Quantifying the Losses from International Trade

Spencer Lyon
NYU

Michael E. Waugh
NYU and NBER

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Big Picture: The Backlash Against Trade

Hard to deny that the benefits of globalization have been under attack...

Motivating this attack is (I think) the perception that trade has imposed hardship on some segments of the populaiton.

Autor, Dorn, and Hanson (2013) provide the most compelling evidence about the distributional consequences... Chinese-import-exposed areas experienced:

- Drops in labor earnings,
- Decreases in labor force participation (and take up of transfer payments),
- Little out-migration (at least in the short/medium run).

This Paper: How Much Do the Losers Lose From Trade?

This paper: Use theory + data to quantitatively evaluate the welfare losses associated with trade.

Three important model elements:

1. Dynamic, Ricardo-Viner trade model. Similar to Kambourov (2009), Artuç, Chaudhuri, and McLaren (2010), Caliendo, Dvorkin, and Parro (2015).
2. Households can vary labor-supply given labor-market conditions.
3. Households face incomplete markets, but can partially self insure as in the standard incomplete market model.

Estimate the parameters of the model using ADH evidence + new evidence on debt and consumption. . . and evaluate the welfare gains/loses(?) of trade.

Model: Overview

Time: Discrete time, infinite horizon.

- I'll drop time subscripts unless necessary.

Domestic Geography: A continuum of "islands" indexed by $\omega \in [0, 1]$.

On an island ω...

- Competitive producers on an island produce intermediate good ω.
- Households living on ω are available to work for those producers on the island.

International Trade: Focus on a Small Open Economy, where world prices for an island's intermediate good follow an exogenous, stochastic process.

Model: Production

Island level intermediate good production:

$$q(\omega) = z(\omega)\ell.$$

Productivity z evolves according to:

$$\log z_{t+1} = \phi_z \log z_t + \epsilon_{t+1}$$

where $\epsilon_{t+1} \sim \mathcal{N}(0, \sigma_\epsilon)$. ϵ_{t+1} is independent across time and goods.

Intermediate goods are aggregated according to:

$$Q = \left[\int_0^1 q_(\omega)^\rho d\omega \right]^{\frac{1}{\rho}}.$$

where $\theta = \frac{1}{1-\rho}$ is the elasticity of substitution.

Model: Production and Trade

Focus on a Small Open Economy (SOE). World prices for intermediate good ω evolve according to:

$$\log p_w(\omega)_{t+1} = \phi_w \log p_w(\omega)_t + \epsilon_{w,t+1}$$

where $\epsilon_{w,t+1} \sim \mathcal{N}(0, \sigma_w)$. $\epsilon_{w,t+1}$ is independent across t and w.r.t. z shocks.

Intermediate goods can be produced domestically, imported, or exported. Trade is subject to iceberg trade cost:

- To ship internationally, produce $\tau > 1$ to deliver one unit.
- International arbitrage $\Rightarrow$ domestic prices must lie between

$$\left[\frac{p_w(\omega)_t}{\tau} \ , \ \tau p_w(\omega)_t \right].$$

Island level state variable: $\mathbf{s} = \{ z_h, \ p_w \}$.

Model: Households

Unit mass of households. Individual households **live and work** on islands.

Individual households have preferences:

$$E \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} - B \frac{h_t^{1-\gamma}}{1-\gamma} \right\},$$

- c_t: consumption of the final good,
- h_t is hours worked.

Model: Households' Choices

1. **Work or not**...
   - Constrain the choice of labor units to be $h_t \in \{0, \bar{h}\}$.
   - If a household works, receive island level wage: $w(\mathbf{s})$.
   - If a household does not work, it receives home production.
2. **Stay or move**...
   - By paying $m > 0$ in units of the final good, households migrate and move to a new island.
   - Today — moving households arrive at a random island.
3. **Save or borrow**...
   - Accumulate a non-state contingent asset a that pays gross return R.
   - Face a lower bound on asset holding $-\bar{a}$.

Equilibrium: Overview

A Stationary Small Open Economy (SSOE) Equilibrium. Given world prices $\{p_w, R\}$, a stationary Small Open Economy Equilibrium is domestic prices $\{p_h(\mathbf{s}), P_h\}$, policy functions $\{\ g_a(\mathbf{s}, a), \iota_n(\mathbf{s}, a), \iota_m(\mathbf{s}, a)\ \}$, a probability distribution $\lambda_h(\mathbf{s}, a)$ such that

i Firms maximize profits; The policy functions solves the household's optimization problem;

ii Demand for the final and intermediate goods equals production;

iii The probability distribution $\lambda_h(\mathbf{s}, a)$ is a stationary distribution.

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The basic idea...

1. Households' consumption/savings, work, and moving decisions determine goods demand and labor supply.
2. Bounds on international arbitrage + firm optimization determine goods supply and labor demand.

Need **1.** and **2.** to be consistent.

Equilibrium: A Little Bit of Detail. . . Non-Traded Goods

Non-Traded Case: An islands with state **s** where the good is non traded. . .

- Because it's non-traded: $\frac{p_w}{\tau} < p_h(\mathbf{s}) < \tau p_w$.
- Real wages on the island are:

$$w_h(\mathbf{s}) = \frac{p_h(\mathbf{s})z}{P}.$$

- Goods market clearing:

$$\pi(\mathbf{s}) \left(\frac{p_h(\mathbf{s})}{P} \right)^{-\theta} C = z\mu(\mathbf{s})\bar{h}.$$

Note: Household decisions matter in two places: (i) labor supply $\mu(\mathbf{s})$ on the island and (ii) aggregate consumption, C.

Equilibrium: A Little Bit of Detail...Imported Goods

Imported Case: An islands with state **s** where the good is **imported**...

- Because it's imported: $p_h(\mathbf{s}) = \tau p_w$.
- Real wages on the island are:

$$w_h(\mathbf{s}) = \frac{\tau p_w z}{P}.$$

- Goods market clearing:

$$\pi(\mathbf{s}) \left(\frac{p_h(\mathbf{s})}{P} \right)^{-\theta} C \; - \; z\mu(\mathbf{s})\bar{h} \; > \; 0$$

Equilibrium: A Little Bit of Detail. . . Exported Goods

Exported Case: An islands with state **s** where the good is **exported**. . .

