Exchange Rate Policies at the Zero Lower Bound (International Spillovers with Limited Capital Mobility)

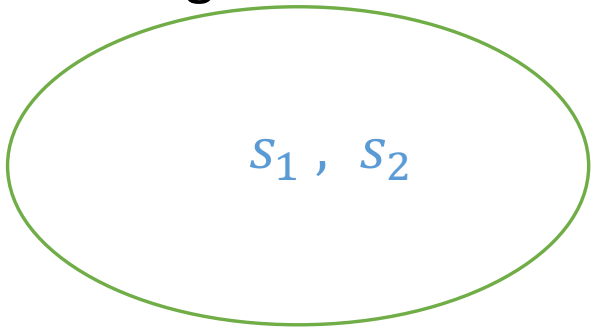
Manuel Amador, Javier Bianchi, Luigi Bocola, Fabrizio Perri

MPLS Fed and UMN MPLS Fed Northwestern MPLS Fed

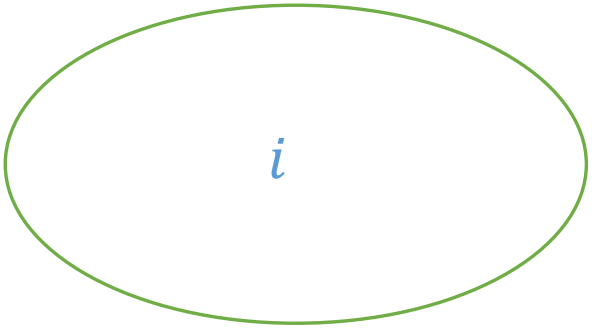
Twentieth Annual Conference of the Central Bank of Chile
Monetary Policy and Global Spillovers: Mechanisms, Effects and Policy Measures
October 2016

The Mundellian Trilemma

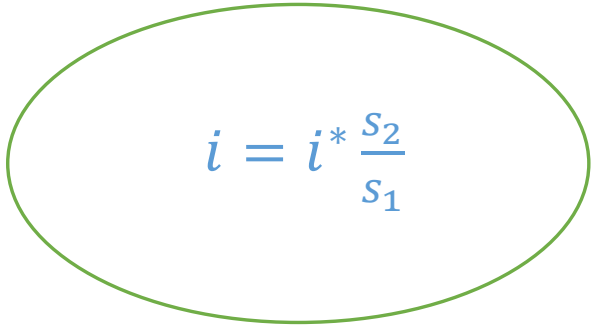
Exchange Rate Policies



Interest Rate Policies



International Capital Mobility



Abandoning Capital Mobility?

- What are, exactly, limits to capital mobility (CM)?
- How do limits to CM interact with and constrain policy choices?

Abandoning Capital Mobility?

- What are, exactly, limits to capital mobility (CM)?
- How do limits to CM interact with and constrain policy choices?
- How do restriction to policy choices (i.e. zero lower bound, exchange rate policies) interact with CM?
- How do changes in external conditions (International spillovers) affect policy/welfare?

Today

- Simple framework of the Mundellian trilemma with limited capital mobility (limits to arbitrage) to answer these questions

Today

- Simple framework of the Mundellian trilemma with limited capital mobility (limits to arbitrage) to answer these questions
- Results:
  - With limited CM independent exchange rate and interest policies can be pursued, at a cost of losing resources to foreigners
  - Following fixed exchange rate and interest policies (ZLB), with varying external conditions can impose high cost on domestic economy
- Case study: Switzerland

Environment

- Two period, one good, deterministic, open monetary economy

Environment

- Two period, one good, deterministic, open monetary economy
- Three agents
  1. Households:
     - Endowments, standard consumption/saving problem, hold money
  2. Foreign investors:
     - Buy domestic/foreign assets, have limited wealth $\bar{w}$
  3. Central Bank:
     - Issues money (M), buys domestic/foreign assets (A, F)
     - Implements exchange rate policy (s_1, s_2), with $s_1 > s_2$ i.e. keeps exchange rate depreciated for a while.

Notation

- Price of good abroad constant and normalized at 1
- Exchange rate:
  - s_t = # of domestic currency per foreign currency
- Law of one price holds: $P_t = s_t$
- Nominal interest rate on domestic currency assets: $1 + i$
- Real interest rate on domestic currency assets: $(1 + i)\frac{s_1}{s_2}$
- Real interest rate on foreign currency assets, $1 + i^\star$
- Money does not pay interest

Households

$$U(c_1, c_2, m) = \max_{c_1, c_2, f \geq 0, a, m} u(c_1) + h\left(\frac{m}{s_1}\right) + \beta u(c_2)$$

$$\begin{aligned} y_1 + T_1 &= c_1 + \frac{m + a}{s_1} + f \\ y_2 + T_2 &= c_2 - \frac{(1+i)a + m}{s_2} - (1 + i^*)f \end{aligned}$$

- Borrow/save in domestic assets a. Foreign assets $f \geq 0$
- $h' \geq 0, h'' \leq 0$ and satiation level

Households: domestic and foreign bonds

- Domestic bonds FOC

$$u'(c_1) = \beta(1+i)\frac{s_1}{s_2}u'(c_2)$$

- Foreign bonds FOC

$$u'(c_1) \geq \beta(1+i^\star)u'(c_2)$$

$\rightarrow$ In equilibrium

$$\boxed{(1+i) \geq (1+i^*)\frac{s_2}{s_1}}$$

- Equality $\Rightarrow$ standard interest rate parity condition

$$(1+i) = (1+i^*)\frac{s_2}{s_1} \qquad \text{(IP)}$$

- Inequality strict, domestic rate is high $\rightarrow f = 0$

Households: Money demand

- Money FOC

$$h'\left(\frac{m}{s_1}\right) = \frac{i}{1+i}\frac{\lambda_2}{s_2}$$

which implies that $i \geq 0$ (i.e., the ZLB)

Foreigners

- Have limited initial wealth $\bar{w}$ and can't go short
  limits to international arbitrage.
- Invest at home in either assets or money, $a^\star, m^\star$ or internationally in foreign assets f^*
- Linear. Maximize their return:

$$\max_{f^\star \geq 0, a^\star \geq 0, m^\star \geq 0} c^*$$

s.t.:

$$\bar{w} = f^\star + \frac{a^\star + m^\star}{s_1}$$

$$c^\star = (1 + i^\star) f^\star + (1 + i) \frac{a^\star}{s_2} + \frac{m^\star}{s_2}$$

Foreigners

- Have limited initial wealth $\bar{w}$ and can't go short
  limits to international arbitrage.
- Invest at home in either assets or money, $a^\star, m^\star$ or internationally in foreign assets f^*
- Linear. Maximize their return:

$$\max_{f^\star \geq 0, a^\star \geq 0, m^\star \geq 0} c^*$$

s.t.:

$$\bar{w} = f^\star + \frac{a^\star + m^\star}{s_1}$$

$$c^\star = (1 + i^\star) f^\star + (1 + i)\frac{a^\star}{s_2} + \frac{m^\star}{s_2}$$

- If (IP) violated, foreigners invest all $\bar{w}$ at home

Central Bank

- Implements given exchange rate policy, s_1, s_2 and nominal interest rate policy i
- Issues money, M, redeemed at exchange rate in period 2
- Buys foreign reserves, F and domestic assets, A
- Transfers profits/losses to households, T_1, T_2

$$\frac{M}{s_1} + T_1 = F + \frac{A}{s_1}$$

$$(1 + i^\star)F + (1 + i)\frac{A}{s_2} = \frac{M}{s_2} + T_2$$

$$M \geq 0; F \geq 0$$

Equilibrium

1. HH max. utility
2. Foreign lenders maximize return
3. CB budget constraint holds
4. Market clearing for money and domestic assets

$$\begin{aligned} m + m^\star &= M \\ a + a^\star + A &= 0 \end{aligned}$$

Central bank policies in a real economy

- Forget exchange rates and money
- Let r and r^* be domestic and foreign real rates
- Let $\tilde{y}_1 = y_1 - F$ and $\tilde{y}_2 = y_2 + F(1 + r^*)$ (central bank interventions intertemporally shift the endowments)

Household IBC

$$\underbrace{c_1 + \frac{c_2}{1+r}}_{\text{Present value of consumption}} = \underbrace{y_1 + \frac{y_2}{1+r}}_{\text{Present value of income}} - \underbrace{\left[1 - \frac{1+r^*}{1+r}\right] F}_{\text{Intervention loss}}$$

Central bank policies in a real economy

- Forget exchange rates and money
- Let r and r^* be domestic and foreign real rates
- Let $\tilde{y}_1 = y_1 - F$ and $\tilde{y}_2 = y_2 + F(1 + r^*)$ (central bank interventions intertemporally shift the endowments)

Household IBC

$$\underbrace{c_1 + \frac{c_2}{1+r}}_{\text{Present value of consumption}} = \underbrace{y_1 + \frac{y_2}{1+r}}_{\text{Present value of income}} - \underbrace{\left[1 - \frac{1+r^*}{1+r}\right] F}_{\text{Intervention loss}}$$

- If $r = r^*$ (perfect CM) interventions irrelevant, CB cannot affect real rate, trilemma

