The Slowdown in Immigration, Labor Market Shortages, and the Decline in the Skill-Premium

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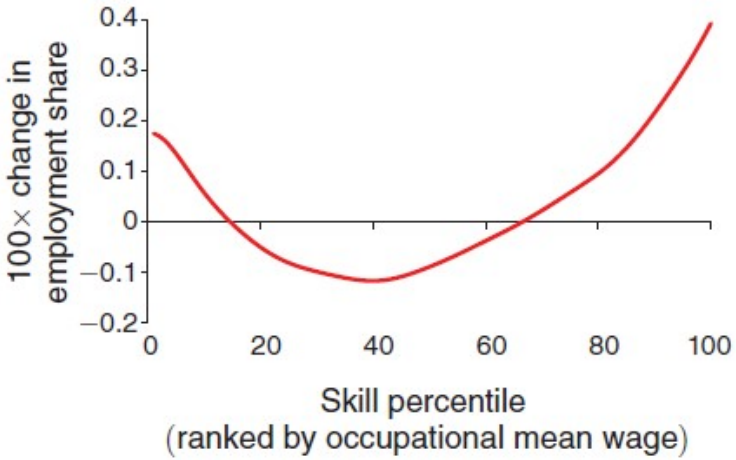
Labor market polarization, 1980-2010 (Mandelman and Zlate, 2002)

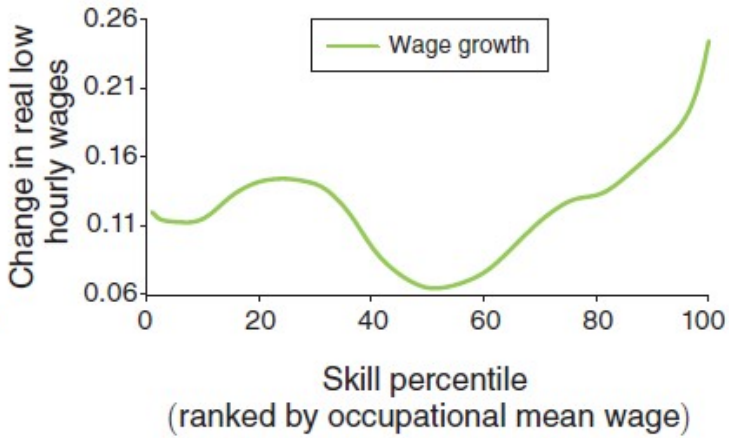
- Four empirical facts characterized the labor market during 1980-2010:
  1. Employment polarization (see Acemoglu and Autor, 2011).
  2. Asymmetric polarization for employment and wages.
     - Low-skill wages did not match the rise in low-skill employment.
  3. The emergence of low-skill service jobs (see Autor and Dorn, 2013).
  4. Rising immigrant employment in low-skill occupations, whose output is non-tradable.

Labor market polarization, 1980-2010 (Mandelman and Zlate, 2002)

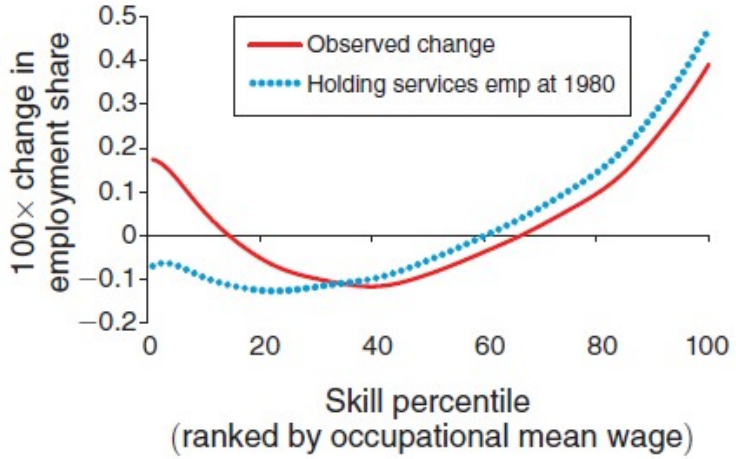
Panel A. Smoothed changes in employment by skill percentile



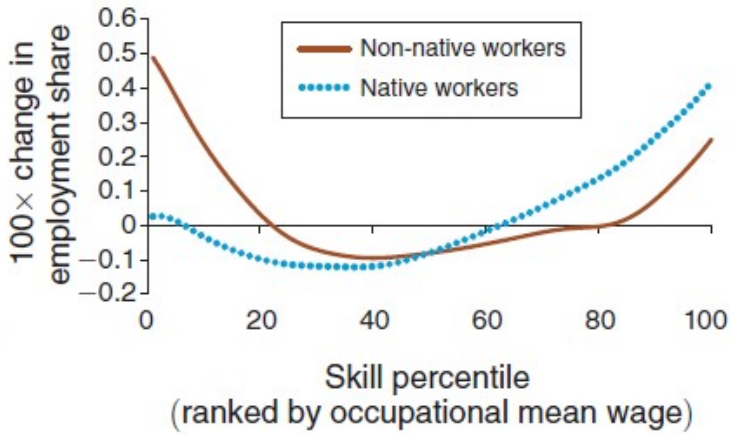
Panel B. Smoothed changes in wages by skill percentile



Panel C. Observed and counterfactual changes in employment



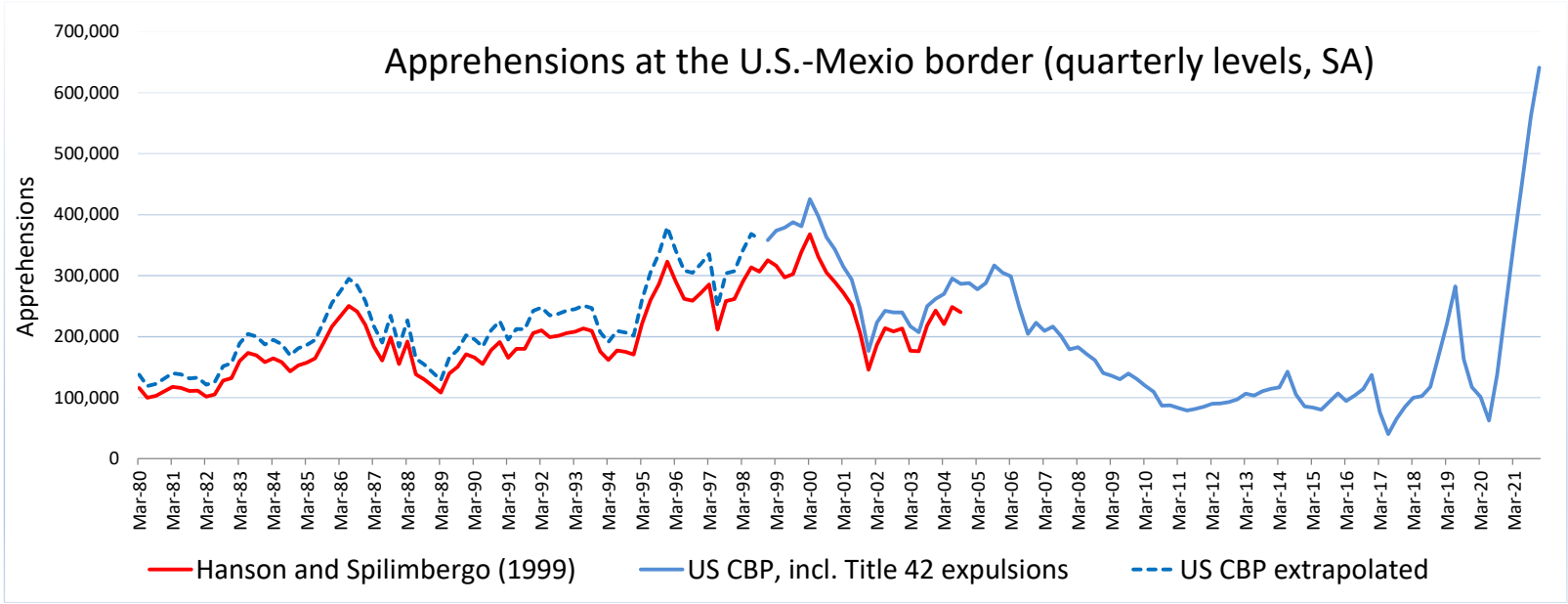
Panel D. Changes in employment by place of birth



