The Optimal Macro Tariff

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Questions

- What is the optimal macroeconomic tariff when trade is imbalanced?
  - bilateral imbalances across trade partners
  - more importantly, aggregate CA imbalances reflecting international financial position

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  - more importantly, aggregate CA imbalances reflecting international financial position

- Can a tariff be used to (permanently) close an aggregate trade imbalance?

- We develop a primal approach (Johnson 1950, Lucas-Stokey 1983, CLW 2014) and an implementability condition (TPF) for the home planner that allows to handle:
  - alternative objectives (e.g., revenue maximization, manufacturing employment)
  - alternative macro models with bilateral and aggregate trade deficits
  - and valuation effects and convenience yields ("exorbitant privilege") on foreign assets

Main Insights

1. Lerner symmetry between import tariff and export tax does not, generally, hold with gross international assets and liabilities
    - combination of a tariff and a subsidy engineers a transfer via valuation effects
    - closing trade deficit could be done with an import tariff or an export subsidy

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    - US dollar assets offer a hedge to US trade partners against the trade war

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4. Optimal (bilateral) tariffs do not generally depend on (bilateral) trade deficits

Related literature

- Classics: Lerner (1936), Baldwin (1948), Johnson (1950,1953), Gros (1987), Jones (1967), Razin and Svensson (1983), Diamond and Mirrlees (1971)
- Optimal tariff: Caliendo and Parro (2022) + vast literature
- Imbalances: Cuñat and Zymek (2024), Pujolas and Rossbach (2024), Aguiar, Amador and Fitzgerald (2025), Costinot and Werning (2025)
- Other: Gourinchas and Rey (2007), Farhi, Gopinath and Itskhoki (2014), Itskhoki and Mukhin (2022), Aguiar, Itskhoki and Mukhin (2024)

Outline

Baseline Model with Balanced Trade

Optimal Tariff

Global Imbalances

Closing the imbalance

Convenience Yields

Multi-country and Bilateral Imbalances

Conclusion

Baseline Model: Physical Environment

- Two-country: Home (the U.S.) and Foreign (the rest of the world, $*$)

- Two goods with resource constraints:

$$Y = C_H + C_H^* \qquad \text{and} \qquad Y^* = C_F + C_F^*$$

- Homothetic preferences:

$$u(C_H, C_F) = \left[(1-\gamma)^{\frac{1}{\theta}} C_H^{\frac{\theta-1}{\theta}} + \gamma^{\frac{1}{\theta}} C_F^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}},$$

$$u^*(C_H^*, C_F^*) = \left[{\gamma^*}^{\frac{1}{\eta}} {C_H^*}^{\frac{\eta-1}{\eta}} + (1-\gamma^*)^{\frac{1}{\eta}} {C_F^*}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

Decentralized Equilibrium

- Ad valorem tariffs τ^E, τ^I result in deviations from law of one price:

$$P_H^* = \tau^E P_H \qquad \text{and} \qquad P_F = \tau^I P_F^*$$

  - flexible prices; e.g., monetary model with $P_H = 1$ and $P_F^*/\mathcal{E} = 1$

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- Household optimization:

$$\frac{u_F}{u_H} = \frac{P_F}{P_H} \qquad \text{and} \qquad \frac{u_F^*}{u_H^*} = \frac{P_F^*}{P_H^*}$$

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- Households and government combined yield the country budget constraint, or TB:

$$P_H^* C_H^* = P_F^* C_F, \qquad \text{where} \quad \mathcal{S} \equiv \frac{P_F^*}{P_H^*} \quad \text{is terms of trade}$$

Primal Approach

- Home planner takes foreign optimization and TB as implementability constraints
- Trade policy is the only instrument. Overall tariff wedge:

$$\tau \equiv \tau^I \tau^E = \frac{P_F/P_H}{P_F^*/P_H^*} = \frac{u_F/u_H}{u_F^*/u_H^*}$$

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- **Lemma (Implementability)**: The planner can choose any combination (C_F, C_H^*) that satisfies the implementability condition $C_H^* = g(C_F)$ implicitly defined by:

$$u_H^*(C_H^*, Y^* - C_F)C_H^* = u_F^*(C_H^*, Y^* - C_F)C_F$$

Under CES preferences, the function $g(\cdot)$ is strictly increasing and strictly convex.

