On the Heterogeneous Welfare Gains and Losses from Trade

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  - limited mobility across jobs, skill-bias
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- Prices
  - tradable goods/services: poor vs rich (e.g. Matsuyama 2000, Fajgelbaum and Khandelwal 2016)
  - cost of investment: savers vs dissavers
  - factor prices: workers vs capitalists

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$\rightarrow$ In this paper, we focus on prices

What we do

- Document that tradable goods and services 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
- Reduce trade costs by 7 percentage points:
  - import share rises from 13 to 17 percent
  - average welfare rises by 1.4 percent
  - low-wealth households experience welfare gains that are 57 percent larger than high-wealth households

Empirical analysis

Data

- We use two complementary datasets
- Consumer Expenditure Survey (CEX, 2004–14)
  - \+ detailed expenditure categories
  - \+ self-reported owner-equivalent rent
  - – can't compute net worth: only liquid wealth
- Panel Survey of Income Dynamics (PSID, 2004–14)
  - – more aggregated expenditure categories
  - – have to impute owner-equivalent rent
  - \+ detailed measures of wealth

Tradable expenditure shares (CEX)

- Total expenditures: 500+ expenditure categories
  - exclude mortgage interest, property taxes, home insurance
  - include self-reported owner's equivalent rent
- Tradable expenditures: 307 items
  - if imports or exports exceed 11 percent of production Examples
- 23,484 working-age household-year observations

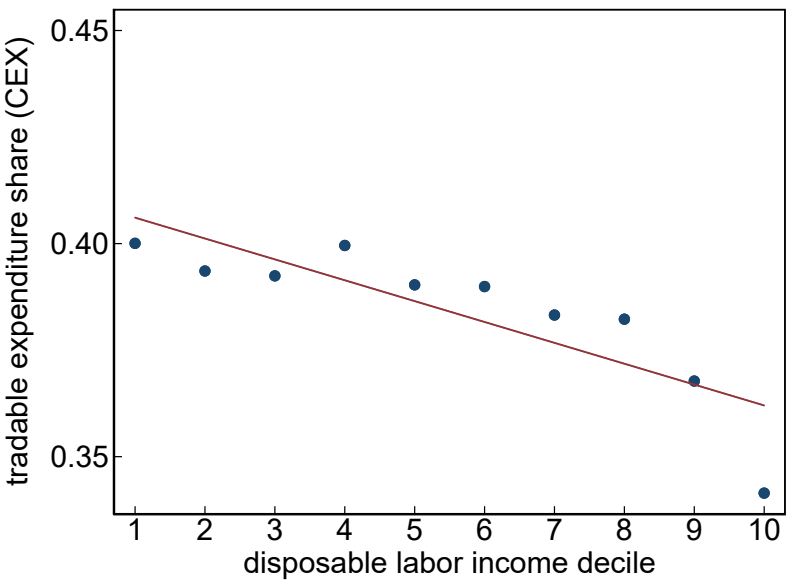
Tradable expenditure shares (PSID)

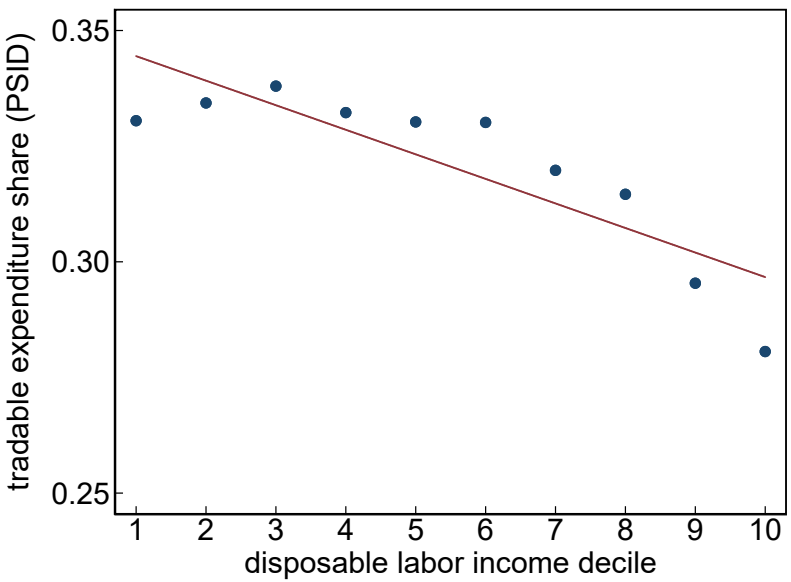
Exp. category	Tradable	Nontradable
Child care & education		✓
Clothing	✓	
Food	food at home	away from home
Health care	prescriptions	all other
Housing w/o repairs	furnishings	utilities, rent*
Transportation w/o repairs	gasoline, purchase and lease of cars and trucks	all other
Vacation/ent.	22 percent	all other
Repairs	21 percent	all other

- * : excludes mortgage, property taxes, and home insurance, but includes owner's equivalent rent, imputed by dividing state-level price-to-rent ratios from value of primary residence
- 30,244 working-age household-year observations

Tradable shares and disposable labor income

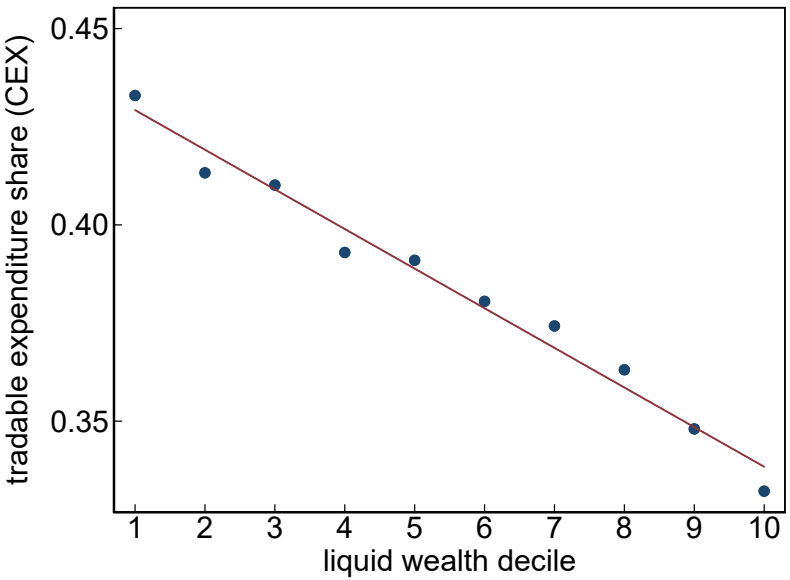
- Tradable shares decline with disposable labor income
- Level is higher in CEX

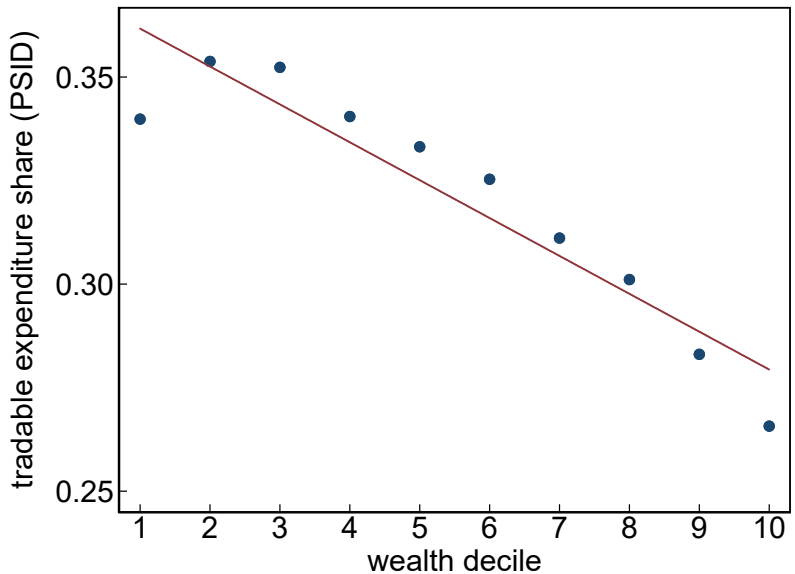




Tradable shares and wealth

- Tradable shares decline with wealth





Related empirical work

- Boppart (2014) uses CEX to show that goods expenditure shares decline with income
- Borusyak and Jaravel (2018) also use CEX to show that *import* expenditure shares are similar across income and education groups
- We focus on *tradable* expenditure shares since trade can impact prices of all tradable goods and services through
  - increased competition
  - input-output linkages
- Many other papers use barcode data, which cover a small fraction of overall household expenditures

