International Trade of Essential Goods During a Pandemic

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International Trade of Essential Medical Goods

Some goods have proved critical to address ongoing COVID-19 pandemic:

- **Personal protective equipment (PPE):** Gloves, medical masks, face shields, ...
- **Medical equipment:** Respirators
- **COVID-19 tests**

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Key role of trade for countries to consume these goods in normal times

- Production of these goods is highly concentrated in a few locations
  - Only 20% of countries are net exporters of these goods
- Some countries are highly dependent on imports
  - e.g., US: $\approx$ 36% of total absorption of these goods is imported

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$\Rightarrow$ **Increasing unease about relying so much on other countries for these goods**

$\Rightarrow$ **To what extent does trade of these goods affect impact of a pandemic?**

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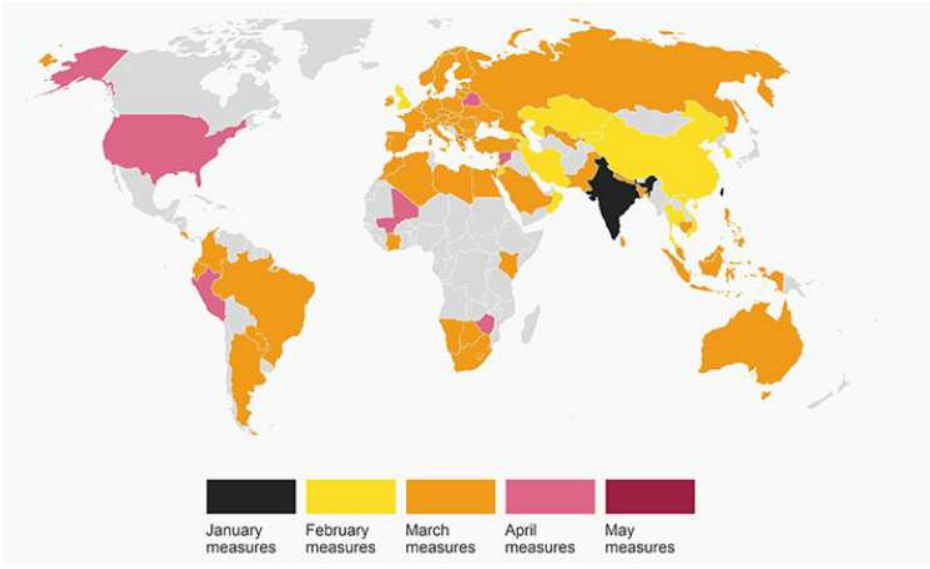
COVID-19:

- Global shock, all countries suddenly need more essential goods
- Adjusting production takes time, prices ration limited supply
- If trade breaks down (via prices or trade policy), countries that import these goods may face autarky with very limited access to them

$\Rightarrow$ **This paper: Investigate role of trade of essential goods during pandemic**

Sharp Trade Policy Changes During COVID-19

Data from Global Trade Alert + World Bank as of May 29:



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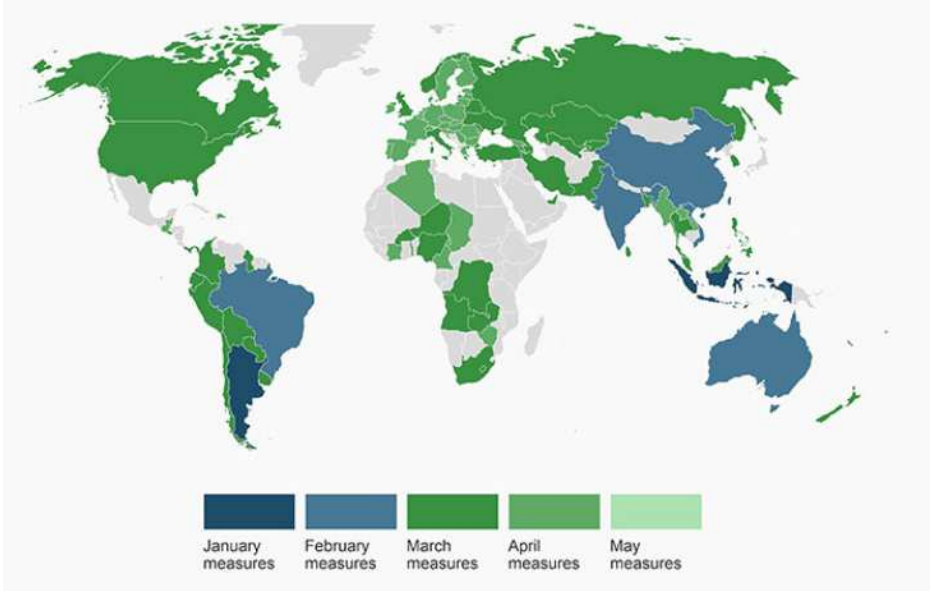

Lower import barriers

⇒ **Key role of international trade of essential medical goods during a pandemic**

This Paper

Question:

- What is the role of intl. trade of essential medical goods during a pandemic?

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To answer this question, we investigate:

1. What is the cross-country impact of a pandemic?
2. Do countries prefer to be hit with a pandemic in a world with low trade barriers?
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3. Do countries prefer to decrease trade barriers once the pandemic hits?

To do so:

- Quantitative dynamic trade model with **essential goods**
  - Preferences for essential goods are non-homothetic
  - Sectoral adjustment costs on capital and labor
  - Trade imbalances in essential goods
- Study impact of a pandemic across countries + international trade policy
- Contrast with evidence from COVID-19 + evidence for broader set of essential goods

This Paper: Preliminary Findings

Key finding: **Trade role depends critically on countries' sectoral trade imbalances**

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   - **Net exporters**: Better off in world with lower initial trade barriers
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$\Rightarrow$ **We show trade policy changes during COVID-19 consistent with these findings**

This Paper: Implications

Our paper has implications beyond COVID-19 and essential medical goods...

1. There is a broader range of essential goods subject to shocks

- Food and agriculture: Natural disasters, famine, pests, global warming
- Defense and steel: Threats to national security, wars

  ⇒ **We document that trade policy looks different for these goods**

  ⇒ **They are typically subject to higher trade barriers**

2. Quantitative analysis of trade policy under uncertainty

- Our work connects with theoretical studies from 70s and 80s
  (Feenstra 1977, Newbery and Stiglitz 1984, Eaton and Grossman 1985, Lapan 1988)
- We study trade policy in an environment with uncertainty and agg. fluctuations

3. Trade policy in dynamic models of international trade

(Ravikumar, Santacreu, Sposi 2019; Kohn, Leibovici, Tretvoll 2020)

Model

- Two countries: Home, foreign
  - Present model for home, foreign is symmetric except for parameters
  - Will be specific about differences in quantitative analysis
- Two sectors: Essential (e), non-essential (c)
- In each country:
  - Household
  - Producer of a **domestic variety** in each sector
  - Producer of **bundles of domestic and imported varieties** in each sector
  - Essential and non-essential bundles are used for consumption and investment
- International trade
  - Goods: Essential and non-essential varieties
  - No trade in financial assets

Household: Preferences

Preferences

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t - \gamma \exp\left(\frac{\overline{e}_t}{e_t} \right) \right]$$

where...

- c_t: non-essential goods
- e_t: essential goods
- $\overline{e}_t$: "reference level" of essential good consumption (exogenous)

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Idea

- Consumption of essential goods is high or low relative to some reference level
- e.g. Food consumption compared to physical needs
- e.g. Health services compared to medical needs

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Observation

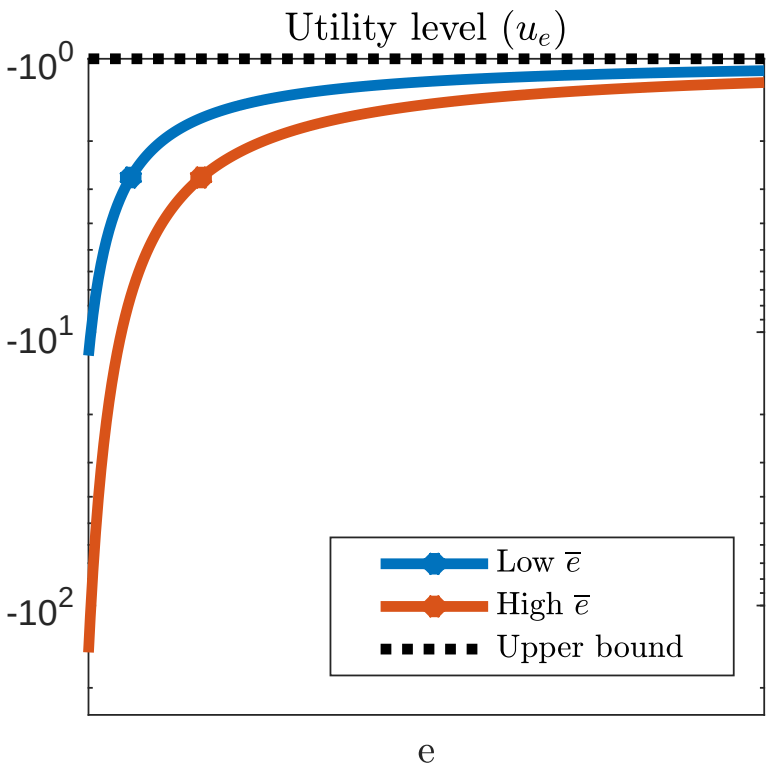
- Akin to Stone-Geary: $\ln c_t + \gamma \ln (e_t - \overline{e}_t)$
- Same idea and similar implications as our specification
- But key advantage of our specification: Avoids kink at $\overline{e}_t$
  (we have $e_t > 0$ vs. $e_t > \overline{e}_t$ in Stone-Geary)

