International Trade and Macroeconomic Dynamics with Sanctions

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Introduction

24 February 2022: Russian invasion of Ukraine

- Sanctions by 38 governments (Mulder, 2022)
- Russia 11th largest economy
  - Not since the 1930s has a similar economy been placed under such restrictions
- In contrast to sanctioned economies in the 1930s,
  - Russia major exporter of oil and gas
  - Global economy is far more integrated (*e.g.*, trade-to-GDP ratio)

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This paper: Understanding international interdependence and transmission mechanisms of sanctions in a microfounded model of international trade and macro dynamics

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- What is the exchange rate response?
  - Responses of relative prices

What We Do (1)

Developing a two-region model of international trade and macroeconomic dynamics

- Upstream perfectly competitive gas production

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- Downstream consumption good production
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A dynamic, general equilibrium setting with Melitz (2003) as the microfoundation

- Ghironi and Melitz (2005)

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Tractable relationships and numerical illustrations on the impact of sanctions

3-country extension

New Insights

Reallocation of resources in the sanctioned economy

- Final good export & gas sanctions:
  - Towards final goods production
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Significant welfare losses in the sanctioned economy if

- sanctions on less efficient sectors, and
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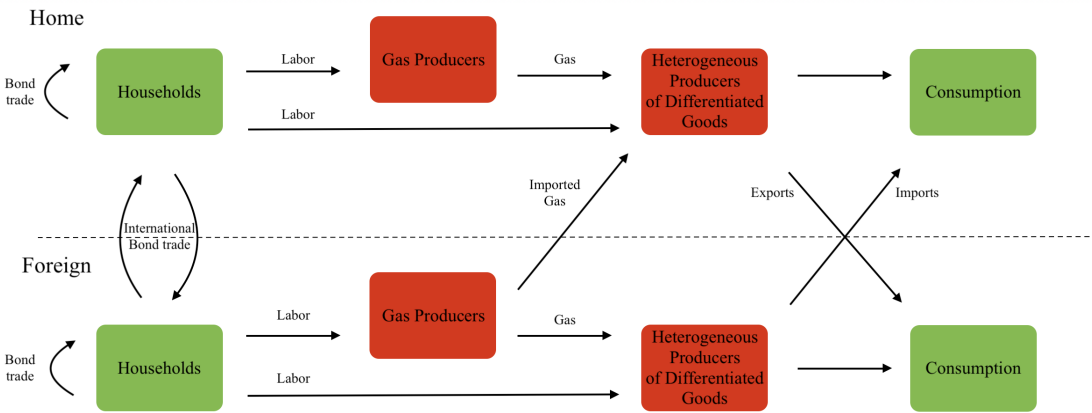
Related Literature

THE MODEL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Households
Labor
Gas Producers
Gas
Heterogeneous Producers of Differentiated Goods
Consumption
Labor
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Exports
Imports
International Bond trade
Foreign
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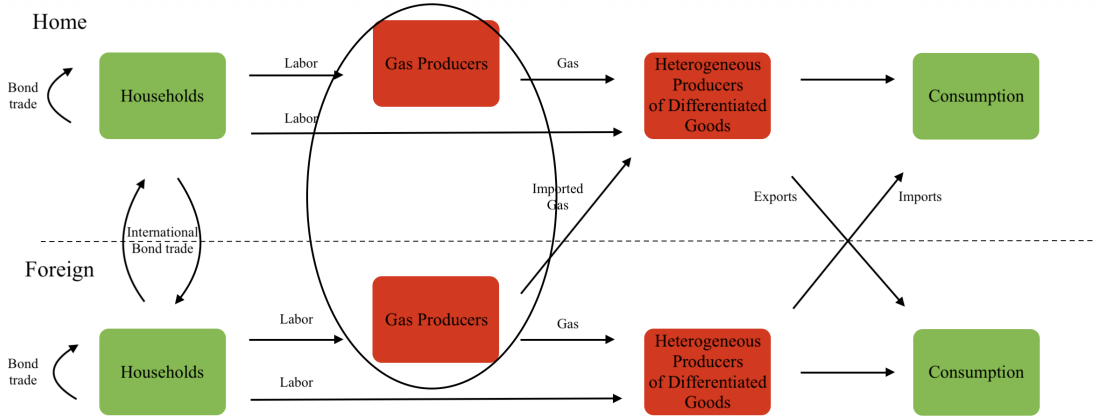

