Trade Shocks and Labor Adjustment, ACM(2010)

October 16, 2020

Outline

Model

Estimation

Counter-factual Simulation

Model (lifetime utility maximization)

$$V_t(x,\epsilon) = \pi_t(x) + \max_{a\in\{1,\ldots,A\}} \left\{ u_t^a(x) + \epsilon_{i,t}^a + \beta \mathbb{E}_t \left[V_{t+1}\left(x',\epsilon'\right) \mid x, a \right] \right\}$$

- x: individual state
- $\pi_t(x)$: payoff at time t
  - observed by econometrician
  - common to all individuals in state x
  - subject to aggregate shocks
- Timeline: in each period.

1. Aggregate shocks are realized so that $\pi_t(x)$ is realized.
2. Individual receive $\pi_t(x)$
3. The individual receives an idiosyncratic shock $\epsilon_{i,t} \equiv \left(\epsilon_{i,t}^a\right)$ and chooses a. After choosing, receiving $u_t^a(x) + \epsilon_{i,t}^a$
4. The individual enters the next period in state x' with transition probability $Pr(x'|x,a)$

Model

Assumptions:

- $x_t = a_{t-1} = j$
- $u_t^{a_t}(x_t) = -C^{a_{t-1},a_t} = -C^{j,k}$

Given assumptions, the model can be written as:

$$V_t^j(\epsilon) = w_t^j + \max_k \left\{ \epsilon_{i,t}^k - C^{j,k} + \beta \mathbb{E}_t \bar{V}_{t+1}^k \right\} \tag{1}$$

, where $\bar{V}_t^j = \mathbb{E}_\epsilon \left[V_t^j(\epsilon) \right]$, and $C^{j,j} = 0$.

Model

From (1),

$$\begin{aligned} V_t^j(\epsilon) &= w_t^j + \max_k \left\{ \epsilon_{i,t}^k - C^{j,k} + \beta \mathbb{E}_t \bar{V}_{t+1}^k \right\} \\ &= w_t^j + \max_k \left\{ \epsilon_{i,t}^k - C^{j,k} + \beta \mathbb{E}_t \bar{V}_{t+1}^j - \beta \mathbb{E}_t \bar{V}_{t+1}^j + \beta \mathbb{E}_t \bar{V}_{t+1}^k \right\} \\ &= w_t^j + \beta \mathbb{E}_t \bar{V}_{t+1}^j + \max_k \left\{ \epsilon_{i,t}^k \underbrace{- C^{j,k} + \beta \left[\mathbb{E}_t \bar{V}_{t+1}^k - \mathbb{E}_t \bar{V}_{t+1}^j \right]}_{\bar{\epsilon}_t^{j,k}} \right\} \\ &= w_t^j + \beta \mathbb{E}_t \bar{V}_{t+1}^j + \max_k \left\{ \epsilon_{i,t}^k + \bar{\epsilon}_t^{j,k} \right\} \end{aligned}$$

Model

The probability of individual choosing k can be written as:

$$\begin{aligned}
\Pr(k|j) &= \Pr\left(\bar{\epsilon}^{jk} + \epsilon^{k} \geq \bar{\epsilon}^{jl} + \epsilon^{l}\right) \\
&= \Pr\left(\epsilon^{l} \leq \bar{\epsilon}^{jk} + \epsilon^{k} - \bar{\epsilon}^{jl}\right) \\
&= \int_{-\infty}^{\infty} f\left(\epsilon^{k}\right) \prod_{l \neq k} F\left(\bar{\epsilon}^{jk} + \epsilon^{k} - \bar{\epsilon}^{jl}\right) d\epsilon^{k}
\end{aligned}$$