- Because it's exported: $p_h(\mathbf{s}) = \frac{p_w}{\tau}$.
- Real wages on the island are:

$$w_h(\mathbf{s}) = \frac{p_w z}{\tau P}.$$

- Goods market clearing:

$$\pi(\mathbf{s}) \left(\frac{p_h(\mathbf{s})}{P} \right)^{-\theta} C \; - \; z\mu(\mathbf{s})\bar{h} \; < \; 0$$

Island-Level Wages and Trade

Wages and Trade Exposure: Real wages in a market with state $\mathbf{s}$ equal

$$w(\mathbf{s}) = \omega(\mathbf{s})^{\frac{1}{\theta}} \hat{\mu}(\mathbf{s})^{\frac{-1}{\theta}} z^{\frac{\theta-1}{\theta}} C^{\frac{1}{\theta}}.$$

where

$$\omega(\mathbf{s}) := \frac{p_h(\mathbf{s}) z \mu(\mathbf{s}) \bar{h}}{p_h(\mathbf{s}) z \mu(\mathbf{s}) \bar{h} \quad + \quad p_h(\mathbf{s}) \text{imports}(\mathbf{s}) - p_h(\mathbf{s}) \text{exports}(\mathbf{s})},$$

which is the "home share," and $\hat{\mu}(\mathbf{s}) = \frac{\mu_h(\mathbf{s})\bar{h}}{\pi(\mathbf{s})}$ is labor units per market.

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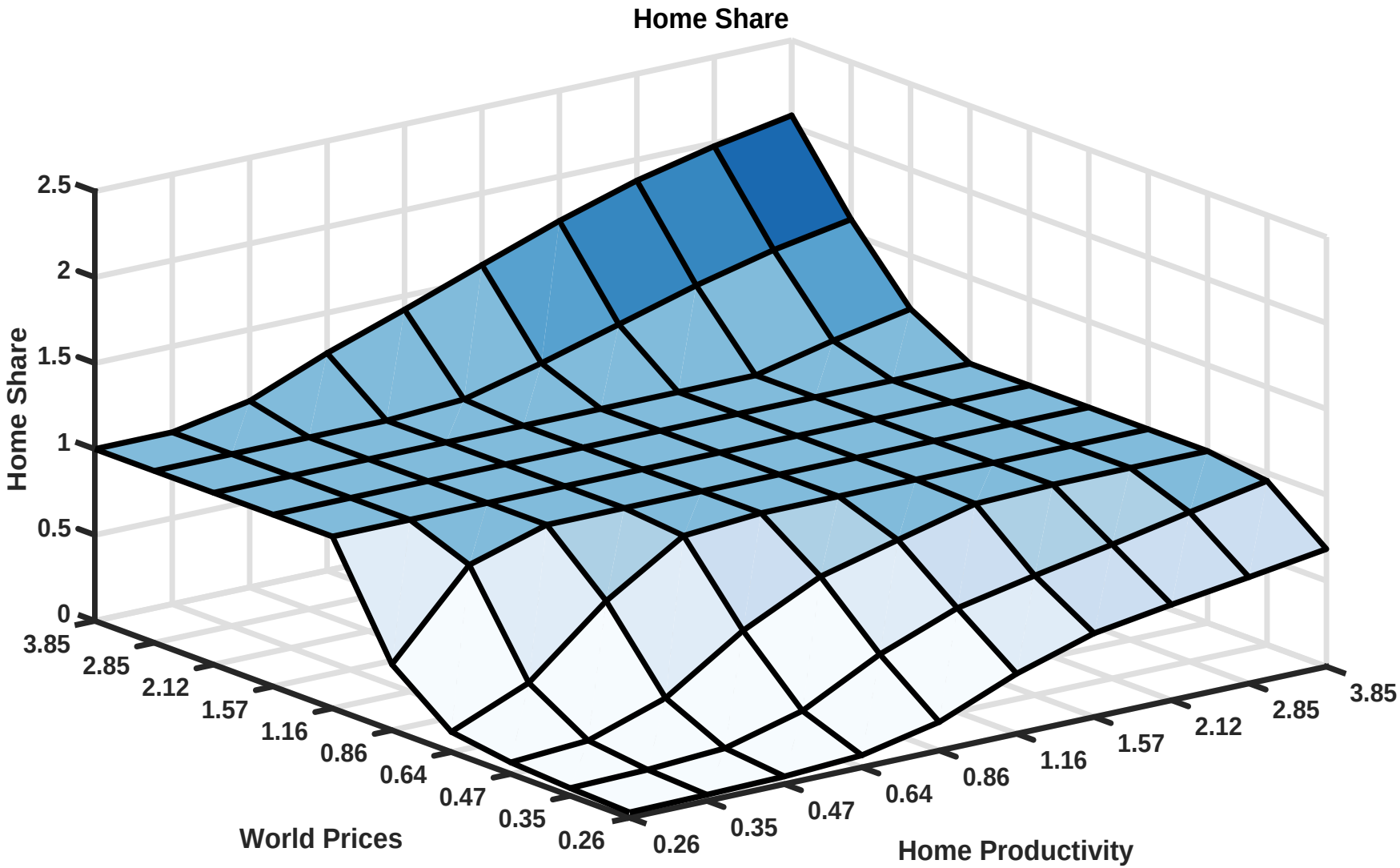
Important observation...