This paper: Slowdown in low-skill immigration, 2010-present

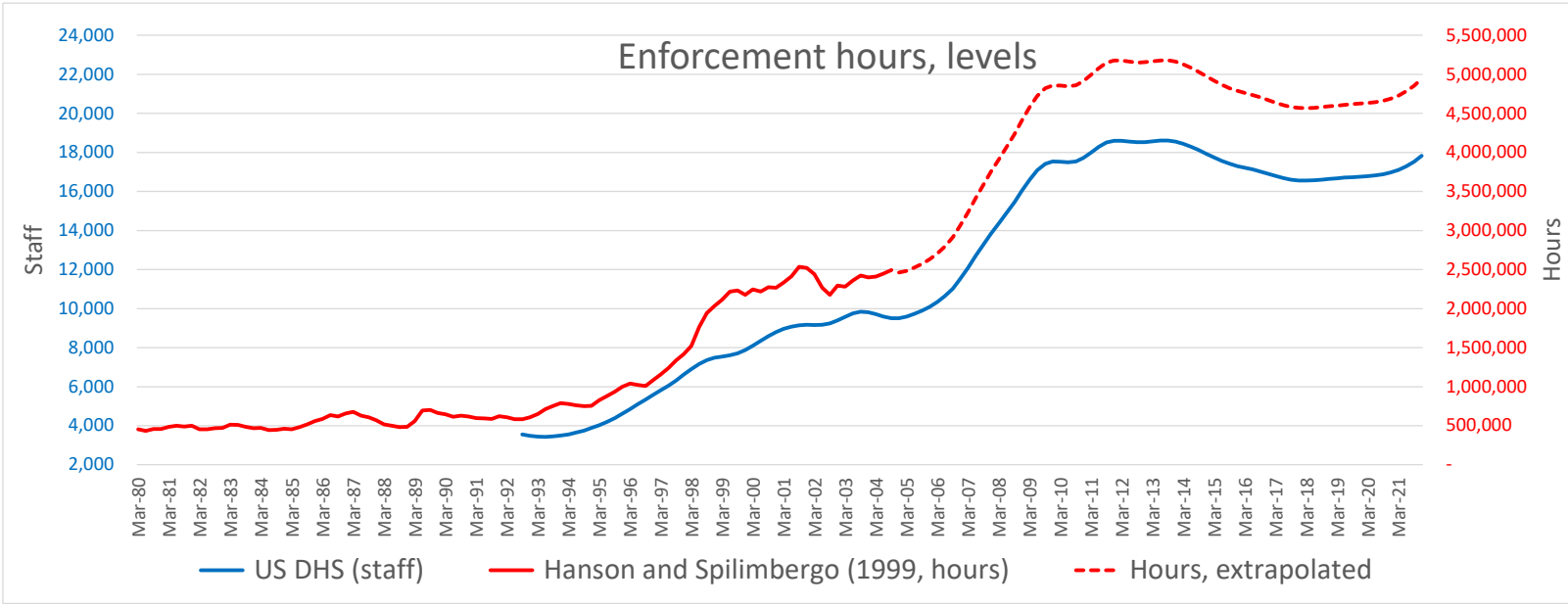
- Slowdown in low-skill immigration contributes to labor shortages:
  1. Slowdown in low-skill immigration has compounded the effect of U.S. population ageing.
  2. Stricter border enforcement has contributed to the slowdown in low-skill immigration.
  3. The share of low-skill employment has declined dramatically since 2010, especially for foreign-born employment (i.e., a reversal of polarization from 1980-2010).
  4. Rising low-skill wages, falling skill premium, lower real tuition costs.

Motivation: Slowdown in low-skill immigration



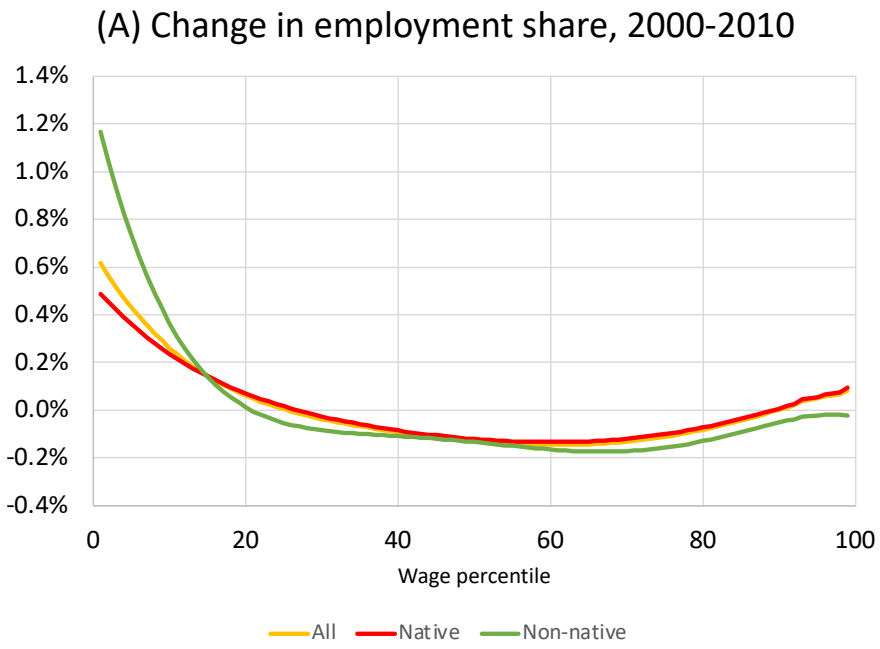
- Apprehensions at the U.S.-Mexico border as proxy for undocumented immigration.
  - Rose after the 1982 and 1995 Mexican crises, and with the U.S. housing boom in the early-2000s.
  - They fell after the U.S. housing bust, the GFC, and the 2016 elections.
  - Recent developments reflect a recovery in immigration, but also changes in reporting (Title 42 expulsions during Covid) and one-off events (2018).

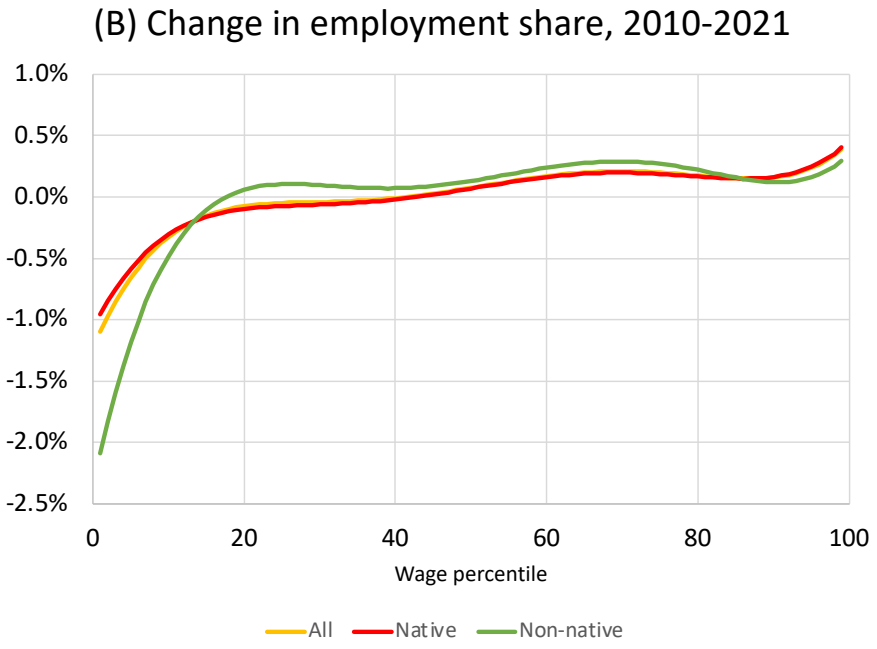
Motivation: Stricter border enforcement



- Border enforcement has been intensified in discrete steps:
  - Illegal Immigration Reform and Immigrant Responsibility Act of 1996; Secure Fence Act of 2006.
  - Deportations also increased sharply after 2009 (not shown).

Motivation: Declining share of low-skill employment since 2010

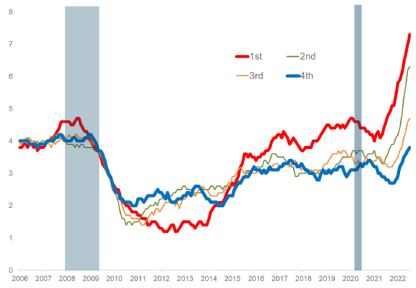




- Falling share of low-skill occupations in total employment since 2010:
  - Especially for foreign-born employment.
  - Low-skill service occupations cannot be automated or offshored, but hire immigrant labor.

