

# On the Heterogeneous Welfare Gains and Losses from Trade

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# Heterogeneous welfare gains and losses from trade

What are the heterogeneous impacts of trade along the income and wealth distribution?

- ▶ Labor markets
- ▶ Prices

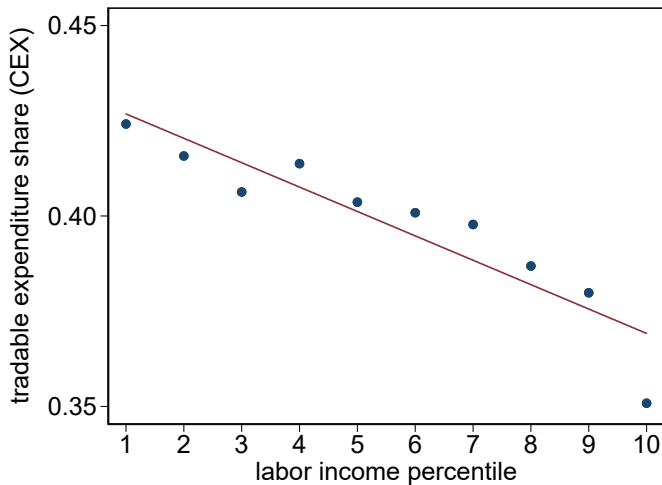
# What we do

- ▶ Document that tradable goods constitute a larger fraction of expenditures for low-income and low-wealth households
- ▶ Build a Ricardian trade model with
  - ▶ non-homothetic preferences
  - ▶ uninsurable income risk
- ▶ Use the calibrated model to quantify the differential welfare gains and losses from trade
- ▶ Increase trade costs by 20 percentage points:
  - ▶ average welfare falls by 3.2 percent
  - ▶ low-wealth households experience welfare losses that are 60 percent larger than high-wealth households
- ▶ Fiscal policy can greatly reduce welfare costs both on average and for the poor

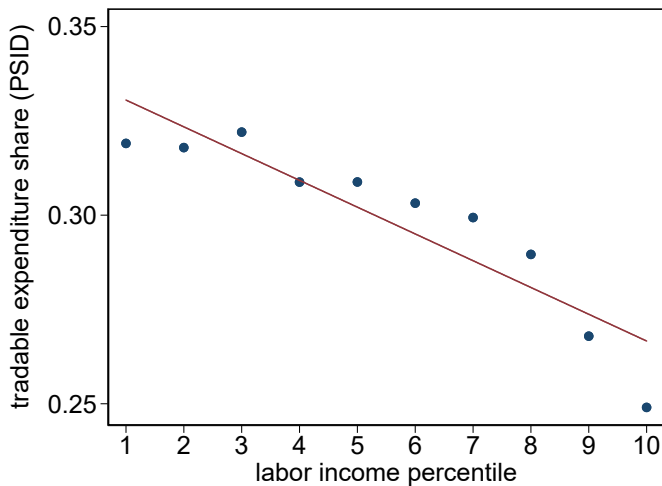
# Data

- ▶ We use two complementary datasets
- ▶ Consumer Expenditure Survey (2004–14)
  - + detailed expenditure categories
  - can't compute net worth: only liquid wealth
  - + self-reported owner-imputed rent
- ▶ Panel Survey of Income Dynamics (2004–14)
  - broad expenditure categories
  - + detailed measures of wealth
  - have to impute owner-rent (using price-rent ratios)

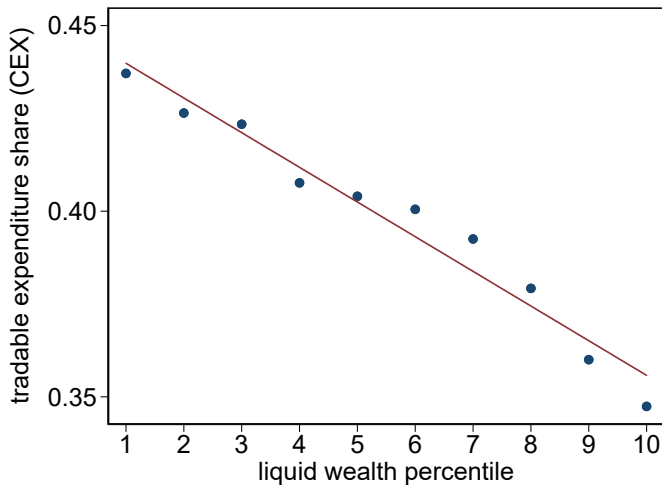
## Tradable exp. shares decline with labor income



