Monetary & Fiscal Interactions: Big Picture

- Modeling convention
  - Canonical macro models assume
    1. MP can and does control inflation
    2. FP can and does ensure solvency
  1. MP optimal or obeys Taylor-type rule
    - unconstrained or “active”
  2. FP takes MP & private behavior as given and stabilizes debt
    - constrained or “passive”
  - This modeling convention makes sense in normal times
    - embedded in textbooks (Walsh, Woodford, Galí)
  - It also makes MP omnipotent & FP trivial
Why focus on price-level determination?

- monetary & fiscal policies surely have many other—and perhaps more important—effects on economy

Price-level determination is first step

- study price-level determination before studying more complicated things
- permits use of simple models

We are not interested only in inflationary effects of monetary & fiscal policies
Monetary & Fiscal Interactions: Big Picture

- Modeling convention a stretch since 2008
  - What have policies actually been doing?
    1. MP at or near zero lower bound
    2. FP bouncing between stimulus & austerity

- Central banks aggressively pursuing growth
  - thrown Taylor principle out the window

- Recent fiscal advice from IMF:
  1. 2008–2009: urgent need to stimulate
  2. 2010–2011: urgent need to consolidate
  3. 2012: urgent need for stimulative consolidation ("growsterity")

- How can such policies anchor monetary expectations on inflation target?
- How can such policies anchor fiscal expectations on debt stabilization?
Monetary & Fiscal Interactions: Big Picture

- Need to understand implications of policy interactions that deviate from convention

- Short-run reasons:
  - Europe enters second recession, emerging economies slowing down, U.S. on brink of new recession, Japan still stuck
  - Ubiquitous tradeoff between stabilization & sustainability
  - What are effect of fiscal policy when MP pegs rate?

- Long-run reasons:
  - Aging populations & unfunded old-age benefits
  - Huge uncertainty about future fiscal policies
  - What are impacts of unresolved long-run fiscal stress?

- Conventional modeling cannot address these issues
  - assumes away the problems
Messages

1. Effects of monetary policy—open-market operations—depend on the sense in which fiscal policy is “held constant”
2. Effects of fiscal policy—bond-financed tax cuts—depend on the sense in which monetary policy is “held constant”
3. MP cannot uniquely determine inflation; FP can
4. MP can uniquely determine *bounded* inflation—if FP cooperates
5. If FP does not cooperate, MP cannot affect economy in usual ways
6. Without credible, enforceable fiscal rules that anchor expectations on appropriate FP behavior, fiscal disturbances *always* affect economy
General Points About Inflation

- Why does fiat currency have value?
- Because the government accepts currency—and only currency—in payment of taxes
- Inflation arises when government prints more currency than it eventually absorbs in taxes
  - people try to get rid of currency & buy things
  - pushes up prices & wages
- Government can soak up currency by selling bonds
  - does this when it spends more—handing out currency—than it taxes—soaking up currency
- Nominal bonds—like fiat currency—are promises to pay back more currency in future
- If government doesn’t soak up bonds with taxes... inflation
General Points About Inflation

- Just as money gets its value from taxes...
- Monetary policy gets its power from fiscal backing
- When fiscal backing is assured, MP operates as taught in textbooks
  - MP can control inflation
  - higher interest rates—open-market sale of bonds—reduce consumption & inflation
- But only if future taxes rise to soak up bonds
  - higher taxes eliminate the wealth effects of higher interest payments on government debt
- Otherwise, higher rates...
  - raises wealth, reduce value of bonds, increase aggregate demand & inflation

- It’s all about fiscal backing
The Model

- Endowment economy at the cashless limit; complete financial markets, one-period nominal debt
- Representative household maximizes

\[ E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U(C_t) \right\} \]

subject to sequence of flow budget constraints

\[ P_t C_t + P_t \tau_t + E_t[Q_{t,t+1}B_t] = P_t Y_t + P_t z_t + B_{t-1} \]

given \( B_{-1} > 0 \)

