Controlling inflation with timid monetary-fiscal regime changes

Guido Ascari, *University of Oxford*
Anna Florio, *Politecnico di Milano*
Alessandro Gobbi, *Università di Pavia*

20th Annual DNB Research Conference
"Fiscal and Monetary Policy in a changing Economic and Political Environment"
De Nederlandsche Bank, 9-10 October 2017

Motivation

- Inflation depends from Monetary and Fiscal Policy interaction

Motivation

- Inflation depends from Monetary and Fiscal Policy interaction
  - → Under which conditions can monetary policy control inflation?
  - → Is fiscal policy getting in the way?
  - → Need/gain from coordination?

Motivation

- Inflation depends from Monetary and Fiscal Policy interaction
  - → Under which conditions can monetary policy control inflation?
  - → Is fiscal policy getting in the way?
  - → Need/gain from coordination?

- Policies change over time

Motivation

- Inflation depends from Monetary and Fiscal Policy interaction
  - → Under which conditions can monetary policy control inflation?
  - → Is fiscal policy getting in the way?
  - → Need/gain from coordination?

- Policies change over time
  - → How expectations of future policy switch affects: (i) equilibria; (ii) dynamics

Motivation

- Inflation depends from Monetary and Fiscal Policy interaction
  - → Under which conditions can monetary policy control inflation?
  - → Is fiscal policy getting in the way?
  - → Need/gain from coordination?
- Policies change over time
  - → How expectations of future policy switch affects: (i) equilibria; (ii) dynamics
- Characterize the properties of the economy when both monetary and fiscal policies change over time

Motivation: Monetary and Fiscal Policy Interaction

Leeper (1991): Equilibria under ***active*** and ***passive*** monetary and fiscal policies

	AM	PM
AF	Explosiveness	Determinacy (non-Ricardian case, FTPL)
PF	Determinacy (Ricardian case)	Indeterminacy

Motivation: Monetary and Fiscal Policy Interaction

Leeper (1991): Equilibria under ***active*** and ***passive*** monetary and fiscal policies

	AM	PM
AF	Explosiveness	Determinacy (non-Ricardian case, FTPL)
PF	Determinacy (Ricardian case)	Indeterminacy

FTPL features wealth effect (Non-Ricardian) $\rightarrow$ more difficult to control inflation

Motivation: Monetary and Fiscal Policy Interaction

Leeper (1991): Equilibria under ***active*** and ***passive*** monetary and fiscal policies

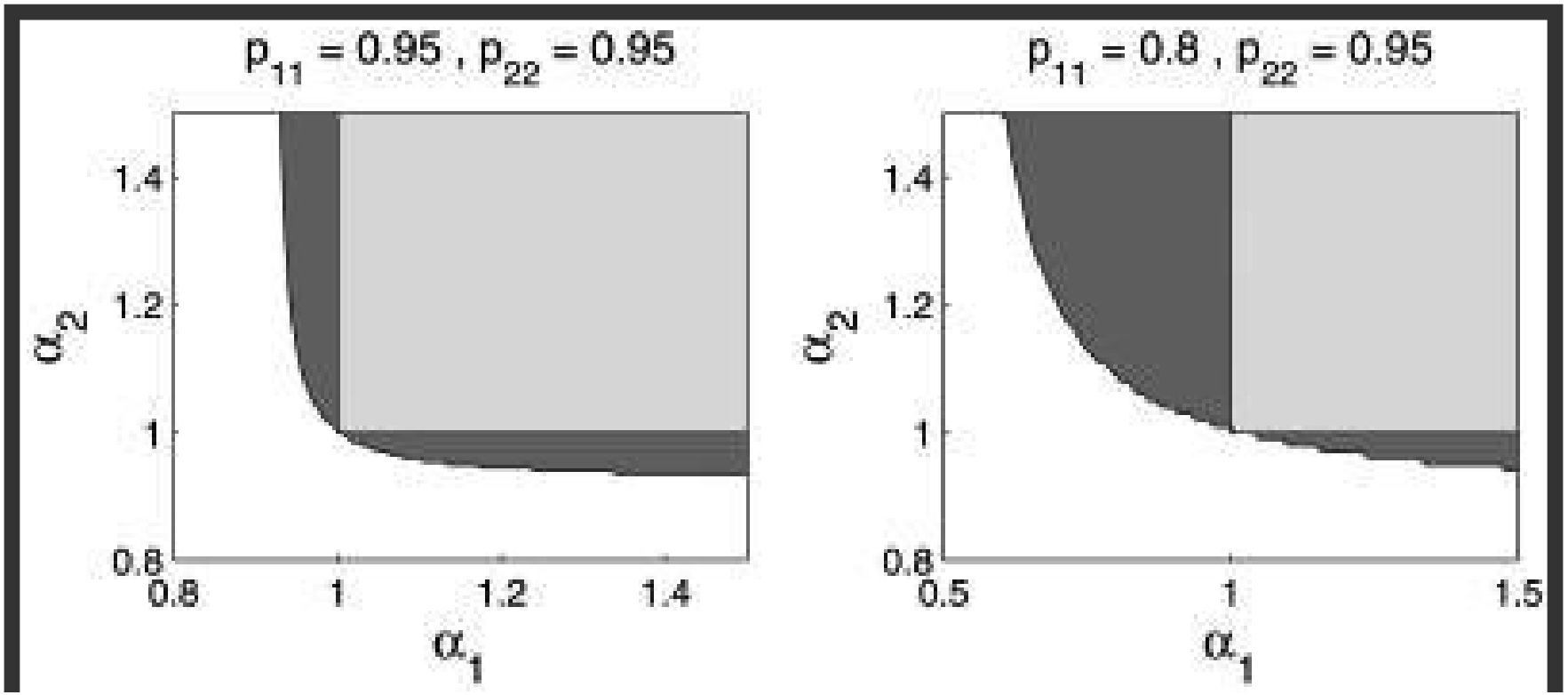
	AM	PM
AF	Explosiveness	Determinacy (non-Ricardian case, FTPL)
PF	Determinacy (Ricardian case)	Indeterminacy

FTPL features wealth effect (Non-Ricardian) $\rightarrow$ more difficult to control inflation

However, policy regimes change over time $\rightarrow$ **Expectations about future policies** are crucial: affects dynamics and eq. uniqueness

The Long-run Taylor principle

Davig and Leeper (2007, AER): Markov switching in monetary policy rule



	AM	PM
PF	Determinacy (Ricardian)	Indeterminacy

Motivation: Changes in Monetary Policy

Davig and Leeper (2007, AER):

→ DSGE model with Markov switching in monetary policy rule

Motivation: Changes in Monetary Policy

Davig and Leeper (2007, AER):

→ DSGE model with Markov switching in monetary policy rule

→ Fiscal policy in the background, always PF

Motivation: Changes in Monetary Policy

Davig and Leeper (2007, AER):

- → DSGE model with Markov switching in monetary policy rule
- → Fiscal policy in the background, always PF
- → Findings:

  Determinacy **Long-run Taylor principle** (LRTP): "*even while deviating from [the Taylor principle] substantially for brief periods or modestly for prolonged periods*"
  → "on average" AM
  → allows timid temporary deviations

