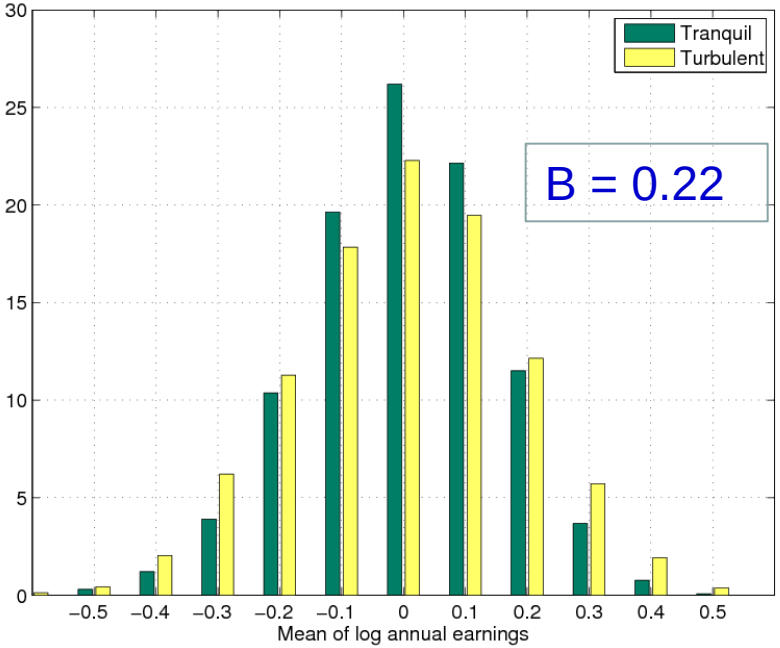
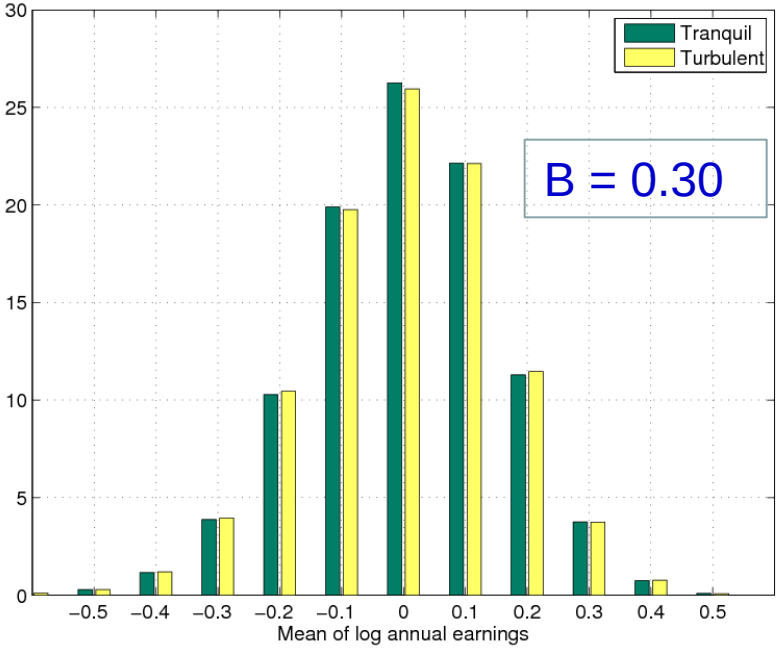
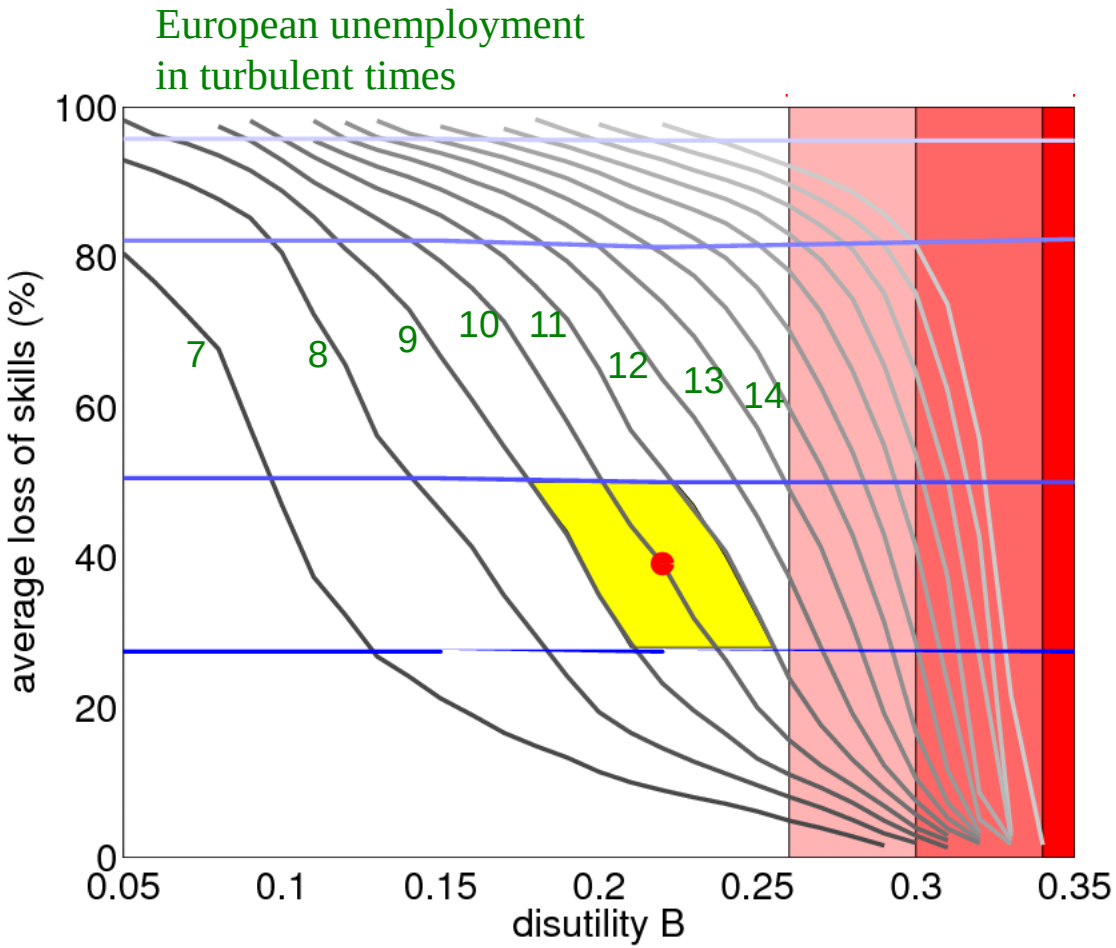


