Protectionism and Inequality

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Presented @ ESAM 2024

Motivation

- Over the past few years, the world has been hit with large disruptions in international trade.
  - Examples: Brexit, the US-China trade war, Covid-19

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- Protectionism on the rise: the White House and the European Parliament has moved up reshoring to key priorities (White House 2021, EU 2021).
  - e.g. ”More resilient supply chains are secure and diverse — facilitating greater domestic production, a range of supply,..., and a world-class American manufacturing base and workforce.” (White House 2021)

▸ US-China trade war

Question

- What are the distributional effects of protectionism?
- How do protectionist trade policies affect the wage and employment ratio between high-skilled and low-skilled workers in the U.S.?

What We Do

- Empirical evidence:
  - VARs using high-frequency measures of temporary trade barriers for the U.S.
  - A panel VAR for a sample of 36 countries using the applied tariff rates
  - Protectionism lowers the skill premium but increases the employment ratio between high-skilled and low-skilled workers in the short run

What We Do

- Empirical evidence:
  - VARs using high-frequency measures of temporary trade barriers for the U.S.
  - A panel VAR for a sample of 36 countries using the applied tariff rates
  - Protectionism lowers the skill premium but increases the employment ratio between high-skilled and low-skilled workers in the short run
- Model:
  - Two-country dynamic general equilibrium model featuring capital-skill complementarity (CSC), asymmetric search-and-matching (SAM) frictions, and producer dynamics
    Krusell, Ohanian, Rios-Rull & Violante (2000); Lindquist (2004);
    Barnichon and Figura (2015); Wolcott (2021)
  - Successfully replicates the VAR evidence
  - Counterfactual analysis highlights the mechanisms

Related Literature

- Macroeconomic effects of protectionism: little discussion on lmk inequality
  - Amiti et al. (2019), Barattieri et al. (2021), Barattieri and Cacciatore (2023), Fajgelbaum et al. (2020), Flaaen and Pierce (2019), Jiang (2023), Furceri et al. (2022), Waugh (2019)
- Trade and the skill premium: mostly static models
  - Acemoglu (2003), Bernard et al. (2007), Goldberg and Pavcnik (2007), Thoenig and Verdier (2003), Yeaple (2005), Matsuyama (2007), Monte (2011), Parro (2013), Burstein et al. (2013), Burstein and Vogel (2017)... Dix-Carneiro and Traiberman (2023)
- Other closely related works:
  - Dolado et al. (2021)

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Dissecting the Mechanism

Temporary Trade Barriers (TTBs)

- TTBs: Antidumping duties, global safeguards, and countervailing duties (Bown (2011))
  - Antidumping initiatives account for 80% to 90% among TTBs. (Barattieri et al. (2021))
- Data source: the Global Antidumping Database (GAD).
- Baseline measure of U.S. protectionist trade policy: the number of HS-6 products for which an antidumping investigation begins in a given month (or quarter) (Bown and Crowley (2013))

Empirical Strategy-Structural VAR

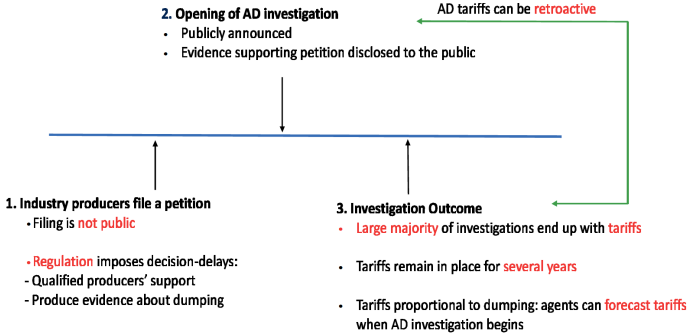
$$Y_t = \Theta + \sum_{i=1}^{p} \Phi_i Y_{t-i} + A u_t$$

- Y_t: a vector that includes trade cost measures and labor market variables
- u_t: a vector of structural innovations that satisfy the condition of $E(u_t u_t^{'}) = I_N$
- A: a matrix that links structural and reduced-form innovations
- Benchmark: monthly data (May 1979- December 2019); quarterly data also examined

Identification Assumption

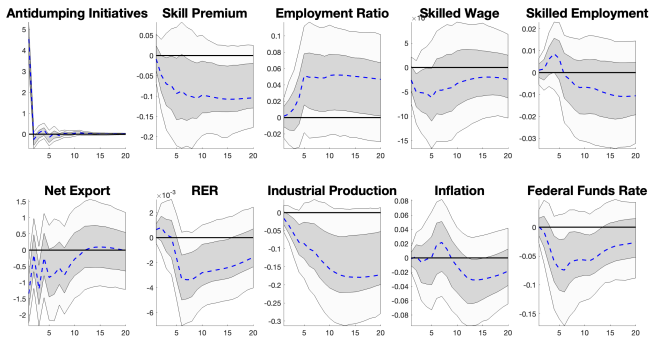
- Contemporaneous exogeneity of antidumping investigations with respect to macroeconomic/labor market shocks

- Reflects the existence of decision lags in the opening of investigations



Source: Barattieri et al. (2021)

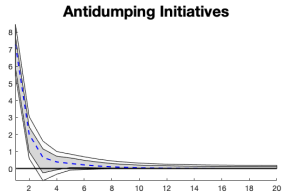
Monthly VAR Results

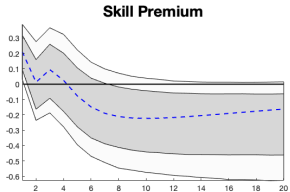


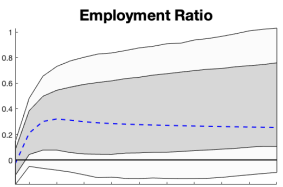
A one-standard deviation shock to antidumping initiatives implies

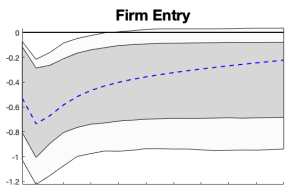
- a 350% ↑ in the average number of AD.
- ↓ wage inequality
- ↑ employment ratio
- ↓ unskilled employment opportunities relatively more
- ↓ industrial production
- Real ER appreciates.

Quarterly VAR Results



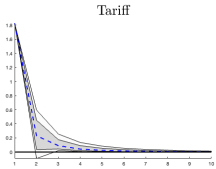


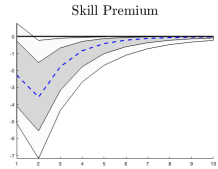


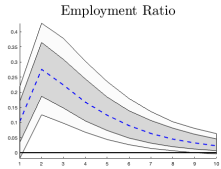


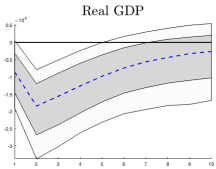
- Consistent with the monthly results:
  - Skill premium ↓
  - Employment ratio ↑
- A significant decline in firm entry

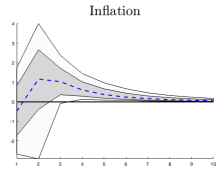
Annual Panel SVAR Results











- A Panel SVAR of 36 countries over 1995-2009
- Measure temporary trade policy shocks by detrending the tariff series using HP filter
- Robust evidence that protectionism reduces the skill premium but increases the employment ratio between high-skilled and low-skilled workers

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Dissecting the Mechanism

Household Preferences

- Focus on Home (U.S.)
- The representative household maximizes:

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{(C_s)^{1-\eta}}{1-\eta} - \chi_l L_{l,s} - \chi_h L_{h,s} \right]$$

- The consumption basket: $C_t = \left(\int_{\omega \in \Omega} c_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}}$
  - Only a subset $\Omega_t \in \Omega$ is available in each period
- The consumption-based price index: $P_t = \left(\int_{\omega \in \Omega_t} p_t(\omega)^{1-\theta} d\omega \right)^{\frac{1}{1-\theta}}$
  - $p_t(\omega)$: the Home nominal price for the good $\omega \in \Omega_t$
- $L_{l,t}$: the number of employed low-skilled workers
  $L_{h,t}$: the number of employed high-skilled workers

Production as in Krusell et al. (2000)

$$
\begin{aligned}
y_t(z) &= Z_t z \left[\phi \left[\lambda \left(k_t(z) \right)^{\gamma} + (1-\lambda) \left(l_{h,t}(z) \right)^{\gamma} \right]^{\frac{\alpha}{\gamma}} + (1-\phi) \left(l_{l,t}(z) \right)^{\alpha} \right]^{\frac{1}{\alpha}} \\
&= Z_t z \, F(z)
\end{aligned}
$$

- Z_t: aggregate productivity
- z: firm's idiosyncratic productivity level
- $\frac{1}{1-\gamma}$: elasticity of substitution between capital and high-skilled labor
- $\frac{1}{1-\alpha}$: elasticity of substitution between low-skilled labor and the composite product of capital and high-skilled labor
- $\alpha > \gamma$.

The Labor Market

- Firms recruit workers through a search and matching process (DMP framework).
- In order to hire the workers, they have to post vacancies $v_{j,t}(z)$ $(j = h, l)$, incurring a vacancy-posting cost κ
- Matching function: $M_{j,t} \equiv M_{j,t}(V_{j,t}, S_{j,t}) = \xi_j (V_{j,t})^{\varepsilon} (S_{j,t})^{1-\varepsilon}$
  - Vacancy filling rate: $\nu_{j,t} \equiv M_{j,t} / V_{j,t}$
  - Labor market tightness: $\vartheta_{j,t} = V_{j,t} / S_{j,t}$
- The law of motion of employment for firm z:

$$l_{j,t}(z) = (1 - \sigma_j) l_{j,t-1}(z) + \nu_{j,t} v_{j,t}(z)$$

  - σ_j is workers' separation rate

First Order Conditions

- The job creation equations for worker type j:

$$\frac{\kappa}{\nu_{j,t}} = \underbrace{\varphi_t(z) z Z_t \frac{\partial F(z)}{\partial l_{j,t}(z)}}_{\text{marginal product of an extra type } j \text{ worker}} - w_{j,t} + \underbrace{(1-\sigma_j)(1-\delta) E_t \left[\beta_{t,t+1} \frac{\kappa}{\nu_{j,t+1}} \right]}_{\text{expected discounted savings on future vacancy posting}}$$

- F.O.C. for capital:

$$r_t = \varphi_t(z) z Z_t \frac{\partial F(z)}{\partial k_t(z)}$$

- Optimal price setting:

$$\rho_{D,t}(z) \equiv \frac{p_{D,t}(z)}{P_t} = \frac{\theta}{\theta - 1} \varphi_t(z)$$

$$\rho_{X,t}(z) \equiv \frac{p_{X,t}(z)}{P_t^*} = Q_t^{-1} \tau_t \rho_{D,t}(z)$$

▸ Cost minimization

Wage Determination

- Wage is the solution of an individual Nash bargaining process that splits the surplus of the match between the firm and the worker.

- $w_{j,t} = \zeta_j \varphi_t(z) z Z_t \frac{\partial F(z)}{\partial l_{j,t}(z)} + (1 - \zeta_j)\bar{\omega}_{j,t}$
  - $\zeta_j \in (0, 1)$: type j worker's bargaining share

- Workers' outside option: $\bar{\omega}_{j,t} = \underbrace{\chi_j / C_t^{-\eta} + \varkappa_j}_{\text{benefits from unemployment}} + \underbrace{E_t[\beta_{t,t+1}\mu_{j,t+1}S^W_{j,t+1}]}_{\text{expected discounted value of searching for jobs in the next period}}$

Firms' Export and Entry Decisions

- Exporting involves both a melting-iceberg trade cost τ_t as well as a fixed cost $f_{X,t}$
- A firm will export if and only if the profit from exporting is non-negative, which pins down the cutoff productivity level $z_{X,t}$
- Firm entry takes place until the expected value of the average firm $\tilde{e}_t$ is equal to $f_{e,t}$ units of the consumption basket: $\tilde{e}_t = f_{e,t}$
- Law of motion for firms: $N_{t+1} = (1 - \delta)(N_t + N_{E,t})$

▸ Firm averages ▸ HH budget constraint

Calibration

- External parameters from various sources Go
- Internal parameters to match macro and micro moments Go
- Parameters reflecting asymmetric search-and-matching and capital-skill complementarity:

Parameter	Meaning	Value	Source/target
Externally calibrated			
σ_h	seperation rate, H	0.0245	Fallick et al. (2004)
σ_l	seperation rate, L	0.0562	Fallick et al. (2004)
ζ_h	bargaining power, H	0.6955	Dolado et al. (2021)
ζ_l	bargaining power, L	0.3740	Dolado et al. (2021)
α	substitution between (l_h, k) and l_l	0.4000	Krusell et al. (2000)
γ	substitution between l_h and k	-0.4902	Krusell et al. (2000)
Internally calibrated			
ξ_h	matching efficiency, H	0.5500	market tightness for high-skilled=1.4
ξ_l	matching efficiency, L	0.3587	market tightness for low-skilled=2.13

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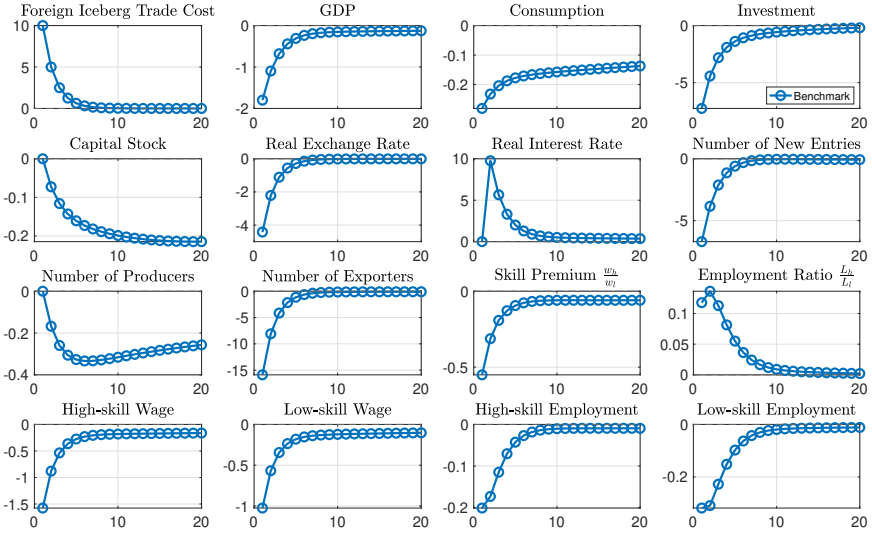
The Effects of Temporary Increase in Home Trade Barriers