Motivation: Changes in Monetary Policy

Davig and Leeper (2007, AER):

- → DSGE model with Markov switching in monetary policy rule
- → Fiscal policy in the background, always PF
- → Findings:

  Determinacy **Long-run Taylor principle** (LRTP): "*even while deviating from [the Taylor principle] substantially for brief periods or modestly for prolonged periods*"
  → "on average" AM
  → allows timid temporary deviations

  Dynamics **Cross-regime spillovers:** equilibrium properties are "contaminated" both by the characteristics of the other regimes and by the probability of shifting towards those alternative regimes

Research questions: Changes in Monetary ***and Fiscal*** Policy

AIM: Study the properties of the economy when both monetary ***and fiscal*** policies change in a New Keynesian model

Research questions: Changes in Monetary ***and Fiscal*** Policy

AIM: Study the properties of the economy when both monetary ***and fiscal*** policies change in a New Keynesian model

1. **Equilibrium properties: uniqueness** $\rightarrow$ specify the role of fiscal policy (extending Davig-Leeper, 2007)

Research questions: Changes in Monetary ***and Fiscal*** Policy

AIM: Study the properties of the economy when both monetary ***and fiscal*** policies change in a New Keynesian model

1. **Equilibrium properties: uniqueness** $\rightarrow$ specify the role of fiscal policy (extending Davig-Leeper, 2007)
2. **Dynamics: wealth effects vs Ricardian** $\rightarrow$ expectation effects/cross-regime spillovers in IRFs

Research questions: Changes in Monetary ***and Fiscal*** Policy

AIM: Study the properties of the economy when both monetary ***and fiscal*** policies change in a New Keynesian model

1. **Equilibrium properties: uniqueness** $\rightarrow$ specify the role of fiscal policy (extending Davig-Leeper, 2007)
2. **Dynamics: wealth effects vs Ricardian** $\rightarrow$ expectation effects/cross-regime spillovers in IRFs
3. **Policy implications:** $\rightarrow$ Useful framework to interpret the data: Great Moderation, policy response to the Great Recession

Results

1. **The long-run fiscal principle**

Results

1. **The long-run fiscal principle**

   → Conditions that a switching fiscal policy needs to satisfy to yield a unique rational expectations, when MP is always active

Results

1. **The long-run fiscal principle**

   → Conditions that a switching fiscal policy needs to satisfy to yield a unique rational expectations, when MP is always active

   → Similar to LRTP: the long-run fiscal principle entails some fiscal policy flexibility: it could deviate from PF substantially for brief periods or timidly for prolonged periods.

Results

2. **Importance of Coordination *across* regimes**

Results

2. **Importance of Coordination *across* regimes**

   → Multiplicity: Monetary and fiscal policy need to be balanced across regimes to have a unique equilibrium

Results

2. **Importance of Coordination *across* regimes**
   - → Multiplicity: Monetary and fiscal policy need to be balanced across regimes to have a unique equilibrium
   - → New taxonomy: overall AM/PF vs overall switching policy mix

Results

2. **Importance of Coordination *across* regimes**
   - → Multiplicity: Monetary and fiscal policy need to be balanced across regimes to have a unique equilibrium
   - → New taxonomy: overall AM/PF vs overall switching policy mix
3. **These two regimes have different dynamic behaviour**

Results

2. **Importance of Coordination *across* regimes**
   - → Multiplicity: Monetary and fiscal policy need to be balanced across regimes to have a unique equilibrium
   - → New taxonomy: overall AM/PF vs overall switching policy mix

3. **These two regimes have different dynamic behaviour**
   - → overall AM/PF mix ⇒ NO WEALTH EFFECTS

Results

2. **Importance of Coordination *across* regimes**
   - → Multiplicity: Monetary and fiscal policy need to be balanced across regimes to have a unique equilibrium
   - → New taxonomy: overall AM/PF vs overall switching policy mix

3. **These two regimes have different dynamic behaviour**
   - → overall AM/PF mix ⇒ NO WEALTH EFFECTS
   - → overall switching mix ⇒ WEALTH EFFECTS

Results

4. **Timidity trap (Krugman, 2014)**

Results

4. **Timidity trap (Krugman, 2014)**

   → If only timid deviation into PM/AF ⇒ overall AM/PF ⇒ no wealth effects needed to reflate the economy

Results

4. **Timidity trap (Krugman, 2014)**

   → If only timid deviation into PM/AF ⇒ overall AM/PF ⇒ no wealth effects needed to reflate the economy

5. **Application to ZLB and US data**

Results

4. **Timidity trap (Krugman, 2014)**
   - → If only timid deviation into PM/AF ⇒ overall AM/PF ⇒ no wealth effects needed to reflate the economy

5. **Application to ZLB and US data**
   - → BVAR on US data for the recent ZLB period ⇒ IRFs: a deficit shock do not spur inflation

Results

4. **Timidity trap (Krugman, 2014)**
   - → If only timid deviation into PM/AF ⇒ overall AM/PF ⇒ no wealth effects needed to reflate the economy
5. **Application to ZLB and US data**
   - → BVAR on US data for the recent ZLB period ⇒ IRFs: a deficit shock do not spur inflation
   - → ZLB + "timidity" in fiscal action ⇒ multiple equilibria ⇒ agents coordinating on the solution with no wealth effects

Related literature

Regime changes in monetary policy

- Davig and Leeper (2007) $\Rightarrow$ determinacy condition (LRTP)
- Liu, Waggoner and Zha (2009) $\Rightarrow$ asymmetric expectation effects under the dovish and the hawkish monetary regime
- Bianchi (2013) $\Rightarrow$ counterfactuals to show how equilibrium outcomes depend on agents' beliefs about alternative dovish or hawkish monetary regimes

Related literature

Regime changes in both monetary and fiscal policies

- Davig and Leeper (2006, 2011), Chung, Davig and Leeper (2007), Bianchi (2012), Bianchi and Ilut (2014) $\Rightarrow$ Estimate Markov switching monetary and fiscal regimes for the U.S. and study the impact of policy shocks employing actual and counterfactual IRF
- Bhattarai, Lee and Park (2012): allow for indeterminacy in the estimate à la Lubik and Shorfheide (2004) $\Rightarrow$ PM/PF in pre-Volcker, AM/PF in post-Volcker
- Bianchi and Melosi (2013, 2016) $\Rightarrow$ study the link between inflation and fiscal imbalances

Related literature

Technical literature on solving DSGE models with MS parameters

- Blake-Zampolli (2006), Davig-Leeper (2007), Farmer-Waggoner-Zha (2009, 2011), Cho (2014), Foerster (2013), **Foester-Rubio Ramirez-Waggoner-Zha (2014)**, Maih (2014), Barthelemy-Marx (2015)