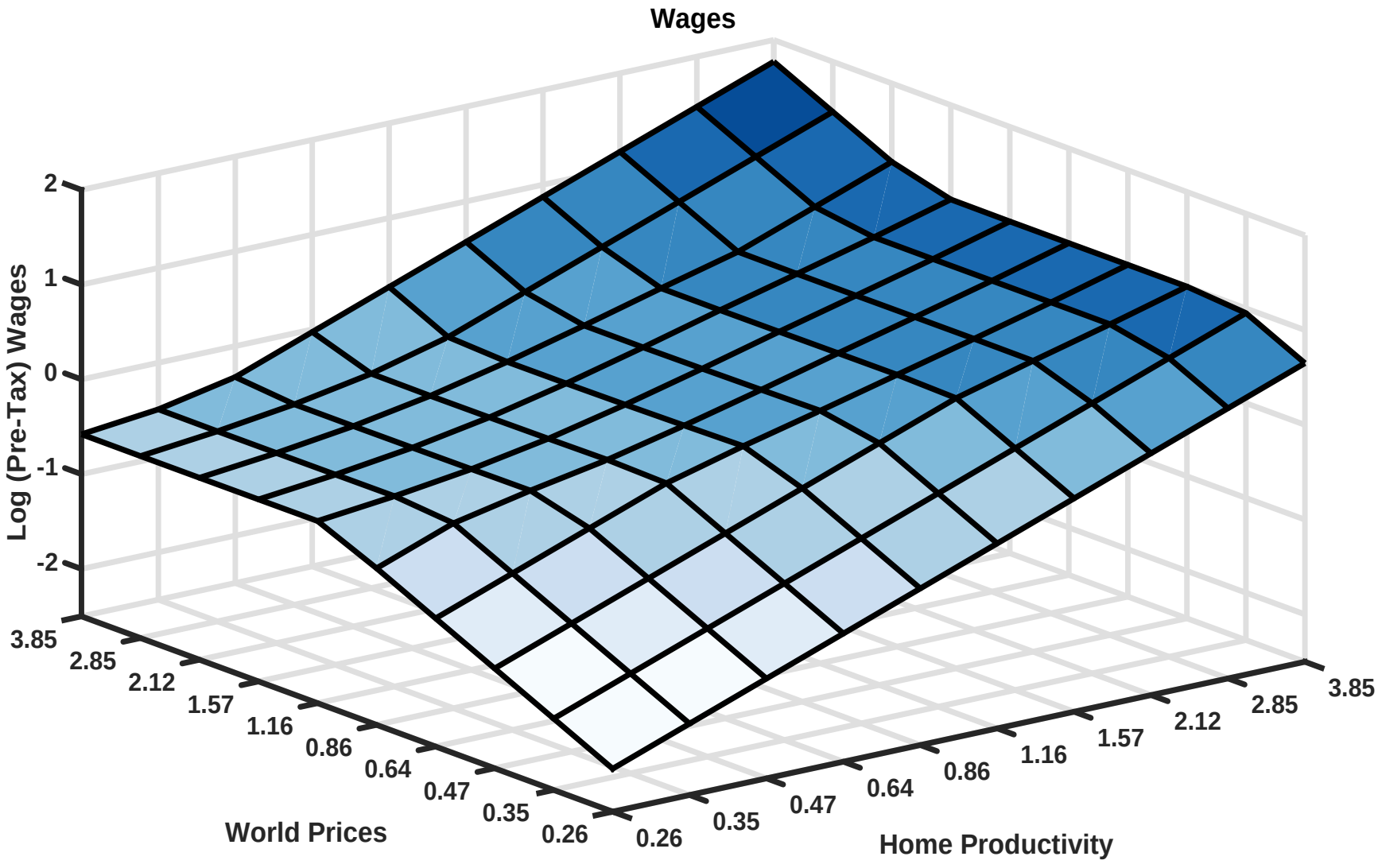
A **smaller** home share implies that wages are **lower** with elasticity $\frac{1}{\theta}$. The economics are easy to understand...

- More imports $\Rightarrow$ lower prices $\Rightarrow$ lower wages
- CES tightly connects the price with the home share and θ.

Home Share $\omega(\mathbf{s})^{\frac{1}{\theta}}$ Across Islands



Real Wages Across Islands



Connecting with ADH's Empirical Approach

ADH Empirical Approach: Relate changes in labor earnings in a market to changes in import exposure

$$\Delta \log w(\mathbf{s}) = \frac{1}{\theta}\Delta \log \left(\omega(\mathbf{s})/\hat{\mu}(\mathbf{s})\right) + \frac{1}{\theta}\Delta \log C_h + \Delta \log \left(z^{\frac{\theta-1}{\theta}}\right),$$

1. Highlights the key empirical challenge of ADH:

- Productivity shocks z are unobserved, but correlated with trade.

2. ADH's solution—use another country's imports as an instrument— is a valid IV strategy within our model...

- Another country's imports is orthogonal to z (the exclusion restriction),
- But correlated domestic import exposure via world prices.

The Quantitative Excercise...

What we will do: estimate the model to match the ADH + new evidence...

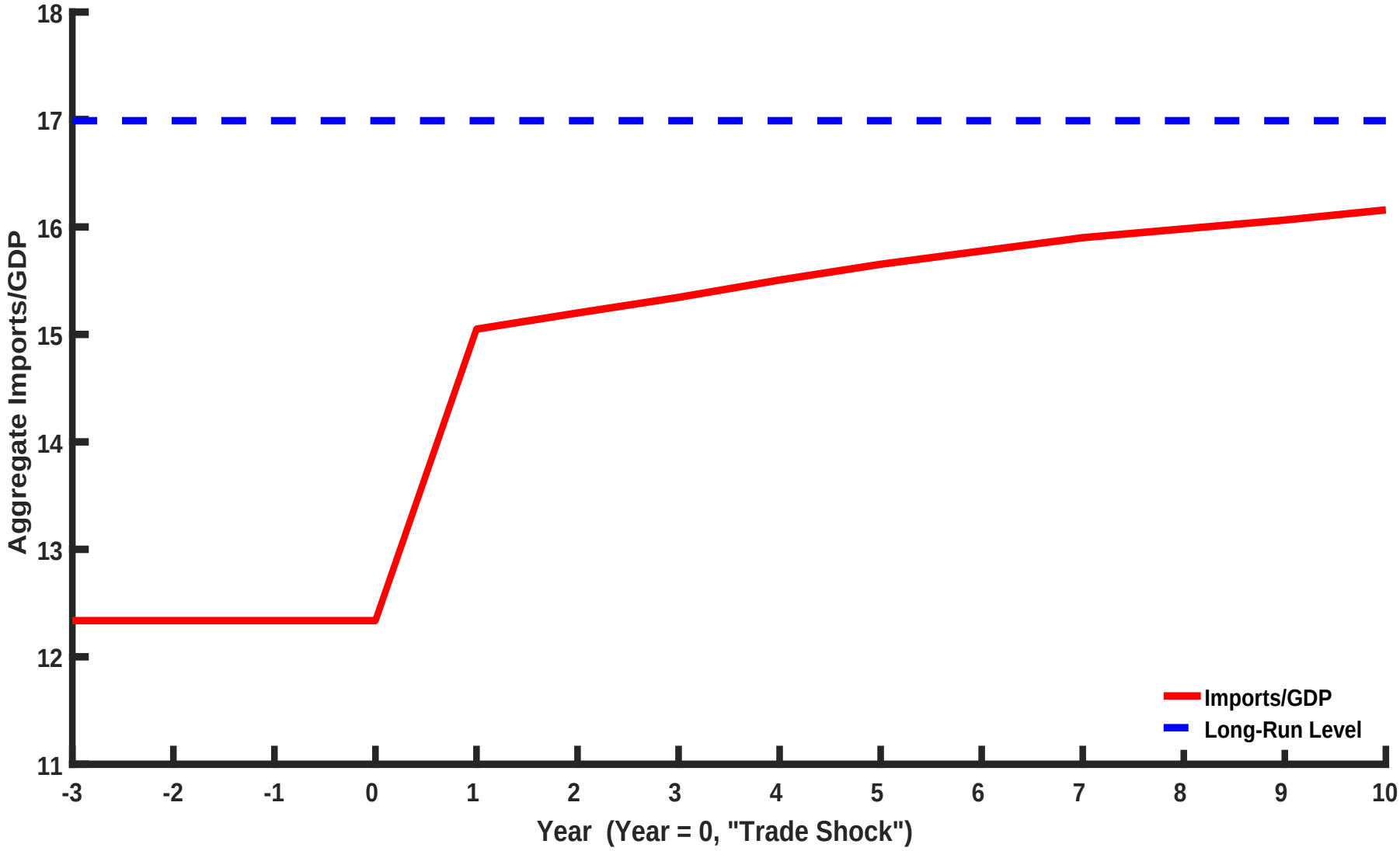
- How wages respond to trade shocks,
- How labor supply and migration respond to trade-induced wage changes,
- Debt response from Barrot, Loualiche, Plosser, and Sauvagnat (2016),
- Consumption response (we are currently working on this).

