Specificity of Human Capital and European Unemployment

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Some Facts

- European Unemployment was lower in the 60's and 70's relative to the U.S, but has gone up since then.

	1960-69	1970-74	1975-79	1980-89	1990-99	2000-06
U.S.	4.78	5.38	7.04	7.27	5.71	5.11
EU	2.16	2.62	4.76	8.36	9.55	8.43

(Source: European Commission Annual Macroeconomic Database)

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- There is still significant heterogeneity among EU countries.

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- Specific: To what extent a combination of the higher pace of technological change and the specificity of human capital account for this?
- Why do we think these two might interact in a certain way?

Some Other Facts

- Technological investment in information and communications technologies (ICT) has been relatively weak in E.U.

ICT Investment as a share of GDP					
	1980	1985	1990	1995	2001
U.S.	2.5	3.4	3.3	3.7	4.2
EU	1.2	1.9	2.2	2.1	2.6

(Source: Timmer et al.)

More Facts

- ICT contribution to output growth has been stronger in the U.S. relative to European nations.

ICT Contribution to Output Growth			
	1980-85	1985-90	1990-96
U.S.	0.28	0.34	0.42
Germany	0.12	0.17	0.19
Italy	0.13	0.18	0.21

(Source: Krueger and Kumar (2004))

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  - Vocational education in the U.S. is typically in two-year community colleges: In 1994, only 10.5 % of them were working towards a vocational degree.
  - Net entry into universities (general education) is much higher in the U.S. as well as college attainment.

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  - Unemployment might rise further than economies with a bias towards general education.
  - Productive matches will not be able to adapt easily.

An Example

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- Share of workforce with vocational education is higher in Poland relative to Estonia, 65 and 33 percent respectively.
- EU enlargement is interpreted as increasing turbulance.
- After enlargement Poland has persistently higher unemployment rates and durations.

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- Each productive match consists of a firm-worker pair.
- Match output is a function of worker's human capital and the level of technology.
- There are two types of workers, T different vintages of technology.

Workers

- Among workers, λ fraction has 'general' human capital (h_g), $1-\lambda$ fraction has 'specific' (vocational) human capita (h_s)l.

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- When employed, workers paid w.
- Wages determined via Nash bargaining.

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- Firms post vacancies as long as they make nonnegative expected profits.
- Filled jobs end exogenously each period with probability δ.

Production Technology

- Each match produces $Y_i(\tau) = A_\tau h_i$, where $\tau = \{0, 1, 2, ..., T\}$ and $A_0 > A_1 > ... > A_\tau > ... > A_T$.

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  - $C_i(A_\tau, A_{\tau'}) = \begin{cases} \frac{A_\tau}{2}\left(\gamma_i \frac{A_{\tau'}}{A_\tau} - 1\right)^2 & if\ \tau > \tau' \\ 0 & o/w \end{cases}$ where $\gamma_g < \gamma_s$.

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  - Cost of upgrading is higher for firms with type-s workers.

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- In a stationary equilibrium, among those unemployed, a fraction ϕ of them are type-g, i.e. $\phi = \frac{U_g}{U_g + U_s}$.
- All new meetings draw a random vintage available from a distribution $G(\tau)$.

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- Unemployed and vacant firms come together via $M(U, V)$.
- Matches that produced this period are subject to exogenous destruction with prob δ.

Bellman Equations

Workers

- Value of being unemployed for type-i worker, V_i^w satisfies

$$V_i^w = b_i + \beta \left\{ (1 - f(\theta)) V_i^w + f(\theta) \int_1^T J_i^w(\tau') dG(\tau') \right\}$$

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- Value of being employed for type-i worker in a match with τ vintage, $J_i^w(\tau)$ is defined as

$$J_i^w(\tau) = \max \left\{ V_i^w, \sum_{\tau'} \chi(\tau, \tau') \left[\begin{array}{c} w_i(\tau') + \\ \beta \left\{ \delta V_i^w + (1 - \delta) J_i^w(\tau' + 1) \right\} \end{array} \right] \right\}$$

where $J_i^w(T+1) = V_i^w$ and $\chi(\tau, \tau')$ is an indicator function that gives technological upgrading decision of the firm.