Central bank policies in a real economy

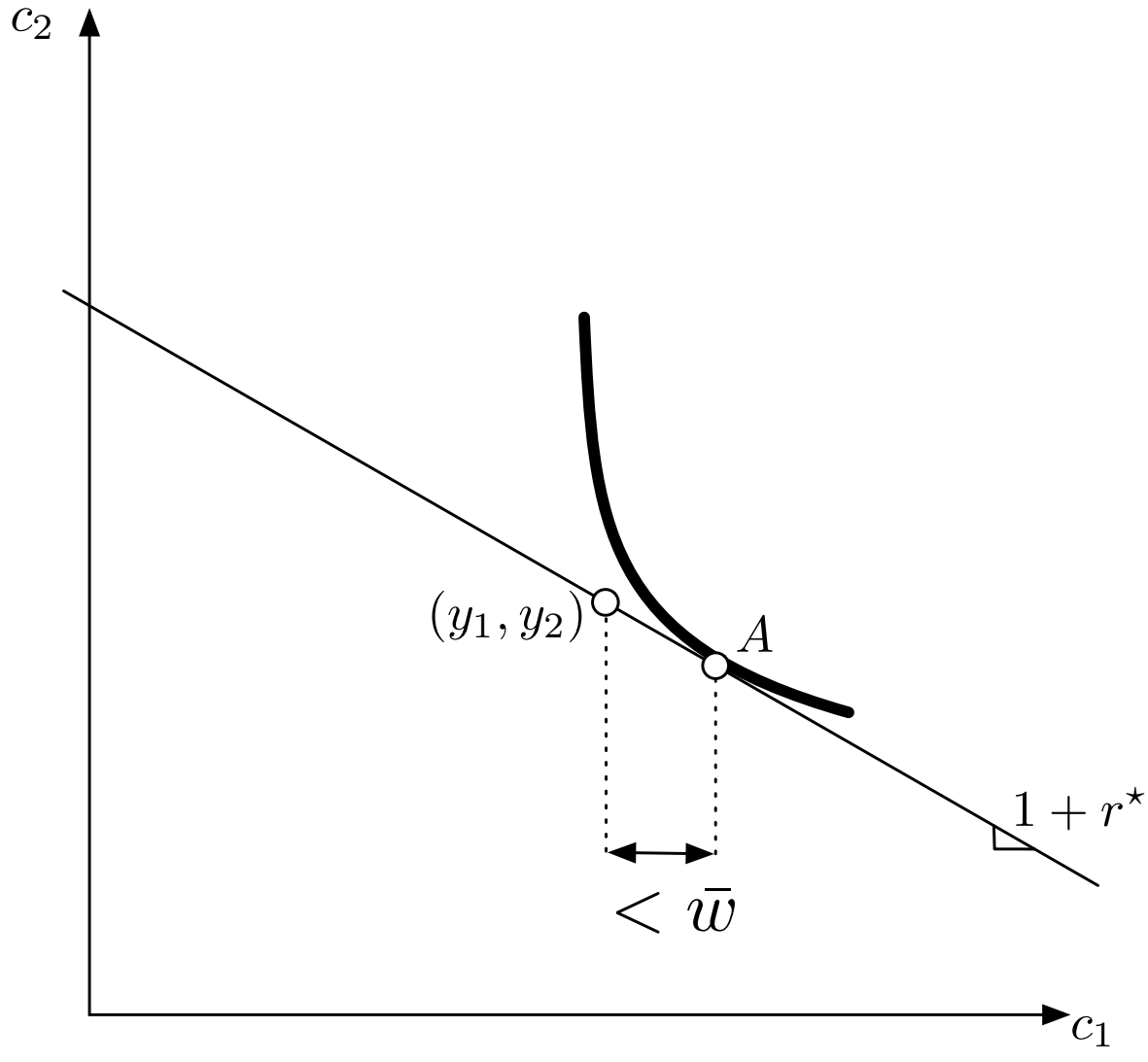
- Forget exchange rates and money
- Let r and r^* be domestic and foreign real rates
- Let $\tilde{y}_1 = y_1 - F$ and $\tilde{y}_2 = y_2 + F(1 + r^*)$ (central bank interventions intertemporally shift the endowments)

Household IBC

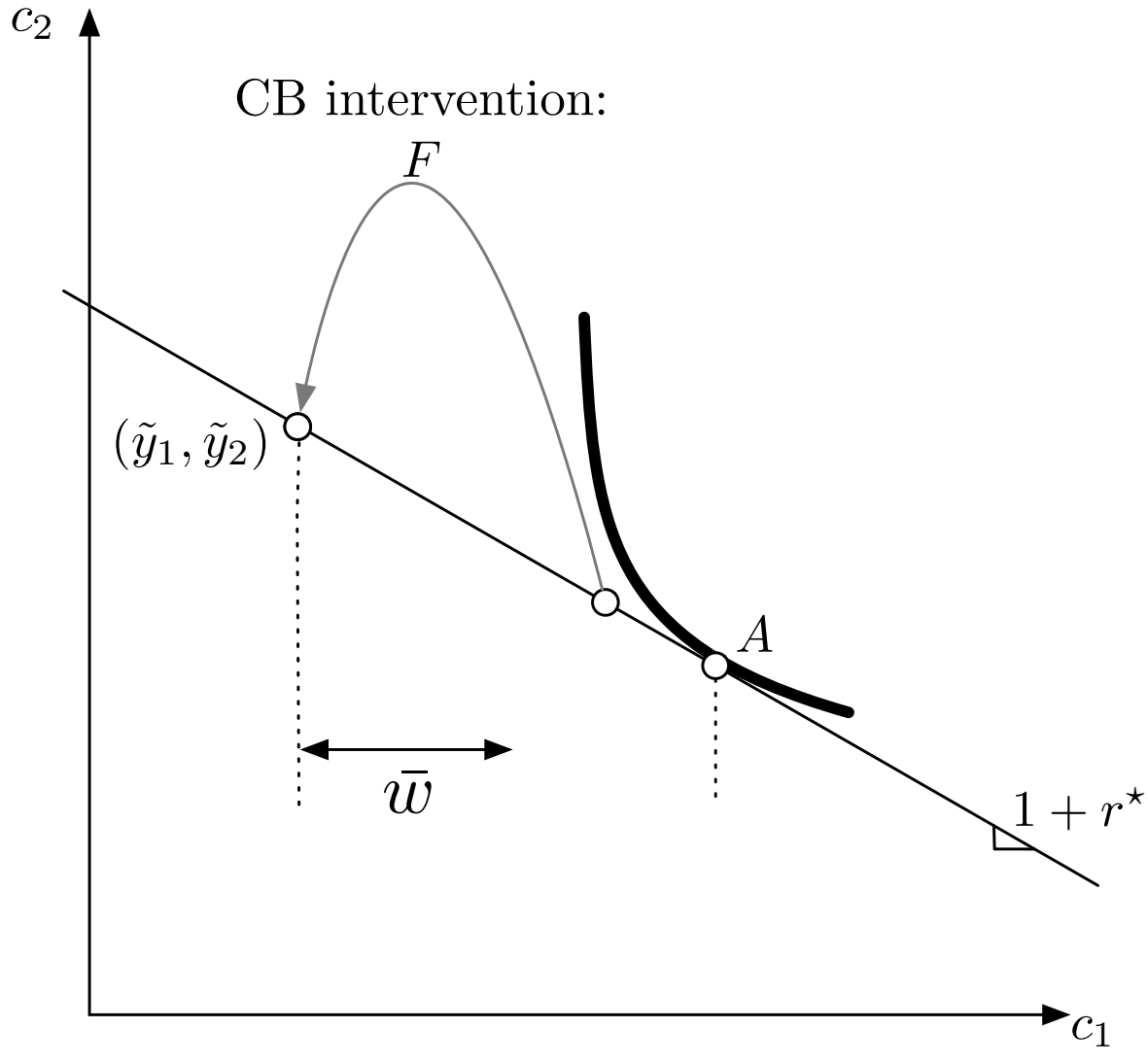
$$\underbrace{c_1 + \frac{c_2}{1+r}}_{\text{Present value of consumption}} = \underbrace{y_1 + \frac{y_2}{1+r}}_{\text{Present value of income}} - \underbrace{\left[1 - \frac{1+r^*}{1+r}\right] F}_{\text{Intervention loss}}$$

- If $r = r^*$ (perfect CM) interventions irrelevant, CB cannot affect real rate, trilemma
- If $r > r^*$ (limited CM), interventions can affect real rate, costly
- Central Bank Interventions F determine r and cost