- Home and Foreign are endowed with natural gas G_N and G_N^* where $G_N^* > G_N$

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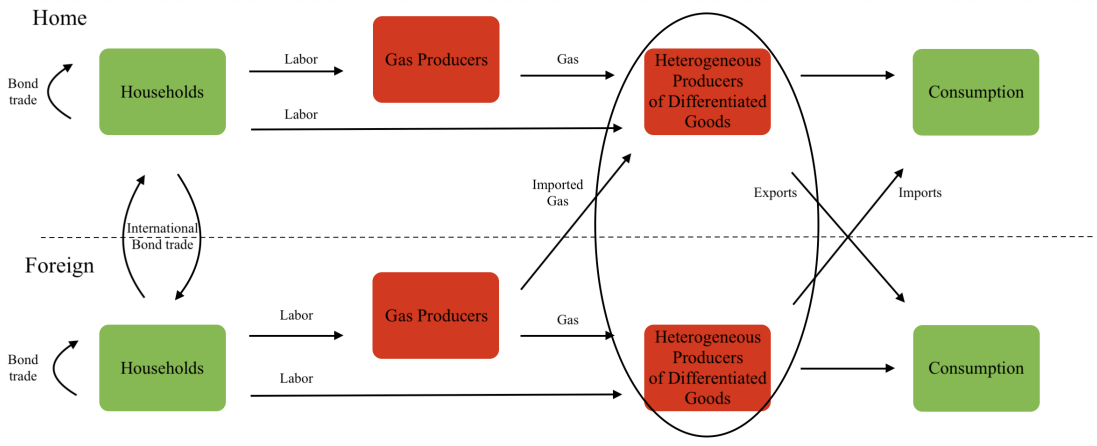

- Heterogeneous firm productivity, z, determined upon firm entry
  - Only more productive export
  - Higher sunk costs of firm entry in Foreign Details

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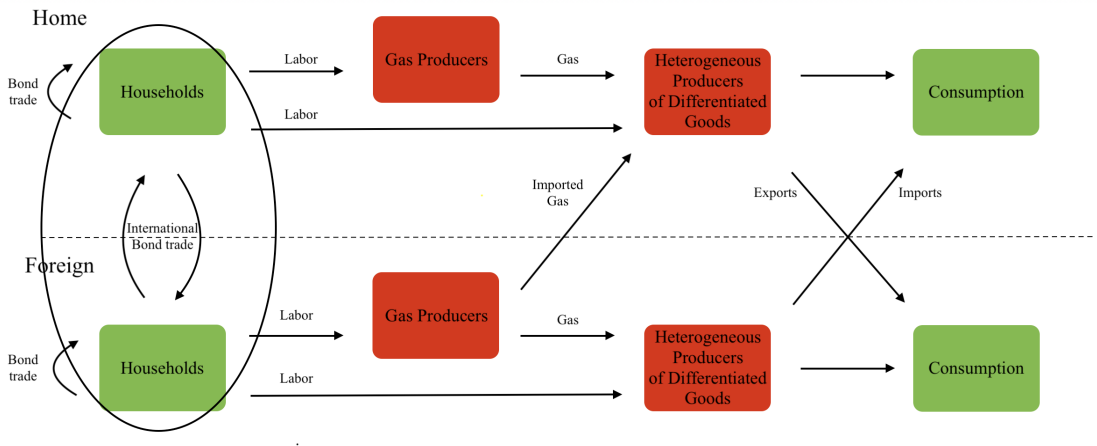

- Countries trade non-contingent bonds with each other
  - Preferences
  - Budget constraint

SANCTIONS

Consumption-good trade sanctions:

- Support of the distribution of exporter productivity levels: $[z_{X,t}, \infty) \rightarrow [z_{X,t}, z_S)$
- Affects the proportion of Home exporters:

$$(1 - \mathbb{1}^{TS}) + \mathbb{1}^{TS} F(z_S) - F(z_{X,t}) = N_{X,t}/N_{D,t}$$

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Financial sanctions:

- Sanctioned household:

$$C_{S,t}^* + B_{S,F,t+1}^* + adj_t + expen_t = \left(1 + r_t^*\right) B_{S,F,t}^* + inc_t + T_{S,t}^{*f}$$

