# Currency Wars, Trade Wars and Global Demand

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UVA, November 18 2019

# Introduction

- Policy debate about currency wars since the global financial crisis
- A currency war can be waged with a variety of policy instruments: interest rates, foreign exchange interventions, capital controls, inflation target, forward guidance etc.
  - multilateral implications should depend on the instrument
- Now tariffs and trade wars are added to the policy mix
  - alleged equivalence between currency manipulation and tariffs
- What are the multilateral implications of these instruments in a Keynesian environment?

# Introduction

- I use a simple model with many countries and Armington assumption
- Downward nominal wage stickiness like in Schmitt-Grohé and Uribe (2016)
- Low global demand can lead to a global liquidity trap with unemployment
- Countries can increase their employment by depreciating their currency (using various instruments), by imposing a tariff on imports or subsidies on exports
- Equivalence between instruments? Multilateral implications? Case for international coordination?

# Introduction

## Literature

- International monetary coordination: Obstfeld and Rogoff (2002), Benigno and Benigno (2006), Canzoneri, Cumby and Diba (2005) etc.
- International contagion in global liquidity traps: Eggertsson et al (2016), Caballero, Farhi and Gourinchas (2015), Fujiwara et al. (2013), Devereux and Yetman (2014), Acharya and Bengui (2016), Fornaro and Romei (2019) etc.
- Fiscal devaluations: Farhi, Gopinath and Itzkhoki (2014), Correia et al (2013)
- Macro impact of trade policy: Barbiero et al (2017), Erceg, Prestipino and Raffo (2017), Lindé and Pescatori (2017)
- Two distinct features of this paper: multiplicity of policy instruments and explicit characterization of Nash equilibria (tractability through intertemporally quasi-linear preferences)

# Introduction

**Roadmap**

1. A Two-period Model
2. National Policymaking
3. Benefits of International Policy Coordination
4. Dynamic Extensions

## A Two-period Model

- World composed of a continuum of small open economies $j \in [0,1]$
- Each economy is populated by representative household with utility

$$U_1 = u(C_1) + \beta U_2$$

where $u(C) = C^{1-1/\sigma}/(1-1/\sigma)$

- In $t = 1$ consumption is the Cobb-Douglas index

$$C = \left(\frac{C_H}{\alpha_H}\right)^{\alpha_H} \left(\frac{C_F}{\alpha_F}\right)^{\alpha_F}$$

where

$$C_F = \left[\int_0^1 C_k^{(\gamma-1)/\gamma} dk\right]^{\gamma/(\gamma-1)} \qquad \gamma > 1$$

- Final utility

$$U_2 = C_{H2} + C_{F2}$$

# A Two-period Model

- Production of home good

$$Y_t = L_t$$

- Home-currency price of the home good is equal to the nominal wage, $W_t$
- The representative consumer is endowed with a fixed quantity of labor $\overline{L}$

$$L_t \leq \overline{L}$$

unemployment $\overline{L} - L_t$

# A Two-period Model

- Downward nominal stickiness in wage like in Schmitt-Grohé and Uribe (2016) or Eggertsson et al (2016)

$$\pi_t = \frac{W_t}{W_{t-1}} - 1 \geq \underline{\pi}$$

- The economy can be in two regimes: full employment ($L = \overline{L}$), or less than full employment, in which case $\pi = \underline{\pi}$
  - L-shaped Phillips curve