- \( Q_{t,t+1} \): nominal price at \( t \) of an asset that pays $1 at \( t + 1 \)
- \( m_{t+1} \): real contingent claims price
- \( Q_{t,t+1} = \frac{P_t}{P_{t+1}} m_{t,t+1} \): no-arbitrage condition
- Nominal interest rate, \( R_t \): \( \frac{1}{R_t} = E_t[Q_{t,t+1}] \)
Can write HH’s real intertemporal b.c. as

\[
E_t \sum_{j=0}^{\infty} m_{t,t+j} C_{t+j} = \frac{B_{t-1}}{P_t} + E_t \sum_{j=0}^{\infty} m_{t,t+j}(Y_{t+j} - s_{t+j})
\]

\[s_t \equiv \tau_t - z_t\]

\[m_{t,t+j} = \prod_{k=0}^{j} m_{t,t+k}\] is real discount factor, \(m_{t,t} = 1\)

HH choices also satisfy the transversality condition

\[
\lim_{T \to \infty} E_t \left[ m_{t,T} \frac{B_{T-1}}{P_T} \right] = 0
\]

It is not optimal for HHs to overaccumulate assets
The Model

- Impose equilibrium, \( C_t = Y \), and TVC to get two eqm conditions

\[
\frac{1}{R_t} = \beta E_t \frac{P_t}{P_{t+1}} \equiv \beta E_t \frac{1}{\pi_{t+1}}
\]

\[
\frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t s_{t+j}
\]

\( s_t \equiv \tau_t - z_t \) (We assume \( 0 < E_t PV(s) < \infty \))

- Price sequence \( \{P_t\} \) must satisfy these to be an eqm (markets clear & HH’s optimization problem solved)

- Without additional restrictions from policy behavior, there are many possible eqm \( \{P_t\} \) sequences
The Model

- Specify policy rules & government budget constraint

\[
\frac{1}{R_t} = \frac{1}{R^*} + \alpha \left( \frac{1}{\pi_t} - \frac{1}{\pi^*} \right)
\]

\[
s_t = s^* + \gamma \left( \frac{B_{t-1}}{P_t} - b^* \right)
\]

\[
\frac{E_t[Q_{t,t+1}B_t]}{P_t} + s_t = \frac{B_{t-1}}{P_t}
\]

- Steady state

\[
\frac{B_{t-1}}{P_t} = b^*, \quad s^* = (1 - \beta)b^*, \quad R^* = \frac{\pi^*}{\beta}, \quad m^* = \beta
\]
The Model

- Combine MP rule w/ Fisher equation
- Combine FP rule w/ government budget constraint
- Dynamical system in inflation, $\pi_t$, and real debt, $b_t$, after imposing asset-pricing relations and market clearing

\[
E_t \left( \frac{1}{\pi_{t+1}} - \frac{1}{\pi^*} \right) = \frac{\alpha}{\beta} \left( \frac{1}{\pi_t} - \frac{1}{\pi^*} \right)
\]

\[
\frac{B_t}{P_{t+1}} - b^* = \frac{1 - \gamma}{\beta} \left( \frac{B_{t-1}}{P_t} - b^* \right)
\]

where $\frac{B_t}{P_{t+1}} \equiv b_t$ and $b^* = \frac{B_t}{P_{t+1}}$ in steady state and in equilibrium $m_{t,t+1} = \beta \frac{U'(C_{t+1})}{U'(C_t)} = \beta \frac{U'(Y)}{U'(Y)} = \beta$
Two Tasks of Policy

- Monetary & fiscal policy have two tasks: (1) control inflation; (2) stabilize debt
- Two different policy mixes that can accomplish these tasks

**Regime M:** conventional assignment—MP targets inflation; FP targets real debt (called active MP/passive FP)

**Regime F:** alternative assignment—MP maintains value of debt; FP controls inflation (called passive MP/active FP)

- **Regime M:** normal state of affairs
- **Regime F:** can arise in an era of fiscal stress
Regime M Policy Behavior

- MP behavior completely familiar: target inflation by aggressively adjusting nominal interest rates
- FP adjusts future surpluses to cover interest plus principal on debt
- In terms of policy rules