- Non-Sanctioned household:

$$C_{NS,t}^* + \frac{B_{NS,F,t+1}}{Q_t} + B_{NS,F,t+1}^* + expen_t = (1 + r_t) \frac{B_{NS,F,t}}{Q_t} + \left(1 + r_t^*\right) B_{NS,F,t}^* + inc_t + T_{NS,t}^{*f}$$

Analytical Insights

Key identities: Real Exchange Rate

Using price index equations and optimal price setting by Home and Foreign firms

$$\tilde{Q}_t = f(TOL_t, \tilde{z}^*_{X,t}, \tilde{z}_{X,t}, \frac{N_{X,t}}{N^*_t}, \frac{N^*_{X,t}}{N_t}, \cdot)$$

- $\tilde{Q}$ is the real exchange rate ($\tilde{Q}\uparrow$ is Home currency depreciation)

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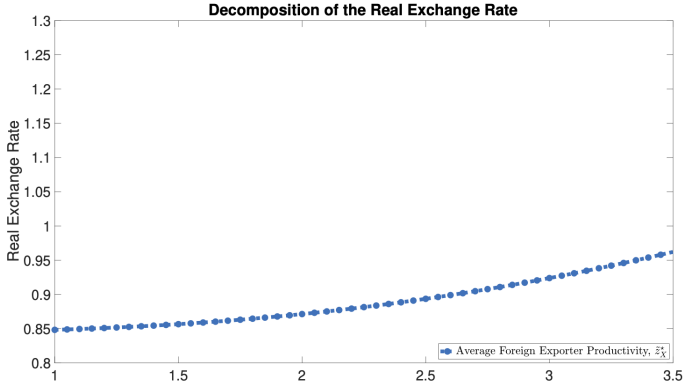
- $\frac{N_{X,t}}{N^*_t}$ and $\frac{N^*_{X,t}}{N_t}$ are shares of imported goods in total # of products (in Foreign and Home)

▸ Data-consistent vs. welfare-consistent

REAL EXCHANGE RATE



Average exporter productivity in Foreign, $\tilde{z}^*_X \uparrow \rightarrow$ Foreign export prices, $\tilde{p}^*_X \downarrow \rightarrow$ Home aggregate price index, $\tilde{P} \downarrow \rightarrow$ Home currency depreciates, $\tilde{Q} \uparrow$

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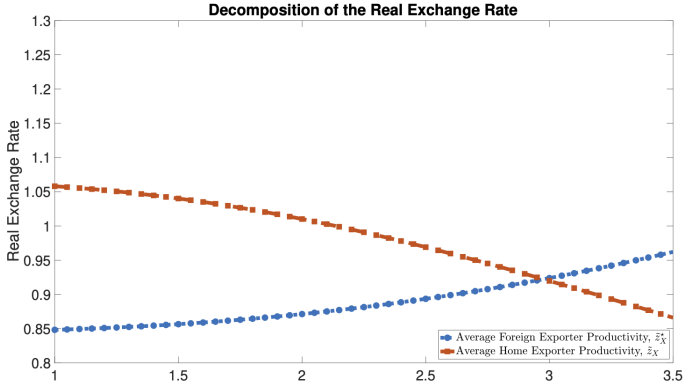

Average exporter productivity in Home, $\tilde{z}_X \uparrow \rightarrow$ Home export prices, $\tilde{p}_X \downarrow \rightarrow$ Foreign aggregate price index, $\tilde{P}^* \downarrow \rightarrow$ Home currency appreciates ,$\tilde{Q} \downarrow$

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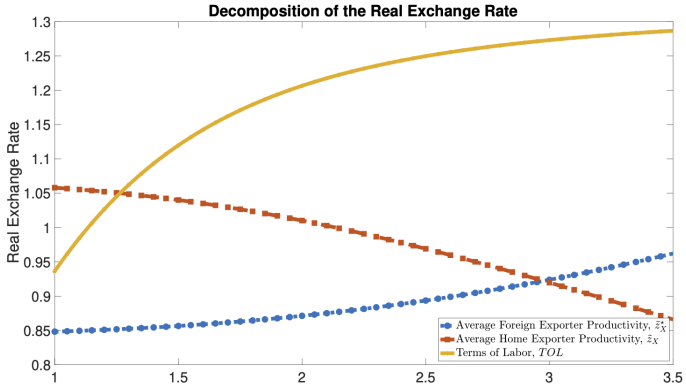

Depreciation of terms of labor, $TOL \propto \frac{w^*/Z^*}{w/Z} \uparrow \rightarrow$ Home currency depreciates, $\tilde{Q}_t \uparrow$