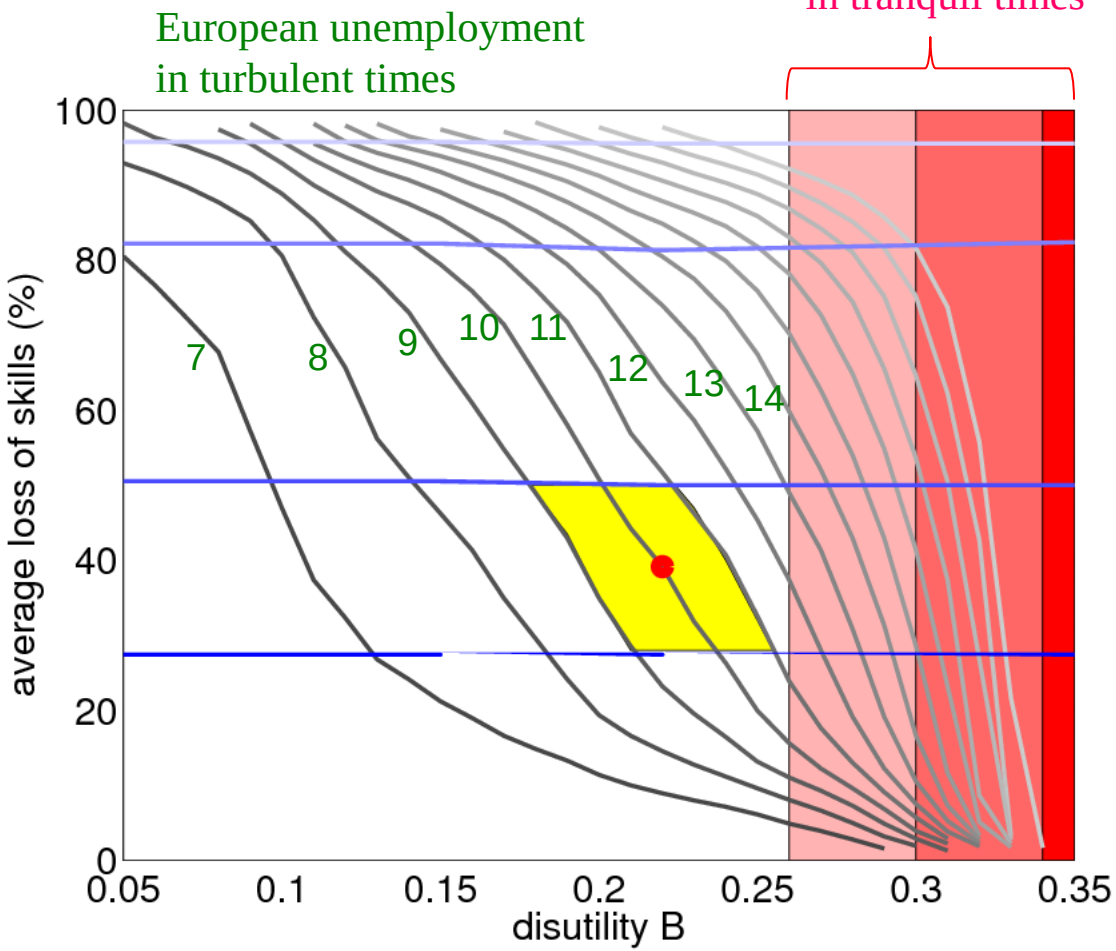


6. Disutility of work



6. Disutility of work

European unemployment
exceeds calibration target