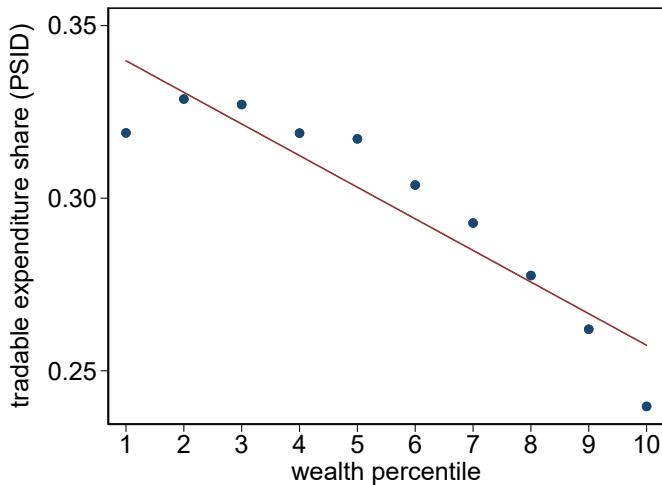
## Tradable exp. shares decline with labor income



## Tradable expenditure shares decline with wealth



# Tradable expenditure shares decline with wealth





# Summary of empirical findings

- ▶ Tradable expenditure shares decline with income and wealth
- ▶ Robust to controlling for household characteristics:
  - ▶ household head age and education
  - ▶ household size
  - ▶ home ownership
- ▶ Motivates our model of
  - ▶ uninsurable income risk → wealth and income heterogeneity
  - ▶ non-homothetic preferences → different consumption baskets

Model

# Model

- ▶ Two symmetric countries indexed by  $i = 1, 2$
- ▶ Households
  - ▶ consume, work, and save
  - ▶ face uninsurable labor income risk
- ▶ Production and Trade
  - ▶ tradables and non-tradables used for consumption and for investment
  - ▶  $\omega \in [0, 1]$  continuum of tradable intermediate goods
  - ▶ shipment of good  $\omega$  from  $o$  to  $i$  faces trade costs  $\tau_{oi}$
  - ▶  $\tau_{oi}$  consists of a technological cost  $\tau_{oi,T}$  and a tariff  $\tau_{i,P}$
- ▶ Government taxes to finance wasteful spending

## Non-tradables producer

- ▶ A representative firm produces non-tradable output  $Y_{iN}$
- ▶ It solves the static profit maximization problem

$$\begin{aligned} \max_{L_{iN}, K_{iN}} \quad & P_{iN} Y_{iN} - w_i L_{iN} - r_i K_{iN} \\ \text{s.t.} \quad & Y_{iN} = z_{iN} L_{iN}^\alpha K_{iN}^{1-\alpha}. \end{aligned}$$

- ▶ Numeraire: set  $P_{iN} = 1$

## Final tradables producer

- ▶ A representative final tradables producer bundles the varieties of tradables  $\{q_{oi}(\omega)\}_{\omega,o}$  into a final good,  $Y_{iT}$ , and solves

$$\begin{aligned} \max_{\{q_{oi}(\omega)\}_{\omega}} \quad & P_{iT} Y_{iT} - \int_0^1 \sum_{o=1,2} [\tau_{oi} p_o(\omega) q_{oi}(\omega)] d\omega \\ \text{s.t.} \quad & Y_{iT} = \left\{ \int_0^1 \left[ \sum_{o=1,2} q_{oi}(\omega) \right]^{\rho} d\omega \right\}^{\frac{1}{\rho}}. \end{aligned}$$

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- ▶ Solution:  $q_{oi}(\omega) \leq \left( \frac{\tau_{oi} p_o(\omega)}{P_{iT}} \right)^{-\theta} Y_{iT}$ , = if  $q_{oi}(\omega) > 0$ .
- ▶ Price:  $P_{iT} = \left[ \int_0^1 \min_o \{ \tau_{oi} p_o(\omega) \}^{1-\theta} d\omega \right]^{\frac{1}{1-\theta}}$  where  $\theta = \frac{1}{1-\rho}$  is the elasticity of substitution across varieties.

## Intermediate tradables producer

- ▶ Each intermediate firm produces a single tradable variety,  $\omega$
- ▶ Taking as given the price  $p_i(\omega)$ , it solves

$$\begin{aligned} \max_{l(\omega), k(\omega)} & p_i(\omega) y_i(\omega) - w_i l_i(\omega) - r_i k_i(\omega) \\ \text{s.t.} & y_i(\omega) = z_i(\omega) l_i(\omega)^\alpha k_i(\omega)^{1-\alpha} \end{aligned}$$