Bellman Equations

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- Value of posting a vacancy, V^f satisfies

$$V^f = -c + \beta \left\{ (1 - h(\theta)) V^f + h(\theta) \left[\begin{array}{c} \phi \int_1^T J_g^f(\tau') dG(\tau') \\ +(1-\phi) \int_1^T J_s^f(\tau') dG(\tau') \end{array} \right. \right.$$

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- Value of a filled job with worker, $J_i^w(\tau)$ is defined as

$$J_i^f(\tau) = \max \left\{ V^f, \max_{\tau'} \left\{ \begin{array}{c} y_i(\tau') - w_i(\tau') - c(\tau, \tau') \\ +\beta \left\{ \delta V^f + (1-\delta) J_i^f(\tau'+1) \right\} \end{array} \right. \right\}$$

where $J_i^f(T+1) = V^f$.

Wage Determination

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- Remaining share of the surplus goes to the firm

$$J_i^f(\tau) - V^f = (1-\mu) S_i(\tau) \tag{2}$$

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  - Some matches upgrade and change vintage.
  - Some matches are kept productive at the current vintage.
  - Some matches become either obsolete or too costly to maintain.
  - New matches are formed.

Equilibrium

- Equilibrium is a list $(J_i^w(\tau), V_i^w, J_i^f(\tau), V^f, \theta, \bar{\tau}, \chi(\tau, \tau'), w(\tau), \phi, u_g, u_s)$ such that:

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3. θ derives the value of posting a vacancy to zero.
4. ϕ satisfies the condition, $\phi = \frac{U_g}{U_g + U_s}$.
5. Cutoff decision, $\bar{\tau}$, and upgrading decisions, $\chi(\tau, \tau')$ are optimal.

A Benchmark Calibration (?)

Table: Benchmark Calibration

Parameter	Value
β	0.99
μ	0.3
δ	0.03
(h_g, h_s)	$(1.2, 1.32)$
c	0.29
b	$b_h = 0.84,\ b_l = 0.87$
λ	$\lambda_h = 0.7,\ \lambda_l = 0.4$
g	$g_h = 1.015, g_l = 1.01$

A Numerical Exercise

Equilibrium for different λ and g's.								
	λ_h				λ_l			
	θ	u	u_s	u_dur	θ	u	u_s	u_dur
g_l	1.53	0.044	0.049	2.62	1.58	0.045	0.048	3.09
g_h	1.04	0.061	0.083	4.12	1.04	0.070	0.083	5.05

A Numerical Exercise

Equilibrium for different b and g's.								
	b_h				b_l			
	θ	u	u_s	u_dur	θ	u	u_s	u_dur
g_l	1.28	0.051	0.057	3.575	1.58	0.045	0.048	3.09
g_h	0.75	0.090	0.106	6.407	1.04	0.070	0.083	5.05

A Numerical Exercise

Equilibrium for different b, λ and g's.								
	λ_h, b_l				λ_l, b_h			
	θ	u	u_s	u_dur	θ	u	u_s	u_dur
g_l	1.53	0.044	0.049	2.62	1.28	0.051	0.057	3.575
g_h	1.04	0.061	0.083	4.12	0.75	0.090	0.106	6.407