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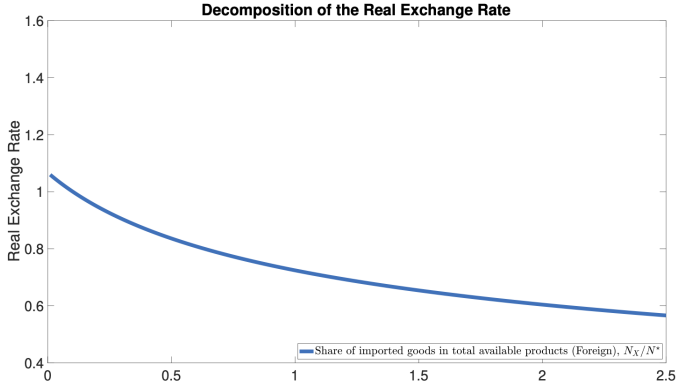

Relative share of imported goods in total number of products in Foreign, $\frac{N_X}{N^*} \uparrow \rightarrow$ Exporters charge lower prices than others $\rightarrow$ Foreign aggregate price index, $\tilde{P}^* \downarrow \rightarrow$ Home currency appreciates, $\tilde{Q} \downarrow$

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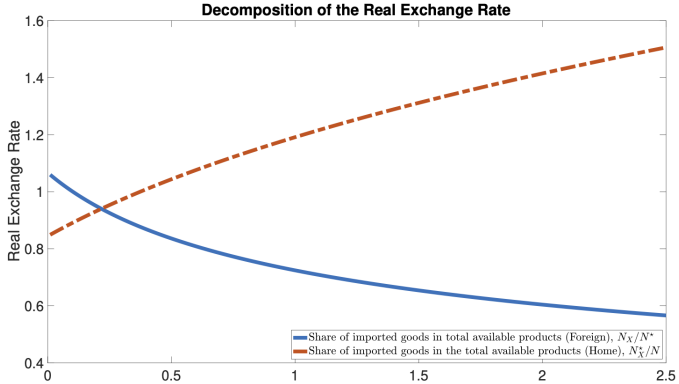

Relative share of imported goods in total number of products in Home, $\frac{N_X^*}{N} \uparrow \rightarrow$ Exporters charge lower prices than others $\rightarrow$ Home aggregate price index, $\tilde{P}\downarrow \rightarrow$ Home currency depreciates, $\tilde{Q}\uparrow$

Model Simulations

Numerical illustrations to assess the impact of sanctions

- Model solution as a nonlinear, forward-looking, deterministic system
- Transition dynamics (e.g., short, medium and long-term impact)

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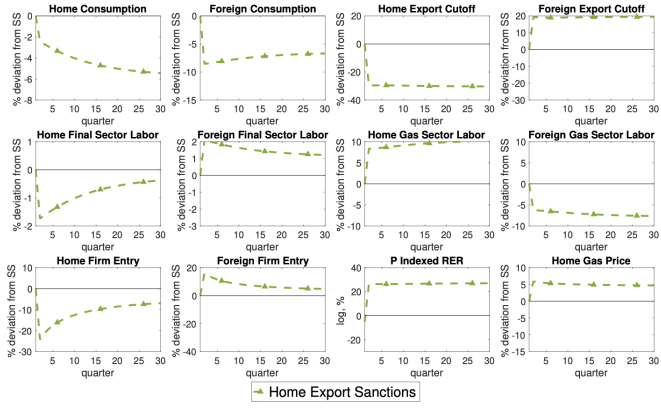
Today: Effects of individual sanctions

Paper: Also combinations

Calibration

Consumption Good Trade Sanctions



Home export sanctions: Top 5% most productive Home exporters drop from trade

Home export cutoff $\downarrow \rightarrow$ Home export price $\uparrow \rightarrow$ RER $\uparrow$

Rebalancing in Foreign towards consumption good sector: Foreign demand of Foreign goods $\uparrow \rightarrow$ Factor input demand $\uparrow$, Entry in Foreign $\uparrow$