in tranquil times



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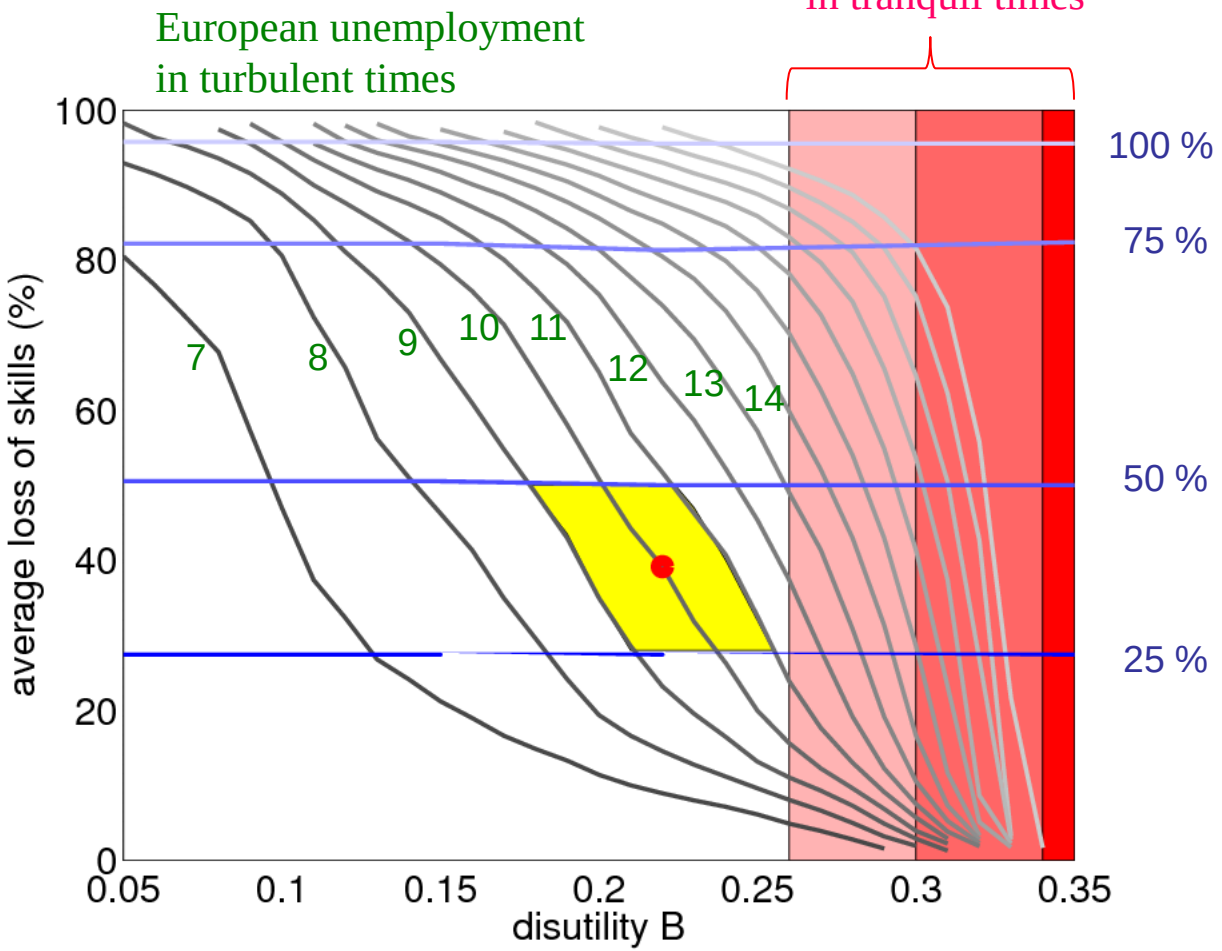
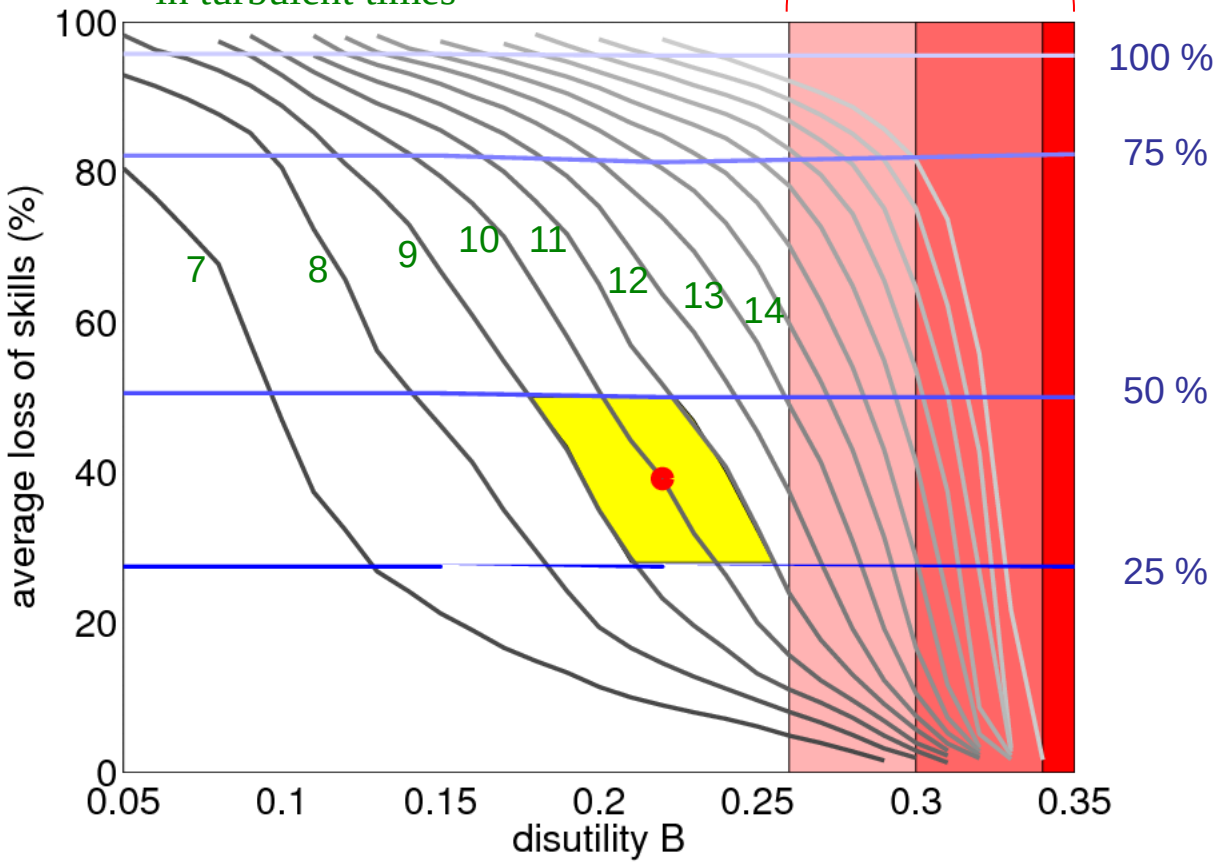


