Offshoring, Low-skilled Immigration, and Labor Market Polarization[1]

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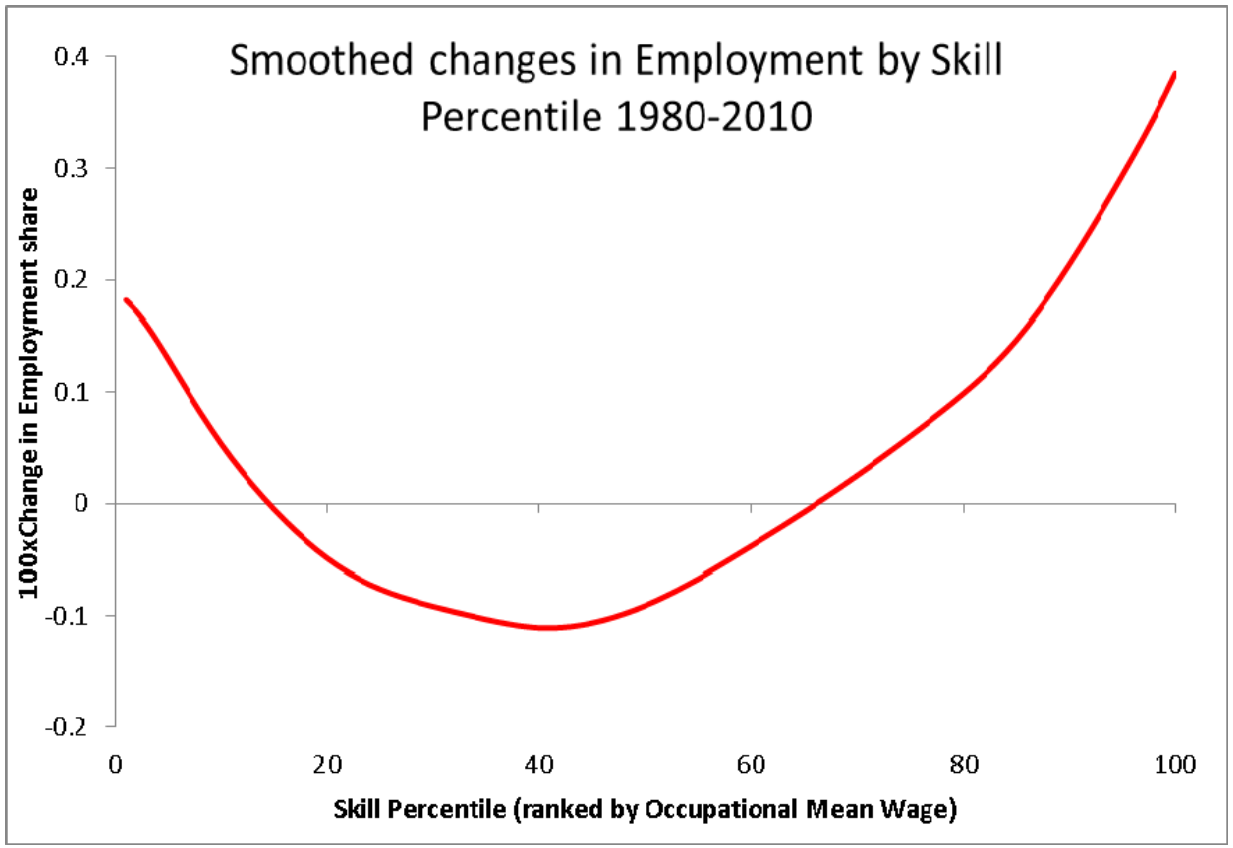
(1) The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Banks of Atlanta or Boston, or of the Federal Reserve System.

Roadmap

- Bring together **4 empirical facts** characterizing the US labor market over the past three decades:
  1. Employment polarization.
  2. Asymmetric polarization for employment and wages.
  3. The emergence of low-skill service jobs.
  4. Rising immigrant employment in low-skill occupations.
- Build 3-country stochastic growth model to rationalize these facts.
- Estimate the model, analyze alternative trade and immigration policy scenarios.

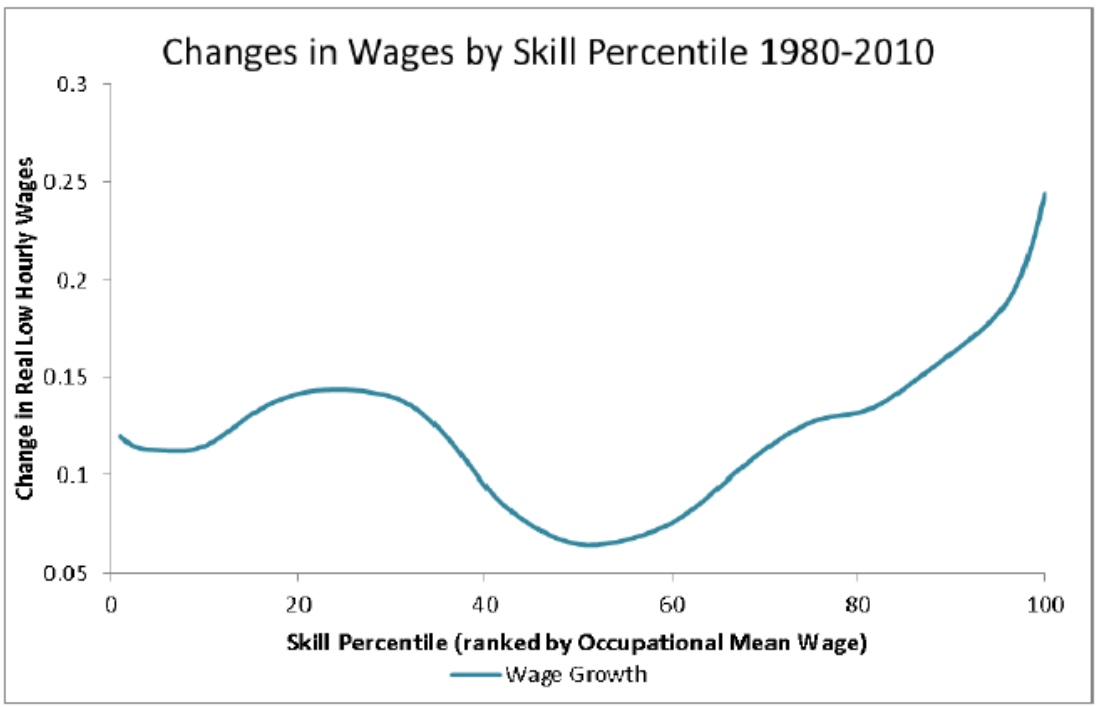
Fact 1: Employment polarization

- Employment became **increasingly concentrated at the tails** of the skill distribution, shrank in the medium-skill occupations (see Acemoglu and Autor, 2011).