# Productivity distributions in tradables production

- ▶ Productivities for variety  $\omega$  are distributed according to

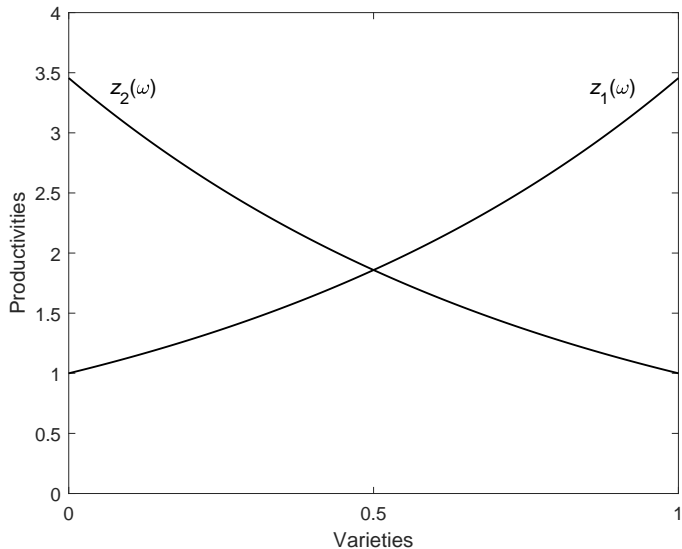
$$z_1(\omega) = e^{\eta\omega}$$

$$z_2(\omega) = e^{\eta(1-\omega)}$$

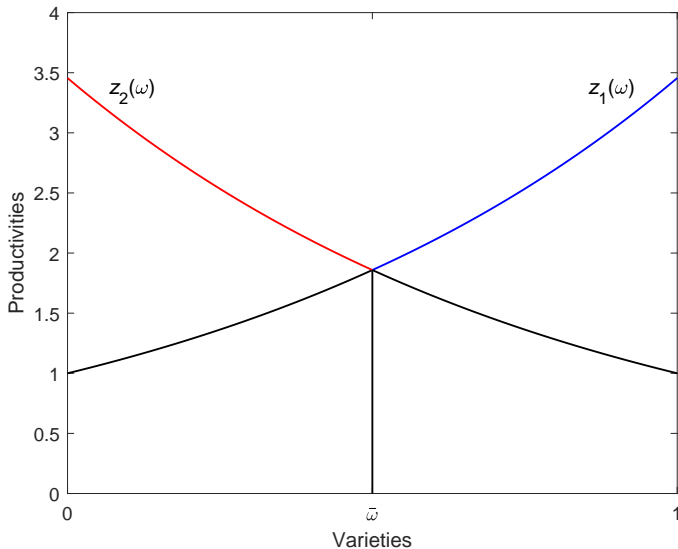
- ▶ Country  $i = 1$  is more productive at producing high  $\omega$



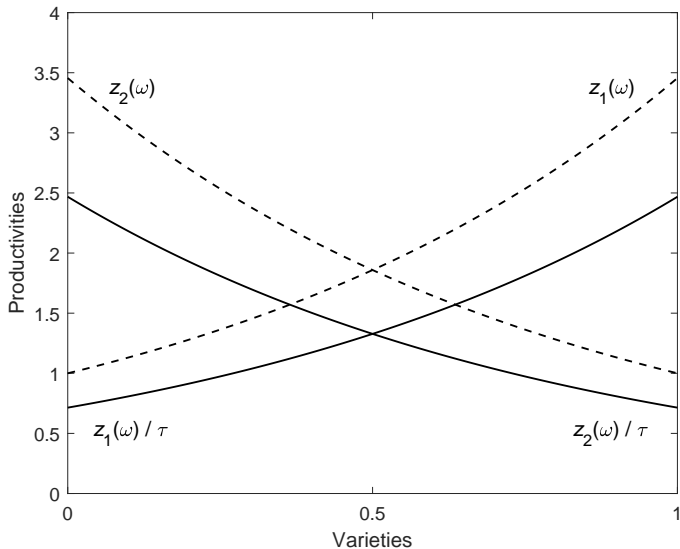
# Pattern of production (free trade)



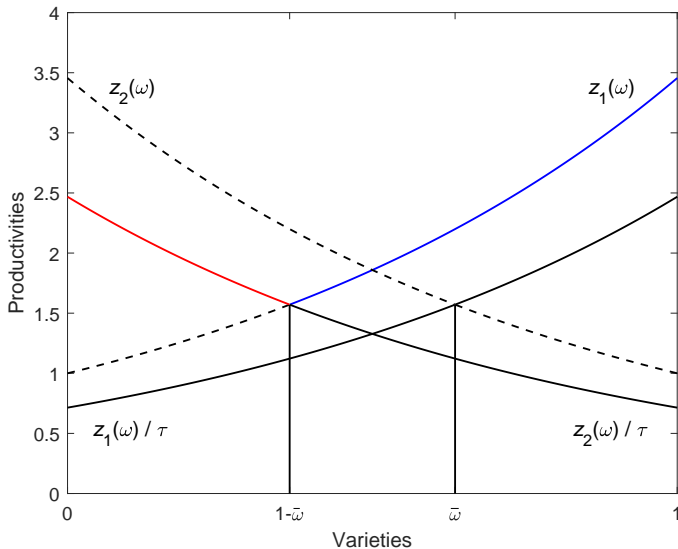
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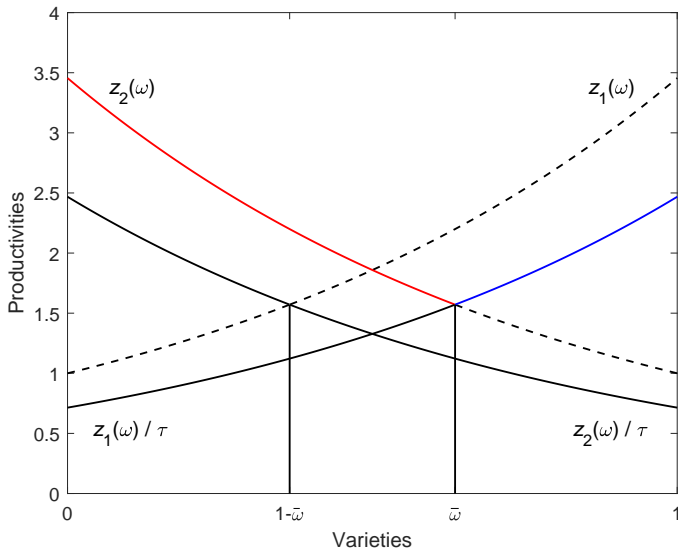
# Pattern of production (costly trade)