Trade Possibilities Frontier (TPF)

- Implementability condition $C_H^* = g(C_F)$ can be equivalently re-stated as:
  1. Mapping: $G(C_H^*, C_F\,;\, u^*, Y^*) = 0$
  2. Trade production function (Diamond and Mirrlees 1971): $C_F = g^{-1}(C_H^*)$

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  - for example, maximizing $u(C_H, C_F)$ can be represented as:

$$\max_{C_F} u\big(Y - g(C_F), C_F\big) \qquad \text{which yields optimality} \qquad u_H \cdot g' = u_F$$

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- Convenient graphical representation of g in the Edgeworth box (AIM 2024)
  - g is an offer curve

Edgeworth box

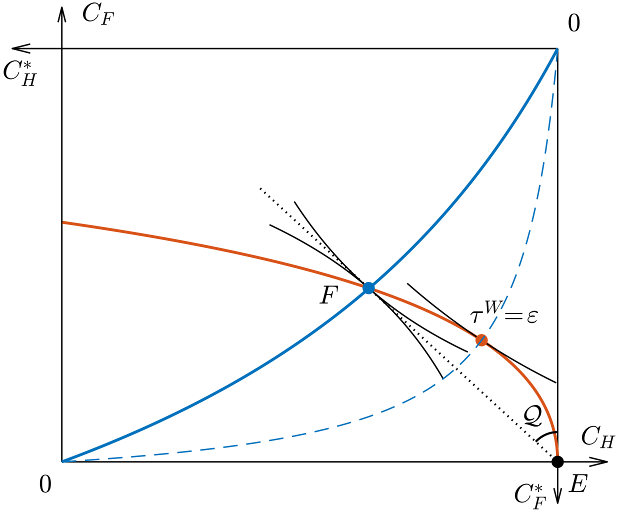

Figure: Laissez faire allocation and the optimal tariff

Outline

Optimal Tariff

- **Proposition**: The optimal tariff against the rest of the world (Johnson 1950):

$$\tau^W = \varepsilon \qquad \text{where} \qquad \varepsilon \equiv \frac{d\log C_H^*}{d\log C_F} = \frac{g'(C_F)\cdot C_F}{g(C_F)}.$$

Under CES, this can be expressed as (Caliendo and Parro 2022):

$$\tau^W = \varepsilon = 1 + \frac{1}{\eta - 1}\frac{1}{\Lambda^*} > 1 \qquad \text{where} \qquad \Lambda^* \equiv \frac{C_F^*}{Y^*} = \frac{P_F^* C_F^*}{P^* C^*}.$$

  - using optimality $u_H \cdot g' = u_F$, back out $\tau = \frac{u_H/u_F}{u_H^*/u_F^*} = g' \frac{C_F}{C_H^*}$ using $\frac{u_F^*}{u_H^*} = \frac{P_F^*}{P_H^*} = \frac{C_H^*}{C_F}$
  - even a small country ($\Lambda^* = 0$) has an optimal tariff $\tau^W = \frac{\eta}{\eta - 1} \geq 1$

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- Free trade: $\tau = \frac{u_H/u_F}{u_H^*/u_F^*} = 1$. Optimal iff g is linear: $C_H^* = \mathcal{S} \cdot C_F$ (exogenous ToT)

Alternative Objectives I: Tariff Revenues

- Under Lerner symmetry (IM 2022), without loss $\max \frac{(P_F - P_F^*)C_F}{P_H} = \frac{\tau P_F^* C_F}{P_H^*}$
- In the space of allocation, this is equivalent to:

$$\max_{C_F} \frac{u_F(Y - g(C_F), C_F)}{u_H(Y - g(C_F), C_F)} C_F - g(C_F),$$

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$$\tau^R = \frac{\theta\varepsilon}{\theta - 1 - \varepsilon\frac{1-\Lambda}{\Lambda}} \qquad \text{where} \qquad \Lambda \equiv \frac{C_H}{Y}$$

