Capital Controls and Free Trade Agreements

Money, Macro and Finance Annual Conference

Simon Lloyd[1] Emile Marin[2]

[1]Bank of England
[2]University of Cambridge

September 2021

Trade & Financial Openness: Not Always Aligned

- *Bretton Woods*: Free trade promoted, but capital controls widely used
- *Post-Bretton Woods*: Increased trade and more financial openness
- *Recent Years*:
  - Growing protectionism (China-US trade war; Brexit; export restrictions post-Covid)
  - More sanguine views on capital controls (IMF's Integrated Policy Framework) and increasing 'macroprudential FX regulation'

How does conduct of capital controls change in a world with less free trade?

Graphs

This Paper: Trade-Finance Nexus

- Optimal capital controls $\leftrightarrow$ free trade agreements (FTAs) / import tariffs
  - How does trade policy influence optimal capital controls?
  - How do domestic welfare gains, and spillovers, from capital controls depend on trade policy?
- Simple theoretical framework: two-country endowment economy (Home and Foreign) with terms-of-trade externality
  - Ramsey planner (Unilateral & Nash) maximises welfare, manipulating interest rates and relative prices using capital flow taxes and:

  i. **with** FTA in place; or

  ii. **absent** FTA, with **optimal import tariff**

▸ Related Literature

Key Findings

Cannot separate discussions of capital controls and trade protectionism.

1. Policy prescriptions around trade and financial openness interlinked.
   - With FTA, optimal capital controls stabilise balance of payments
   - Without FTA, optimal capital controls and tariffs stabilise terms of trade/real exchange rate
2. Accounting for strategic interactions across countries:
   - Capital controls more prevalent in the absence of a FTA
   - Capital control wars more prevalent if intertemporal elasticity low, tariff wars if intratemporal elasticity low
3. In absence of FTA, **domestic gains from optimal capital controls are small**, but **spillovers are large**

Model

Model-in-a-Slide

- Countries: Home H and Foreign F $(^*)$. Goods: 1 and 2.
- Time: $t = 0, 1, ..., \infty$. No uncertainty. Zero assets at $t = 0$
- Preferences: $U_0 = \sum_{t=0}^{\infty} \beta^t u(C_t)$, where $\beta \in (0, 1)$, C_t aggregate consumption, and $u(C) = \frac{C^{1-\sigma}-1}{1-\sigma}$ with $\sigma > 0$
- Households consume both goods 1 and 2:

$$C_t \equiv g(\mathbf{c}_t) = \left[\alpha_1^{\frac{1}{\phi}} c_{1,t}^{\frac{\phi-1}{\phi}} + (1-\alpha_1)^{\frac{1}{\phi}} c_{2,t}^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}}$$

  where $\mathbf{c}_t = [c_{1,t}, c_{2,t}]$, $\alpha_1 \in (0.5, 1]$, and $\phi > 0$ is 'elasticity of trade'

- Country endowments: $\mathbf{y}_t^{(*)} = [y_{1,t}^{(*)}, y_{2,t}^{(*)}]$
- Real Exchange Rate $Q = \frac{P^*}{P}$ and Terms of Trade $S = \frac{p_2}{p_1}$

Key Friction: Terms-of-Trade Externality

- Large countries affect prices when making consumption decisions, i.e. $\frac{\mathrm{d}C^*}{\mathrm{d}C} \neq 0$, $\frac{\mathrm{d}c_1^*}{\mathrm{d}c_1} \neq 0$ [Geanakoplos and Polemarchakis, 1986]

$\Rightarrow$ Planner incentives to exercise monopoly/monopsony power [Costinot et al, 2014]

- **Inter**-temporal:

  Faster growth $\rightarrow$ Larger future trade surplus (ie future seller)
  $\rightarrow$ Incentive to increase future consumption
  $\rightarrow$ Promote domestic saving today (eg capital inflow tax)

- **Intra**-temporal:

  Faster gr. of good sold abroad $\rightarrow$ Incentive to increase future price
  $\rightarrow$ If home bias, can increase consumption
  $\rightarrow$ Promote saving today (eg inflow tax) / increase good cons. in future (eg tariffs)