Model: simple structure in nonlinear form

$$1 = \beta \mathbb{E}_t \left(\frac{Y_t - G}{Y_{t+1} - G} \frac{R_t}{\Pi_{t+1}} \right), \qquad \text{(Euler eq.)}$$

$$\phi_t \left(1 - \alpha \Pi_t^{\theta-1}\right)^{\frac{1}{1-\theta}} = \frac{\mu\theta \left(1-\alpha\right)^{\frac{1}{1-\theta}}}{\theta - 1} Y_t + \alpha\beta \mathbb{E}_t \left[\phi_{t+1} \Pi_{t+1}^{\theta} \left(1 - \alpha \Pi_{t+1}^{\theta-1}\right)^{\frac{1}{1-\theta}} \right], \qquad \text{(NKPC)}$$

$$\phi_t = \frac{Y_t}{Y_t - G} + \alpha\beta \mathbb{E}_t \left(\Pi_{t+1}^{\theta-1} \phi_{t+1} \right),$$

$$\frac{b_t}{R_t} = \frac{b_{t-1}}{\Pi_t} + G - \tau_t, \quad \text{with } b_t = \frac{B_t}{P_t}. \qquad \text{(govt b.c.)}$$

Fiscal and Monetary Policy Rules

Fiscal policy

$$\tau_t = \tau_{ss} \left(\frac{b_{t-1}}{b_{ss}} \right)^{\gamma_\tau(s_t)} e^{\sigma_\tau u_{\tau,t}}$$

Monetary policy

$$R_t = R_{ss} \left(\Pi_t \right)^{\gamma_\pi(s_t)} e^{\sigma_r u_{m,t}}$$

both depend on the underlying Markov process s_t

Methodology

- We follow the method in FRWZ $\Rightarrow$ regime-dependent recursive MSV solutions perturbed around the non-stochastic steady state

Methodology

- We follow the method in FRWZ $\Rightarrow$ regime-dependent recursive MSV solutions perturbed around the non-stochastic steady state
- UCM $\Rightarrow$ MSV solutions, no sunspots

Methodology

- We follow the method in FRWZ ⇒ regime-dependent recursive MSV solutions perturbed around the non-stochastic steady state
- UCM ⇒ MSV solutions, no sunspots
- System of quadratic equations ⇒ Groebner basis algorithm using Matlab's Symbolic Toolbox to get all the solutions

Methodology

- We follow the method in FRWZ ⇒ regime-dependent recursive MSV solutions perturbed around the non-stochastic steady state
- UCM ⇒ MSV solutions, no sunspots
- System of quadratic equations ⇒ Groebner basis algorithm using Matlab's Symbolic Toolbox to get all the solutions
- Stability: Mean Square Stable

Methodology

- We follow the method in FRWZ ⇒ regime-dependent recursive MSV solutions perturbed around the non-stochastic steady state
- UCM ⇒ MSV solutions, no sunspots
- System of quadratic equations ⇒ Groebner basis algorithm using Matlab's Symbolic Toolbox to get all the solutions
- Stability: Mean Square Stable
- Unique solution when a single MSV MSS solution exists

◂ Appendix Method

Uniqueness under fixed coefficients

Recasting Leeper (1991) in the context of our model

monetary policy **active** (**AM**) when

$$\gamma_\pi > 1$$

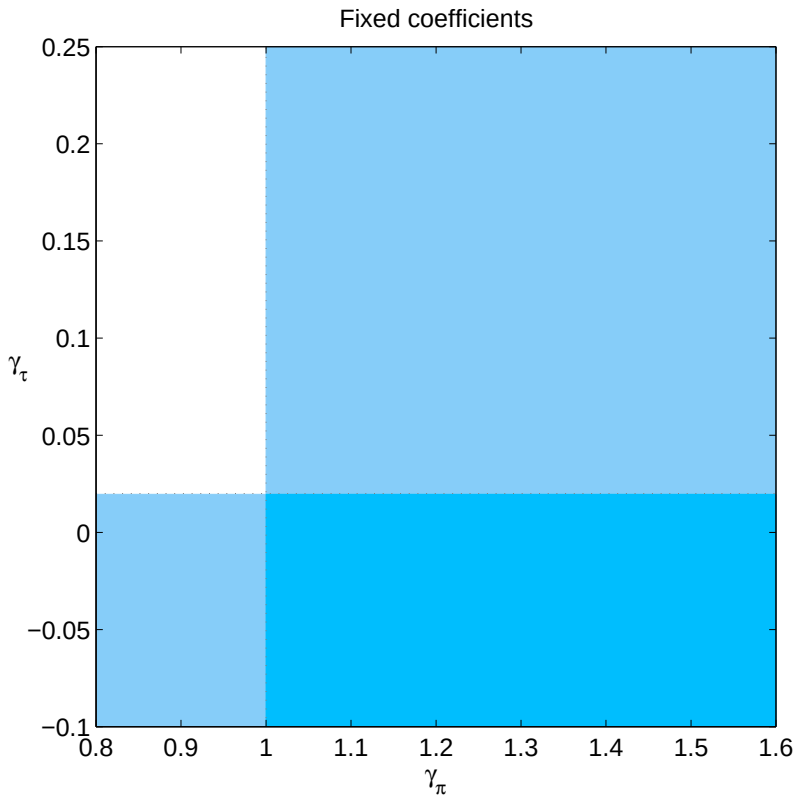
and **passive** (**PM**) otherwise

fiscal policy **passive** (**PF**) when $\left|\frac{1}{\beta} - \frac{1}{\beta}\frac{\tau_{ss}}{b_{ss}}\gamma_\tau\right| < 1$, i.e.

$$\gamma_\tau > \frac{b_{ss}}{\tau_{ss}}(1-\beta) = 0.0196$$

and **active** (**AF**) otherwise (e.g. $\gamma_\tau = 0$)