# Pattern of production (costly trade)



# Pattern of production (costly trade)



## Capital producer

- ▶ A representative firm produces capital  $X_i$ , by solving

$$\begin{aligned} \max_{l_{iT}, l_{iN}} & P_{iX} X_i - P_{iT} l_{iT} - l_{iN} \\ \text{s.t.} & X_i = z_{iX} l_{iT}^{\kappa} l_{iN}^{1-\kappa}. \end{aligned}$$

# Government

- ▶ The government finances a constant stream of (wasteful) expenditures,  $G_I$ , by collecting
  - ▶ taxes on labor income,  $\tau_{il}$ ,
  - ▶ taxes on capital income,  $\tau_{ik}$ ,
  - ▶ and tariffs  $\tau_{iP}$

# Households

- ▶ Household solves

$$V_i(k, \varepsilon) = \max_{c_T, c_N, h, k'} u(c_T, c_N, h) + \beta E_{\varepsilon'|\varepsilon} V(k', \varepsilon')$$
$$\text{s.t. } P_{iT}c_T + c_N + P_{iX}(k' - k) \leq \tilde{w}_i h \varepsilon + \tilde{r}_i k$$
$$k' \geq 0$$

$$\text{where } u(c_T, c_N, h) = \frac{\left(c_T^\gamma (c_N + \bar{c})^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} - \psi \frac{h^{1+\nu}}{1+\nu}$$

- ▶  $\tilde{w}_i$  and  $\tilde{r}_i$  are after-tax returns:

$$\tilde{w}_i = (1 - \tau_{il})w$$

$$\tilde{r}_i = (1 - \tau_{ik})(r_i - \delta P_{iX}).$$



# Productivity shocks

- ▶  $\varepsilon$  follows a finite-state Markov process which approximates the continuous process,

$$\log \varepsilon_t = \rho_\varepsilon \log \varepsilon_{t-1} + \nu_t, \nu_t \sim N(0, \sigma_\varepsilon^2)$$

- ▶ We set  $\rho_\varepsilon = 0.92$  and  $\sigma_\varepsilon = 0.21$  following Floden and Linde (2001)

# Equilibrium

A *symmetric steady-state recursive equilibrium*, given fiscal policies  $\{\tau_l, \tau_k, \tau_P\}$ , is, for  $i = 1, 2$

- ▶ functions  $\{V, g_T, g_N, g_h, g_k\}$ ,
- ▶ nontradable producer plans  $\{Y_N, L_N, K_N\}$ ,
- ▶ final tradable producer plans  $\left\{Y_T, \{q_{oi}(\omega)\}_{\omega \in [0,1], o=1,2}\right\}$ ,
- ▶ intermediate producer plans  $\{y_i(\omega), l_i(\omega), k_i(\omega)\}_{\omega \in [0,1]}$ ,
- ▶ capital producer plans  $\{X, I_T, I_N\}$ ,
- ▶ prices  $\left\{w, r, P_T, \{p_i(\omega)\}_{\omega \in [0,1]}\right\}$ , and
- ▶ an invariant distribution  $\mu^*$  such that:

1. Given prices, households optimize.
2. Given prices, firms optimize.
3. Goods markets clear:  $\int g_T(k, \varepsilon) d\mu(k, \varepsilon) + I_T = Y_T$ ,  
 $\int g_N(k, \varepsilon) d\mu(k, \varepsilon) + I_N + G = Y_N$ ,  $X = \delta \int k d\mu(k, \varepsilon)$ ,  
 $y_1(\omega) = q_{11}(\omega) + \tau_T q_{12}(\omega)$ , and  $y_2(\omega) = \tau_T q_{21}(\omega) + q_{22}(\omega)$ .
4. Factor markets clear:  $K_N + \int k_i(\omega) d\omega = \int g_k(k, \varepsilon) d\mu(k, \varepsilon)$ ,  
 $L_N + \int l_i(\omega) d\omega = \int \varepsilon g_h(k, \varepsilon) d\mu(k, \varepsilon)$ .
5. Balanced trade:  $\int q_{12}(\omega) d\omega = \int q_{21}(\omega) d\omega$ .
6. Gov't budget holds:  $G = \tau_I w \int \varepsilon g_h(k, \varepsilon) d\mu(k, \varepsilon)$   
 $+ \tau_k(r - \delta P_X) \int k d\mu(k, \varepsilon) + \tau_P \int q_{oi}(\omega) d\omega$ , for  $o \neq i$ .
7. For any subset  $(\mathcal{K}, \mathcal{E}) \in \mathcal{B}$ , the invariant distribution  $\mu^*$  satisfies