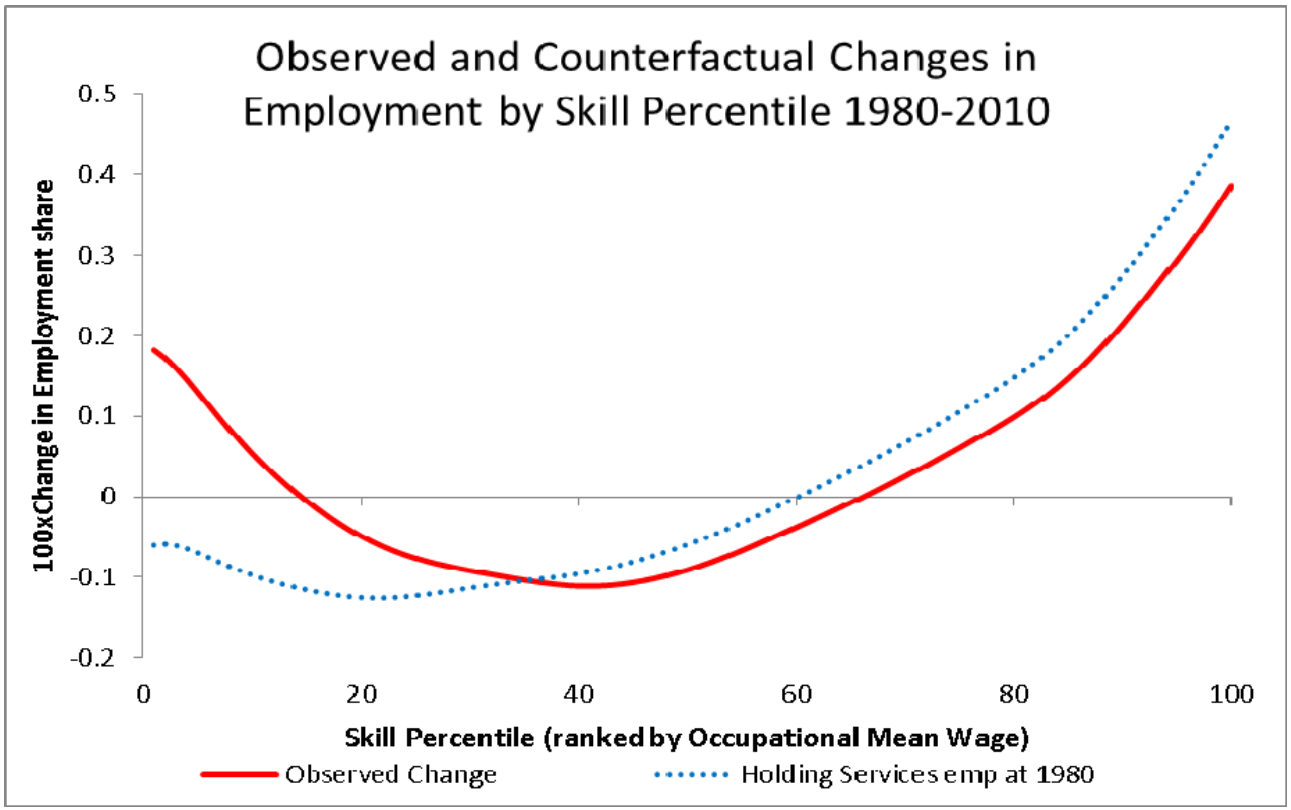
Fact 2: Asymmetric polarization, empl. vs. wages

- Wages rose robustly for the high-skilled, but performed poorly in medium-skill occupations, same as employment;
- However, **low-skill wages did not match the strong increase in low-skill employment.**



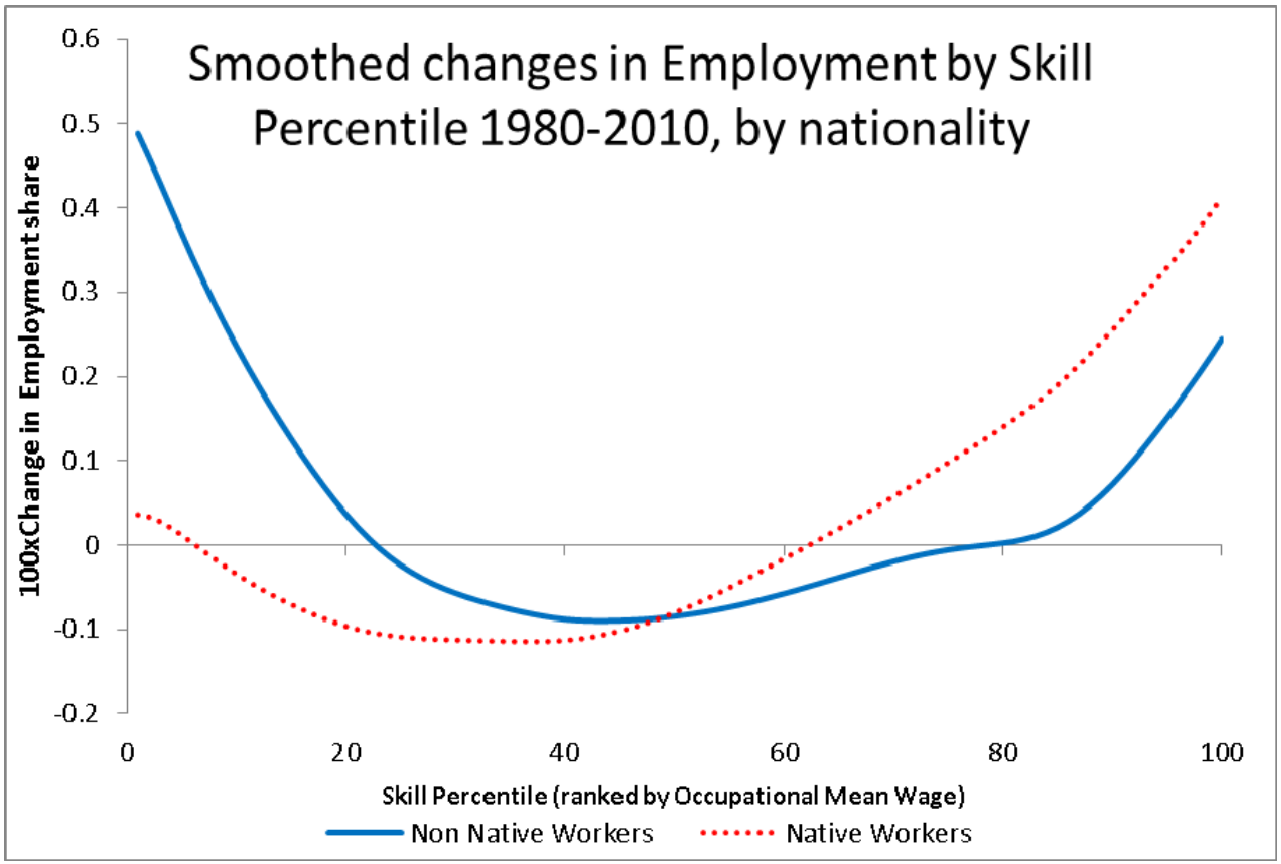
Fact 3: The emergence of low-skill service jobs

- Employment gains at the low-end of the skill distribution were mostly due to **service occupations** (see Autor and Dorn, 2013);
  - These hire food service workers, home care aids, child care workers, recreation occupations, gardeners, janitors, etc.