Motivation: Rising Low-Skill Wages, Falling Skill Premia

Figure 2. Wage growth by Earnings Quartiles

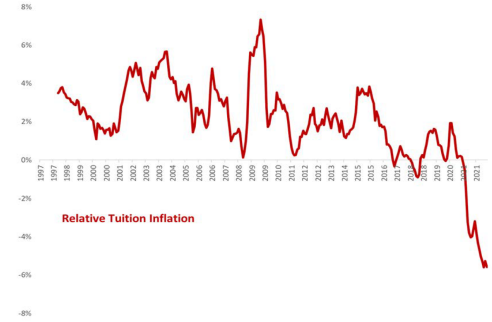


Note: Annual percentage change for different quartiles in the earnings distribution. Source: Atlanta Fed wage Tracker.

Figure 3. Skill Premium by education level

Note: Annual wage growth differential between workers with college and high school (or less). Source: Atlanta Fed wage tracker.

Figure 4. Growth in Real Tuition Costs



Note: Annual percentage change in tuition costs (tuition, other school fees, and childcare) deflated by the CPI index

- Low-skill labor shortage not felt at first, amid the GFC and slow recovery.
- As labor markets tightened after 2015, low-skill wages outperformed.
- The skill premium and real tuition costs declined.

Stochastic Growth Model: Key Ingredients

- Build 3-country stochastic growth model to rationalize these facts and study their implications for the U.S. labor market.
- Two large economies (Home and Foreign) and a small one (South).
- Two sectors in Home:
  - **Low-skill service sector** hires local labor only (natives+immigrants).
  - **Tradable sector** hires trained workers, which are heterogeneous in productivity (either in Home or offshore in Foreign).
- **Endogenous trade in tasks** between Home and Foreign, subject to a *fixed cost* (payable every period).
- **Endogenous migration of unskilled labor** from South to Home, subject to a *sunk emigration cost* (payable once);
- **Endogenous training of native labor** in Home and Foreign, subject to a *sunk training cost* (payable once).

Key Model Implications

- Model estimated with data on GDP, border enforcement, and real tuition costs for 1983-2018.
  - Replicates empirical pattern of migration, trade costs, skill premium.
- U.S. skill premium has declined substantially since the mid-2010s.
  - Caused by the slump in low-skill immigration since the mid-2000s, which became evident when labor markets tightened in mid-2010s.
- The slowdown in low-skill immigration is welfare-reducing.
  - Lower skill premium reduces training, hence aggregate productivity.
  - Immigrant labor shortages boost the price of low-skill services.
  - Increase in the price of services is amplified as temporary demand spikes (stimulus) interact with shortages of low-skill labor.

Stochastic Growth Model

Home: Low-Skill Service Sector

- The **service sector output**, $Y_{N,t}$, is a linear function of **"raw" (unskilled)** labor, and is non-tradable by definition:

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

- Where X_t is a **"global" unit-root trend-growth technology shock.**

- The labor input is a composite of native, $L_{N,t}$, and immigrant unskilled labor, $L^{\mathbf{s}}_{\mathbf{i},t}$:

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

Home: Training and Job Creation

- Households can allocate "raw" (unskilled) labor in the service sector or **invest in training, creating a diversity of skilled tasks (occupations)**.
- The **training (or job creation) cost** is $f_{j,t}$. Once training is done, an occupation with an idiosyncratic productivity $\mathbf{z}$ is revealed.
- $\mathbf{z}$ is **Pareto distributed** $G(\mathbf{z})$ with support $[1, \infty)$, suitable to match a skewed income distribution.
- Trained (skilled) labor is measured in **efficiency units**: the product of raw hours and its productivity index $\mathbf{z}$: $l_{\mathbf{z},t} \equiv \mathbf{z} l_t$.

Home: Productivity in Tradable Occupations

- Each **efficiency unit** of labor, $l_{\mathbf{z},t}$, will be augmented by:
  1. The unit-root global technology shock (X_t)
  2. **Temporary AR(1)** technology shock, $\mathbf{Z}_t$, that characterizes the relative productivity of labor in the tradable sector:

$$n_t(\mathbf{z}) \equiv (X_t \mathbf{Z}_t) l_{\mathbf{z},t}$$

$n_t(\mathbf{z})$ are labor tasks which are heterogenous across occupations, $\tilde{\zeta}$.

Home: Tradeable Sector Output

- The labor input, $\mathbf{N}_t$, is a composite of heterogeneous job tasks (occupations),ξ, existing over a continuum Ξ.
- Provided by **local** and **foreign** workers–subject to **melting-iceberg trade cost** $(\boldsymbol{\phi}_t \geqslant 1)$ and **fixed outsourcing costs** (f_t).
- The wage paid to each skilled/trained worker is w_t, with $\mathbf{W}_t$ being the total wage bill.

$$\mathbf{N}_t^T = \left[\int_{\xi \epsilon \Xi} n_t(\mathbf{z}, \xi)^{\frac{\theta-1}{\theta}} d\xi\right]^{\frac{\theta}{\theta-1}} \qquad \mathbf{W}_t^T = \left[\int_{\xi \epsilon \Xi} w_t(\mathbf{z}, \xi)^{1-\theta} d\xi\right]^{\frac{1}{1-\theta}}.$$

Home: Household's Optimization Problem

- **Family members perfectly insure each other** against variation in labor income as they pool their income.

- Household maximizes standard utility $U(C_t, L_t)$ s.t.

$$\underbrace{w_{\mathbf{u},t} L_t + N_{D,t} \tilde{\pi}_t}_{\text{Labor income}} = P_t C_t + \underbrace{f_{j,t} N_{e,t}}_{\text{Inv. in training}}$$

  - $N_{e,t}$ are the new skilled "occupations" created every period, such that $N_{D,t} = (1-\delta)(N_{D,t-1} + N_{e,t-1})$. $f_{j,t}$ is the training cost.

  - $\tilde{\pi}_t$ is the average skill premium = wage differential between (a) average *skilled* worker (of average $\mathbf{z}$, or $\tilde{\mathbf{z}}$) and (b) *unskilled* (raw) labor.

  - $w_{\mathbf{u},t} L_t + N_{D,t} \tilde{\pi}_t$, is the total labor income (raw labor income+skill premium).

Home: Household's Optimization Problem

- The cost to create a job (training), $f_{j,t}$, equals the present discounted value of the expected stream of skill premia.

$$\underbrace{f_{j,t}}_{\text{Training Cost}} = \mathbb{E}_t \sum_{s=t+1}^{\infty} \underbrace{\left[\beta\left(1-\delta\right)\right]^{s-t}\left(\frac{\zeta_s}{\zeta_t}\right)}_{\text{Stochastic Discount Factor}} \underbrace{\tilde{\pi}_s}_{\text{Skill Premium}}$$

- Discounted flow of skill premia $\tilde{\pi}_t$ matches the sunk training cost $f_{j,t}$
- $f_{j,t} = \left(Tuition_t\right)^{\nu}$ .Allows for non-linear between effective training and tuition costs (as measured in the data).
- ζ_t is the marginal utility of consumption and δ is the job destruction rate (technology disruption).

Extension: Model with Capital

- **Tradable Output**

$$Y_{T,t} = \left(\alpha K_t^{\frac{\sigma-1}{\sigma}} + (1-\alpha) \mathbf{N}_t^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}.$$

- **Capital Stock**

$$K_t = (1-\delta_K) K_{t-1} + V_t \left(I_t - \phi_K(.) \right)$$

Where V_t is an **Investment-Specific Technology Shock.** Measured with Information-and-Communications Technology (ICT) capital data.

- If automated capital becomes cheaper: V_t increases.

Extension: Effect of Trade and Automation on Middle-Skill Workers

- All employed labor produces tasks for Home, some tasks can be imported from foreign (through imports or offshored).
- Automated capital can substitute labor tasks as well.
- **Less-productive middle-skill tasks (those with low z)** may be displaced:
  - If trade/offshoring costs fall $\Longrightarrow$ more of them are offshored overseas.
  - If automated capital becomes cheaper $\Longrightarrow$ They are substituted by capital.