Uniqueness under fixed coefficients



AM/PF uniqueness

PM/AF uniqueness

PM/PF multiplicity

AM/AF no stable solutions

Uniqueness under regime switching

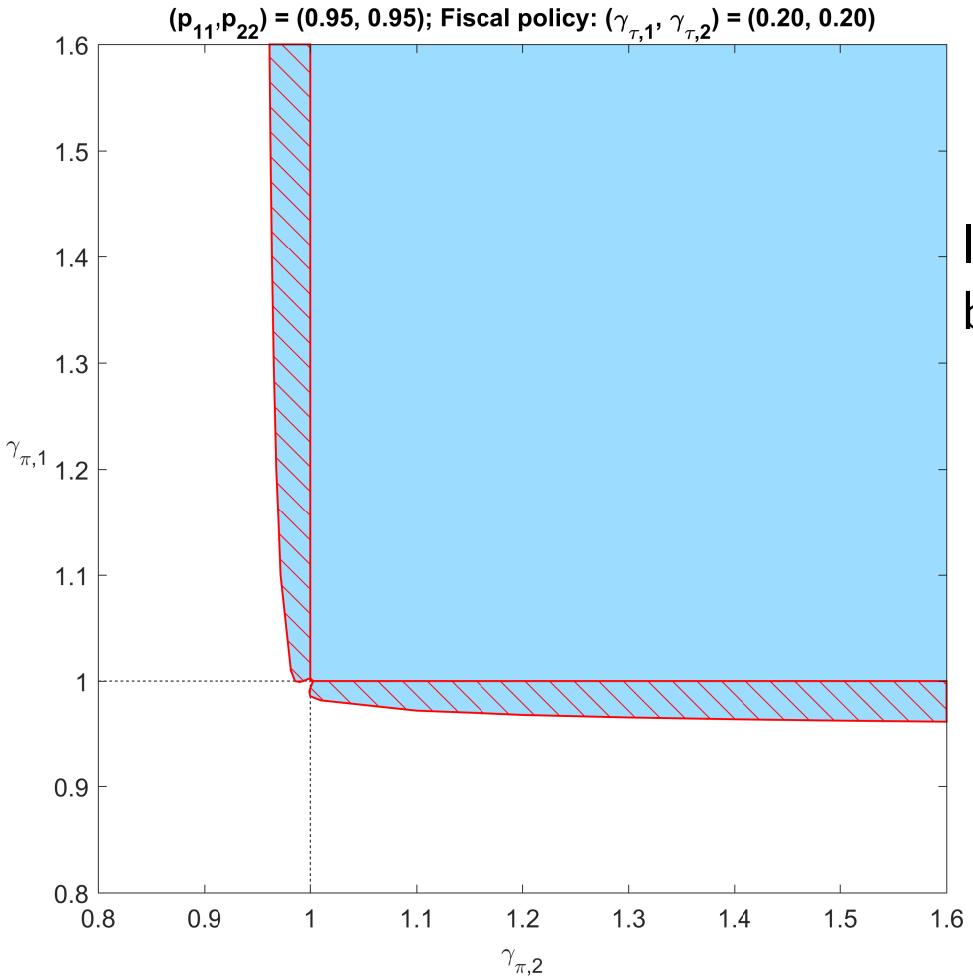
- We consider two regimes: $s_t = 1, 2$
- Contemporaneous switching in monetary and fiscal policy
- We focus on scenarios where one regime is AM/PF
- Reduce to a two dimensional graph:
  - $\rightarrow$ fix a given (monetary or fiscal) policy in both regimes
  - $\rightarrow$ fix a given regime (AM/PF)

The Monetary Policy Frontier (MPF)

Given Passive Fiscal Policy (Davig and Leeper, 2007)

The Monetary Policy Frontier (MPF)

Given Passive Fiscal Policy (Davig and Leeper, 2007)



If fiscal policy stays passive in both regimes

→ back to Davig and Leeper's Long-Run Taylor Principle

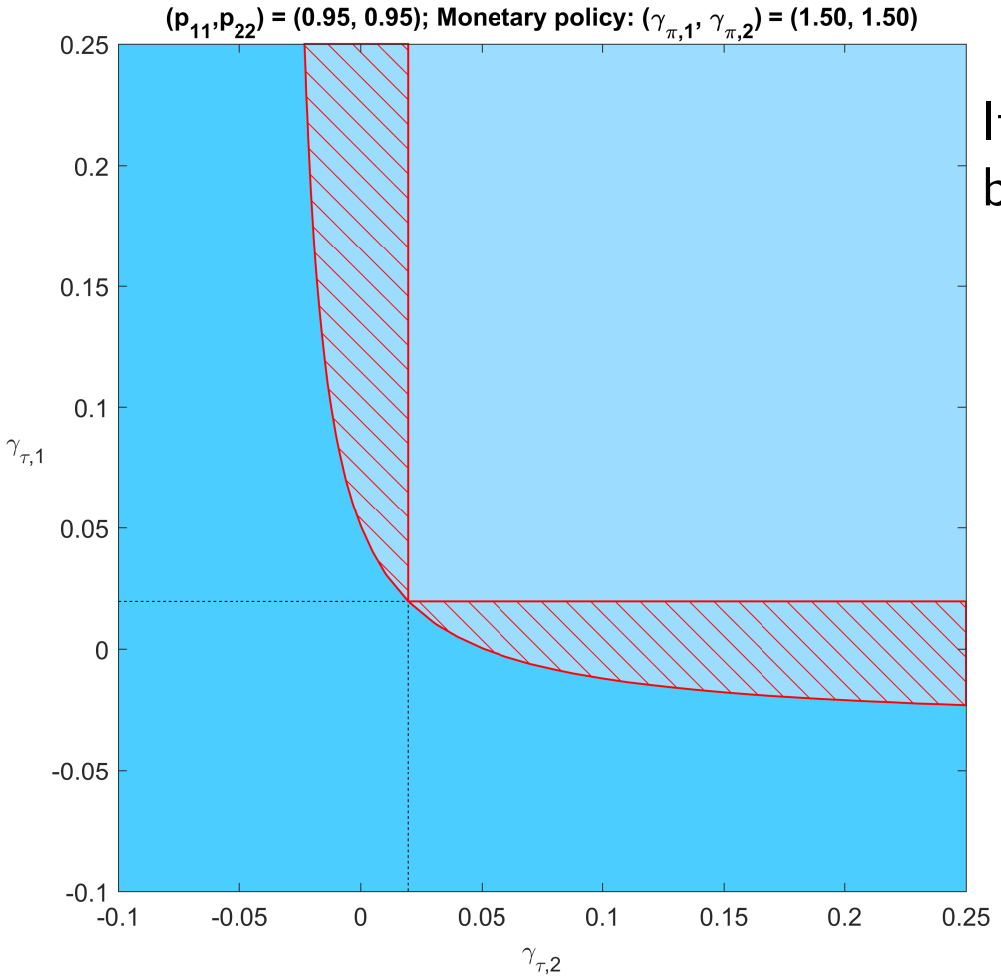
→ uniqueness allows timid deviations into PM → overall AM

The Fiscal Policy Frontier (FPF)

Given Active Monetary Policy

The Fiscal Policy Frontier (FPF)

Given Active Monetary Policy



If monetary policy stays active in both regimes

→ Long-Run Fiscal Principle → uniqueness above the fiscal policy frontier

→ uniqueness allows timid deviations into AF → overall PF

→ MPF unaffected if LRFP holds (above FPF)

The Fiscal Policy Frontier (FPF)

Proposition. The FPF and the long-run Fiscal Principle

For any policy parameter combination, there always exists a particular solution such that in each regime:

$$h_i = \frac{1}{\beta}\left(1 - \frac{\tau}{b}\gamma_{\tau,i}\right) \equiv \bar{h}_i(\gamma_{\tau,i}) \text{ and } g_{\pi,i} = 0, \text{ for } i = 1, 2.$$

Then, this solution:

(i) Is MSS, if above the Fiscal Policy Frontier (eq. (22));

(ii) Depends only on $\gamma_{\tau,i}$ for $i = 1, 2$, and it is independent of the monetary policy coefficients;

(iii) If MSS, it yields no wealth effects in both regimes because $g_{\pi,i} = 0$, so it is a Ricardian solution.

Switching Policies

We want now consider a switching monetary policy:

- consider an AM regime 1
  - $\rightarrow$ for example $(\gamma_{\pi,1} = 1.5)$

Switching Policies

We want now consider a switching monetary policy:

- consider an AM regime 1
  - $\rightarrow$ for example $(\gamma_{\pi,1} = 1.5)$
- the central bank switches to PM in regime 2...