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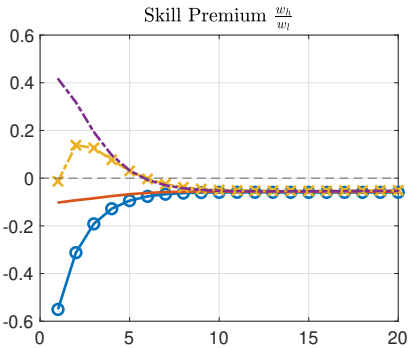
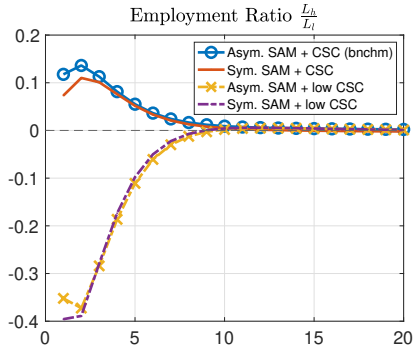
Preview of the results

Three elements play key roles in shaping the distributional patterns:

- Asymmetric SAM and CSC affect the outcomes qualitatively



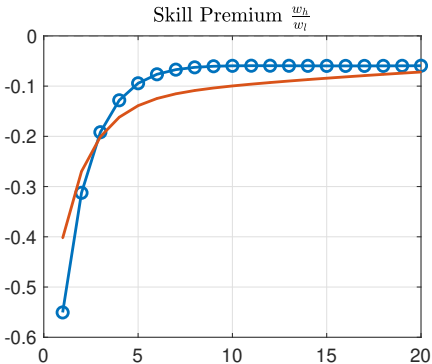


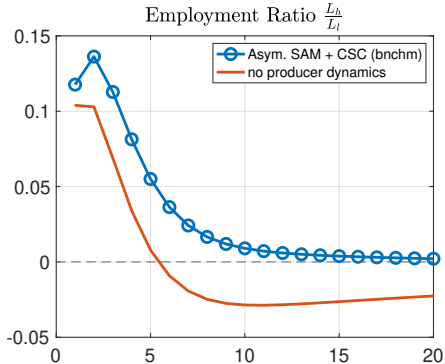
- Blue: Asymmetric SAM + CSC (Benchmark)
  Yellow: Asymmetric SAM + Low CSC
  Red: Symmetric SAM + CSC
  Purple: Symmetric SAM + Low CSC

Preview of the results, cont.

Three elements play key roles in shaping the distributional patterns:

- Producer dynamics magnify these effects quantitatively





Decomposing the Dynamics of the Skill Premium

- Focus primarily on the skill premium, with implications for the employment ratio
- The log deviation of skill premium:

$$\begin{aligned}\hat{w}_{h,t} - \hat{w}_{l,t} =& (\alpha^h_{\varphi} - \alpha^l_{\varphi})\hat{\varphi}_t + [\alpha^h_{F_l}\hat{F}_{l_h,t} - \alpha^l_{F_l}\hat{F}_{l_l,t}] + (\alpha^h_{c} - \alpha^l_{c})\hat{c}_t + (\alpha^h_{c_{+1}} - \alpha^l_{c_{+1}})\hat{c}_{t+1} \\ &+ [\alpha^h_{\vartheta_{+1}}\hat{\vartheta}_{h,t+1} - \alpha^l_{\vartheta_{+1}}\hat{\vartheta}_{l,t+1}]\end{aligned}$$

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- Five channels through which the trade shock propagates
  - aggregate demand pressure -real marginal cost/revenue $\hat{\varphi}_t$
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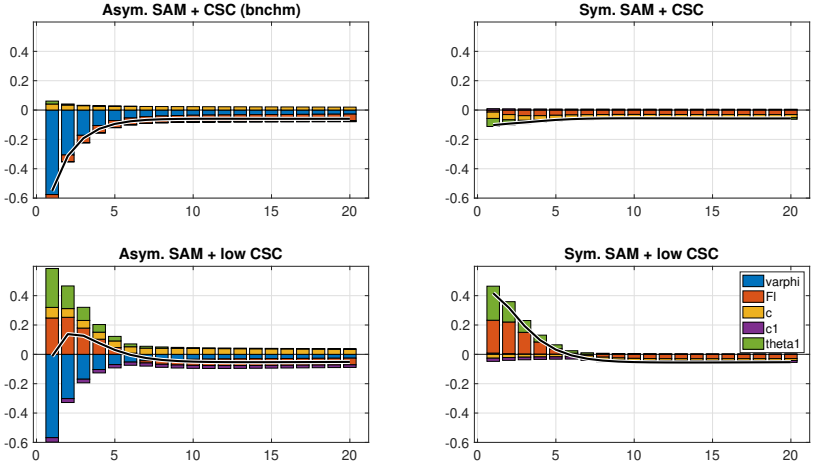
  - aggregate demand pressure -real marginal cost/revenue $\hat{\varphi}_t$
  - skill-specific marginal product of labor $\hat{F}_{l_j,t}$
  - current wealth effects $\hat{c}_t$
  - future wealth effects $\hat{c}_{t+1}$
  - future labor market tightness $\hat{\vartheta}_{j,t+1}$

The Role of Asymmetric SAM



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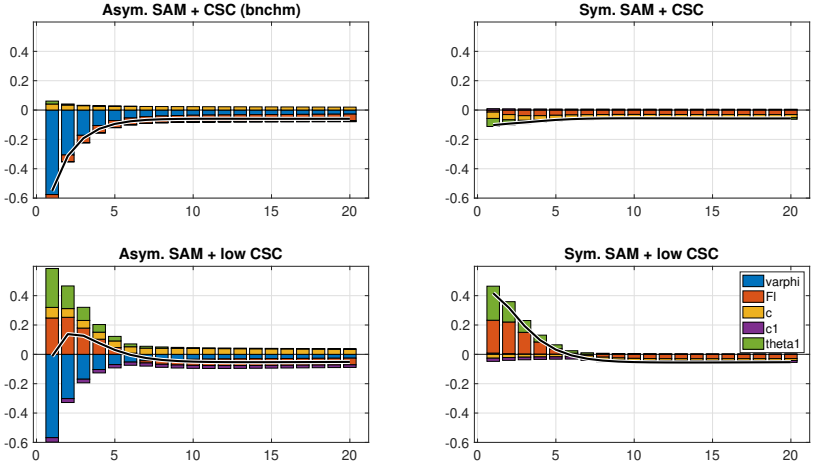
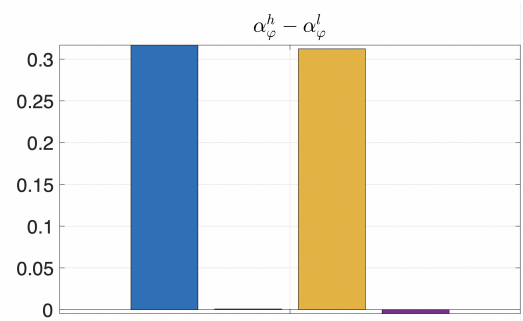


- Left ⇒ Right (Asym SAM ⇒ Sym SAM): Eliminating the asymmetry of SAM removes the negative contribution of the marginal cost channel $(\alpha_{\varphi}^{h} - \alpha_{\varphi}^{l})\hat{\varphi}_t$