$$\mu^*(\mathcal{K}, \mathcal{E}) = \int_S \sum_{\varepsilon' \in \mathcal{E}} \mathbf{1}_{\{g_k(k, \varepsilon) \in \mathcal{K}\}} \Gamma(\varepsilon', \varepsilon) d\mu^*(k, \varepsilon).$$

## Characterization of equilibrium

- ▶ The tradable price is given by  $P_T = \frac{1}{\tilde{z}(\tau)}$ ,

where  $\tilde{z}(\tau)$  is a measure of average productivity:

$$\tilde{z}(\tau) = \left[ \tau^{1-\theta} \int_0^{1-\bar{\omega}(\tau)} z_2(\omega)^{\theta-1} d\omega + \int_{1-\bar{\omega}(\tau)}^1 z_1(\omega)^{\theta-1} d\omega \right]^{\frac{1}{\theta-1}}$$

- ▶ The capital price is given by  $P_X = \frac{1}{z_X} \left( \frac{P_T}{\eta} \right)^\eta \left( \frac{1}{1-\eta} \right)^{1-\eta}$
- ▶ Comparative statics:

$$\frac{d \log(P_T)}{d\tau} = - \frac{d \log(\tilde{z}(\tau))}{d\tau} > 0$$

$$\frac{d \log(P_X)}{d\tau} = -\eta \frac{d \log(\tilde{z}(\tau))}{d\tau} > 0$$

# Quantitative Analysis

# Quantitative Analysis

- ▶ Calibrate model to match features of U.S. economy
- ▶ Experiment
  - ▶ raise trade costs by 20 percentage points by imposing a tariff
  - ▶ compute transition to new steady state
  - ▶ baseline: tariff revenue is thrown into the ocean
  - ▶ alternatives: tariff revenue reduces other taxes

# Calibration

- ▶ Calibrate to United States
- ▶ Preferences and shock processes:

Parameters	Values	Targets / Source
Discount factor $\beta$	0.97	Wealth-to-GDP: 4.8 (2014)
Risk aversion $\sigma$	2	Standard value
Tradable share $\gamma$	0.29	Tradable exp. share: 35% (2004–14)
Non-homotheticity $\bar{c}$	0.09	Tradable exp. share of top wealth decile: 30 percent (2004–14)
Disutility from labor $\psi$	61	Average hours: 33 percent
Frisch elasticity $1/\nu$	2	Standard value
Persistence $\rho_\varepsilon$	0.92	Floden and Linde (2001)
Standard deviation $\sigma_\nu$	0.21	Floden and Linde (2001)

# Calibration

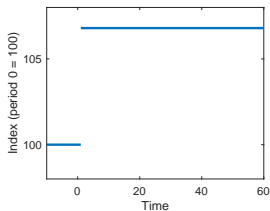
- ▶ Assume  $\tau_P = 0$  (less than 2% of gov't revenue in 2014)
- ▶ Technology and fiscal policy:

Parameters	Values	Targets / Source
Labor elasticities $\alpha$	0.64	Labor income share
Tradable elasticity $\kappa$	0.59	Tradable input shares in capital production (2014)
Elas. of substitution $\theta$	4	Simonovska and Waugh (2014)
Prod. distribution $\eta$	1.24	Employment share of top 17% of large manufacturing est.: 32% (2014)
Trade cost $\tau_T - 1$	0.05	Import share: 17 percent (2014)
Income tax $\tau_\ell = \tau_k$	0.18	Gov't consumption: 15% of GDP (2014)