Percent change in variance
of permanent earnings

6. Disutility of work

European unemployment exceeds calibration target in tranquil times

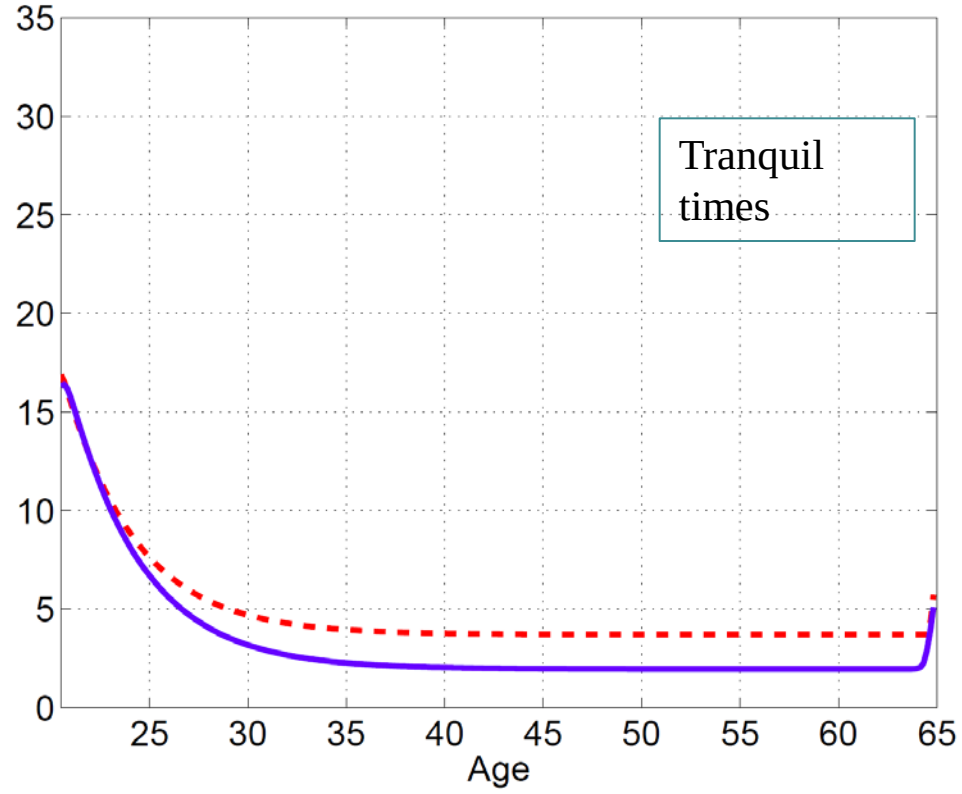
European unemployment in turbulent times

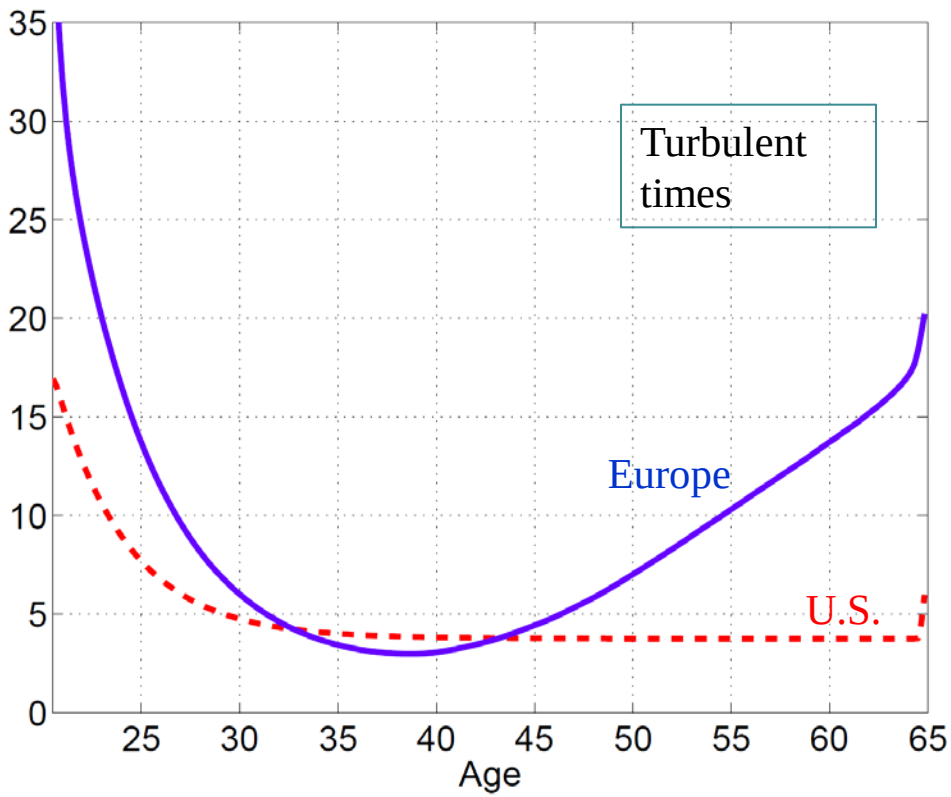


Percent change in variance of permanent earnings

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

Unemployment in Europe and in the U.S.