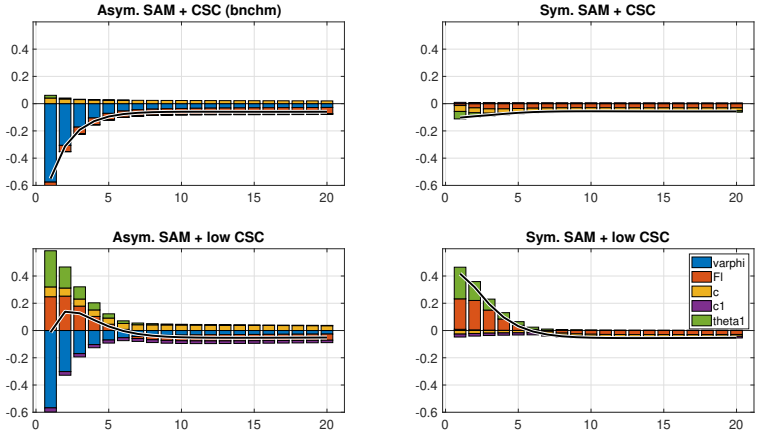
▸ Wage levels

Asymmetric SAM: the Marginal Cost Channel



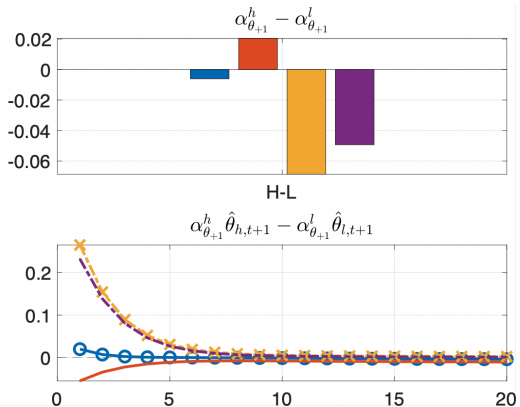
- The coefficient $(\alpha_\varphi^h - \alpha_\varphi^l) \equiv \frac{\zeta_h F_{l_h} \varphi}{w_h} - \frac{\zeta_l F_{l_l} \varphi}{w_l} \approx 0$ under symmetric SAM (red and purple)
- Under asymmetric SAM (blue and yellow), high-skilled workers having larger bargaining power ($\zeta_h > \zeta_l$)) $\Rightarrow$ a larger fraction of wage is tied to their MPL (F_{l_j}) $\Rightarrow w_h \downarrow$ by more when $\tau \downarrow \Rightarrow$ asym SAM exerts downward pressure on skill premium

The Role of CSC



- Upper ⇓ Lower (lower CSC) reverses the skill premium and changes contributions from
  - the labor market tightness channel $\alpha^h_{\vartheta_{+1}} \hat{\vartheta}_{h,t+1} - \alpha^l_{\vartheta_{+1}} \hat{\vartheta}_{l,t+1}$
  - the marginal product of labor channel $\alpha^h_{F_l} \hat{F}_{l_h,t} - \alpha^l_{F_l} \hat{F}_{l_l,t}$

CSC: the Labor Market Tightness Channel



- Labor market tightness $\hat{\vartheta}_{j,t+1}$ drops with downward demand pressure from $\tau \downarrow$

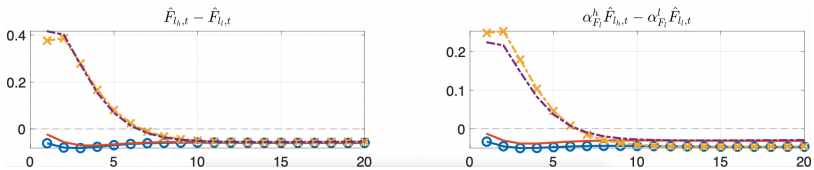
- The result hinges on the steady state lmk tightness: $\alpha^j_{\vartheta_{+1}} \equiv \zeta_j \kappa \beta \vartheta_j$

- Low CSC (yellow and purple): $\downarrow MPL_h/MPL_l$, $\downarrow \vartheta_h/\vartheta_l \Rightarrow \downarrow \alpha^h_{\vartheta_{+1}}/\alpha^l_{\vartheta_{+1}}$, dampening the relative drop in high-skill wage

- Thus, this channel $\alpha^h_{\vartheta_{+1}} \hat{\vartheta}_{h,t+1} - \alpha^l_{\vartheta_{+1}} \hat{\vartheta}_{l,t+1}$ becomes largely positive under low CSC.

CSC: the Marginal Product of Labor Channel

Components of the marginal product of labor channel $\alpha^h_{F_l}\hat{F}_{l_h,t} - \alpha^l_{F_l}\hat{F}_{l_l,t}$



- The significant positive contribution through this channel under low CSC is driven by the large increase in the ratio of the change in MPL between the two types of labor:

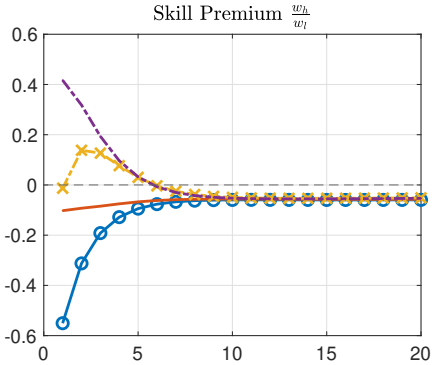
$$\hat{F}_{l_h,t} - \hat{F}_{l_l,t} \equiv \frac{\frac{\partial \bar{F}}{\partial l_{h,t}}}{\frac{\partial \bar{F}}{\partial l_{l,t}}} \uparrow = \frac{\phi(1-\lambda)}{1-\phi}\left[\lambda\left(\frac{\tilde{k}_t}{\tilde{l}_{h,t}}\downarrow\right)^{\gamma} + (1-\lambda)\right]^{\frac{\alpha-\gamma}{\gamma}}\left(\frac{\tilde{l}_{l,t}}{\tilde{l}_{h,t}}\downarrow\right)^{1-\alpha},$$

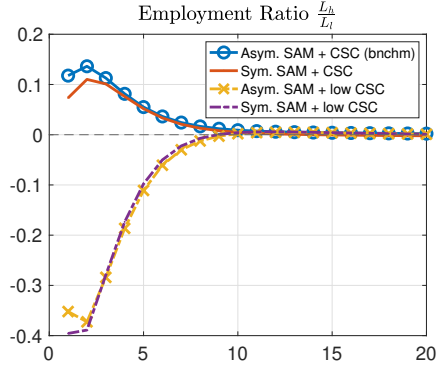
– mainly caused by the larger drop in the average high-skill employment $\tilde{l}_h$ as low CSC weakens average domestic firm's incentive to post vacancies for $l_{D,h}$

Implications for the Aggregate Employment Ratio

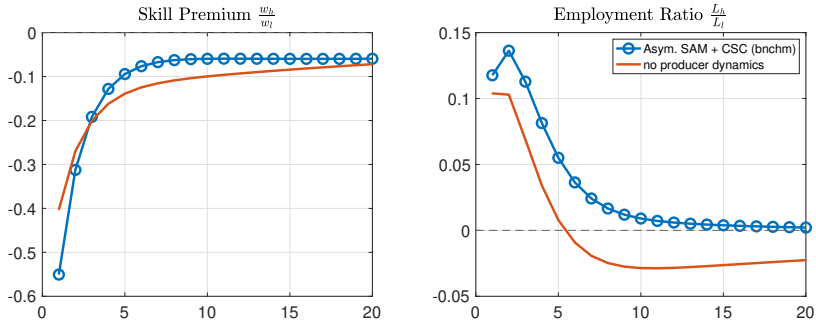
Why is there a drop in aggregate employment ratio under low CSC?