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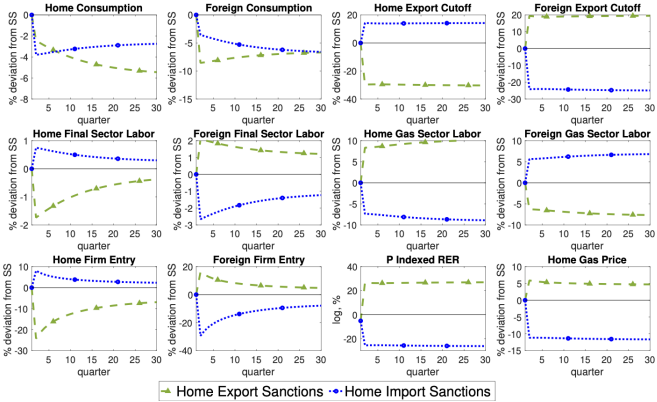
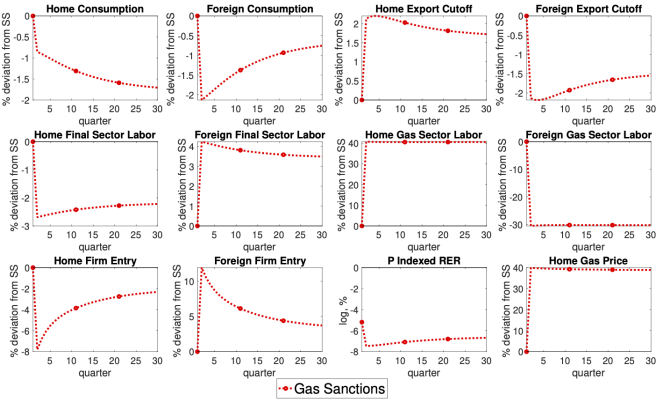


Home import sanctions: Top 5% most productive Foreign exporters drop from trade

Foreign export cutoff ↓ → Average productivity of Foreign exporters ↓ → Foreign export price ↑ → RER ↓

Rebalancing in Foreign towards gas sector: Number of producers ↓ → Labor supply shifts towards gas sector

Gas Sanctions

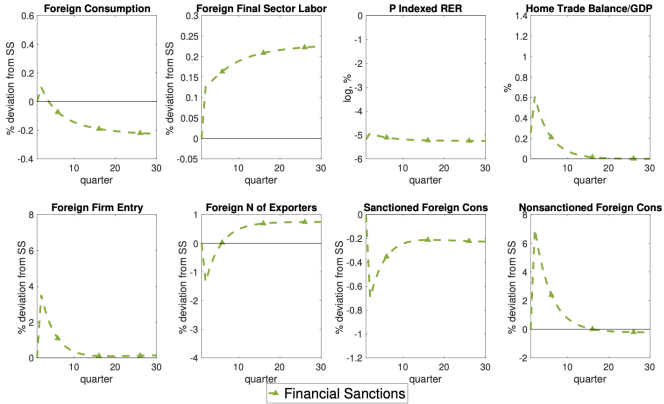


Gas import sanctions: Full stop of gas imports from Foreign

Demand for Home gas ↑ → Home gas price ↑ → Marginal costs ↑ → Home entrants ↓

Rebalancing in Foreign towards consumption good sector: Foreign entry in export ↑ → Foreign average export price ↑ → Home RER ↓

Financial Sanctions



Financial sanctions: Foreign NFA $\rightarrow 0$ & fraction of Foreign households cannot trade international bonds

Foreign incentive to front-load entry during the transition $\uparrow \rightarrow$ Non-sanctioned borrowing $\uparrow$

Number of entrants in Foreign $\uparrow \rightarrow$ Labor demand in Foreign $\uparrow \rightarrow$ TOL $\uparrow \rightarrow$ RER $\uparrow$

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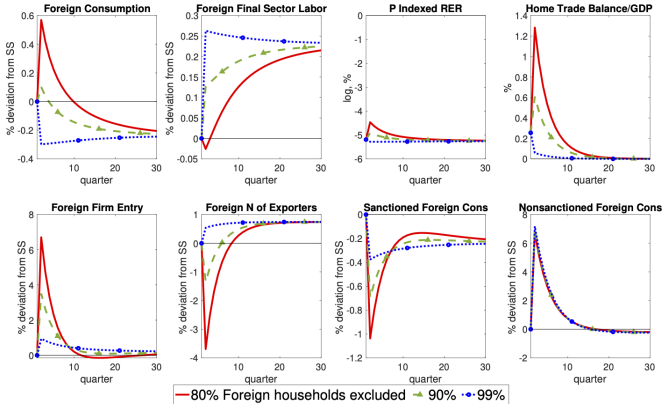