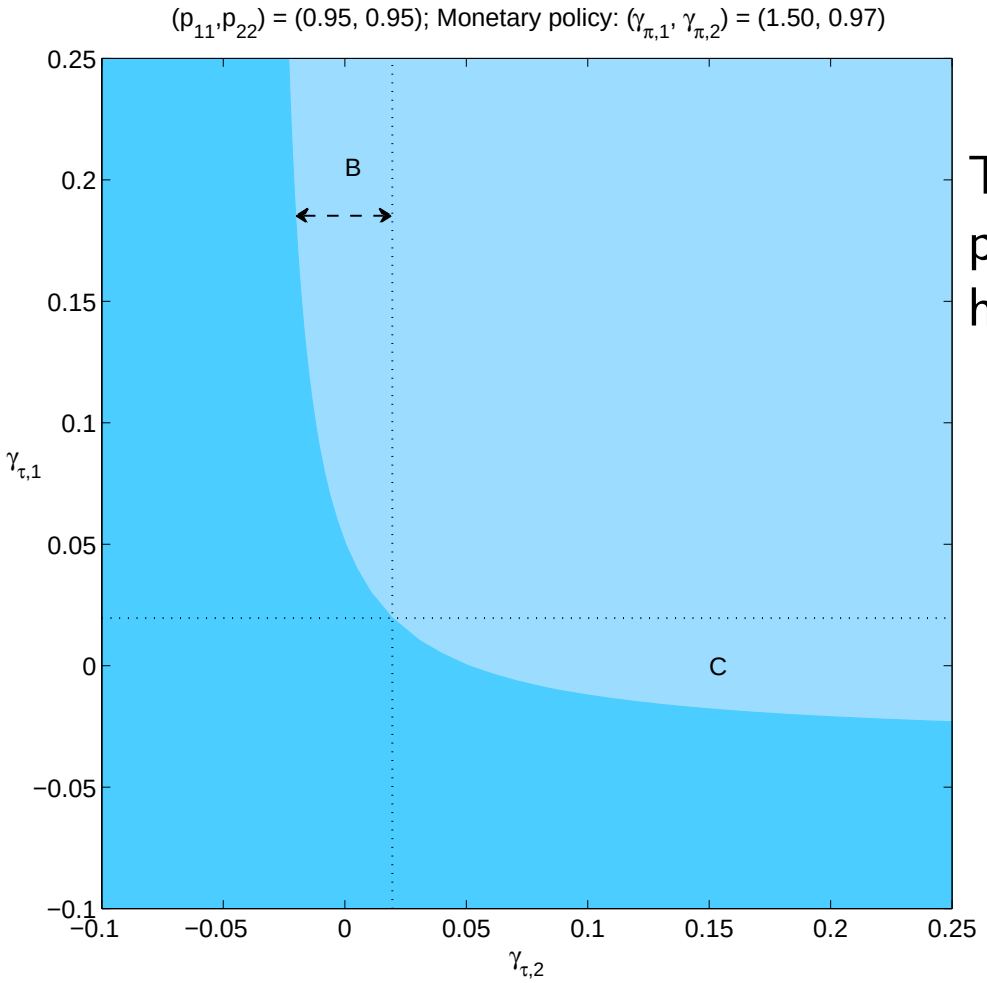
Switching Policies

We want now consider a switching monetary policy:

- consider an AM regime 1
  - $\rightarrow$ for example $(\gamma_{\pi,1} = 1.5)$
- the central bank switches to PM in regime 2...
- How should fiscal policy be in order to have uniqueness?
  - $\rightarrow$ Need to distinguish two cases: timid vs. substantial switch

Timid Switching Monetary Policy

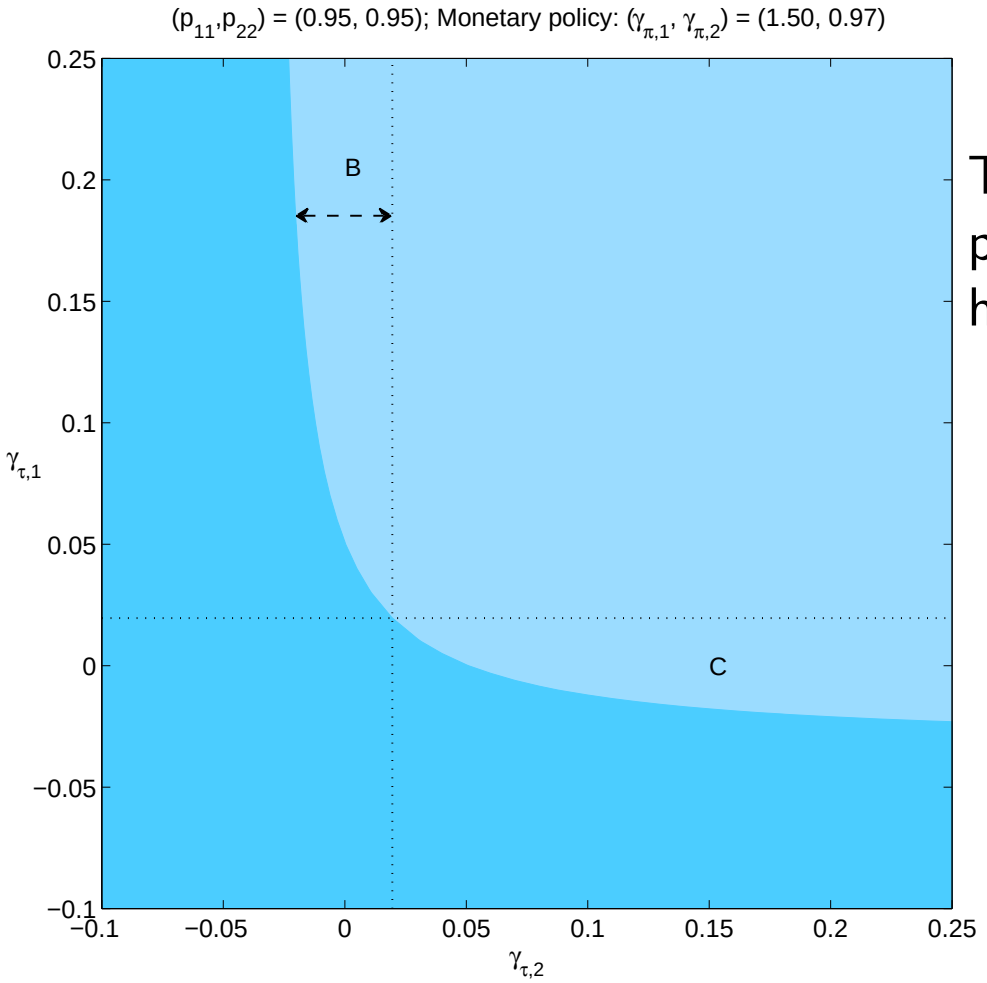
Timid monetary deviation: $(\gamma_{\pi,2} = 0.97)$



Timid deviations in monetary policy within the MPF: LRTP holds $\Rightarrow$ Overall AM

