Trade and Labor Market Dynamics

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Motivation

- Recent models of trade emphasize labor reallocation within sectors from less to more productive firms

  $\Longrightarrow$ trade shocks result in simultaneous job destruction and job creation within sectors

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  1. slow down the adjustment to trade?
  2. lead to a dissipation of the gains from trade?
  3. create winners and losers (good and bad jobs)?

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- This paper studies transition dynamics in a version of Melitz model with DMP labor market frictions
  — DMP frictions in a model of large firms
  — challenging task due to the size of the state space
  — focus on a limiting case with full analytical characterization

Related Literature

- A dynamic version of Helpman and Itskhoki (2010) with focus on transition dynamics
- Trade and labor market dynamics:
  - Coşar, Guner and Tybout (2011)
  - Davidson, Martin and Matusz (1999)
  - Kambourov (2009), Coşar (2010)
- Labor-macro: Elsby and Michaels (2013), Schaal (2012)

Main findings

1. Steady state gains from trade do not depend on LM frictions
2. Gains in consumer surplus are instantaneous and do not depend on labor market frictions
   — due to free entry $\sim$ Atkeson and Burstein (2010)
3. This is despite that in the short run:
   (a) slow transitions in the labor market
   (b) depressed trade flows
   (c) new productive entrants crowded out by slowly shrinking old unproductive incumbents
4. But LM frictions lead to short-run profit loss and depressed wages in incumbent firms hurt by foreign competition
   — temporary and permanent 'bad jobs'
   — income losses are increasing in LM frictions, but small
5. LM frictions result in non-monotonic path of productivity

Setup

- Two symmetric countries
- Two goods:
  1. homogenous non-traded good
     — numeraire outside good
  2. differentiated traded good
     — large monopolistically competitive firms
- Symmetric DMP labor market frictions in both sectors:
  — random search and matching
  — Nash wage bargaining without commitment
- One-time unanticipated bilateral trade liberalization
- Discrete time with time period Δ, short enough for accurate continuous-time approximation

Demand

- Representative family's utility:

$$\mathbb{U} = \int_0^\infty e^{-\rho t} \mathcal{U}\big(q_{0t}, Q_t\big) \mathrm{d}t$$

- CES aggregator of differentiated goods:

$$Q = \left(\int_{\omega \in \Omega} q(\omega)^\beta \mathrm{d}\omega \right)^{1/\beta}, \quad 0 < \beta < 1$$

- **Assumption 1**: *The utility function is quasi-linear:*

$$\mathcal{U}(q_0, Q) = q_0 + \frac{1}{\zeta} Q^\zeta, \quad 0 < \zeta < \beta, \quad q_0 \in \mathbb{R}, Q \in \mathbb{R}_+.$$

- Period utility is then: $\mathcal{U}_t = E_t + \frac{1-\zeta}{\zeta} Q_t^\zeta$ with expenditure E_t

Families and Labor Supply

- Unit-continuum of families with L units of labor per period:
  - N workers are assigned to differentiated sector
  - $N_0 = L - N$ workers are assigned to outside sector
- Workers can be employed H or unemployed (searching) U
  - s is exogenous job separation rate
  - x is job finding rate ($\sim$ labor market tightness)
- **Assumption 2**: *Unemployed are mobile across sectors.*
- Families pool consumption risk and consume their income (labor income plus distributed profits)

Outside sector

- Hiring cost (Cobb-Douglas matching function):

$$b_0 = a_0 x_0^{\alpha}$$

- Hired worked produces one unit of outside good per unit of time and job is destroyed at rate s_0
- Wages are Nash bargained without commitment

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- Wages are Nash bargained without commitment
- **Assumption 3**: *L is large enough that along the equilibrium path $U_{0t} > 0$ for all t.*
- **Lemma 1**: (i) (x_0, b_0) *are constant and satisfy:*

$$\left[2(r + s_0) + x_0\right] b_0 = 1 - b_u.$$

(ii) *The value of unemployed is constant and given by:*

$$rJ_0^U = b_u + x_0 b_0.$$

▸ proof

1. Fixed cost f_e $\Rightarrow$ productivity $\theta \sim G(\theta) = 1 - \theta^{-k}$, $k \geq \frac{\beta}{1-\beta}$
2. Production $y = \theta h$ at fixed cost f_d with revenue:

$$R = \left[1 + \iota \tau^{-\beta} (Q^*/Q)^{-\frac{\beta-\zeta}{1-\beta}}\right]^{1-\beta} Q^{-(\beta-\zeta)} y^{\beta} \quad \rightarrow \quad R = \Theta^{1-\beta} h^{\beta}$$