- The larger drop in the average high-skilled employment under low CSC implies a larger fall in the aggregate high-skilled employment ($L_{h,t} \downarrow = (N_{D,t} + N_{E,t})\tilde{l}_{h,t} \downarrow$)





The Role of Producer Dynamics



Introducing producer dynamics amplifies the skill premium ↓ initially and persistently strengthens the employment ratio ↑.

- Selection into export amplifies the micro-level reallocation of market shares toward the less-efficient firms
- Endogenous entry translates ↓ real income into ↓ investment in business creation
- Both tend to magnify the downward aggregate demand pressure ($(\alpha_\varphi^h - \alpha_\varphi^l)\hat{\varphi}_t$)

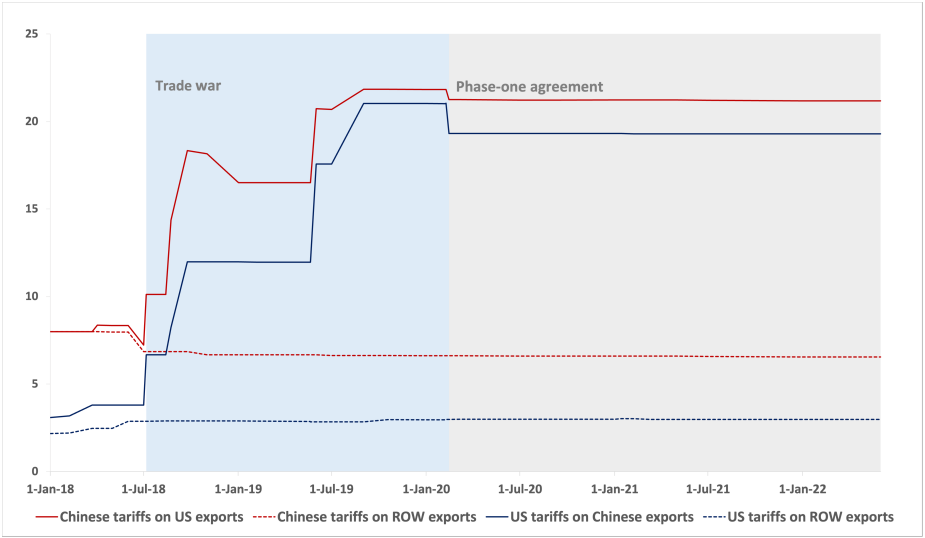
Conclusion

- We find robust evidence that protectionism reduces the skill premium but increases the employment ratio between high-skilled and low-skilled workers.
- Our counterfactual analysis highlights the role of the interaction between asymmetric SAM and CSC, as well as producer dynamics in shaping the distributional patterns of protectionism at business cycle frequencies.
- Our results suggest that protectionism worsens macroeconomic and labor market outcomes, for workers regardless of their skill levels. It alleviates wage inequality, but widens employment inequality.

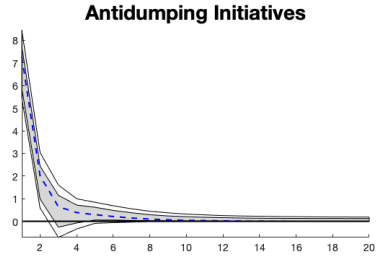
Thank You!

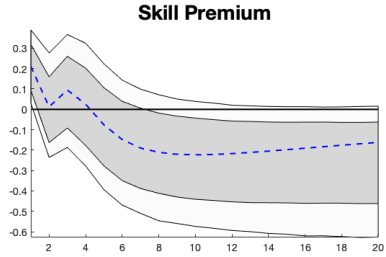
EXTRA SLIDES

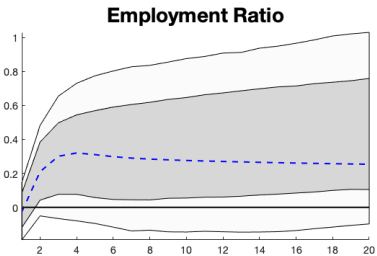
US-China tariff rates toward each other and rest of world.

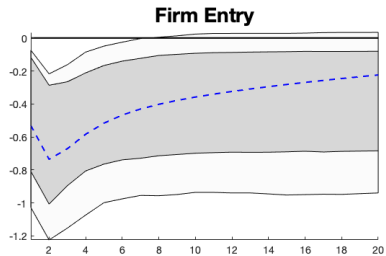


Quarterly VAR Results









Household Preferences

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{(C_s)^{1-\eta}}{1-\eta} - \chi_l L_{l,s} - \chi_h L_{h,s} \right]$$

- Full consumption insurance across individuals within the household
- The consumption basket C_t defined over a continuum Ω: $C_t = \left(\int_{\omega \in \Omega} c_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}}$
- At any period t, only a subset of goods $\Omega_t \subset \Omega$ is available
- The consumption-based price index for the Home economy: $P_t = \left(\int_{\omega \in \Omega_t} p_t(\omega)^{1-\theta} d\omega \right)^{\frac{1}{1-\theta}}$
  - $p_t(\omega)$: the Home nominal price for the good $\omega \in \Omega_t$

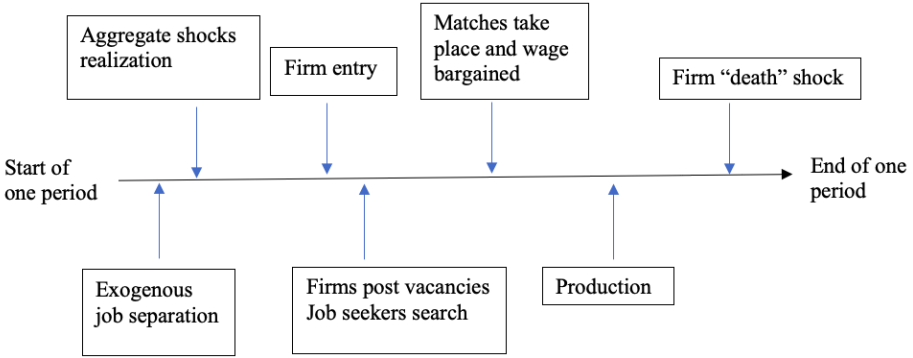
Back

Overview of Firms

- A continuum of monopolistically competitive firms indexed by relative productivity z
- The number of firms serving the domestic and export market is endogenous (Ghironi and Melitz (2005))
- Prior to entry, firms are identical and face a sunk entry cost $f_{E,t}$
- Upon entry, firms draw their productivity level from a common Pareto distribution: $G(z) = 1 - (z_{min}/z)^{\vartheta}$
- Every period, all firms produce until they are hit with an exit shock with probability δ
- Exporting involves both a melting-iceberg trade cost τ_t as well as a fixed cost $f_{X,t}$

Back

The Timing of Hiring and Firing



- Exogenous sepration rate: σ_j
- Aggregate job seekers: $S_{j,t} \equiv \bar{L}_j - (1-\sigma_j)(1-\delta)L_{j,t-1}$
- Aggregate employment: $L_{j,t} = M_{j,t} + (1-\sigma_j)(1-\delta)L_{j,t-1}$
- Aggregate unemployment: $\bar{L}_j - L_{j,t}$
- The law of motion of employment for (surviving) firm z: $l_{j,t}(z) = (1-\sigma_j)l_{j,t-1}(z) + \nu_{j,t}v_{j,t}(z)$