Model

Assuming $\epsilon \sim \text{Gumbel}(0, \nu)$, i.e. $F(\epsilon) = e^{-\exp\left(-\frac{\epsilon}{\nu} - \gamma\right)}$, (1) $\Rightarrow$

$$\mathrm{P}_t(k|j) = \frac{\exp\left(\bar{\varepsilon}^{jk}/\nu\right)}{\sum_{l=1}^{n} \exp\left(\bar{\varepsilon}^{jl}/\nu\right)}$$

$$\mathrm{P}_t(k|j) = \frac{\exp\left[\frac{1}{\nu}\left(-C^{j,k} + \beta \mathbb{E}_t \bar{V}_{t+1}^{k}\right)\right]}{\sum_l \exp\left[\frac{1}{\nu}\left(-C^{j,l} + \beta \mathbb{E}_t \bar{V}_{t+1}^{l}\right)\right]} \tag{2}$$

Let $\Omega_t^j = \nu \ln\left\{\sum_k \exp\left[\frac{1}{\nu}\left(-C^{j,k} + \beta \mathbb{E}_t \bar{V}_{t+1}^{k}\right)\right]\right\}$,

$$\bar{V}_t^j = w_t^j + \Omega_t^j \tag{3}$$

$$\mathrm{P}_t(k|j) = \exp\left[\frac{1}{\nu}\left(-C^{j,k} + \beta \mathbb{E}_t \bar{V}_{t+1}^{k} - \Omega_t^j\right)\right] \tag{4}$$

Identification Strategy

From (3) and (4),

$$
\begin{aligned}
&\ln \mathrm{P}_t(k \mid j) - \ln \mathrm{P}_t(j \mid j) \\
\overset{[1]}{=}& -\frac{1}{\nu} C^{j,k} + \frac{\beta}{\nu} \mathbb{E}_t \left[\bar{V}^k_{t+1} - \bar{V}^j_{t+1} \right] \\
\overset{[2]}{=}& -\frac{1}{\nu} C^{j,k} + \frac{\beta}{\nu} \mathbb{E}_t \left[w^k_{t+1} - w^j_{t+1} + \Omega^k_{t+1} - \Omega^j_{t+1} \right]
\end{aligned}
\tag{5}
$$

Remark:
Step [1] relates current choice probabilities to expected next-period values.

Identification Strategy

$$
\begin{aligned}
&\Omega^k_{t+1} - \Omega^j_{t+1} \\
&\overset{[3]}{=} C^{j,m} - C^{k,n} + \beta \mathbb{E}_{t+1}\left[\bar{V}^n_{t+2} - \bar{V}^m_{t+2}\right] - \nu \left[\ln \mathrm{P}_{t+1}(n \mid k) - \ln \mathrm{P}_{t+1}(m \mid j \right. \\
&\overset{[4]}{=} C^{j,n} - C^{k,n} - \nu \left[\ln \mathrm{P}_{t+1}(n \mid k) - \ln \mathrm{P}_{t+1}(n \mid j)\right]
\end{aligned}
\tag{6}
$$

, where [4] follows by $m = n$

Remark:

Step [3] relates next-period values to next-period choice probabilities and next-next-period values. By choosing the same next-next-period state, step [4] directly relates differences in next-period values to differences in next-period choice probabilities.

Identification Strategy

From (5) and(6), $\Rightarrow$

$$\begin{aligned} & \ln \mathrm{P}_t(k \mid j) - \ln \mathrm{P}_t(j \mid j) \\ = & -\frac{1}{\nu} C^{j,k} + \frac{\beta}{\nu} \mathbb{E}_t \left[w_{t+1}^k - w_{t+1}^j \right] \\ & + \frac{\beta}{\nu} \left(C^{j,n} - C^{k,n} \right) - \beta \left[\ln \mathrm{P}_{t+1}(n \mid k) - \ln \mathrm{P}_{t+1}(n \mid j) \right] \\ \overset{[5]}{=} & -\frac{1-\beta}{\nu} C^{j,k} + \frac{\beta}{\nu} \mathbb{E}_t \left[w_{t+1}^k - w_{t+1}^j \right] - \beta \left[\ln \mathrm{P}_{t+1}(k \mid k) - \ln \mathrm{P}_{t+1}(k \mid j) \right] \end{aligned} \tag{7}$$

,where [5] follows by letting $n = k$

Remark: (7) is a type of Euler equation that relates current choice probabilities to per-period payoffs and next-period choice probabilities.