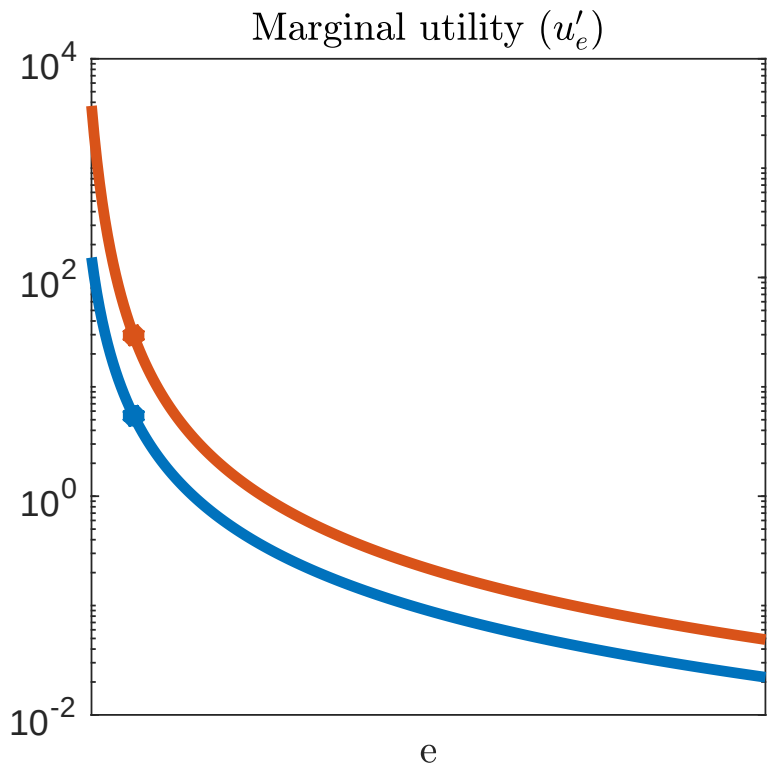
Household: Preferences (cont.)

Preferences

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t - \gamma \exp\left(\frac{\overline{e}_t}{e_t} \right) \right]$$

To illustrate...





Household: Income and Household's Problem

Income

- One unit of labor supplied inelastically at wage w_t
- Own producers of domestic essential and non-essential varieties, earn $\pi_{c,t}$ and $\pi_{e,t}$

Household's problem:

$$\max_{\{c_t, e_t\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t - \gamma \exp\left(\frac{\overline{e}_t}{e_t} \right) \right]$$

subject to

$$p_{c,t} c_t + p_{e,t} e_t = w_t + \pi_{c,t} + \pi_{e,t} \quad \forall t = 0, ..., \infty$$

Producers of Domestic Varieties in Sector $j \in \{c, e\}$

Technologies

1. Produce varieties: $Y_{j,t} = A_j \, N_{j,t}^{\alpha} \, K_{j,t}^{1-\alpha}$
2. Accumulate capital: $K_{j,t+1} = (1-\delta)K_{j,t} + I_{j,t}$

Sectoral adjustment costs

- Capital: $\phi_k(K_{j,t+1}, K_{j,t}) = \frac{\Omega_k}{2}\left(\frac{K_{j,t+1}}{K_{j,t}} - 1\right)^2$
- Labor: $\phi_n(N_{j,t}, N_{j,t-1}) = \frac{\Omega_n}{2}\left(\frac{N_{j,t}}{N_{j,t-1}} - 1\right)^2$
- Denominated in units of non-essential goods

Alternative assumptions on decision-making

1. Externality (baseline): Myopic firms, do not discount profits with household's SDF
2. No externality: Firms discount profits with household's SDF

   $\Rightarrow$ Producers of essential goods internalize importance of production in a pandemic?

   $\Rightarrow$ This talk: Myopic firms as the baseline

Producers of Domestic Varieties in Sector $j \in \{c, e\}$ (cont.)

Producers' problem:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} m_t \left[q_{j,t} Y_{j,t} - w_t N_{j,t} - p_{c,t} I_{j,t} - p_{c,t} \phi_k(K_{j,t+1}, K_{j,t}) - p_{c,t} \phi_n(N_{j,t}, N_{j,t-1}) \right]$$

subject to

$$K_{j,t+1} = (1 - \delta) K_{j,t} + I_{j,t} \quad \forall t = 0, ..., \infty$$

$$Y_{j,t} = A_j N_{j,t}^{\alpha} K_{j,t}^{1-\alpha} \qquad \forall t = 0, ..., \infty.$$

where...

- control variables: $\{N_{j,t}, I_{j,t}, K_{j,t+1}, Y_{j,t}\}_{t=0}^{\infty}$

and...

- $m_t = \beta^t$ in baseline, $m_t = \text{SDF}_t$ in model with no externality
- $q_{j,t}$: price of domestic variety j
- $p_{j,t}$: price of bundle of domestic and imported varieties from sector j

Producers of Composite Good $j \in \{c, e\}$

Technology

$$Q_{j,t} = \left[\omega_j Q_{j,h,t}^{\frac{\sigma-1}{\sigma}} + (1-\omega_j) Q_{j,f,t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

where...

- $Q_{j,h,t}$: Domestic variety
- $Q_{j,f,t}$: Imported variety
- $\omega_j \in (0,1)$: Weight across varieties

International trade

- Imported varieties subject to sector-specific iceberg trade cost τ_j

Uses of composite goods

- Non-essential goods: Consumption, investment, adj. costs
- Essential goods: Consumption

Competitive Equilibrium

Home country:

1. Given prices, allocations solve the household's problem
2. Given prices, allocations solve problem of domestic producers
3. Given prices, allocations solve problem of composite good producers
4. Labor market clears: $N_{c,t} + N_{e,t} = 1 \; \forall t$
5. Home essential goods market clearing: $Q_{e,h,t} + \tau_e^* Q_{e,h,t}^* = Y_{e,t} \; \forall t$
6. Home non-essential goods market clearing: $Q_{c,h,t} + \tau_c^* Q_{c,h,t}^* = Y_{c,t} \; \forall t$
7. Essential composite good market clearing: $e_t = Q_{e,t} \; \forall t$
8. Non-essential composite good market clearing:

$$c_t + \sum_{j \in \{c,e\}} \left[I_{j,t} + \frac{\Omega_k}{2} \left(\frac{K_{j,t+1}}{K_{j,t}} - 1 \right)^2 + \frac{\Omega_n}{2} \left(\frac{N_{j,t}}{N_{j,t-1}} - 1 \right)^2 \right] = Q_{c,t} \; \forall t$$

$\Rightarrow$ **Foreign country is symmetric except for some parameters**

A Pandemic in Our Model

We model a pandemic as...

- **An increase in $\overline{e}_t$** (the reference level of essential goods)

Goal is to capture:

- Increased need for essential medical goods (e.g., PPE, COVID-19 tests, etc.)
- Utility is lower if these increased needs are not satisfied (e.g., disease, death, etc.)

Does not capture other important features of a pandemic:

- Lockdown policies and their economic consequences
- Endogeneity between increased needs and the level of economic activity

$\Rightarrow$ **We take increased needs as exogenous, study role the of international trade**

What is the Impact of a Pandemic in Our Model?

1. **Sharp increase in the demand for essential medical goods**
   - Reallocation of demand from non-essential to essential goods

What is the Impact of a Pandemic in Our Model?