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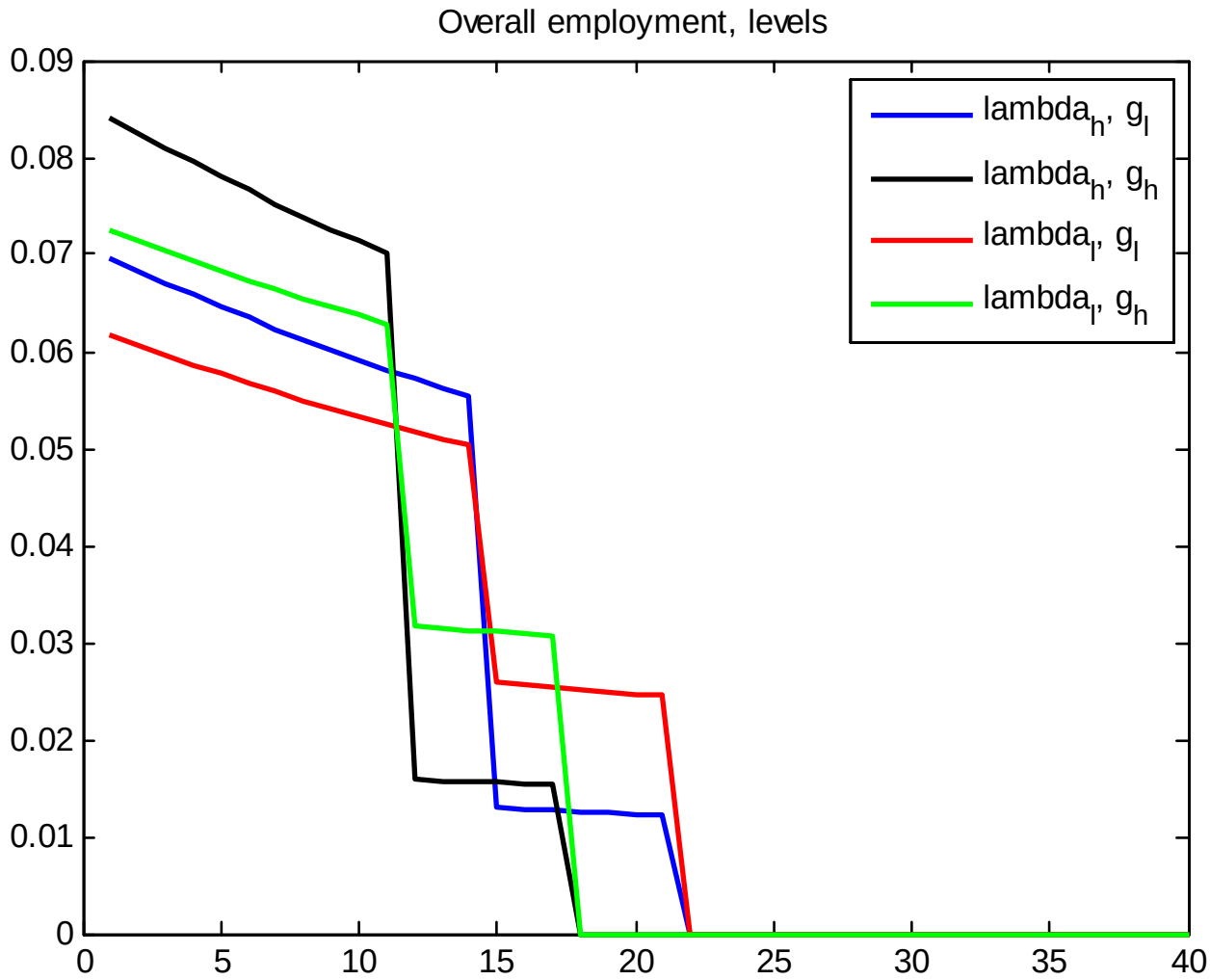