Timid Switching Monetary Policy

Timid monetary deviation: $(\gamma_{\pi,2} = 0.97)$

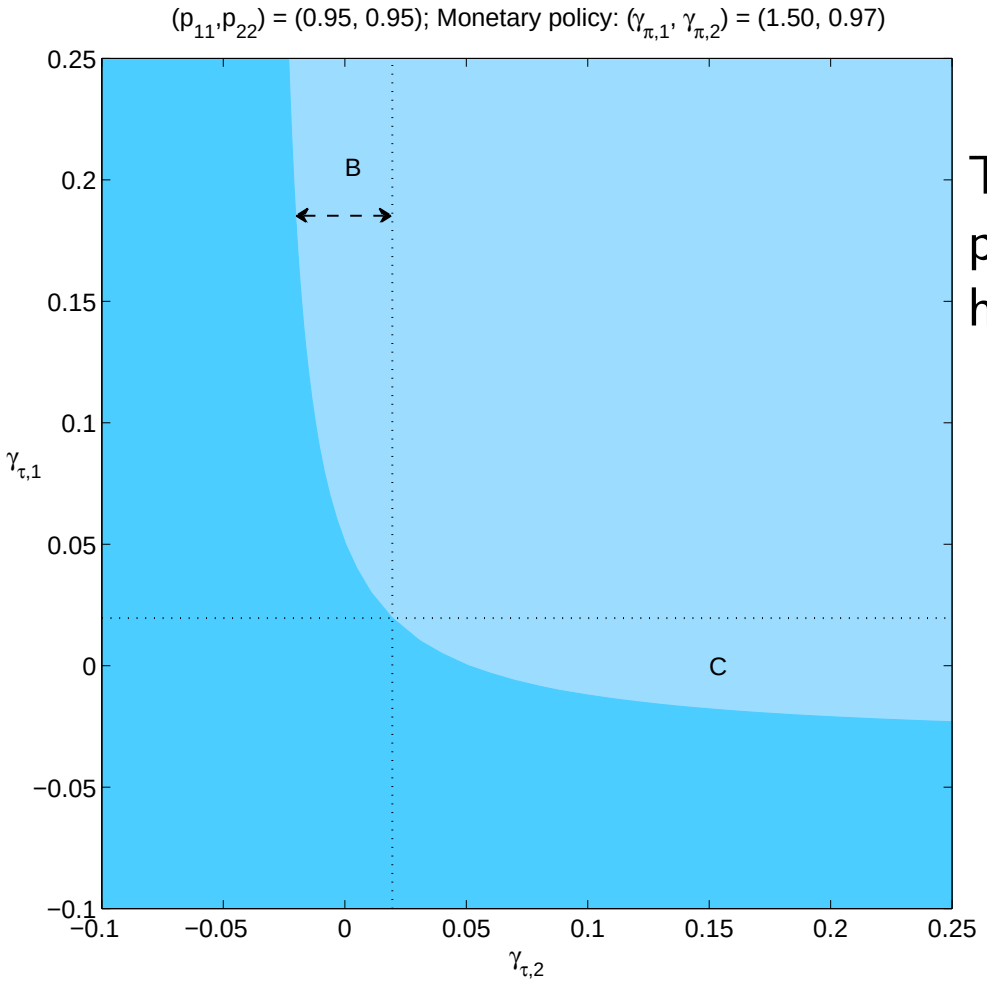


Timid deviations in monetary policy within the MPF: LRTP holds $\Rightarrow$ Overall AM

$\rightarrow$ uniqueness preserved above FPF $\Rightarrow$ timid deviations into AF $\Rightarrow$ overall PF

Timid Switching Monetary Policy

Timid monetary deviation: $(\gamma_{\pi,2} = 0.97)$



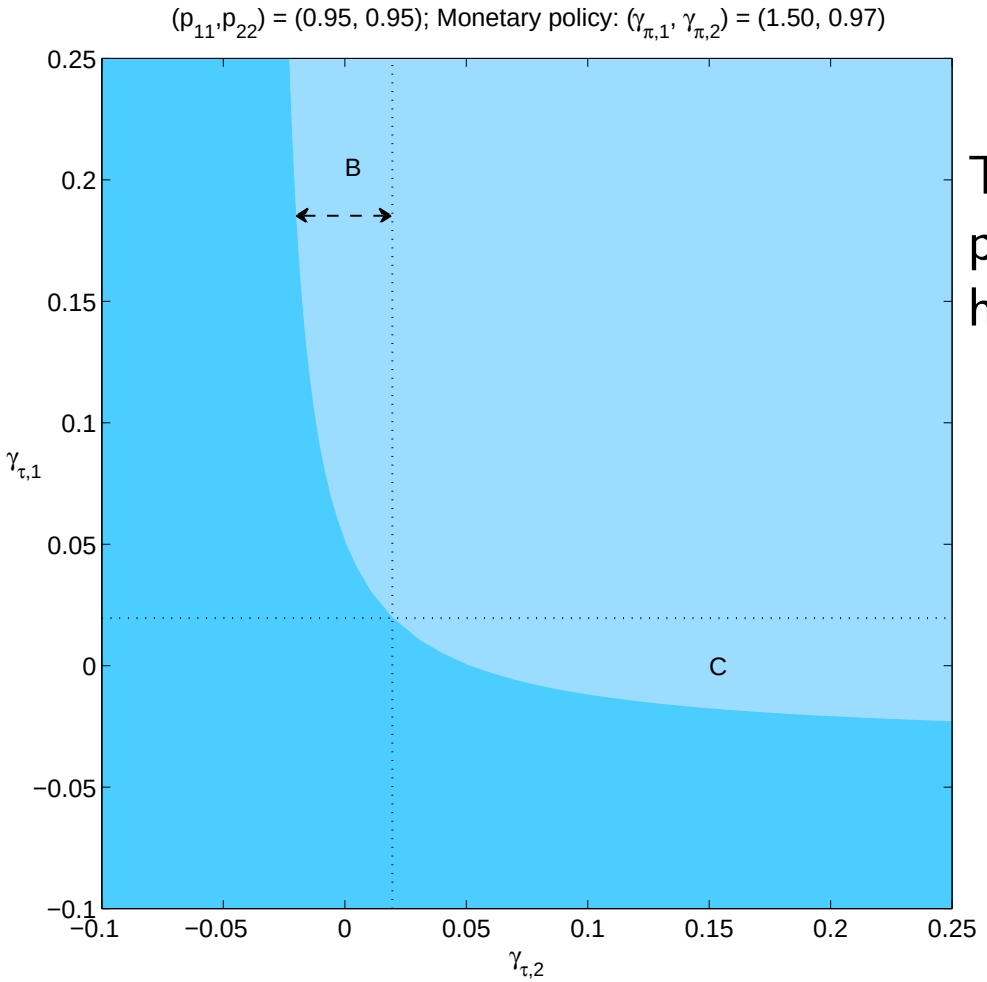
Timid deviations in monetary policy within the MPF: LRTP holds $\Rightarrow$ Overall AM

$\rightarrow$ uniqueness preserved above FPF $\Rightarrow$ timid deviations into AF $\Rightarrow$ overall PF