Fact 4: Immigration and low-skill occupations

- Immigrant employment increased mostly in **low-skill occupations**, whose output is **non-tradable**:



Results

- **(1) Offshoring leads to employment polarization.**
  - As offshoring costs decline, trade in tasks benefits the employment and wages of high-skill workers (whose tasks are sold globally), but harms the medium-skill workers (who only sell domestically);
  - Complementarity between goods and services boosts demand for low-skill occupations.
- **(2) Low-skilled immigration supports employment in services but dampens wages.**
  - The model generates asymmetric polarization of employment and wages.

Results (cont'd)

- **(3) Low-skill immigration encourages training by natives.**
  - Low-skill immigration is procyclical like in the data;
  - Negative correlation between immigrant and native unskilled employment.
- **(4) Reducing the barriers to trade and immigration is welfare-improving.**
  - With lower trade barriers, the economy becomes more productive as it specializes in its most efficient tasks;
  - Low-skill immigration lowers the price of services and encourages natives to train, thus increasing productivity.

Literature

- Employment polarization:
  - Routine-biased technological change (Acemoglu and Autor, 2011; Autor and Dorn, 2013; Jaimovich and Siu, 2012);
  - Offshoring (Firpo et al., 2011; Goos et al. 2011; Mandelman, 2013).
- Offshoring and immigration:
  - Effect of offshoring and immigration on U.S. native-born workers (Ottaviano, Peri and Wright, 2013 AER).
- Immigration:
  - Secular rise in immigration, concentration on low-skill jobs (Grogger and Hanson, 2008; Peri and Sparber, 2009);
  - Low-skilled immigration and native education (Hunt, 2012).
- Modelling trade and entry with fixed, sunk costs:
  - Firm entry, endogenous exporting (Ghironi and Melitz, 2005 QJE);
  - Endogenous immigration (Mandelman and Zlate, 2012 JME);
  - Skill heterogeneity and endogenous training (Mandelman, 2013);
  - Endogenous offshoring, extensive margin (Zlate, 2012).

Model overview

- Two large economies (Home and Foreign), and a small one (South).
- **Home and Foreign** have two sectors each:
  1. **The tradable sector** hires skilled labor:
     - Households train endogenously;
     - Training results in a continuum of heterogeneous occupations;
     - Tasks, rather than the final good, are tradable.
  2. **The non-tradable/services sector** hires unskilled labor:
     - In Home, unskilled labor is a composite of natives and immigrants.
- **South** is the source of unskilled labor migrating to Home:
  - Households invest in emigration endogenously.

Tradable sector, Home

- **The training of skilled workers**:
  - Every period, households can either allocate "raw" labor to the service sector, or invest in training workers for the tradable sector.
  - Training a new skilled worker requires sunk cost $f_{j,t}$, and results in a new occupation with idiosyncratic productivity $\mathbf{z}$ revealed ex-post.
  - Draws $\mathbf{z}$ follow a Pareto distribution over the support interval $[1, \infty)$.
  - Thus, training creates a diversity of skilled occupations
- **Production of tasks**:
  - Each occupation produces a tradable task:

$$n_t(z) \equiv (X_t \varepsilon_t^T)\mathbf{z} l_t.$$

  - ... where X_t is a permanent world technology shock, and ε_t^T is an AR(1) country-specific technology shock.

Tradable sector, Home (cont'd)

- **Composite good of tradable sector:**
  - Is a composite of the heterogeneous tasks:

$$Y_{T,t} = \left[\int_{\xi \epsilon \Xi} n_t(\mathbf{z}, \xi)^{\frac{\theta-1}{\theta}} d\xi \right]^{\frac{\theta}{\theta-1}}.$$

  - Serves as numeraire, $P_{T,t} \equiv 1$.
- **Trade in tasks:**
  - All occupations produce tasks for Home.
  - In addition, some occupations also sell to Foreign.
  - Selling to Foreign requires iceberg cost $\tau_t \geqslant 1$ and fixed cost $f_{o,t} = \frac{w_{\mathbf{u},t}}{(\varepsilon_t^T X_t)}(X_t f_o)$.
  - Shocks to the iceberg trade cost reflect changes in trade barriers: $\tau_t = \varepsilon_t^{\tau} \tau$.

Tradable sector, Home (cont'd)

- **The skill premium:**
  - Workers selling their tasks in **Home** obtain:

$$\pi_{D,t}(\mathbf{z}) = w_{D,t}(\mathbf{z}) n_{D,t}(\mathbf{z}) - w_{\mathbf{u},t} l_t.$$

  - In addition, workers selling their tasks to **Foreign** also get:

$$\pi_{X,t}(\mathbf{z}) = \left(\frac{w_{X,t}(\mathbf{z})}{\tau_t} n_{X,t}(\mathbf{z}) - f_{o,t} \right) - w_{\mathbf{u},t} l_t.$$

  - Due to the fixed cost, only the most productive occupations sell tasks to Foreign, whose productivity $\mathbf{z}$ is above a threshold:

$$\mathbf{z}_{X,t} = \inf\{\mathbf{z} : \pi_{X,t}(\mathbf{z}) > 0\}.$$

Tradable sector, Home (cont'd)

- **Average productivity of skilled workers:**
  - All occupations vs. exporting occupations:

$$\tilde{\mathbf{z}}_D \equiv \left[\int_1^{\infty} \mathbf{z}^{\theta-1} dG(\mathbf{z})\right]^{\frac{1}{\theta-1}} \text{ and } \tilde{\mathbf{z}}_{X,t} \equiv \left[\frac{1}{1-G\left(\mathbf{z}_{X,t}\right)} \int_{\mathbf{z}_{X,t}}^{\infty} \mathbf{z}^{\theta-1} dG(\mathbf{z})\right]^{\frac{1}{\theta-1}}.$$

- **Average skill premium** from selling tasks domestically and abroad**:**

$$\widetilde{\pi}_{D,t} = \pi_{D,t}(\tilde{\mathbf{z}}_{D,t}) \text{ and } \widetilde{\pi}_{X,t} = \pi_{X,t}(\tilde{\mathbf{z}}_{X,t})$$

- **Number of occupations** selling tasks domestically and abroad**:**

$$N_{D,t} \text{ and } N_{X,t}.$$

Non-tradable sector, Home

- **Output of non-tradable sector:**
  - Output is:

$$Y_{N,t} = X_t L^A_{N,t}.$$

  - where X_t is the permanent world technology shock;
  - and $L^A_{N,t}$ is a composite of native and immigrant unskilled labor:

$$L^A_{N,t} = \left[\alpha_N \left(L_{N,t}\right)^{\frac{\sigma_N - 1}{\sigma_N}} + (1-\alpha_N)\left(L^s_{\mathbf{i},t}\right)^{\frac{\sigma_N - 1}{\sigma_N}}\right]^{\frac{\sigma_N}{\sigma_N - 1}}.$$

Household, Home

- Utility: $\mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \varepsilon_t^b \left[\frac{1}{1-\gamma} C_t^{1-\gamma} - a_n X_t^{1-\gamma} \frac{L_t^{1+\gamma_n}}{1+\gamma_n} \right]$.