Summary of empirical findings

- Tradable expenditure shares decline with income and wealth
- Robust to controlling for household characteristics: Regressions
  - household head age and education
  - household size
  - home ownership
- Robust to: Sensitivity
  - excluding all housing expenditures
  - no partial PSID adjustments (vacation/ent./repairs)
  - using total labor income
  - alternative tradability measures (to include indirect imports)

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  - alternative tradability measures (to include indirect imports)
- Motivates our model of
  - uninsurable income risk $\rightarrow$ wealth and income heterogeneity
  - non-homothetic preferences $\rightarrow$ different consumption baskets

Model

Main ingredients of model

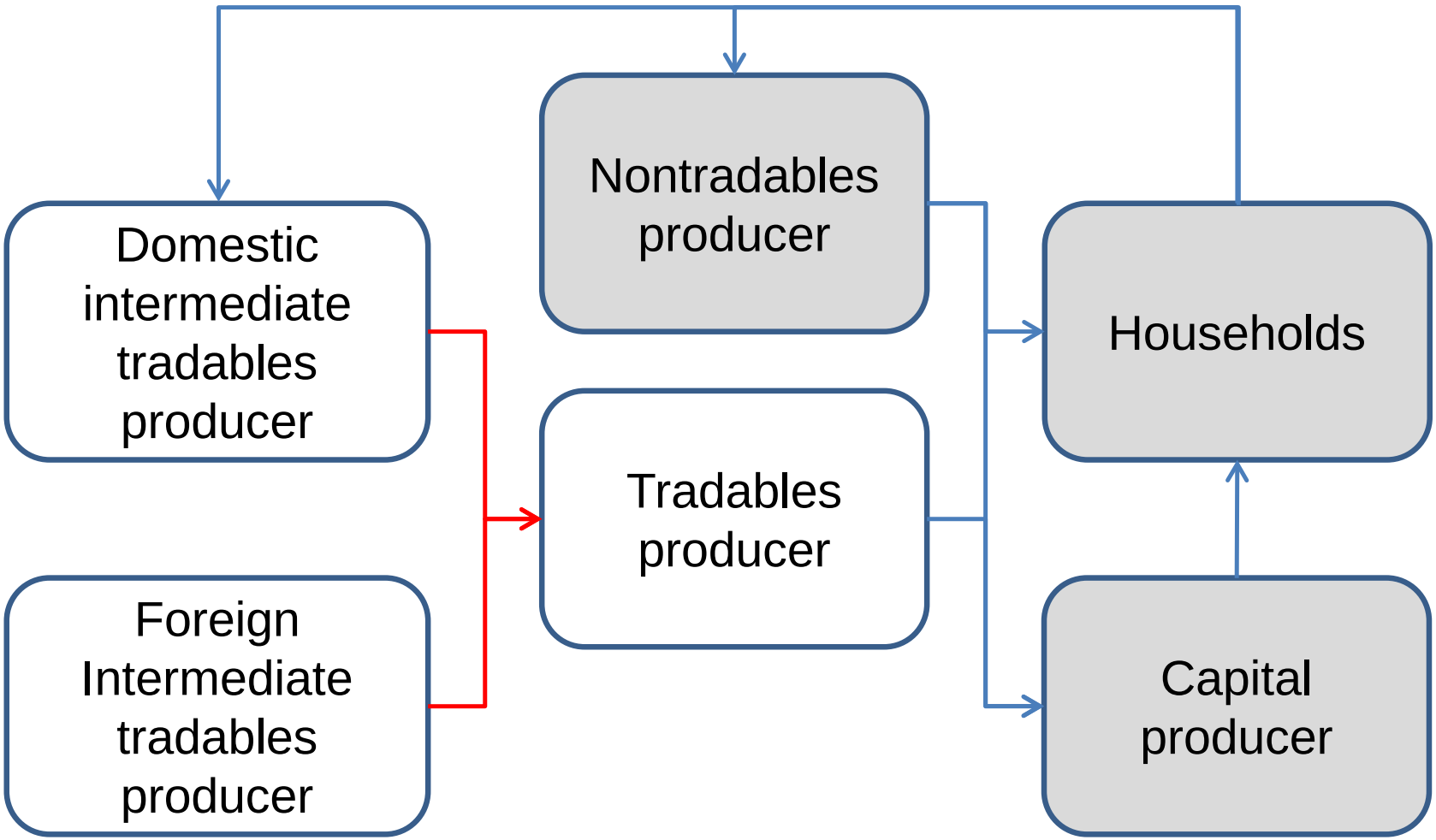
- Ricardian model of trade (Dornbusch-Fisher-Samuelson)
- Uninsurable labor income risk and capital accumulation (Aiyagari-Bewley-Hugget-Imrohoroglu)
- Non-homothetic preferences (Stone-Geary)

Model

- Two symmetric countries indexed by $i = 1, 2$
- Households
  - consume, work, and save
  - face uninsurable labor income risk
- Production and Trade
  - tradables and nontradables used for consumption and investment
  - continuum of tradable intermediate goods, indexed by $\omega \in [0, 1]$
  - shipment of good ω from o to i faces iceberg trade costs $\tau_{oi} \geq 1$

Outline of model

- We begin with the production of tradable goods



Final tradables producer

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

$$Y_{iT} = \left\{ \int_0^1 \left[\sum_{o=1,2} q_{oi}(\omega) \right]^{\rho} d\omega \right\}^{\frac{1}{\rho}}$$

and solves

$$\max_{\{q_{oi}(\omega)\}_{\omega}} P_{iT} Y_{iT} - \int_0^1 \sum_{o=1,2} \left[\tau_{oi} p_o(\omega) q_{oi}(\omega) \right] d\omega$$

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- It sources each ω from the lowest-cost producer
- 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, ω
- It combines labor and capital to produce

$$y_i(\omega) = z_i(\omega)\, l_i(\omega)^{\alpha}\, k_i(\omega)^{1-\alpha}$$

- Taking as given the price $p_i(\omega)$, it solves

$$\max_{l_i(\omega),k_i(\omega)} \; p_i(\omega)\, y_i(\omega) - w_i l_i(\omega) - r_i k_i(\omega)$$

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$$\max_{l_i(\omega),k_i(\omega)} \; p_i(\omega)\, y_i(\omega) - w_i l_i(\omega) - r_i k_i(\omega)$$