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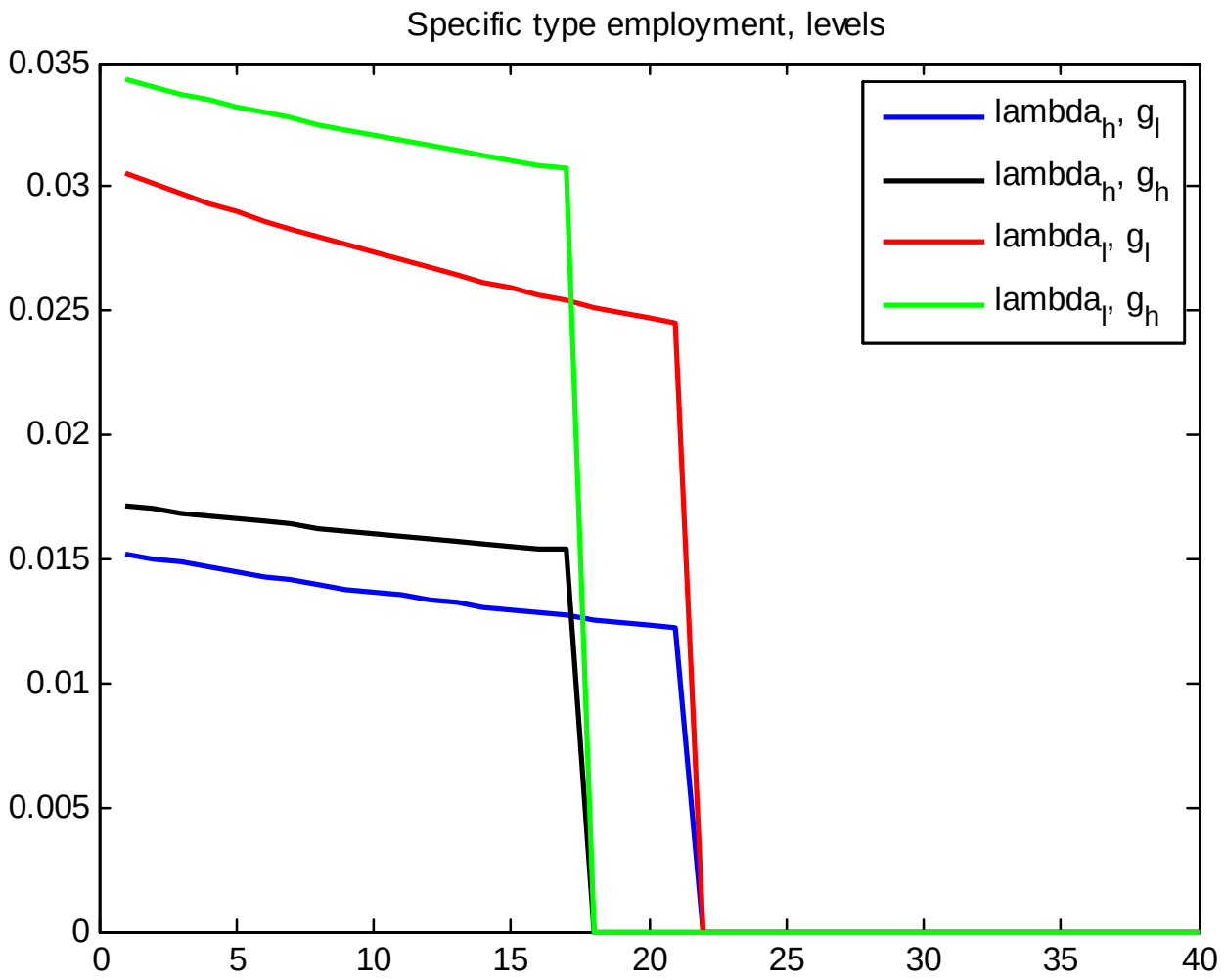

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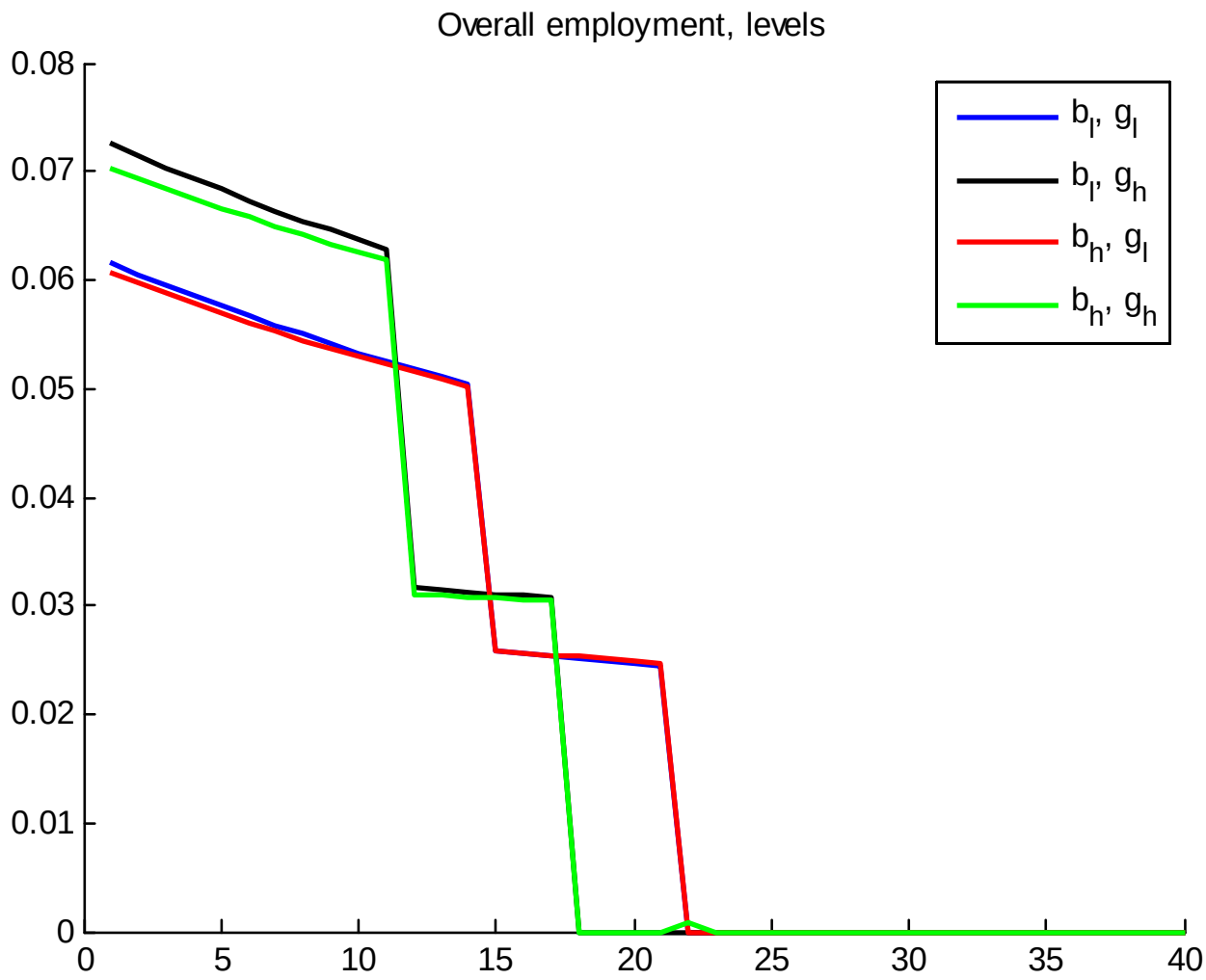