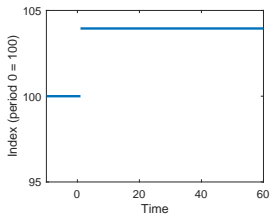


# Effect of tariffs on prices

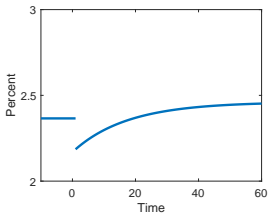
(a) Tradables price



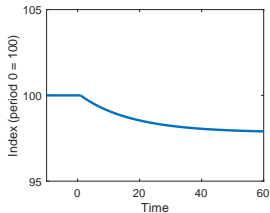
(b) Investment price



(c) After-tax net return

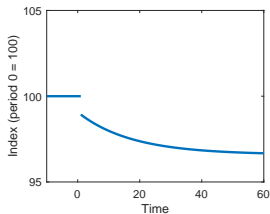


(d) After-tax wage

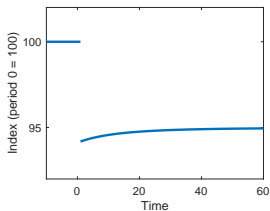


# Effect of tariffs on economic activity

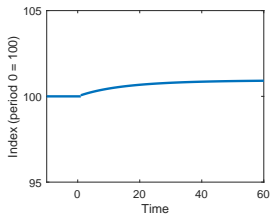
(a) Consumption



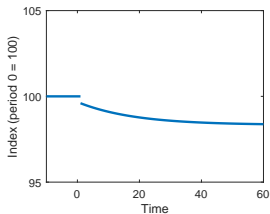
(b) Investment



(c) Labor



(d) GDP



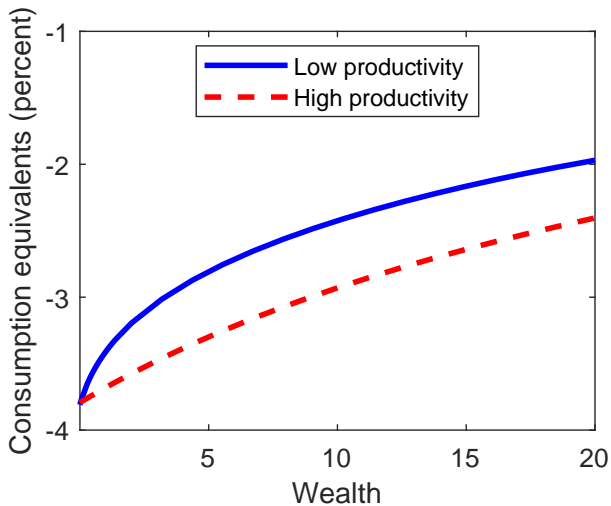
# Welfare Calculation

- ▶ For each household, we compute the consumption equivalence,  $\Delta$
- ▶ How much would initial steady state consumption have to be permanently increased for a household to be indifferent between raising tariffs or not?
- ▶ Solve for  $\Delta$  such that  $V_{\Delta}(k, \varepsilon) = V_{t=1}(k, \varepsilon)$

$$V_{\Delta}(k, \varepsilon) = u((1 + \Delta) g_T^{ss}(k, \varepsilon), (1 + \Delta) g_N^{ss}(k, \varepsilon), g_h^{ss}(k, \varepsilon)) \\ + \beta E_{\varepsilon'|\varepsilon} V_{\Delta}(g_k^{ss}(k, \varepsilon), \varepsilon').$$

- ▶ If  $\Delta > 0$ , then the household supports tariffs. If  $\Delta < 0$ , then it does not.

## Welfare across households: baseline



# Decomposing welfare changes

We conduct three partial equilibrium exercises to isolate effects on welfare from three channels

$$P_T c_T + c_N + P_X(k' - k) \leq \tilde{w}h\varepsilon + \tilde{r}k$$

- ▶ **Expenditure channel:**  $P_T \uparrow$  makes tradable consumption more expensive.
- ▶ Poor vs. Wealthy

# Decomposing welfare changes

We conduct three partial equilibrium exercises to isolate effects on welfare from three channels

$$P_T c_T + c_N + P_X(k' - k) \leq \tilde{w}h\varepsilon + \tilde{r}k$$

- ▶ **Investment channel:**  $P_X \uparrow$  makes saving more expensive
- ▶ Savers vs. Dissavers

## Decomposing welfare changes

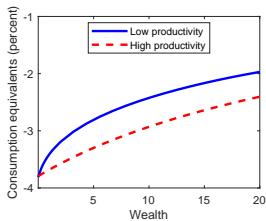
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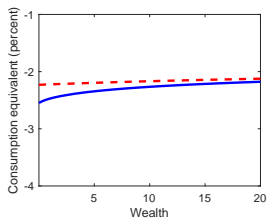
- ▶ **Factor price channel:**  $\tilde{w}$  and  $\tilde{r}$  change
- ▶ Labor vs Capital

# Welfare by channel

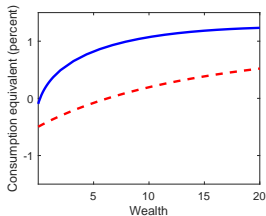
(a) Baseline



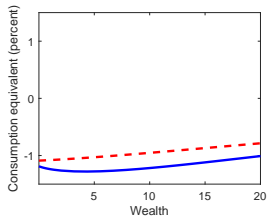
(b) Expenditure



(c) Investment



(d) Factor price





## Decomposition of welfare changes

Average	Low wealth		High wealth		Average
	Low prod.	High prod.	Low prod.	High prod.	
Expenditure	-2.54	-2.23	-2.22	-2.14	-2.30
Investment	-0.09	-0.49	1.17	0.42	0.27
Factor price	-1.19	-1.09	-0.84	-1.17	-1.17
All	-3.81	-3.79	-2.18	-2.57	<b>-3.19</b>

Units: percent.