Use the model to evaluate the welfare consequences rising import exposure.

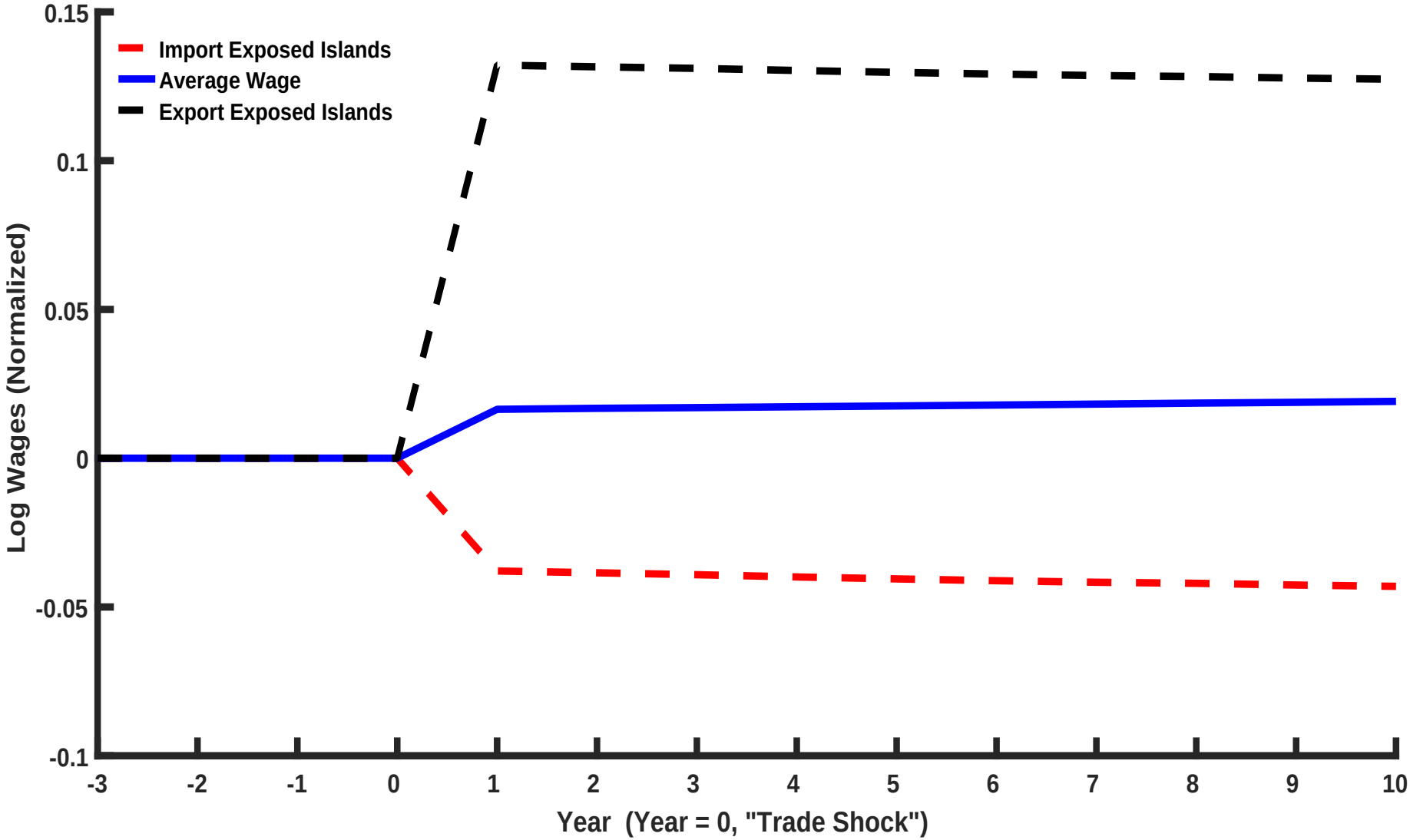
Today: not as ambitious (sorry)...

- Pick some parameter values,
- Compute the transition path associated with a reduction in τ, look at some pictures/outcomes.