Unilateral Home Planner:
With and Without Free Trade

Optimal Unilateral Policy: Setup

- Home country sets capital flow taxes to maximise welfare of domestic representative agent
- **Primal Approach**: Home planner chooses $\{\mathbf{c}_t\}$ in order to maximise welfare of representative agent U_0, taking as given:
  1. Foreign consumer maximising U_0^* subject to intertemporal budget constraint

  $$\sum_{t=0}^{\infty} \mathbf{p}_t \cdot (\mathbf{c}_t^* - \mathbf{y}_t^*) \leq 0$$

  where $\mathbf{p}_t = [p_{1,t}, p_{2,t}]$ is vector of world prices

  ▸ Foreign Maximisation

  2. Goods market clearing

  $$y_{1,t} + y_{1,t}^* = c_{1,t} + c_{1,t}^*, \qquad y_{2,t} + y_{2,t}^* = c_{2,t} + c_{2,t}^*$$

  3. Prevailing trade agreement

  ▸ FTA Problem ▸ nFTA Problem

Optimal Allocations with FTA

With FTA [Costinot, Lorenzoni, Werning, 2014]

- 1 FOC + 1 Instrument

$$\underbrace{\frac{\mathrm{d}\mathcal{L}}{\mathrm{d}C}}_{FOC=0} = \frac{\partial \mathcal{L}}{\partial c_1} \underbrace{c_1'(C)}_{FTA} + \frac{\partial \mathcal{L}}{\partial c_2} \underbrace{c_2'(C)}_{FTA}$$

- $u'(C_t) = \mu \mathcal{MB}_t^{FTA}$, where RHS reflects price of cons., Δ inter-temporal price, and Δ intra-temporal price

- Choose C given FTA

$\Rightarrow$ Trade off $\frac{\partial \mathcal{L}}{\partial c_1}$ and $\frac{\partial \mathcal{L}}{\partial c_2}$, with c_1 and c_2 constrained by FTA

Optimal Allocations with and without FTA

With FTA [Costinot, Lorenzoni, Werning, 2014]

- 1 FOC + 1 Instrument

$$\underbrace{\frac{\mathrm{d}\mathcal{L}}{\mathrm{d}C}}_{FOC=0} = \frac{\partial \mathcal{L}}{\partial c_1} \underbrace{c_1'(C)}_{FTA} + \frac{\partial \mathcal{L}}{\partial c_2} \underbrace{c_2'(C)}_{FTA}$$

- $u'(C_t) = \mu \mathcal{M}\mathcal{B}_t^{FTA}$, where RHS reflects price of cons., Δ inter-temporal price, and Δ intra-temporal price

- Choose C given FTA

⇒ Trade off $\frac{\partial \mathcal{L}}{\partial c_1}$ and $\frac{\partial \mathcal{L}}{\partial c_2}$, with c_1 and c_2 constrained by FTA

Without FTA

⋆ 2 FOCs + 2 Instruments

$$\frac{\mathrm{d}\mathcal{L}}{\mathrm{d}C} = \underbrace{\frac{\partial \mathcal{L}}{\partial c_1}}_{FOC=0} c_1'(C) + \underbrace{\frac{\partial \mathcal{L}}{\partial c_2}}_{FOC=0} c_2'(C)$$

⋆ $u'(c_{i,t}) = \mu \mathcal{M}\mathcal{B}_{i,t}^{nFTA}$ for $i = 1, 2$, where RHS reflects price of cons., Δ inter-temporal price, and Δ intra-temporal price

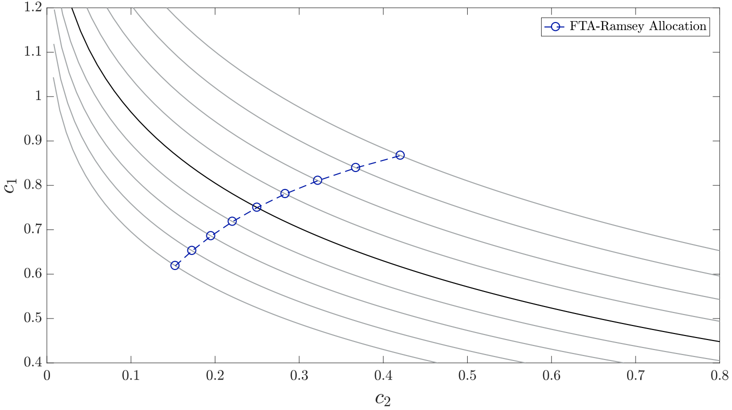
⋆ Choose c_1 and c_2, given $C = g(\mathbf{c})$