$\rightarrow$ **Overall AM/PF Mix**

Timid Switching Monetary Policy

Timid monetary deviation: $(\gamma_{\pi,2} = 0.97)$

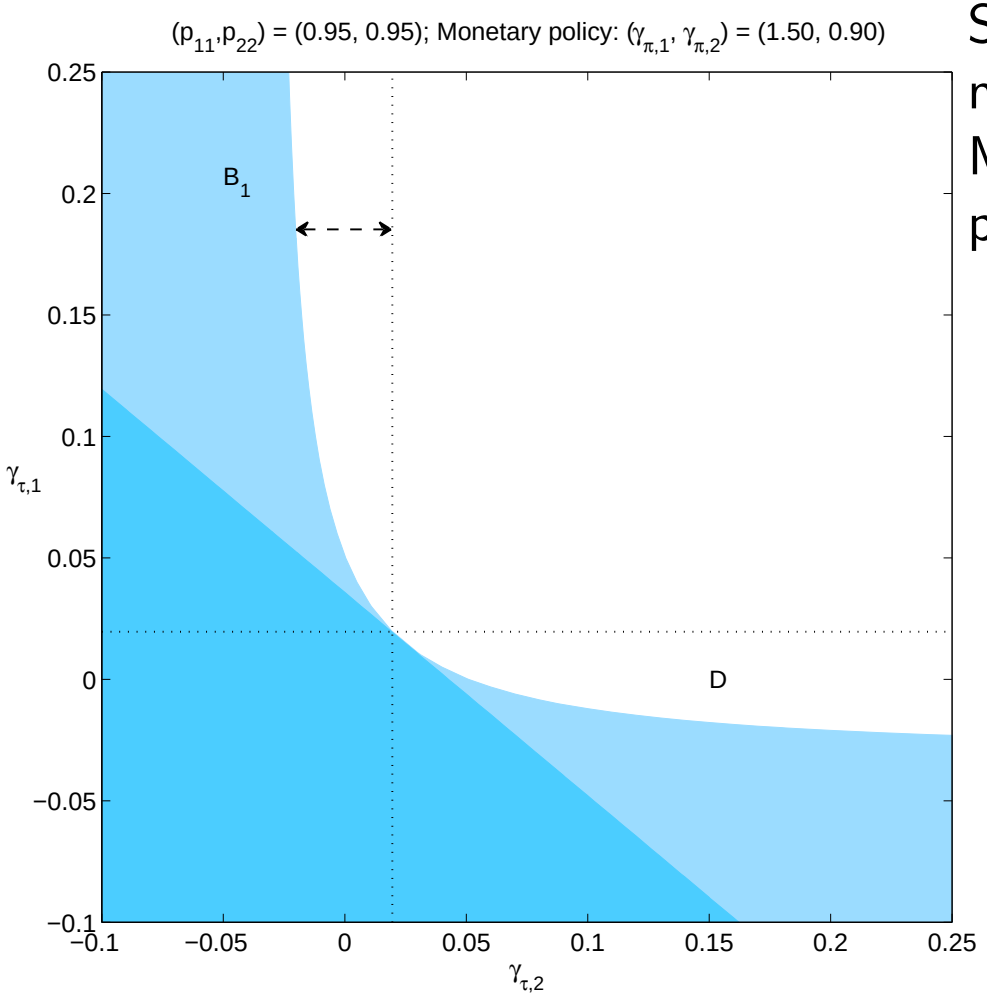


Timid deviations in monetary policy within the MPF: LRTP holds $\Rightarrow$ Overall AM

- $\rightarrow$ uniqueness preserved above FPF $\Rightarrow$ timid deviations into AF $\Rightarrow$ overall PF
- $\rightarrow$ **Overall AM/PF Mix**
- $\rightarrow$ one Ricardian solution $\Rightarrow$ no wealth effects

Switching Monetary Policy

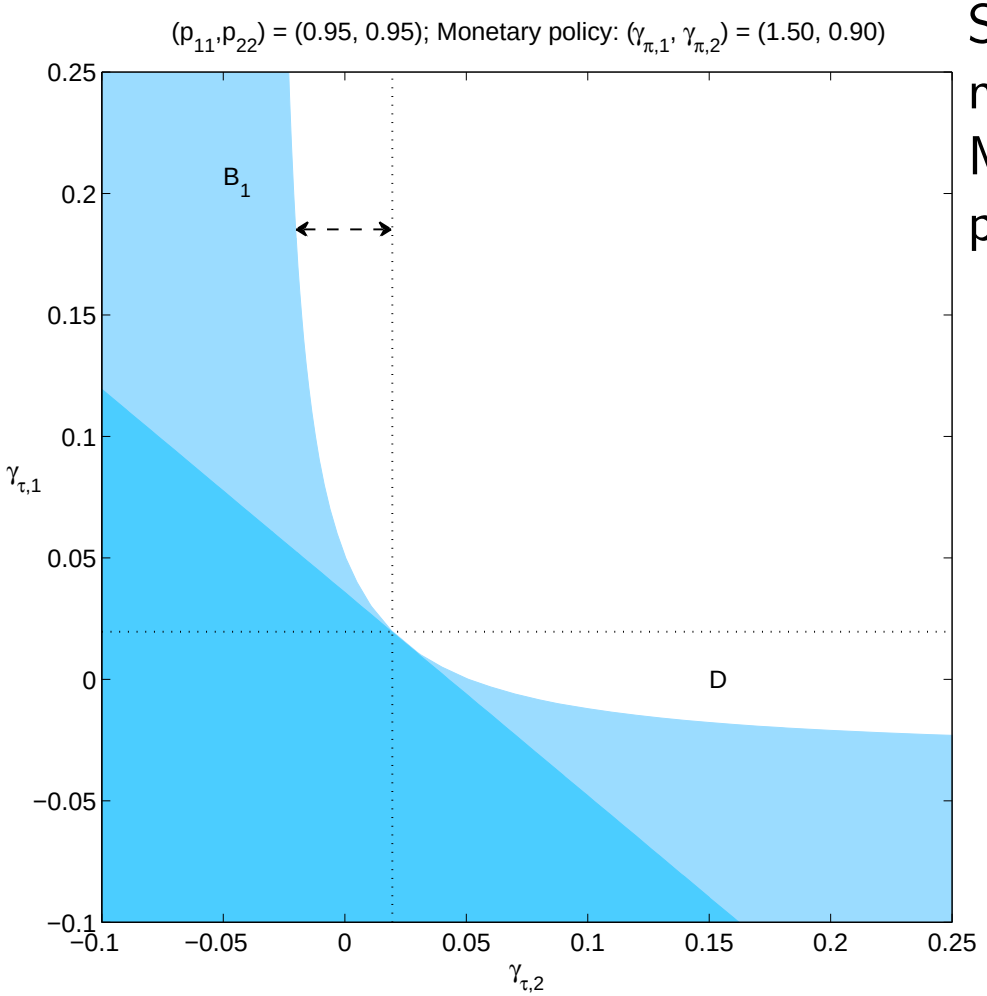
Substantial monetary deviation: $(\gamma_{\pi,2} = 0.90)$