- Zero-profit price: $p_i(\omega) = \dfrac{1}{z_i(\omega)}$

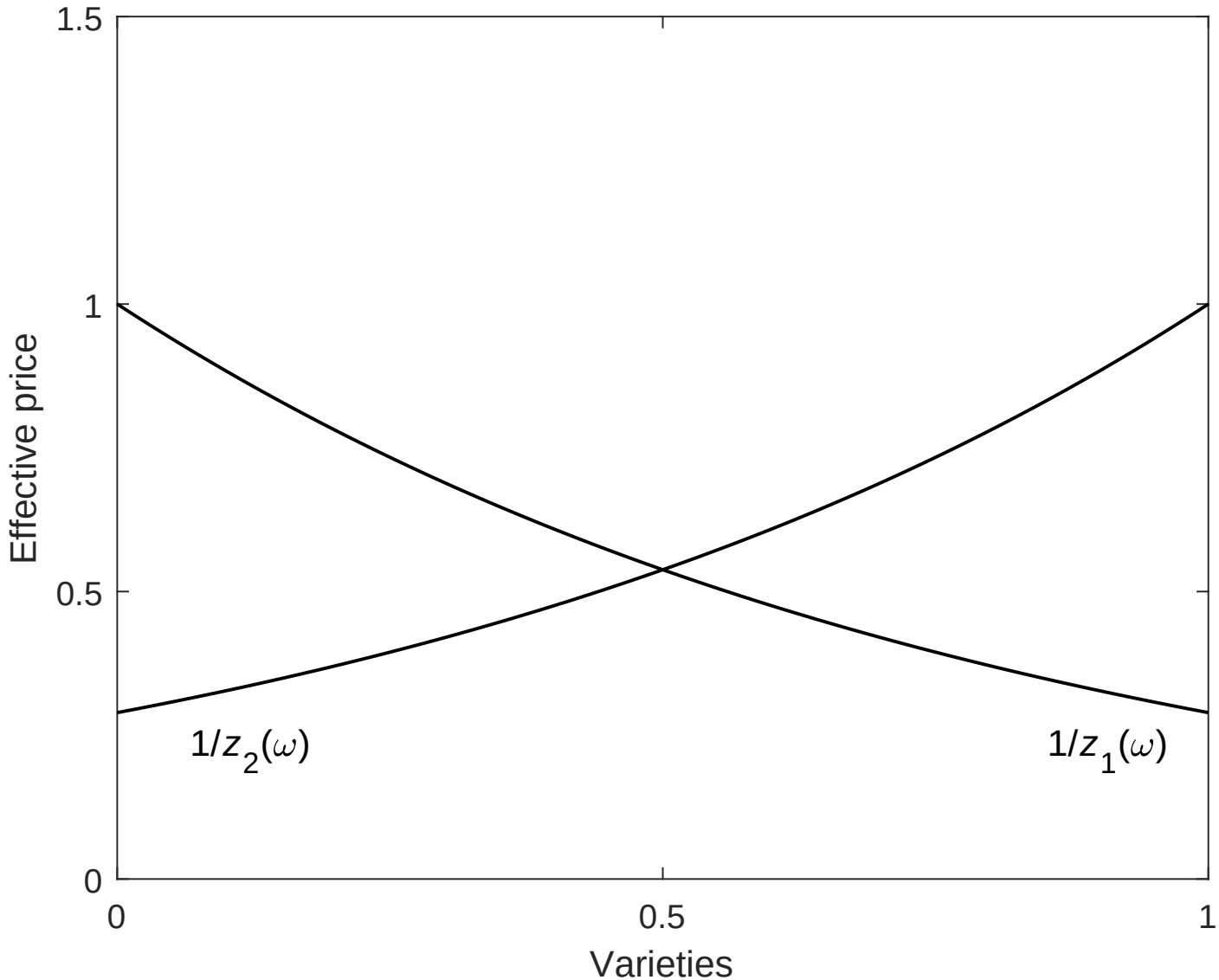
Productivity distributions in tradables production

- Productivities for variety ω 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 ω

Pattern of production (free trade)



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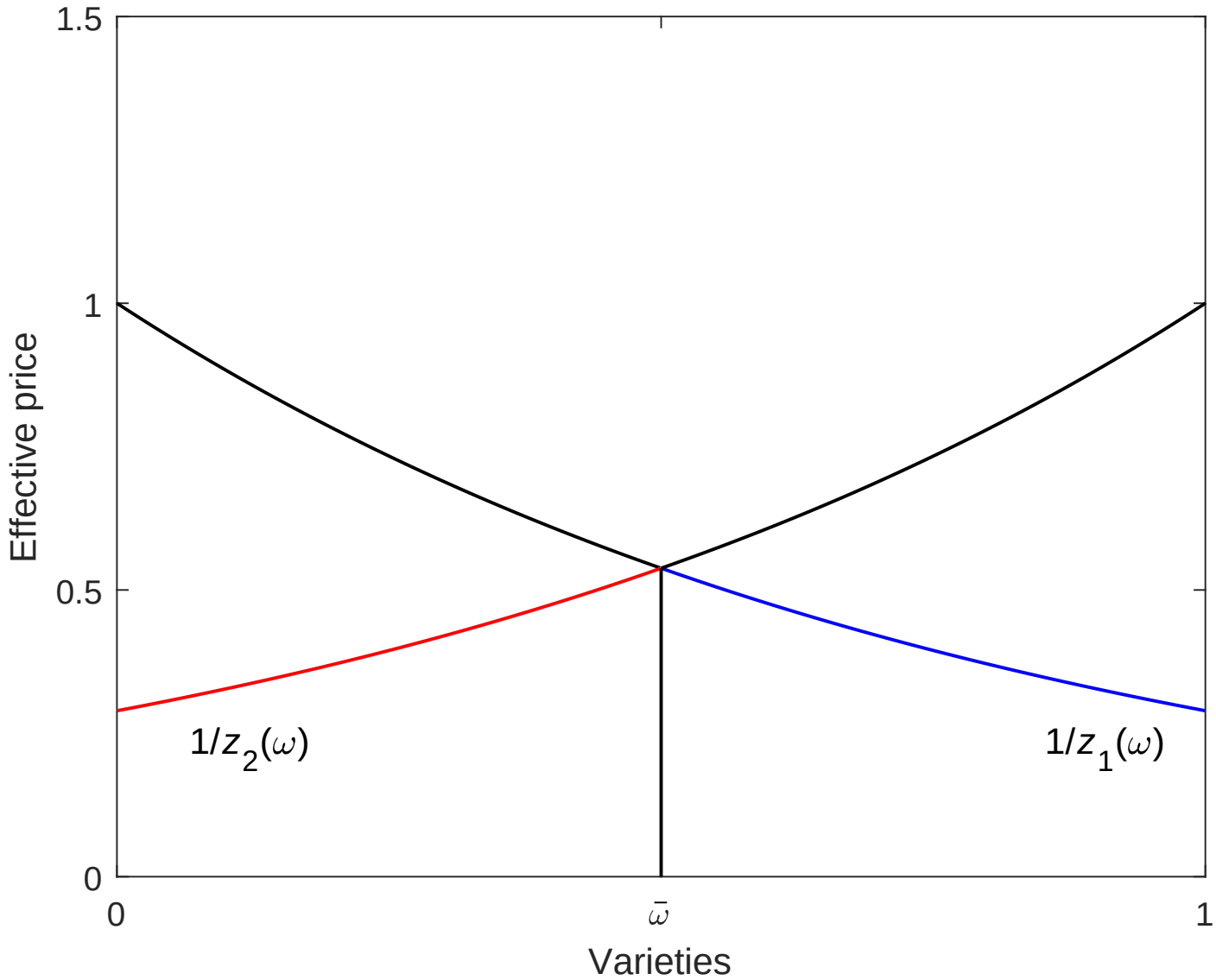

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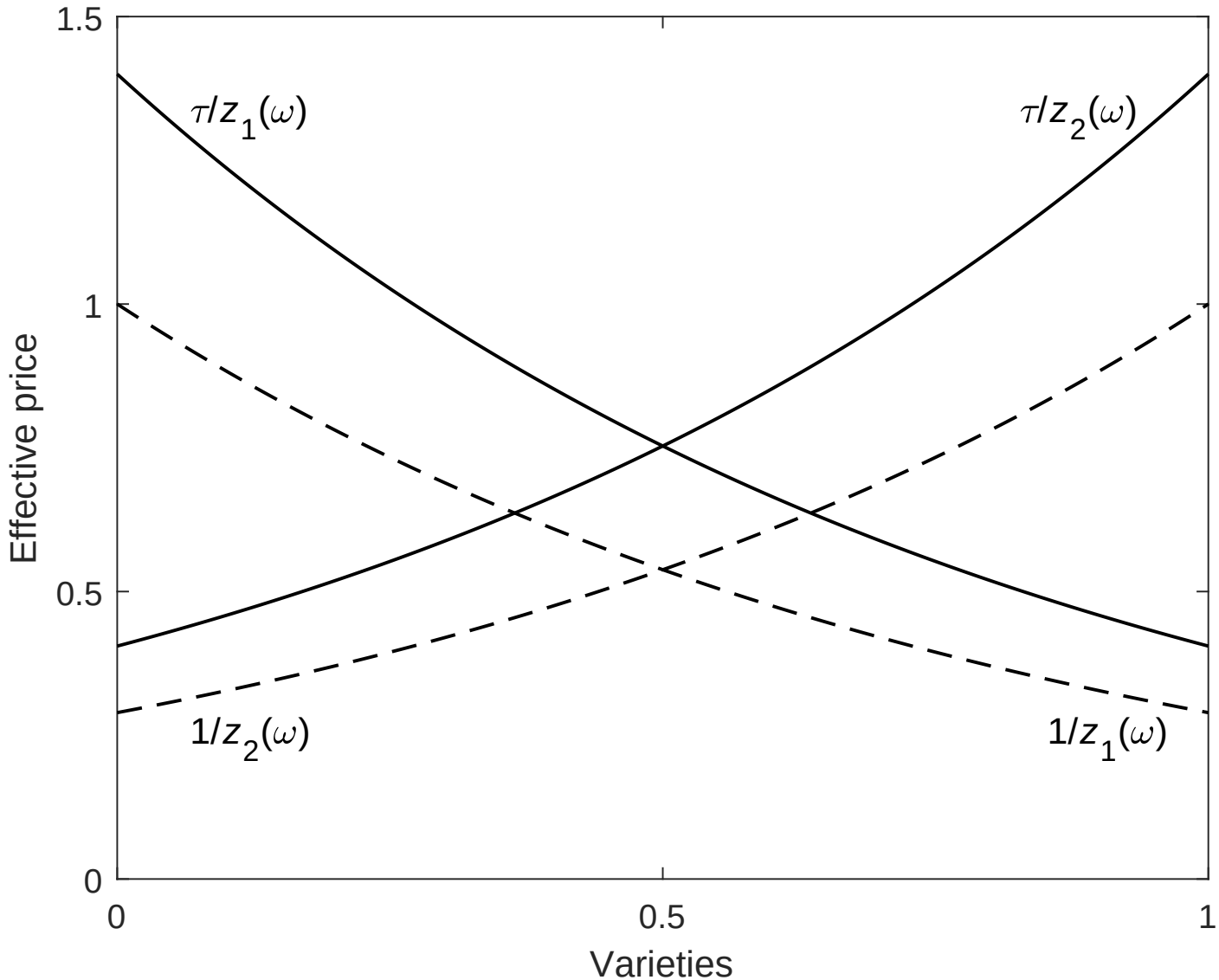