South Economy: Labor Migration

- Households supply $L^s_{\mathbf{u},t}$ units of "raw" labor **without** the possibility of training.
- A fraction $L^s_{\mathbf{i},t}$ reside and work abroad (Home). The remaining $L^s_{\mathbf{u},t} - L^s_{\mathbf{i},t}$ remains at origin (South).
- The household sends $L^s_{\mathbf{e},t}$ new migrants every period, which **slowly** adds to the stock $L^s_{\mathbf{i},t}$.
- The continue working until they are hit by a return (deportation) shock δ_l :

$$L^s_{\mathbf{i},t} = (1 - \delta_l)(L^s_{\mathbf{i},t-1} + L^s_{\mathbf{e},t}).$$

- Migration requires a sunk migration cost, $f_{e,t}$, which is affected by migration policy (measured with border enforcement data)

South Economy: Labor Migration (continued)

Household's Decision Problem:

- FOC with respect to new emigrant $L^s_{\mathbf{e},t}$ implies:

$$f_{e,t} = \mathbb{E}_t \sum_{s=t+1}^{\infty} \underbrace{[\beta(1-\delta_l)]^{s-t} \left(\frac{\zeta_s}{\zeta_t}\right)}_{\text{Stochastic Discount Factor}} \underbrace{(w_{\mathbf{i},t} - w^s_{\mathbf{u},t})}_{\text{Wage gain}}.$$

The sunk migration cost $(f_{e,t})$ must equate the net present value of wage gains from migration, $(w_{\mathbf{i},t} - w^s_{\mathbf{u},t})$, subject to the return shock δ_l.

Model Estimation and Model Fit

Bayesian Estimation: Observed Variables

Quarterly Data (not detrended, but SA, log-differences):

1. **GDP:** US, Mexico, rest-of-the-world (major U.S. trade partners).
2. **Border Enforcement:** U.S. border patrol hours from DHS .
3. **Real Tuition Costs.**
4. **Extended Model:** ICT Technology and Offshore Employment by U.S. Multinationals (in progress).

Estimation results

	Prior distribution				Posterior distribution			
Description	Name	Density	Mean	Std Dev	Mode	Mean	10%	90%
Training sunk cost concavity	γ_{TR}	Beta	0.35	0.05	0.1927	0.1979	0.1639	0.2341
Migration sunk cost	f_{MIG}	Gamma	8.8	0.1	7.2320	7.3579	6.4824	8.2679
Trade iceberg cost (H)	τ	Gamma	1.40	0.15	1.4141	1.3920	1.2399	1.5521
Trade iceberg cost (F)	τ^*	Gamma	1.40	0.15	1.4816	1.5014	1.3786	1.6268
Inv. Elast. Labor Supp (H)	γ_n	Gamma	1.33	0.3	1.0768	1.1997	0.9604	1.4838
Weight leisure (H)	a_n	Gamma	3.90	0.3	4.0379	4.0037	3.6298	4.3699
Inv. Elast. Labor Supp (S)	γ_n^s	Gamma	1.33	0.3	1.0634	1.1439	0.8200	1.4873
Weight leisure (S)	a_n^s	Gamma	8.6	1	8.5748	8.6473	7.4334	9.8875
Training cost shock	ρ_{fTR}	Beta	0.75	0.1	0.9988	0.9983	0.9974	0.9990
Migration cost shock	ρ_{fMIG}	Beta	0.75	0.1	0.9802	0.9786	0.9676	0.9885
Trade cost shock	ρ_τ	Beta	0.75	0.1	0.9918	0.9894	0.9831	0.9948
Tech. shock (H)	ρ_Z	Beta	0.75	0.1	0.9973	0.9966	0.9946	0.9983
Tech. shock (F)	ρ_{Z^*}	Beta	0.75	0.1	0.7123	0.7057	0.6506	0.7582
Tech shock (S)	ρ_s	Beta	0.75	0.1	0.9961	0.9944	0.9903	0.9977
Demand shock (H)	ρ_b	Beta	0.5	0.05	0.7806	0.7659	0.7410	0.7861
Demand shock (F)	ρ_{b^*}	Beta	0.5	0.05	0.4995	0.4989	0.4297	0.5657

Empirical Validation

Quarterly Data (not detrended, but SA, log-differences):

1. **Migration Flows:** Apprehensions (arrests) at the U.S.-Mexico border adjusted for border enforcement like in Hanson and Spilimbergo (AER 1999):

$$ln(App) - 0.8ln(Enf)$$

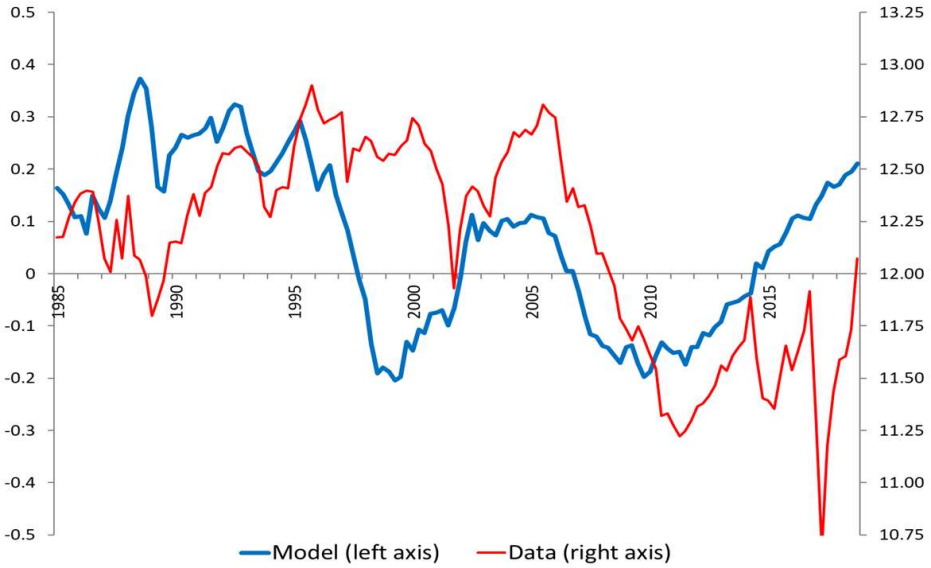
2. **Trade/offshoring costs**

3. **Employment by skill group:** Census data split into Non-Routine Cognitive (high-skilled), Routine Cognitive (medium-skilled), and Non-Routine Manual (unskilled), like in Jaimovich and Siu (2012).

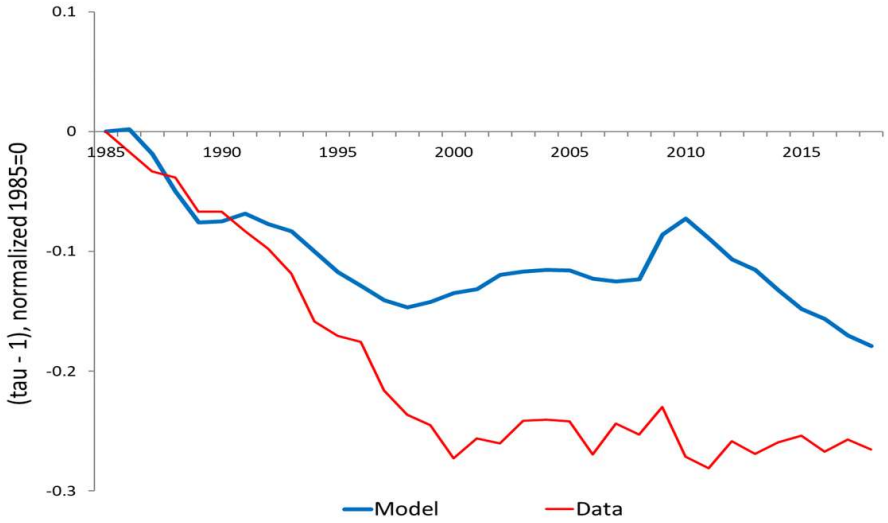
Estimation Results

- Model predicts well the migration flows.
- Model understates trade costs, hence overstates the role of trade/offshoring. The gap may capture advances in automation, not included in the baseline, which exert a similar effect on labor markets.

