When Offshoring Threatens Jobs: Lifelong Education and Occupation Choice

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Motivation

Offshoring has reduced demand for low-skill jobs (Hummels et al. '14; Traiberman '19)

- It shifted labor demand from manufacturing to services (Utar '18)
- Workers may face severe transition costs due to obsolete skills

Training these workers with new skills may mitigate the distributional concern

- Policymakers seek a resilient environment to labor market shocks

However, a quantitative model for assessing adult training policy has lacked

We develop a framework to study the role of adult training in occupation choice

- We focus on the Danish adult apprenticeship scheme, which aims to provide adult individuals with the skills relevant to the current labor market.

What we do

Provide facts about Danish adult apprenticeship, offshoring exposure, and jobs

- We propose matching between training areas and relevant occupations
- Offshoring exposure is associated with apprentice program take-ups
- We estimate a dynamic D-in-D model of occupation changes on training

Develop and estimate a life-cycle model of occupation and education choices

- The model has a logit solution to occupation and education choices
  - A correlation between programs within an occupation is introduced to capture heterogeneous responses
- We estimate it using a combination of pseudo-expectation maximization (EM) algorithm (Arcidiacono Miller '11) and the Bellman equation (Artuc et al. '10)
- We do counterfactual analysis about alternative training policies

Takeaways

- Mobility: Among production workers, business service (BS) training takers move to BS occupations 0.9-3.1 p.p. higher
- The elasticity of program take-up is lower than that of the occupational switch, indicating special insensitivity to apprenticeship incentives
- More attractive BS programs raise training take-up in the BS area, with strong churning effects on occupation choices
- The same counterfactual reform reduces the non-employment share in case of negative labor market shocks, providing resilience

Related literature

Evaluation of Adult Training Programs: Ashenfelter ('78); Ashenfelter Card ('85); Heckman et al. ('97); Heckman et al. ('99); Sianesi ('04); Jacobsen et al. ('05); Jespersen et al. ('08); Hyman ('18); Humlum ('20); Pulito ('22)

→ We study the effect of programs on occupational transition

Dynamic Discrete Choice Models of Labor Market Adjustment: Artuç et al ('10); Dix-Carneiro ('14); Caliendo et al ('19); Traiberman ('19)

→ We open up a way of human capital accumulation by adult apprenticeship

Danish Flexicurity: Aagaard et al ('04); Anderson Svarer ('07); Christensen Skipper ('09); Bolvig et al. ('17); Humlum Munch ('19); Kreiner Svarer ('22)

→ We propose a finer classification of programs in Denmark

Roadmap

Danish Adult Apprenticeship and Administrative Data

Offshoring, Course take-up, Jobs

Quantitative analysis of training policy changes

Adult apprenticeship in Denmark

The Danish education system has a strong lifelong and vocational nature

- Large adult learners shares (Rasmussen et al., '19)
- Large share of vocational education relative to general education both for youth and adults

We focus on training decisions made by workers rather than firms

- For this purpose, we study adult apprenticeship "*Voksenlærling*"
  - Adults aged 25+ can apply for these introductory programs free of charge
- So, we omit labor market education *"Arbejdsmarkedsuddannelser" (AMU)*
  - AMU programs typically last very short (only a few days), and normally, firms decide who to participate (Humlum and Munch, '19)

Main data sources: Danish administrative data

Integrated database for employment (IDAN)

- An employer-employee matched register
- Each individual's main job as of November is registered
- Used to measure the employment, earnings, occupation, and firm

Course participants with adult and continuing education (VEUV)

- The activity-level register of adult and continuing education
- Includes the program code, start/end date, completion flag, etc.
- Aggregated into the individual-year panel and matched with IDAN
  - In case of multiple course taking, we assign the one with the highest hours in each year to each individual

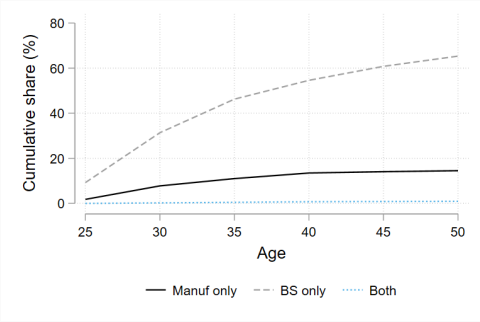
Final sample: Individuals aged 25-64 between 1993 and 2022