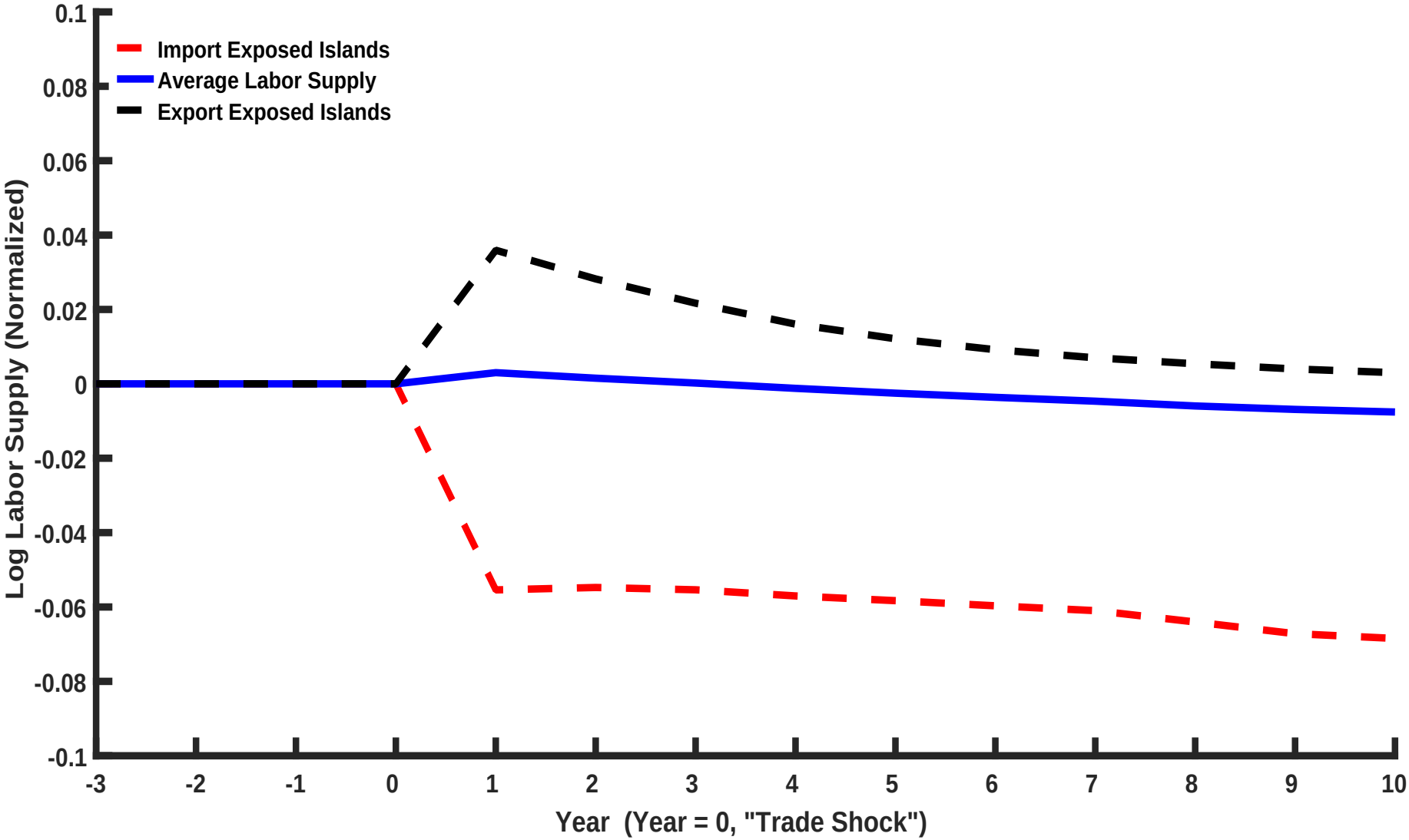
The Trade Shock...



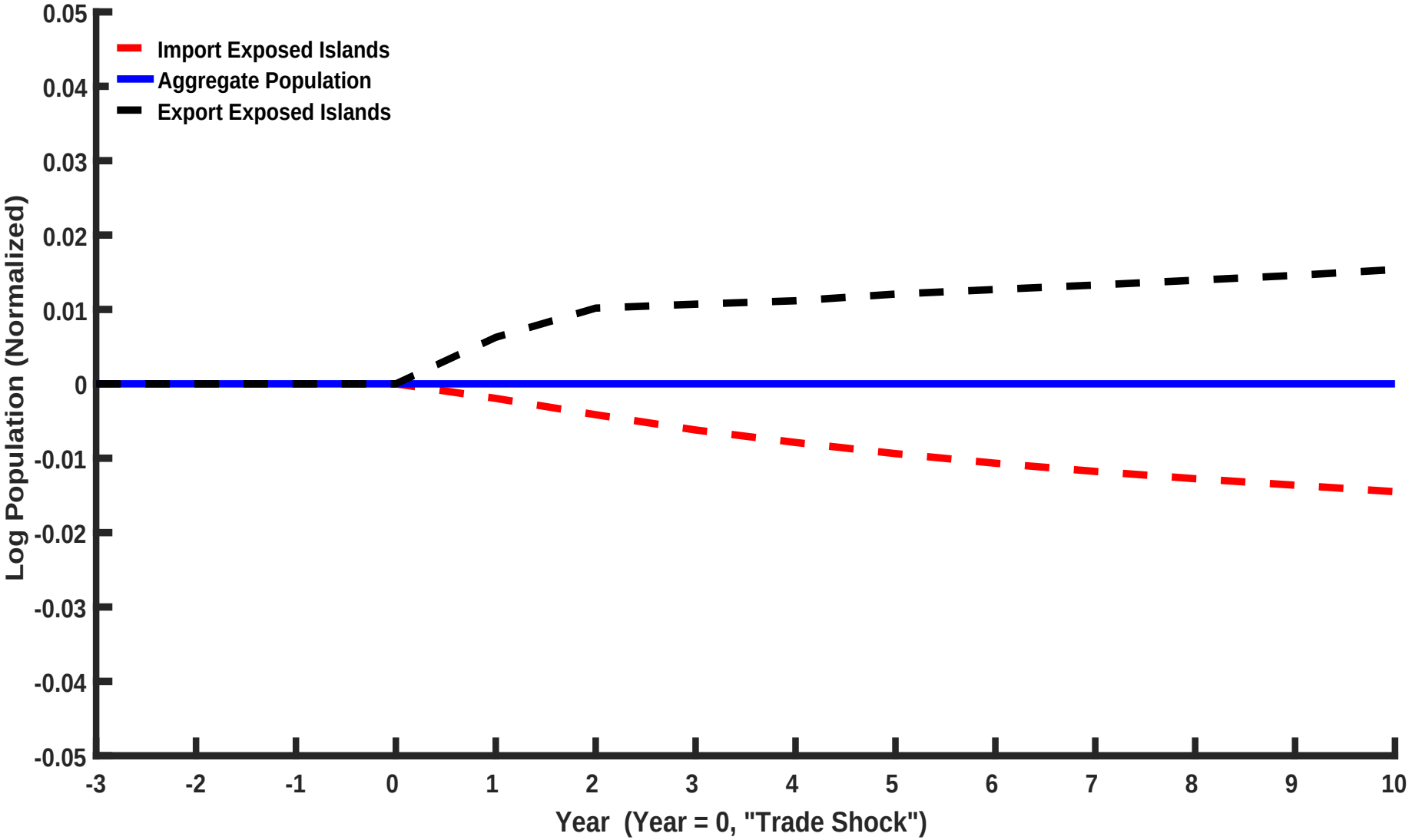
Wages


Import Exposed Islands
Average Wage
Export Exposed Islands
0.15
0.1
0.05
0
-0.05
-0.1
Log Wages (Normalized)
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
Year (Year = 0, "Trade Shock")