A-Immigrant Entry (Deviations from Trend Growth)



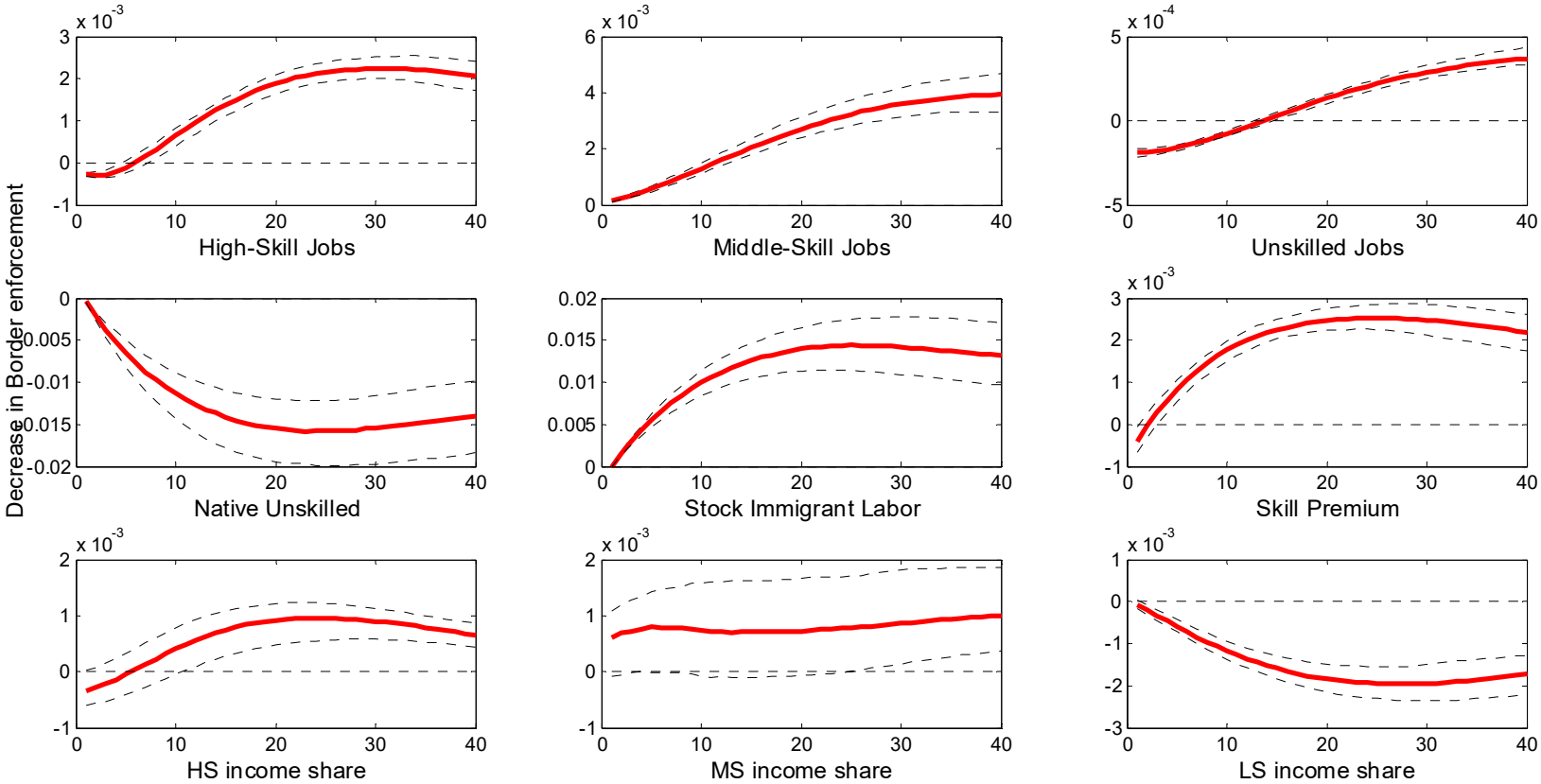
B-Trade/Offshoring Costs



Model Implications

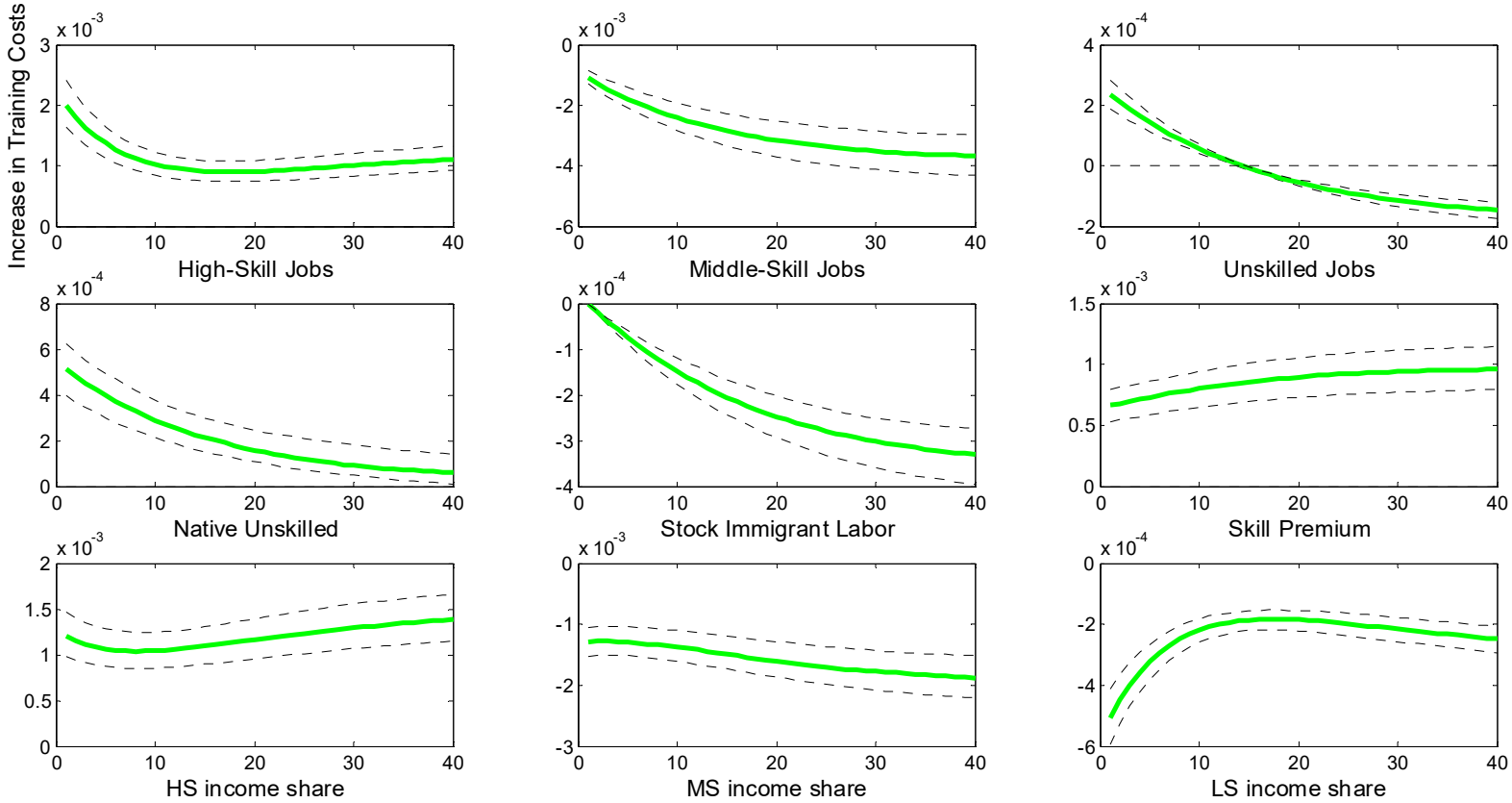
1. Impulse Responses: Decrease in Sunk Migration Cost

- Low-skill immigrant flows and stock ⇑.
- Low-skill wage and income share ⇓, skill premium ⇑.
- Native unskilled jobs ⇓, training and aggregate productivity ⇑.