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Greater share of sanctioned households → Limited borrowing → Entry dampens → Labor supply ↑

Smaller share of sanctioned households → Share of nonsanctioned's consumption during transition ↑

WELFARE

- Welfare losses in consumption per capita equivalent terms
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		% of Welfare Loss			
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		No	1.14%	2.02%	0.67%
	C-good export sanction	Yes	1.18%	7.99%	1.18%
		No	1.31%	4.20%	0.69%
	C-good import sanction	Yes	0.96%	1.90%	0.96%
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Related Literature

- Sanctions
  - Albrizio et al. (2022), Bachmann et al. (2022), Bianchi and Sosa-Padilla (2022), Itskhoki and Mukhin (2022), Korhonen (2019) and references therein, Lorenzoni and Werning (2022), Sonnenfeld et al. (2022), Strum (2022), Van Bergeijk (2021) and references therein

- Endogenous entry, product variety, and business cycles in closed and open economies
  - Bilbiie, Ghironi, and Melitz (2012) and references therein, Auray and Eyquem (2011), Cacciatore (2014), Contessi (2010), Corsetti, Martin, and Pesenti (2007, 2013), Dekle, Jeong, and Kiyotaki (2010), Ghironi and Melitz (2005), Imura and Shukayev (2019), Rodríguez-López (2011), and Zlate (2010)
    - Most related to Ghironi and Melitz (2005)

Back

Household Preferences

- Expected intertemporal utility:

$$\mathbb{E}_t \left[\sum_{s=t}^{\infty} \beta^{s-t} \left(\ln C_s - \frac{\kappa}{2} L_s^2 - \frac{\kappa_G}{2} L_{G,s}^2 \right) \right]$$

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- Demand for each individual good ω: $c_t(\omega) = (\rho_t(\omega))^{-\theta} C_t$

Back

Household Budget Constraint

The budget constraint of the Home household:

$$
\begin{aligned}
&C_t + B_{H,t+1} + Q_t B^*_{H,t+1} + adj_t + \tilde{\upsilon}_t N_t x_{t+1} \\
&\quad = (1 + r_t) B_{H,t} + Q_t \left(1 + r^*_t\right) B^*_{H,t} \\
&+ w_{G,t} L_{G,t} + w_t L_t + \left(\tilde{d}_t + \tilde{\upsilon}_t\right) N_{D,t} x_t + T^f_t
\end{aligned}
$$

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Household finances continuing operations of all currently producing firms and entry of all producers

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- Only $N_{D,t+1} = (1-\delta) N_t$ firms will produce and pay dividends in $t+1$

Optimal labor supply:

$\kappa_G L_{G,t} = w_{G,t}/C_t$ and $\kappa L_t = w_t/C_t$

Back

Consumption Good Production

- Home firm ω produces output $y_t(\omega)$ of good ω with production function:

$$y_t(\omega) = zZ_t \left(G_{H,t}(\omega) + \frac{G^*_{H,t}(\omega)}{\tau_{G,t}} \right)^{\alpha} L_t(\omega)^{1-\alpha}$$

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Firm Averages

Following Melitz (2003), we define the productivity average $\tilde{z}_D$ for all producing firms:

$$\tilde{z}_D \equiv \left(\int_{zmin}^{\infty} z^{\theta-1} dF(z) \right)^{\frac{1}{\theta-1}},$$

and the productivity averages for Home exporters as:

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Back

Parameterization

Parameterization of Productivity Draws

- We assume that productivity z is distributed Pareto with lower bound $zmin$ and shape parameter $k > \theta - 1$:

$$F(z) = 1 - \left(\frac{zmin}{z}\right)^k$$

- Hence, $\tilde{z}_D = \left[\frac{k}{k-(\theta-1)}\right]^{\frac{1}{\theta-1}} zmin$ and $\tilde{z}_{X,t} = \left[\frac{k}{k-(\theta-1)}\right]^{\frac{1}{\theta-1}} z_{X,t}$
- The share of exporting firms is then:

$$\frac{N_{X,t}}{N_{D,t}} = \left(\frac{zmin}{\tilde{z}_{X,t}}\right)^k \left[\frac{k}{k-(\theta-1)}\right]^{\frac{k}{\theta-1}}$$