- Cons: $C_t = \left[(\gamma_c)^{\frac{1}{\rho_c}} (C_{T,t})^{\frac{\rho_c - 1}{\rho_c}} + (1-\gamma_c)^{\frac{1}{\rho_c}} (C_{N,t})^{\frac{\rho_c - 1}{\rho_c}} \right]^{\frac{\rho_c}{\rho_c - 1}}$.

- Budget constraint:

$$\underbrace{w_{\mathbf{u},t} L_t + \tilde{\pi}_t N_{D,t}}_{\text{Labor income}} + B_{t-1} = \underbrace{f_{j,t} N_{E,t}}_{\text{Inv. in training}} + P_t C_t + q_t B_t + \Phi(B_t).$$

- Average skill income premium: $\tilde{\pi}_t = (N_{D,t} \tilde{\pi}_{D,t} + N_{X,t} \tilde{\pi}_{X,t}) / N_{D,t}$.
- Law of motion for skilled workers: $N_{D,t} = (1-\delta)(N_{D,t-1} + N_{E,t-1})$.
- FOC for training:

$$f_{j,t} = \mathbb{E}_t \sum_{s=t+1}^{\infty} [\beta (1-\delta)]^{s-t} \left(\frac{\zeta_s}{\zeta_t} \right) \tilde{\pi}_s.$$

South Economy

- **Household's Decision Problem:**
  - Utility: $\mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{1}{1-\gamma} (C_t^s)^{1-\gamma} - a_n^s X_t^{1-\gamma} \frac{(L_{\mathbf{u},t}^s)^{1+\gamma_n}}{1+\gamma_n} \right].$
  - Budget constraint:

$$\underbrace{w_{\mathbf{i},t} L_{\mathbf{i},t}^s}_{\text{Imm. labor income}} + \underbrace{w_{\mathbf{u},t}^s \left(L_{\mathbf{u},t}^s - L_{\mathbf{i},t}^s \right)}_{\text{Dom. labor income}} \geqslant \underbrace{f_{e,t} L_{\mathbf{e},t}^s}_{\text{Inv. in migration}} + P_t^s C_t^s.$$

  - Law of motion, stock of immigrant labor:

$$L_{\mathbf{i},t}^s = (1 - \delta_l)(L_{\mathbf{i},t-1}^s + L_{\mathbf{e},t-1}^s);$$

  - FOC for emigrant flow $L_{\mathbf{e},t}^s$:

$$f_{e,t} = \mathbb{E}_t \sum_{s=t+1}^{\infty} [\beta(1 - \delta_l)]^{s-t} \left(\frac{\zeta_s^s}{\zeta_t^s} \right) (w_{\mathbf{i},t} - w_{\mathbf{u},t}^s).$$

Calibration

Standard parameters for quarterly calibration			
Discount factor and CRRA coeff.	$\beta = 0.99, \gamma = 2$	Sunk training cost	$f_j = 1$
Frisch elasticity (H, F, S)	$(1/\gamma_n) = 0.75$	Destruction rate of skilled jobs (DH 1990)	$\delta = 0.025$
Weight on disutility from labor	$a_n^{h,f} = 2.8, a_n^s = 7$	Sunk emigr. cost	$f_e = 8.7$
Share of the trad good (H, F)	$\gamma_c = 0.75$	Exit rate of immigrant labor	$\delta_I = 0.025$
Elast subst trad, nontrad (H, F)	$\rho_c = 0.44$	Iceberg trade cost (Novy, 2007)	$\tau = 1.4$

Key parameters		Steady-state targets	Data	Model
Pareto shape parameter (H, F)	$k = 2.36$	U.S. exports/GDP	0.13	0.13
Elast subst home, foreign tasks (H, F)	$\theta = 1.8$	Jobs ratio, high/middle-skill, US	0.60	0.49
Fixed cost of offshoring (H, F)	$f_o = 0.0233$	Income ratio, high/middle-skill, US	1.73-2.87	1.88
Relative productivity of raw labor (S)	$\varsigma = 0.8$	Share of Mexico's labor force in US	0.10	0.32
Share of natives in nontrad (H)	$\alpha_N = 0.6$	US skill premium (>= high school)	2.2	1.74
Elast subst. natives, immigrants (H)	$\sigma_N = 1.1$	Wage ratio, unskilled native vs. imm.	1.3	1.26
Share of imports in consumption (S)	$\gamma_c^s = 0.2$	Wage ratio, Mex imm vs. residents	3.6	1.46
Elast of subst trad vs. non-trad (S)	$\rho_c^s = 1.5$			

Estimation

- **Shocks:**
  - World technology shock has unit root: $\log X_t = \log X_{t-1} + \eta_t^X$;
  - Otherwise: $\log \varepsilon_t^{\hat{\imath}} = \rho^{\hat{\imath}} \log \varepsilon_{t-1} + \eta_t^{\hat{\imath}}$, with $0 < \rho^{\hat{\imath}} < 1$, $\eta \sim N(0, \sigma^{\hat{\imath}})$;
  - $\hat{\imath} = \{T, T^*, s, b, b^*, \tau, f_e\}$ denote technology shocks in Home, Foreign and South; demand shocks in Home and Foreign; shock to the iceberg trade cost; and shock to the sunk emigration cost.
- **Estimation data** (1983:Q1-2004:Q3, not detrended, but SA, log-differences):
  - (a) US, Mexico, rest-of-the-world GDP;
  - (b) U.S. border patrol hours from U.S. Dept.of Homeland Security, with an increase interpreted as an increase in the sunk migration cost;
  - (c) U.S. employment by skill group, divided into Non-Routine Cognitive (high-skilled), Routine Cognitive (medium-skilled), and Non-Routine Manual (unskilled), following Jaimovich and Siu (2012), with Census data.