First Order Conditions

- The job creation equations for worker type j:

$$\frac{\kappa}{\nu_{j,t}} = \underbrace{\varphi_t(z) z Z_t \frac{\partial F(z)}{\partial l_{h,t}(z)}}_{\text{marginal product of an extra type } j \text{ worker}} - w_{j,t} + \underbrace{(1-\sigma_h)(1-\delta) E_t \left[\beta_{t,t+1} \frac{\kappa}{\nu_{h,t+1}} \right]}_{\text{expected discounted savings on future vacancy posting}}$$

- F.O.C. for capital:

$$r_t = \varphi_t(z) z Z_t \frac{\partial F(z)}{\partial k_t(z)}$$

- Optimal price setting:

$$\rho_{D,t}(z) \equiv \frac{p_{D,t}(z)}{P_t} = \frac{\theta}{\theta - 1} \varphi_t(z)$$

$$\rho_{X,t}(z) \equiv \frac{p_{X,t}(z)}{P_t^*} = Q_t^{-1} \tau_t \rho_{D,t}(z)$$

Back

Cost Minimization

$$\min E_t \sum_{s=t}^{\infty} \beta_{t,s}(1-\delta)^{(s-t)}(l_{h,s}(z)w_{h,s}(z) + l_{l,s}(z)w_{l,s}(z) + \kappa v_{h,s}(z) + \kappa v_{l,s}(z) + r_s k_s(z))$$

subject to:

$$y_t(z) = Z_t z F(z)$$

$$l_{h,t}(z) = (1-\sigma_h) l_{h,t-1}(z) + \nu_{h,t} v_{h,t}(z)$$

$$l_{l,t}(z) = (1-\sigma_l) l_{l,t-1}(z) + \nu_{l,t} v_{l,t}(z)$$

Back

Cost Minimization

$$\min E_t \sum_{s=t}^{\infty} \beta_{t,s}(1-\delta)^{(s-t)}(l_{h,s}(z)w_{h,s}(z) + l_{l,s}(z)w_{l,s}(z) + \kappa v_{h,s}(z) + \kappa v_{l,s}(z) + r_s k_s(z))$$

subject to:

$$y_t(z) = Z_t z \left[\phi \left[\lambda \left(k_t(z)\right)^{\gamma} + (1-\lambda)\left(l_{h,t}(z)\right)^{\gamma}\right]^{\frac{\alpha}{\gamma}} + (1-\phi)\left(l_{l,t}(z)\right)^{\alpha}\right]^{\frac{1}{\alpha}} \quad (1)$$

$$l_{h,t}(z) = (1-\sigma_h)l_{h,t-1}(z) + \nu_{h,t}v_{h,t}(z) \quad (2)$$

$$l_{l,t}(z) = (1-\sigma_l)l_{l,t-1}(z) + \nu_{l,t}v_{l,t}(z) \quad (3)$$

- Underlying assumption for simplicity: firms take wages as given when choosing employment and capital (Cacciatore (2014))

Back

Cost Minimization

The job creation equations (F.O.C. for vacancies and employment):

$$\frac{\kappa}{\nu_{h,t}} = (1-\sigma_h)(1-\delta)E_t\left[\beta_{t,t+1}\frac{\kappa}{\nu_{h,t+1}}\right] + \varphi_t(z)zZ_t\frac{\partial F(z)}{\partial l_{h,t}(z)} - w_{h,t}(z) \tag{4}$$

$$\frac{\kappa}{\nu_{l,t}} = (1-\sigma_l)(1-\delta)E_t\left[\beta_{t,t+1}\frac{\kappa}{\nu_{l,t+1}}\right] + \varphi_t(z)zZ_t\frac{\partial F(z)}{\partial l_{l,t}(z)} - w_{l,t}(z) \tag{5}$$

- $\varphi_t(z)$: the Lagrange multiplier attached to the constraint (1), i.e. the real marginal cost of production
- Equate the marginal cost to the marginal benefit of posting a vacancy for the two skill types respectively

▸ Back

Cost Minimization

F.O.C. for capital:

$$r_t = \varphi_t(z) z Z_t \frac{\partial F(z)}{\partial k_t(z)}, \tag{6}$$

- Equates the rental rate of capital to its marginal revenue product

Back

Profit Maximization

- Firms set flexible prices that reflect the same proportional markup $\theta/(\theta-1)$ over marginal cost
- Prices, in real terms relative to the price index in the destination market:
  - $\rho_{D,t}(z) \equiv \frac{p_{D,t}(z)}{P_t} = \frac{\theta}{\theta-1}\varphi_t(z)$
  - $\rho_{X,t}(z) \equiv \frac{p_{X,t}(z)}{P_t^*} = Q_t^{-1}\tau_t\rho_{D,t}(z)$
  - $Q_t \equiv \frac{\epsilon_t P_t^*}{P_t}$: the consumption-based real exchange rate
- Profits from domestic sales and potential export sales:
  - $d_{D,t}(z) = (1/\theta)\,\rho_{D,t}^{1-\theta}(z)\,Y_t$
  - $d_{X,t}(z) = (Q_t/\theta)\,\rho_{X,t}^{1-\theta}(z)\,Y_t^* - f_{X,t}$
  - Y_t and Y_t^*: the aggregate demand for the composite goods in Home and Foreign, respectively

▸ Back

Firm Averages

- A key implication from the wage determination: $\varphi_t(z)z$ is symmetric across z, i.e. $\varphi_t(z) = \frac{\varphi_t}{z}$
- The ratio of any two firms' output and revenues depends only on the ratio of their productivity levels
- All the information relevant for macroeconomic variables can be summarized by means of "average" productivity levels (Melitz (2003), Ghironi and Melitz (2005) and Cacciatore (2014))

Back

Firm Averages

- Average productivity level for all producing firms that serve the domestic market:
  $\tilde{z}_D \equiv \left[\int_{z_{\min}}^{\infty} z^{\theta-1} dG(z)\right]^{1/(\theta-1)}$
- Average productivity level for all Home exporters:
  $\tilde{z}_{X,t} \equiv \left[\frac{1}{1-G(z_{x,t})} \int_{z_{x,t}}^{\infty} z^{\theta-1} dG(z)\right]^{1/(\theta-1)}$
- The model can then be restated in terms of average (representative) firms ▸ Details

▸ Back

Firm Averages

- The average real price of Home firms in their domestic market: $\tilde{\rho}_{D,t} \equiv \rho_{D,t}\left(\tilde{z}_D\right)$
- The average real price of Home exporters in the export market: $\tilde{\rho}_{X,t} \equiv \rho_{X,t}\left(\tilde{z}_X\right)$
- The average domestic profit: $\tilde{d}_{D,t} \equiv d_{D,t}\left(\tilde{z}_D\right)$
- The average export profit: $\tilde{d}_{X,t} \equiv d_{X,t}\left(\tilde{z}_X\right)$
- The average total profit of Home firms: $\tilde{d}_t = \tilde{d}_{D,t} + \frac{N_{X,t}}{N_{D,t}}\tilde{d}_{X,t}$
- The stock of type j workers of the representative producer: $\tilde{l}_{j,t} = \tilde{l}_{D,j,t} + \frac{N_{X,t}}{N_{D,t}}\tilde{l}_{X,j,t}$
- The stock of physical capital of the representative producer: $\tilde{k}_t = \tilde{k}_{D,t} + \frac{N_{X,t}}{N_{D,t}}\tilde{k}_{X,t}$