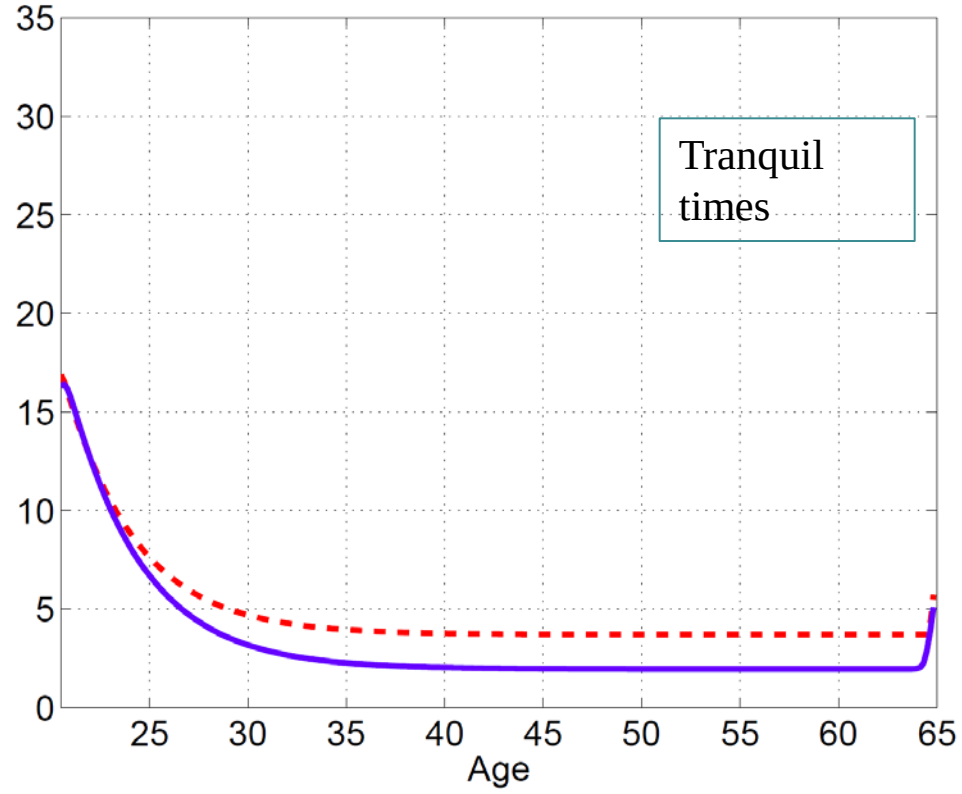


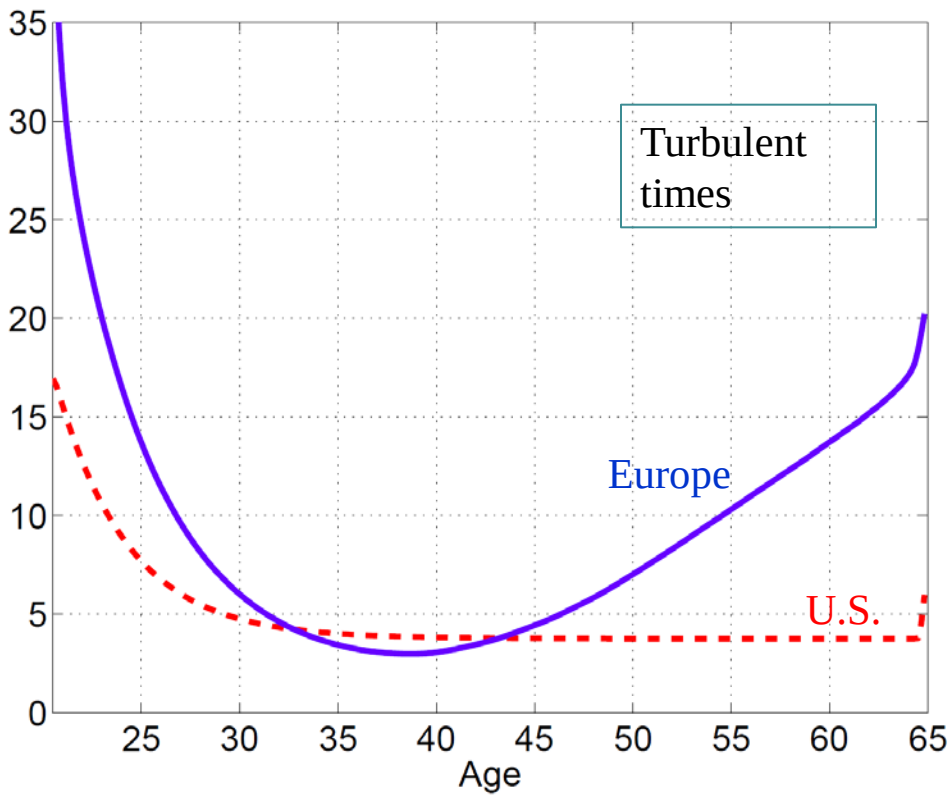


Unemployment (percent)

	Europe		U.S.	
	Tranquil	Turbulent	Tranquil	Turbulent
Low type	3.93	11.73	5.41	5.47
High type	3.83	5.91	5.39	5.40
All	3.90	9.99	5.39	5.45

Unemployment in Europe and in the U.S.





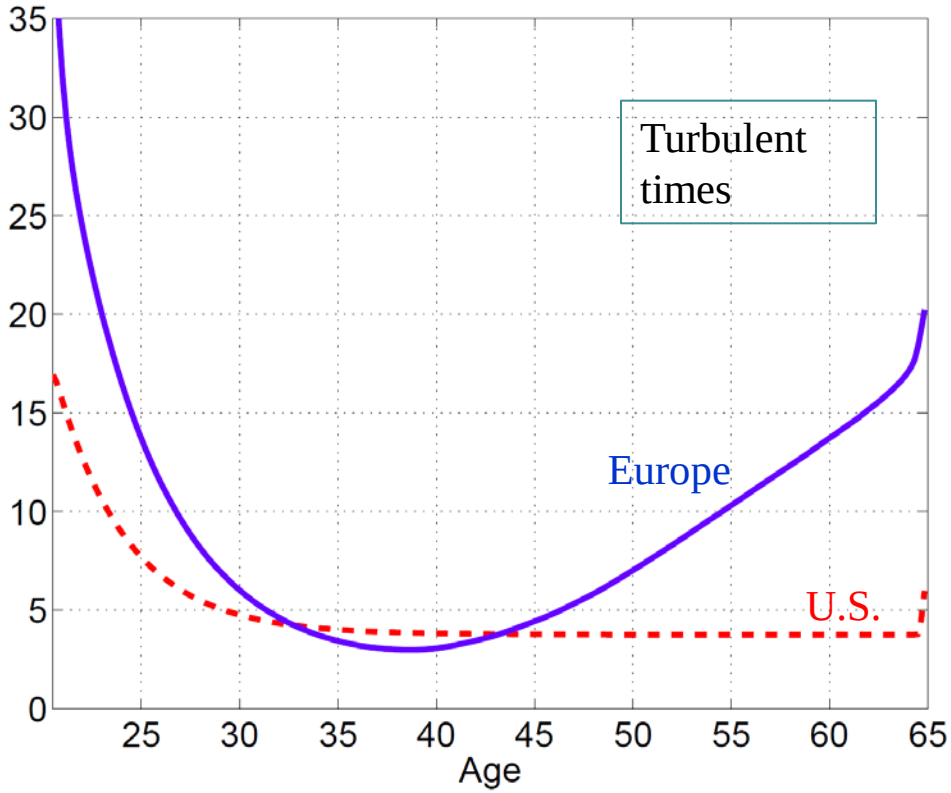
Flow rates into and out of unemployment (in bi-monthly model frequency)

	Europe		U.S.	
	Tranquil	Turbulent	Tranquil	Turbulent
Inflow rate	2.16	2.22	3.41	3.45
Outflow rate	62.85	23.24	66.60	66.55

Unemployment in Europe and in the U.S.