Back

Euler Equations

The Euler equations for optimal holdings of Home and Foreign bonds are, respectively:

$$C_t^{-1}\left(1+\eta(B_{H,t+1}-B_H)\right)=\beta\left(1+r_{t+1}\right)E_t\left(C_{t+1}^{-1}\right),$$

and

$$C_t^{-1}\left(1+\eta(B^*_{H,t+1}-B^*_H)\right)=\beta\left(1+r^*_{t+1}\right)E_t\left(\frac{Q_{t+1}}{Q_t}C_{t+1}^{-1}\right).$$

The Euler equation for optimal share holdings implies:

$$\tilde{\upsilon}_t=\beta\left(1-\delta\right)E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-1}\left(\tilde{\upsilon}_{t+1}+\tilde{d}_{t+1}\right)\right].$$

Back

Data-Consistent vs. Welfare-Consistent Prices

- $Q \equiv \frac{S_t P_t^*}{P_t}$ is computed using welfare-consistent price indices
- These price indexes can be decomposed into components reflecting average prices and product variety
- The average prices (e.g., $\tilde{P}_t$) correspond much more closely to empirical measures such as the CPI than the welfare-based indexes
- As in GM, the data-consistent real exchange rate $\tilde{Q}_t$ is related to Q_t by the equation:

$$\tilde{Q}_t = \left(\frac{N_t^*}{N_t}\right)^{\frac{1}{\theta-1}} Q_t,$$

where $N_t^* \equiv N_{D,t}^* + N_{X,t}$ is the total number of products available to Foreign consumers.

Back

Real Exchange Rate

$$
\begin{aligned}
\tilde{Q}_t \quad = \quad & \Xi_1[(1-\alpha)\mathsf{TOL}_t + \alpha(\mathsf{Z}_t - \mathsf{Z}^*_t - \tau_{G,t})] \\
& + \Xi_2 \tilde{z}^*_{X,t} - \Xi_3(\tilde{z}_{X,t} - \tau_t) \\
& + \Phi_1[\mathsf{N}_{\mathsf{D,t}} - \mathsf{N}_\mathsf{t} - (\mathsf{N}^*_{\mathsf{D,t}} - \mathsf{N}^*_\mathsf{t})] \\
& + \Phi_2[\mathsf{N}^*_{\mathsf{X,t}} - \mathsf{N}_\mathsf{t} - (\mathsf{N}_{\mathsf{X,t}} - \mathsf{N}^*_\mathsf{t})] \\
& - \Phi_3[\mathsf{N}_{\mathsf{X,t}} - \mathsf{N}^*_\mathsf{t} - (\mathsf{N}_{\mathsf{D,t}} - \mathsf{N}_\mathsf{t})] \\
& + \Phi_4[\mathsf{N}^*_{\mathsf{X,t}} - \mathsf{N}_\mathsf{t} - (\mathsf{N}^*_{\mathsf{D,t}} - \mathsf{N}^*_\mathsf{t})],
\end{aligned}
$$

with $\Xi_1, \Xi_2, \Xi_3, \Phi_1, \Phi_2, \Phi_3, \Phi_4 > 0$

Back

Real Exchange Rate

To build intuition for the implications of equation, suppose that markets are indeed complete, so that, up to a constant, $C_t = Q_t C_t^*$. Suppose also that $\tau_{G,t} = 1$, $G_N = G_N^*$, and $\kappa_G = \kappa_G^*$. then, gas price equation becomes:

$$\rho_{G,t} = \frac{(1-\alpha)^{(1-\alpha)(\theta-1)} \kappa_G C_t}{G_N^2} \left\{ \frac{3 - (1-\alpha)^{(1-\alpha)(\theta-1)}}{2\left[2 - (1-\alpha)^{(1-\alpha)(\theta-1)}\right]} \right\}. \tag{1}$$

Back

CALIBRATION

Parameter		*Value*	*Comments*
Discount factor	β	*0.99*	*Standard*
Disutility from labor	κ, κ_G	*0.75*	*Normalizes labor supply to 1*
Firm exit rate	δ	*0.025*	*Standard*
Elasticity of substitution between varieties	θ	*3.8*	*Ghironi and Melitz (2005)*
Lower bound entry	z_{min}	*1*	*To ensure* $z_{X,t} > z_{min}$
Fixed export costs	f_X	*0.085*	*17% and 24% of producers export in Home and Foreign* *Bernard, Eaton, Jensen and Kortum (2003)*
Gas endowment (Home)	G_N	*1*	
Gas Endowment (Foreign)	G_N^*	*1.5*	
Aggregate Productivity (Home)	Z	*1.5*	*Home GDP appx. 50% bigger*
Aggregate Productivity (Foreign)	Z^*	*1*	*than Foreign GDP*
Foreign initial NFA position	B_H	*-5*	*Foreign NFA position is*
	B_H^*	*3*	*appx. 40% of Foreign GDP*