1. Sharp increase in the demand for essential medical goods

- Reallocation of demand from non-essential to essential goods

2. Hard to adjust production and consumption in short-run, prices increase sharply

$$\frac{p_e}{p_c} = \gamma \frac{c}{e} \times \underbrace{\frac{\overline{e}}{e} \exp\left(\frac{\overline{e}}{e}\right)}$$

Extra term relative
to log-log preferences

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3. **Net exporters of essential medical goods are better off, net importers worse off**

$$\text{Real Absorption}_t = \frac{\text{PPI}_t}{\text{CPI}_t} \times \text{Real Output}_t$$

$\Rightarrow$ corr$(p_e/p_c, \text{PPI}_t/\text{CPI}_t) > 0$ for net exporters

$\Rightarrow$ corr$(p_e/p_c, \text{PPI}_t/\text{CPI}_t) < 0$ for net importers

Quantitative Analysis

We quantitatively investigate:

1. What is the cross-country impact of a pandemic?
2. Do countries prefer to be hit with a pandemic in a world with low trade barriers?
3. Do countries prefer to decrease trade barriers once the pandemic hits?

To do so, parametrize model:

- One period = One month
- Two countries: Home is U.S., foreign is the rest of the world
- Both countries are identical except for the sectoral productivities
  - Home: $A_c > A_e$
  - Foreign: $A_e^* > A_c^*$
  - Symmetry and normalization: $A_c = A_e^*$, $A_e = A_c^* = 1$
- Estimate parameters to match pattern of production and trade in the U.S.

Parametrization

Predetermined parameters

Parameter	Value	Description
β	0.9967	Discount factor (4% annual interest rate)
σ	4	Elasticity of substitution
α	0.66	Labor share
δ	0.06	Capital depreciation rate
$\Omega_k = \Omega_n$	6	Adjustment costs
$\omega_e = \omega_c$	0.50	Weight on home goods

Estimated parameters

Parameter	Value	Description
$A_c = A_e^*$	1.10	Sectoral productivities
γ	7.80×10^{-5}	Utility weight on essential goods
τ_e	1.52	Trade costs on essential goods
τ_c	1.44	Trade costs on non-essential goods
$\overline{e}$	0.14	Reference level of essential goods

	Targeted		*Untargeted*
	Home country S.S.		Foreign country S.S.
Moment	Target value	Model	Model
NX_e / GDP_e	-0.25	-0.25	0.18
GDP_e / GDP	0.03	0.03	0.05
$M_e / p_e e$	0.36	0.36	0.17
$M_c / p_c c$	0.21	0.21	0.24
$e / \overline{e}$	0.20	0.20	0.20

Implementation + Reference Level + Pandemic Shock

Skipping some implementation details

- Essential goods $\equiv$ PPE and other medical goods
- Non-essential goods $\equiv$ All other goods

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Key calibration challenge: Pinning down $\overline{e}$, adj. costs, and shock

- This talk:
  1. $\overline{e}$ such that $e/\overline{e} = 0.20$
  2. Shock (AR1 with $\rho = 0.95$) $\Rightarrow$ Quantity dynamics following pandemic
  3. Adj. cost $\Rightarrow$ Price dynamics following pandemic

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- Reasonable reference level?

  $\Rightarrow$ Income elasticity of essential good imports similar to data during normal times

  $\Rightarrow$ Similar effects to standard parametrizations of Stone-Geary

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This talk: Pin down dynamics focusing on masks, Jan to Apr 2020

- **Quantities:** 59% increase in N95 masks by 3M in US (22m to 35m per month)
- **Prices:** 429% increase in price of masks imported from China

Dynamics Following a Pandemic

Q1: What is the cross-country impact of a pandemic?

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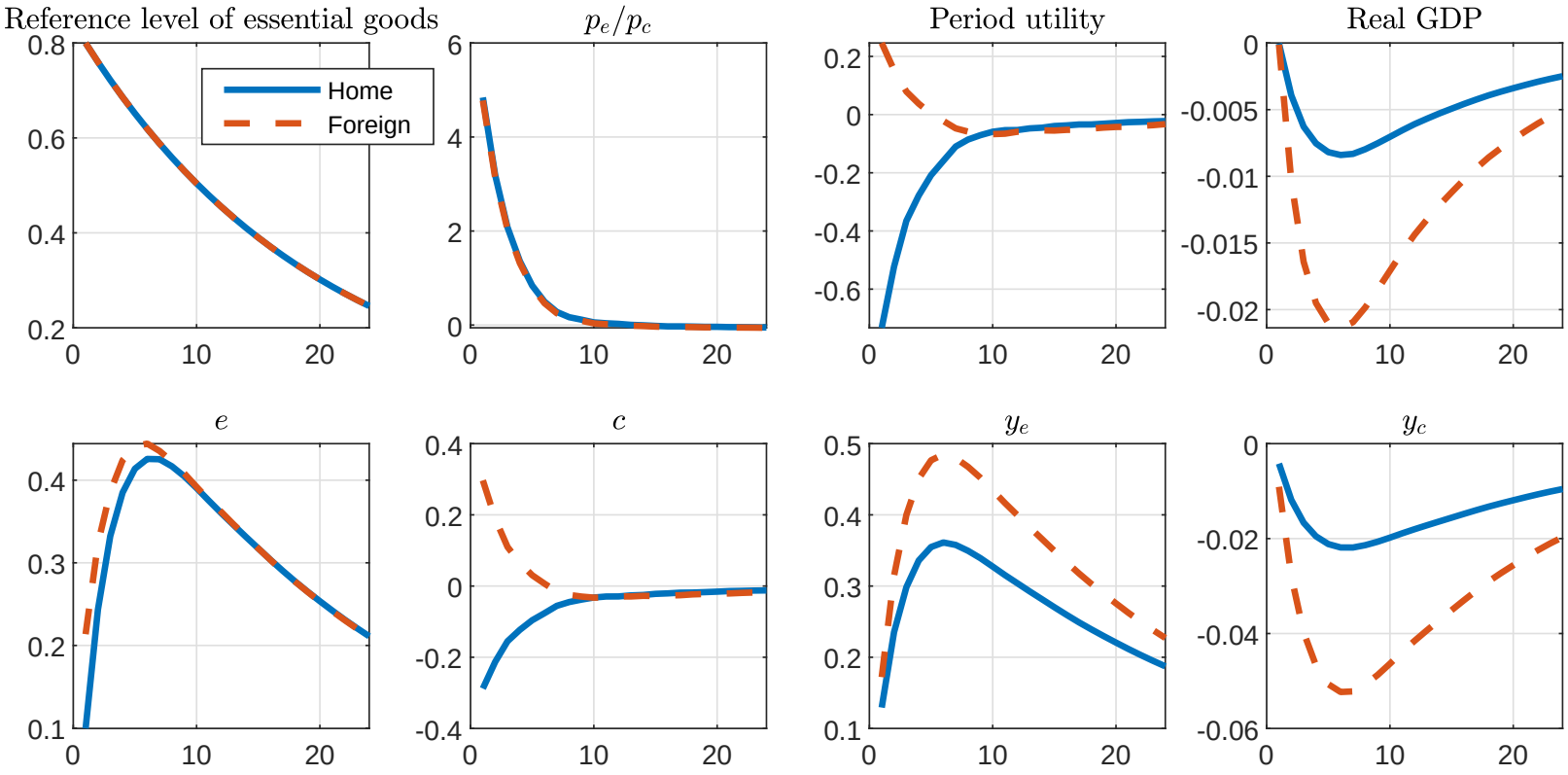