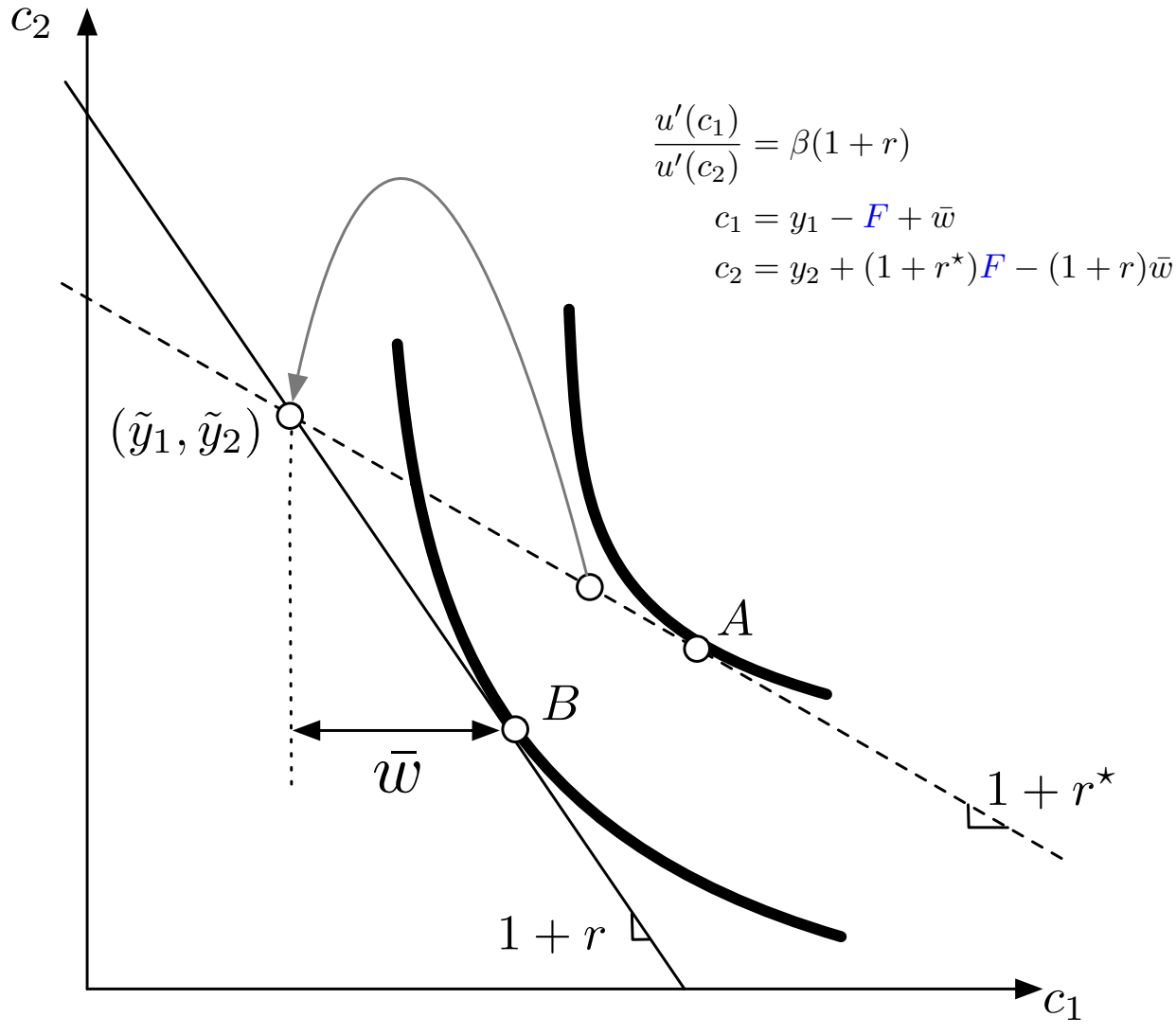
The effect of interventions



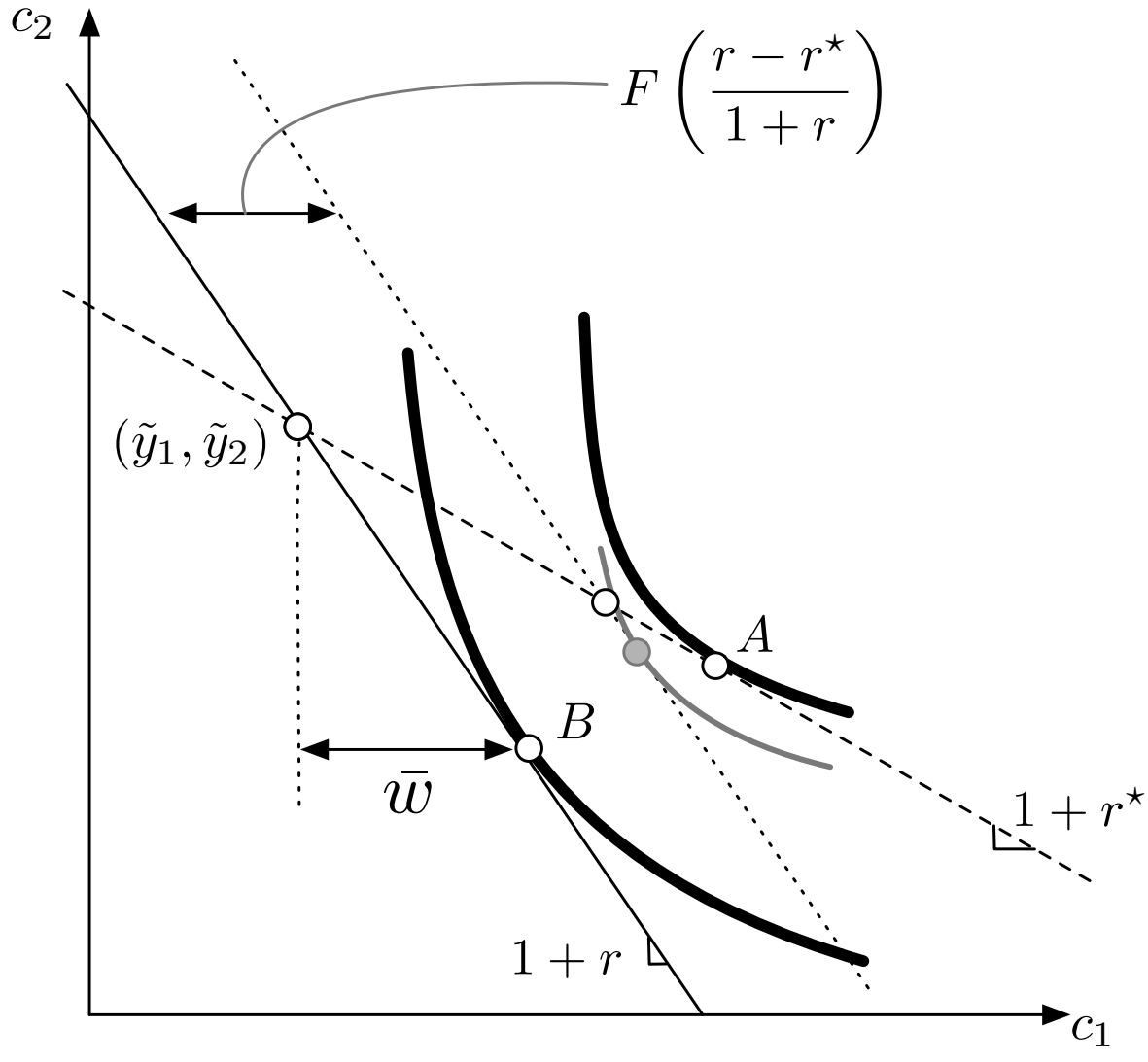
The effect of interventions



The effect of interventions



The effect of interventions



Interventions in Non Monetary Equilibria

- If $\bar{w}$ large enough: neutral, as households undo their effect with borrowing
- If $\bar{w}$ not large enough, CB forces private agents to compete to borrow scarce foreign resources, driving up borrowing rates (rent for foreigners, Costinot et al. 2014), while saving at low foreign rate
  - Generates arbitrage losses: $\left[1 - \frac{1+i^*}{1+r}\right] F$
  - Allow CB to set independent real rate

Why would CB incur these losses?

Return to Monetary Equilibria

- Suppose $i^* = 0$ and CB wants $\frac{s_2}{s_1} < 1$
- Exchange rate policy implies that domestic i consistent with parity negative...
- .. but negative i NOT an equilibrium because of M
- hence $i = 0$, and $i = 0$ is above parity (i.e. $r > r^*$) so both foreigners and domestic agents go all in domestic assets (or money), NOT an equilibrium in domestic asset markets

Why would CB incur these losses?