Europeans by age groups

	Unempl. duration (months)		Long-term unempl. (percent of unempl.)	
Age	Tranquil	Turbulent	Tranquil	Turbulent
20-29	3.29	7.51	0.51	16.42
30-39	3.17	6.20	0.37	11.61
40-49	3.01	7.58	0.17	16.13
50-59	2.99	17.34	0.14	47.94
60-	3.35	26.36	0.29	63.77
All	3.21	12.93	0.40	31.40



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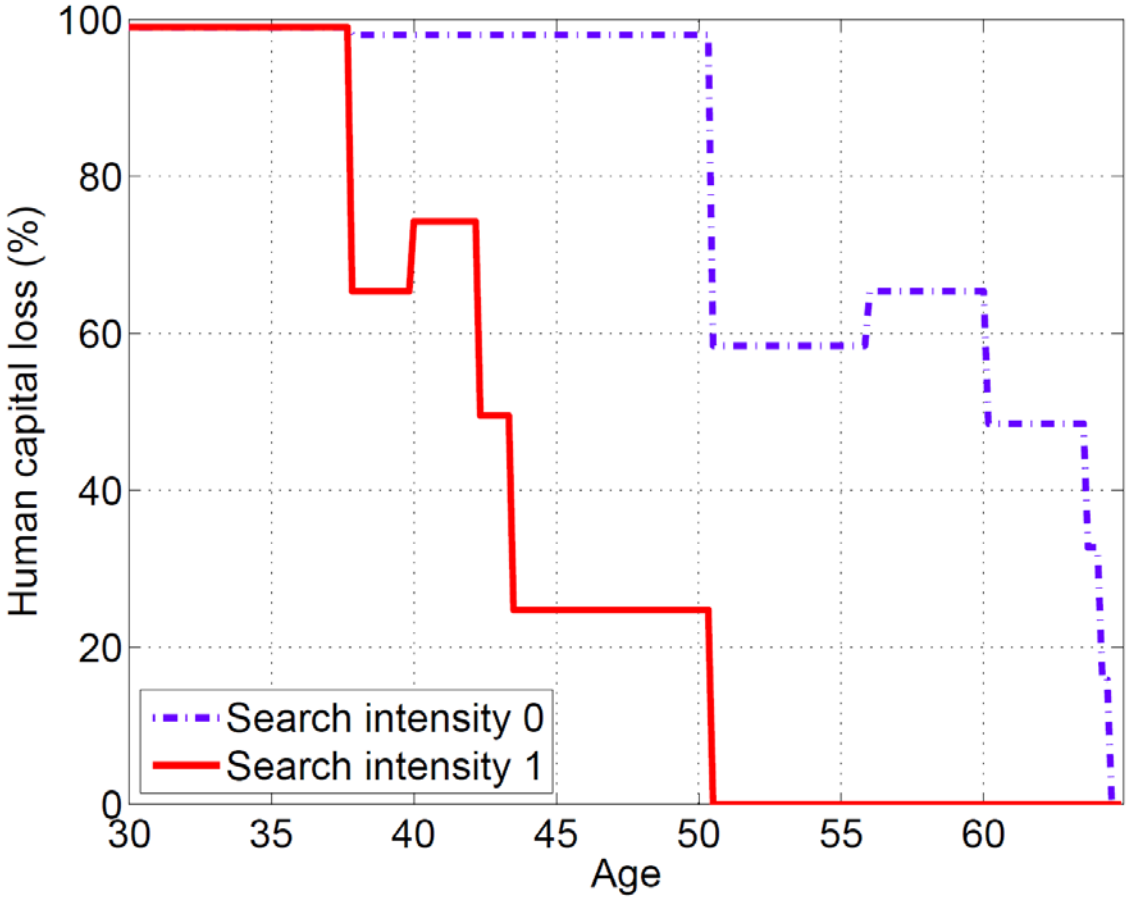
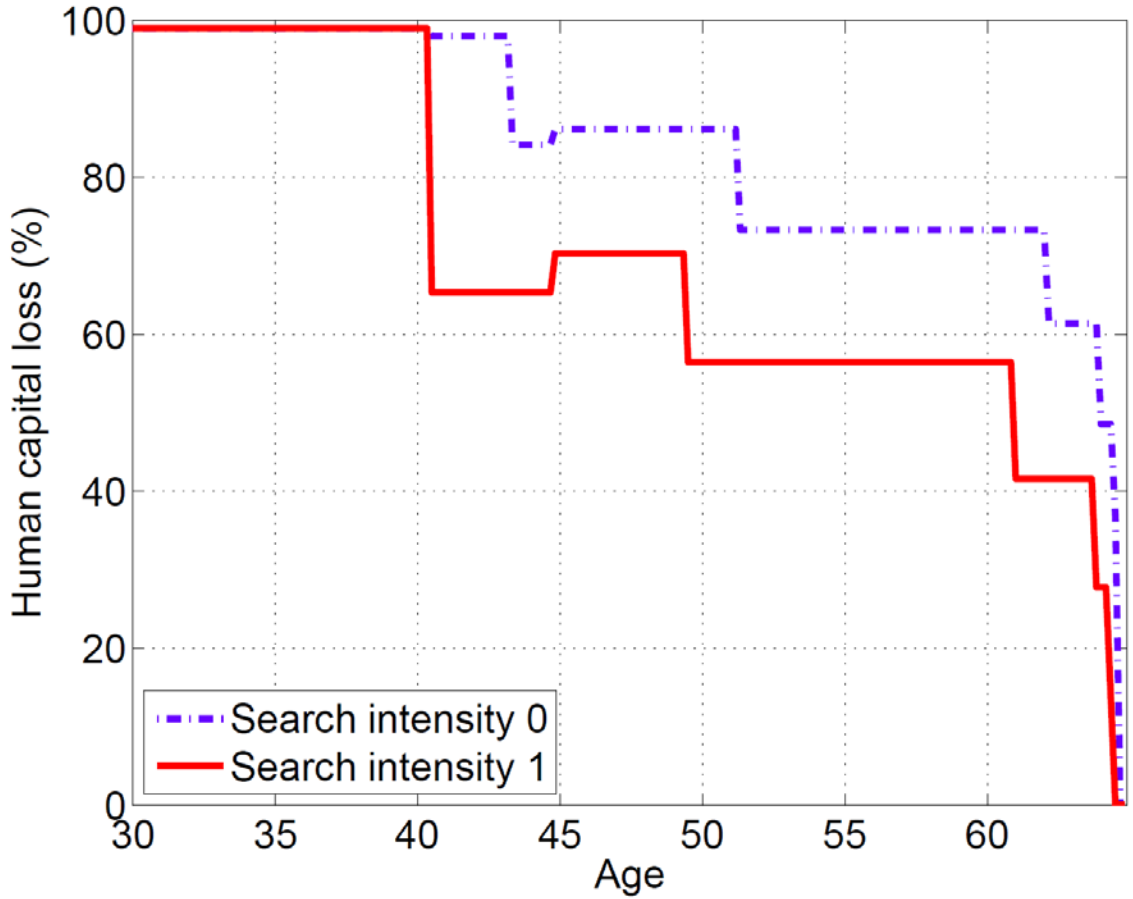
Search intensity of low-type workers in Europe in tranquil times