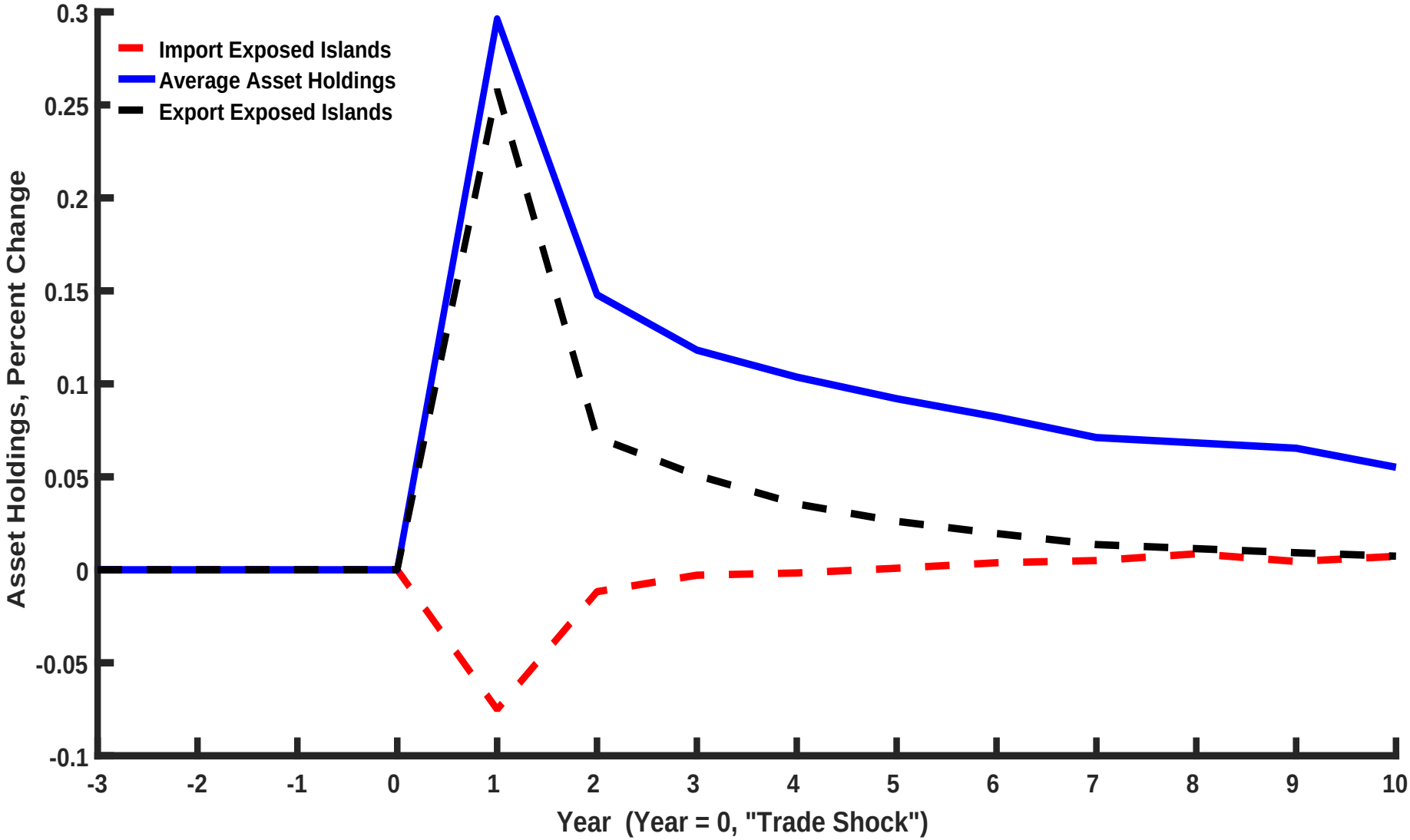
Labor Supply



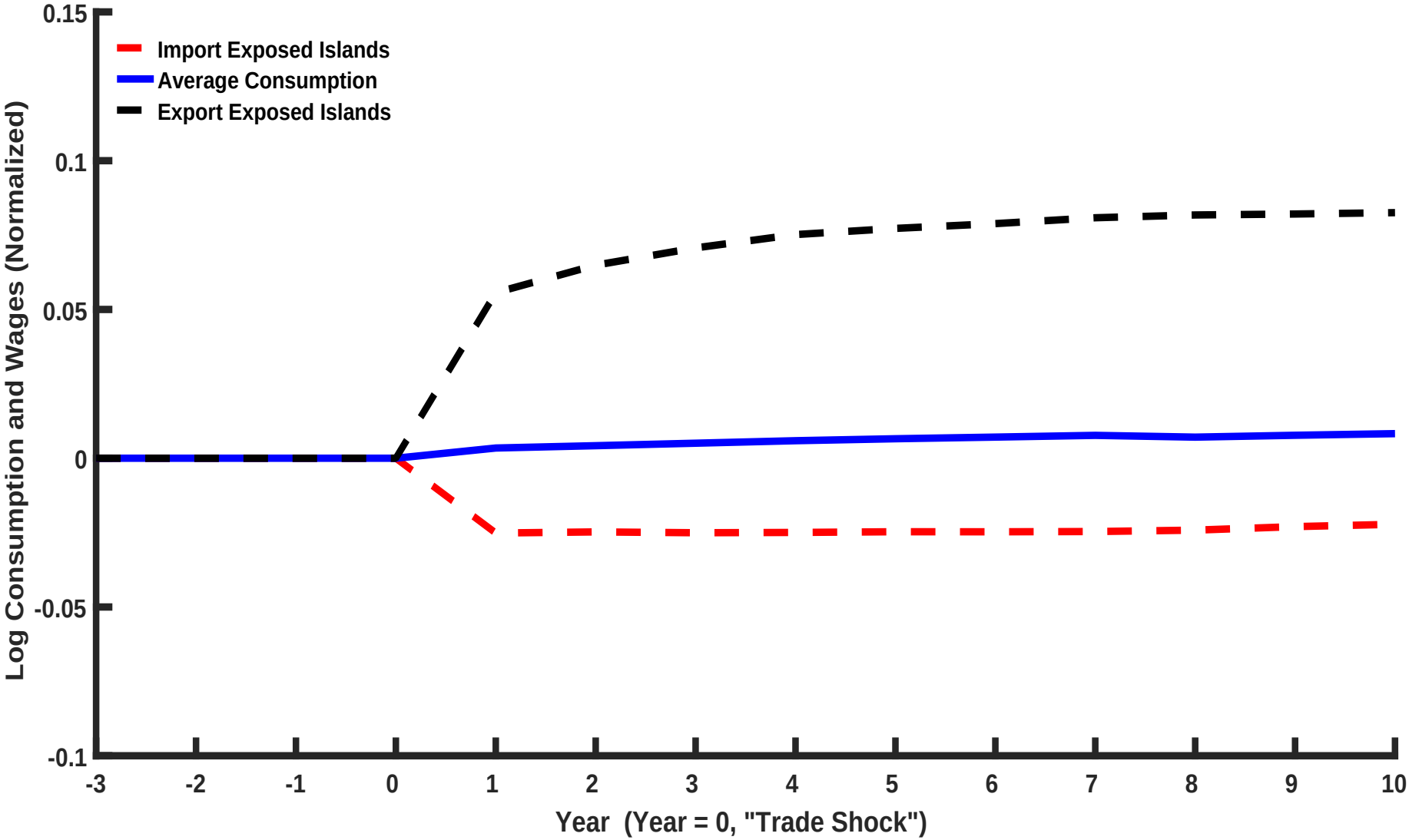
Island Population



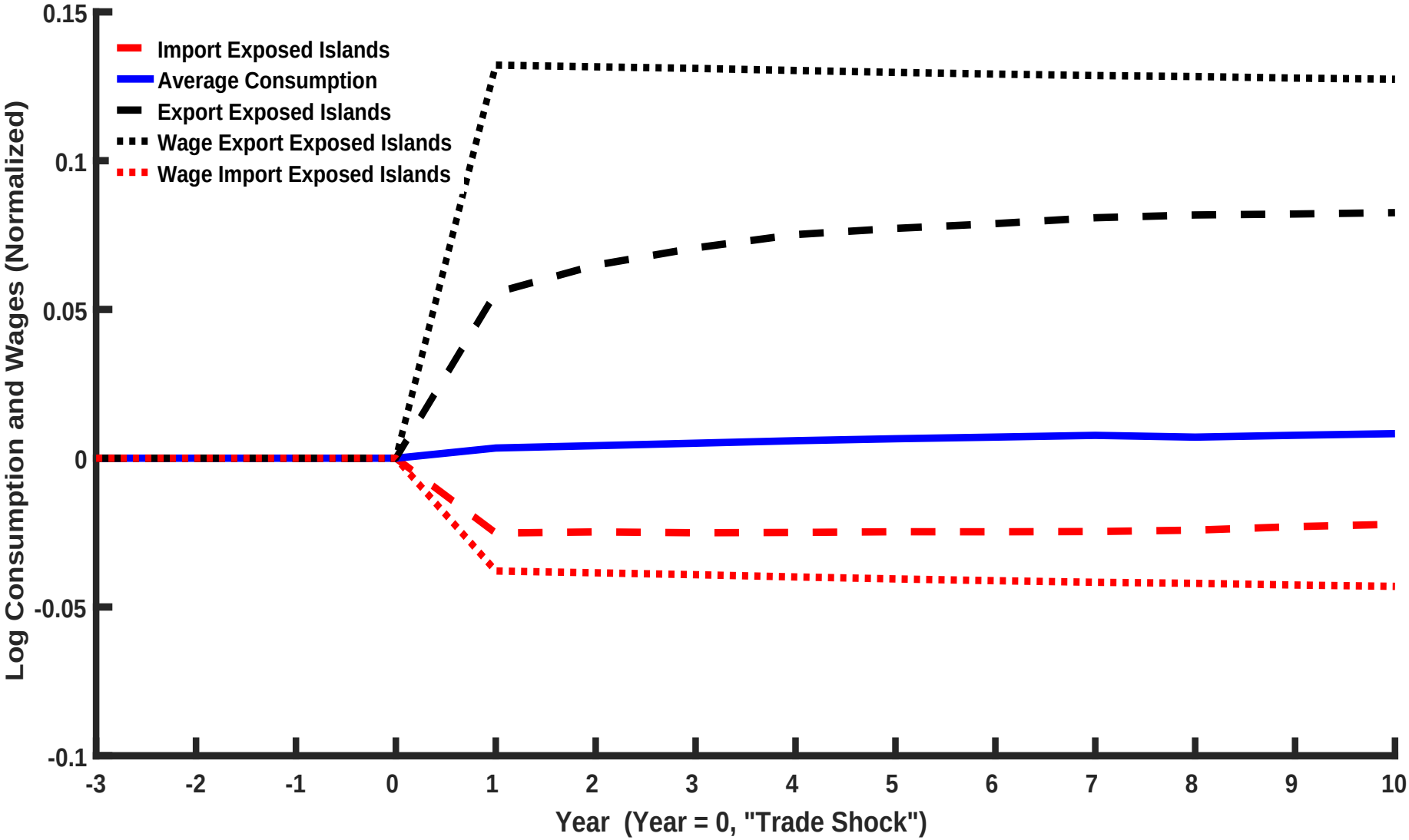
Asset Holdings



Consumption



Consumption and Wages



Welfare Evaluation...

		Welfare (Across SSs)	Welfare (Including Transition)
Initial Exposure	Average	1.23	0.55
	Import Exposed	0.15	-0.02
	Non-Traded	0.88	0.28
	Export Exposed	3.76	2.11

Final Thoughts: Still Baking...

Lots more to do!

References

Artuç, E., S. Chaudhuri, and J. McLaren (2010): "Trade shocks and labor adjustment: A structural empirical approach," *The American Economic Review*, 100(3), 1008–1045.