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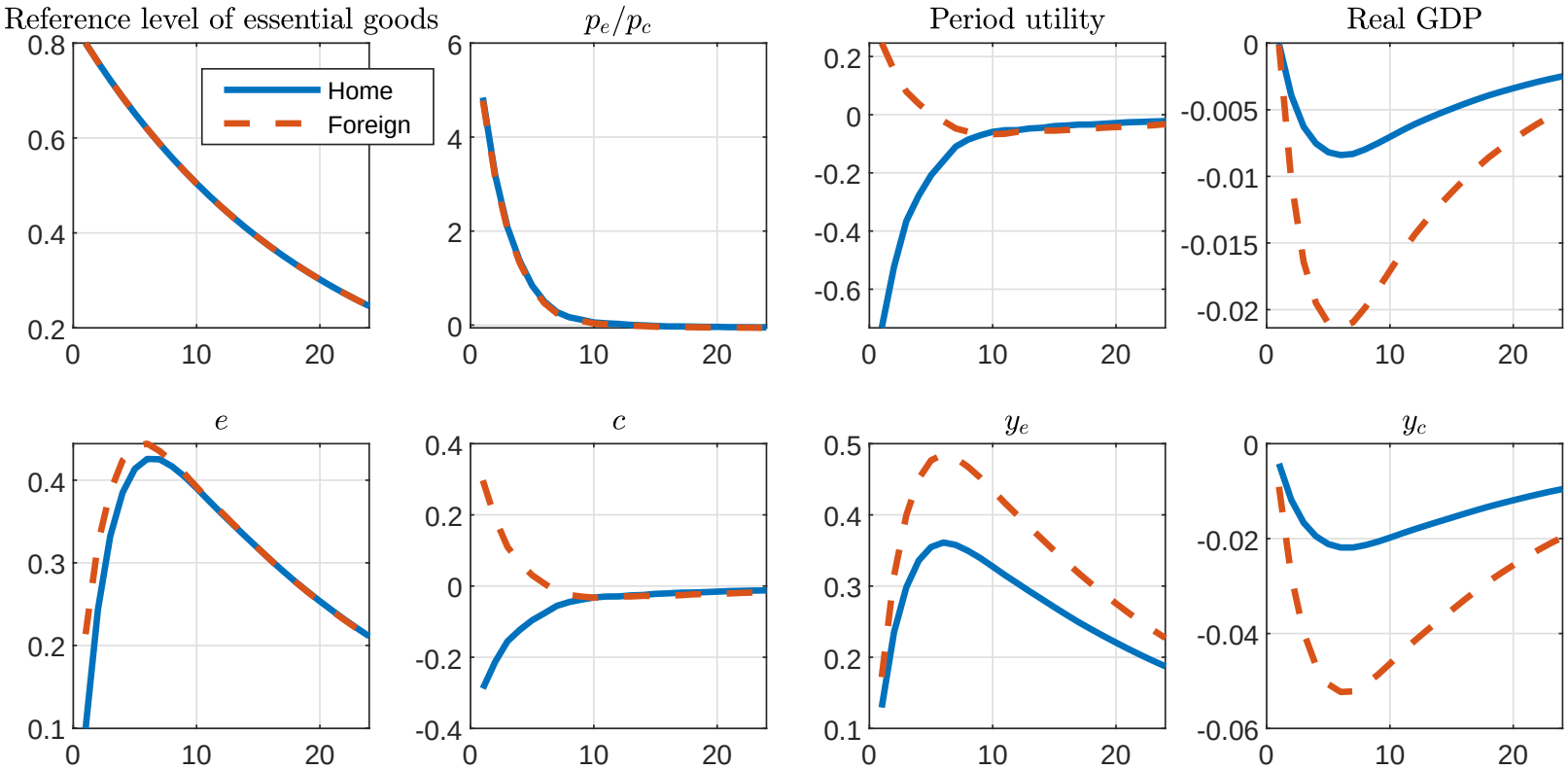

1/2 — Recall:

- Countries are identical except for sectoral productivities
  - $A_c > A_e \Rightarrow$ Home is a net importer of essential goods
  - $A_e^* > A_c^* \Rightarrow$ Foreign is a net exporter of essential goods

Dynamics Following a Pandemic

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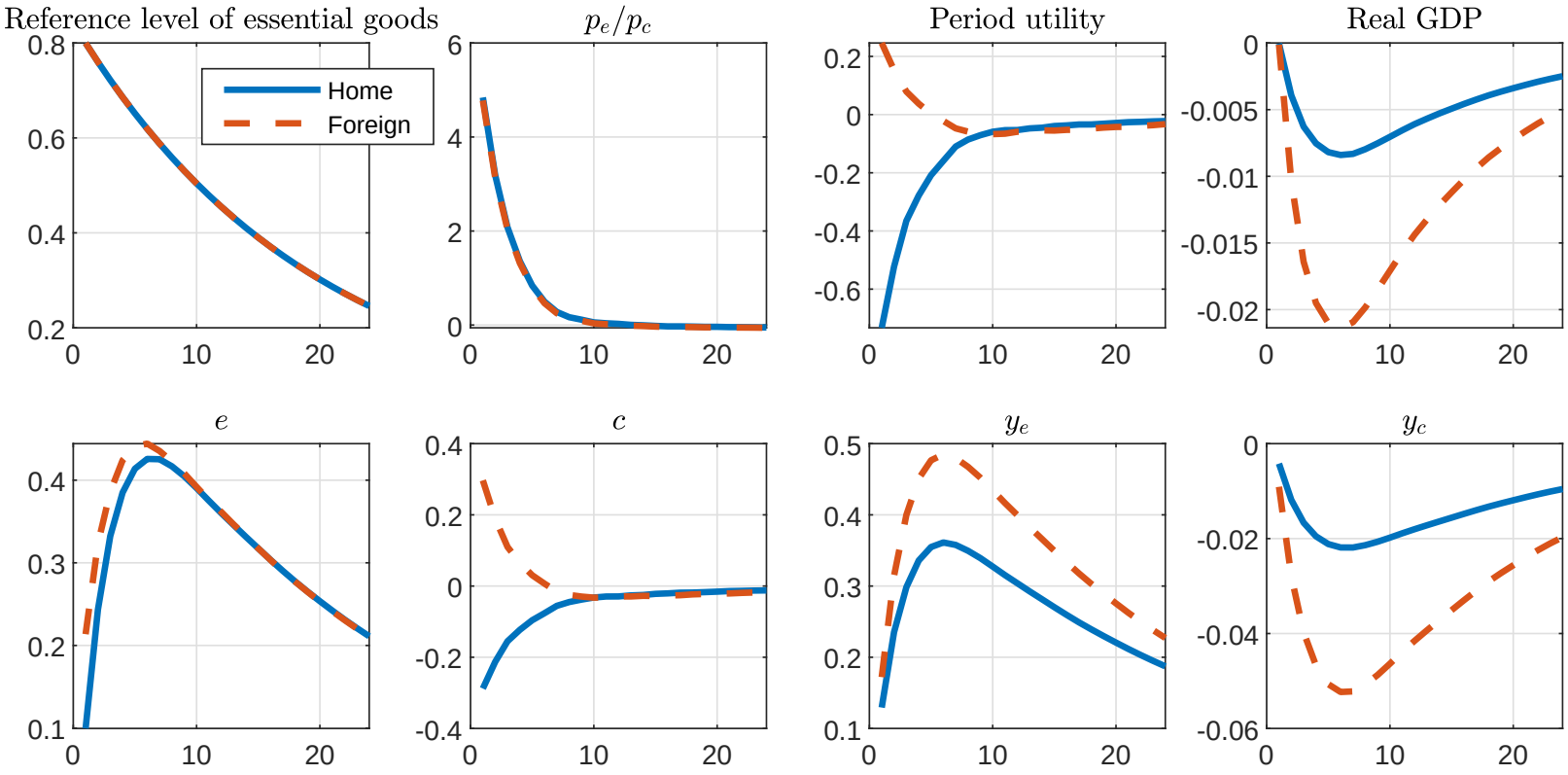


2/2 — We find:

- Limits to short-run adjustment ⇒ Higher prices ⇒ Hurt importers, benefit exporters
- Trade amplifies impact of pandemic for net importers, mitigates it for net exporters

Dynamics Following a Pandemic (cont.)

Which channels/ingredients are most important for our findings?

Dynamics Following a Pandemic (cont.)

Which channels/ingredients are most important for our findings?

In the paper, we show that:

1. **Sectoral adjustment costs: Important**
   - Control speed at which production of essential goods can be scaled up
   - Lower adjustment costs $\Rightarrow$ Importers less hurt, exporters less well off
2. **Non-hometetic preferences on essential goods: Important**
   - High curvature to get large price change and heterogeneous impact across countries
   - Same as Stone-Geary w/shock to subsistence, $\neq$ Cobb-Douglas with shock to weight
3. **Sectoral trade imbalances: Important**
   - Substantially smaller effects in world where sectoral trade flows are balanced
4. **Myopic firms: Important**
   - Net importers less worse off if firms assign more weight to profits during pandemic
   - Trade policy implications: Different incentives of planner vs. individual firms for producing essential goods despite being less productive than trade partners