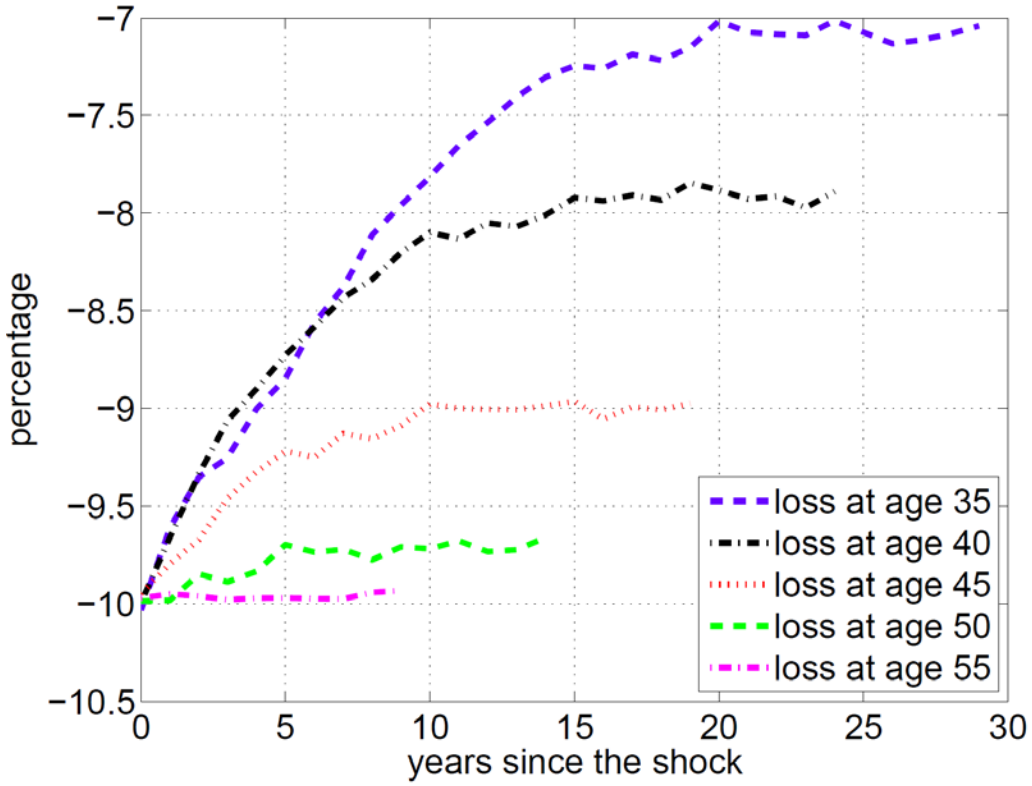


Optimal search intensity of the average low-type worker in Europe in tranquil times, as a function of age and 'human capital loss'. The agent is assumed to hold the average wealth level and to be entitled to benefits based on average earnings in her age group. The search intensity is plotted for different 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.



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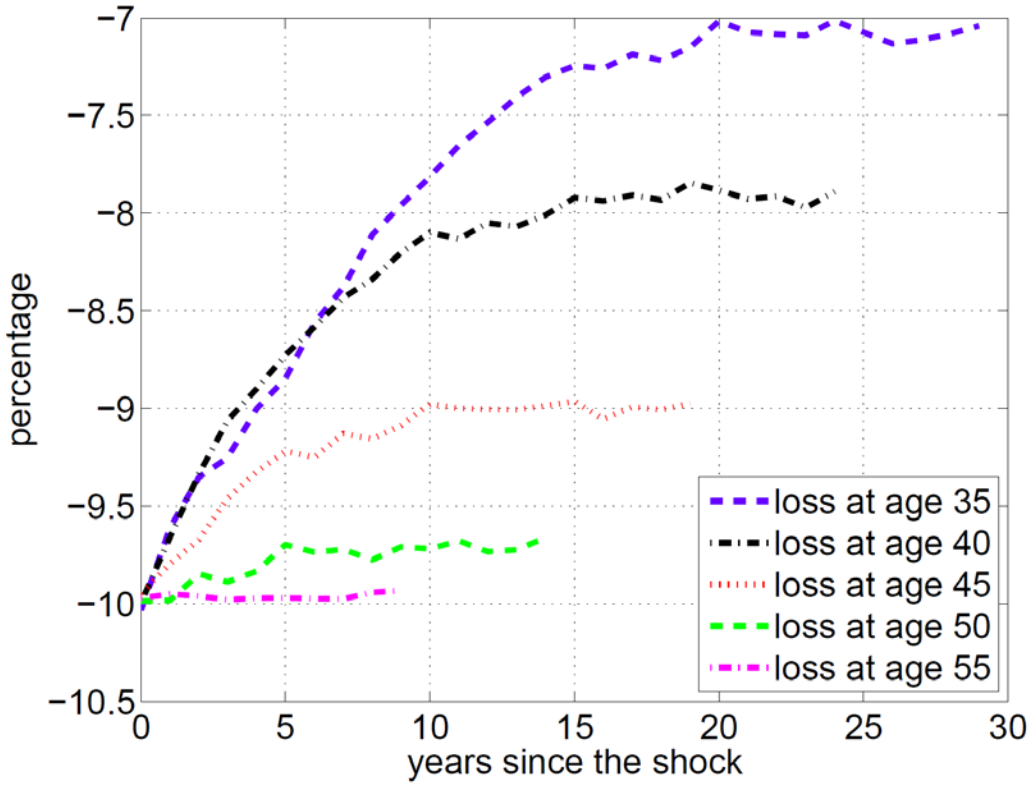