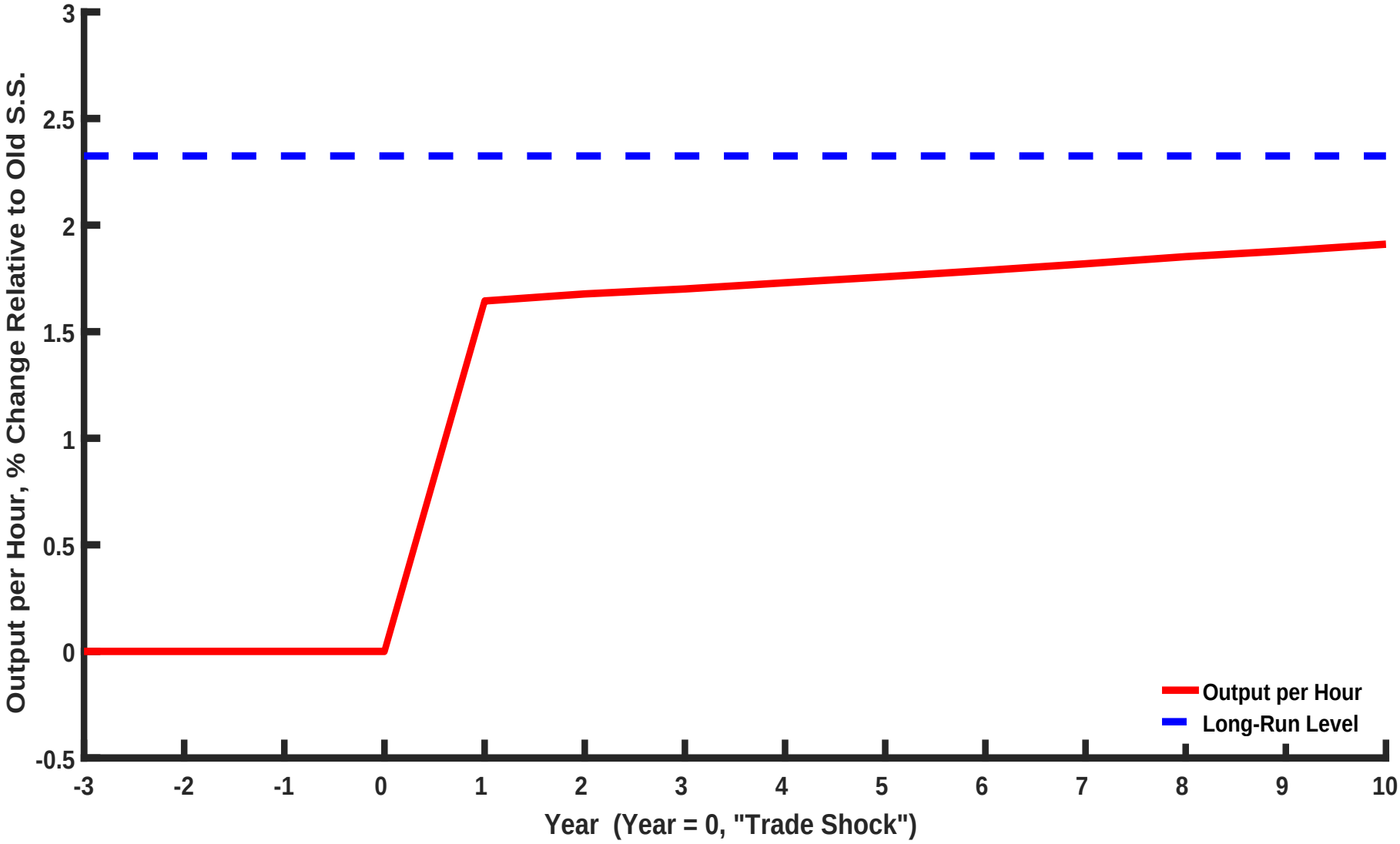
Autor, D., D. Dorn, and G. H. Hanson (2013): "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *The American Economic Review*, 103(6), 2121–2168.

Barrot, J.-N., E. Loualiche, M. C. Plosser, and J. Sauvagnat (2016): "Import Competition and Household Debt," .

Caliendo, L., M. A. Dvorkin, and F. Parro (2015): "Trade and labor market dynamics," .

Kambourov, G. (2009): "Labour Market Regulations and the Sectoral Reallocation of Workers: The Case of Trade Reforms," *Review of Economic Studies*, 76(4), 1321–1358.

Output Per Hour



Connection with National Accounts. . . Income Side

The value functions for different options

$$V^{s,w}(a,\ \mathbf{s}) = \max_{a' \geq -\bar{a}} \left[u(Ra + w(\mathbf{s})\bar{h} - a') - \bar{h}B + \beta EV(a', \mathbf{s'}) \right],$$

$$V^{s,nw}(a,\ \mathbf{s}) = \max_{a' \geq -\bar{a}} \left[u(Ra + w_n - a') + \beta EV(a', \mathbf{s'}) \right]$$

$$V^{m,w}(a,\ \mathbf{s}) = \max_{a' \geq -\bar{a}} \left[u(Ra + w(\mathbf{s})\bar{h} - a' - m) - \bar{h}B + \beta V^m(a') \right]$$

$$V^{m,nw}(a,\ \mathbf{s}) = \max_{a' \geq -\bar{a}} \left[u(Ra + w_n - a' - m) + \beta EV^m(a') \right]$$

Putting everything together. . .

$$V(a,\ \mathbf{s}) = \max \left[V^{s,w},\ V^{s,nw},\ V^{m,w},\ V^{m,nw} \right].$$

Connection with National Accounts. . . Income Side

Aggregate income must equal all payments to labor. . .

$$P_h Y_h = \int_{\mathbf{s}} P_h w_h(\mathbf{s}) \mu_h(\mathbf{s}) \tag{1}$$

Combining (1) and aggregating over households budget constraints connects aggregate income with consumption

$$P_h Y_h = P_h C_h - P_h R \mathcal{A} + P_h \mathcal{A}' - P_h \int_a \int_z w_n (1 - \iota_n(\mathbf{s}, a)) \lambda_h(\mathbf{s}, a) + P_h \int_a \int_z m \iota_m(\mathbf{s}, a) \lambda_h(\mathbf{s}, a).$$

In words income equals consumption minus (i) returns on assets (ii) new purchases of assets (iii) home production and (iv) plus moving costs.

Connection with National Accounts. . . Production Side

Aggregate production equals the value of all island level output. . .

$$P_h Y = \int_{\mathbf{s}} p_h(\mathbf{s}) z \mu_h(\mathbf{s})$$

which then working with the island level market clearing conditions gives

$$P_h Y = P_h C_h + \int_z \text{exports}(\mathbf{s}) - \int_z \text{imports}(\mathbf{s}).$$

Savings, Trade Imbalances, and Capital Flows.

Then combining the previous results allows us to connect savings with trade imbalances...

$$
\begin{aligned}
P_h Y - P_h C_h &= \int_z \text{exports}(\mathbf{s}) - \int_z \text{imports}(\mathbf{s}), \\
&= -P_h r \mathcal{A} + P_h(\mathcal{A}' - \mathcal{A}) && \text{net change in asset holdings} \\
&\quad - P_h \int_a \int_z w_n(1 - \iota_n(\mathbf{s}, a))\lambda_h(\mathbf{s}, a) && \text{-home production} \\
&\quad + P_h \int_a \int_z m\iota_m(\mathbf{s}, a)\lambda_h(\mathbf{s}, a), && + \text{ moving costs}
\end{aligned}
$$

Special case with no moving, home production, and in stationary equilibrium:

$$
P_h Y - P_h C_h = \int_z \text{exports}(\mathbf{s}) - \int_z \text{imports}(\mathbf{s}) = -P_h r \mathcal{A}
$$