Program classification and concordance with occupation group Jump

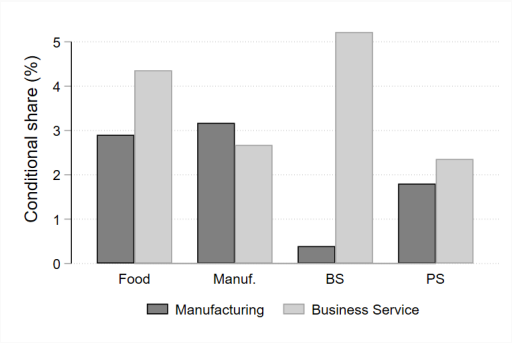
DISCED education areas	Occupations (DISCO)
Agriculture and Food	51, 52 (Restaurant/stores), 6X (Agriculture)
Manufacturing and Technology	7X (Craftsmanship), 8X (Machine operator)
Business Service (BS)	33 (Administration), 41, 43 (Office work)
Personal Service	32 (Health technician), 53 (Caring work)

- Our classification is more granular than existing ones (e.g, Jacobsen et al., '05)
- Manufacturing and BS have ample variation, which we mostly focus on

Patterns of adult apprenticeship areas



Portfolio



Area Share Conditional on Occupation

The “portfolio” shows the distribution of apprentice experiences up to each age

- Most individuals take courses in at most one area through the life cycle

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Offshoring exposure

We first develop the offshoring exposure measure

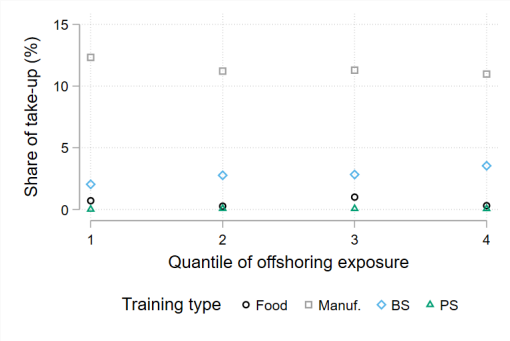
We use a firm-level "narrow offshoring" value (Feenstra Hanson '99; Hummels et al, '14)

- We take output product codes (HS4) from the Danish PRODCOM survey (*VARS*)
- We also obtain the import values from customs data (*UHDI*)
- Then, we compute the total import values of the products the firm produces

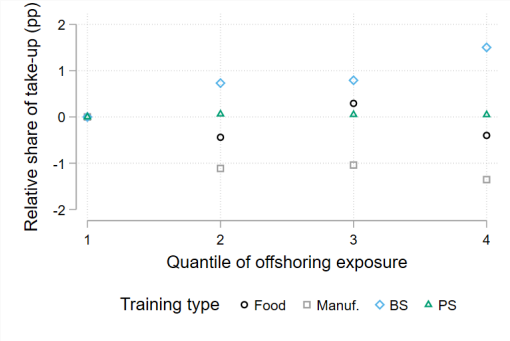
We relate the worker's offshoring exposure and apprenticeship take-up share

- We compute 10-year growth rates of offshoring values for each firm
- We assign workers to the firm they worked in the initial period
- Worker's exposure is measured by the quantile of the offshoring growth
- We focus on low-skilled workers

Offshoring and training by types



Levels



Relative to Quantile 1

The BS-program training intensity is higher for workers exposed to offshoring

Sample Construction for Dynamic Matching Analysis

To study the dynamic job effect of training, we make an exact-matching sample

Notation:

- τ: treatment year (cohort)
- o: previous occupation
- v: program type

Matching procedure:

1. For each (τ, o), we select all individuals who worked in occupation o in all years $t = \tau - 5, \ldots, \tau - 1$ (cf. "stacked event study" in Cengiz et al., '19)
2. Then, for each v, we define:
   - Control group: selected individuals that did not receive education v in year τ
   - Treatment group: those that receive education v for the first time in year τ

Apprenticeship and occupation choice over time

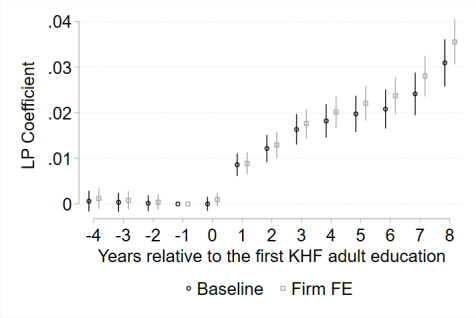
We estimate the following linear probability local projection model (Dube et al. '22)

$$y^v_{i,t+k} - y^v_{i,t-1} = \beta^{o,v}_k \Delta D^v_{it} + \gamma^{o,v}_k X_{i,t,k} + \varepsilon^{o,v}_{i,t,k},$$