(a) as $\theta \to \infty$, the same optimal tariff for welfare and revenues $\tau^W = \tau^R = \varepsilon$

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- Optimal tariff $\tau^W = \varepsilon = 34\%$ versus revenue-max tariff $\tau^R = 80\%$

Alternative Objectives II: Manufacturing Employment

- Tradables and non-tradables:

$$u = \frac{\rho}{\rho - 1}\left(\kappa C_N^{\frac{\rho-1}{\rho}} + C_T^{\frac{\rho-1}{\rho}}\right), \qquad C_T = \left[(1-\gamma)^{\frac{1}{\theta}} C_H^{\frac{\theta-1}{\theta}} + \gamma^{\frac{1}{\theta}} C_F^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \quad \rho \leq \theta$$

- Production economy:

$$C_N = Y_N = F_N(L_N), \qquad Y = F_T(L_T), \qquad L_N + L_T = L$$

- Labor market equilibrium ($\max L_T$ is equivalent to $\max C_F = g^{-1}(C_H^*)$)

$$\frac{P_H}{P_N} = \frac{W/F_T'}{W/F_N'} = \frac{F_N'(L - L_T)}{F_T'(L_T)} \quad \text{and} \quad \frac{P_H}{P_N} = \frac{u_H}{u_N} = \frac{u_H\big(F_T(L_T) - g(C_F), C_F\big)}{u_N\big(F_N(L - L_T)\big)}$$

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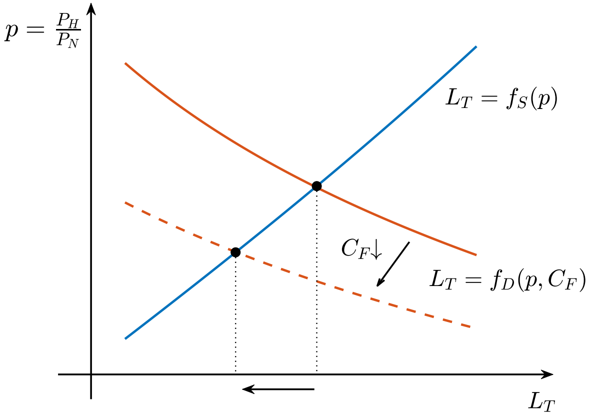

Figure: Tradable-sector employment

- both a "China shock" $(Y^* \uparrow)$ and tariff τ reduce tradable employment L_T
- if increasing L_T is a goal, the optimal response to "China shock" is trade subsidy

Retaliation and Trade War Nash

- Home and foreign impose tariffs:

$$P_F = \tau^I \tau^{E*} P_F^* \qquad \text{and} \qquad P_H^* = \tau^E \tau^{I*} P_H \qquad \Rightarrow \qquad \frac{P_F}{P_H} = \tau\tau^* \frac{P_F^*}{P_H^*}$$

- Trade balance for home $P_H^* C_H^* = \tau^* P_F^* C_F$ yields generalized $C_H^* = g(C_F; \tau^*)$

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- Trade war turns a 0.5% welfare gain under unilateral tariff into a 2.5% welfare loss