3. Export decision $\iota \in \{0, 1\}$ at fixed cost f_d and iceberg cost τ
4. Cost of hiring: bh, where $b = ax^{\alpha}$
5. Stole-Zweibel wage bargaining $\Rightarrow$ $w(h; \cdot)$
6. Firms die at rate δ and matches are destroyed at rate σ
   $\Rightarrow$ exogenous separation rate $s \equiv \delta + \sigma$

- Bellman equation for firm θ with export status ι:

$$J^F(h) = \max_{h'} \left\{ \varphi(h)\Delta - b\big[h' - (1-\sigma\Delta)h\big]^+ + \frac{1-\delta\Delta}{1+r\Delta} J^F_+(h') \right\},$$

where $\varphi(h) = R(h) - w(h)h - f_d - \iota f_x$

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- First order condition (*sS rule*):

$$\frac{1-\delta\Delta}{1+r\Delta} J^F_{h,+}(h') = \left[\begin{array}{cl} b, & \text{when } h' > (1-\sigma\Delta)h, \\ \in [0,b], & \text{when } h' = (1-\sigma\Delta)h, \\ 0, & \text{when } h' < (1-\sigma\Delta)h, \end{array} \right.$$

- Envelope theorem:

$$J^F_h(h) = \varphi'(h)\Delta + \frac{1-s\Delta}{1+r\Delta} J^F_{h,+}(h')$$

- Worker Bellman equation:

$$J^E(h) \qquad = w(h)\Delta + \frac{1 - s\Delta}{1 + r\Delta} \; J^E_+(h') \qquad + \; \frac{s\Delta}{1 + r\Delta} J^U_+$$

- Worker Bellman equation:

$$J^E(h) - J^U = w(h)\Delta + \frac{1 - s\Delta}{1 + r\Delta}\left(J^E_+(h') - J^U_+\right) + \left(\frac{1}{1 + r\Delta}J^U_+ - J^U\right)$$

Differentiated sector

Wage schedule and LM equilibrium

- Worker Bellman equation:

$$J^E(h)-J^U = w(h)\Delta + \frac{1-s\Delta}{1+r\Delta}\Big(J^E_+(h')-J^U_+\Big)+\Big(\frac{1}{1+r\Delta}J^U_+-J^U\Big)$$

- Stole-Zweibel bargaining: $J^E(h) - J^U = J^F_h(h)$

- Wage schedule solves:

$$\varphi'(h) = w(h) - \Delta^U \quad \Rightarrow \quad w(h) = \frac{\beta}{1+\beta}\frac{R(h)}{h} + \frac{1}{2}\Delta^U$$

where $\Delta^U = \frac{1}{\Delta}\Big(J^U - \frac{1}{1+r\Delta}J^U_+\Big) = b_u + \frac{x}{1+r\Delta}\big(J^E_+ - J^U_+\big)$

- Worker Bellman equation:

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- **Lemma 2**: (x, b) are constant and satisfy $xb = x_0 b_0$.

- Optimal hiring satisfies:

$$\varphi'(h) = (r+s)b \qquad \Rightarrow \qquad h = \Phi^{1/\beta}\Theta$$

$$\text{where} \quad \Phi = \left[\frac{\beta}{1+\beta}\frac{2}{b_u + [2(r+s)+x]b}\right]^{\beta/(1-\beta)}$$

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- **Lemma 3**: *Value of an entrant (with zero employees) if it hires in every future period:*

$$J^F(0) = \int e^{-(r+\delta)\tilde{t}} \left[\frac{1-\beta}{1+\beta}\Phi\Theta - f_d - \iota f_x\right] \mathrm{d}\tilde{t}$$

▸ proof

- For a hiring firm, production and export cutoffs:

$$\frac{1-\beta}{1+\beta}\Phi Q^{-\frac{\beta-\zeta}{1-\zeta}}\theta_d^{\frac{\beta}{1-\beta}} = f_d,$$

$$\frac{1-\beta}{1+\beta}\Phi \tau^{-\frac{\beta}{1-\beta}} Q^{*-\frac{\beta-\zeta}{1-\zeta}}\theta_x^{\frac{\beta}{1-\beta}} = f_x$$

- Therefore, we can write the flow value of the firm:

$$\frac{1-\beta}{1+\beta}\Phi\Theta - f_d - \iota f_x = f_d\left[(\theta/\theta_d)^{\frac{\beta}{1-\beta}} - 1\right] + f_x\left[(\theta/\theta_x)^{\frac{\beta}{1-\beta}} - 1\right]^+$$

- Free entry condition is then:

$$\int_{\theta_d}^{\infty}\left[\frac{1-\beta}{1+\beta}\Phi\Theta - f_d - \iota f_x\right]\mathrm{d}G(\theta) \leq (r+\delta)f_e$$