# A Two-period Model

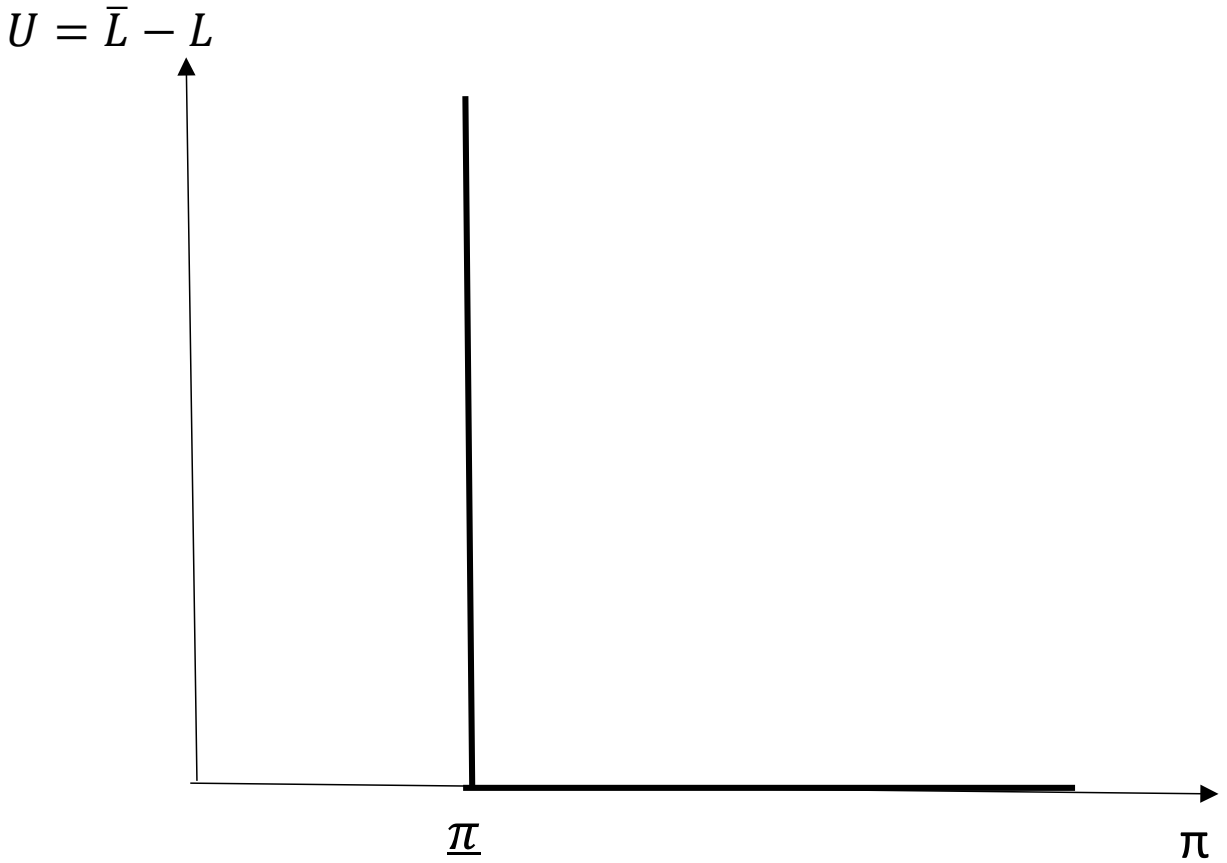



Figure: Phillips Curve

**Budget constraints**

- Period 1

$$P_1 \frac{B}{R\left(1+\tau^b\right)} + W_1 C_{H1} + \left(1+\tau^m\right) P_1 C_{F1} = W_1 L_1 + Z_1$$

$P_1$: offshore domestic-currency price of the global good
$\tau^m$: tax on imports
$B$: quantity of real bonds accumulated by the representative consumer
$\tau^b$: tax on foreign borrowing (capital inflows)
$R$: gross real interest rate in terms of the global good
$Z_1$: lump-sum rebate of the proceeds of the taxes

- One can introduce markets for money and domestic nominal bonds to endogenize the nominal interest rate $i$ (zero trade in equilibrium)

# A Two-period Model

- Period 2: full employment and no taxes so

$$W_2 C_{H2} + P_2 C_{F2} = W_2 \bar{L} + P_2 B$$

- This implies that final terms of trade $S_2 = W_2/P_2$ are equal to 1

$$S_2 = 1$$

- Final welfare

$$U_2 = \bar{L} + B$$

- Why make utility intertemporally quasi-linear: tractability and good approximation
  - the $T$-period model will inherit the properties of the 2-period model

# A Two-period Model

- Three terms of trade

$$S_1 \equiv \frac{W_1}{P_1}, \; S_1^m \equiv \frac{S_1}{1+\tau^m} \text{ and } S_1^x \equiv (1+\tau^x) S_1$$

$\tau^x$: tax on exports

- Demand for home labor

$$L_1 = \alpha_H (S_1^m)^{-\alpha_F} C_1 + (S_1^x)^{-\gamma} C_{F1}^W$$

where $C_F^W$ is world demand for imports

- BOP equation

$$\begin{aligned} \frac{B}{R} &= X \\ X &= (S_1^x)^{1-\gamma} C_{F1}^W - \alpha_F (S_1^m)^{\alpha_H} C_1 \end{aligned}$$

# National Policymaking

**Three policy areas and four instruments for each country $j$:**

- **monetary policy:** nominal interest rate $i_j$ subject to ZLB constraint
- **trade policy:** taxes $\tau_j^m$ and $\tau_j^x$
- **capital account policy:** tax on external borrowing $\tau_j^b$
  - equivalent to reserves intervention with a closed capital account (set $B_j$ instead of $\tau_j^b$)
- Inflation is set to a target $\pi^*$ when there is full employment

$$\begin{aligned} \pi_t &= \pi^* \text{ if } L_t = \overline{L} \\ &= \underline{\pi} \text{ if } L_t < \overline{L} \end{aligned}$$