Identification Strategy

From (7),

$$\left(\ln m_t^{jk} - \ln m_t^{jj}\right) = \frac{-(1-\beta)}{\nu} C^{jk} + \frac{\beta}{\nu}\left(w_{t+1}^k - w_{t+1}^j\right) + \beta\left(\ln m_{t+1}^{kj} - \ln m_{t+1}^{kk}\right) + \mu_{t+1} \quad (8)$$

,where m denotes the flow probability observed from data.

Rearrangement:

$$\ln \frac{m_t^{jk}}{m_t^{jj}} + \beta \ln \frac{m_{t+1}^{kk}}{m_{t+1}^{kj}} = \frac{-(1-\beta)}{\nu} C^{jk} + \frac{\beta}{\nu}\left(w_{t+1}^k - w_{t+1}^j\right) + \mu_{t+1} \quad (9)$$

Run (9) as regression, we can estimate C^{jk} and ν.

What's the meaning of ν?

It relates to the variance of idiosyncratic shock.

- $\text{Var}(\varepsilon) = \frac{\pi^2 \nu^2}{6}$
- High value of ν means that idiosyncratic non-pecuniary factors are dominant in workers' transition decisions, so that workers do not pay much attentions to wages when making decisions.
- High ν implies a low elasticity of response to wages.

Data

CPS data from 1976-2001.

- micro data $\Rightarrow$ flow probability $m_t^{j,k}$, and industry wage w_t^j.
- gender: male
- age: 25-64
- full-time workers: $\geq$ 26 weeks/year
- income: \$50-5,000 /week
- 6 industries:
  1. Agriculture and Mining
  2. Construction
  3. Manufacture
  4. Transportation
  5. Communication and Utility
  6. Services

Data

Table: Descriptive Statistics: Gross flows, 1975-2000

	Agric/Min	Const	Manuf	Trans/Util	Trade	Service
Agric/Min	0.9292	0.0126	0.0142	0.0075	0.0160	0.0206
	(0.0146)	(0.0040)	(0.0046)	(0.0032)	(0.0063)	(0.0057)
Const	0.0056	0.9432	0.0139	0.0063	0.0119	0.0191
	(0.0028)	(0.0108)	(0.0029)	(0.0023)	(0.0027)	(0.0040)
Manuf	0.0020	0.0041	0.9708	0.0031	0.0080	0.0120
	(0.0008)	(0.0008)	(0.0035)	(0.0010)	(0.0012)	(0.0021)
Trans/Util	0.0025	0.0044	0.0068	0.9643	0.0081	0.0138
	(0.0011)	(0.0018)	(0.0016)	(0.0050)	(0.0023)	(0.0033)
Trade	0.0030	0.0061	0.0135	0.0055	0.9469	0.0250
	(0.0011)	(0.0015)	(0.0033)	(0.0017)	(0.0073)	(0.0036)
Service	0.0018	0.0043	0.0079	0.0037	0.0103	0.9720
	(0.0008)	(0.0011)	(0.0013)	(0.0008)	(0.0014)	(0.0033)

Data

Table: Descriptive Statistics: Wages, 1975-2000

	Mean [1]	Standard deviation [1]	Mean [2]	Standard deviation [2]	Sample size
Agric/Min	34,739	24,978	0.8374	0.6021	20,952
Const	38,432	21,623	0.9265	0.5213	44,943
Manuf	42,655	21,706	1.0283	0.5233	140,339
Trans/Util	43,608	20,552	1.0512	0.4954	55,699
Trade	37,024	23,288	0.8925	0.5614	83,833
Service	43,617	26,810	1.0514	0.6463	173,012