Additional eqm conditions

Steady state

- **Proposition 1**: *In a symmetric (Pareto) world economy, a reduction in τ leads to:*
  - (i) *an increase in Q, H, M, with H/M constant, and changes in these variables not depend on labor market frictions:*

$$\left(\frac{Q'}{Q_0}\right)^{\zeta} = \frac{H'}{H_0} = \frac{M'}{M_0} = \left(\frac{\theta_d'}{\theta_{d,0}}\right)^{\frac{\beta\zeta}{\beta-\zeta}}$$

and $\theta_d = \left[\frac{\left(\frac{1-\beta}{\beta}k-1\right)(r+\delta)f_e/f_d}{1+\tau^{-k}(f_d/f_x)^{\frac{1-\beta}{\beta}k-1}}\right]^{1/k}$

  - (ii) *Assume $s = s_0$ and $x = x_0$. Then aggregate unemployment and income do not change with τ, and steady state welfare gains from trade do not depend on labor market frictions.*

- To measure welfare, we use $\frac{(E'-E)+\frac{1-\zeta}{\zeta}(Q')^{\zeta}}{\frac{1-\zeta}{\zeta}Q^{\zeta}} = \left(\frac{Q'}{Q}\right)^{\zeta}$
- If $s > s_0$ or $x < x_0$, unemployment $\uparrow$ and income $\downarrow$

Transition Dynamics

- **Proposition 2**: *Along the transition path, $Q_t \geq Q'$. If there is entry in every period, then $Q_t \equiv Q'$.*
- **Proof**: Free entry condition for hiring firms:

$$\int_{\theta_d(Q)}^{\infty} \left[\frac{1-\beta}{1+\beta}\Phi\Theta(\tau, Q) - f_d - \mathbf{1}_{\{\theta \geq \theta_x(Q)\}} f_x\right] \mathrm{d}G(\theta) \leq (r+\delta) f_e$$

- Non-increasing Q verifies the conjecture that:
  - no new stayer exits
  - no new exporter switches to non-exporting
  - all new entrants hire in every period conditional on staying ■

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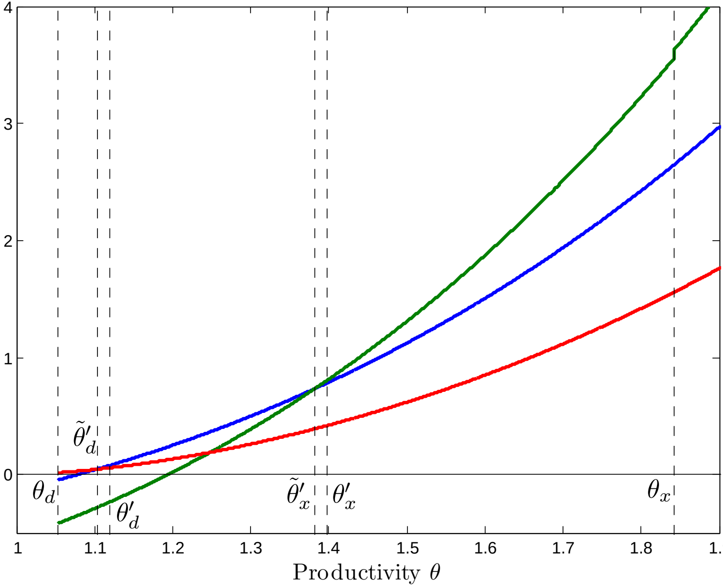
- Gains in consumer surplus are instantaneous and do not depend on labor market frictions!

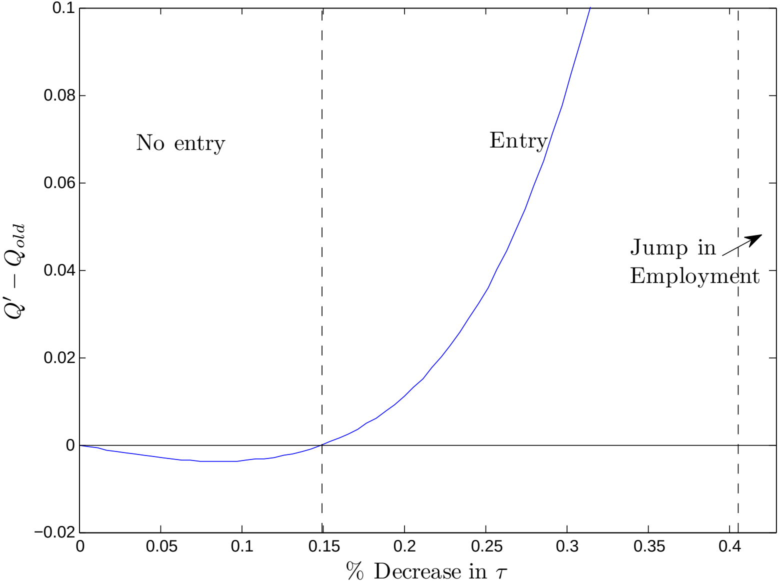
- Income E changes in general:
  1. decrease in the aggregate value of firms
  2. decrease in the value of employed at shrinking firms
  3. changing composition of employed-unemployed