Retaliation and Trade War Nash

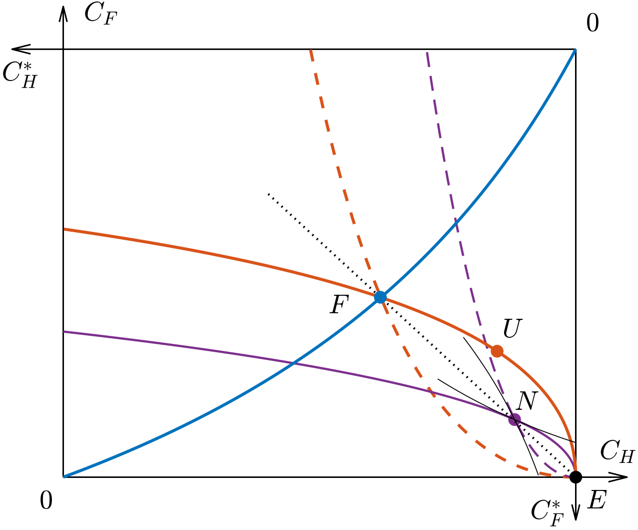

Figure: Tariff war Nash equilibrium

Outline

Global Imbalances

- General restriction on long-run trade imbalance from country budget constraint

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- In any t, B^j_{t-1}, $j \in J_{t-1}$ are asset holding paying dividend D^j_t and valued at Q^j_t, with realized return $R^j_t \equiv (Q^j_t + D^j_t)/Q^j_{t-1}$
- $\bar{R}_t$ is the risk-free interest rate between t and $t+1$ (known at t)
- The value of new asset positions at t: $\mathcal{B}_t \equiv \sum_{j \in J_t} Q^j_t B^j_t$
- The pay-out on entire NFA position: $\mathcal{R}_t \mathcal{B}_{t-1} \equiv \sum_{j \in J_{t-1}} (Q^j_t + D^j_t) B^j_{t-1}$
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- **Lemma**: If there is no arbitrage in J_t, then there exists SDF Θ_{t+1} such that:

$$\mathbb{E}_t\{\Theta_{t+1}(\mathcal{R}_{t+1} - \bar{R}_t)\} = 0.$$

Long-run Trade Imbalance

- **Proposition**: Long-run trade deficit is determined by the financial position:

$$\underbrace{-\sum_{t=0}^{\infty}\beta^t NX_t}_{\text{long-run trade deficit}} = \underbrace{\bar{R}\,\mathcal{B}_{-1}}_{\substack{\text{exogenous}\\ \text{initial NFA}}} + \underbrace{(\mathcal{R}_t - \bar{R})\mathcal{B}_{-1}}_{\substack{\text{on-impact}\\ \text{valuation effect}}} + \underbrace{\sum_{t=1}^{\infty}\beta^t\left(\mathcal{R}_t - \bar{R}\right)\mathcal{B}_{t-1}}_{\text{future realized excess returns}},$$

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$$-\sum_{t=0}^{\infty}\mathbb{E}_t\{\Theta_t NX_t\} = \bar{R}\,\mathcal{B}_{-1} + (\mathcal{R}_0 - \bar{R})\mathcal{B}_{-1}, \qquad \text{where} \quad \mathbb{E}_0\Theta_t = \beta^t.$$

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- Tariffs do, in general, have valuation effects on a country's international portfolio
  - but not shaped by trade shares, trade elasticities, or terms of trade
  - there is an optimal tariff even without the effect on the LR trade imbalance

Static Model with NFA and Valuation Effects

- International portfolio $(-B, B^*)$ with total net value of $P_F^* B^* - P_H B$
  - two interpretations: local-currency bonds or equities (Lucas trees)
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- Country budget constraint:

$$\underbrace{P_H^* C_H^* - P_F^* C_F}_{NX} + \underbrace{P_F^* B^* - P_H B}_{NFA} = 0$$

  - now two relative prices, ToT $\mathcal{S} = \frac{P_F^*}{P_H^*}$ and RER $\mathcal{Q} = \frac{P_F^*}{P_H}$, such that $\mathcal{Q} = \tau^E \mathcal{S}$

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- Two questions: (i) optimal tariff and (ii) close the deficit $(\min |NX|)$
  - closing trade deficit requires both $NX = 0$ and $NFA = 0$

Lerner symmetry and infinite tariff

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- **Lemma**: If $B \in (0, Y)$ and $B^* \in (0, Y^*)$, then home planner can use (τ^E, τ^I) to unilaterally implement any balanced-trade equilibrium, including trade autarky.

Optimal Import Tariff

- We restrict $\tau^E = 1$ and study the use of the import tariff τ^I
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- **Corollary**: (a) If $B^* = 0$, τ is increasing in trade deficits IM/EX

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- **Corollary**: (a) If $B^* = 0$, τ is increasing in trade deficits IM/EX

  (b) In general, trade imbalances are neither necessary nor sufficient to affect τ.