Return to Monetary Equilibria

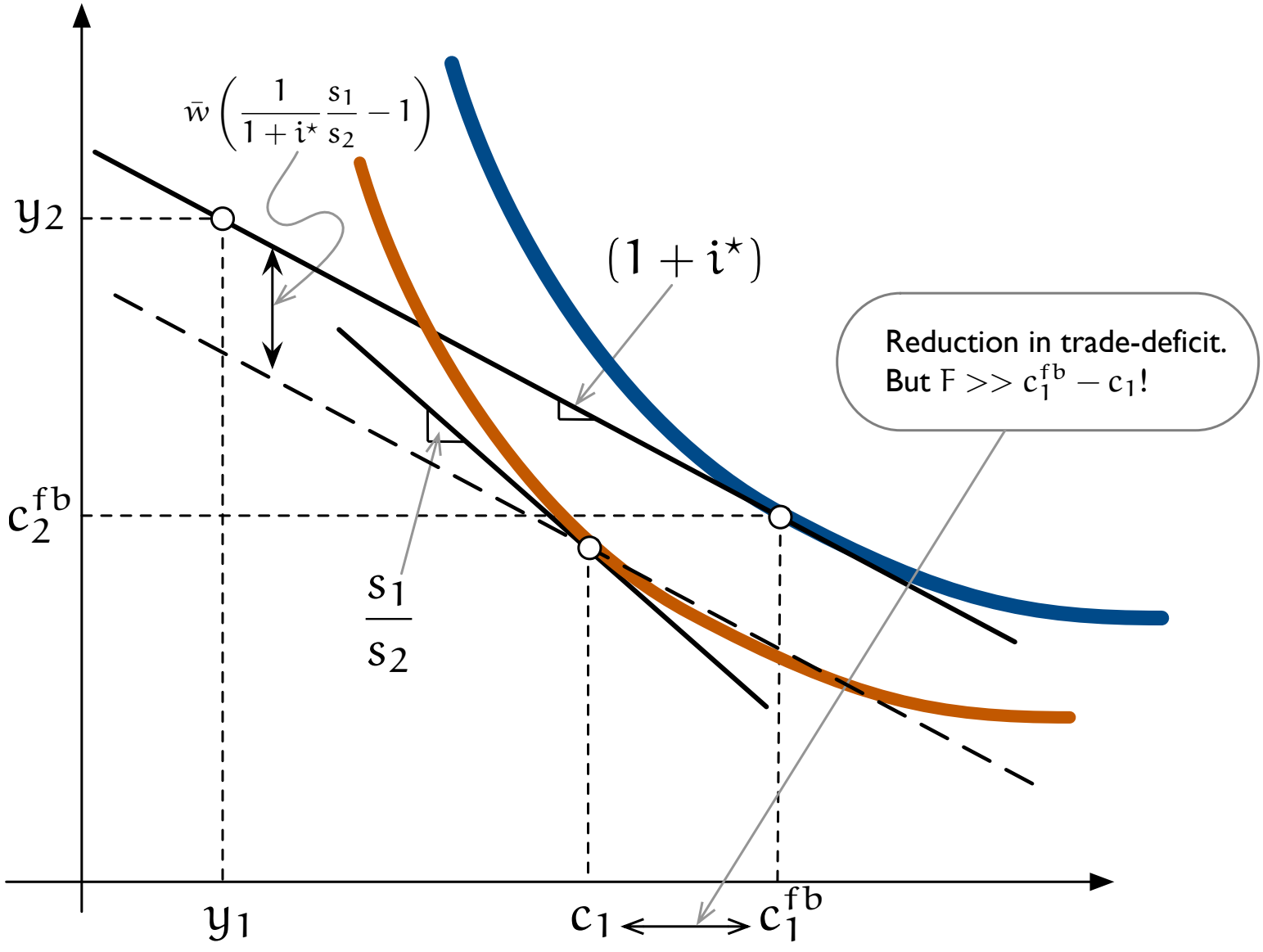
- Suppose $i^* = 0$ and CB wants $\frac{s_2}{s_1} < 1$
- Exchange rate policy implies that domestic i consistent with parity negative...
- .. but negative i NOT an equilibrium because of M
- hence $i = 0$, and $i = 0$ is above parity (i.e. $r > r^*$) so both foreigners and domestic agents go all in domestic assets (or money), NOT an equilibrium in domestic asset markets
- Equilibrium restored by costly CB interventions
- Interventions (achieved simply by maintaining peg) make domestic agents poorer (esp. today), curb their saving

Why would CB incur these losses?

Return to Monetary Equilibria

- Suppose $i^* = 0$ and CB wants $\frac{s_2}{s_1} < 1$
- Exchange rate policy implies that domestic i consistent with parity negative...
- .. but negative i NOT an equilibrium because of M
- hence $i = 0$, and $i = 0$ is above parity (i.e. $r > r^*$) so both foreigners and domestic agents go all in domestic assets (or money), NOT an equilibrium in domestic asset markets
- Equilibrium restored by costly CB interventions
- Interventions (achieved simply by maintaining peg) make domestic agents poorer (esp. today), curb their saving
- Cost allows CB to follow a desired exchange rate policy (escape trilemma)

Monetary Equilibria at the ZLB



Relation to Closed Economy ZLB

- In both cases problem is "too much saving"
- In closed economy (e.g. Christiano, Eichenbaum and Rebelo, 2011) equilibrium restored by current recession that reduces desired saving

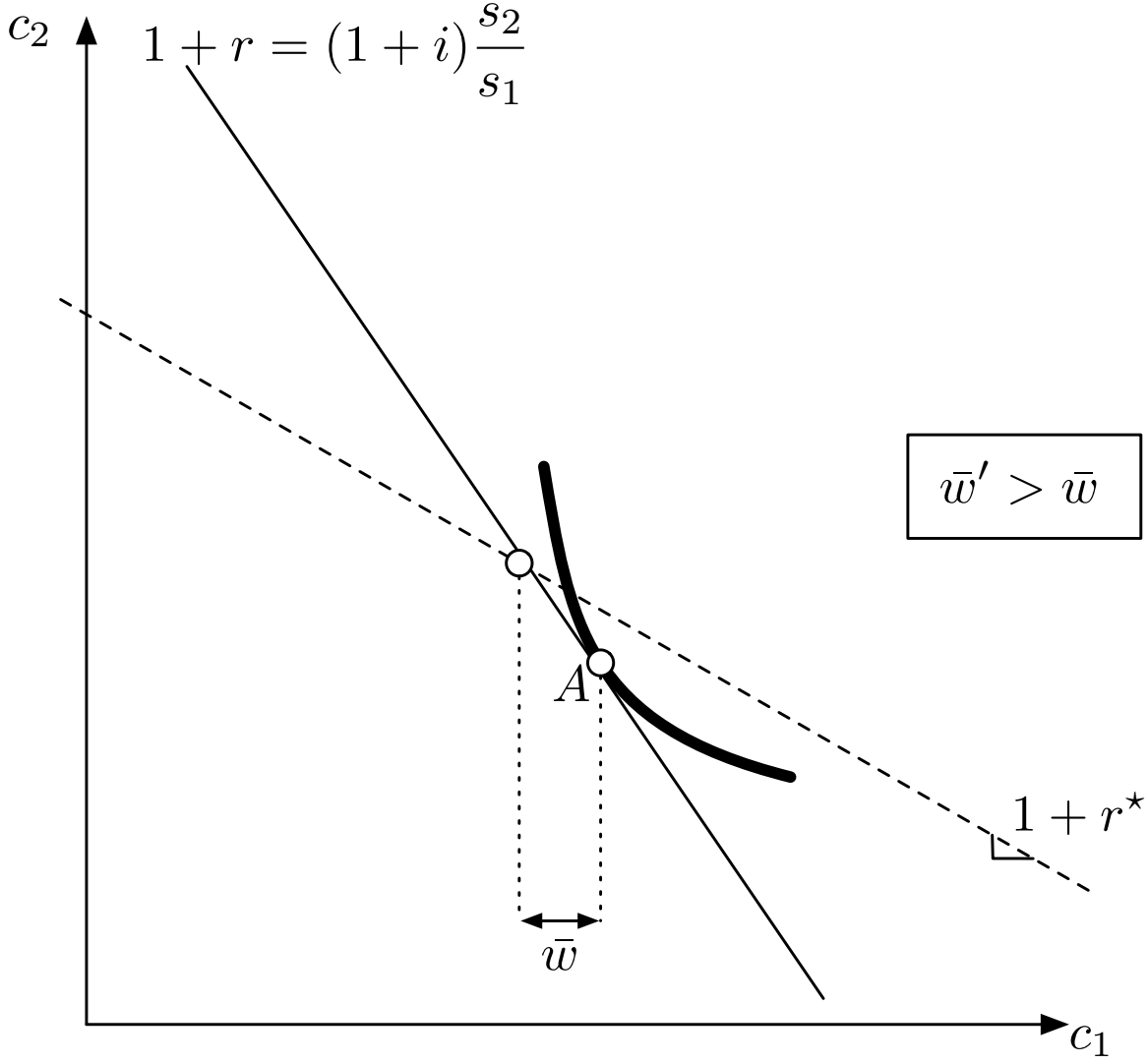
Relation to Closed Economy ZLB

- In both cases problem is "too much saving"
- In closed economy (e.g. Christiano, Eichenbaum and Rebelo, 2011) equilibrium restored by current recession that reduces desired saving
- Here central bank intervention mops up the saving, creating losses and lowering current consumption until equilibrium is restored
- Notice that no deliberate action by the CB is required, just maintaining the peg in face of increasing demand for domestic assets!