⇒ C optimal for Home planner and can violate FTA constraint

Allocations with a Free Trade Agreement

Feasible combinations of $\{c_1, c_2\}$ given F

FTA $\Rightarrow H$ cannot impose good-specific taxes $\Rightarrow (\mathbf{c}_t, \mathbf{c}_t^*)$ is Pareto efficient

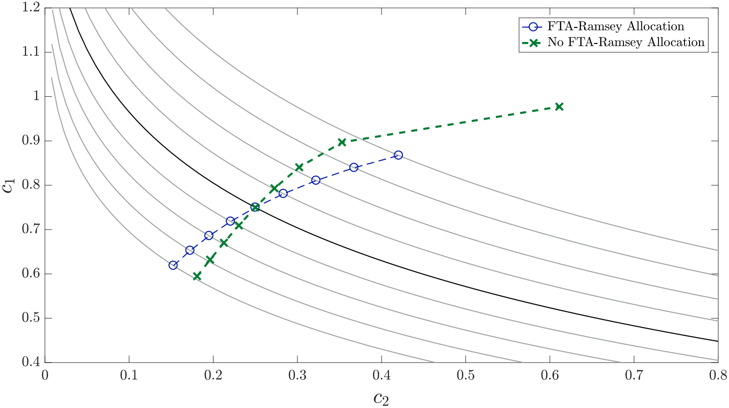


Note: $\phi = 1.5$, $\alpha_1 = \alpha_2^* = 0.75$, $y_1 = \alpha_1 \pm 0.25$, $y_2 = \alpha_2$, $y_i^* = 1 - y_i$ for $i = 1, 2$.

Relaxing the Free Trade Agreement

Feasible combinations of $\{c_1, c_2\}$ given F

No FTA $\Rightarrow$ H sets optimal import tariffs $\Rightarrow$ unconstrained by Pareto frontier



Note: $\phi = 1.5$, $\alpha_1 = \alpha_2^* = 0.75$, $y_1 = \alpha_1 \pm 0.25$, $y_2 = \alpha_2$, $y_i^* = 1 - y_i$ for $i = 1, 2$.

Relaxing the FTA can Increase Home Welfare

Proposition

Suppose goods preferences are symmetric, $\alpha_1 = \alpha_2^*$ and $\alpha_2 = \alpha_1^*$:

(i) In general: $C^{nFTA} \geq C^{FTA}$

(ii) When $C^{nFTA} > C^{FTA}$: optimal nFTA allocation violates Pareto frontier

(iii) $C^{nFTA} = C^{FTA}$ when endowments are proportional to preferences, i.e. $y_1 \propto \alpha_1$, $y_2 \propto \alpha_2$, $y_1^* \propto \alpha_1^*$ and $y_2^* \propto \alpha_2^*$

Graph

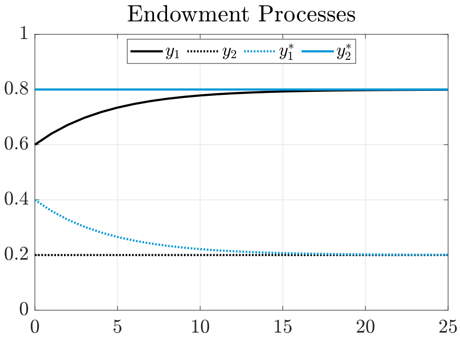
What Drives Optimal Policy?

Simulation: Growing Endowment of Home-Bias Good

Non-linear model simulation with AR(1) endowments (persistence ρ) ▸ Details

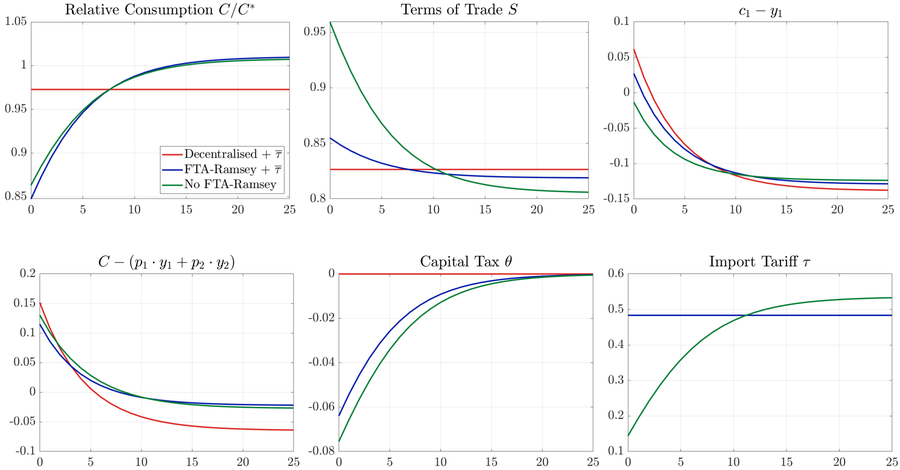
Implement allocation with **capital inflow tax** ($\theta_t < 0$) and **import tariff** ($\tau_t > 0$)