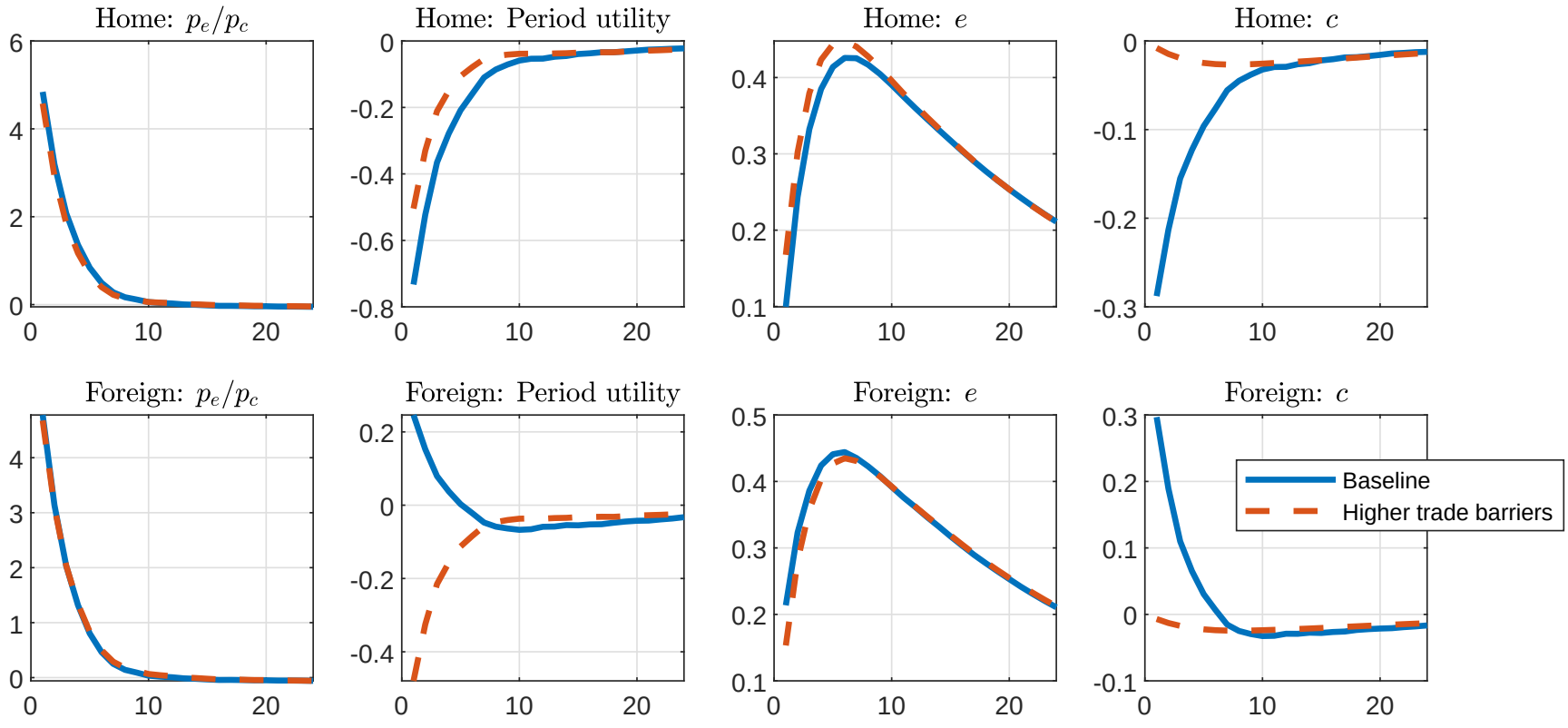
Trade Policy at the Onset of the Pandemic

Q2: Do countries prefer to be hit with pandemic in a world with low trade barriers? (or... should we protect essential sectors?)

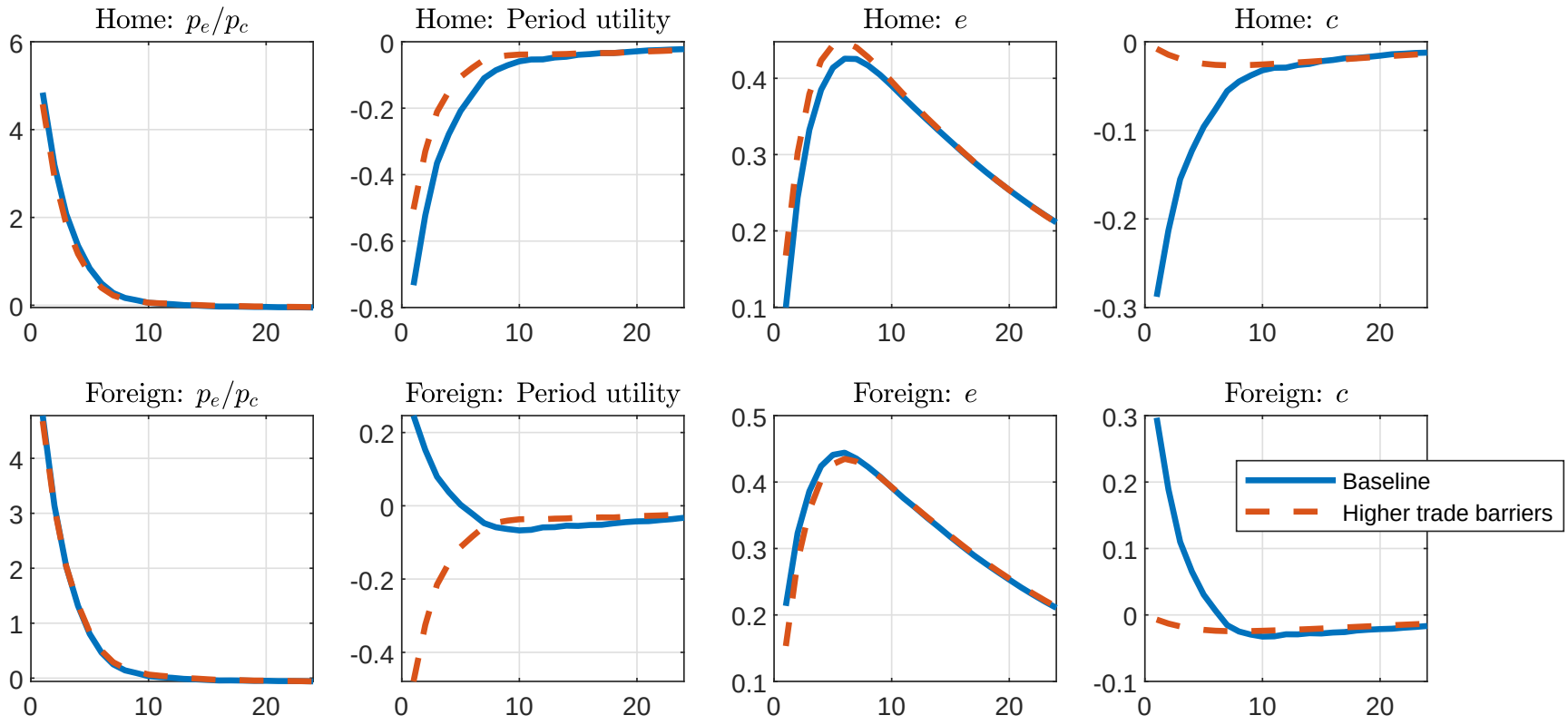
First pass at answering this question:

- Examine pandemic in a world with **high initial trade barriers on essential goods**
  - Global change in trade barriers, not unilateral
  - $\tau_e = 100$ instead of $\tau_e = 1.52 \Rightarrow \approx$ Autarky
- For each country, we now contrast world with high vs. low initial trade barriers
- Welfare analysis
  - This talk: Contrast welfare with high vs. low initial trade barriers
  - In progress: Optimal trade policy

Trade Policy at the Onset of the Pandemic (cont.)