Parameter Values

Moment	Parameter	Value
Interest rate	r	0.05
Exogenous separation rate	$s = s_0$	0.2
— firm death rate	δ	0.025
Job finding rate	$x = x_0$	2
Elasticity of matching wrt unemployment (relative)	α	1
Unemployment benefit	b_u	0.4
ES within sector	$\varepsilon \equiv \frac{1}{1-\beta}$	4
ES across sectors	$\frac{1}{1-\zeta}$	2
Pareto shape for revenues	$\frac{k}{\varepsilon-1}$	1.33
Share of manufacturing sector	f_d, L	10%
Share of exitors	f_e/f_d	25%
Iceberg trade cost	τ	1.75 $\searrow$ 1.25
$\Rightarrow$ share of output exported		16% $\nearrow$ 34%
$\Rightarrow$ share of exporters	f_x/f_d	11% $\nearrow$ 41%

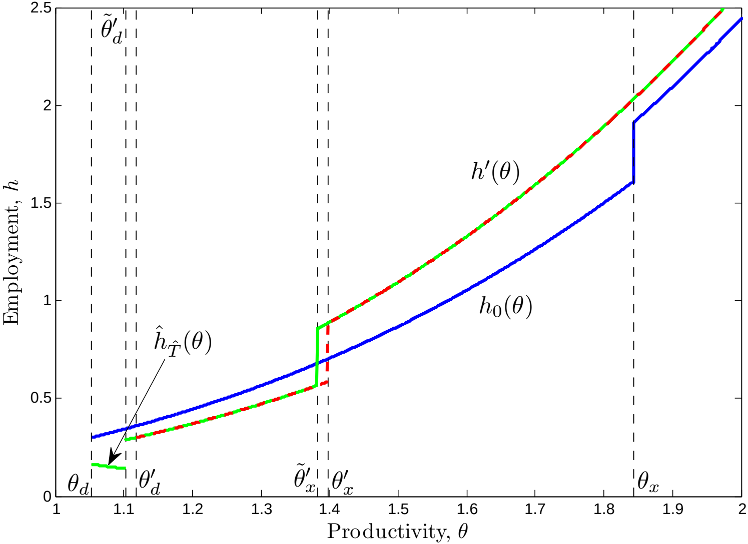
Value of firms and cutoffs





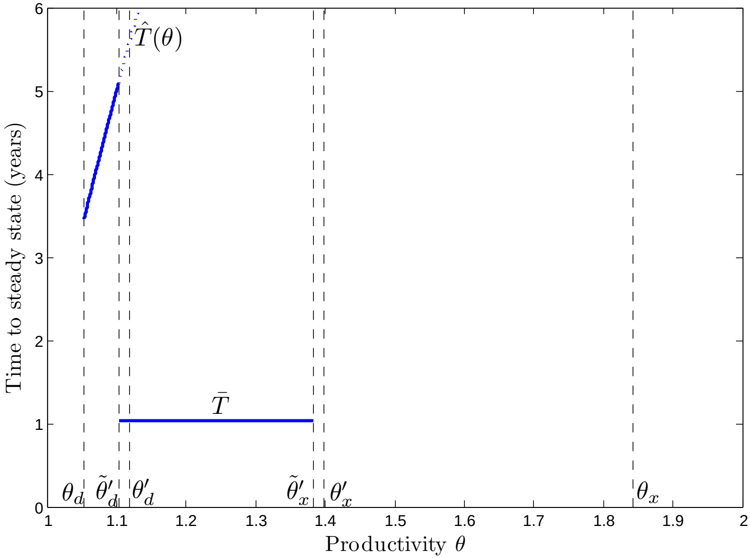
0.1
0.08
0.06
0.04
0.02
0
−0.02
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
$Q' - Q_{old}$
% Decrease in τ
No entry
Entry
Jump in
Employment