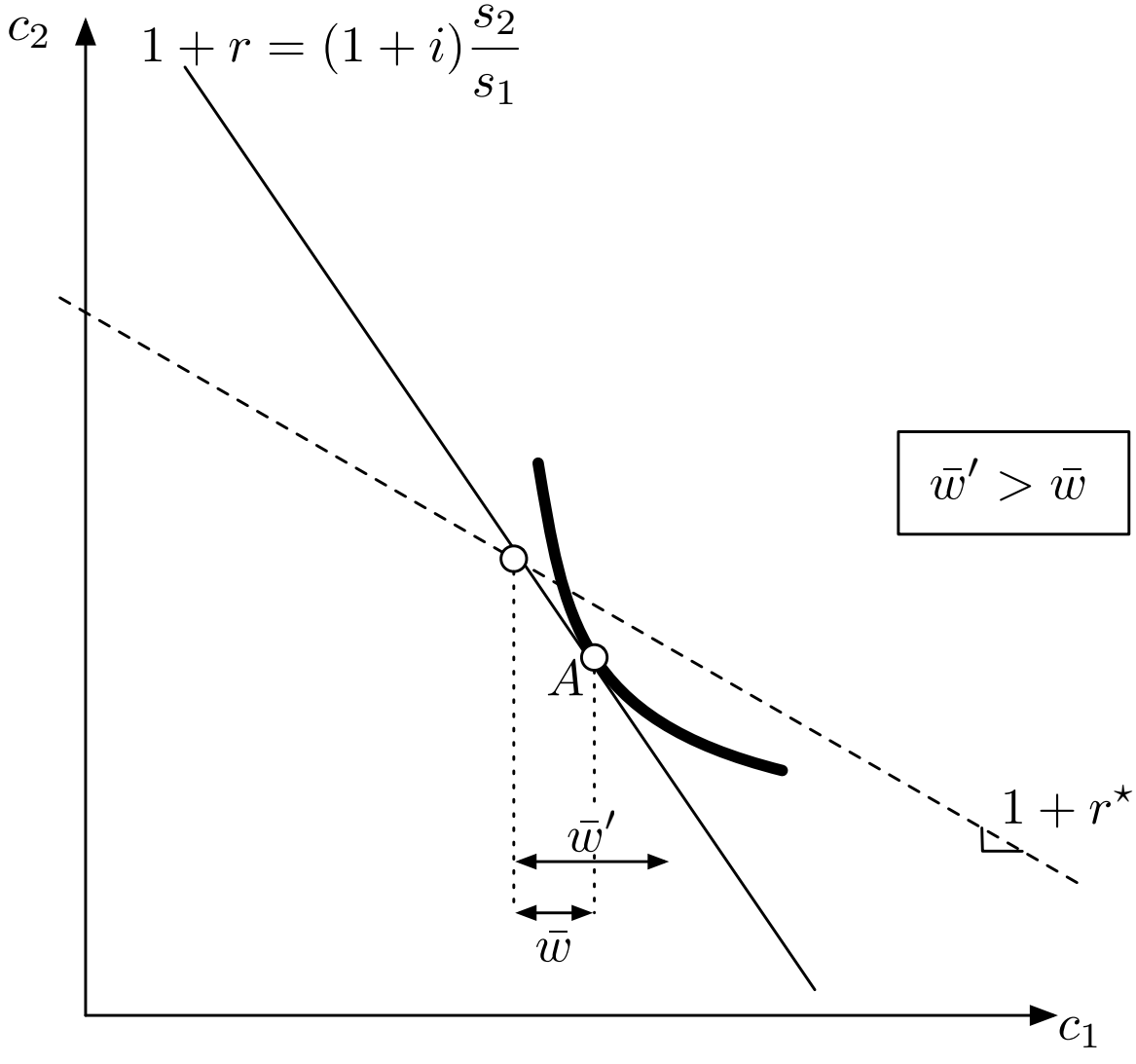
International Spillovers

- Spillovers
  - More financial integration (high $\bar{w}$)
    - Beneficial when domestic policies flexible
    - Costly when domestic policies constrained (ZLB)
  - Lower international rates: same
  - Irrational speculators: same
- Additional Policies
  - Capital Controls
  - Negative Interest rates

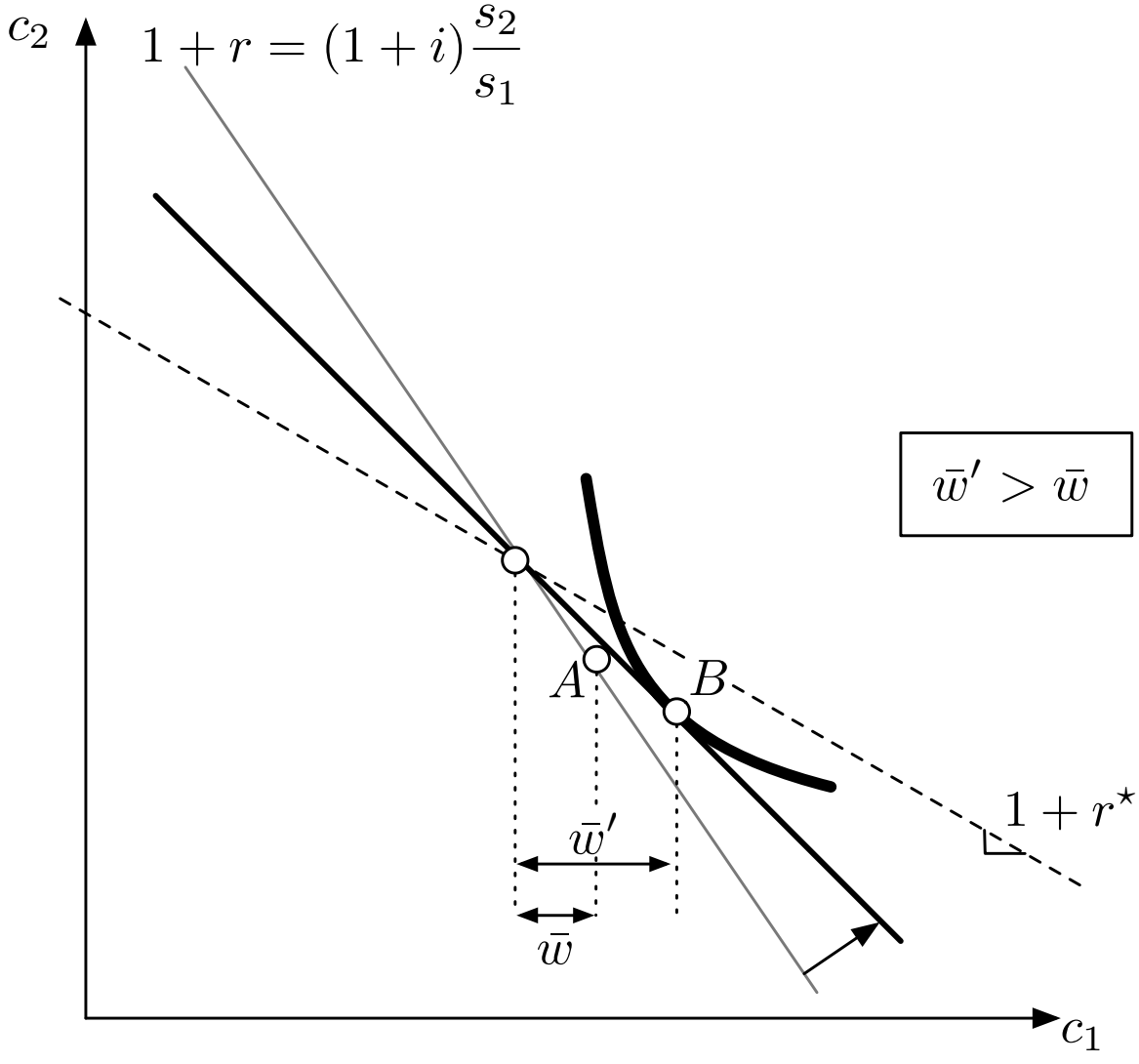
More integration (higher $\bar{w}$) with flexible policies