[1] In 2000 dollars

[2] Normalized

Empirical results

$\beta = 0.97$		$\beta = 0.9$	
Panel I. Full sample: OLS			
ν	C	ν	C
4.466	22.065	2.085	10.261
(1.829**)	(1.780**)	(3.731***)	(3.684***)
Panel II. Full sample with instruments			
ν	C	ν	C
2.897	13.210	1.600	7.699
(2.667***)	(2.558***)	(4.606***)	(4.561***)

- OLS: extremely high transition cost.
- IV: endogenous variable in $(t-1)$ period as IV.
- Labor movement in response to a differential in wages are very sluggish. Unobserved and nonpecuniary factors motivated labor movement.

Empirical results

Panel III. Time averaging			
ν	C	ν	C
3.338	8.477	1.424	4.320
(7.932***)	(6.035***)	(10.401***)	(10.117***)
Panel IV. Annualized flows			
ν	C	ν	C
1.884	6.565	1.217	4.703
(3.846***)	(3.381***)	(5.700***)	(5.626***)
Panel V. Correction for composition effects (linear, basic)			
ν	C	ν	C
2.750	9.586	2.266	8.756
(1.974**)	(1.914**)	(2.259**)	(2.257**)
Panel VI. Correction for composition effects (linear, extra interactions)			
ν	C	ν	C
2.539	8.848	2.051	7.924
(2.143**)	(2.065**)	(2.491***)	(2.488***)
Panel VII. Correction for composition effects (log-linear, basic)			
ν	C	ν	C
2.978	10.378	2.177	8.413
(2.394***)	(2.288**)	(3.121***)	(3.116***)
Panel VIII. Correction for composition effects (log-linear, extra interactions)			
ν	C	ν	C
2.795	9.743	2.051	7.924
(2.489***)	(2.369***)	(3.225***)	(3.219***)

Counter-factual Simulation Setup

CES production function:

$$y_t^i = \psi^i \left(\alpha^i \left(L_t^i \right)^{\rho^i} + \left(1 - \alpha^i \right) \left(K^i \right)^{\rho^i} \right)^{1/\rho^i} \tag{10}$$

,where $K^i = 1 \forall i$, parameters $\alpha^i > 0, \rho^i < 1, \psi^i > 0$

Take the FOC with respect to L_t^i,

$$w_t^i = p_t^i \alpha^i \psi^i \left(L_t^i \right)^{\rho i - 1} \left(\alpha^i \left(L_t^i \right)^{\rho^i} + \left(1 - \alpha^i \right) \right)^{\left(1 - \rho^i\right)/\rho^i} \tag{11}$$

Pinning down α, ψ, ρ

Minimize the loss function:

$$\mathsf{L} = \sum_i \sum_t \left[\left(\widehat{w_t^i} - \bar{w}_i \right)^2 + \left(\widehat{L_t^i} - \bar{L}_i \right)^2 \right] \tag{12}$$

and

$$(\alpha_i, \psi_i, \rho_i) = \arg\min \mathsf{L}$$

Other parameters for simulation

- ν and C^{jk}: result from annualized-flow-rate in Panel IV.
- w: generate from production
- L: based on w from production function and ddcm.
- initial labor share L_0^i:

Trade shock specification

Assumptions:

1. Units are chosen so that the domestic price of each good at date $t = -1$ is unity.
2. There are no tariffs on any sector aside from manufacturing, at any date.
3. The world price of manufacturing output is 0.7 at each date. Other tradable good prices remain unity.
4. Tariff $= 0.3$ so that domestic price is unity for manufacture sector
5. Tariff is permanent, economy is at the steady state with this expectation.(Without anticipation)
6. Government announce at the end of $t = -1$ (after the transition decisions). Tariff takes place at the beginning of $t = 0$

Parameters for simulation

Table: Parameters for simulation

	α^i	ρ^i	ψ^i	Consumer share	Domestic price	World price
Agric/Min	0.691	0.6828	0.6733	0.07	1	1
Const	0.6544	0.4924	0.7653	0.3	1	1*
Manuf	0.3224	0.3553	1.6965	0.3	1	0.7
Trans/Util	0.5721	0.5664	1.0393	0.08	1	1*
Trade	0.5714	0.445	0.9125	0	1	1*
Service	0.3418	0.5576	2.2135	0.25	1	1

Note: Under the second simulation specification, the sectors marked with an asterisk are nontraded, so they have no world price.