(inflation is set independently of $i$ if there is full employment)

**Interest parity**

- Arbitrage between real and nominal bonds

$$1+i=R\left(1+\tau^{b}\right)\frac{P_2}{P_1},$$

- Using $S_t = W_t/P_t$ and $W_2/W_1 = 1+\pi^*$ this implies

$$S_1=\frac{1+i}{R\left(1+\tau^{b}\right)\left(1+\pi^*\right)}$$

$\rightarrow$ two policy instruments can be used in a "currency war:" $i$ and $\tau^b$ (conventional monetary policy vs. capital controls/fxi interventions)

**Euler**

- Euler equation

$$u'(C_1)(S_1^m)^{\alpha_F} = \beta \frac{1+i}{1+\pi^*}$$

  where $(S^m)^{\alpha_F}$ is price of home good in terms of home consumption

- Monetary policy affects demand in standard way: $i \nearrow$ leads to $C \searrow$

- A tariff on imports is a tax on consumption: $\tau^m \nearrow$ leads to $C \searrow$

# National Policymaking

The national social planner's (NSP) problem

$$maxU_1 = u(C_1) + \beta RX$$

over policy instruments, subject to

$$u'(C_1)(S_1^m)^{\alpha_F} = \beta \frac{1+i}{1+\pi^*}$$

$$S_1 = \frac{1+i}{R(1+\tau^b)(1+\pi^*)}$$

$$X = (S_1^x)^{1-\gamma} C_{F1}^W - \alpha_F (S_1^m)^{\alpha_H} C_1$$

$$L_1 = \alpha_H (S_1^m)^{-\alpha_F} C_1 + (S_1^x)^{-\gamma} C_{F1}^W \leq \bar{L}$$

and $i \geq 0$

**Comparative statics**

**Proposition 1.** *Consider a symmetric undistorted allocation with unemployment and assume $\sigma < 1$. Then employment and welfare are moved in the same direction by all policy instruments. The employment and welfare of a given country are increased by (i) a decrease in the nominal interest rate; (ii) an increase in the tariff on imports; (iii) a decrease in the tax on exports; (iv) an increase in the tax on capital inflows:*

$$\frac{\partial U_1}{\partial i} < 0, \ \frac{\partial U_1}{\partial \tau^m} > 0, \ \frac{\partial U_1}{\partial \tau^x} < 0, \ \frac{\partial U_1}{\partial \tau^b} > 0.$$

Condition $\sigma < 1$ ensures that **expenditure-switching** dominates **expenditure-reducing** effect when using tariff

**Equivalence results**

**Proposition 2** *(Instrument equivalence) Any allocation* $(C_H, C_F, L, \pi)$ *achieved by policy* $(i, \tau^m, \tau^x, \tau^b)$ *can also be achieved by policy* $(i, \widetilde{\tau}^m, \widetilde{\tau}^x, \widetilde{\tau}^b)$ *with*

$$\begin{aligned} (1+\widetilde{\tau}^m)(1+\widetilde{\tau}^x) &= (1+\tau^m)(1+\tau^x), \\ (1+\widetilde{\tau}^m)(1+\widetilde{\tau}^b) &= (1+\tau^m)(1+\tau^b) \end{aligned}$$

- Related to Lerner (1936), Farhi, Gopinath and Itzkhoki (2014), Costinot and Werning (2017)
- One tax is redundant
- It does not matter which tax is not used in **partial** equilibrium, but it matters in **general** equilibrium (the international spillovers are different)

# National Policymaking

- When can a floating exchange rate be a substitute to trade taxes (Meade, 1955)?
- Assume $P_1 = E_1 P_1^*$
- **Result:** The allocations achievable with a fixed exchange rate $E_1 = \overline{E}$ and trade taxes $\tau^m$ and $\tau^x$ can be replicated with a floating exchange rate and zero trade taxes if and only if

$$(1+\tau^m)(1+\tau^x) = 1$$

- Equivalent floating exchange rate given by

$$\widetilde{E}_1 = (1+\tau^m)\overline{E}$$

- The floating exchange rate must be implemented with capital controls (or forex interventions), not monetary policy
  - to keep the domestic Euler condition the same