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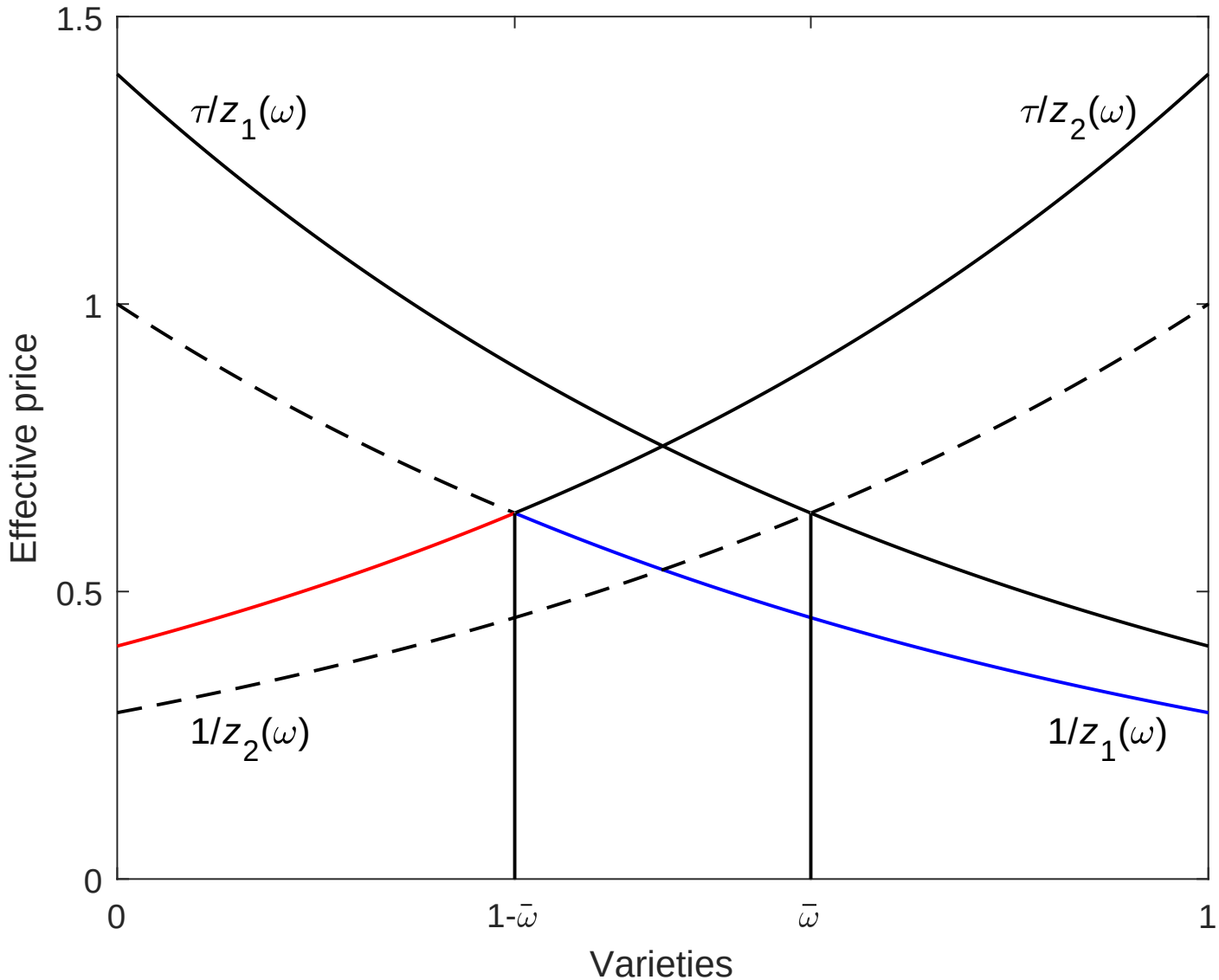