Specification 1: All goods are tradable

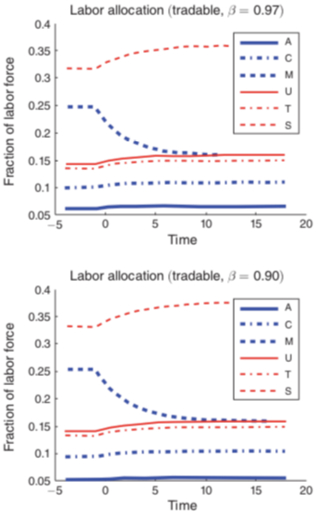


Figure: labor share

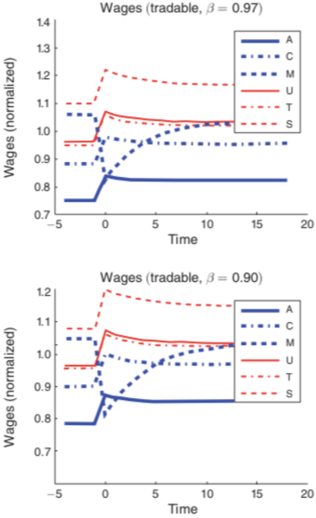


Figure: wage

Specification 1: All goods are tradable

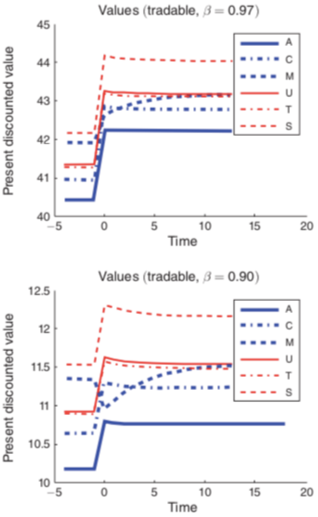


Figure: walfare

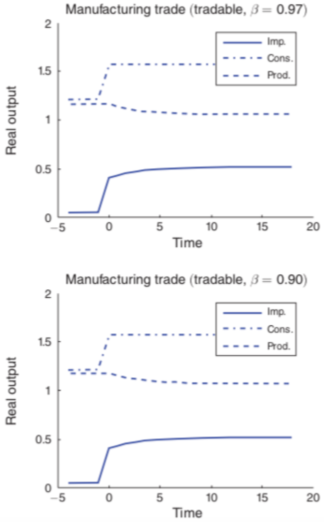


Figure: manufacture sector

Specification 1: All goods are tradable

- labor share $\downarrow$: 25%$\rightarrow$ 16% (Manufacture labor share)
- wage: $\downarrow$, $\nearrow$ gradually. (labor supply shift)
- welfare:
  - $\beta = 0.97$, all workers benefit.
  - $\beta = 0.9$, value $\downarrow$ sharply, $\nearrow$ gradually. (hurt form liberalization)

Specification 2: Non-traded sectors

- Construction, Transportation/Utilities, and Trade are taken to be non-traded.
- Their price are endogenous, determined from production function (supply) and number of labor forces in the sector (demand)