## Benefits of International Policy Coordination

- We consider symmetric equilibria in which

$$\forall j \quad \beta_j = \beta$$

- Global market clearing conditions

$$\begin{aligned} \int X_j dj &= 0 \\ C_F^W &= \alpha_F \int \left(S_j^m\right)^{\alpha_H} C_j dj \end{aligned}$$

implies

$$\int \left(S_j^x\right)^{1-\gamma} dj = 1$$

Terms of trade in export markets must average to 1

# Benefits of International Policy Coordination

**Roadmap**

1. Spillovers
2. Global Liquidity Trap ($i$)
3. Global Social Planner
4. Trade Wars ($\tau^m$ and $\tau^x$)
5. Capital Wars ($\tau^b$)
6. Numerical Illustration

# Benefits of International Policy Coordination

**Spillovers.** Assume that a small mass $\epsilon$ of countries $j$ change their instrument $n_j = i_j, \tau_j^m, \tau_j^x, \tau_j^b$

**Table 1. International spillovers**

| | $i_j$ | $\tau_j^m$ | $\tau_j^x$ | $\tau_j^b$ |
|---|---|---|---|---|
| $U_j$ | $-\eta - \alpha_H \sigma$ | $\alpha_H \alpha_F (1-\sigma)$ | $-\alpha_F (\gamma - 1)$ | $\eta$ |
| $U_{-j}$ | $\eta - \alpha_F \sigma$ | $-\alpha_F (\alpha_H + \alpha_F \sigma)$ | $\alpha_F (\gamma - 1) - \alpha_F \sigma$ | $-\eta$ |
| $U^W$ | $-\sigma$ | $-\alpha_F \sigma$ | $-\alpha_F \sigma$ | 0 |

where $\eta = \alpha_F(\gamma - \alpha_H \sigma - \alpha_F)$ is elasticity of trade deficit w.r.t. $i$

- Positive-sum game: monetary stimulus, subsidy on exports
- Zero-sum game: capital controls (or forex interventions)
- Negative-sum game: tariff on imports

# Benefits of International Policy Coordination

Assume countries only have the interest rate as a policy instrument

A Nash equilibrium is then composed of global economic conditions $\left(R, C_F^W\right)$, monetary policies $(i_j)$ and allocations $(C_{Hj}, C_{Fj}, C_j, L_j, \pi_j)$ for all countries $j \in [0,1]$ such that: (i) the monetary policy of any country $j$ maximizes domestic welfare given the global economic conditions; (ii) country allocations satisfy the equilibrium conditions given country policies and global economic conditions; and (iii) the global markets clearing conditions are satisfied.

# Benefits of International Policy Coordination

**Proposition 3. (Conventional currency war)** *Assume that the only policy instrument available to national social planners is the nominal interest rate. Then there is a unique Nash equilibrium between national planners and the nominal interest rate is given by,*

$$i = \left( \frac{1 + \pi^*}{\beta} - 1 \right)^+$$

*There is full employment in period* 1 *if and only if* $\beta \leq 1 + \pi^*$. *If this condition is violated the global economy falls in a liquidity trap with the same level of unemployment in all countries and welfare is at the first best level.*

**Proposition 4. (Inflation target war)** *Assume that the national social planners can choose their inflation targets before period* 1. *Then in a symmetric Nash equilibrium social planners set an inflation target* $\pi^* \geq \beta - 1$ *and* $i_j = (1 + \pi^*) / \beta - 1$. *There is full employment in all countries.*

# Benefits of International Policy Coordination

**Global Social Planner (GSP)** (sets the policy instruments for the representative country)

**Proposition 5. (Global Social Planner)** *The GSP sets the interest rate like in the Nash equilibrium and the trade taxes such that* $(1+\tau^m)(1+\tau^x)=1/S^*$, *where* $S^*>1$ *satisfies*

$$(S^*)^{-\alpha_F(1-\sigma)}(\alpha_H+\alpha_F S^*)=(1+i)^{-\sigma}.$$

*If the ZLB constraint is not binding the GSP sets the trade taxes to zero. There is full employment in the GSP allocation.*

- Monetary policy is the preferred instrument to achieve full employment
- In a global liquidity trap, the GSP uses trade taxes to *subsidize* consumption

# Benefits of International Policy Coordination

**Trade wars**

Use tariffs in a global liquidity trap ($\beta > 1 + \pi^*$)