**Regime M:** \( \frac{\alpha}{\beta} > 1 \) & \( \gamma > 1 - \beta \)
Regime M Equilibrium

- Unique *bounded* equilibrium is
  \[ \pi_t = \pi^* \]

- And expected evolution of government debt is
  \[ E_t \left( \frac{B_t}{P_{t+1}} - b^* \right) = \frac{1 - \gamma}{\beta} \left( \frac{B_{t-1}}{P_t} - b^* \right) \]
  which ensures \( E_t b_T \to b^* \) as \( T \to \infty \)

- But... also a continuum of equilibria with
  \[ \lim_{T \to \infty} \pi_T = \infty \]

- Neither MP nor private behavior rules out equilibria with \( \pi_t = \infty \)

- This (minor?) anomaly or embarrassment can be resolved only by fiscal policy
Regime M’s Explosive Solutions

- Examine perfect foresight; generalize policy rule

\[ R_t = \beta^{-1} \pi_{t+1} \]
\[ R_t = \tilde{\Phi}(\pi_t) \]

- Solution satisfies non-linear difference equation

\[ \pi_{t+1} = \Phi(\pi_t) \]

- Two steady states: \( \pi^* \) and \( \pi_L \)
- \( \pi_L \) are zero lower bound for nominal interest rate
Regime M’s Explosive Solutions

Indeterminacy of steady state and dynamic path
What is FP doing in Regime M?
- any shock that changes debt must create the *expectation* that future surpluses will adjust to stabilize debt’s value
- people must believe adjustments will occur eventually
- eliminates wealth effects from government debt
- for MP to target inflation, fiscal expectations must be **anchored** on FP adjusting to maintain value of debt

Can rule out equilibria with $\pi_t \to \infty$ where $b_t \to 0$, so $s_t \to 0$
- FP commits to a fixed floor value of debt, $b$
- surplus rule becomes $s = (1 - \beta)b$
- this requires a switch in fiscal regime
- ironically, by “passively” supporting MP, FP permits explosive inflation
An Equilibrium Condition

\[ \frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t [s_{t+j}] \]

- In Regime M. . .
  - MP delivers equilibrium inflation process
  - taking inflation as given, FP must choose compatible surplus policy
  - “compatible” means: stabilizes debt
  - imposes restrictions on \( E_t PV(s) \)
Primer on Monetary-Fiscal Interactions

- Monetary & fiscal policy have two tasks: (1) control inflation; (2) stabilize debt
- Beautiful symmetry: two different policy mixes that can accomplish these tasks

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- **Regime F:** can arise in an era of fiscal stress
- Regime F arises in two ways
  1. Sargent & Wallace’s unpleasant monetarist arithmetic
Primer on Monetary-Fiscal Interactions

- Unpleasant monetarist arithmetic
  - economy hits the fiscal limit
  - surpluses unresponsive to debt
  - seigniorage adjusts to stabilize debt
  - produces high & volatile inflation

- Many countries have guarded against this
  - central bank independence
  - clear mandate to control inflation—e.g., inflation targeting

- Designed to *force* FP to be passive

- Will focus on second way Regime F can arise
Primer on Monetary-Fiscal Interactions

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**Regime M:** conventional assignment—MP targets inflation; FP targets real debt (called active MP/passive FP)

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- **Regime M:** normal state of affairs
- **Regime F:** can arise in an era of fiscal stress
- **Regime F** arises in two ways
  1. Sargent & Wallace’s unpleasant monetarist arithmetic
  2. fiscal theory of the price level
Governments issue mostly nominal (non-indexed, local currency) bonds

- 90% U.S. debt; 80% U.K. debt; 95% Euro-area debt; most of Australian, Japanese, Korean, New Zealand, & Swedish debt

- Increasing important in Latin America: Chile (92%), Brazil (89%), Colombia (77%), Mexico (75%)

In Regime F:

- FP sets primary surpluses independently of debt
- MP prevents interest payments on debt from destabilizing debt

Nominal debt is revalued to align its value with expected surpluses
Regime F Policy Behavior

- FP responds weakly (or not at all) to state of government indebtedness
- MP prevents nominal interest rate from reacting strongly to inflation
- In terms of policy rules

\[ 0 < \frac{\alpha}{\beta} < 1 \quad \& \quad \gamma < 1 - \beta \]