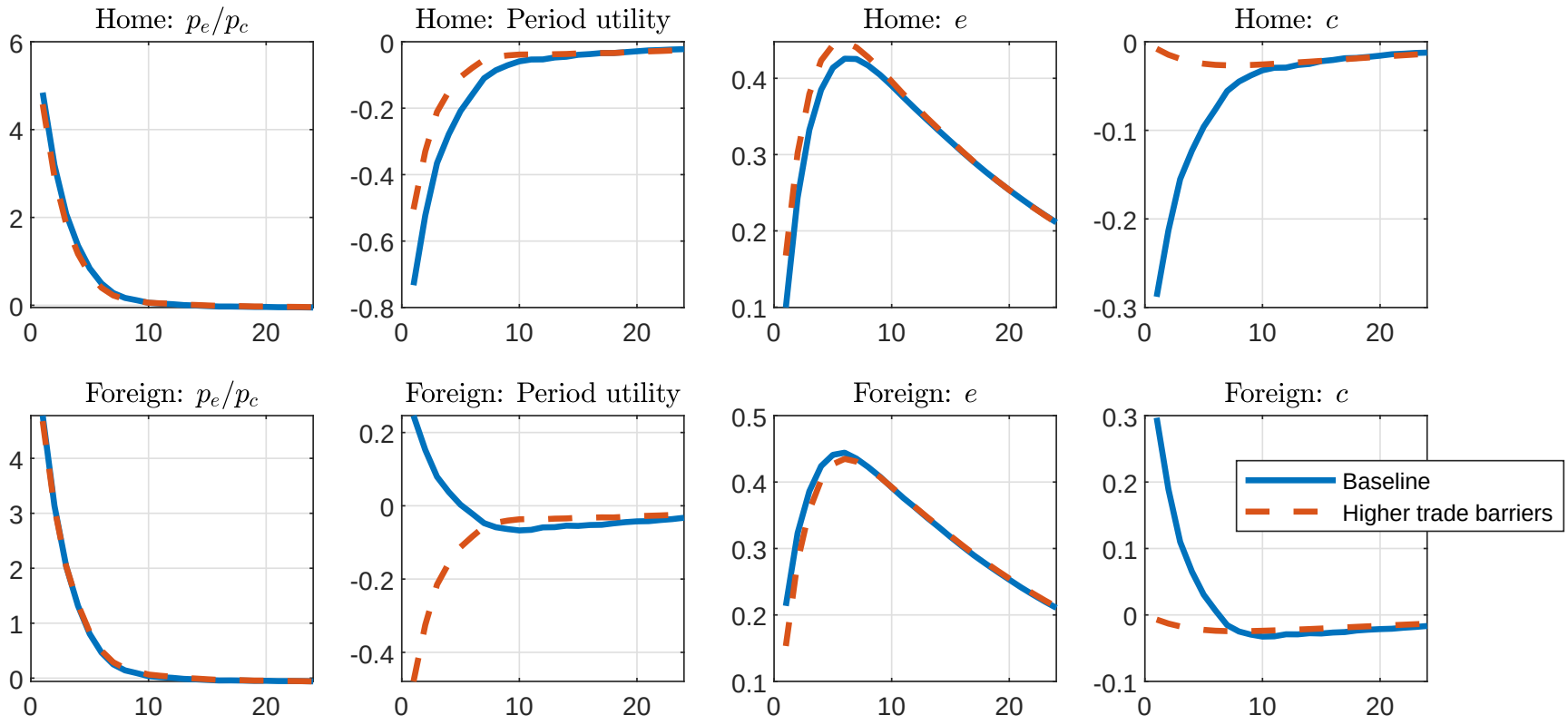
Trade Policy at the Onset of the Pandemic (cont.)



1/3 — Net importer of essential goods:

- **Better off with higher trade barriers at the onset of the pandemic**
- More domestic production, lower imbalances $\Rightarrow$ Smaller impact of higher p_e/p_c

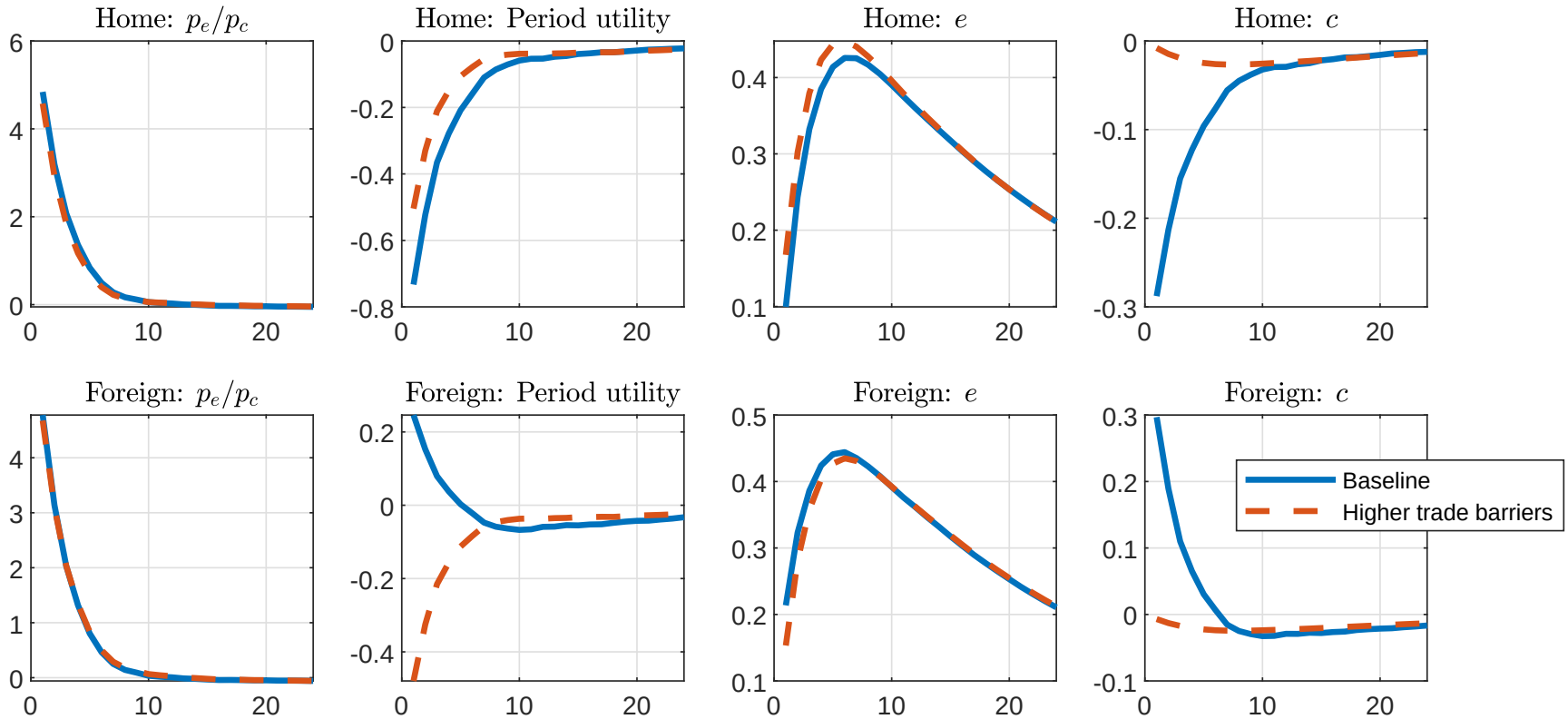
Trade Policy at the Onset of the Pandemic (cont.)



2/3 — Net exporter of essential goods:

- Worse off with lower trade barriers at the onset of the pandemic
- Lower net exports, lower benefits from price increase

Trade Policy at the Onset of the Pandemic (cont.)



3/3 — Thus:

- Protection might be beneficial to mitigate foreign dependence in a **global** pandemic
- i.e. Self-insurance as a way to deal with global shock
- Yet, trade openness preferred without shocks, or even for domestic/local shocks

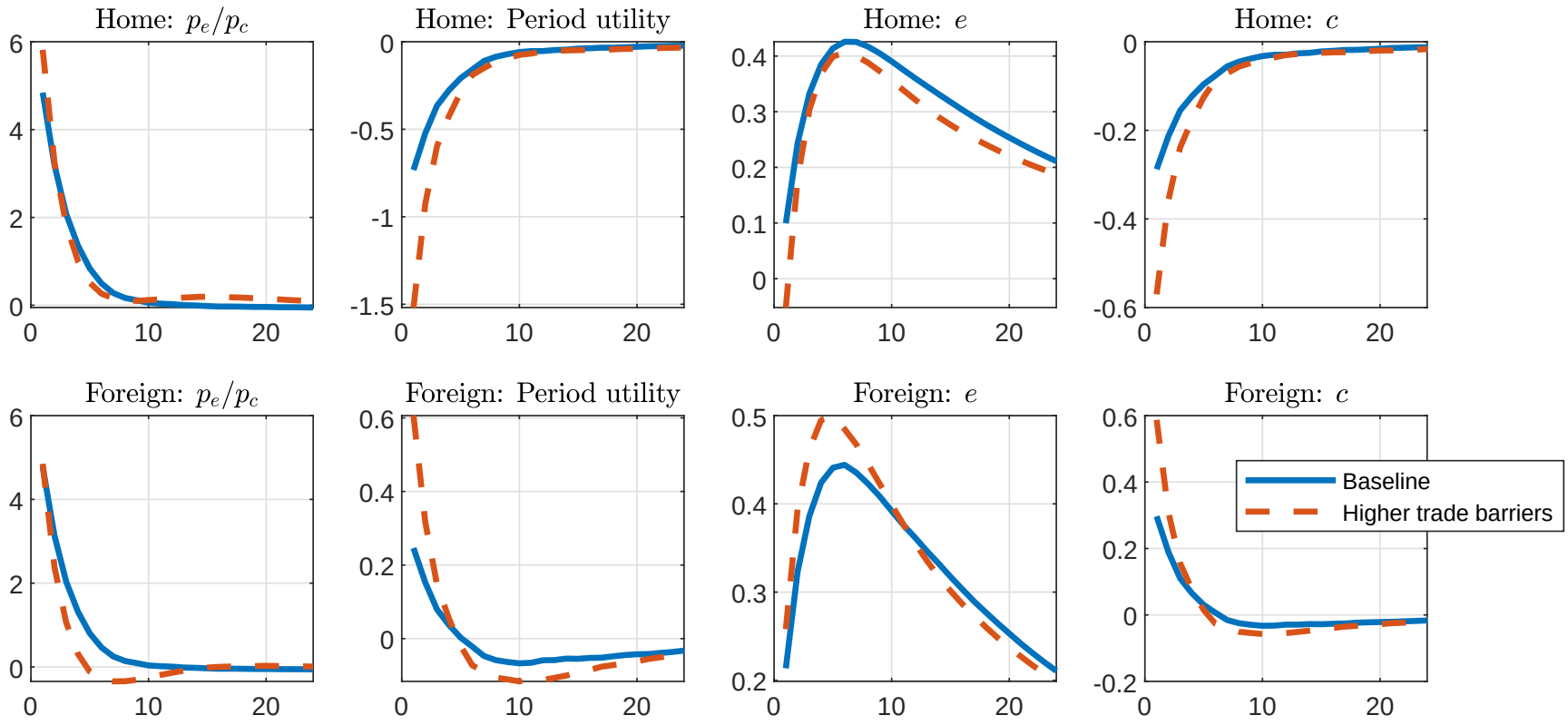
Trade Policy Changes During the Pandemic