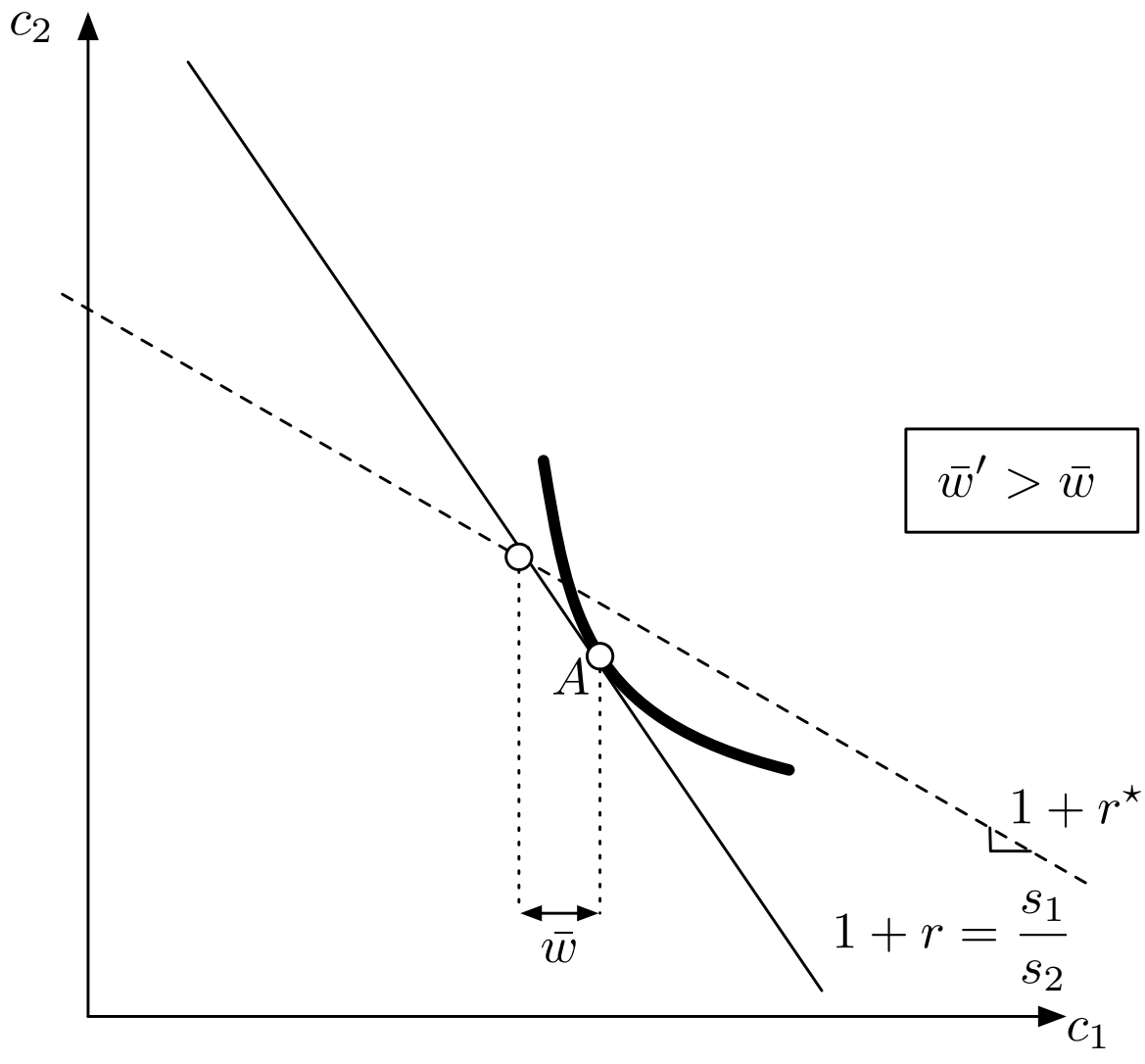
More integration with flexible policies



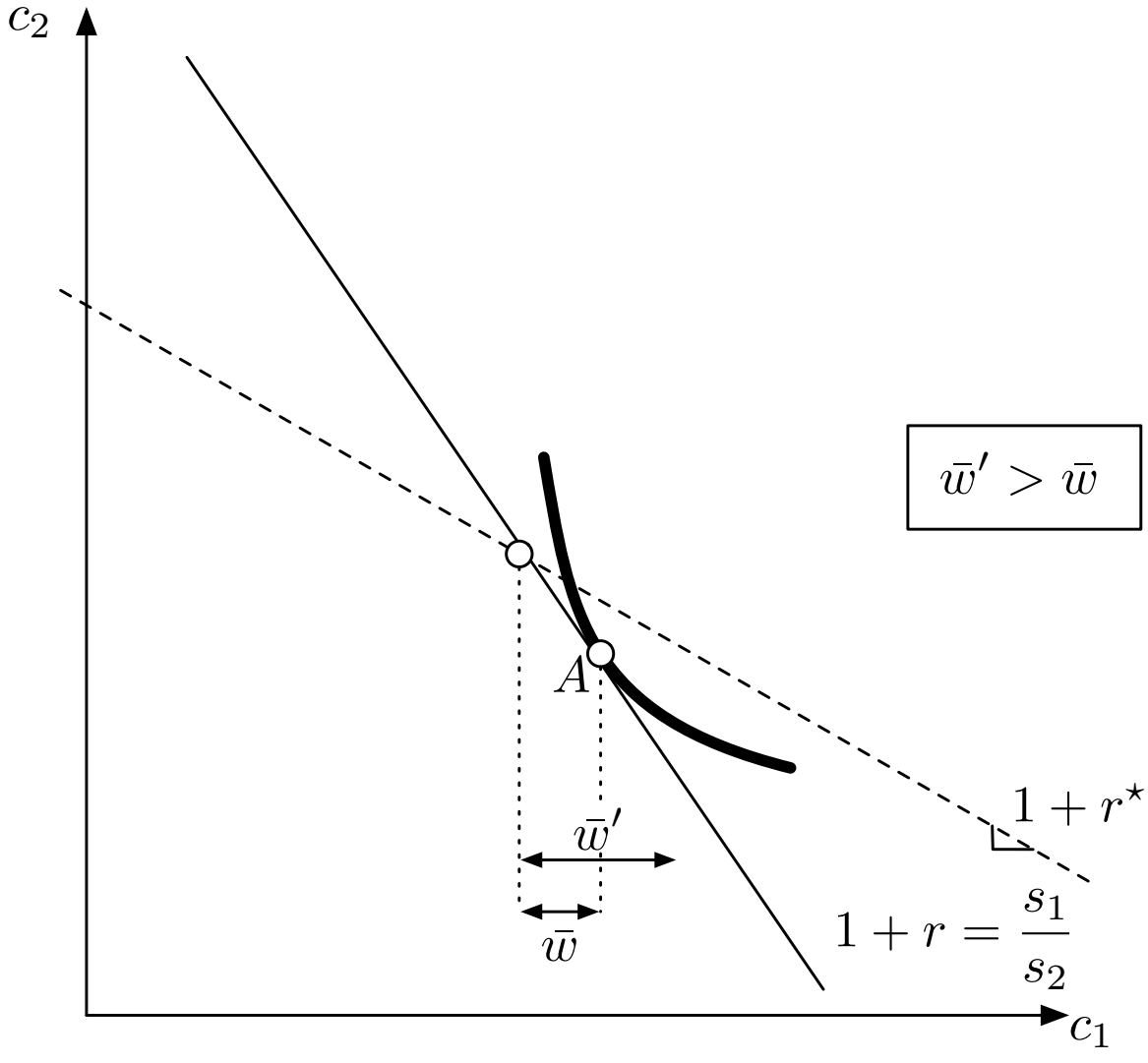
More integration with flexible policies



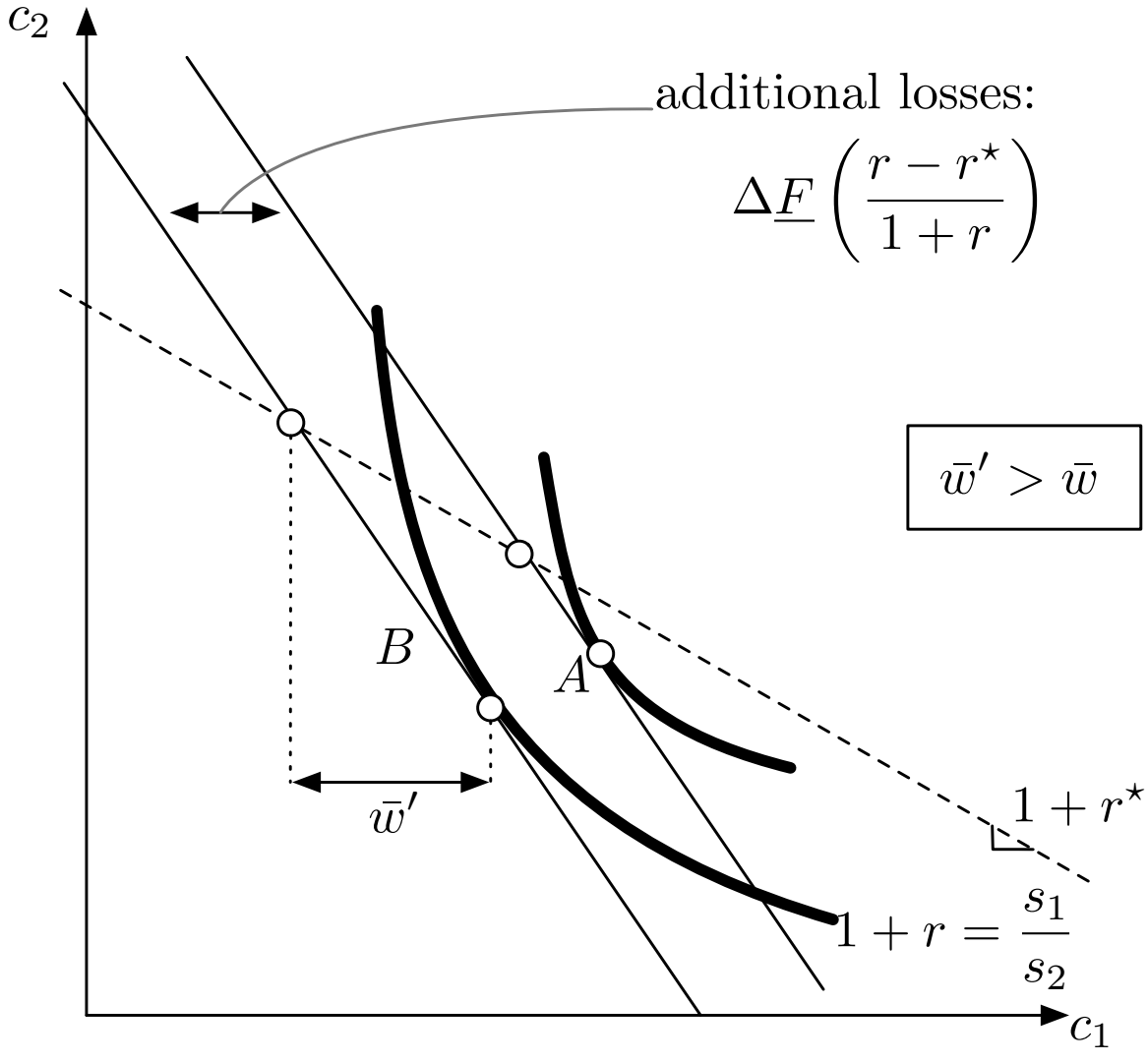
More integration with fixed policies (ZLB)



More integration with fixed policies (ZLB)