## Takeaways from baseline

- ▶ Increased trade costs produce large welfare losses regardless of income/wealth
- ▶ The most significant cost comes through the expenditure channel (tradables become more expensive)
- ▶ The investment channel favors sellers of capital, hurts savers
- ▶ The factor price channel increases costs for all households

## Alternative fiscal policies

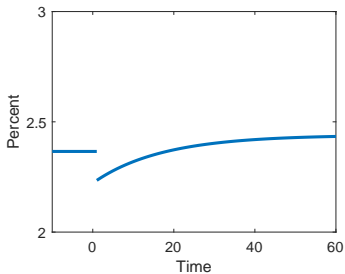
- ▶ Baseline is a lower bound on average trade costs (wastes tariff revenue)
- ▶ We consider three revenue neutral policies
  - ▶ Lower tax rate on both labor and capital income equally
  - ▶ Lower only tax rate on capital
  - ▶ Lower only tax rate on labor
- ▶ Tax policy works only through the factor price channel

## Reducing total income tax rate

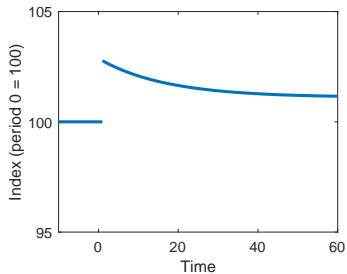
- ▶ Tax rate falls immediately to 16 percent
- ▶ After-tax factor prices increase
- ▶ Smaller changes in the aggregate activity

# Effective factor prices: Total income tax reduction

(a) After-tax net return

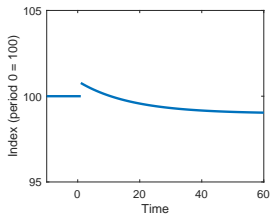


(b) After-tax wage

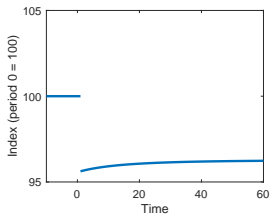


# Aggregates: Total income tax reduction

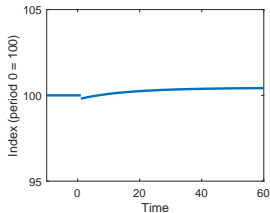
(a) Consumption



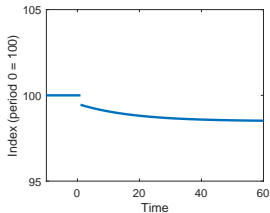
(b) Investment



(c) Labor

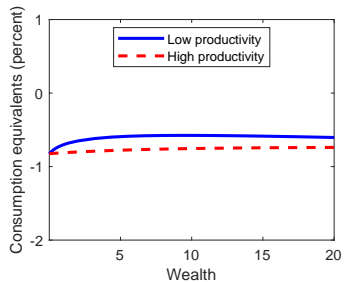


(d) GDP

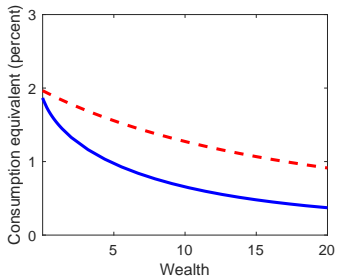


# Welfare: Total income tax reduction

(a) All channels



(b) Factor price channel



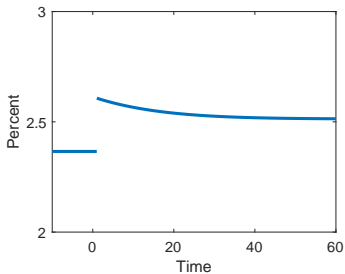
## Reducing capital income tax rate

- ▶ Tax rate falls immediately to 2 percent
- ▶ Large increase in after-tax returns and wages
- ▶ More GDP and investment in the long-run