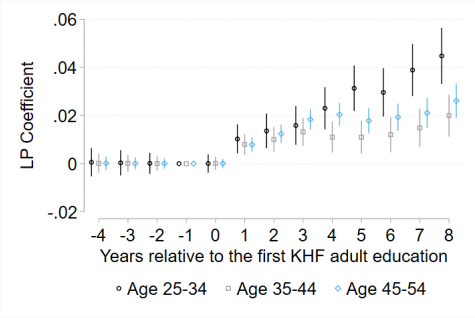
- y^v_{it}: indicator for employment in occupation v
- D^v_{it}: indicator for program-v takeup by t ($D^v_{it} = 1$ is an absorbing state)
- $k = -4, \ldots, 8$ ($k \neq -1$): the lag and lead from the treatment
- $X_{i,t,k}$ includes control variables including "unclean control" indicator

$\beta^{o,v}_k$: probability effect on working in occupation v in k years for those who have worked in o

Positive effect for manufacturing workers who take up business service



Baseline Result



Subsample Analysis By Ages

- Average yearly transition rates from Manuf to BS: 2-4%.

Additional results

Other combinations of (o, v): We find positive results when v is BS Jump

- Reskilling effect when $o = Manuf, v = BS$
- Upskilling effect when $o = v = BS$

Subsample Analysis

- Firm size: Effects are similar in both small and large firms Jump
- Education: The low-skill (high school) and middle-skill (vocational school) have effects Jump
- Gender: Women have stronger effects than men Jump
- Business cycle: The effects are stronger in recession Jump

Results on earnings: Mincerian equations show positive associations between earnings and training Jump

Roadmap

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Quantitative analysis of training policy changes

Overview of the model and estimation

Model: Dynamic discrete choice of occupation (Traiberman '19) and program type

- Program participation raises the occupation-specific human capital at the cost of utility
- Training substitutes human capital accumulation by tenure
- The model is partial equilibrium given skill prices and has a closed-form solution using the correlated Gumbel preference shock

Estimation: Three-step estimation

1. Estimate the human capital function and finite mixture structure by the pseudo-Expectation-Maximization algorithm (Arcidiacono Miller '11)
2. Estimate the occupation choice elasticity using the model-implied relationship between occupation switch and wages (Traiberman '19)
3. Do a similar to derive the relationship between program choice and wages

Policy analysis: Making education more attractive

We consider:

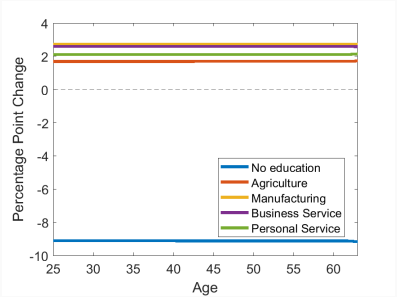
- Conditional on program take-up, 10% of the occupation-specific wage is added to the current consumption amount
- This exercise may reflect
  - a wage subsidy reform (cf. Pedersen et al., '23) or
  - reducing the time cost of program takeup

Two scenarios are studied:

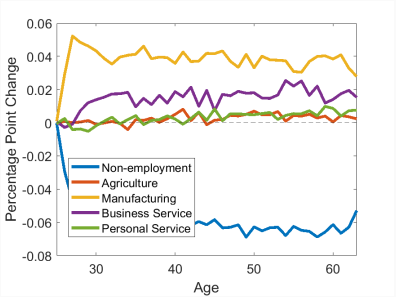
- "Universal" reform: the subsidy is conditional on taking any programs
- "BS-Targeted" reform: the subsidy is conditional on taking a BS program

We simulate 100,000 individuals to study the life-cycle patterns

The effect of the Universal Reform



Education takeup



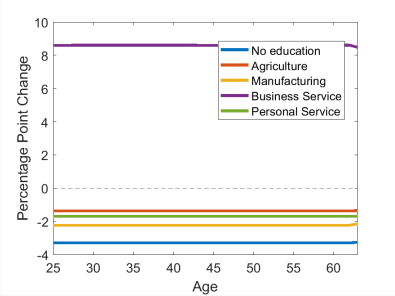
Occupation choice

Many shift from non-education to some education throughout the life-cycle

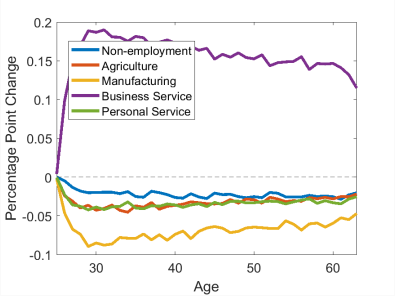
This increases both manufacturing and BS employment