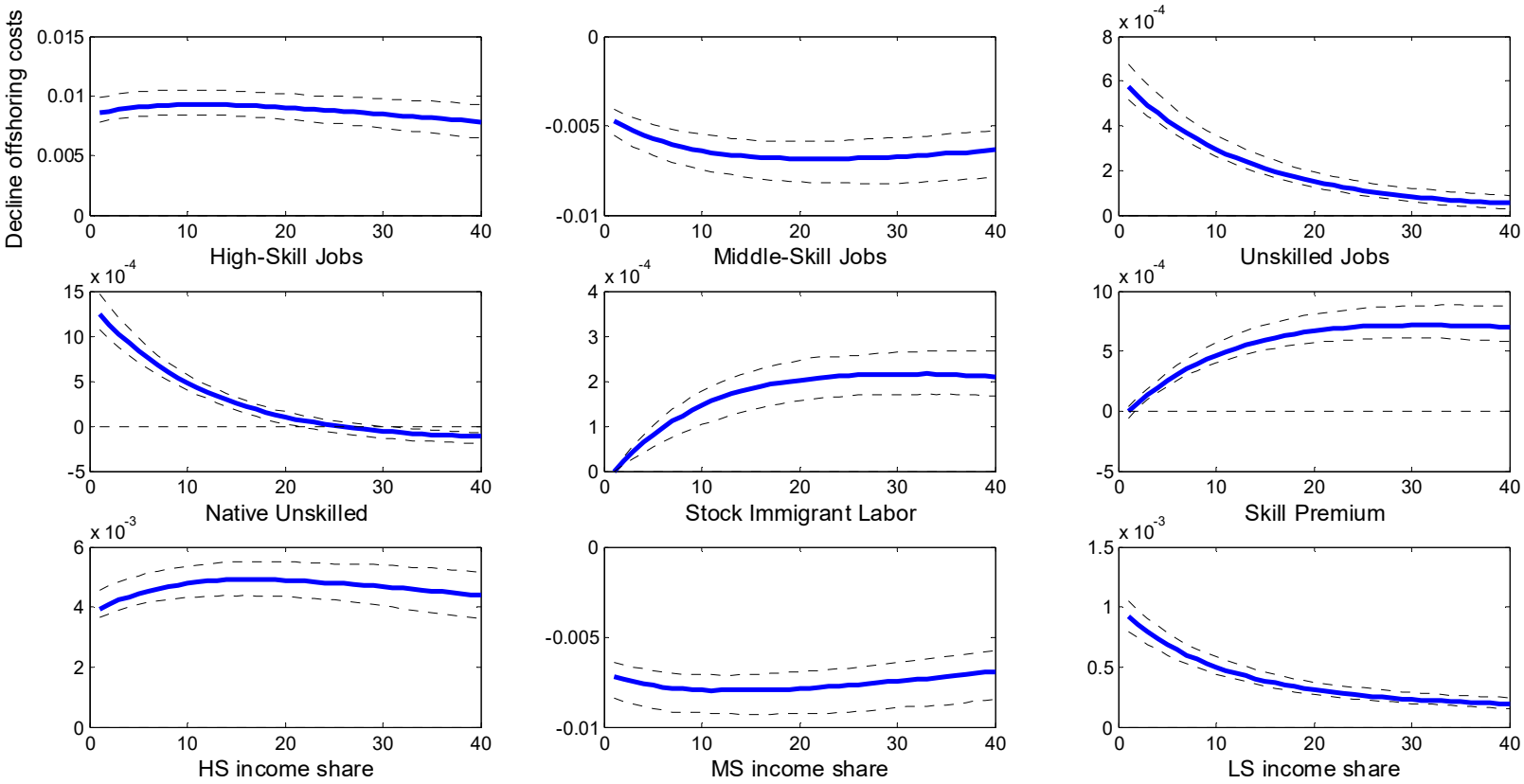
1. Impulse Responses: Increase in Sunk Training Cost

- Native training ⇓, native unskilled jobs ⇑, low-skill immigration ⇓.
- Low-skill income share ⇓, price of non-tradables ⇓, skill premium ⇑.
- Balassa-Samuelson effect: cheaper non-tradables lead to RER depreciation, high-skill jobs ⇑ due to trade.



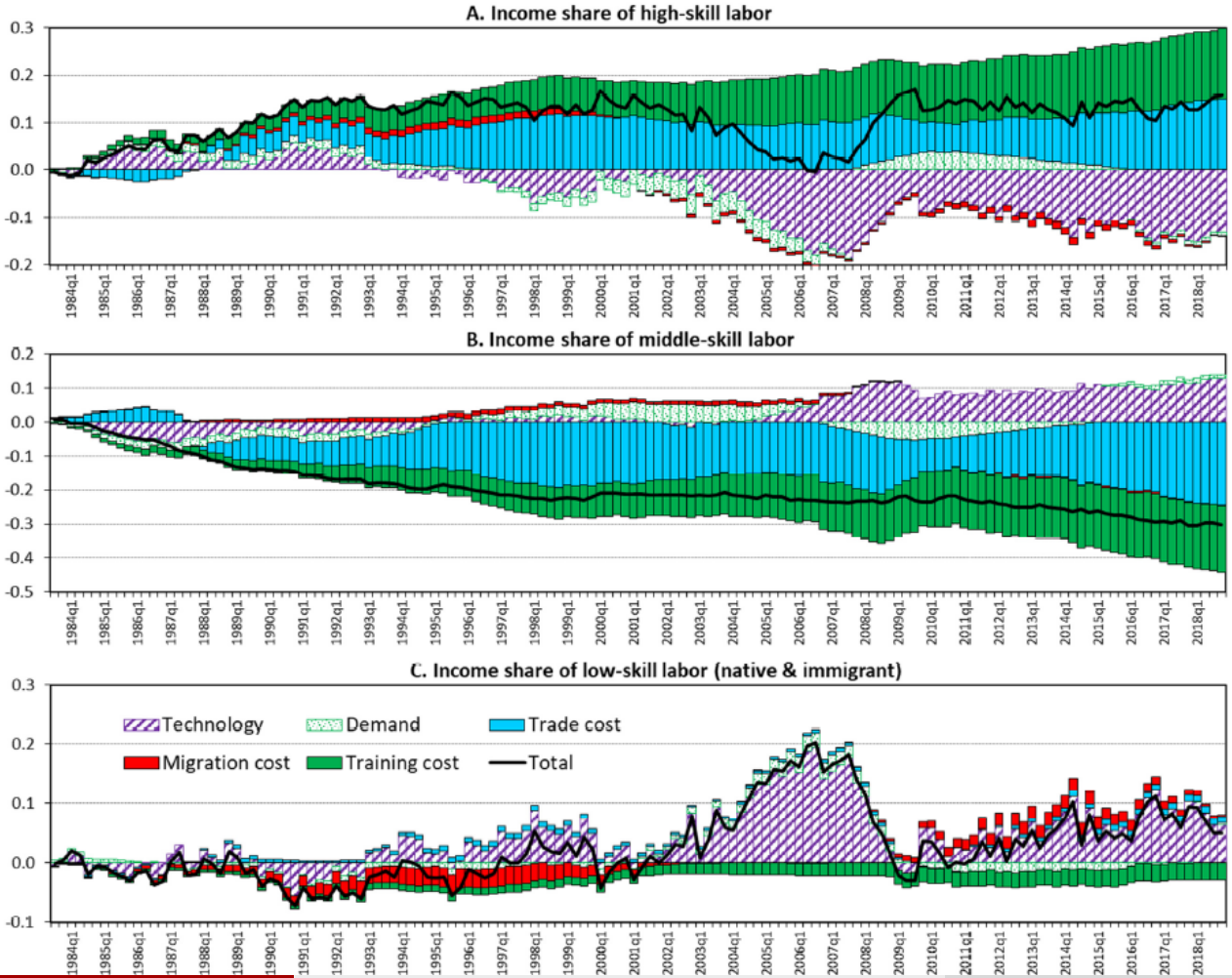
1. Impulse Responses: Decline in Iceberg Offshoring Cost

- High-skill jobs ⇑, middle-skill jobs ⇓.
- Low-skill jobs and their income share ⇑.
- Low-skill immigration ⇑.