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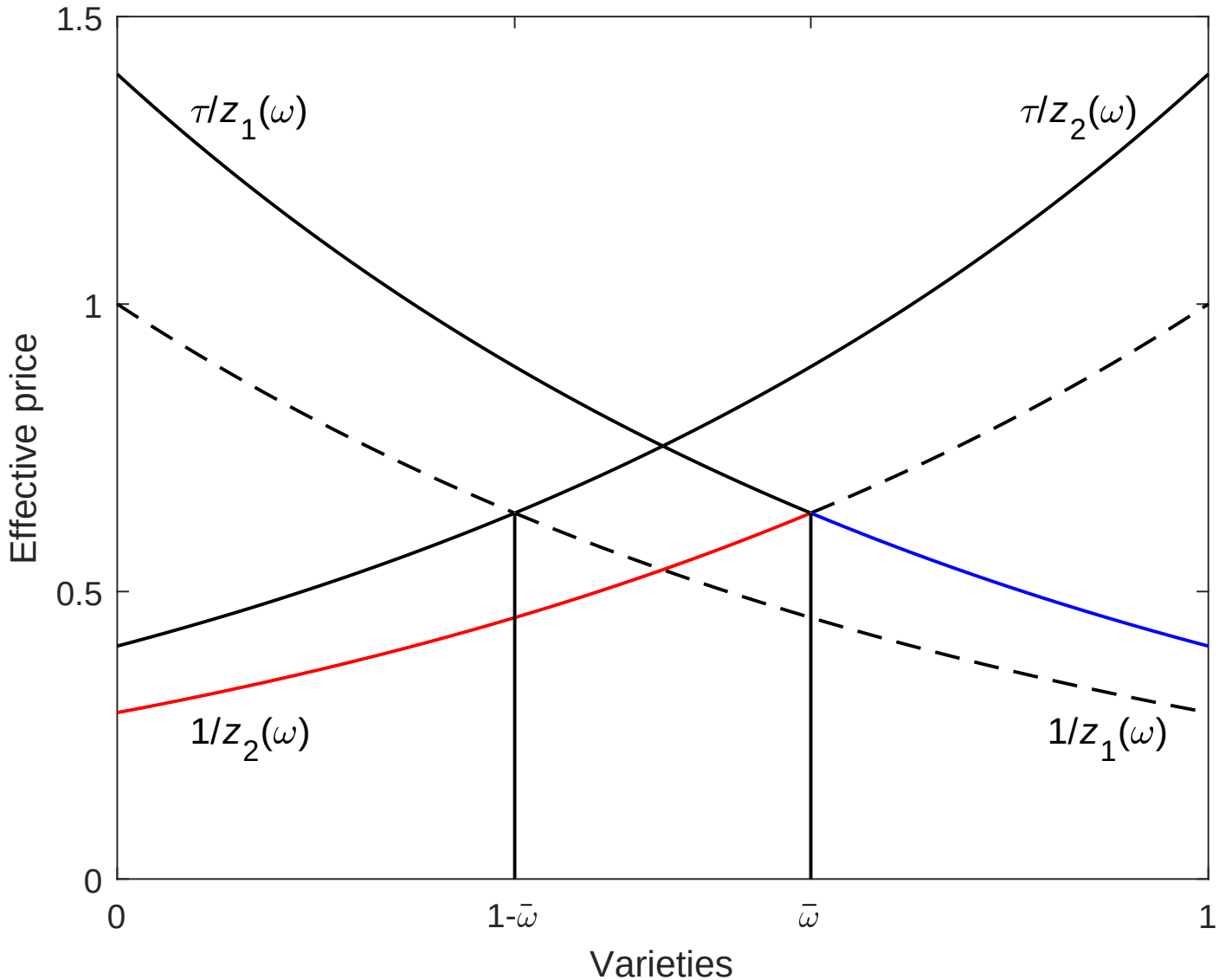
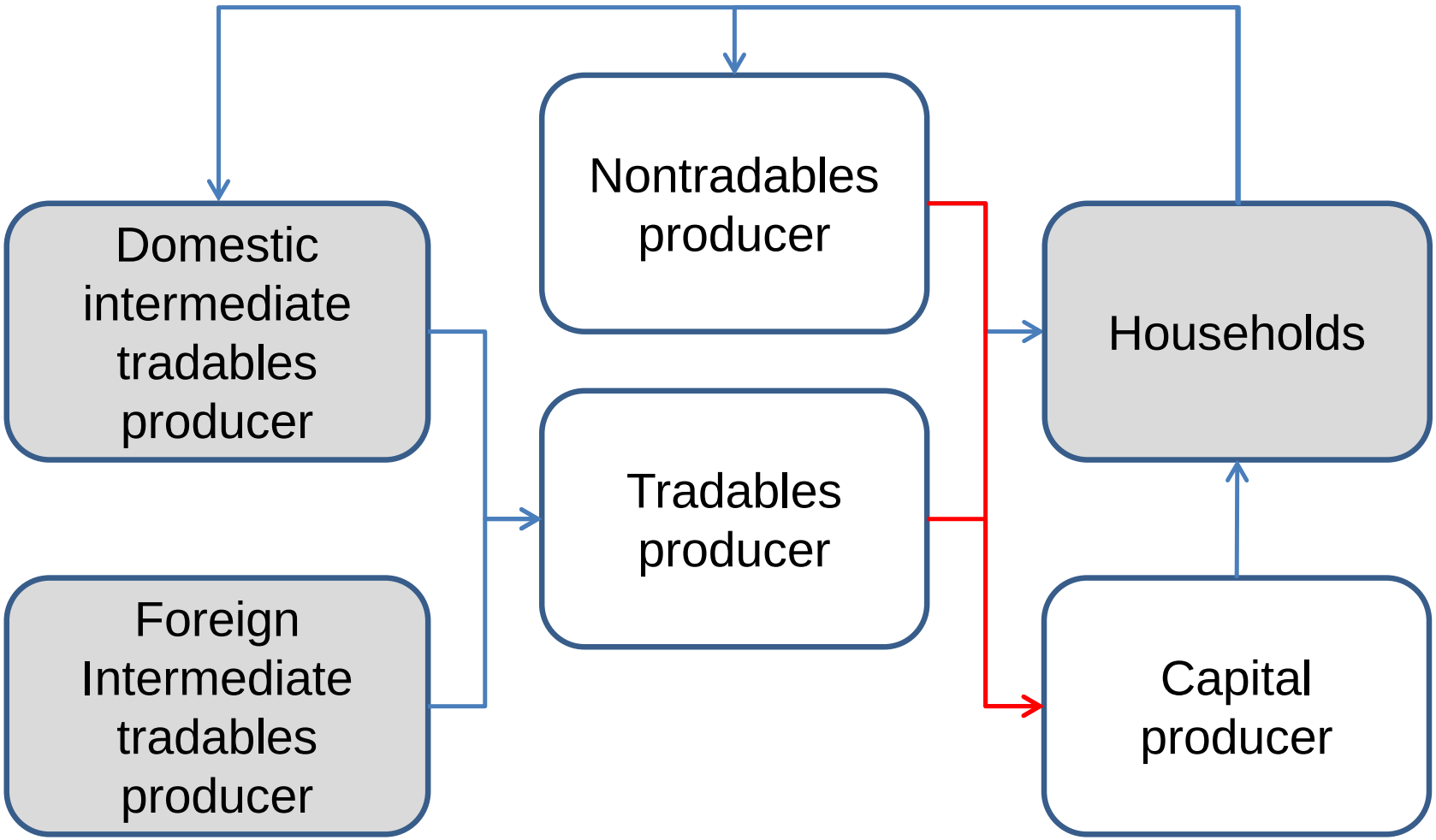


Outline of model

- Let's discuss the production of nontradable goods and capital



Nontradables producer

- A representative firm produces nontradables, Y_{iN}, by combining labor and capital:

$$Y_{iN} = z_{iN} L_{iN}^{\alpha} K_{iN}^{1-\alpha}$$

- It solves the static profit maximization problem

$$\max_{L_{iN}, K_{iN}} P_{iN} Y_{iN} - w_i L_{iN} - r_i K_{iN}$$

- Numeraire: set $P_{iN} = 1$

Capital producer

- A representative firm produces capital X_i, by combining tradable and nontradable goods:

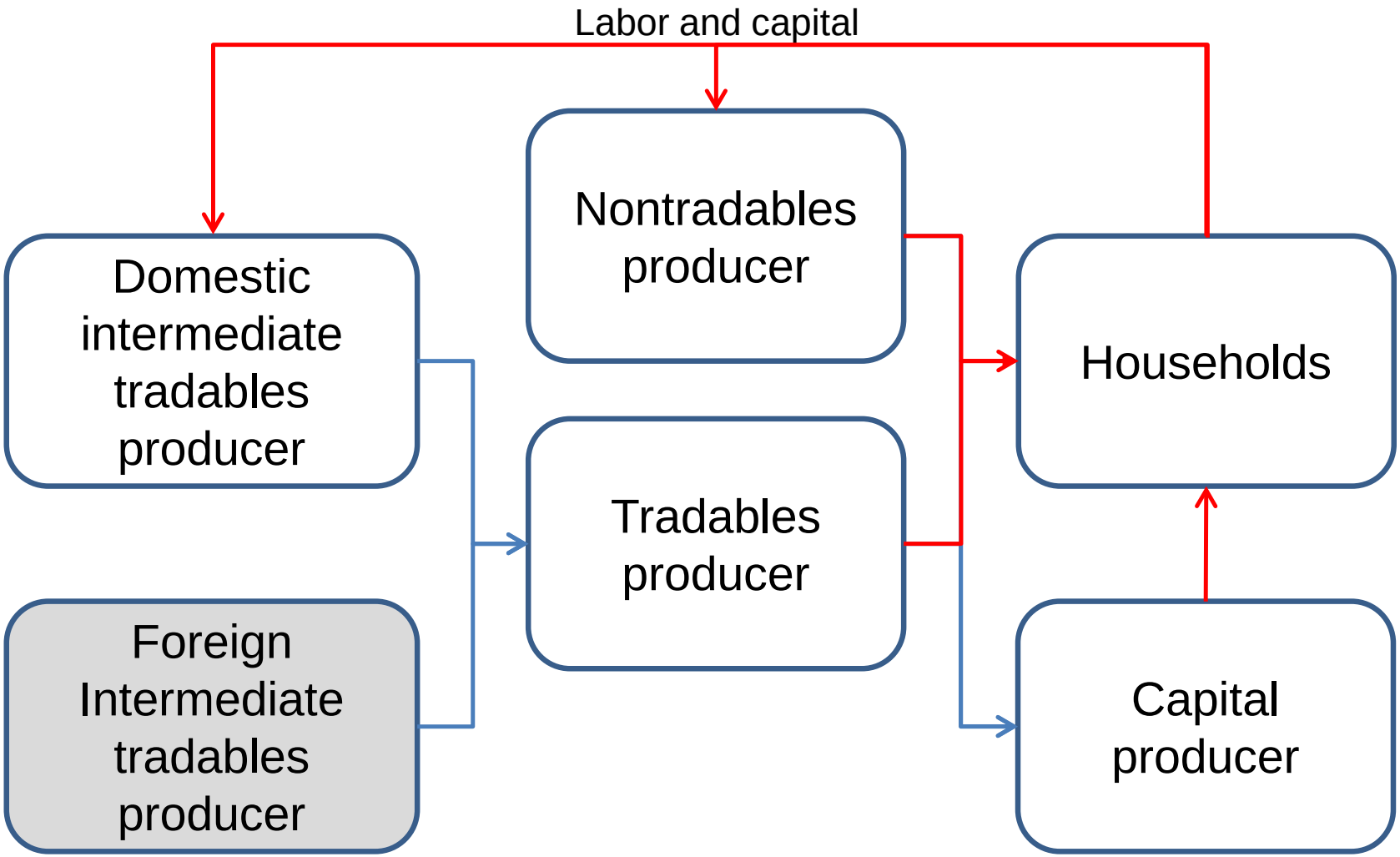
$$X_i = z_{iX} I_{iT}^{\kappa} I_{iN}^{1-\kappa}$$