Q3: Do countries prefer to decrease trade barriers once the pandemic hits?

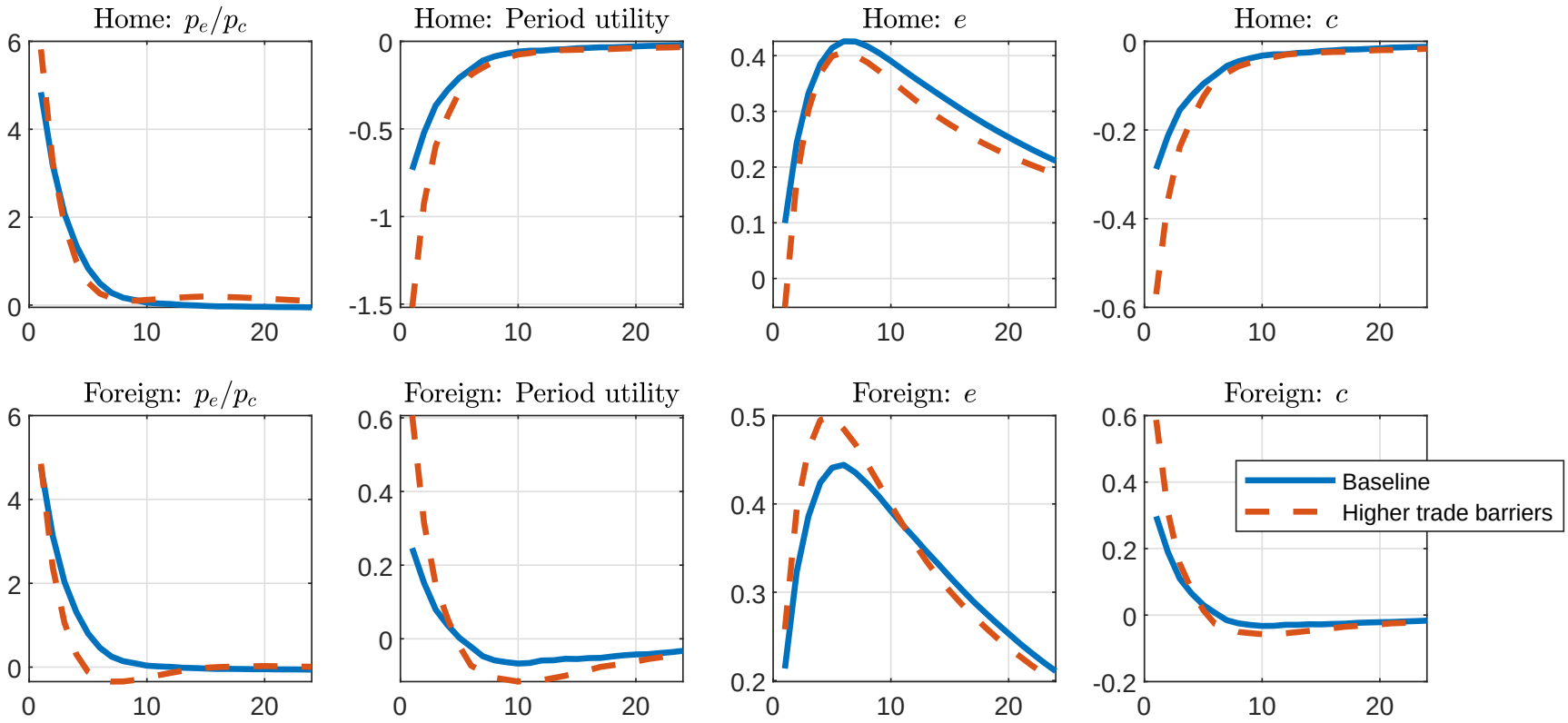
First pass at answering this question:

- Examine pandemic + increase of trade barriers during pandemic
  - τ_e increases by 172% (1 log point) on impact, AR(1) with $\rho = 0.95$
  - Global change in trade barriers, not unilateral
- For each country, contrast baseline vs. raising trade barriers during pandemic

Trade Policy Changes During the Pandemic (cont.)



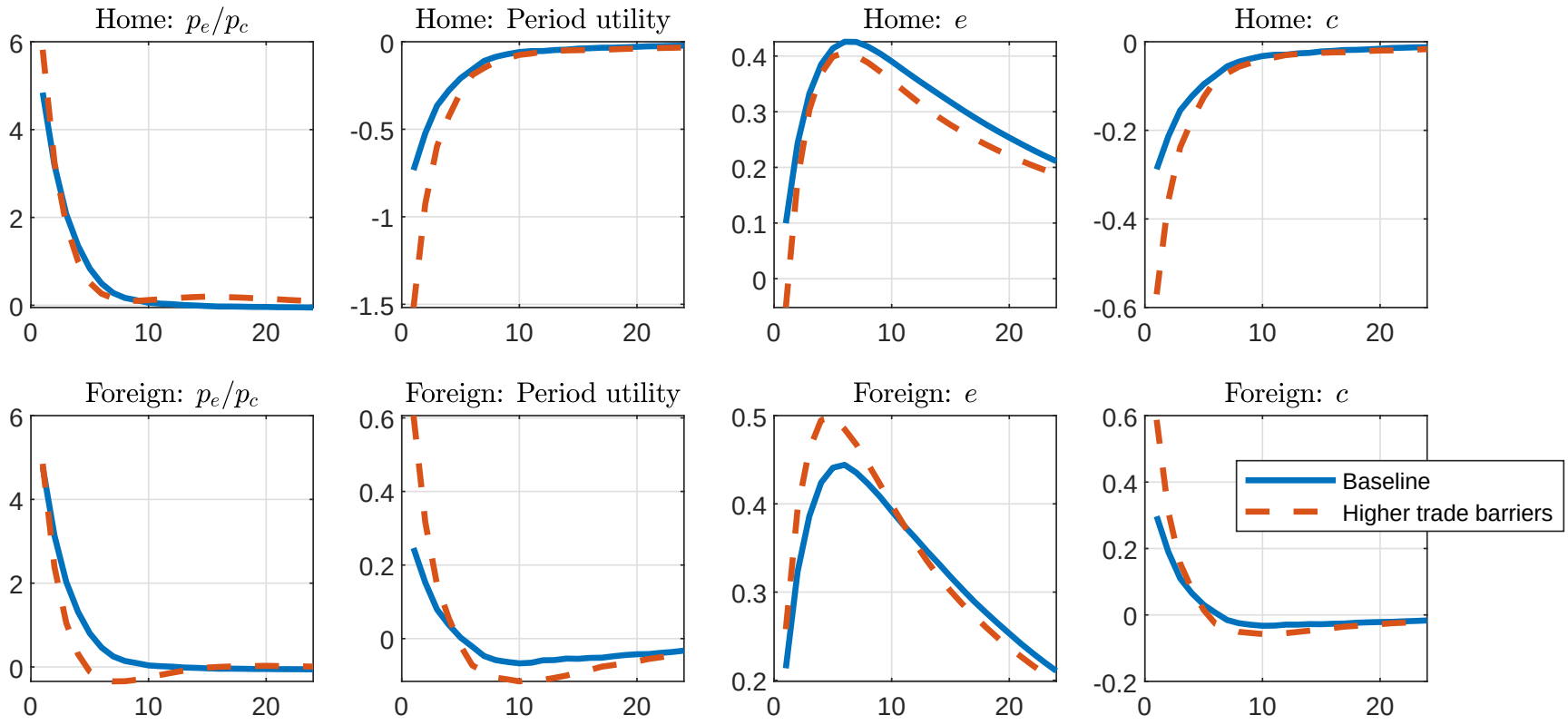
Trade Policy Changes During the Pandemic (cont.)