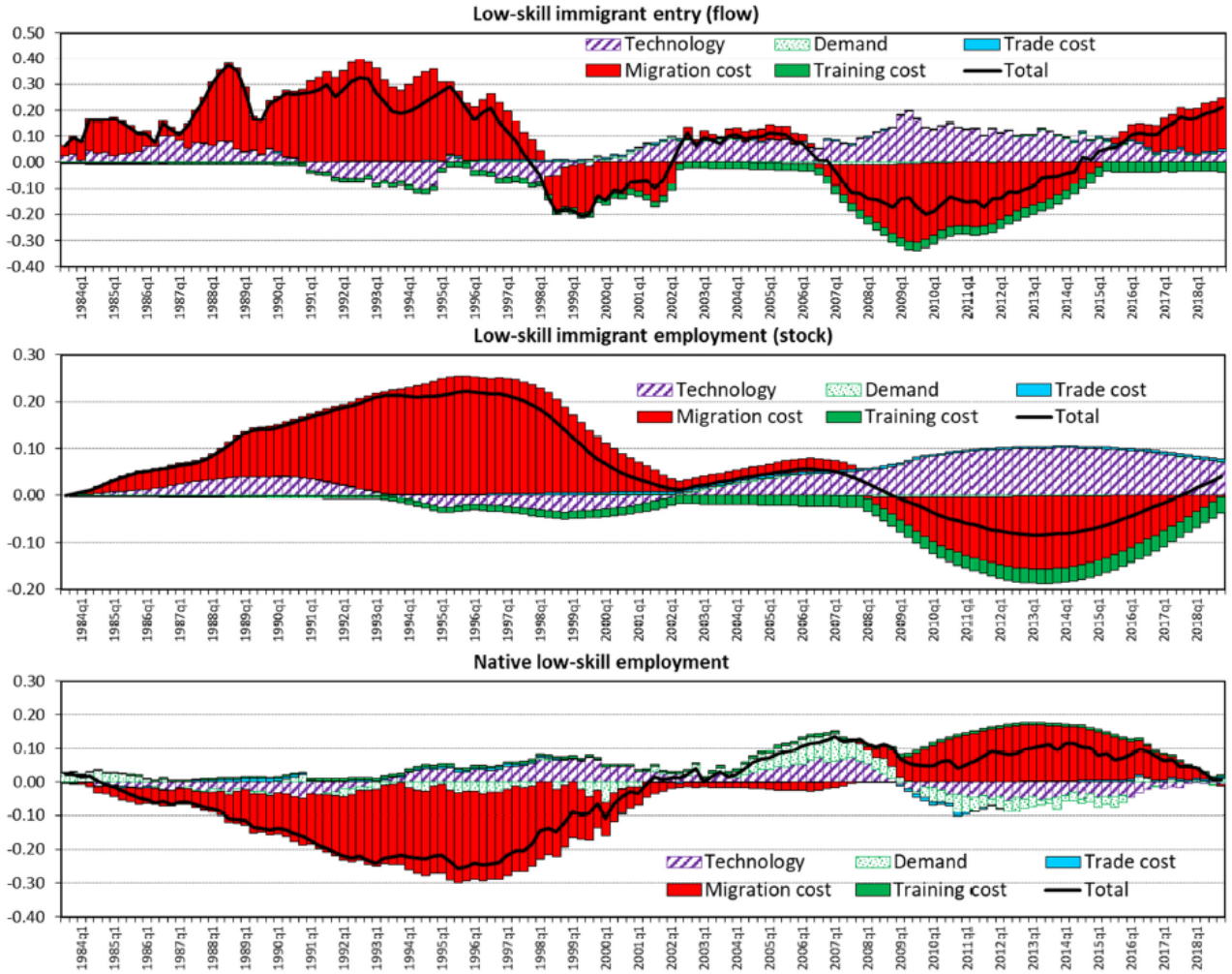
2. Historical Decomposition: Income by Skill Group

- Migration cost (red): positive effect on LS income after 1996, given stricter border enforcement, leading to lower skill premium.
- Training cost (green): negative effect on LS income, as natives train less.
- Trade cost (blue), automation (purple): positive/negative effect on HS/MS income



2. Historical Decomposition: Low-skill Employment

- Migration cost (red): positive effect on low-skill immigration, negative effect on native low-skill employment before 1996 (when the cost was low).
- Opposite effects more recently (with stricter border enforcement).



3. Welfare Analysis

- Welfare gains (losses) are computed as the percent of the expected stream of consumption along its balanced-growth path that one should add (or subtract) to the estimated benchmark model so that the representative household of each country would be just as well-off as in the counterfactual.

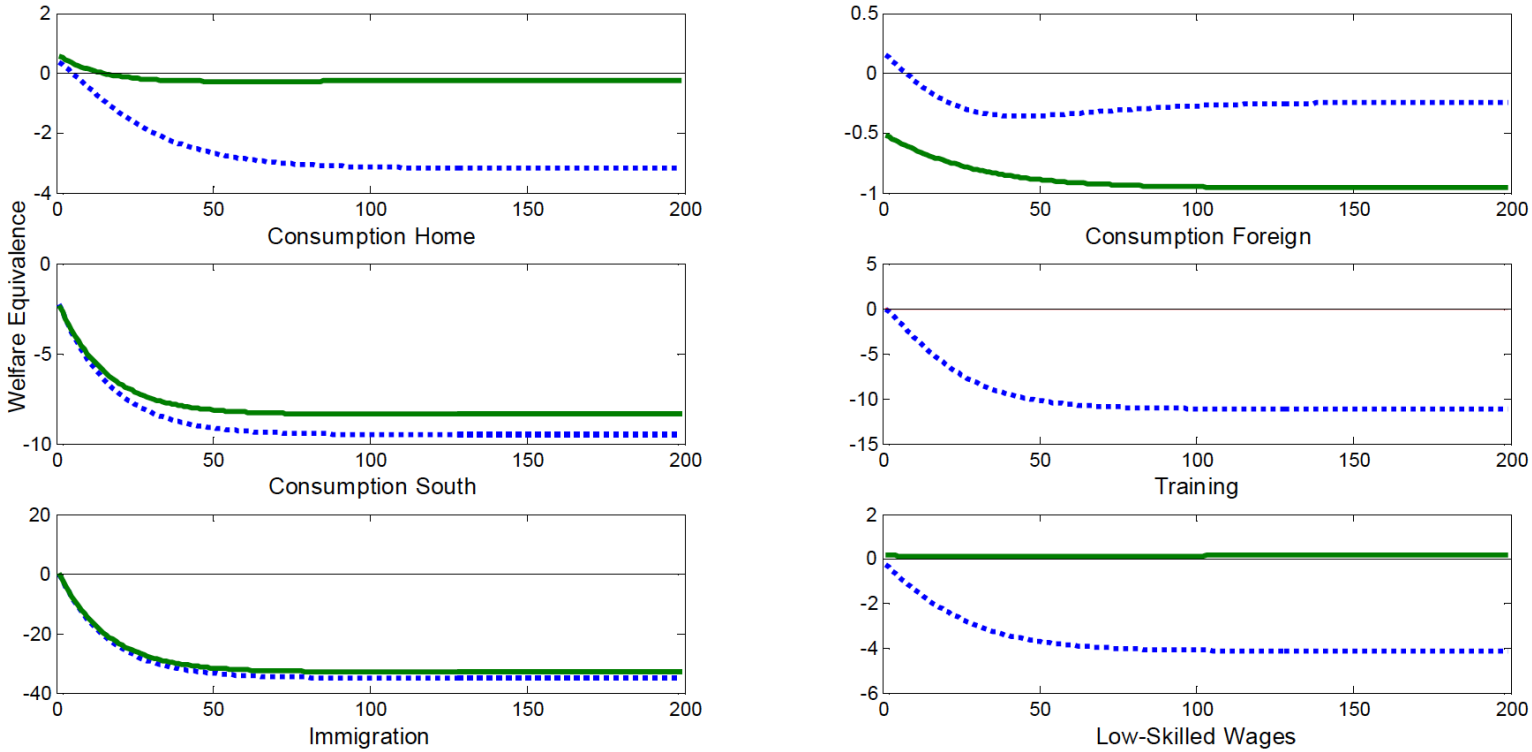
1. Decline in low-skill immigrant inflows observed during 2007-2018: H and S lose.
2. Decline in real training costs from 2018 back to 1983 levels: H and F gain.
3. Decline in trade cost observed during 1983-2018: all gain.

	Home	Foreign	South
Decline in Immigration	-2.54%	-0.19%	-9.06%
Decline in Immigration (with shocks)	-2.52%	-0.29%	-11.00%
Decrease in Training Costs	5.28%	2.07%	-0.31%
Decrease in Training Costs (with shocks)	5.28%	2.35%	-0.31%
Decrease in Offshoring Costs	2.99%	1.30%	4.19%
Decrease in Offshoring Costs (with shocks)	3.86%	1.24%	4.31%

4. Impulse Responses: Decline in Immigration 2007-2018

- Training falls endogenously (blue): Home consumption falls substantially.
- Training is fixed (green): Home consumption falls by less.