  (c) US balance sheet: $B > B^* > 0$. Optimal τ is lower than in financial autarky.
  - the optimal tariff is 9% vs 34% when $B = 0$, and welfare gains are 0.1% vs 0.6%
  - US trade partners accumulate B as a hedge against trade war (Dooley et al. 2004)
- Intuition: ToT manipulation versus the valuation effect (negative and $\propto B$)

Closing the Imbalance

- Budget constraint: $\underbrace{(P_H^* C_H^* - P_F^* C_F)}_{=NX} + \underbrace{(P_F^* B^* - P_H B)}_{=NFA} = 0$

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$$\mathcal{S} \equiv \frac{P_F^*}{P_H^*} = \frac{C_H^*}{C_F} \qquad \text{and} \qquad \mathcal{Q} \equiv \frac{P_F^*}{P_H} = \frac{B}{B^*}.$$

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- **Proposition**: If $NFA > 0$ and $NX < 0$ under free trade, there is a unique balanced-trade equilibrium that the planner can implement with an import tariff.

Closing the Imbalance with an Import Tariff

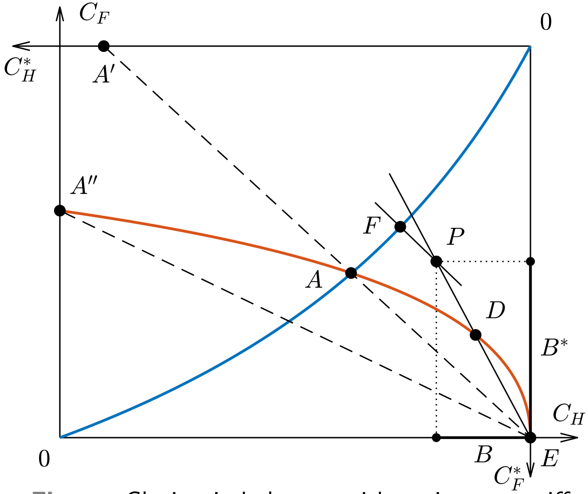

Figure: Closing imbalances with an import tariff

- rebalancing $NX\uparrow$ requires an exchange rate appreciation dictated by (B, B^*)

Closing the Imbalance: Full Set of Possibilities

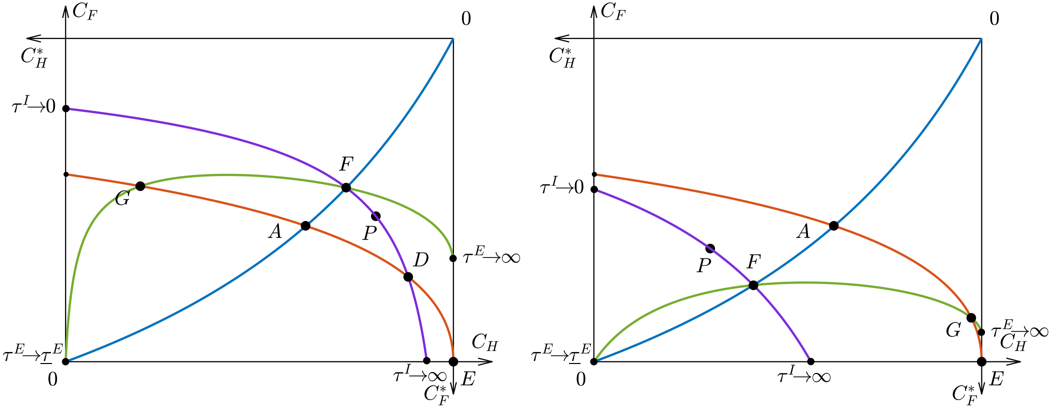

Figure: Effects of import and export tariffs under imbalances

- in contrast to Lerner symmetry under balanced trade, closing trade deficits requires an import tariff $\tau^I > 1$ or an export subsidy $\tau^E < 1$
- $\tau^I \to \infty$ does not result in $NFA = 0$ and $NX = 0$

A Model with Convenience Yields

- Home B_t and foreign B_t^*, exogenously supplied (e.g., govt debt or Lucas trees)
- Foreign households

$$\max_{\{C_t^*, B_t\}} \sum_{t=0}^{\infty} \beta^t \Big(u(C_t^*) + v_t(B_t) \Big) \text{ s.t. } Q_t B_t = (P_{Ht} + \delta Q_t) B_{t-1} + P_{Ft}^* Y_t^* - P_t^* C_t^* + T_t^*$$