- Focus on special case

\[ \alpha = 0 \quad \& \quad \gamma = 0 \]

- MP sets \( \{R_t\} \) exogenously; FP sets \( \{s_t\} \) exogenously
Regime F Equilibrium

- Pegs expected inflation
  \[ E_t \left( \frac{1}{\pi_{t+1}} \right) = \frac{1}{\beta R^*} = \frac{1}{\pi^*} \]

- Price level determined by
  \[ \frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t \left[ s_{t+j} \right] \]

- At \( t \), \( B_{t-1} \) predetermined and \( E_t s_{t+j} \) a number
- \( P_t \) must adjust to equate value of debt to expected cash flows
Regime F Transmission Mechanism

\[ \frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t [s_{t+j}] \]

- Increase in current or expected transfers
  - no offsetting taxes expected, household wealth rises
  - lower expected path of surpluses reduces “cash flows,” lowers value of debt
  - individuals shed debt in favor of consumption, raising aggregate demand
  - higher current & future inflation and economic activity
  - long bonds shift inflation into future

- Demand for debt \( \leftrightarrow \) aggregate demand
Regime F Determinacy

\[ \frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t[s_{t+j}] \]

- How do we know that no other \( \{P_t\} \) sequence is an equilibrium (especially ones with \( P_t \to \infty \))?

- Suppose \( P_t \) is “too low”: debt over-valued relative to cash flows
  - agents substitute out of debt and into buying goods
  - higher aggregate demand drives up \( P_t \) until value of debt consistent with \( E_tPV(s) \)

- Symmetric argument if \( P_t \) is “too high”
An Equilibrium Condition

\[ \frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t [s_{t+j}] \]

- In Regime F...
  - FP delivers unique equilibrium price process
  - taking inflation as given, MP must choose compatible interest rate policy
  - “compatible” means: stabilizes debt
  - imposes restrictions on \( P_t \) (& on MP, if price level to remain stable)
More on the Equilibrium Condition

\[ \frac{B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t [s_{t+j}] \]

- Ubiquitous: holds in any model, in any regime
  - cannot be used to “test” for regime
- It is not an “intertemporal government budget constraint”
  - have imposed market clearing, Euler equations, transversality (from private behavior)
- Government is not restricted to choose \( \{s_t\} \) to satisfy it for any \( \{P_t\} \) (but it is free to do so)
- Cochrane calls it a “debt valuation equation”
  - with only one-period debt, \( B_{t-1}/P_t \) is market value of debt
Why Fiscal Theory ≠ Unpleasant Arithmetic

- Equilibrium conditions for nominal and real debt

Nominal: \( B_{t-1} = P_t \sum_{j=0}^{\infty} \beta^j E_t \left[ \tau_{t+j} - z_{t+j} + \frac{M_{t+j} - M_{t+j-1}}{P_{t+j}} \right] \)

Real: \( v_{t-1} = \sum_{j=0}^{\infty} \beta^j E_t \left[ \tau_{t+j} - z_{t+j} + \frac{M_{t+j} - M_{t+j-1}}{P_{t+j}} \right] \)

- Hypothetical increase in \( P_t \), all else fixed
  - raises nominal backing: support more nominal debt with no change in surpluses or seigniorage
  - lowers real backing: reduces seigniorage revenues

- Fiscal Theory is not about seigniorage: if \( M/P \) tiny, higher \( P_t \) raises backing of nominal debt but not of real debt

- Unpleasant Arithmetic is about seigniorage: growing real debt requires growing seigniorage & inflation
Role of Debt Maturity Structure: 1

- Allow one- and two-period zero-coupon nominal bonds: $B_t(t + 1), B_t(t + 2)$; equilibrium condition is

$$\frac{B_{t-1}(t)}{P_t} + \beta B_{t-1}(t + 1)E_t \frac{1}{P_{t+1}} = \sum_{j=0}^{\infty} \beta^j E_t s_{t+j}$$