Percentage increase in earnings autocovariances between tranquil and turbulent times

Lag order	Age group 25-34	35-44	45-54
1-4	5.4	25.3	54.1
5-9	2.6	15.0	39.4
10-15	3.0	5.3	23.4

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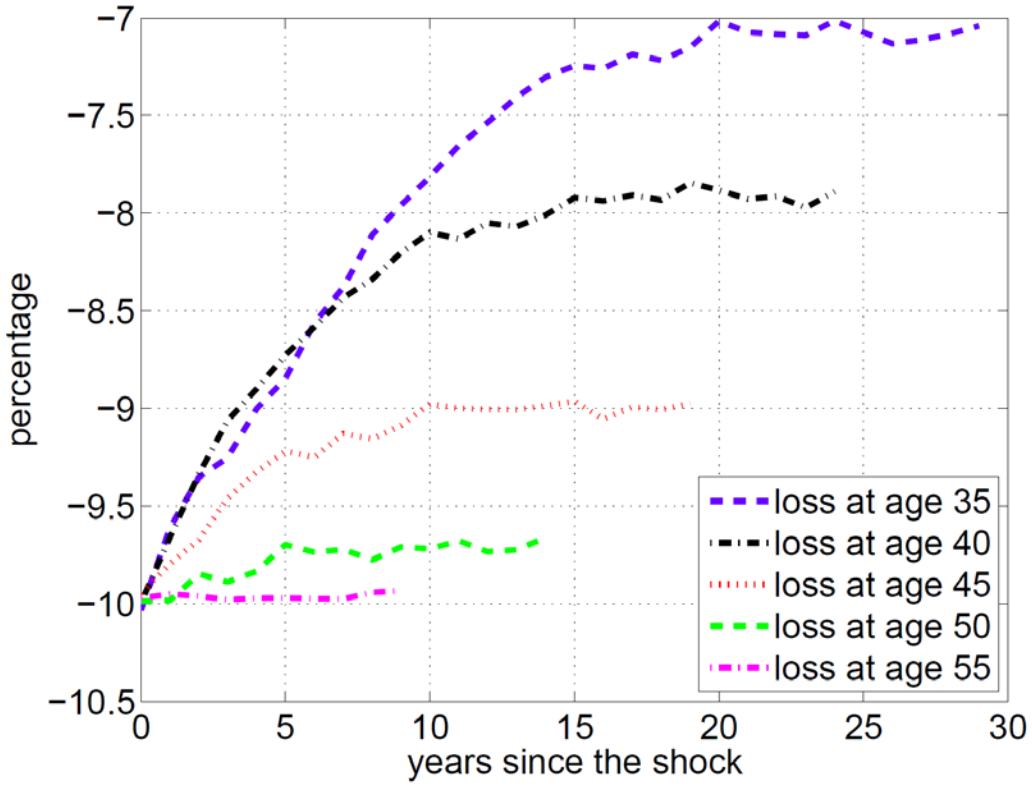

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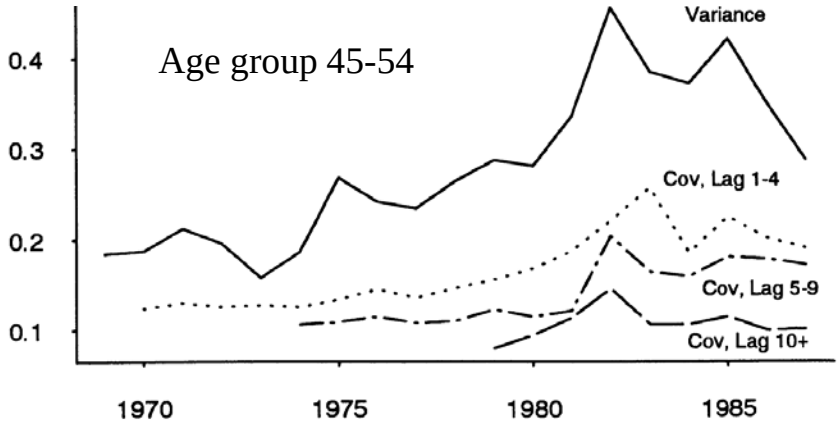
Moffitt & Gottschalk (1995):

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.
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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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This paper

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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)

Framework robustness

- Yes, matching and search-island (JME 2007a)
- No, employment-lottery rep. family (JME 2007b)

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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Probing the "tax story" for European unemployment

- 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)
- …. social security can put careers at a corner solution
- …. permanent neg. earnings shocks can shorten careers
- …. agents with "steeper" earnings profiles choose longer careers (RED 2014)

Random matching in the labor market

Realization of stochastic events

Workers supply labor $\hat{n}$ and invest in human capital

Firms with productivity z demand labor

Earnings shock θ

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

Human capital invest. outcome $H_i^n(h, \bar{h}; \ell)$

Exogenous job destruction rate λ
(the same fraction of workers must leave the labor market)

Human capital loss $H_i^\lambda(\bar{h}, h')$

Additional forced layoffs of inexperienced workers at rate $\tilde{\lambda} - \lambda$
(but no jobs are destroyed)

Firm productivity $Z(z, z')$

Endogenous job destruction by firms at rate q
(the same fraction of workers must leave the labor market)

Continuing employed inexperienced workers become experienced with prob. π

Workers quit voluntarily
(but no jobs are destroyed)

Workers consume and make decisions for next period