- Return $R_t = \frac{P_{Ht} + \delta Q_t}{Q_{t-1}}$ for $\delta \in [0, 1]$. Euler equation:

$$Q_t = \beta \frac{u'(C_{t+1}^*)}{u'(C_t^*)} \frac{P_t^*}{P_{t+1}^*} (P_{Ht+1} + \delta Q_{t+1}) + \frac{v_t'(B_t)}{u'(C_t^*)/P_t^*}$$

- Flow budget constraint, where NFA is $\mathcal{B}_t \equiv Q_t^* B_t^* - Q_t B_t$:

$$\mathcal{B}_t = R_t^* \mathcal{B}_{t-1} + (R_t^* - R_t) Q_{t-1} B_{t-1} + NX_t,$$

Valuation Effects

- Steady state with $R < 1/\beta$ and $R^* = 1/\beta$ where:

$$Q^* = \frac{\beta}{1-\beta\delta} P_F^* \qquad \text{and} \qquad Q = \frac{1}{1-\beta\delta}\left(\beta P_H + \frac{v'(B)}{u'(C^*)/P^*}\right)$$

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- **Lemma**: The intertemporal budget constraint is equivalent to

$$NX + \frac{1-\beta}{1-\beta\delta}(P_F^* B^* - P_H B) + \frac{1-\delta}{1-\beta\delta} \cdot \frac{v'(B)B}{u'(C^*)/P^*} = 0.$$

Valuation effects are zero for equity ($\delta = 1$), highest for short-term bonds ($\delta = 0$).

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where $\bar{B}^* \equiv \frac{1-\beta}{1-\beta\delta} P_F^* B^*$ and $\bar{B} \equiv \frac{1-\beta}{1-\beta\delta} P_H B$ are flow cash payouts on home assets and liabilities, and $CY \equiv \frac{1-\delta}{1-\beta\delta} \frac{v'(B)B}{u'(C^*)/P^*}$ is the flow value of convenience yield, such that $NX + (\bar{B}^* - \bar{B}) + CY = 0$ is the country budget constraint.

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- If convenience yield is endogenous to trade war, then welfare benefits of tariff must offset the cost of loss of excess returns

Outline

Multi-country (TBC)

- The method with implementability generalizes to multiple countries

$$\max_{\{C_j^*\}} \quad u\big(\{Y_j - C_j^*\}_{j=0}^N\big) \qquad \text{s.t.} \quad \sum_{j=0}^N u_j^*\big(\{C_j^*\}\big)(Y_j^* - C_j^*) = 0.$$

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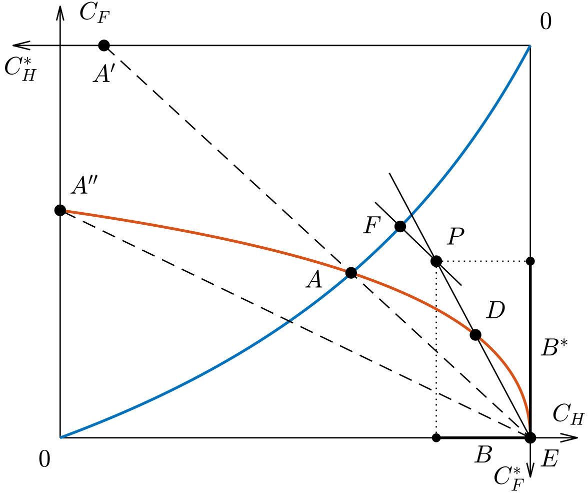
- Otherwise, things look like this...

$$\tau_j = \frac{1}{\Lambda_j^*}\left[\frac{1}{\theta}\bar{\tau}_j + \frac{\theta - 1}{\theta}\sum_{i=1}^N \alpha_{ji}\bar{\tau}_i\right], \qquad \text{where} \quad \bar{\tau}_i \equiv \sum_{j=0}^N s_{ji}\tau_j$$

Outline

Conclusion



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