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EXAMPLES OF SANCTIONS FROM GUIDANCE NOTES

Canadian Sanctions Related to Ukraine

Table of contents

Types of sanctions

Recent developments

- 2023-08-04 - Regulations were amended
- 2023-06-08 - Regulations were amended
- 2022-09-29 - Regulations were amended

Canada and Ukraine have enjoyed close bilateral relations since Canada became the first Western nation to recognize Ukraine's independence on December 2, 1991. On August 1, 2017, the Canada-Ukraine Free Trade Agreement (CUFTA) entered into force, which enhances trade between the two countries. The Trade Commissioner Service provides support and advice to Canadian companies seeking to do business in Ukraine.

Canada has placed sanctions on the Russian-occupied Crimea region of Ukraine and on Ukrainian individuals and entities related to Russia's illegal occupation and attempted annexation of Crimea and the ongoing Russian occupation in parts of eastern Ukraine. While Canada does not have blanket sanctions in place relating to Ukraine, Canadian companies should be mindful of specific and targeted sanctions in line with the above. More information on these targeted measures is included below.

Do you need a permit or certificate?

EXAMPLES OF SANCTIONS FROM GUIDANCE NOTES

European Commission:

HS6	Description
2847.00	Hydrogen peroxide, whether or not solidified with urea
8409.99	Parts suitable for use solely or principally with compression-ignition internal combustion piston engines (diesel or semi-diesel engines), other than for aircraft engines
8412.21	Hydraulic power engines and motors, linear acting (cylinders)
8412.29	Hydraulic power engines and motors, other than linear acting
8413.30	Fuel, lubricating or cooling medium pumps for internal combustion piston engine
8413.50	Reciprocating positive displacement pumps for liquids (excl. those fitted or designed to be fitted with a measuring device, handpumps, fuel, lubricating or cooling medium pumps for internal combustion piston engines and concrete pumps)

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EXAMPLES OF SANCTIONS FROM GUIDANCE NOTES

U.S. Department of Commerce:

TIER 1

HS Code	**HS Description and Representative Part**
8542.31	Electronic integrated circuits: Processors and controllers, whether or not combined with memories, convertors, logic circuits, amplifiers, clock and timing circuits, or other circuits
8542.32	Electronic integrated circuits: Memories
8542.33	Electronic integrated circuits: Amplifiers
8542.39	Electronic integrated circuits: Other

TIER 2

HS Code	**HS Description and Representative Part**
8517.62	Machines for the reception, conversion and transmission or regeneration of voice, images, or other data, including switching and routing apparatus
8526.91	Radar apparatus, radio navigational aid apparatus and radio remote control apparatus: Radio navigational aid apparatus
8532.21	Other fixed capacitors: Tantalum capacitors
8532.24	Other fixed capacitors: Ceramic dielectric, multilayer
8548.00	Electrical parts of machinery or apparatus, not specified or included elsewhere in chapter 85

TIER 3.A

HS Code	**HS Description and Representative Part**
8471.50	Processing units other than those of subheading 8471.41 or 8471.49, whether or not containing in the same housing one or two of the following types of unit: storage units, input units, output units
8504.40	Electrical transformers, static convertors (for example, rectifiers) and inductors; part thereof: Static convertors
8517.69	Other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network
8525.89	Television cameras, digital cameras and video camera recorders
8529.10	Parts suitable for use solely or principally with the apparatus of headings 8524 to 8528; Antennas and antenna reflectors of all kinds; parts suitable for use therewith
8529.90	Parts suitable for use solely or principally with the apparatus of headings 8524 to 8528: Other
8536.69	Coaxial connectors; cylindrical multicontact connectors; rack and panel connectors; printed circuit connectors; ribbon or flat cable connectors; other
8536.90	Electrical apparatus for switching or protecting electrical circuit, or for making connections to or in electrical circuits: Other apparatus
8541.10	Diodes, other than photosensitive or light-emitting diodes (LED)
8541.21	Transistors, other than photosensitive, with a dissipation rate of less than 1W
8541.29	Transistors, other than photosensitive not elsewhere specified