Back

Household Budget Constraint

$$C_t + I_t + T_t + (N_{D,t} + N_{E,t})\,\tilde{e}_t x_{t+1} + B_{t+1} = w_{h,t} L_{h,t} + \varkappa_h(\bar{L}_h - L_{h,t}) + w_{l,t} L_{l,t} + \varkappa_l(\bar{L}_l - L_{l,t}) + r_t K_t + \left(\tilde{e}_t + \tilde{d}_t\right) N_{D,t} x_t + \left(1 + r_t^b\right) B_t,$$

- Euler equation for bonds: $(C_t)^{-\eta} = \beta(1 + r^b_{t+1}) E_t[(C_{t+1})^{-\eta}]$
- Euler equation for stocks: $\tilde{e}_t = E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\eta}(1-\delta)\beta\left(\tilde{e}_{t+1} + \tilde{d}_{t+1}\right)\right]$
- Euler equation for capital:

$$(C_t)^{-\eta}\left[1 + \omega\left(\frac{K_{t+1}}{K_t} - 1\right)\right] = \beta E_t\left\{(C_{t+1})^{-\eta}\left[r_{t+1} + (1-\delta^K) + \frac{\omega}{2}\left[\left(\frac{K_{t+2}}{K_{t+1}}\right)^2 - 1\right]\right]\right\}$$

▸ Equilibrium conditions

Equilibrium

- Aggregate employment for the type j workers: $L_{j,t} = (N_{D,t} + N_{E,t})\tilde{l}_{j,t}$
- Aggregate capital stock: $K_t = N_{D,t}\tilde{k}_t$
- The equilibrium price index at Home: $N_{D,t}\left(\tilde{\rho}_{D,t}\right)^{1-\theta} + N^*_{X,t}\left(\tilde{\rho}^*_{X,t}\right)^{1-\theta} = 1$
- Bonds are in zero net supply: $B_{t+1} = 0$
- The government runs a balanced budget: $T_t = \varkappa_h U_{h,t} + \varkappa_l U_{l,t}$
- The aggregate demand for the composite goods: $Y_t = C_t + I_t + N_{E,t} f_{r,t} + N_{X,t} f_{X,t} + \kappa(V_{h,t} + V_{l,t})$

Back

Equilibrium

- Goods market clearing for the variety produced by the representative producing firm serving the domestic market requires:

$$[\tilde{p}_{D,t}]^{-\theta} Y_t = Z_t \left(\frac{\vartheta}{\vartheta-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min} \left[\phi \left[\lambda \left(\tilde{k}_{D,t}\right)^{\gamma} + (1-\lambda)\left(\tilde{l}_{D,h,t}\right)^{\gamma}\right]^{\frac{\alpha}{\gamma}} + (1-\phi)\left(\tilde{l}_{D,l,t}\right)^{\alpha}\right]^{\frac{1}{\alpha}}$$

- Goods market clearing for the variety produced by the representative exporter requires:

$$\tau_t \left[\tilde{p}_{X,t}\right]^{-\theta} Y_t^* = Z_t \tilde{z}_{X,t} \left[\phi \left[\lambda \left(\tilde{k}_{X,t}\right)^{\gamma} + (1-\lambda)\left(\tilde{l}_{X,h,t}\right)^{\gamma}\right]^{\frac{\alpha}{\gamma}} + (1-\phi)\left(\tilde{l}_{X,l,t}\right)^{\alpha}\right]^{\frac{1}{\alpha}}$$

- Financial autarky implies balanced trade: $Q_t N_{X,t} (\tilde{p}_{X,t})^{1-\theta} Y_t^* = N_{X,t}^* (\tilde{p}_{X,t}^*)^{1-\theta} Y_t$
- Similar conditions hold in the Foreign

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Extrnal Parameters

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Parameter	Meaning	Value	Source/target
β	discount factor	0.9900	Dolado et al. (2021)
η	(inverse) intertemporal elasticity	2.0000	Dolado et al. (2021)
σ_h	seperation rate, H	0.0245	Fallick et al. (2004)
σ_l	seperation rate, L	0.0562	Fallick et al. (2004)
ε	matching elasticity	0.4000	Cacciatore (2014)
κ	vacancy posting costs	0.1300	Dolado et al. (2021)
ζ_h	bargaining power, H	0.6955	Dolado et al. (2021)
ζ_l	bargaining power, L	0.3740	Dolado et al. (2021)
α	substitution between (l_h, k) and l_l	0.4000	Krusell et al. (2000)
γ	substitution between l_h and k	-0.4902	Krusell et al. (2000)
$\bar{L}_h$	population weight, H	0.2300	Dolado et al. (2021)
$\bar{L}_l$	population weight, L	0.7700	Dolado et al. (2021)
ω	capital adjustment costs	4.0000	Dolado et al. (2021)
δ^k	depreciation rate of capital stock	0.0100	Dolado et al. (2021)
δ	exogenous firm exit shock	0.0250	Ghironi and Melitz (2005)
θ	elasticity of substitution between varieties	3.8000	Ghironi and Melitz (2005)
ϑ	shape parameter of productivity distribution	3.4000	Ghironi and Melitz (2005)
τ	melting-iceberg trade cost	1.3000	Ghironi and Melitz (2005)
z_{min}	lower bound of productivity	1.0000	normalization

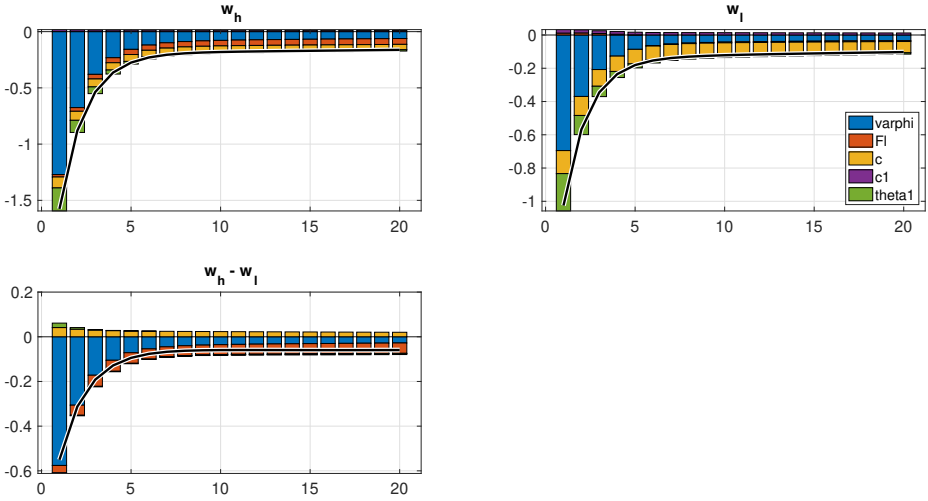
Internal Parameters

Back

Parameter	Meaning	Value	Source/target
f_r	regulation entry cost	6.0000	approximately 5 months of per capita output
ϕ	share parameters of production	0.2743	low-skilled labor share of income=0.45
λ	share parameters of production	0.8018	high-skilled labor share of income=0.2
f_χ	fixed export cost	0.0571	the proportion of exporting plants=21 pct.
ξ_h	matching efficiency, H	0.5500	market tightness for high-skilled=1.4
ξ_l	matching efficiency, L	0.3587	market tightness for low-skilled=2.13
χ_h	disutility of labor, H	0.1834	unemployment rate for high-skilled=0.028
χ_l	disutility of labor, L	0.0951	unemployment rate for low-skilled=0.078
$\varkappa_h$	unemployment benefits, H	1.3440	the replacement rate=0.54
$\varkappa_l$	unemployment benefits, L	1.3440	the replacement rate=0.54