Estimation

Prior and posterior distributions:

Table 1: Prior and posterior distributions of estimated parameters

	Prior distribution				Posterior distribution				
Description	Name	Density	Mean	Std Dev	Sd (Hess)	Mode	Mean	10%	90%
Tech. shock (H)	ρ_T	Beta	0.75	0.1	0.0566	0.9200	0.7547	0.7017	0.7967
Tech. shock (F)	ρ_{T^*}	Beta	0.75	0.1	0.0470	0.6584	0.6372	0.5781	0.6927
Trade cost shock	ρ_τ	Beta	0.75	0.1	0.0098	0.9723	0.9764	0.9687	0.9820
Migration cost shock	ρ_{fe}	Beta	0.75	0.1	0.0104	0.9767	0.9738	0.9671	0.9814
Tech. shock (S)	ρ_s	Beta	0.75	0.1	0.0119	0.9724	0.9786	0.9573	0.9889
Demand shock (H)	ρ_b	Beta	0.5	0.05	0.0527	0.5106	0.5407	0.4738	0.6047
Demand shock (F)	ρ_{b^*}	Beta	0.5	0.05	0.0508	0.4969	0.5293	0.5098	0.5499
Tech. shock (H)	σ_T	Inv gamma	0.01	2*	0.0030	0.0075	0.0039	0.0022	0.0051
Tech. shock (F)	σ_{T^*}	Inv gamma	0.01	2*	0.0019	0.0240	0.0233	0.0225	0.0236
Trade cost shock	σ_τ	Inv gamma	0.01	2*	0.0016	0.0158	0.0168	0.0149	0.0194
Migration cost shock	σ_{fe}	Inv gamma	0.01	2*	0.0041	0.0518	0.0531	0.0492	0.0567
Tech. shock (S)	σ_s	Inv gamma	0.01	2*	0.0019	0.0242	0.0238	0.0227	0.0250
Demand shock (H)	σ_b	Inv gamma	0.01	2*	0.0028	0.0309	0.0331	0.0311	0.0345
Demand shock (F)	σ_{b^*}	Inv gamma	0.01	2*	0.0020	0.0048	0.0048	0.0028	0.0071
Global tech. shock	σ_x	Inv gamma	0.01	2*	0.0014	0.0190	0.0181	0.0169	0.0190

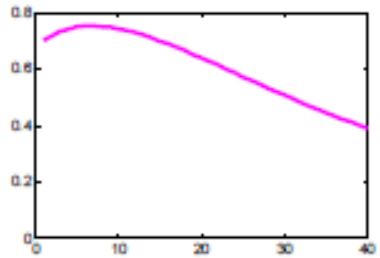
Notes: For the Inverted gamma function the degrees of freedom are indicated. Results are based on 50,000 simulations of the Metropolis-Hastings algorithm.

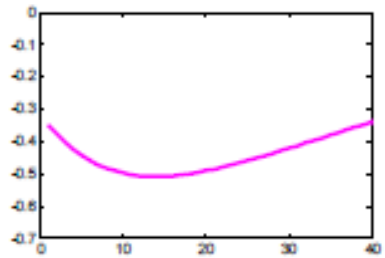
Defining key variables

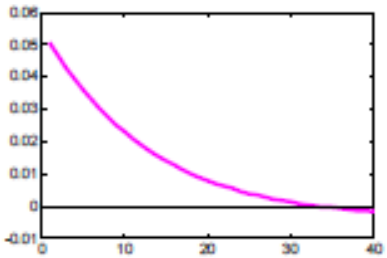
- A few definitions:
  - High-skill (N_X) vs. medium skill jobs (N_M), where $N_M = N_D - N_X$;
  - Unskilled employment in Home (L_N);
  - New skilled jobs (N_E, as a measure of "task upgrading");
  - Entry of unskilled immigrant labor (L_E).
- Impulse responses:
  - Temporary decline in the iceberg trade cost;
  - Temporary decrease in the sunk cost of immigration;
  - Temporary increase in productivity in the South.

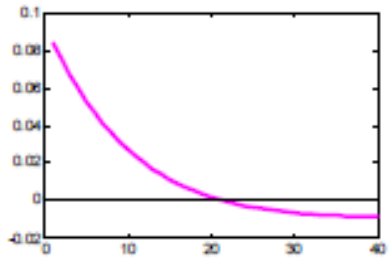
1. Impulse responses

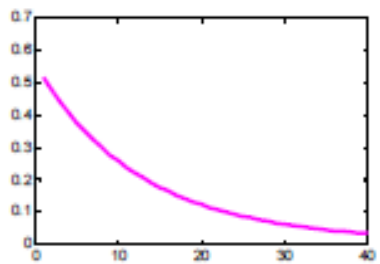
Temporary decline in the iceberg trade cost