- MP determines the timing of inflation
  - stabilize expected inflation: forces adjustment in $P_t$
  - lean against current inflation: forces adjustment in $E_t(1/P_{t+1})$
  - tradeoff depends on maturity structure, $B_{t-1}(t + 1)/B_{t-1}(t)$
  - shorter average maturity $\Rightarrow$ need larger $\Delta E_t(1/P_{t+1})$ to compensate for given $\Delta(1/P_t)$

- Message: MP not impotent, but it cannot control both actual & expected inflation
Allow a consol: perpetuity that pays $1 each period

Government budget constraint

\[
\frac{Q_tB_t}{P_t} + s_t = \frac{(1 + Q_t)B_{t-1}}{P_t}
\]

Asset-pricing relation, in equilibrium

\[
Q_t = \beta E_t \frac{P_t}{P_{t+1}} (1 + Q_{t+1}) = \sum_{j=1}^{\infty} \beta^j E_t \frac{P_t}{P_{t+j}}
\]

Central bank controls \( R_t \): \( 1/R_t = P_{St} = \beta E_t (P_t/P_{t+1}) \)

Intertemporal equilibrium condition

\[
\frac{(1 + Q_t)B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t s_{t+j}
\]

FP determines the present value of inflation; MP determines the timing of inflation
Role of Debt Maturity Structure: II

\[ Q_t = E_t \sum_{j=0}^{\infty} \left( \frac{1}{\prod_{i=0}^{j} R_{t+i}} \right) = E_t \sum_{j=1}^{\infty} \beta^j \left( \frac{1}{\prod_{i=1}^{j} \pi_{t+i}} \right) \]

\[ \frac{(1 + Q_t)B_{t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t s_{t+j} \]

- Any path of \( \{P_t\} \) consistent with these conditions is an equilibrium
- By choosing a (constrained) path for \( \{R_t\} \), MP determines when inflation occurs
- Consider two pegged paths for \( R_t \)\( ^\dagger \) & \( ^* \)with \( R^\dagger > R^* \Rightarrow Q^\dagger < Q^* \)
  - \( \pi^\dagger_t < \pi^*_t \) but future \( \pi^\dagger > future \pi^* \)
  - a higher nominal rate lowers current inflation, but raises future inflation
Role of Debt Maturity Structure: III

- Zero-coupon bonds
- Write government’s flow constraint as

\[ B_{t-1}(t) - \sum_{j=1}^{\infty} Q_t(t+j)[B_t(t+j) - B_{t-1}(t+j)] = P_t s_t \]

- Impose equilibrium on asset-pricing relation

\[ Q_t(t+j) = \beta^j E_t \frac{P_t}{P_{t+j}} \]

- Combine these

\[ \frac{B_{t-1}(t)}{P_t} - \sum_{j=1}^{\infty} \beta^j E_t \frac{1}{P_{t+j}}[B_t(t+j) - B_{t-1}(t+j)] = s_t \]
Role of Debt Maturity Structure: III

\[
\frac{B_{t-1}(t)}{P_t} - \sum_{j=1}^{\infty} \beta^j E_t \frac{1}{P_{t+j}} [B_t(t+j) - B_{t-1}(t+j)] = s_t
\]

- Suppose govt neither issues new debt nor repurchases outstanding debt, so \( B_{t-1}(t+j) = B_t(t+j) = B_{t-1}(t), j > 0 \)

\[
P_t = \frac{B_{t-1}(t)}{s_t}
\]

- Future deficits don’t matter (constant debt ⇒ no link between value of debt today & future surpluses)
- Inflation occurs only when surplus realized
- But current bond prices reflect \( E_t s_{t+j} \) which changes \( E_t(1/P_{t+j}) \)

\[
Q_t(t+j) = \beta^j E_t \frac{P_t}{P_{t+j}}
\]
A Monetary Union

- Two-country union (Sims, Bergin)
  - world endowment: $Y_t = Y_{1,t} + Y_{2,t} = Y$
  - household in country $j$ maximizes
    
    $$E_0 \sum_{t=0}^{\infty} \beta^t u(C_{j,t})$$

    subject to
    
    $$C_{j,t} + \frac{B_{j,t}}{P_t} + \tau_{j,t} = Y_{j,t} + z_{j,t} + \frac{R_{t-1}B_{j,t-1}}{P_t}$$