- Initial H endowments:
  $y_{1,0} = 0.75\overline{y}_1$, and $y_{2,0} = \overline{y}_2$
- No aggregate uncertainty:
  $y^*_{i,t} = 1 - y_{i,t}\ \forall i, t$
- $\sigma = 2$, $\beta = 0.96$, $\phi = 1.5$, $\rho = 0.8$
- $\alpha_1 = \alpha^*_2 = 0.6$ and $\overline{y}_1 = \overline{y}^*_2 = 0.8$



Equalise model steady states (via exogenous tax) to focus on welfare gains along transition path ▸ Details

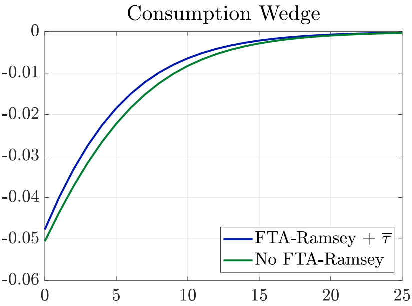
FTA: Stabilise TOT/RER; No-FTA: Stabilise Exports

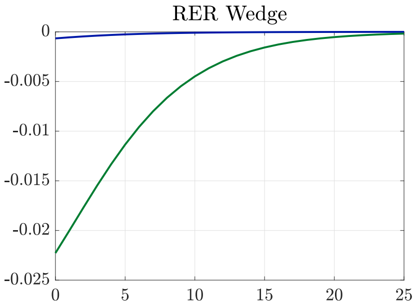


Tariffs ↑ RER Misalignment ⇒ ↑ Capital Controls

Why is the capital tax higher absent FTA?

$$-\ln(\tau_t) = \underbrace{-\sigma\left(\tilde{C}_t - \tilde{C}_{t+1} + \tilde{C}^*_{t+1} - \tilde{C}^*_t\right)}_{\equiv \ln(\Theta_t/\Theta_{t+1})} + (\tilde{Q}_t - \tilde{Q}_{t+1})$$





Alternative Simulation

Strategic Planners:
With and Without Free Trade

Optimal Policy at Nash Equilibrium

Both countries max. dom. welfare, taking other's optimisation as given

$\Rightarrow$ Optimally choose capital controls $\{\theta, \theta^*\}$ and import tariffs $\{\tau, \tau^*\}$ (no FTA).

- Optimality conditions trade off marginal benefits to each country
- **Globally sub-optimal**: cooperation (+ no intervention) is optimal from global perspective

Key results:

⋆ Capital controls are larger in the absence of an FTA in response to both types of shocks ▸ Graphs

⋆ Capital control wars more substantial as $\sigma \uparrow$ whilst tariff wars more substantial as $\phi \downarrow$ ▸ Graphs

How Prevalent Are Capital Controls?

- Simulation: $\sigma_y = 5\%$ (annual) [Benigno and Thoenissen, 2008]; uncorrelated shocks
- Complete specialisation, i.e. H endowed with good 1 ($\overline{y}_1 = 1$, $\overline{y}_2 = 0$)

Nash $\times 10^{-3}$	**Decentralised**	**FTA-Ramsey**	**nFTA-Ramsey**
var(y_i)	8.5	8.5	8.5
var(Q)	0.20	0.17	0.032
var(S)	5.0	4.2	0.80
var(BoP)	1.1	0.23	0.46
cov(C, C^*)	2.6	2.1	1.7
var(θ)		1.1	1.9
var(θ^*)		1.1	1.9
var(τ)			2.9
var(τ^*)			2.9

Note: Median estimates from 100 model simulations, each with simulation length $T = 100$.