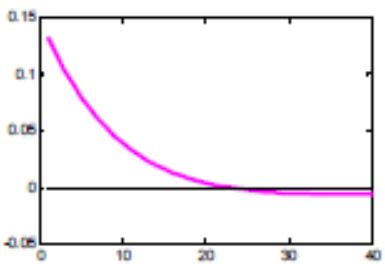


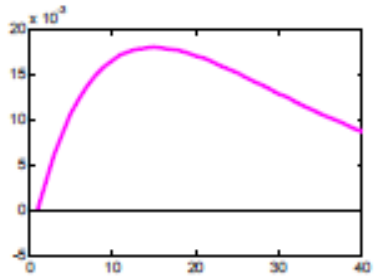


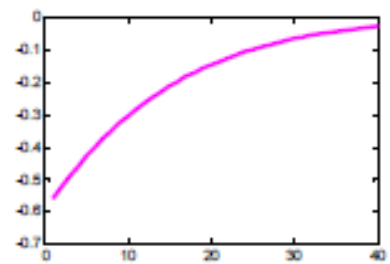


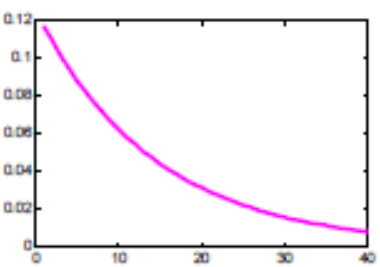


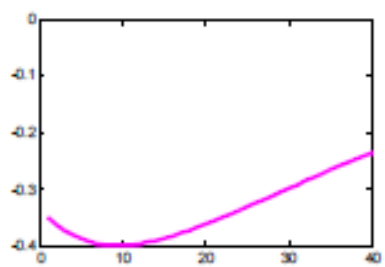


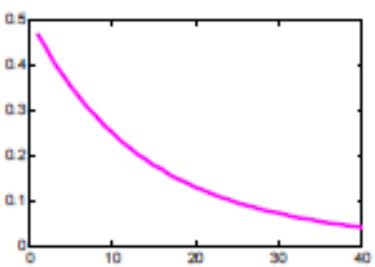


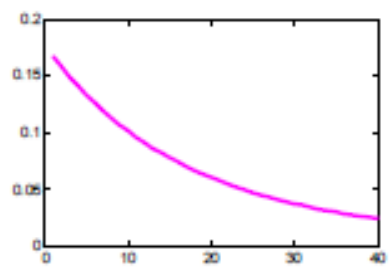






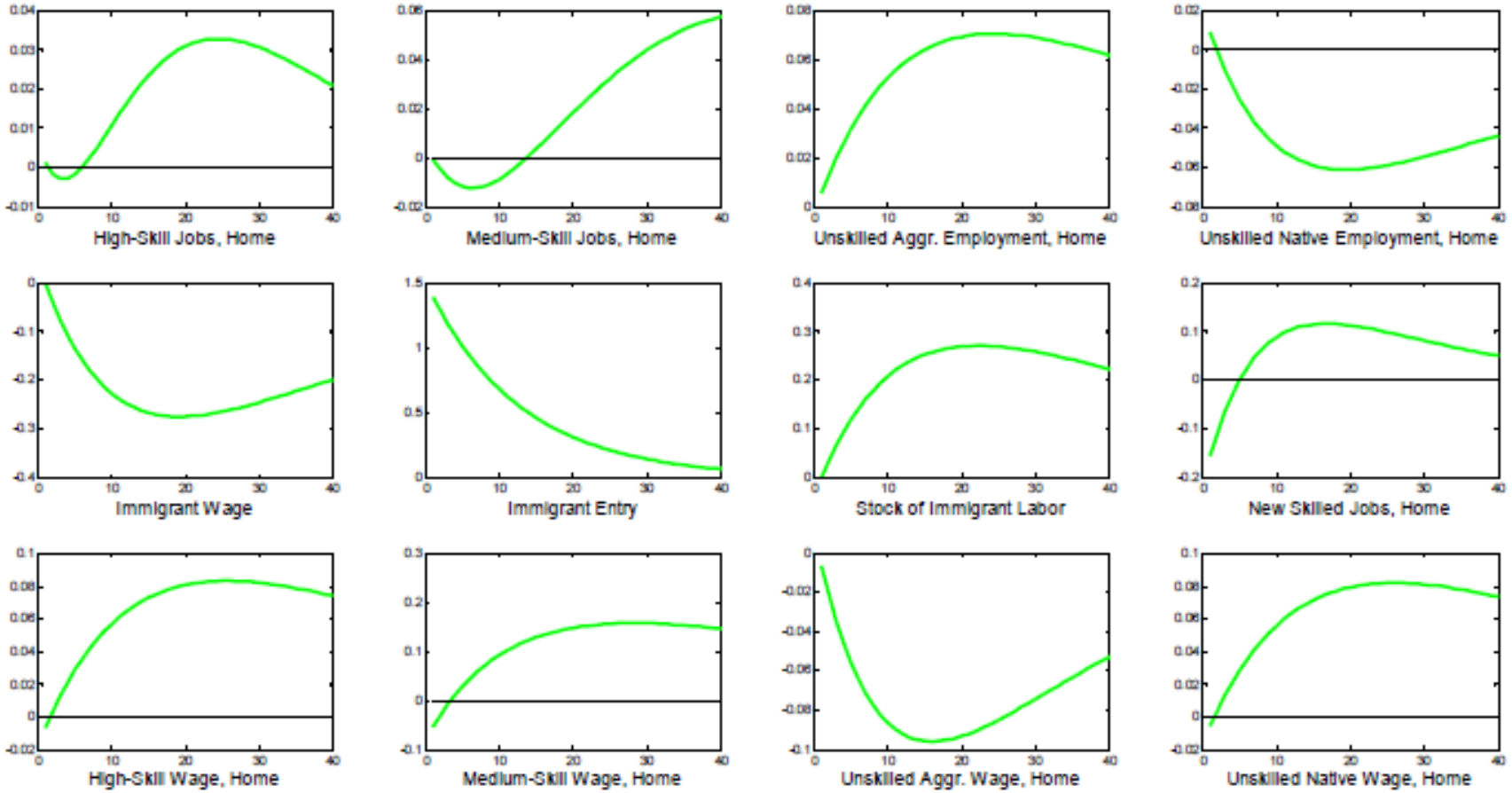






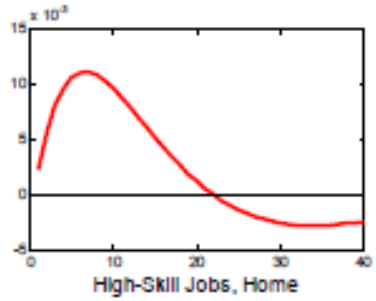
1. Impulse responses

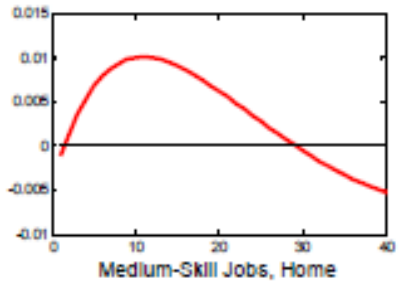
Temporary decline in the sunk cost of labor migration

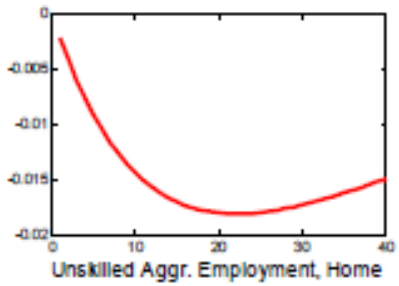


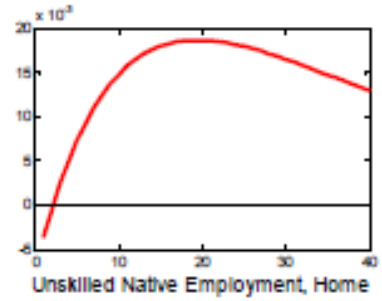
1. Impulse responses

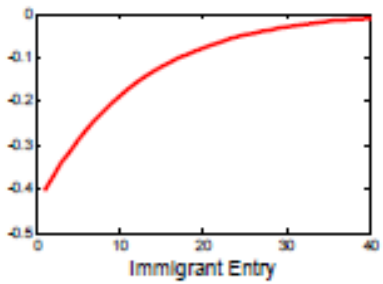
Temporary increase in productivity in the South