Firm Employment: Before and After



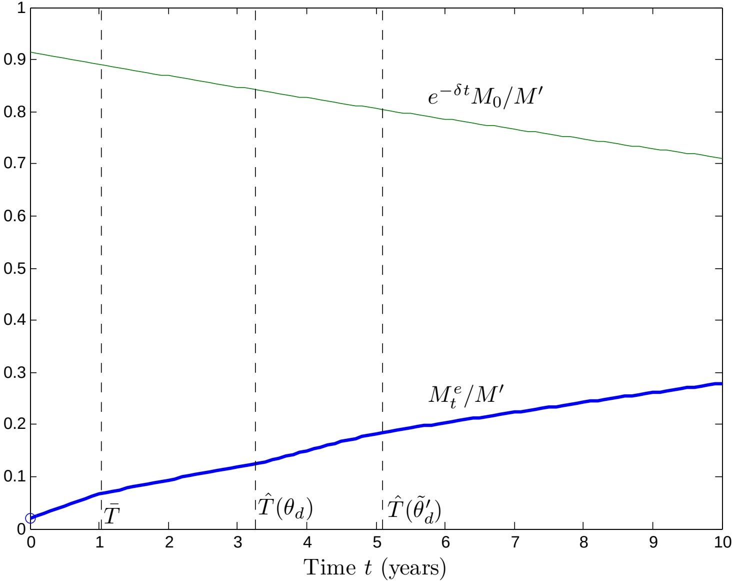
Firm Employment: Before and After

Time to exit or steady state



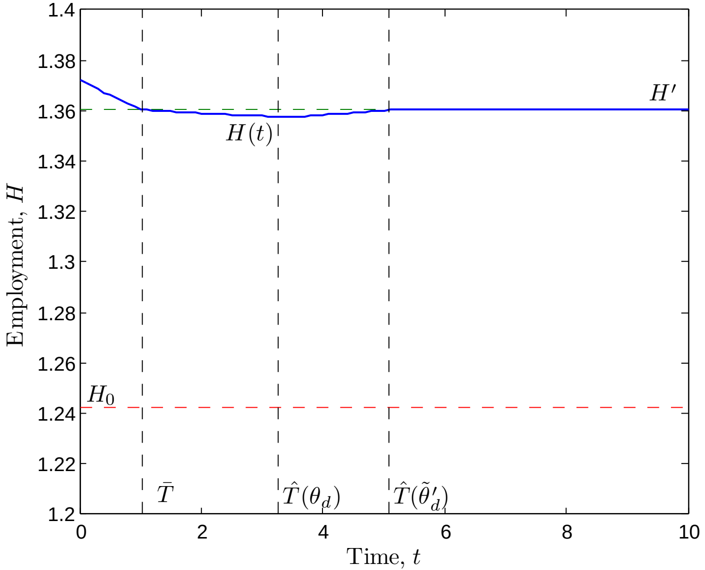
Aggregate dynamics

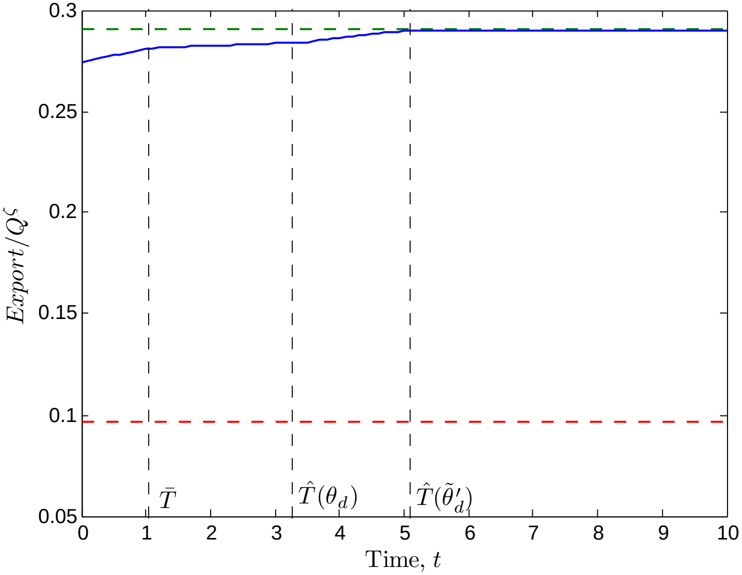
Number of firms



Aggregate dynamics

Employment

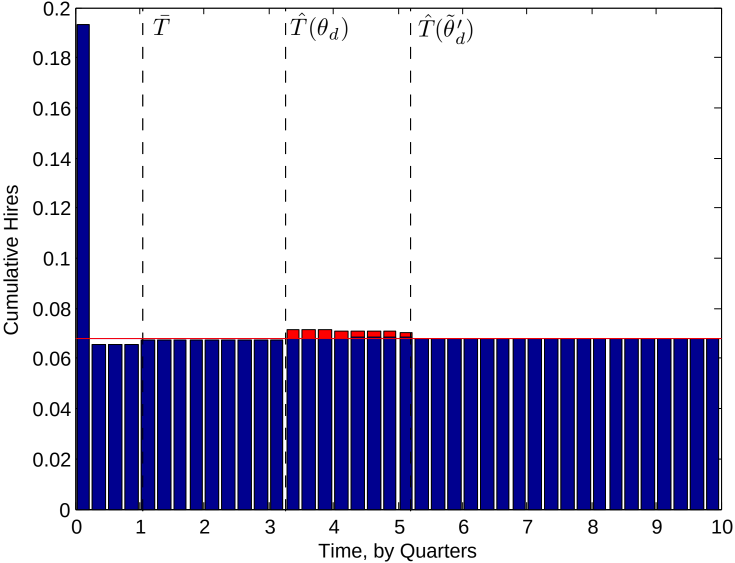




0.3
0.25
0.2
0.15
0.1
0.05
$Export/Q^{\zeta}$
$\bar{T}$
$\hat{T}(\theta_d)$