Global Welfare and Cross-Border Spillovers

Spillovers Dwarf Domestic Gains, esp. with Tariffs

- ⋆ *Unilateral*: Welfare gain in H small relative to loss in F, esp. without FTA
- ⋆ *Nash*: Losses from policy wars
  $\Rightarrow$ **really big with capital control and tariff wars**

Welfare Difference Rel. Dec. (utils) : Experiment 1	H	F	Global $\sum_{H,F}$
with FTA (Unilateral)	$+0.029$	-0.042	-0.012
without FTA (Unilateral)	$+0.50$	-0.77	-0.27
with FTA (Nash)	-0.02	-0.02	-0.04
without FTA (Nash)	-0.44	-0.34	-0.78

Conclusions

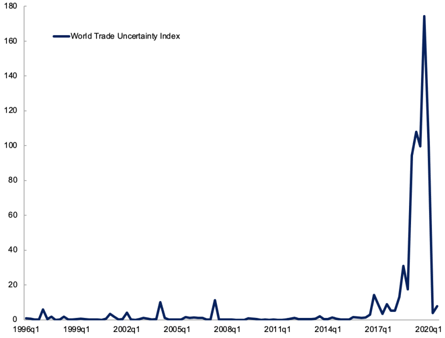
Conclusions

Cannot separate discussions of capital controls and trade protectionism.

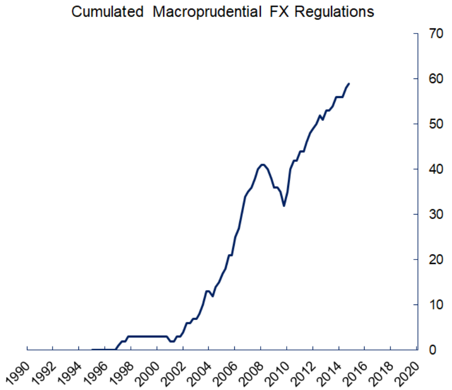
1. Policy prescriptions around trade and financial openness interlinked.
   - With FTA, optimal capital controls stabilise balance of payments
   - Without FTA, optimal capital controls and tariffs stabilise terms of trade/real exchange rate
2. Accounting for strategic interactions across countries:
   - Capital controls more prevalent in the absence of a FTA
   - Capital control wars more prevalent if intertemporal elasticity low, tariff wars if intratemporal elasticity low
3. In absence of FTA, **domestic gains from optimal capital controls are small**, but **spillovers are large**

Appendix

Trade & Financial Openness: Not Always Aligned



Source: Word Trade Uncertainty Index. Ahir, Bloom and Furceri (2018).



Source: Ahnert, Forbes, Friedrich and Reinhardt (2020).

Back

Related Literature

Non-Exhaustive

- **Capital Controls**: Costinot, Lorenzoni and Werning (2014); Bianchi (2011); Farhi and Werning (2016); ...
- **Trade Policy**: Lerner (1936); Broda, Limao and Weinstein (2008); Costinot and Werning (2019); Corsetti and Bergin (2020); ...
- **Integrated Policy Analysis**: Ostry et al. (2010); Basu et al. (2020); Auray, Deveraux and Eyquem (2020) ...

Back

Foreign Consumer Maximisation

- Representative Foreign consumer problem:

$$\max_{\{\mathbf{c}_t^*\}} \quad U_0^* = \sum_{t=0}^{\infty} \beta^t U^*(C_t^*) \quad \text{s.t.} \quad \sum_{t=0}^{\infty} \mathbf{p}_t \cdot (\mathbf{c}_t^* - \mathbf{y}_t^*) \leq 0$$

$\Rightarrow$ Optimality conditions:

$$\beta^t U^{*\prime}(C_t^*) \nabla g_c^*(\mathbf{c}_t^*) = \lambda^* \mathbf{p}_t$$

$$\sum_{t=0}^{\infty} \mathbf{p}_t \cdot (\mathbf{c}_t^* - \mathbf{y}_t^*) = 0$$

where $\nabla g_c^*(\mathbf{c}_t) = \left[\frac{\partial g^*(\mathbf{c}_t^*)}{\partial c_{1,t}^*}, \frac{\partial g^*(\mathbf{c}_t^*)}{\partial c_{2,t}^*} \right]$