Price

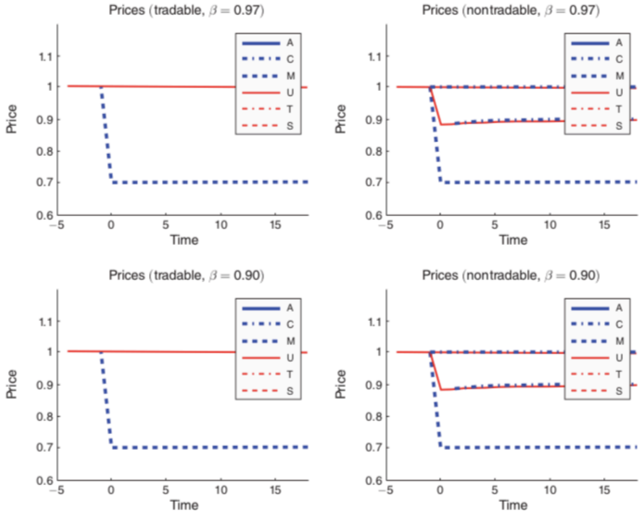


Figure: Price setup, tradable and nontradable

Specification 2: Non-traded sectors

- The pattern is similar, but non-traded sectors expand less.
  - Compare to manufacture product, goods of non-traded sector become more expansive, reducing their demand. price $\downarrow$

Worker heterogeneity

- A life cycle model considering workers are Old/young; less/more educated

Worker heterogeneity - Trans cost

TABLE 8—ESTIMATES FROM THE LIFE-CYCLE MODEL

	$\beta = 0.97$	$\beta = 0.9$
ν	1.606	1.429
	(3.148***)	(3.365***)
$C^{N,Y}$ (young, no college degree)	3.666	4.553
	(2.277**)	(3.222***)
$C^{C,Y}$ (young, college degree)	7.054	6.294
	(2.103**)	(3.006***)
$C^{N,O}$ (old, no college degree)	5.054	5.552
	(2.346***)	(3.102***)
$C^{C,O}$ (old, college degree)	9.817	8.566
	(2.397***)	(3.028***)

Notes: Full sample, with instruments. Gross flows are annualized as in panel IV of Table 3.

Worker heterogeneity - Trans cost

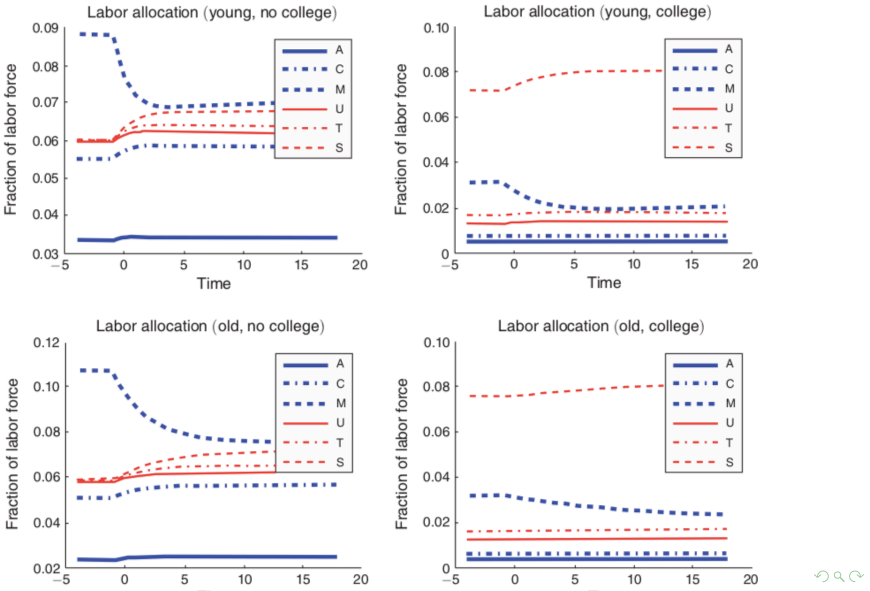
TABLE 9—WALD TESTS FOR DIFFERENCES IN MOVING COSTS ACROSS TYPES

Null hypothesis	$\beta = 0.97$	$\beta = 0.9$
$C^{N,Y} = C^{C,Y}$	1.437	2.624
$C^{N,O} = C^{C,O}$	2.103	3.443*
$C^{N,Y} = C^{N,O}$	3.676*	3.556*
$C^{C,Y} = C^{C,O}$	1.824	3.152*