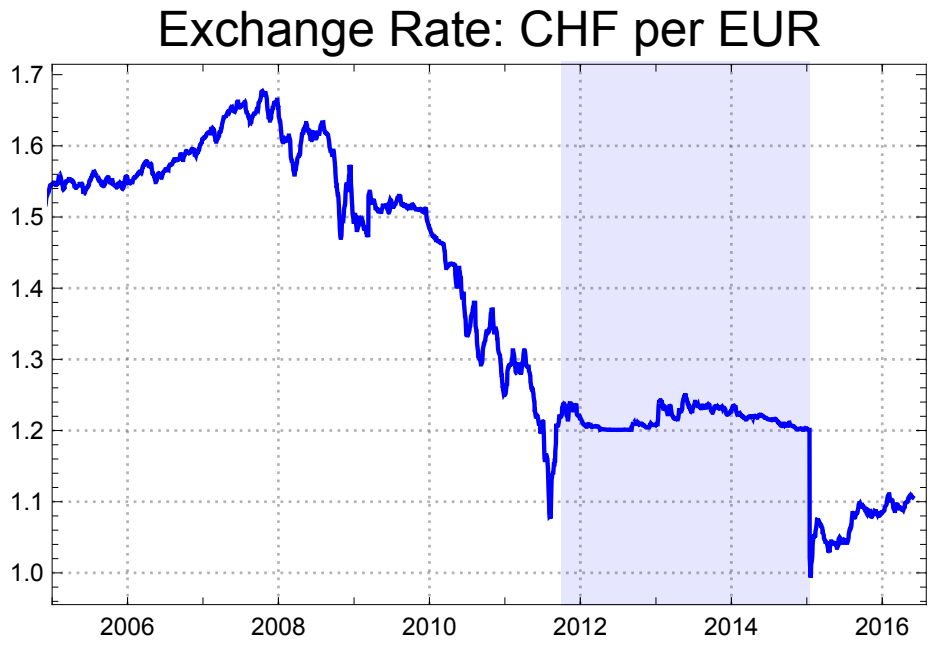
More integration with fixed policies (ZLB)

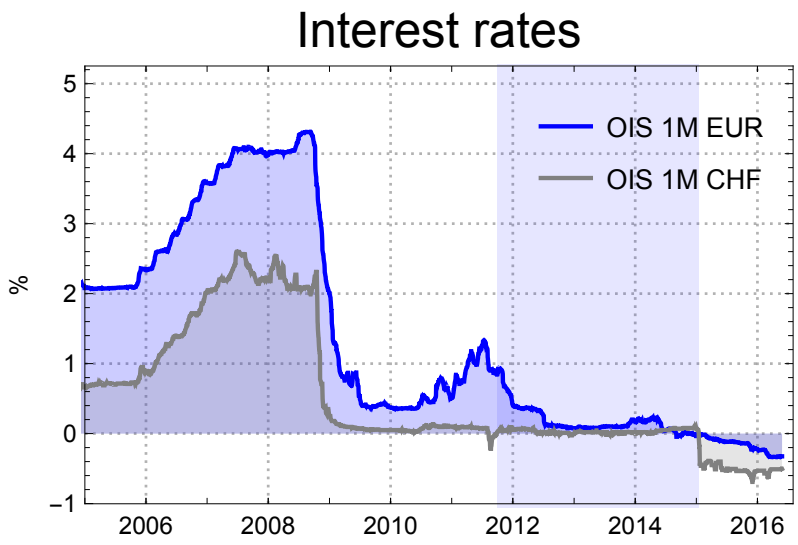


Financial Integration and Domestic Monetary Policy

- When domestic policies (i or $\frac{s_1}{s_2}$) can adjust, more $\bar{w}$ desirable, as it can reduces borrowing rate and allows larger net positions
- When domestic policies are constrained (ZLB and $\frac{s_1}{s_2}$) more integration increase gross position (inflows can't be stopped) increase losses
- Natural role for capital controls

Switzerland

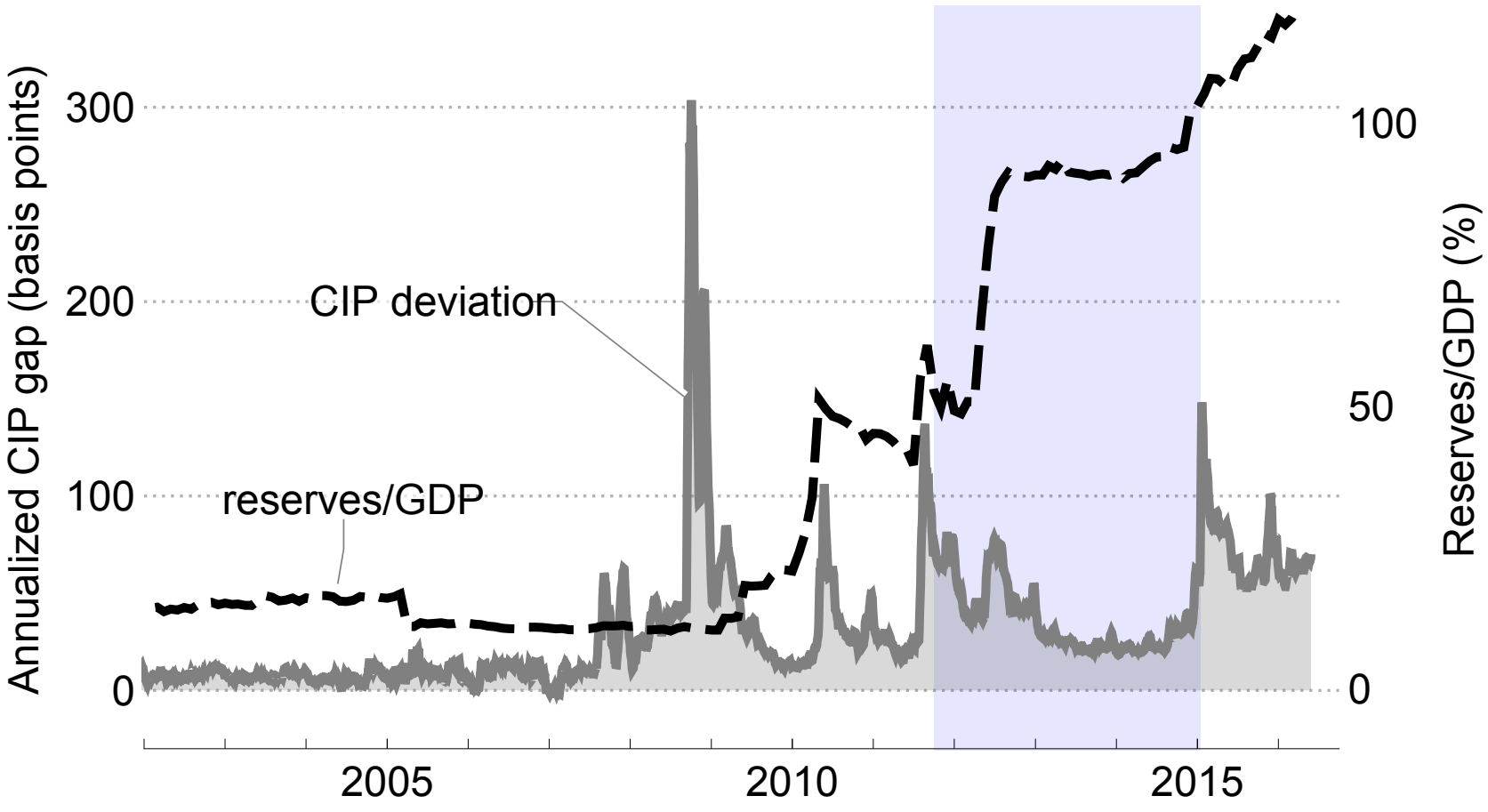




Supporting evidence

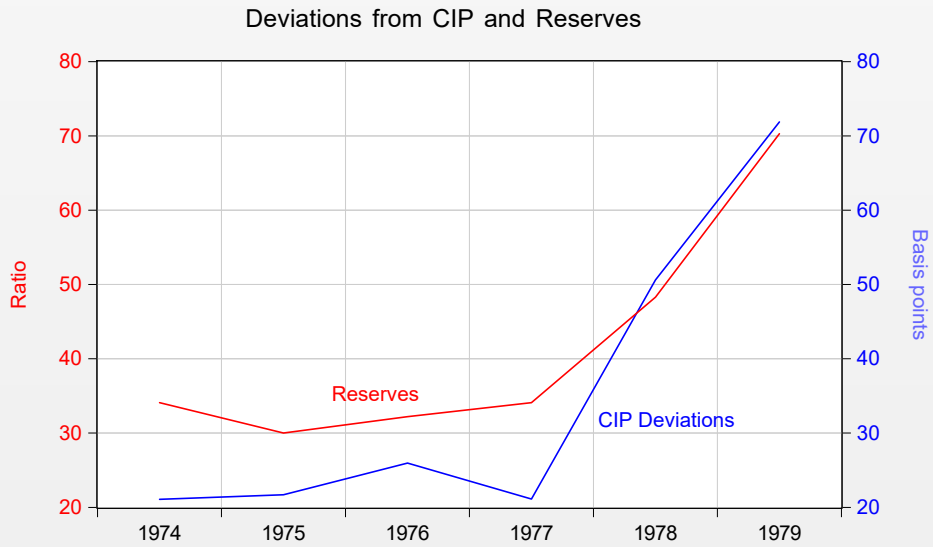
- Limits to arbitrage (CIP deviations) associated to large accumulation of reserves (CB is bearing the losses)
- CIP Deviations should be prevalent when domestic monetary policy inflexible: ZLB