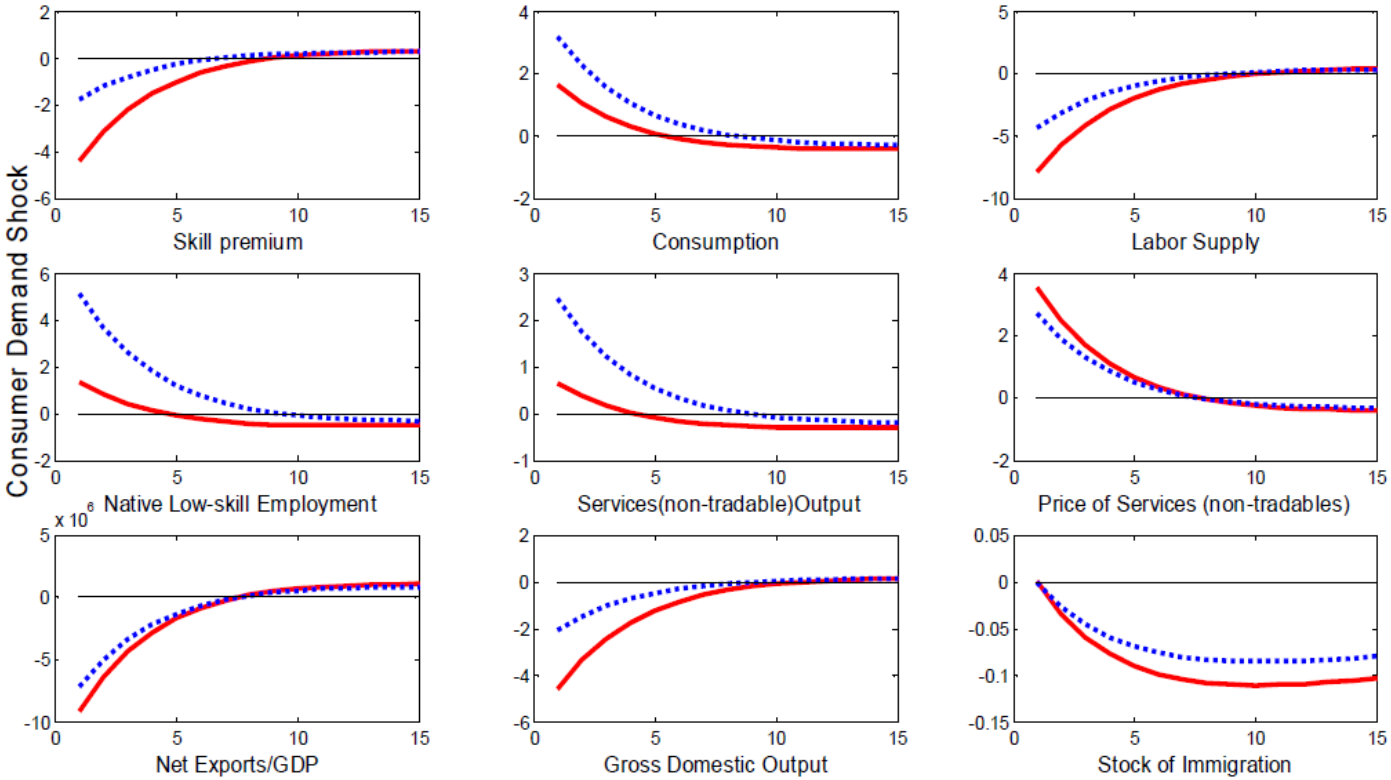
Figure 17A- Welfare: Counterfactual Scenarios with Training Choices Unchanged



5. Impulse Resp.: Demand Stimulus w/ Labor Shortages

- BLUE: Positive demand shock.
  - Home increases consumption, decreases labor supply and training.
  - Home NT output and prices increase, the skill premium falls.
- RED: Positive demand shock + reduced labor force participation.
  - Home NT output increases by less, prices by more.

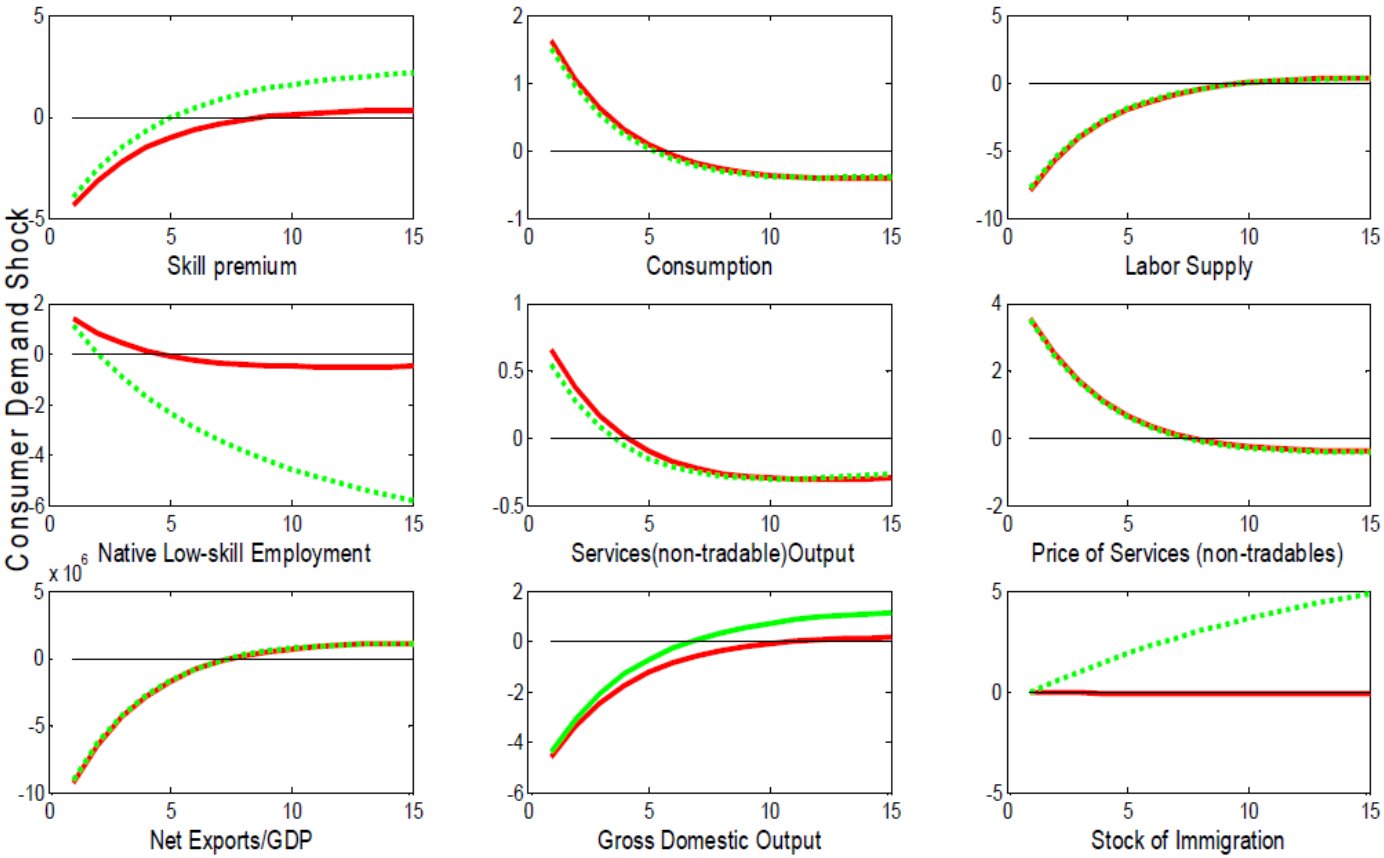
Figure 18A - Transitory Spike in Demand with Constrained Labor (COVID-19 Simulation)



6. Impulse Resp.: Demand Stimulus w/ Immigr. Surge

- GREEN: Rapid increase in immigration (2021-22) has little effect in the short term.
  - It takes time to rebuild the stock of immigrant labor.

Figure 18B- Transitory Spike in Demand with Constrained Labor: A Recovery in Immigration



Conclusions

- Model estimated with data on GDP, border enforcement, and real tuition costs for 1983-2018.
  - Replicates empirical pattern of migration, trade costs, skill premium.
- U.S. skill premium has declined substantially since the mid-2010s.
  - Caused by the slump in low-skill immigration since the mid-2000s, which became evident when labor markets tightened in mid-2010s.
- The slowdown in low-skill immigration is welfare-reducing.
  - Lower skill premium reduces training, hence aggregate productivity.
  - Immigrant labor shortages boost the price of low-skill services.
  - Increase in the price of services is amplified as temporary demand spikes (stimulus) interact with shortages of low-skill labor.