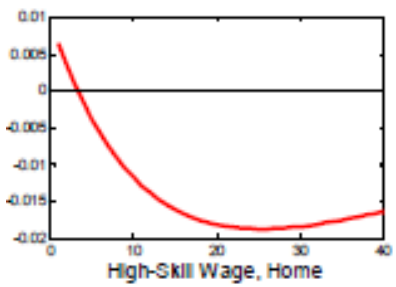


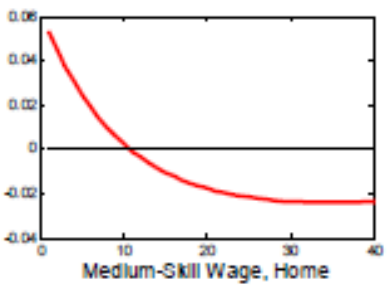


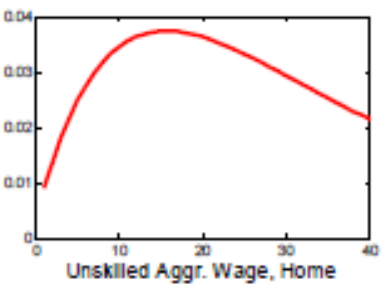


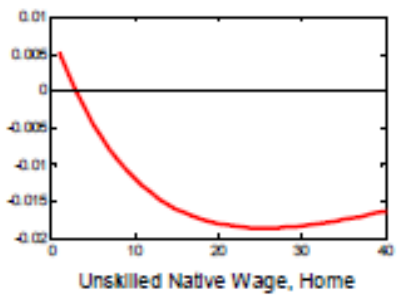












2. Model fit: moments

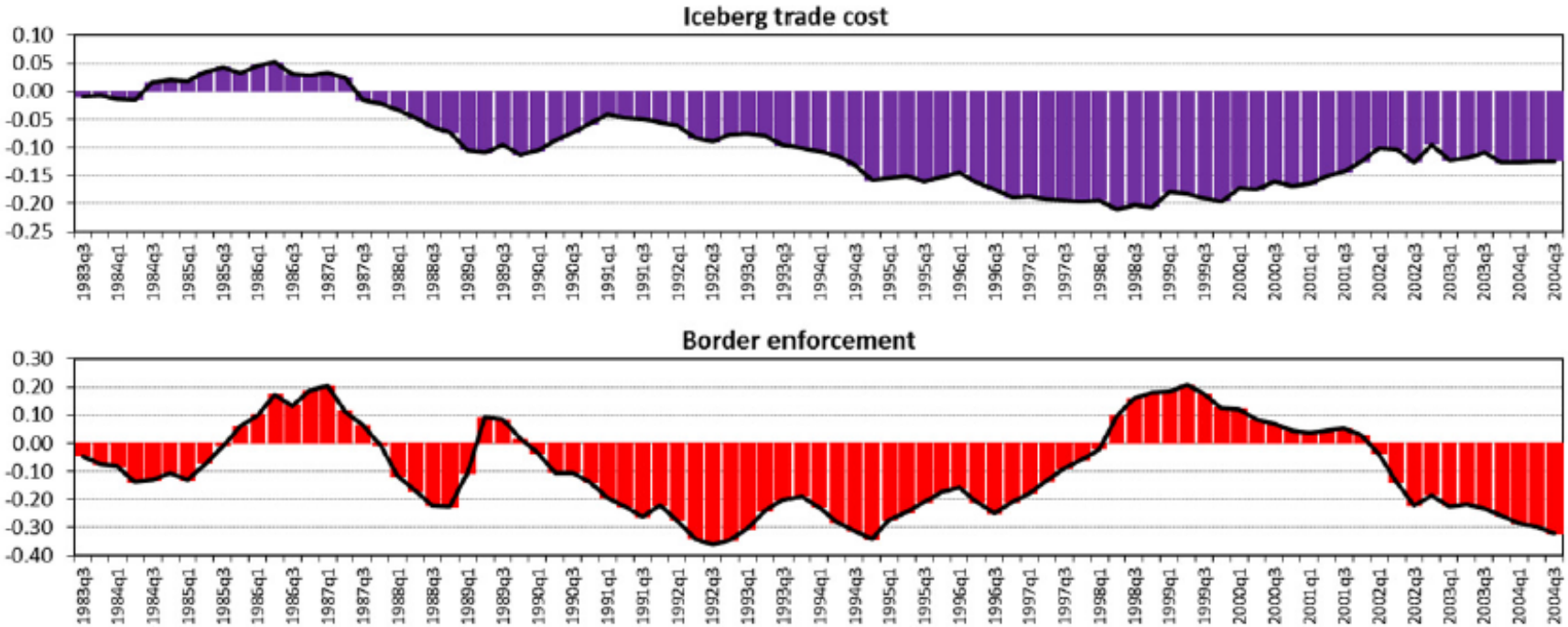
Empirical vs. model-generated unconditional correlations

Table 2: Unconditional moments, data and model

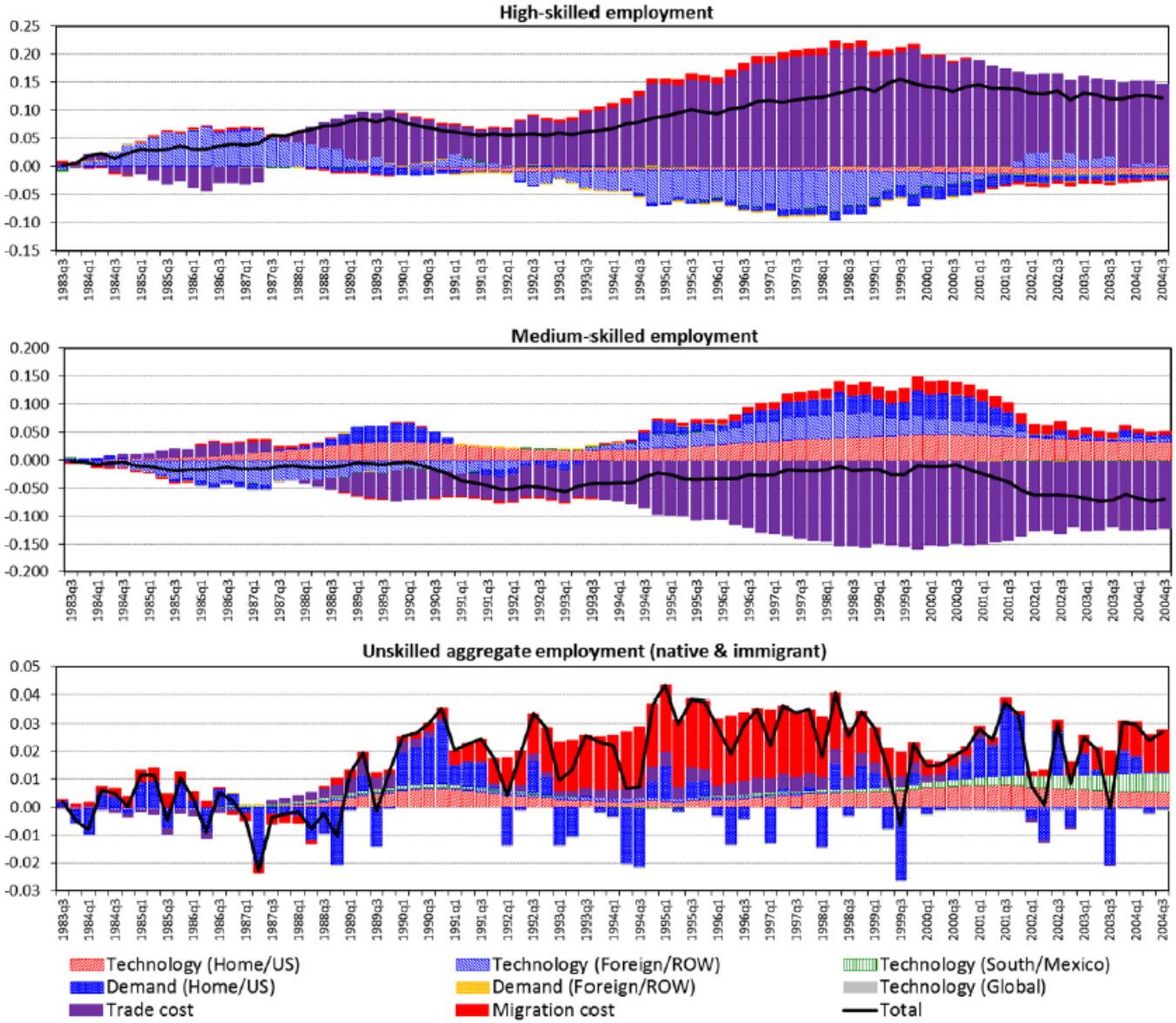
(a) Data for the United States, ROW and Mexico			
Variable (growth)	Corr. with U.S. GDP	Corr. with Mex. GDP	Corr. with border appreh.
GDP U.S.	1		
GDP Mexico	0.15	1	
Border apprehensions	−0.05	−0.23	1
High-skill emploment, U.S.	0.28	−0.10	0.01
Medium-skill employment, U.S.	0.53	0.24	−0.02
Unskilled employment, U.S.	0.34	0.07	−0.16
(b) Estimated benchmark model			
Variable (growth)	Corr. with GDP_{Home}	Corr. with GDP_{South}	Corr. with L_e
GDP Home	1		
GDP South	0.65	1	
Immigrant entry (L_e)	0.24	−0.30	1
High-skill emploment, Home (N_X)	−0.02	−0.04	0.03
Medium-skill employment, Home (N_M)	−0.11	0.00	−0.12
Unskilled aggr. employment, Home (L_N)	−0.57	−0.08	−0.25
New skilled jobs, Home (N_E)	0.59	0.08	0.33