Back

Unilateral Home Planning Problem

With FTA **[Costinot, Lorenzoni & Werning, 2014]**

$$\max_{\{C_t, \mathbf{c}_t\}} \quad \sum_{t=0}^{\infty} \beta^t u(C_t) \tag{P-FTA}$$

$$\text{s.t.} \quad \sum_{t=0}^{\infty} \boldsymbol{\rho}(C_t) \cdot [\mathbf{c}_t - \mathbf{y}_t] = 0 \tag{IC}$$

$$\mathbf{c}_t = \mathbf{c}_t(C_t), \quad \mathbf{c}_t^* = \mathbf{c}_t^*(C_t) \tag{FTA}$$

where $\boldsymbol{\rho}(C_t) \equiv \beta^t u^{*\prime}(C_t^*) \nabla g_c^*(\mathbf{c}_t^*(C_t))$

Back

Unilateral Home Planning Problem

Without FTA

$$\max_{\{C_t, \mathbf{c}_t\}} \quad \sum_{t=0}^{\infty} \beta^t u(C_t) \tag{P-nFTA}$$

$$\text{s.t.} \quad \sum_{t=0}^{\infty} \boldsymbol{\rho}(C_t) \cdot [\mathbf{c}_t - \mathbf{y}_t] = 0 \tag{IC}$$

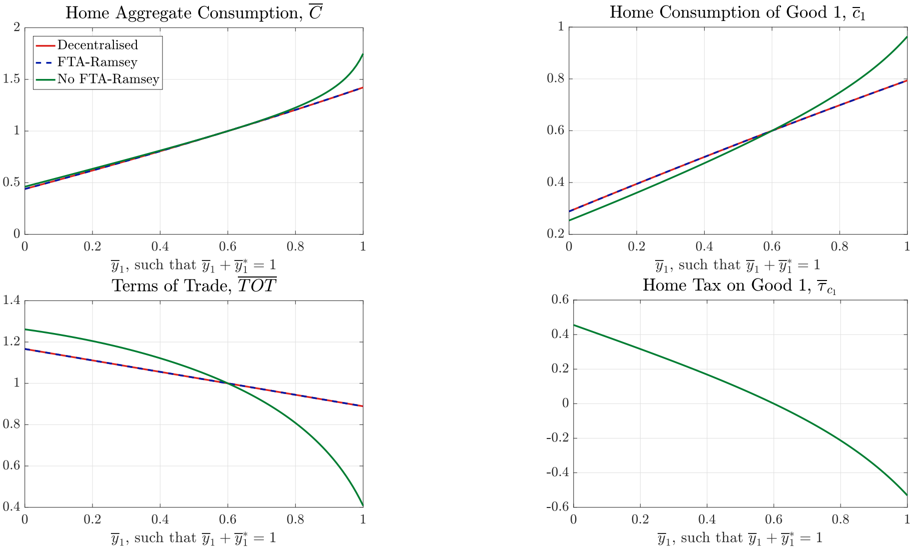
$$\cancel{\mathbf{c}_t = \mathbf{c}_t(C_t), \quad \mathbf{c}_t^* = \mathbf{c}_t^*(C_t)}$$

$$C_t = g(\mathbf{c}_t) \tag{nFTA}$$

where $\boldsymbol{\rho}(C_t) \equiv \beta^t u^{*\prime}(C_t^*) \nabla g_c^*(\mathbf{c}_t^*(C_t))$

▸ Back

Steady State Allocations



Note: $\phi = 1.5$, $\alpha_1 = \alpha_2^* = 0.6$, $\alpha_1^{(*)} + \alpha_2^{(*)} = 1$, $y_2^{(*)} = \alpha_2^{(*)}$.

▸ Back

Model Solution: 1-Good Example

- For simplicity, suppose each country is endowed with a single good
- Endowment processes for H $\{y_t\}_{t=0}^{T}$ and F $\{y_t^*\}_{t=0}^{T}$ fully deterministic, where T refers to length of simulation
- Ramsey problem has $T+2$ FOCs: $T+1$ w.r.t. c_t and 1 w.r.t. the multiplier μ_0

$$c_t^{-\sigma} = \mu_0 \left[c_t^{*\,-\sigma} - \sigma c_t^{*\,-\sigma-1} \left(y_t - c_t \right) \right] \quad \text{for } t = 0, 1, ..., T$$

$$0 = \sum_{t=0}^{T} \beta^t c_t^{*\,-\sigma} \left(y_t - c_t \right)$$

- In addition we have market clearing in each period:

$$c_t + c_t^* = y_t + y_t^* \quad \text{for } t = 0, 1, ..., T$$

$\Rightarrow$ $2T+3$ equations in $2T+3$ unknowns: $\{c_t\}_{t=0}^{T}$, $\{c_t^*\}_{t=0}^{T}$ and μ_0.