In Nash equilibrium

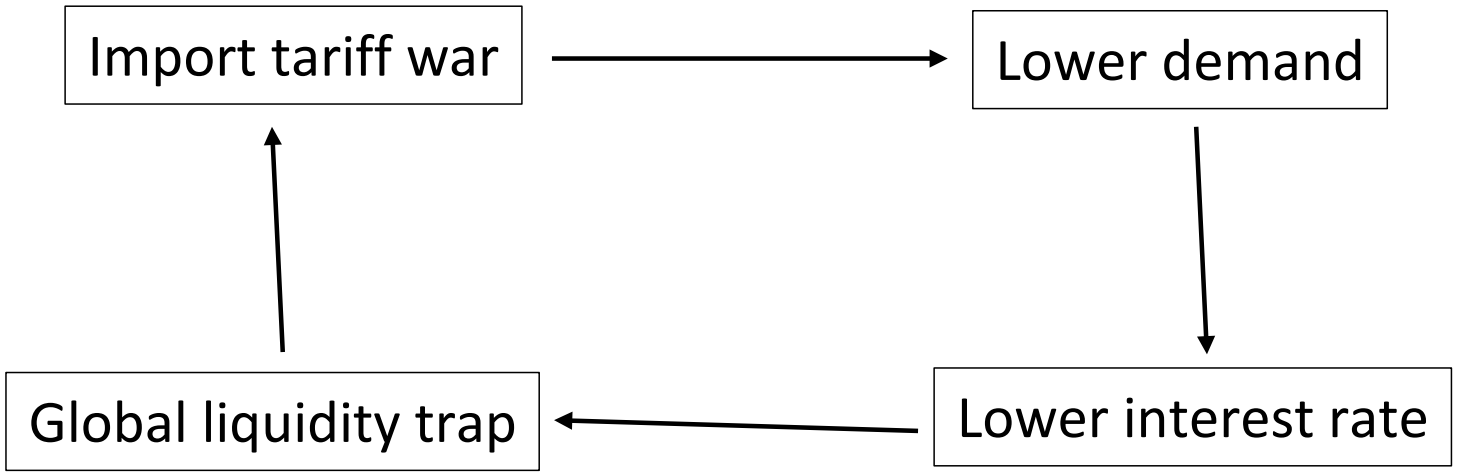
- Equilibrium tariff given by

$$\tau^m = \alpha_H \left( \frac{1}{\sigma} - 1 \right)$$

- The tariff war reduces global employment and welfare (Proposition 7)
  - a tariff war is a negative-sum game
  - the GSP (or international coordination) would set $\tau^m = 0$
- Tariff wars may lead to **self-fulfilling liquidity traps**

# Benefits of International Policy Coordination

- Tariff wars can lead to self-fulfilling liquidity traps



# Benefits of International Policy Coordination

Assume NSPs use **both tariffs on imports and subsidies on exports** ($\tau^m$ and $\tau^x$) in a global liquidity trap

- The Nash equilibrium leads to the GSP allocation with full employment (Proposition 9)
- There is no benefit from international coordination
- It is crucial, in a trade war, whether NSPs use export subsidies

# Benefits of International Policy Coordination

**Capital wars** National social planners can use $i, \tau^b$

**Proposition 10.** *Assume all national social planners can use the tax on capital inflows $\tau^b$ in a global liquidity trap. There is a symmetric Nash equilibrium if and only if $\gamma \leq 2$. The level of the tax in this equilibrium is given by*

$$\tau^b = \frac{\gamma - \alpha_H \sigma - \alpha_F}{\sigma}. \tag{1}$$

*Employment and welfare are the same as in the equilibrium without capital control. The global social planner is indifferent about the level of $\tau^b$, and there is no benefit from international policy coordination.*

- What if $\gamma > 2$? (true under baseline calibration)