- This effect is proportional to the baseline employment share

The effect of the BS-Targeted Reform



Education takeup



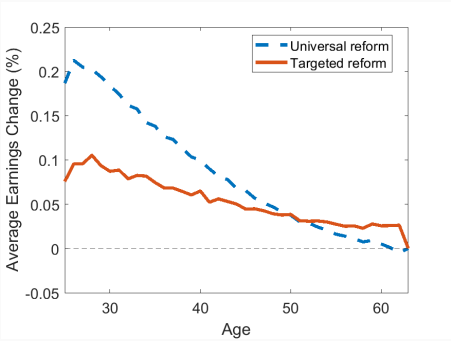
Occupation choice

BS education and occupation increase throughout the life-cycle

Furthermore, there is a great reduction in manufacturing jobs

- Workers do not have to accumulate human capital in a traditional occupation

The effect on earnings over the life-cycle



The youth benefits more as many take apprenticeships when young

Targeted reform helps individuals to leave manufacturing in the long run and raise earnings towards the end of their working life

Resilience to the offshoring shock

We next turn to the question of resilience: How different policies help workers out of non-employment after negative labor market shocks

We (parsimoniously) model the offshoring shock by reducing wages for manufacturing occupations by 10 %

We study the impact on the share of occupations over the life-cycle, conditional on workers working in manufacturing at age 25

Targeted reform provides resilient employment

		Baseline economy (%)			Shock Effect (%)		
	Age	Non-emp	Manuf.	BS	Non-emp	Manuf.	BS
Baseline policy	30	14.21	60.92	9.46	+6.72	-18.43	+4.22
	45	21.13	59.19	7.10	+9.85	-19.07	+3.05
	60	25.38	58.00	6.03	+12.44	-20.39	+2.76
Targeted reform	30	14.99	58.58	9.71	+6.36	-18.06	+4.45
	45	21.97	56.85	7.79	+8.93	-19.53	+3.29
	60	27.46	55.41	6.21	+11.95	-21.15	+3.00
Universal reform	30	14.09	62.11	8.59	+6.61	-18.82	+4.29
	45	20.56	60.28	6.88	+10.32	-19.93	+3.27
	60	24.61	59.38	5.64	+12.33	-20.25	+2.72

Wrapping up

We analyze joint decisions of occupation and education over the life cycle

- Empirical evidence suggests that business-service (BS)-related adult apprenticeship pushes the occupation choice toward more BS
- We develop a canonical logit choice model of occupation and education
- Structural estimation suggests that education choice has lower sensitivity estimates than the occupation choice sensitivity
- Increasing wage subsidies to BS programs reduces production occupations and provides resilience to the labor market shocks

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Roadmap

Backup

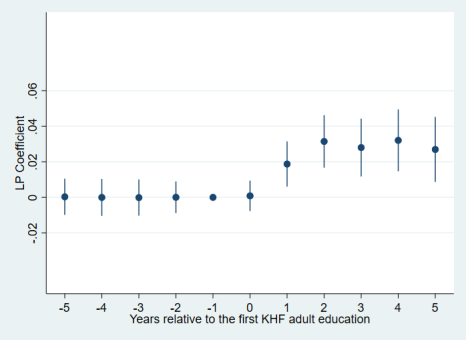
Course examples (2010) Back

DISCED education areas	Course name
Agriculture and Food	Restaurant, canteen and catering
	Food for groups with varied nutritional needs
Manufacturing and Technology	The organization of work in production in industry
	Basic competence driver - goods
Business Service	Administration
	Retail trade
Personal Service	Nursing and educational work
	Social psychiatry and physical/mental disability

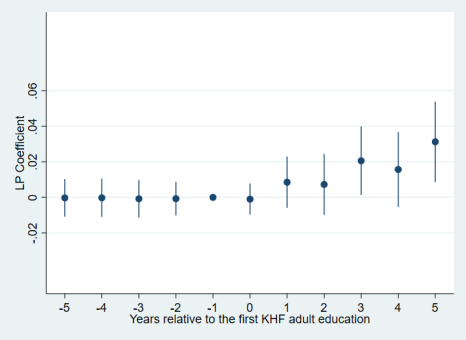
- Broadly, programs are sorted by Danish education classification (DISCED-15)
  - It provides a natural link between education and occupation codes, as follows