- It solves

$$\max_{I_{iT}, I_{iN}} P_{iX} X_i - P_{iT} I_{iT} - I_{iN}$$

Outline of model

- Next, we discuss the household problem



Households

- Household with wealth k and productivity ε chooses tradable and nontradable consumption and investment to solve:

$$V_i(k,\varepsilon) = \max_{c_T, c_N, x} u(c_T, c_N) + \beta E_{\varepsilon'|\varepsilon} V(k', \varepsilon')$$

$$\text{s.t. } P_{iT} c_T + c_N + P_{iX} x \leq w_i \varepsilon + r_i k$$

$$k' = (1-\delta)k + x \geq 0$$

where $u(c_T, c_N) = \dfrac{\left(c_T^{\gamma}\left(c_N + \bar{c}\right)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma}$

Equilibrium

A *symmetric steady-state recursive equilibrium* is, for $i = 1, 2$

- Functions $\{V, g_T, g_N, g_k\}$,
- 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 μ^* such that:

1. Given prices, households optimize.
2. Given prices, firms optimize.
3. Goods markets clear: $\int g_T(k,\varepsilon)\,d\mu(k,\varepsilon) + I_T = Y_T$, $\int g_N(k,\varepsilon)\,d\mu(k,\varepsilon) + I_N = Y_N$, $X = \delta \int k d\mu(k,\varepsilon)$, $y_1(\omega) = q_{11}(\omega) + \tau q_{12}(\omega)$, and $y_2(\omega) = \tau q_{21}(\omega) + q_{22}(\omega)$.
4. Factor markets clear: $K_N + \int k_i(\omega)d\omega = \int g_k(k,\varepsilon)\,d\mu(k,\varepsilon)$, $L_N + \int l_i(\omega)d\omega = \int \varepsilon d\mu(k,\varepsilon)$.
5. Balanced trade: $\int q_{12}(\omega)d\omega = \int q_{21}(\omega)d\omega$.
6. For any $(\mathcal{K},\mathcal{E}) \in \mathcal{B}$, the invariant distribution μ^* satisfies

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

Characterization of equilibrium

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

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

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

- Trade costs distort ...

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

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

Quantitative Analysis

Quantitative Analysis

- Calibrate model to match features of U.S. economy
- Experiment
  - lower trade costs by 7 percentage points, which generates a rise in trade share from 13 to 17 percent
  - compute transition to new steady state
- Decompose welfare gains
  - effect of tradables price
  - effect of investment price
  - effect of factor prices

Calibration

- Preferences:

Parameters	Values	Targets / Source
Discount factor β	0.96	Wealth-to-GDP: 4.8 (2014)
Risk aversion σ	2	Standard value
Tradable share γ	0.27	Tradable expenditure share: 35 percent (2004–14)
Non-homotheticity $\bar{c}$	0.14	Tradable exp. share of wealthiest 25 percent: 30 percent (2004–14)

- Productivity shocks:
  - $\log \varepsilon_t = \rho_\varepsilon \log \varepsilon_{t-1} + \nu_t, \nu_t \sim N\left(0, \sigma_\varepsilon^2\right)$
  - We estimate $\rho_\varepsilon = 0.93$ and $\sigma_\varepsilon = 0.24$, using disposable labor income (PSID)

Calibration

- Production and trade:

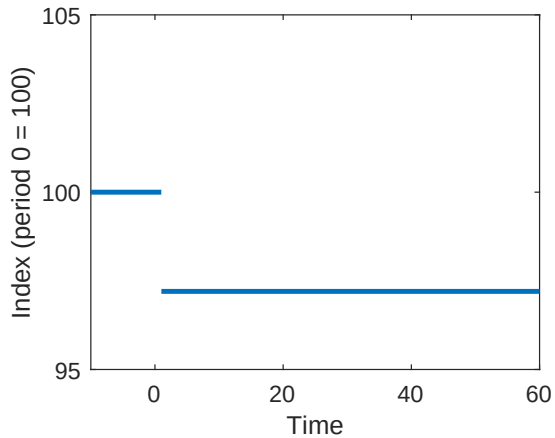
Parameters	Values	Targets / Source
Labor elasticities α	0.64	Labor income share
Tradable elasticity κ	0.56	Tradable input shares in capital production (2014)
Elas. of substitution θ	5.72	Trade elasticity: 4.0
Prod. distribution η	1.29	Employment share of top 17 percent of large mfg. est.: 32 percent (2014)
Trade costs $\tau_L - 1$	0.04	Import shares: 17 percent (2014)
$\tau_H - 1$	0.11	13 percent (2001)

Main results

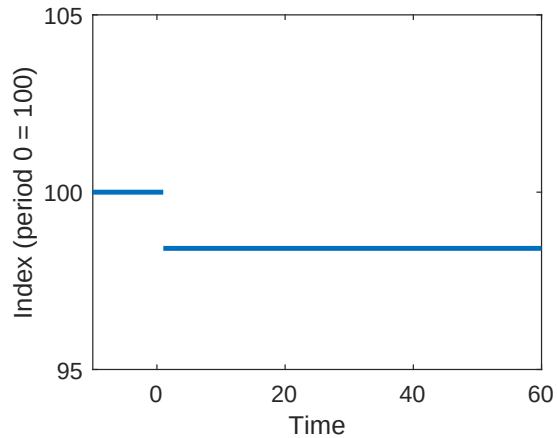
- Lower trade costs lead to
  - decline in tradables and investment price
  - capital deepening
  - increase in wage
  - decline in net return to capital, after initial jump
  - sizable average welfare gain, especially for wealth-poor