Note: For the data, variables are transformed in $\Delta \ln$ and thus expressed in growth rates. The sample period for the variables in growth rates is 1983:Q2 to 2004:3. For the model, we report the moments for the variables in growth rates generated by the model when using the median estimates for the shock parameters reported in Table 1.

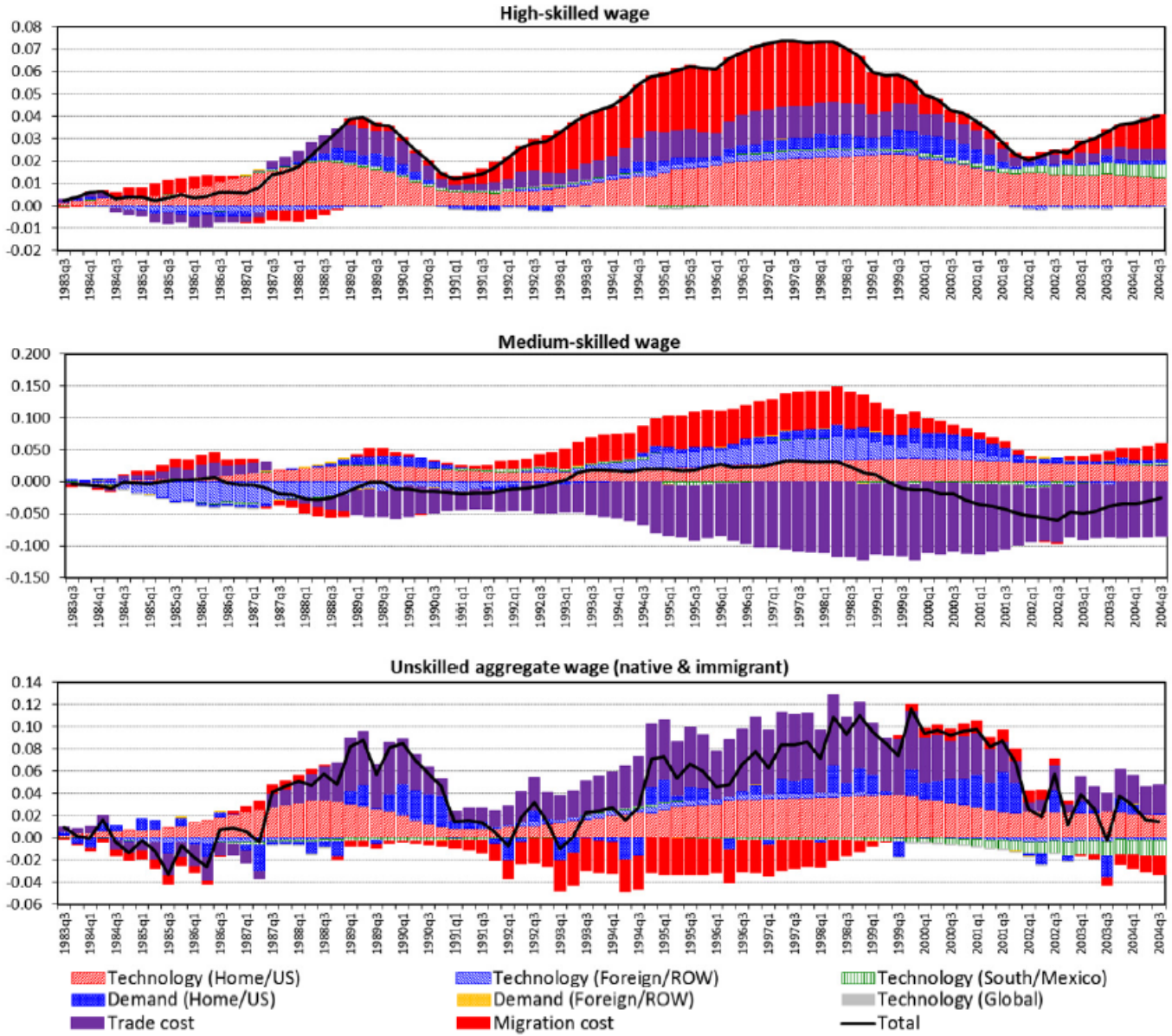
2. Model fit: historical decomposition



2. Model fit: historical decomposition (cont'd)



2. Model fit: historical decomposition (cont'd)



3. Welfare

- Welfare implications of either trade liberalization or decrease in immigration barriers, or both:
  - Either the iceberg trade cost or the sunk immigration cost, or both, are lowered from their benchmark calibration levels (τ to 1.1; and f_e to 1.0).
  - The model is solved using a second-order approximation around the deterministic steady state.
  - The welfare net gain is obtained as the % of the expected stream of consumption that one should add to the benchmark model case, so that households would be just as well-off as in the counterfactual scenario.

3. Welfare (cont'd)

- Reducing barriers to trade and immigration is welfare-improving:
  - With lower trade barriers, the economy becomes more productive as it specializes in its most productive tasks.
  - With lower immigration barriers, the skilled wage declines, but welfare gains arise from (a) cheaper services and (b) training.

Welfare gain/loss (%)	Home	Foreign	South
Lower τ 21 percent	2.7%	3.1%	1.0%
Lower f_e 36 percent	1.2%	0.1%	1.4%
Lower both	3.9%	3.2%	2.4%

Conclusions

- 3-country model with endogenous trade in tasks, endogenous immigration of unskilled labor, endogenous training:
  - Easier offshoring gives rise to employment and wage polarization;
  - Unskilled immigration boosts low-skill employment, dampens wages;
  - In turn, native workers undertake training, which is welfare-improving.
- The effects of training and cheaper services should be considered when assesing the welfare impact of immigration.
- Thank you!