$\hat{T}(\tilde{\theta}'_d)$
0
1
2
3
4
5
6
7
8
9
10
Time, t

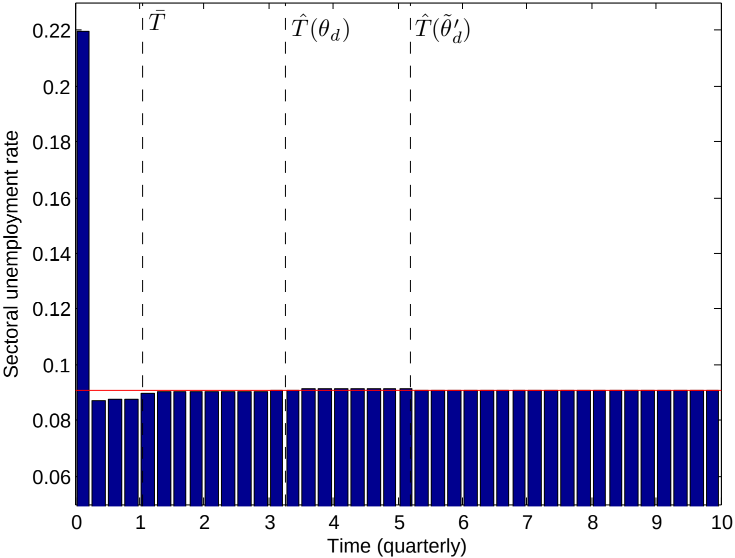
Job Creation and Unemployment

Differentiated-sector hires (quarterly)



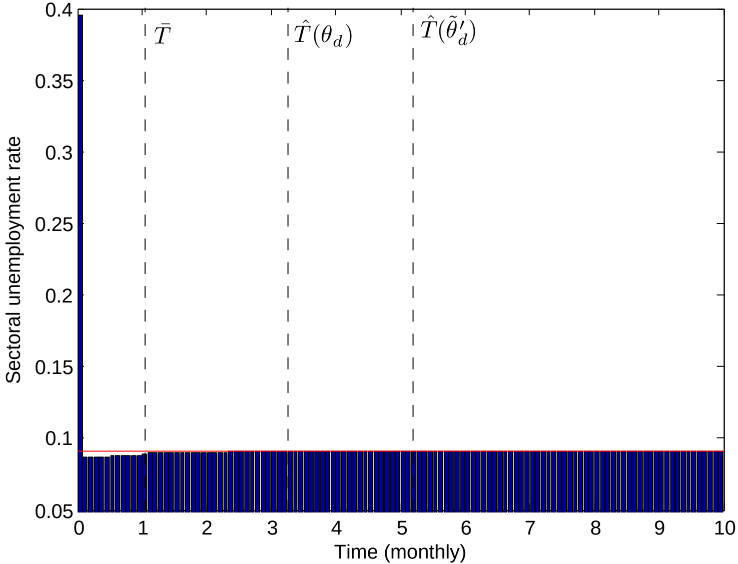
Job Creation and Unemployment

Differentiated-sector unemployment (quarterly)



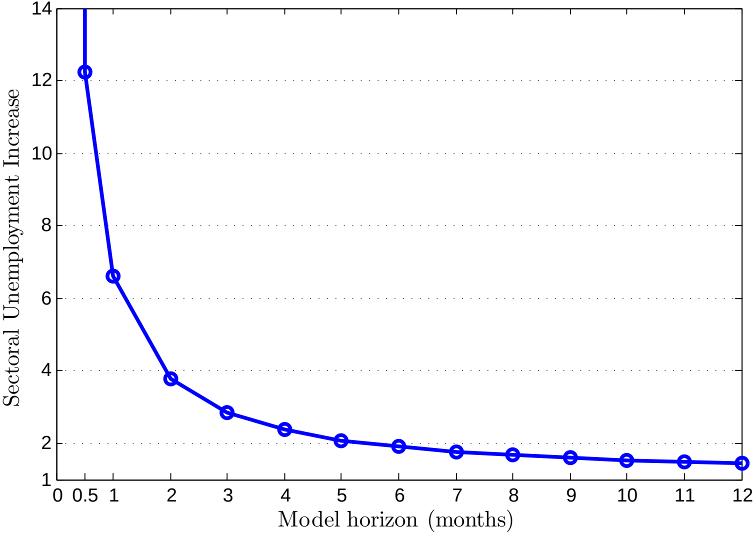
Job Creation and Unemployment

Differentiated-sector unemployment (monthly)