Effects of BS training

Back



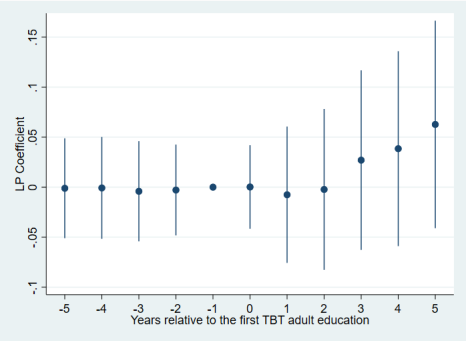
From Manuf. employment to BS education



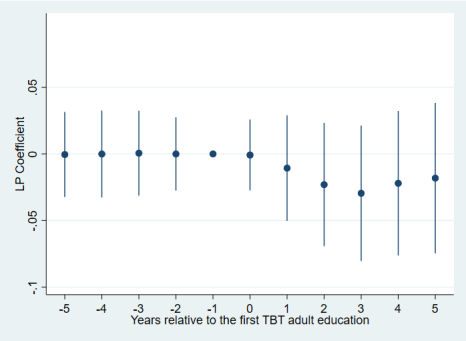
From BS employment to BS education

Effects of Manuf. training

Back



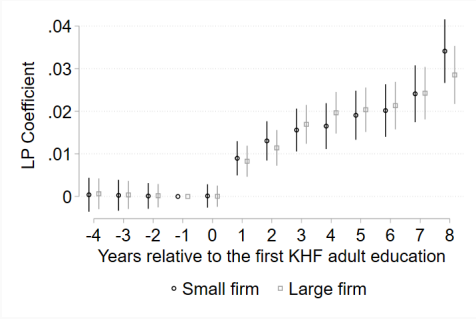
From Manuf. employment to Manuf. education



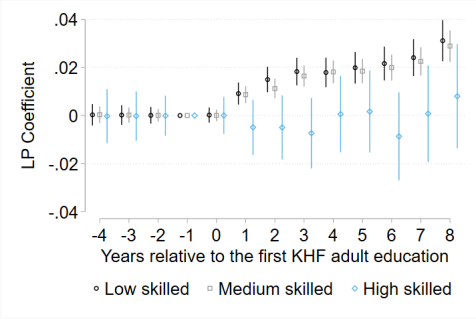
From BS employment to Manuf. education

Subsample analysis–Firm size and Education

Back



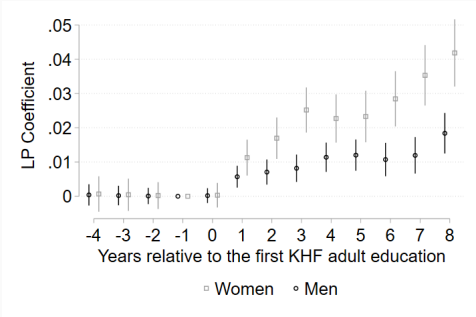
Across Firm Size



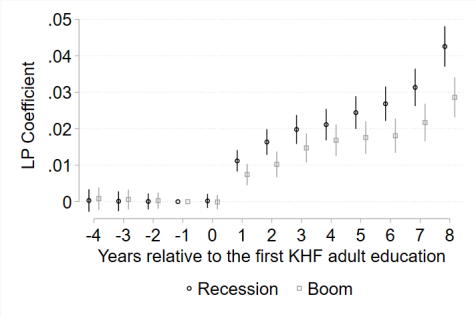
Across Education Level

Subsample analysis–Gender and business cycle

Back



Across Gender



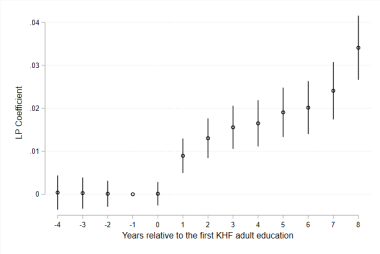
Across Business Cycle

These are consistent with the meta-analysis by Card et al. (2018)