Prices

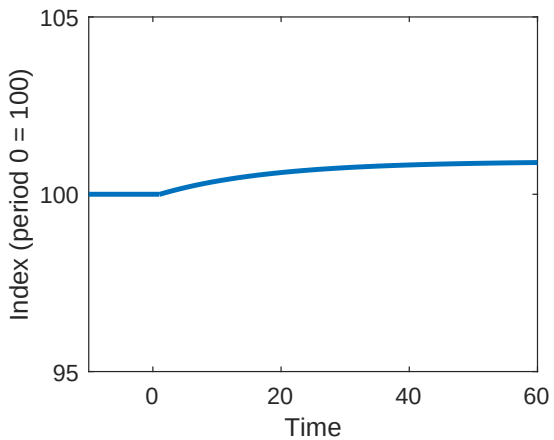
(a) Tradables price



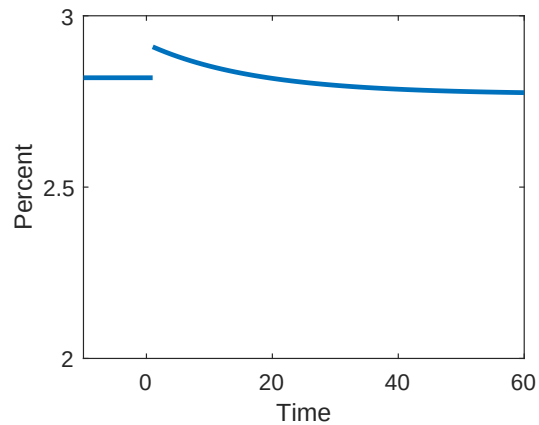
(b) Investment price



(c) Wage

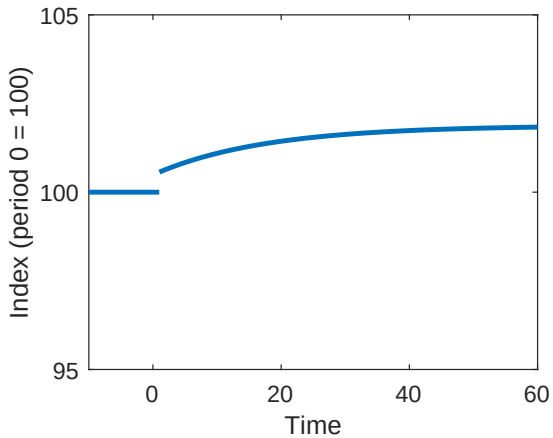


(d) Net return on capital

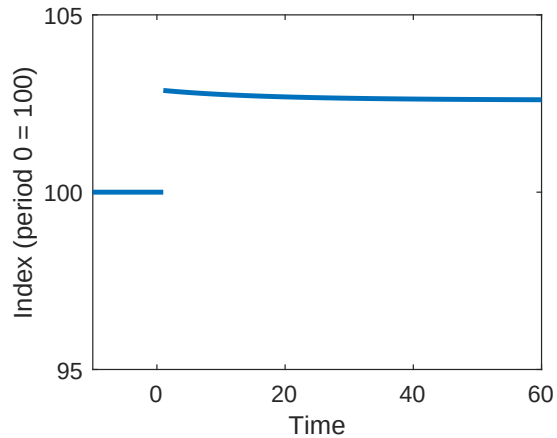


Quantities

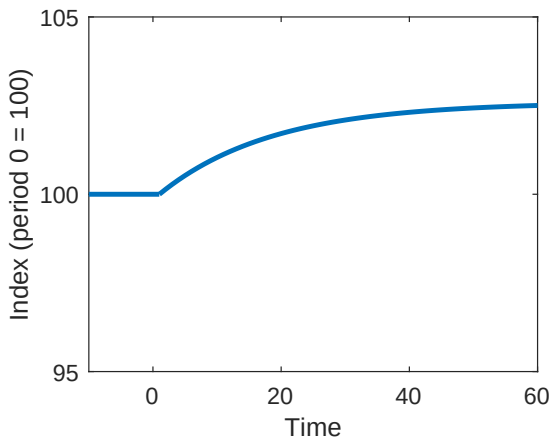
(a) Consumption



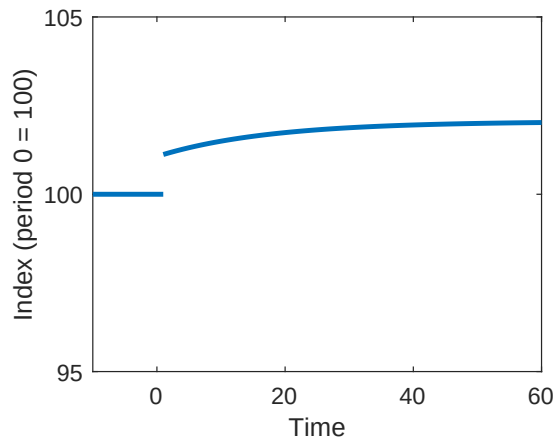
(b) Investment



(c) Capital



(d) GDP



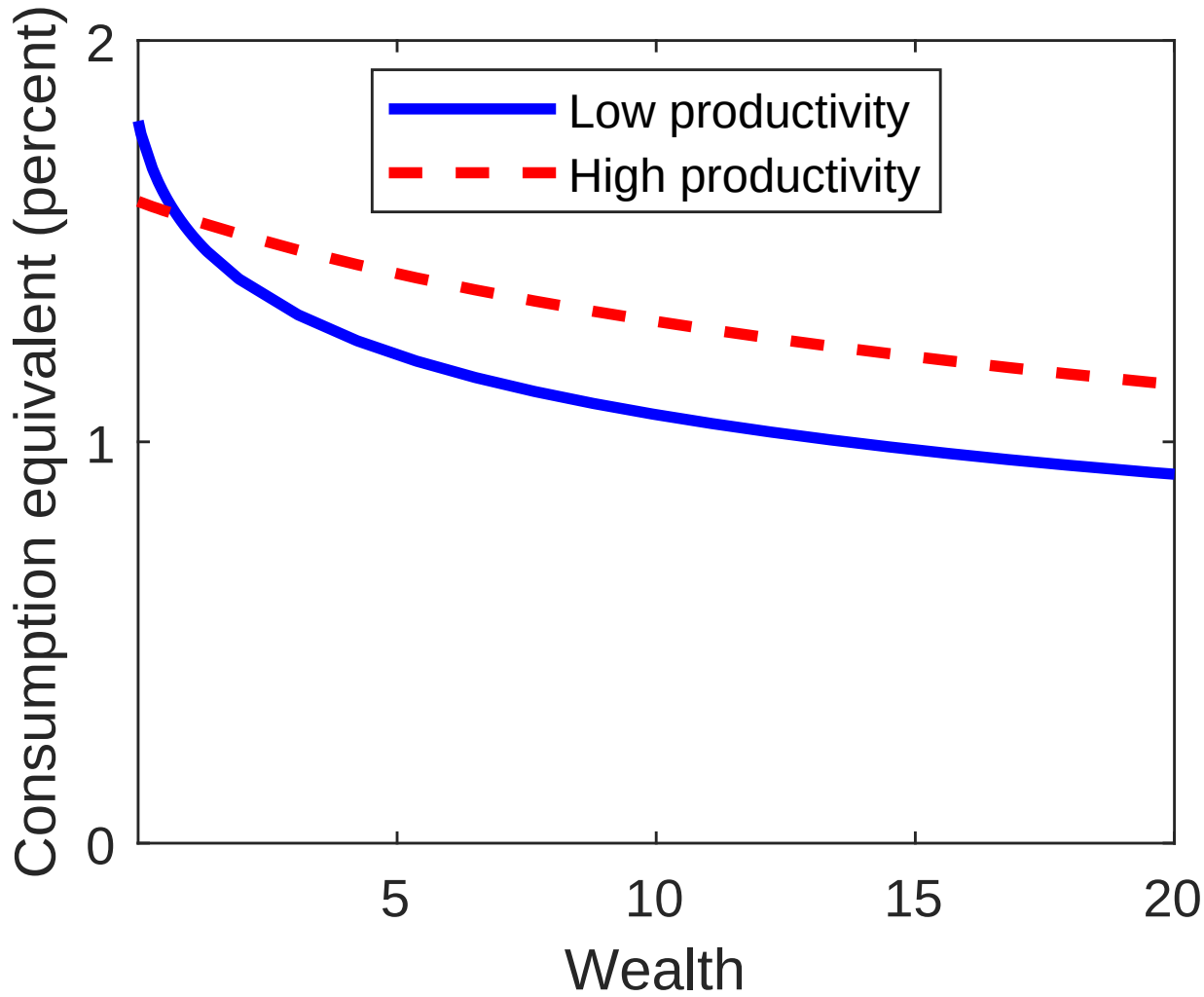
Welfare Calculation

- For each household, we compute consumption equivalents, Δ
- How much would initial steady state consumption have to be permanently increased for a household to be indifferent to the decline in trade costs?
- Solve for Δ such that $V_{\Delta}(k,\varepsilon) = V_{t=1}(k,\varepsilon)$

$$\begin{aligned} V_{\Delta}(k,\varepsilon) =& u\left(\left(1+\Delta\right) g_T^{ss}(k,\varepsilon), \left(1+\Delta\right) g_N^{ss}(k,\varepsilon)\right) \\ &+ \beta E_{\varepsilon'|\varepsilon} V_{\Delta}\left(g_k^{ss}(k,\varepsilon), \varepsilon'\right). \end{aligned}$$

- If $\Delta > 0$, then the household benefits from reduced trade costs. If $\Delta < 0$, then it does not.