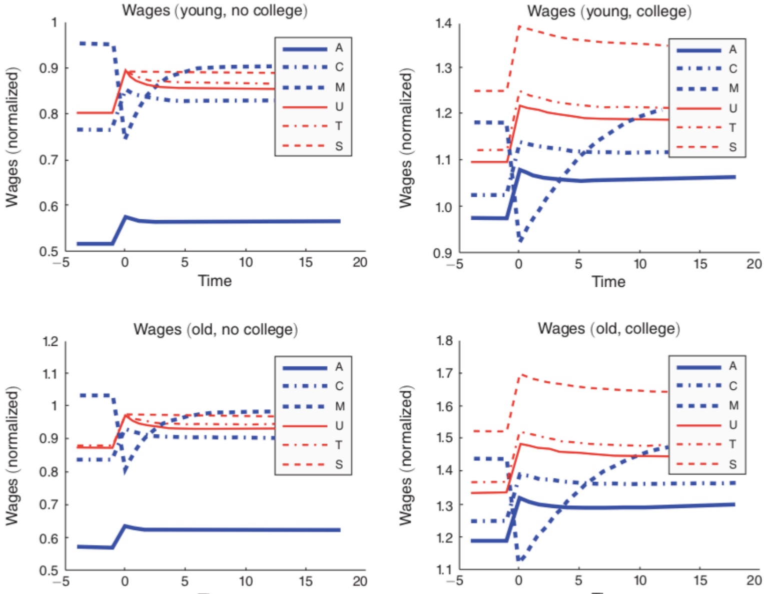
Notes: Wald tests, based on estimation in Table 8.

One-tail significance:
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

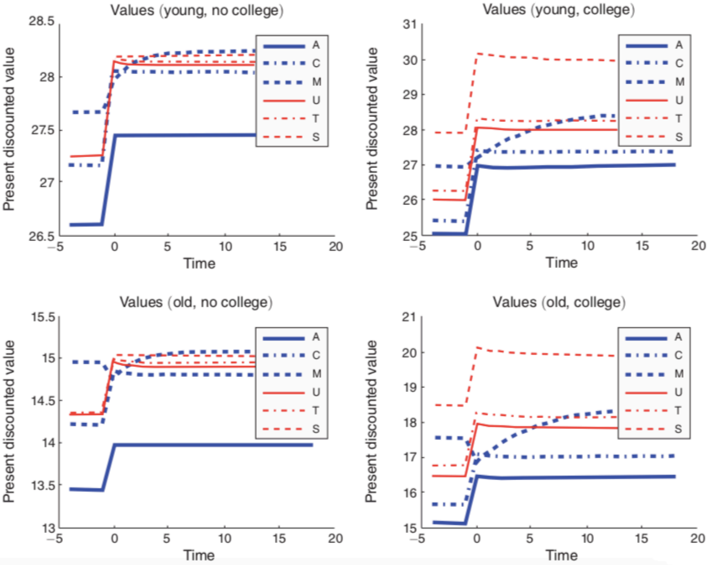
Worker heterogeneity - labor allocation



Worker heterogeneity - wage



Worker heterogeneity - welfare



Conclusion

1. wage differential does not make much sense $\Rightarrow$ Extremely high trans cost.
2. simulation shows 95% reallocation finish in 8 years.
3. sharp movement in the short-run, overshooting the long-run effect.
4. option value matters in welfare analysis.
5. heterogeneity: older worker are more vulnerable under high discount rate, but if discount rate is low, all workers suffer.
6. "birth sector" is much important in terms of the benefits gaining from liberalization.

At the end

- empty cells in ACM. $\Rightarrow$ larger sample size?
- include unemployment sector may reduces the trans cost.