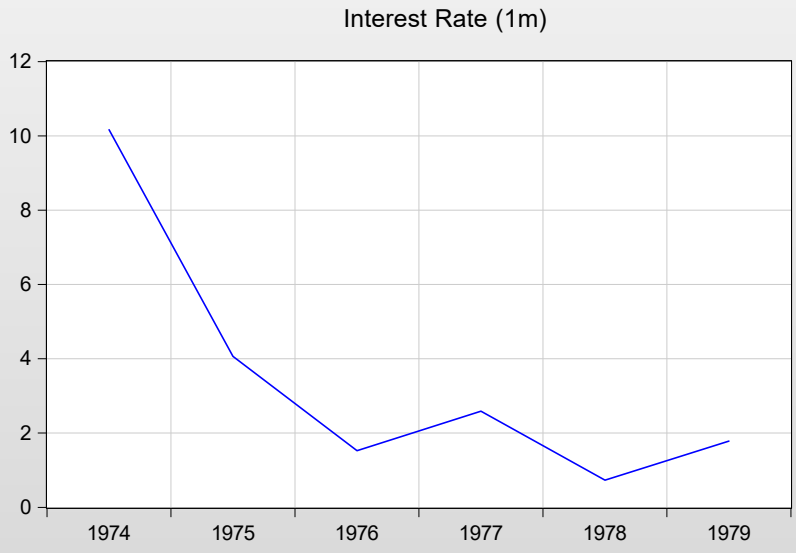
Switerland Post 2008

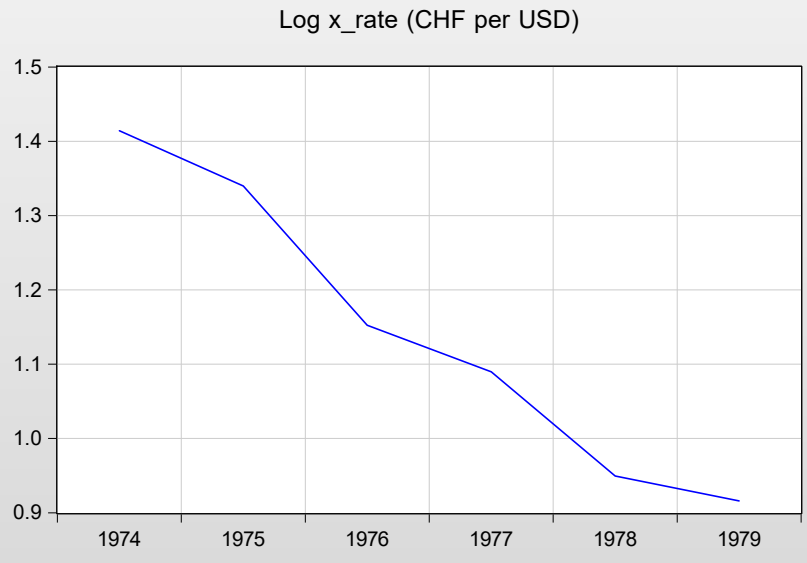


- Interest rate post 2010 is at 0

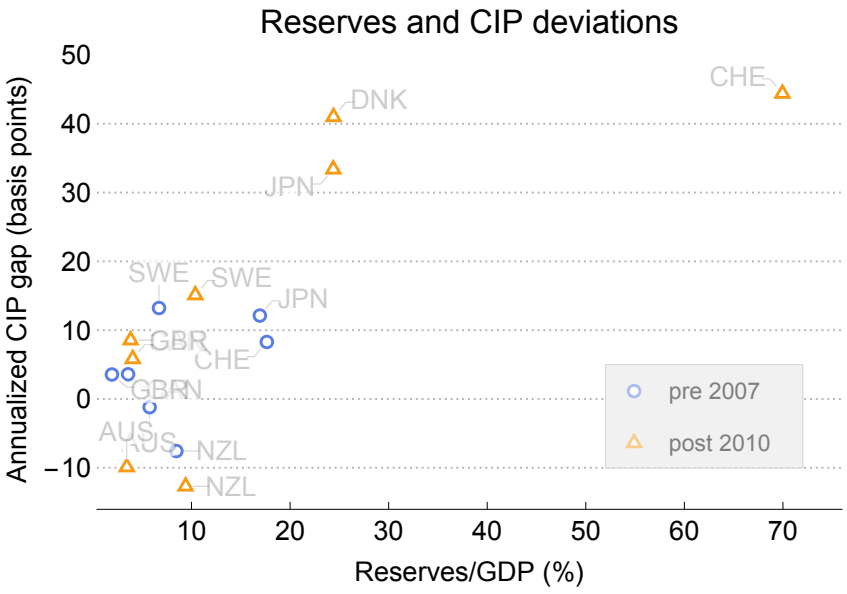
Switerland Pre 1979

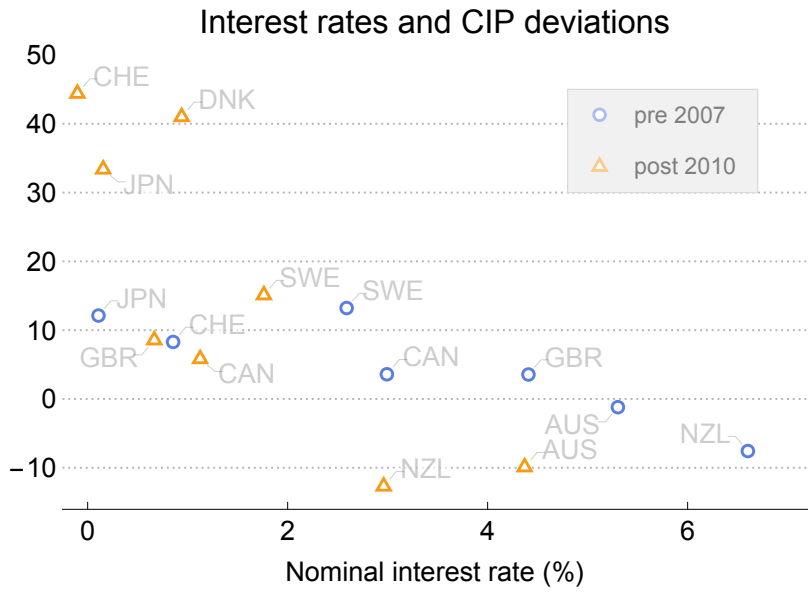






Other Developed Economies





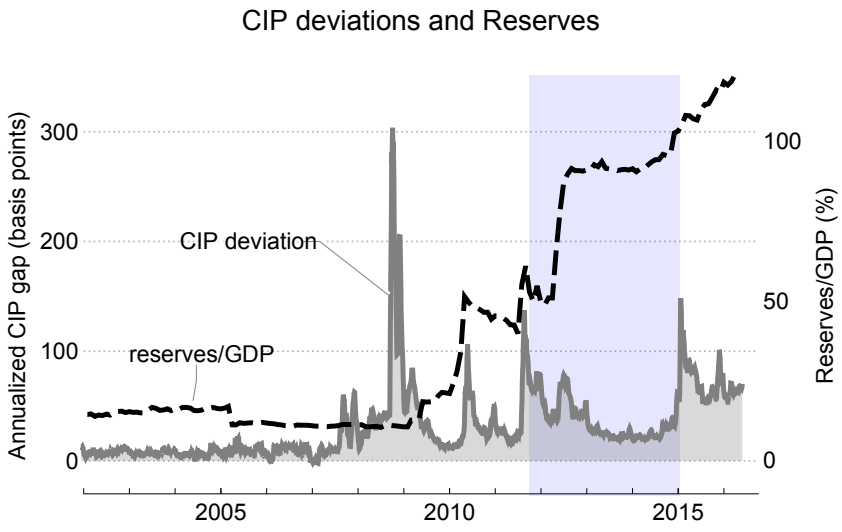
How costly is to escape the trilemma? Switzerland

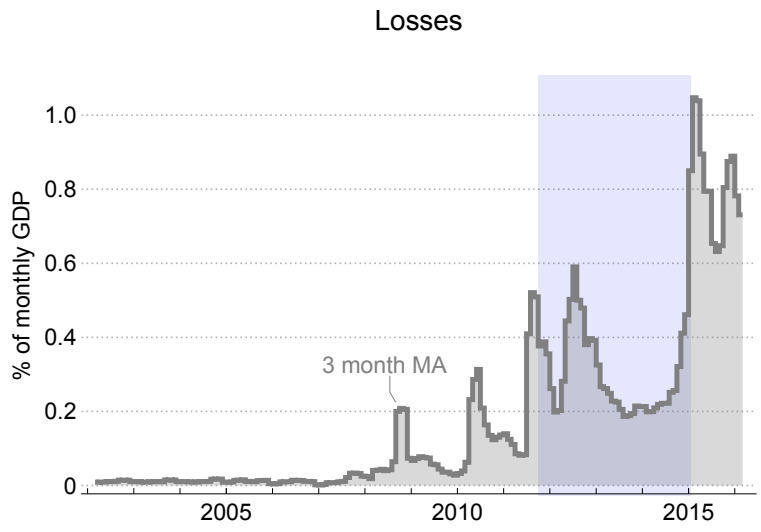
- Sufficient statistic:

$$\underbrace{\left[1 - \frac{1 + i_t^*}{1 + i_t} \frac{s_{t+1}}{s_t}\right]}_{\text{Deviations from [IP]}} \times \underbrace{F_t}_{\text{Foreign reserves}}$$

- Easy to construct empirical counterparts to both terms

Measuring the Costs





Conclusions

- Provide a framework to understand the costs of escaping the Mundellian trilemma
- Also allow to understand how external conditions interact with costs and spillover onto domestic policies