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- In economies with general education bias, on average more recent vintages of technology are used in production. They adapt more easily when the pace of tech. change increases.
- Still more to do....

Table A1. Education indicators.

Country	% Upper Sec. in General	% Upper Sec. in Vocational	University Net Entry Rate	Non-university Tertiary Attainment	University Tertiary Attainment	Non-university Tertiary Return	University Tertiary Return
Austria	23	77	26	2	6		
Finland	48	52		9	12	11	15
France	47	53	33	8	11	18	14
Germany	23	77	27	10	13	17	11
Italy	28	72			8		10
Netherlands	30	70	34		22		11
Sweden	44	53		14	14	7	8
EU	42.4	57.6					
United States			52	8	25	9	13

Notes: Variable description and data sources (all measures are for 1995):
All data from Education at a Glance: OECD Indicators 1997, from specified tables.
% of students enrolled in upper secondary education in general and vocational streams: Table C3.2.
University net entry rate: Table C4.1.
Non-university tertiary (vocational) and tertiary attainment (% adult population): Table A2.1.
Non-university tertiary (vocational) and tertiary rates if return: Table E5.1.

Table A2. Education expenditures.

Country	Exp./GDP (Prim. + Sec.)	Exp./GDP (Vocational Tertiary)	Exp./GDP (Univ. Tertiary)	Exp. Per Student (Vocational Tertiary)	Exp. Per Student % of Per Cap. GDP (Vocational Tertiary)	Exp. Per Student (Univ. Tertiary)	Exp. Per Student % of Per Cap. GDP (Univ. Tertiary)
Austria	4.2	0.3	1.2	7,245	31	11,279	48
Finland	3.7	0.2	1.5	5,776	27	7,582	35
France	4.4	0.3	0.9	7,636	36	7,113	34
Germany	3.7	0.4	1	10,924	48	10,139	44
Italy	3.5	0.1	0.8	6,283	36	6,295	28
Netherlands	3.1		1.2	7,592	31	10,796	44
Sweden	4.5		1.7				
United States	3.7		2.3			19,802	61

Notes: Variable description and data sources (all measures are for 1998):
All data from Education at a Glance: OECD Indicators 2001, from specified tables.
Education expenditure as a % of GDP (all levels): Table B2.1c.
Expenditure per student (in PPP $): Table B1.1.
Expenditure per student as a % of per capita GDP: Table B1.2.
For Austria and Germany, non-university tertiary expenditure per pupil are presented under vocational tertiary; for other countries, expenditure per pupil in tertiary B is presented.