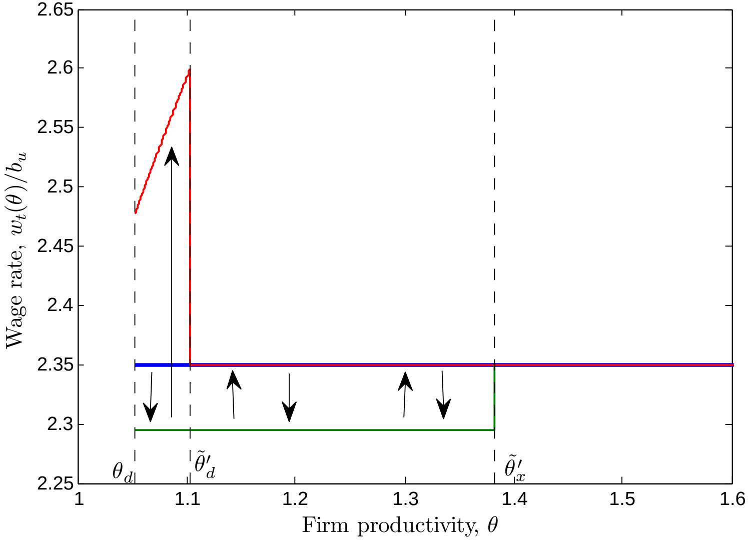
Job Creation and Unemployment

Increase in sectoral unemployment on impact



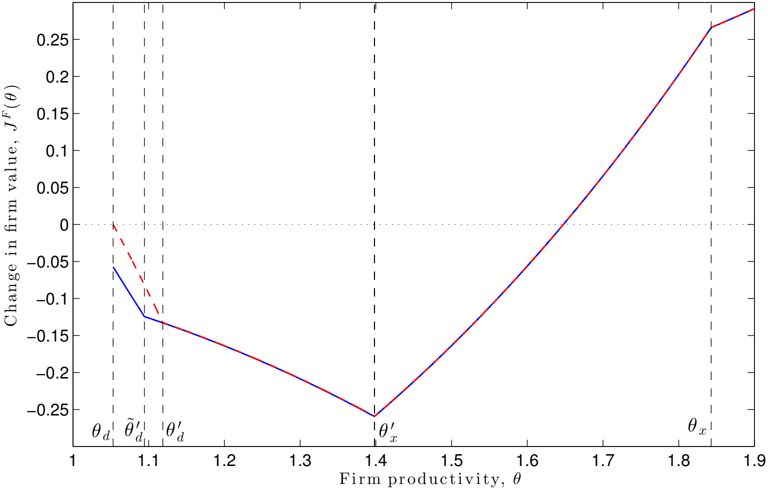
Good and Bad Jobs

Firm wages



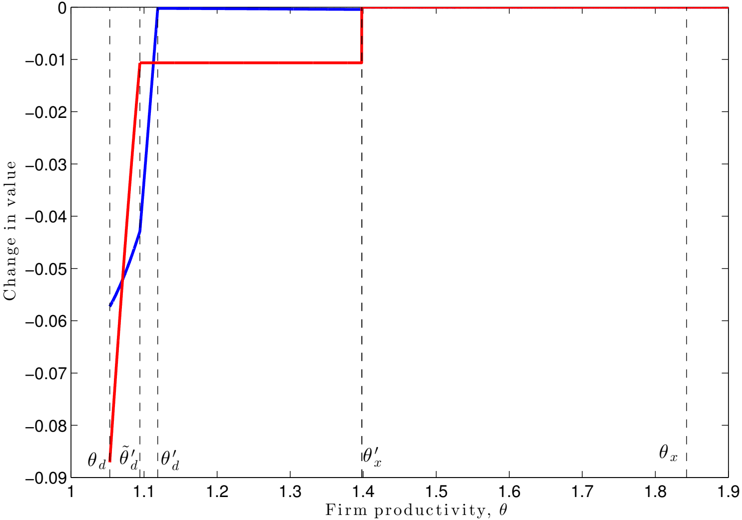
Good and Bad Jobs

Changes in firm values



Good and Bad Jobs

Changes in firm and employment values



Gains from Trade

- Gains from trade are measured as:

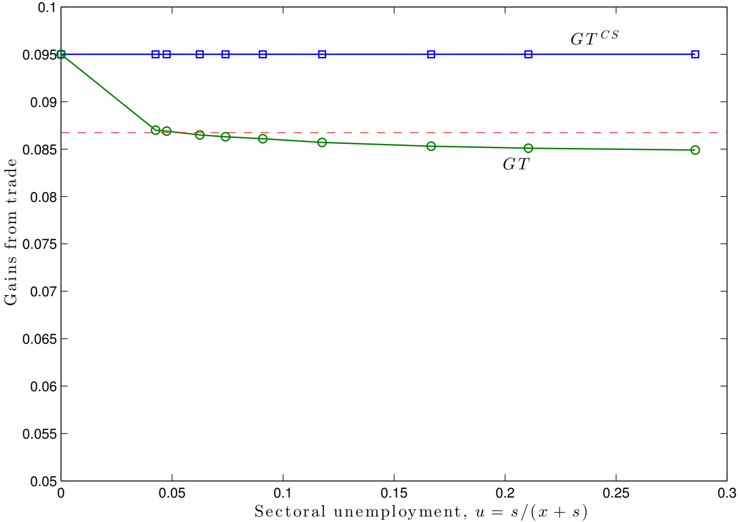
$$GT = \frac{\Delta^I + \frac{1-\zeta}{\zeta}(Q')^\zeta}{\frac{1-\zeta}{\zeta}Q^\zeta} \qquad \text{and} \qquad GT^{CS} = (Q'/Q)^\zeta$$

- $\Delta^I = \Delta^F + \Delta^E + \Delta^U$ is the change in the NPV of income:
  1. Δ^F: change in the value of Firms
  2. Δ^E: change in the value of Employed
  3. Δ^U: loss in value from separations into Unemployed

- Benchmark case:

GT^{CS}	GT	Δ^F	Δ^E	Δ^U
9.50%	8.61%	−0.58%	−0.31%	—

Gains from Trade



Conlusion

Outside sector

Characterization (Proof of Lemma 1)

1. $U_0 > 0$ ensures entry of firms (i.e., vacancy posting)

$$\Rightarrow \qquad J_0^V \equiv 0 \quad \text{and} \quad J_0^F = b_0$$

2. Then Nash bargaining results in:

$$J_0^E - J_0^U = J_0^F = b_0$$

3. Surplus from employment satisfies:

$$(r + s_0) J_0^F = (1 - w_0) + \dot{J}_0^F,$$
$$(r + s_0 + x_0)(J_0^E - J_0^U) = (w_0 - b_u) + (\dot{J}_0^E - \dot{J}_0^U)$$

Has unique stationary solution (x_0, b_0) with $\dot{b}_0 = 0$

4. Finally, the value of unemployed and equilibrium wage are:

$$rJ_0^U = b_u + x_0 b_0,$$
$$w_0 = b_u + (r + s_0 + x_0) b_0.$$

▸ back to slides

Proof of Lemma 3

Value of an Entrant

1. The value of a hiring entrant $(h' > (1-\sigma\Delta)h)$

$$J^F(h) = \varphi(h)\Delta + (1-\sigma\Delta)h - bh' + \frac{1-\delta\Delta}{1+r\Delta} J^F_+(h')$$

2. Optimal hiring is given by:

$$\frac{1+r\Delta}{1-\delta\Delta} b_{-1} = \varphi'(h)\Delta + (1-\sigma\Delta)b$$

3. Combining (1) and (2):

$$\underbrace{\left(J^F(h) - \frac{1+r\Delta}{1-\delta\Delta} b_{-1} h\right)}_{\frac{1-\delta\Delta}{1+r\Delta} J^F_{-1}(0)} = \underbrace{\left(\varphi(h) - \varphi'(h)h\right)}_{\substack{\frac{1-\beta}{1+\beta}\Theta^{1-\beta} h^{\beta} - f_d - \iota f_x \\ = \frac{1-\beta}{1+\beta}\Phi\Theta - f_d - \iota f_x}} \Delta + \underbrace{\left(\frac{1-\delta\Delta}{1+r\Delta} J^F_+(h') - bh'\right)}_{J^F(0)}$$

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Additional Equilibrium Conditions

Number of Firms and Employment

- With two symmetric countries:

$$Q^{\zeta} = M\Phi \int_{\theta_d}^{\infty} \Theta \mathrm{d} G(\theta),$$

$$H = \Phi^{\frac{1-\beta}{\beta}} Q^{\zeta}$$

- Additionally, under Pareto productivity distribution:

$$\frac{H}{M} = \frac{2k(r+\delta)f_e}{b_u + [2(r+s)+x]b}$$

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