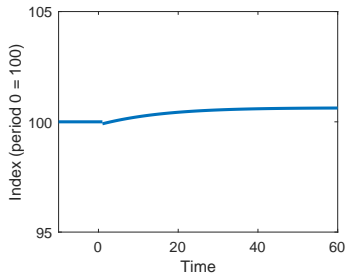


# Effective factor prices: Capital inc. tax reduction

(a) After-tax net return

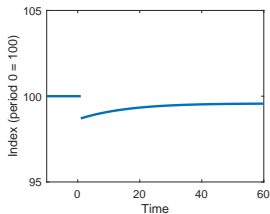


(b) After-tax wage

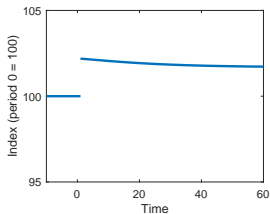


# Aggregates: Capital income tax reduction

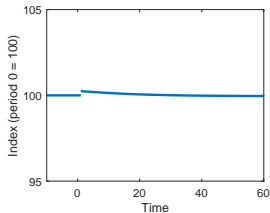
(a) Consumption



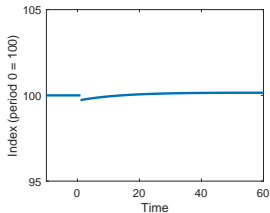
(b) Investment



(c) Labor

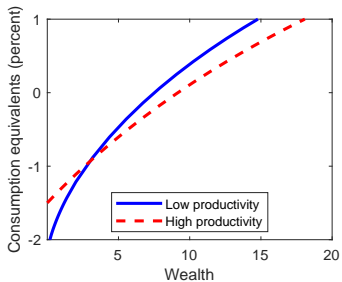


(d) GDP

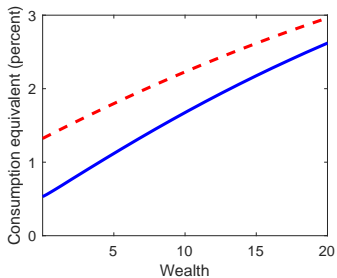


# Welfare: Capital income tax reduction

(a) All channels



(b) Factor price channel

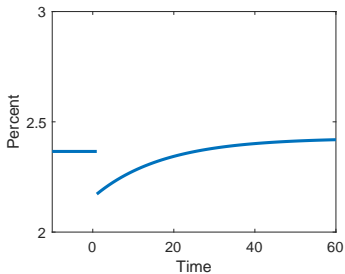


## Reducing labor income tax rate

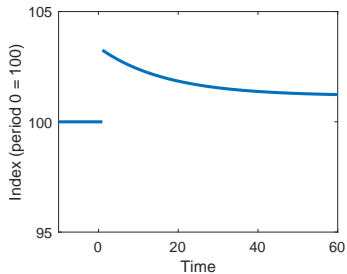
- ▶ Tax rate falls immediately to 15.6 percent
- ▶ Large increase in after-tax wages
- ▶ Less GDP, consumption, and investment in the long run

# Effective factor prices: Labor income tax reduction

(a) After-tax net return

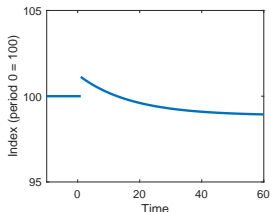


(b) After-tax wage

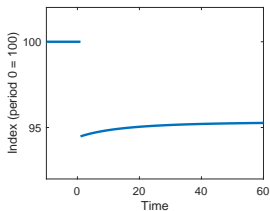


# Aggregates: Labor income tax reduction

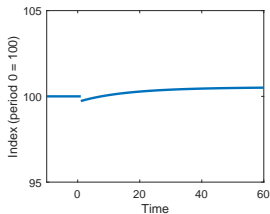
(a) Consumption



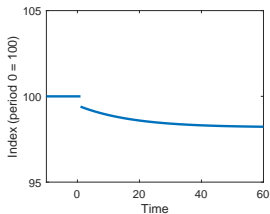
(b) Investment



(c) Labor

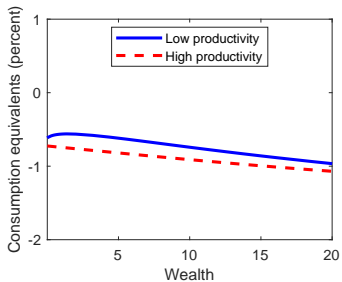


(d) GDP

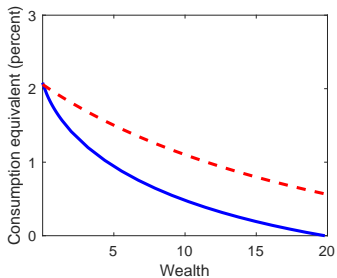


# Welfare: Labor income tax reduction

(a) All channels



(b) Factor price channel



## Summary of Alternative Policies

Channels	Low wealth		High wealth		Average
	Low prod.	High prod.	Low prod.	High prod.	
Expenditure	-2.54	-2.23	-2.22	-2.14	-2.30
Investment	-0.09	-0.49	1.17	0.42	0.27
Factor price					
<i>Total inc. tax</i>	1.86	1.90	0.49	1.03	1.39
<i>Capital inc. tax</i>	0.53	1.33	2.17	2.72	1.27
<i>Labor inc. tax</i>	2.08	2.05	0.21	0.73	1.40
All					
<i>Total inc. tax</i>	-0.83	-0.82	-0.59	-0.74	<b>-0.69</b>
<i>Capital inc. tax</i>	-2.13	-1.49	1.00	0.83	<b>-0.84</b>
<i>Labor inc. tax</i>	-0.61	-0.72	-0.86	-1.02	<b>-0.67</b>

Units: percent.



# Conclusion

- ▶ Poor households consume a larger share tradables compared to higher income, wealthier households
- ▶ In a model with non-homothetic preferences, increased trade costs lead to larger welfare losses for the poor relative to the rich and savers relative to dissavers
- ▶ The government can use tariff revenue to reallocate welfare losses across the distribution
- ▶ Compensating the poor through a labor income tax reduction leads to smaller aggregate welfare losses

# Appendix