1/3 — Net importer of essential goods:

- **Worse off with increasing trade barriers**
- Even harder to purchase essential goods, prefers lower trade barriers and thus lower prices during pandemic!

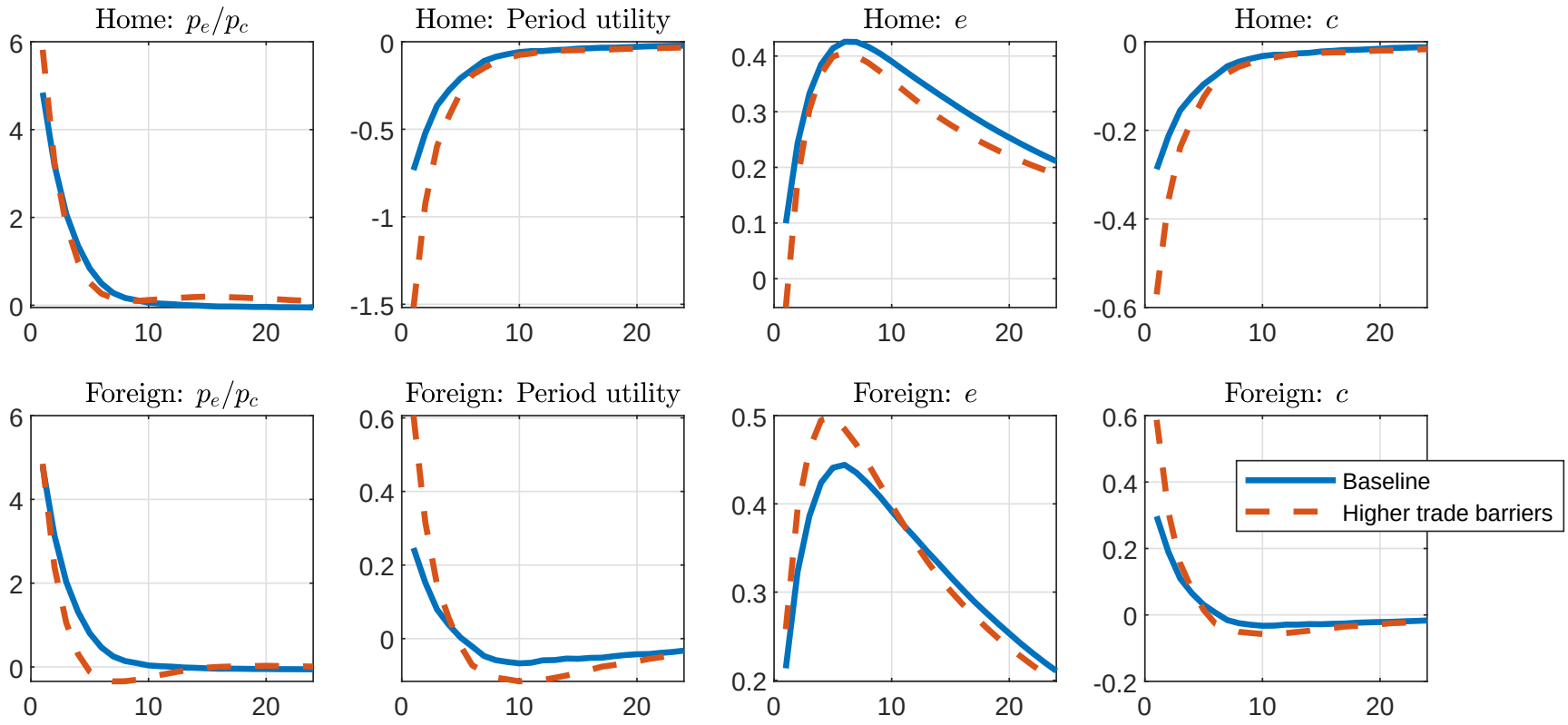
Trade Policy Changes During the Pandemic (cont.)



2/3 — Net exporter of essential goods:

- Better off with increasing trade barriers
- Higher utility due to reallocation of essential goods from exports to domestic sales

Trade Policy Changes During the Pandemic (cont.)



3/3 — Time inconsistency problem in trade policy?

- Net importers want high initial trade barriers, but low trade barriers ex-post
- Net exporters want low initial trade barriers, but high trade barriers ex-post

Pandemic and Trade Policy: Long-Run Welfare Implications

Welfare implications under alternative scenarios:

- Compute consumption-equivalent gains/losses starting from arrival of a pandemic
- Express gains/losses as a permanent change in consumption of non-essential goods

We find...

	Welfare gain/loss for...	
	Home country	Foreign country
Baseline	-1.05%	-0.27%
High initial trade barriers	-0.75%	-0.73%
Raise trade barriers when pandemic hits	-1.79%	-0.32%

Essential Goods and International Trade Policy: Evidence

Q4: Findings on trade policy in essential goods consistent with the data?

1. Trade barrier changes after COVID-19

Essential Goods and International Trade Policy: Evidence

Q4: Findings on trade policy in essential goods consistent with the data?

1. Trade barrier changes after COVID-19

- Are trade policy changes systematically related to trade imbalances pre-COVID-19?
- Focus on subset of medical goods essential to combat COVID-19
- Data on trade policy changes from Global Trade Alert up to mid-April 2020
  - Export curbs
  - Import liberalization
- Data on sectoral trade imbalances from COMTRADE for 2018

Essential Goods and International Trade Policy: Evidence

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1. Trade barrier changes after COVID-19

	Number of countries	Share of countries by row (%)	
		Import liberalization	Export curbs
Surplus	22	18.2	86.4
Deficit	87	28.7	46.0

Essential Goods and International Trade Policy: Evidence

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Consistent with the model...

$\Rightarrow$ Net exporters more likely to introduce export curbs than net importers

$\Rightarrow$ Net importers more likely to lower import barriers than net exporters

Essential Goods and International Trade Policy: Evidence

Q4: Findings on trade policy in essential goods consistent with the data?

2. Trade barriers on broader range of essential goods

Essential Goods and International Trade Policy: Evidence

Q4: Findings on trade policy in essential goods consistent with the data?

2. Trade barriers on broader range of essential goods

- Are essential goods subject to higher trade barriers than non-essential goods?
- Consider broader range of essential goods: Food/agriculture, defense, medical
- Data from UNCTAD:
  - Tariffs: Effectively applied tariffs, year 2018
  - Non-tariff barriers: Frequency index (share of goods), coverage ratio (share of trade), years 2012-2018

Essential Goods and International Trade Policy: Evidence

Q4: Findings on trade policy in essential goods consistent with the data?

2. Trade barriers on broader range of essential goods

	Avg. Tariffs (%)	Frequency index (%)	Coverage index (%)
Food	7.9	92.59	92.96
Defense	7.2	90.58	87.73
Medical	1.7	74.51	86.00
Non-essential	5.4	50.21	64.12

Essential Goods and International Trade Policy: Evidence

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$\Rightarrow$ Trade barriers on essential goods typically larger than on non-essential goods

$\Rightarrow$ One exception: Tariffs on medical imports. Lack of awareness of their importance pre-COVID-19?

Concluding Remarks

Q: What is the role of intl. trade of essential medical goods during a pandemic?

We find:

- Net trade position key for whether trade amplifies or mitigates pandemic
- Net importers better off with higher initial trade barriers, lower upon pandemic
- Net exporters better off with lower initial trade barriers, higher upon pandemic
- Trade policy implications consistent with data

Big picture:

- Optimal trade policy may differ between essential and non-essential goods
- Protectionism might be optimal as self-insurance against global shocks?
- Much broader reach than medical: e.g., food, defense, their inputs, etc.

Concluding Remarks

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Lots more work to do:

- Tighten calibration: Reference level, adjustment costs, shock
- Additional channels: Financial markets, stockpiling/inventories
- Additional results: Unilateral vs. global trade policy, optimal trade policy