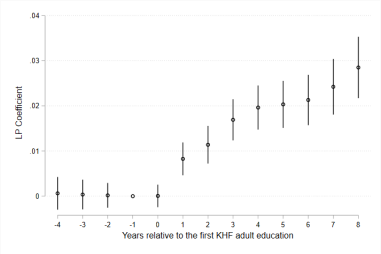
Results across firm sizes

Back

- Internal experiences can lead to managerial positions (Frederiksen Kato '18)
  - This raises concern of employer assignments, especially in large firms
- To mitigate this concern, we separate sample according to firm size



Below median



$(o, v) = (Manuf, BS)$

- We find a similar pattern between the two groups

Past education and earnings in each occupation

Back

We estimate a Mincer equation modified to the adult apprenticeship

$$\ln w_{i,t}^{o} = \beta_0^o + \beta_1^o age_{i,t} + \beta_2^o \left(age_{i,t}\right)^2 + \beta_3^o tenure_{i,t}^{o} + \beta_4^o training_{i,t}^{o} + \eta_i + \varsigma_{i,t}^{o}, \text{ if } o_{it} = o$$

- $w_{i,t}^{o}$ is earning in occupation o
- $tenure_{i,t}^{o}$ is the number of consecutive years of working in o measuring the occupation-specific experience
- $training_{i,t}^{o}$ is the dummy variable of program takeup in the relevant occupation in the past
- η_i is the individual fixed effect to control for unobserved constant abilities

β_4^o captures the correlation between past training and current earnings

Results

Back

	log earnings			
	AgFood.	Manuf.	BusSer.	PerSer.
Tenure	0.0134***	0.0120***	0.0157***	0.0173***
	(0.0009)	(0.0001)	(0.0001)	(0.0001)
Training	-0.0456	0.0338***	0.0247***	-0.0473*
	(0.0674)	(0.0071)	(0.0029)	(0.0189)
Quadratic age and indv FE	Yes	Yes	Yes	Yes
N	148611	6152134	4133980	6591667

Past education takeup is positively correlated with the current earnings in manufacturing and business service

Including past earnings

Back

To address the concern of mean reversion, we include the past earnings control, which did not change the results qualitatively

	log wage			
	AgFood.	Manuf.	BusSer.	PerSer.
Tenure	0.00905***	0.00336***	0.00576***	0.00237***
	(0.000568)	(0.0000988)	(0.0000906)	(0.000129)
Training	-0.0881	0.0156**	0.00623**	-0.0556***
	(0.0638)	(0.00704)	(0.00265)	(0.0188)
Lag log wage	0.0346***	0.0984***	0.129***	0.145***
	(0.00313)	(0.000829)	(0.000892)	(0.00106)
Quadratic age and indv FE	Yes	Yes	Yes	Yes
N	148611	6152134	4133980	6591667

Solution Equations

Back

$$E_t V_{t+1}\left(\tilde{ten}, \tilde{o}, \tilde{v}, \boldsymbol{\omega}\right) = \sigma \ln \Phi_t\left(\tilde{ten}, \tilde{o}, \tilde{v}, \boldsymbol{\omega}\right) + \sigma\gamma$$

for $t < T$ and $V_{T+1} = 0$, where Φ_t is the inclusive value function satisfying

$$\Phi_t\left(\tilde{ten}, \tilde{o}, \tilde{v}, \omega\right) \equiv \sum_{o,v} \exp\left(\frac{1}{\sigma}\frac{1}{1-\rho_o}\left(V_t^D\left(o, v|\tilde{ten}, \tilde{o}, \tilde{v}, \omega\right) + A_{o,v}\right)\right)$$

Relative values of occupations

Back

The relative value can be written as

$$V_t^D\left(o, v_1|\tilde{ten}, \tilde{o}, \tilde{v}\right) - V_t^D\left(o, v_0|\tilde{ten}, \tilde{o}, \tilde{v}\right) =$$

$$\frac{1}{\sigma}\left\{\beta\left[\underbrace{\begin{pmatrix} C_{t+1}\left(o_1'|\tilde{ten}, \tilde{o}, \tilde{v}\right) \\ -C_{t+1}\left(o_0'|\tilde{ten}, \tilde{o}, \tilde{v}\right)\end{pmatrix}}_{\text{current value}} - \underbrace{\sigma \ln\left(\frac{\pi_{t+1}\left(o_1', v'|\omega'\left(o, v_1\right)\right)}{\pi_{t+1}\left(o_0', v'|\omega'\left(o, v_0\right)\right)}\right)}_{\text{future value}}\right] + A_{ov_1} - A_{ov_0}\right\}$$