# Benefits of International Policy Coordination

**Symmetry breaking if $\gamma > 2$**

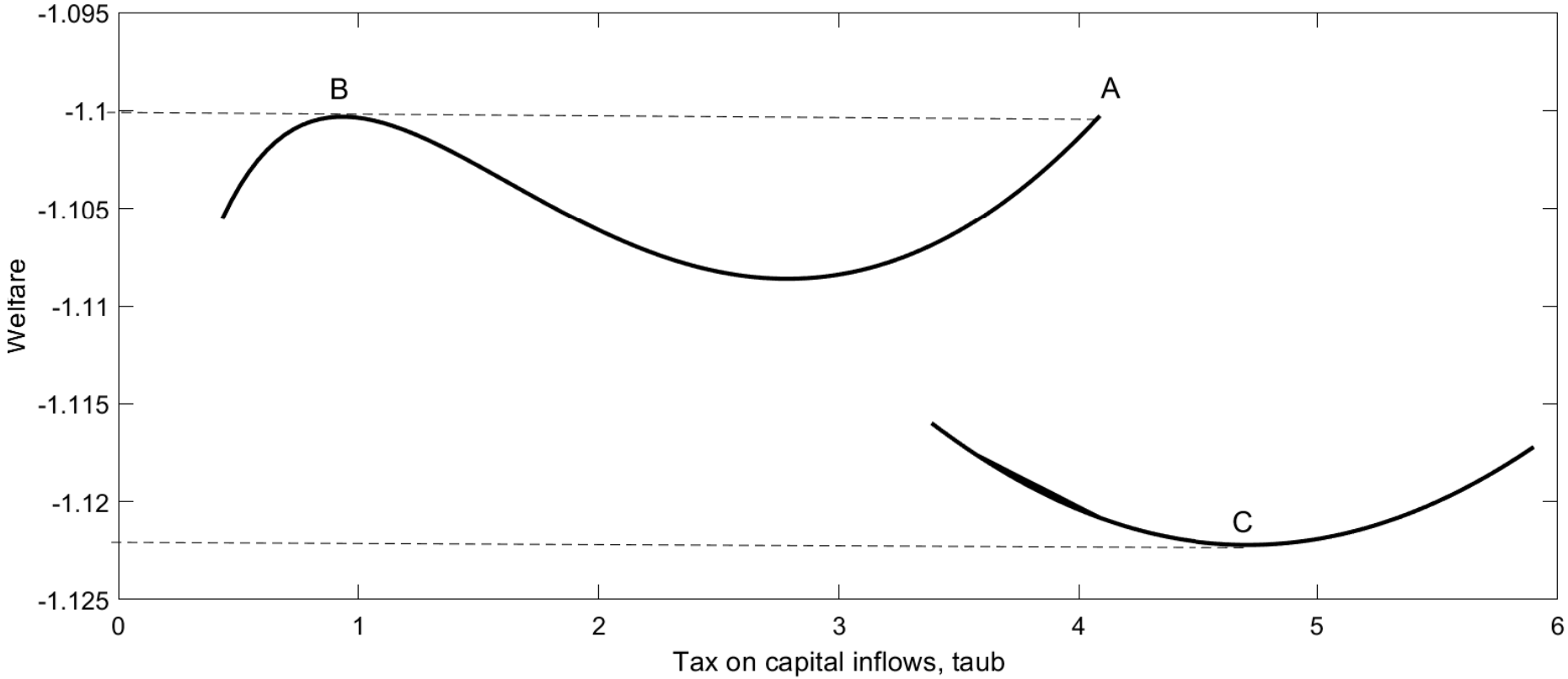



Figure: Variation of welfare with tax on capital inflows in symmetric allocation and Nash equilibrium

# Benefits of International Policy Coordination

- If $\gamma > 2$ the global economy endogenously divides itself into two groups of countries in a capital war
  1. countries with a more competitive currency, a trade surplus, and full employment
  2. countries with a less competitive currency, a trade deficit and some unemployment
- The deficit countries suffer from unemployment and the surplus countries suffer from the low return that they received on their foreign assets
- In equilibrium the welfare of surplus countries and deficit countries is the same

# Benefits of International Coordination

**Numerical illustration**

Benchmark calibration

| $\sigma$ | $\gamma$ | $\alpha_H$ | $\bar{L}$ |
|---|---|---|---|
| 0.5 | 3 | 0.6 | 1 |

$\gamma$ consistent with micro elasticity estimates of Feenstra et al (2018)