Contribution of Each Channel with Wage Levels

Asym. SAM + CSC (bnchm)



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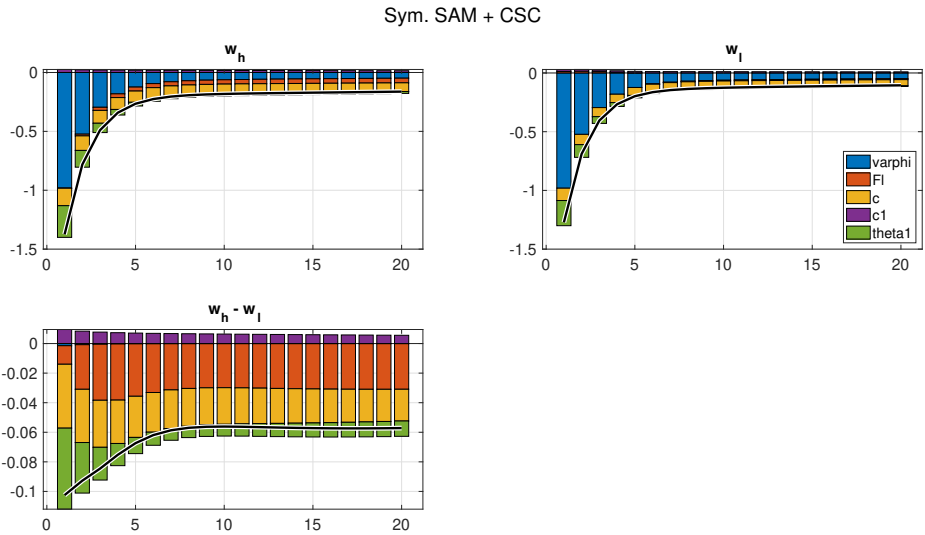
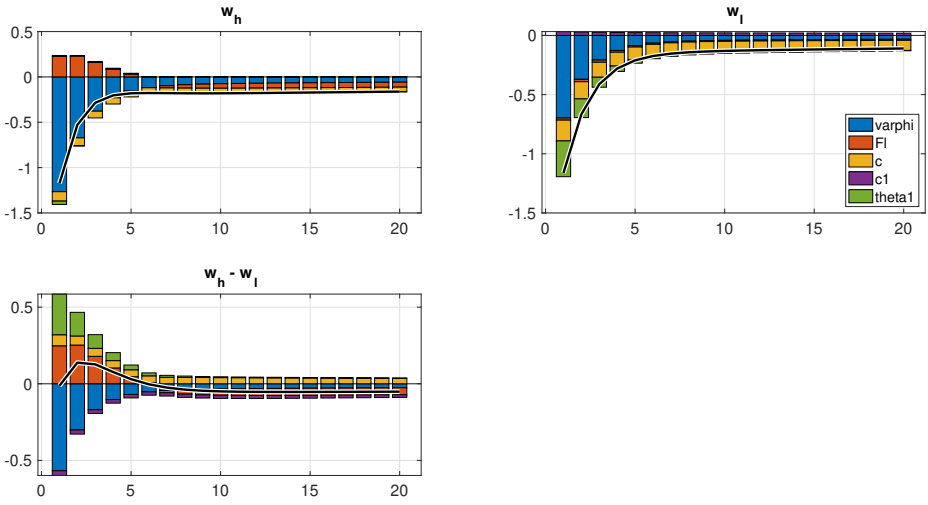
Contribution of Each Channel with Wage Levels



Contribution of Each Channel with Wage Levels

Asym. SAM + low CSC



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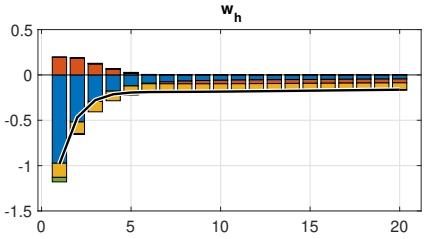
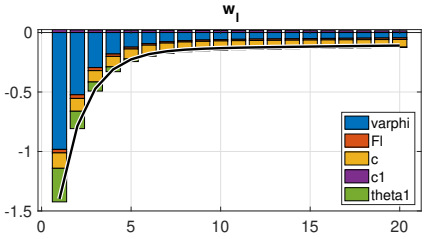
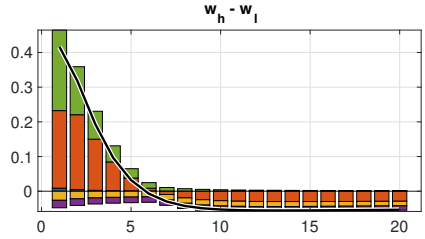
Contribution of Each Channel with Wage Levels

Sym. SAM + low CSC







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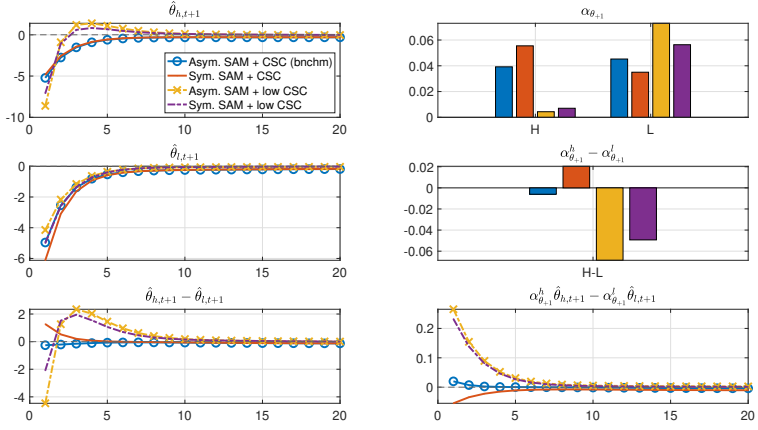
The Effects of CSC on the Labor Market Tightness Channel

- Components of the labor market channel $\alpha^h_{\vartheta_{+1}}\hat{\vartheta}_{h,t+1} - \alpha^l_{\vartheta_{+1}}\hat{\vartheta}_{l,t+1}$ across different scenarios



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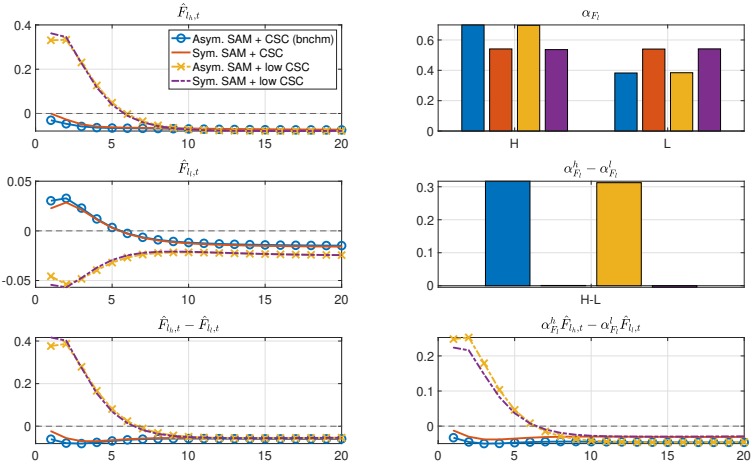
The Effects of CSC on the Marginal Product of Labor Channel

- Components of the marginal product of labor channel $\alpha^h_{F_l}\hat{F}_{l_h,t} - \alpha^l_{F_l}\hat{F}_{l_l,t}$ across different scenarios



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