  - country $j$’s government budget constraint
    
    $$\frac{D_{j,t}}{P_t} + \tau_{j,t} + v_{j,t} = z_{j,t} + \frac{R_{t-1}D_{j,t-1}}{P_t}$$

    $v_{j,t}$: lump-sum transfers from central bank
  - central bank’s budget constraint
    
    $$\frac{B_{m,t}}{P_t} + v_{1,t} + v_{2,t} = \frac{R_{t-1}B_{m,t-1}}{P_t}$$
A Monetary Union

- Equilibrium conditions
  - Euler equation for household $j$
    \[ u'(C_{j,t}) = \beta R_t E_t \frac{P_t}{P_{t+1}} u'(C_{j,t+1}) \]
  - Transversality condition for household $j$
    \[ \lim_{T \to \infty} \beta^T E_t u'(C_{j,t+T}) \frac{B_{j,t+T}}{P_{t+T}} = 0 \]
  - Market clearing conditions
    \[ C_{1,t} + C_{2,t} = Y_{1,t} + Y_{2,t} = Y \]
    \[ B_{1,t} + B_{2,t} + B_{m,t} = D_{1,t} + D_{2,t} \]
- Note: TVC applies to household’s holdings of $B_{j,t}$, not to individual government issues, $D_{j,t}$
  - Can have eqm with $D_{1,t} \to +\infty$ and $D_{2,t} \to -\infty$
A Monetary Union

- If $D_{1,t} \to +\infty$ and $D_{2,t} \to -\infty$, then govt 2 is completely financing govt 1, with no expectation of repayment.
- Not a stable political economy equilibrium.
- Govt 2 can improve well-being of its citizens by refusing to do this.
- Same argument applies to central bank.
- We will impose individual govt and CB solvency.

\[
\lim_{T \to \infty} \beta^T E_t u'(C_{j,t+T}) \frac{D_{j,t+T}}{P_{t+T}} = 0
\]
\[
\lim_{T \to \infty} \beta^T E_t u'(C_{j,t+T}) \frac{B_{m,t+T}}{P_{t+T}} = 0
\]
A Monetary Union

- Assume $u(C_{j,t}) = C_{j,t} - \frac{a}{2}C_{j,t}^2$; adding Euler equations yields
  \[
  \frac{1}{R_t} = \beta E_t \frac{P_t}{P_{t+1}}
  \]

- Applying this, country-specific consumptions are
  \[
  C_{1,t} = E_t C_{1,t+1}, \quad C_{2,t} = E_t C_{2,t+1}
  \]

- Imposing eqm, get conditions
  \[
  \frac{R_{t-1}D_{1,t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t \left[ s_{1,t+j} + v_{1,t+j} \right]
  \]
  \[
  \frac{R_{t-1}D_{2,t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t \left[ s_{2,t+j} + v_{2,t+j} \right]
  \]
  \[
  \frac{R_{t-1}B_{m,t-1}}{P_t} = \sum_{j=0}^{\infty} \beta^j E_t \left[ v_{1,t+j} + v_{2,t+j} \right]
  \]
A Monetary Union

- Policy assumptions
  - CB pegs nominal rate: $R_t = R^*$
  - country 1 raises surpluses passively with debt
  - country 2 sets surpluses independent of debt
  - CB rebates portfolio earnings to countries, independent of their debt

- Results
  1. Union-wide inflation determined by country 2 (one with profligate FP)
  2. News about country 2 surpluses affects inflation & value of debt in both countries
  3. Requires adjustments in country 1’s surpluses
A Monetary Union

- How can CB retain control of inflation?
  - rebates to countries depend on each nation’s debt in the right way
  - make MP active (ECB in normal times)

- Efforts by the CB to reduce inflation
  - raise value of debt in both countries
  - requires higher rebates from CB to country 2 (backs debt of profligate country)
  - rebates to country 1 may need to be negative (taxes)
  - gives CB power to tax and transfer

- Message: A fiscal union can support monetary union’s efforts to control inflation