# Benefits of International Coordination

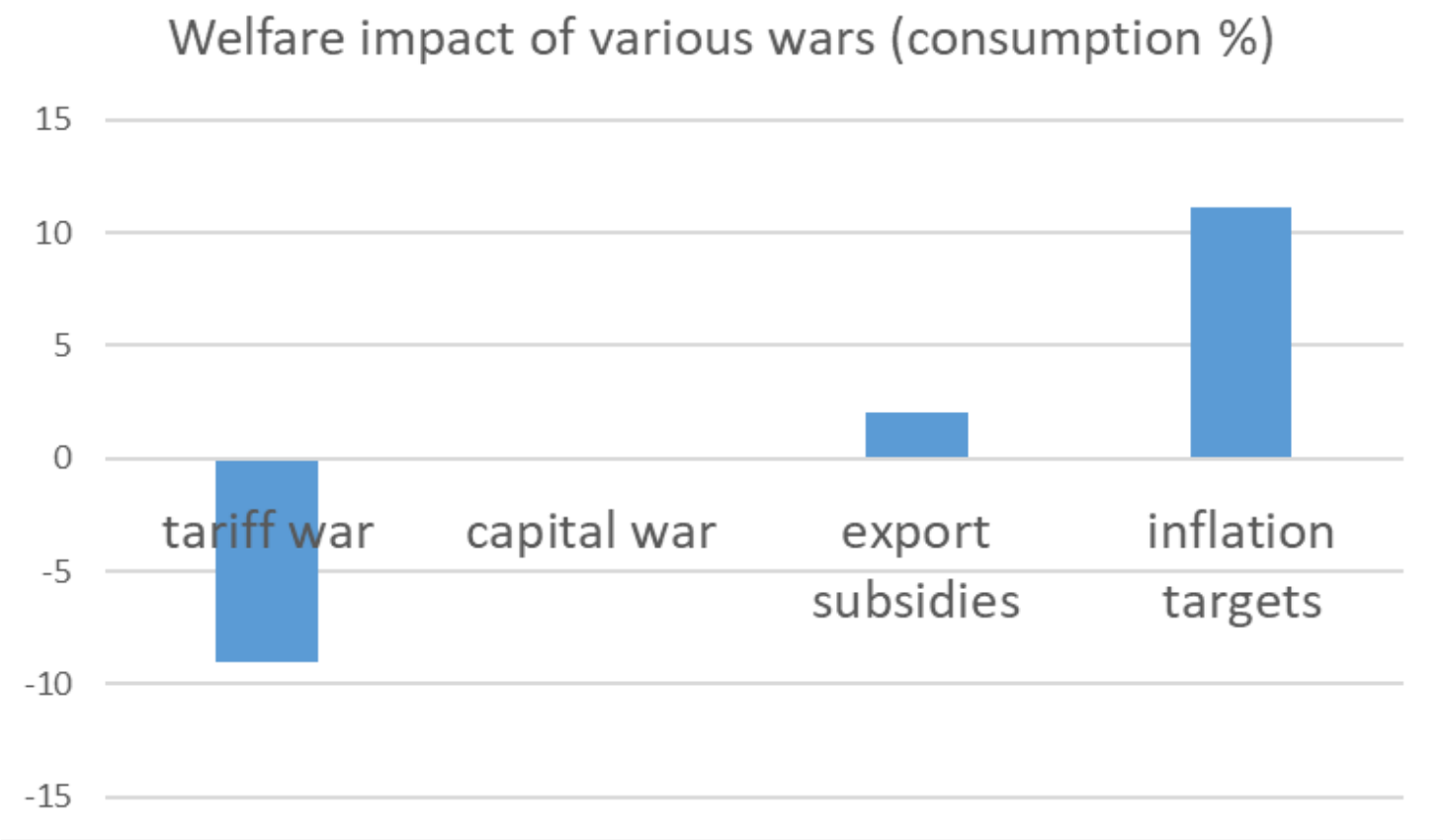



Figure: Impact of trade and currency wars on welfare

## Dynamic Extensions

- A $T$-period model inherits the properties of the 2-period model provided that it is intertemporally quasi-linear
- Assume time $t = 1, 2, ..., T$ where $T$ is arbitrarily large
- Domestic welfare

$$U_t = u(C_t) + \beta_t U_{t+1}$$

for $t < T$ and

$$U_T = C_{HT} + C_{FT}$$

- National social planners set domestic policies in each period $t$ in a time consistent way (no commitment) so as to maximize domestic welfare, taking global economic conditions $(r_t)_{t=1,...,T-1}$ and $\left(C_{Ft}^W\right)_{t=1,...,T}$ as given
  - **no commitment**: hence policy changes are perceived to be temporary

# Dynamic Extensions

$$U_1 = \sum_{t=1}^{T-1} \left( \prod_{t'=1}^{t-1} \beta_{t'} \right) \underbrace{\left[ u\left(C_t\right) + \left( \prod_{t'=t}^{T-1} \beta_{t'} R_{t'} \right) X_t \right]}_{V_t}.$$

$$\begin{aligned} X_t &= \left(S_t^x\right)^{1-\gamma} C_{Ft}^W - \alpha_F \left(S_t^m\right)^{\alpha_H} C_t \\ S_t &= \prod_{t'=1}^{T-1} \frac{1+i_{t'}}{R_{t'}\left(1+\tau_{t'}^b\right)\left(1+\pi_{t'+1}\right)} \\ u'\left(C_t\right)\left(S_t^m\right)^{\alpha_F} &= \prod_{t'=t}^{T-1} \beta_{t'} \frac{1+i_{t'}}{1+\pi_{t'+1}} \end{aligned}$$

# Dynamic Extensions

We look at subgame perfect Nash equilibria between national social planners

**Proposition 11.** *Assume that the only policy instrument available to national social planners if the nominal interest rate. Then there is a unique subgame perfect Nash equilibrium between national planners. There is full employment in all periods if and only if the condition* $\beta_t \leq 1 + \pi^*$ *is satisfied for all* $t$*. The global economy is in a liquidity trap with less than full employment in any period in which this condition is violated.*

**Proposition 12.** *Assume that the national social planners can use tariffs on imports in a period* $t$ *with unemployment. Then the equilibrium tariff is the same as in the 2-period model.*