Welfare across income and wealth



Decomposing welfare changes

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

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

where $\tilde{r} = r - \delta P_X$ is the net return on capital

- Expenditure channel: $P_T \downarrow$ makes tradable consumption more affordable.
- Poor vs. Wealthy

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- Investment channel: $P_X \downarrow$ cheaper to buy more capital
- Savers vs. Dissavers

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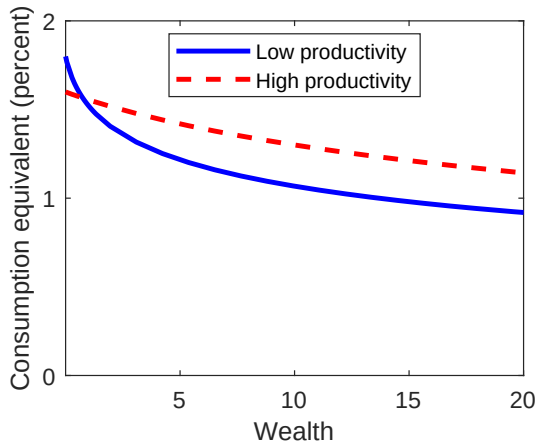
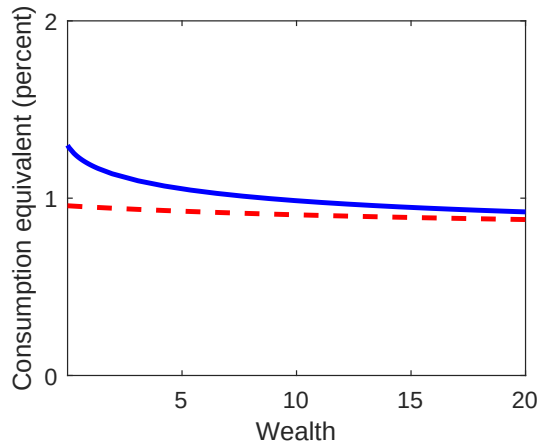
- Factor price channel: w and $\tilde{r}$ change
- Labor vs Capital

Welfare by channel

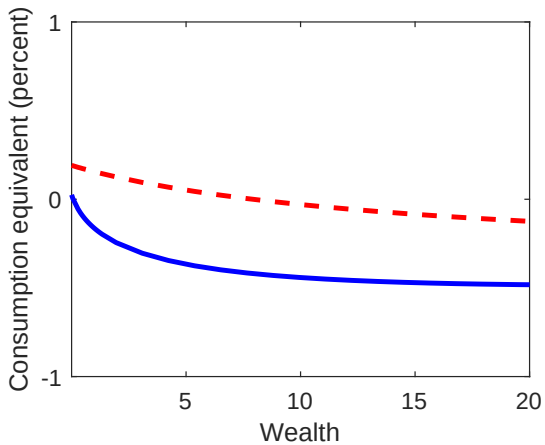
(a) Total



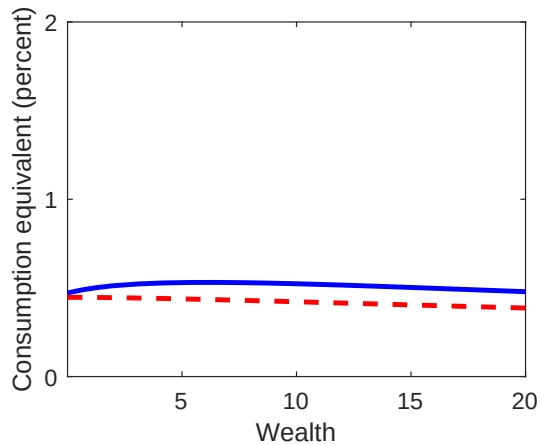
(b) Expenditure



(c) Investment



(d) Factor price



Decomposition of welfare changes

Average	Low wealth		High wealth		Average
	Low prod.	High prod.	Low prod.	High prod.	
Expenditure	1.30	0.96	0.94	0.88	1.03
Investment	0.02	0.19	−0.47	−0.11	−0.10
Factor price	0.47	0.45	0.50	0.39	0.48
All	1.80	1.60	0.96	1.17	**1.40**

Units: percent.

Conclusion

- Poor households consume a larger share of tradables compared to higher income, wealthier households
- Lower trade costs lead to larger welfare gains for
  - the poor relative to the rich
  - savers relative to dissavers
  - workers relative to capitalists
  - all channels favor wealth-poor
- Differences in welfare changes across wealth are similar in magnitude to those across labor markets (Caliendo et al. 2019 and Lyon and Waugh 2019)

Appendix

Tradability measures back

CEX item	IO item	$\frac{\max(exp, imp)}{production}$	$\frac{exp + imp^*}{production}$	Tradable
Men's suits	Apparel manufacturing	5.60	7.35	yes
Calculators	Other comm and service industry machinery mfg.	0.23	0.57	yes
Airline fares	Air transportation	0.20	0.36	yes
Plastic dinnerware	Oth. plastics prod. mfg.	0.12	0.29	yes
Paint, wallpaper, and supplies	Paint and coating mfg.	0.09	0.13	no
Office furniture	Office furniture, custom architectural woodwork, and millwork mfg.	0.08	0.11	no
Newspaper subscr.	Newspaper publishers	0.03	0.03	no
Dining out	Restaurants	0.00	0.00	no

- * : direct and indirect imports

Tradable shares, wealth, and income back

	Tradable expenditure share (percent)			
	(1) PSID	(2) PSID	(3) CEX	(4) CEX
ln(Wealth)	–1.03***	–0.64***	–1.12***	–0.37***
	(0.04)	(0.05)	(0.04)	(0.04)
ln(Income)	–0.20**	–0.46***	–0.24*	–1.17***
	(0.09)	(0.10)	(0.13)	(0.14)
College		–2.77***		–3.31***
		(0.15)		(0.19)
Homeowner		–1.31***		–6.06***
		(0.19)		(0.21)
Other controls	no	yes	no	yes
N	30244	30228	23484	23484
Adj. R^2	0.036	0.066	0.076	0.167

Standard errors in parentheses. All regressions include year fixed effects. Other controls include fixed effects for age and household size.

$*$ $p < 0.10$, $**$ $p < 0.05$, $***$ $p < 0.01$

Sensitivity analysis back

	Tradable expenditure share (percent)					
	(1) PSID no housing	(2) PSID no partial adj.	(3) PSID total lab. inc.	(4) CEX no housing	(5) CEX total lab. inc.	(6) CEX alt. tradability
ln(Wealth)	–0.84***	–0.76***	–0.76***	–1.00***	–0.34***	–0.17***
	(0.07)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)
ln(Income)	–2.14***	–0.66***	–0.41***	–2.50***	–1.03***	–0.24*
	(0.14)	(0.10)	(0.08)	(0.15)	(0.11)	(0.14)
N	30220	30228	28212	23387	21934	23484
Adj. R^2	0.047	0.079	0.072	0.254	0.167	0.163

Standard errors in parentheses. $*$ $p < 0.10$, $**$ $p < 0.05$, $***$ $p < 0.01$

All regressions include year, age, household size, education, and homeowner fixed effects.

Wealth distribution

- Wealth Gini in model: 0.59

Figure: Data

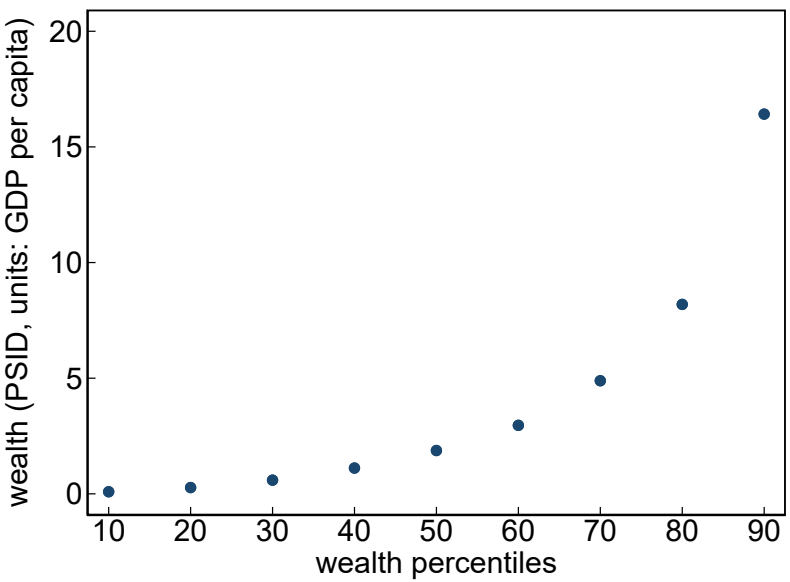


Figure: Model