Back

Model Solution: Taking to MATLAB

Using vector notation, take $\mathbf{y} = [y_0, y_1, ..., y_T]'$ and $\mathbf{y}^* = [y_0^*, y_1^*, ..., y_T^*]'$ as inputs, then use `fsolve` on

$$\mathbf{c}^{-\sigma} = \mu_0 \left[\mathbf{c}^{*\,-\sigma} - \sigma \mathbf{c}^{*\,-\sigma-1}(\mathbf{y} - \mathbf{c}) \right]$$

$$\mathbf{c} + \mathbf{c}^* = \mathbf{y} + \mathbf{y}^*$$

$$0 = \mathbf{x}'(\mathbf{y} - \mathbf{c}), \quad \text{where } \mathbf{x} = \mathbf{b} \odot \mathbf{c}^{*\,-\sigma}$$

where $\mathbf{b} = [\beta^0, \beta^1, ..., \beta^T]'$

Back

Model Solution

- Model solved non-linearly
- Endowment processes specified as AR(1) with no aggregate uncertainty:

$$y_{i,t} = (1-\rho_y)y_{i,0} + \rho_y y_{i,t}, \quad \forall\, t > 0 \text{ and } i = 1, 2$$
$$\mathbf{y}_t = [y_{1,t}, y_{2,t}], \qquad \mathbf{y}_t^* = [1 - y_{1,t}, 1 - y_{2,t}]$$

- Different steady-state allocations across model variants:
    - FTA: no steady-state welfare gains from capital controls
    - w\out FTA: optimal import tariffs deliver steady-state welfare gains

⇒ Compare three model variants, with first-best steady state:

1. Decentralised + Steady-State Goods Tax $\overline{\tau}_1$
2. FTA-Ramsey + Steady-State Goods Tax $\overline{\tau}_1$
3. No FTA-Ramsey

⋆ Focus on welfare gains along transition path – **Explicit WTO arrangement**

▸ Back

Implementation

⋆ **Capital taxation**:

$$\frac{u'(C_{t+1})}{u'(C_t)}(1-\theta_t) = \frac{u'(C^*_{t+1})}{u'(C^*_t)}\ \frac{Q_t}{Q_{t+1}}$$

$\theta_t < 0$ denotes a tax on current consumption relative to future consumption, or **tax on capital inflows**

⋆ **Import tariff**:

$$\frac{\alpha_1}{1-\alpha_1}\frac{c_{1,t}}{c_{2,t}} = \left[\frac{p_{1,t}}{p_{2,t}(1+\tau_t)}\right]^{-\phi}$$

important. where $\tau_t > 0$ denotes **import tariff**

· Implementation not unique [Chari and Kehoe, 1999], but policy-relevant

▸ Back

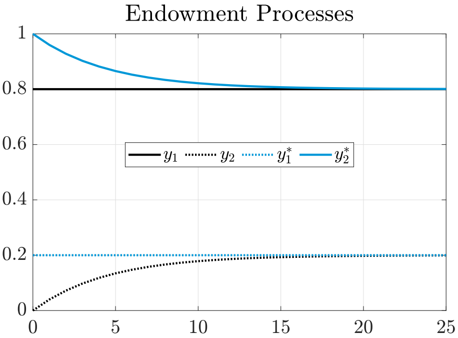
Experiment #2: F Pursues 'F-First' Production

- Share of good 2 falls, on impact, in H, and rises in F:

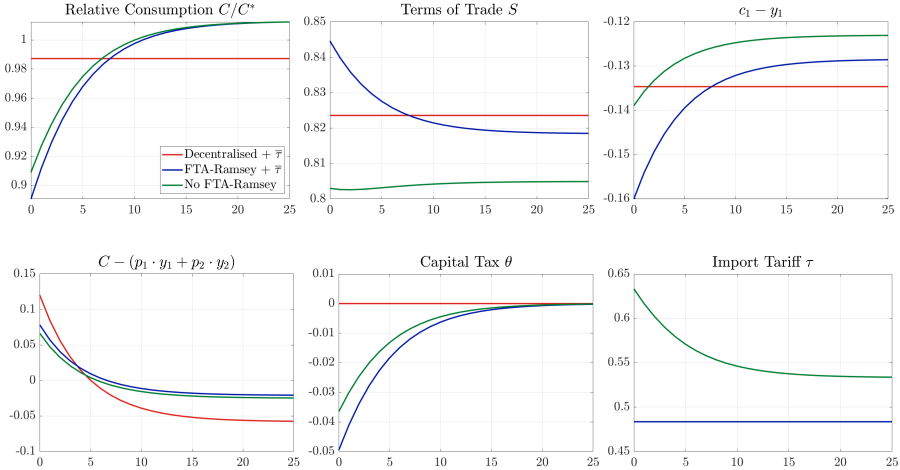
$$y^*_{1,0} = \overline{y}^*_1$$
$$y^*_{2,0} = 1.25\overline{y}^*_2$$

- No aggregate uncertainty $\forall\ t$:

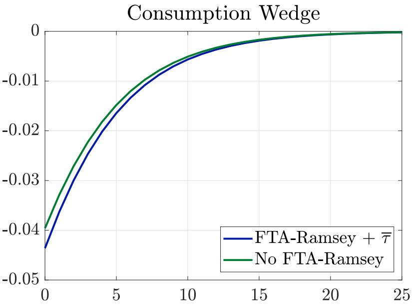
$$y_{1,t} = 1 - y^*_{1,t}$$
$$y_{2,t} = 1 - y^*_{2,t}$$

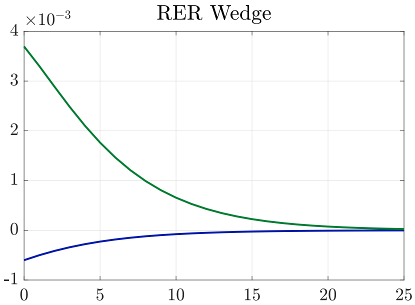


Experiment #2: Macro Dynamics



Experiment #2: Capital Tax Decomposition

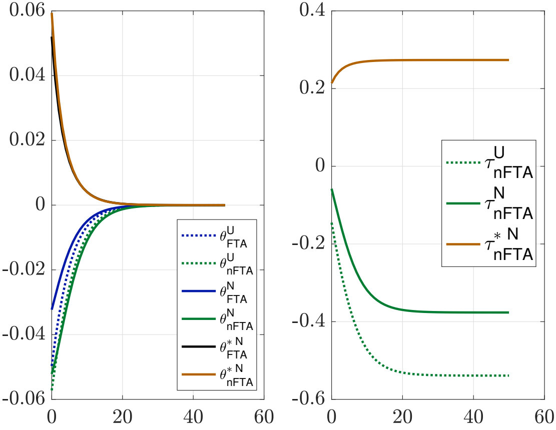




- ⋆ Real exchange rate moves in opposite direction, lower capital controls needed
- ⋆ Trade policy disentagles C growth and Q growth

Back

Figure: Experiment 1 (NASH) – Rising Home Endowment of H Goods



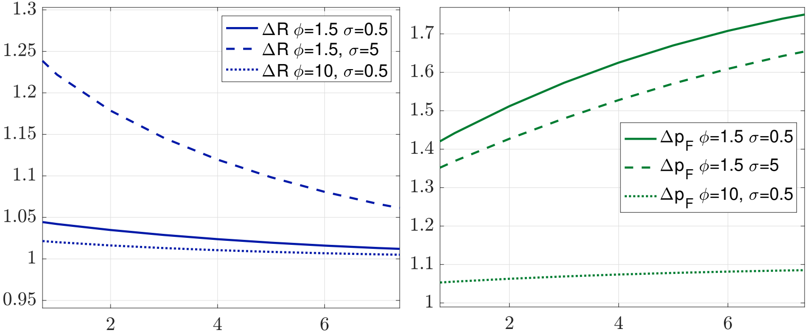
Notes: Optimal capital controls and taxes. "U" subscript denotes unilateral optimal policy result (for Home). "N" denotes Nash outcome.

Back

Capital Control and Tariff Wars

$$\Delta^R = \frac{1-\theta_t}{1-\theta_t^*}, \quad \Delta^{p_F} = \frac{1-\tau_t}{1-\tau_t^*},$$

Figure: Difference in cost of borrowing and cost of $F-$ goods across countries



Back