# Dynamic Extensions

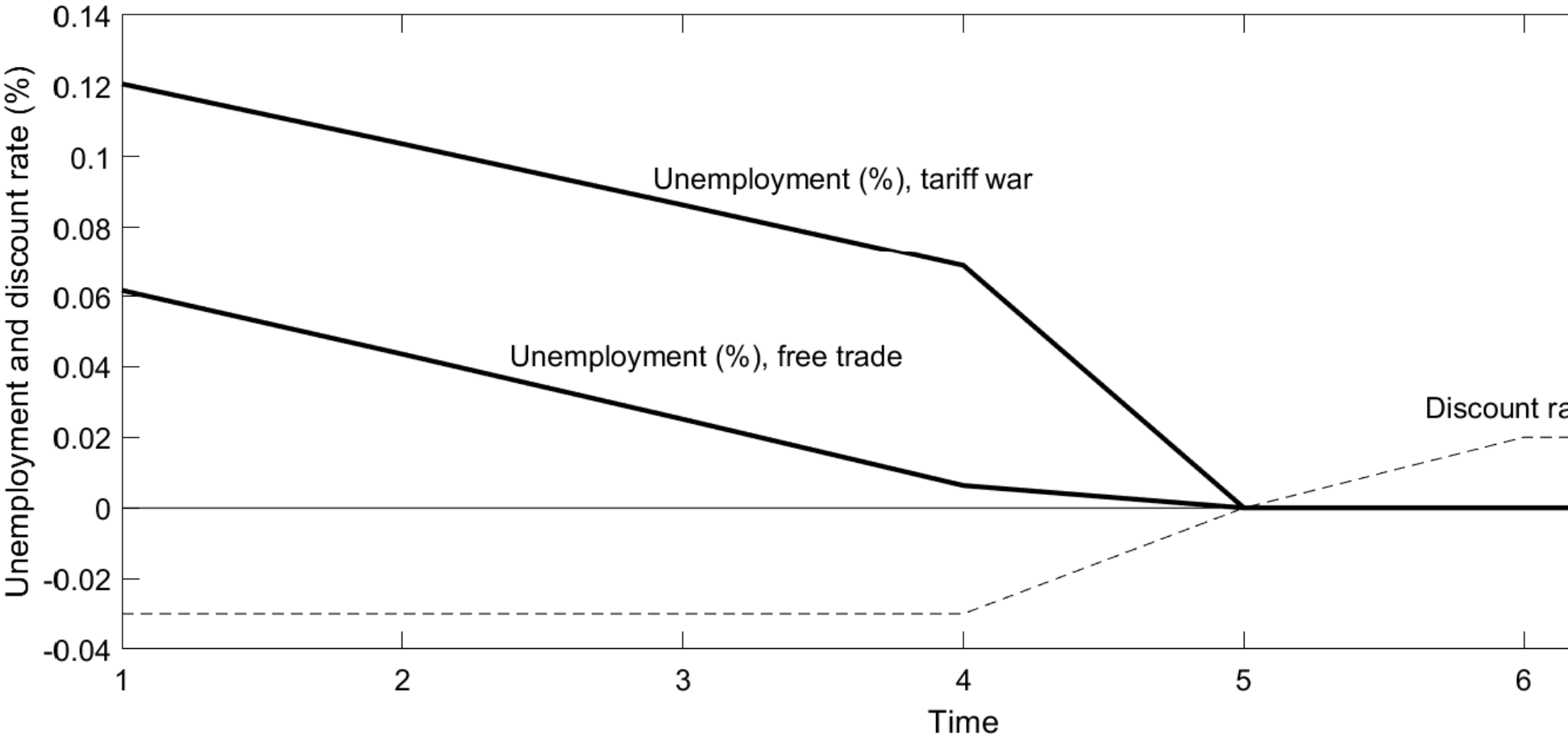



Figure: Unemployment rate in a dynamic trade war

# Conclusions

## Summary

- "Currency wars" and "trade wars" are loose concepts: the policy instruments crucially matter
  - for example, a trade war has opposite welfare implications if it involves tariff imports or export subsidies
  - partial equilibrium equivalence results may be misleading
- The welfare cost of uncoordinated policies also depend on the state of global demand
- The welfare gains from international policy coordination are large when it avoids an import tariff war in a context of low global demand
  - import tariffs seem to be the instrument of choice in the real world

# Conclusions

**Possible extensions**

1. Asymmetric equilibria in which only a subset of countries use certain instruments, or with regional saving gluts
2. Study how the incentives to deviate from free trade depend on global demand
3. How do the results depend on assumptions about pricing?
    - Calvo nominal stickiness
    - LCP or DCP instead of PCP