Substantial deviations in monetary policy outside the MPF $\Rightarrow$ Switching monetary policy

Switching Monetary Policy

Substantial monetary deviation: $(\gamma_{\pi,2} = 0.90)$

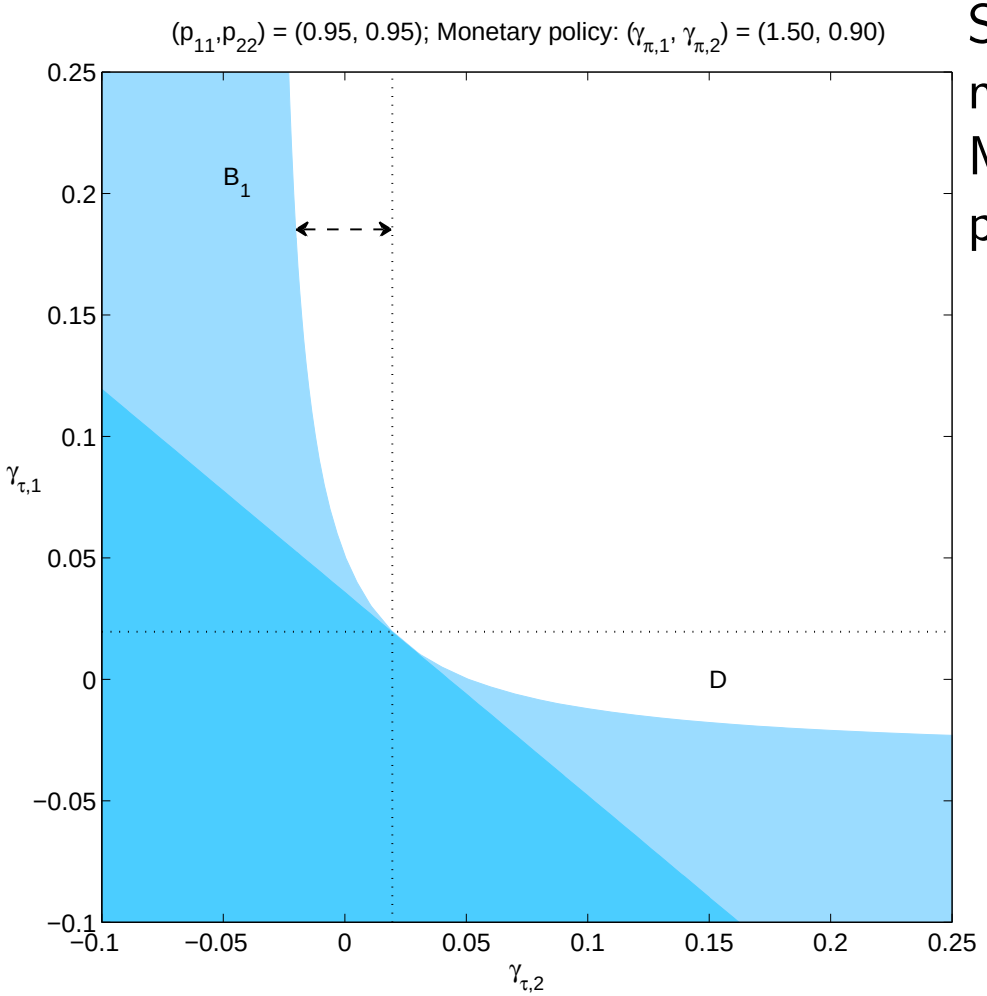


Substantial deviations in monetary policy outside the MPF $\Rightarrow$ Switching monetary policy

$\rightarrow$ Uniqueness if substantial deviation in fiscal policy: Switching fiscal policy

Switching Monetary Policy

Substantial monetary deviation: $(\gamma_{\pi,2} = 0.90)$

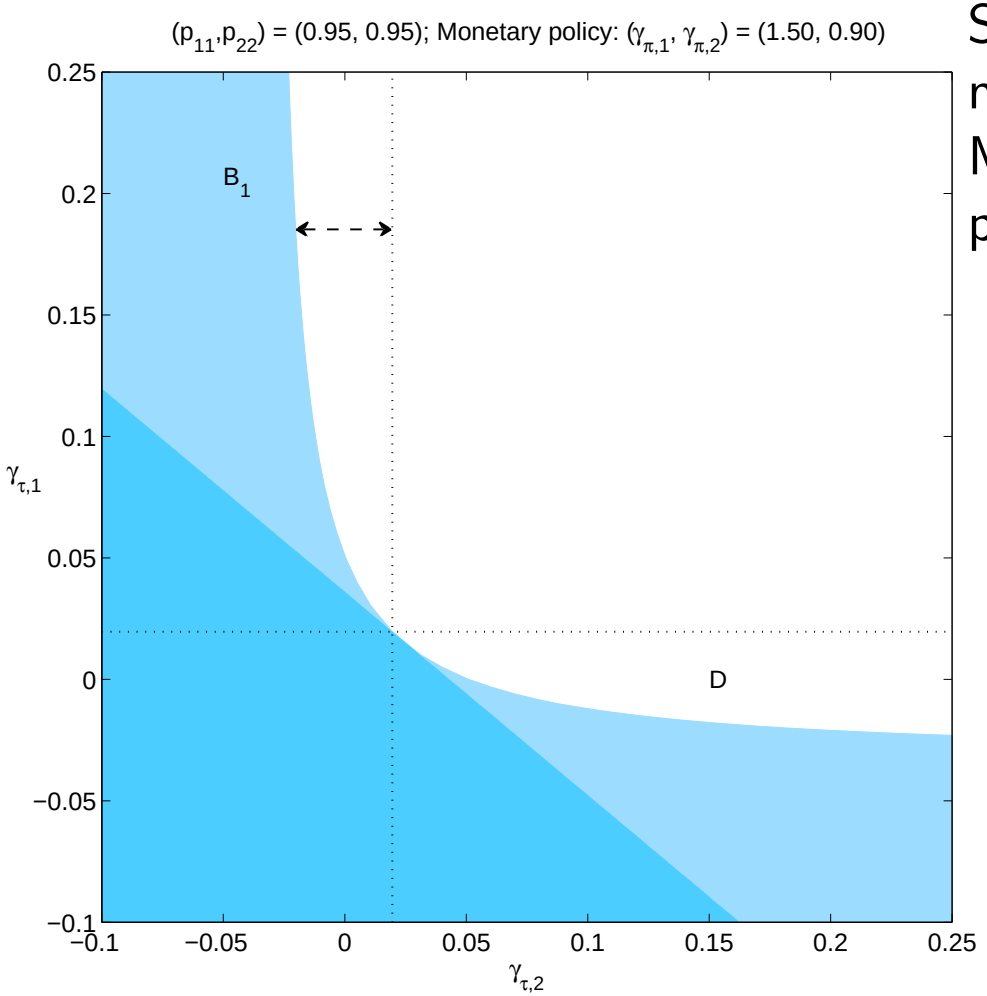


Substantial deviations in monetary policy outside the MPF $\Rightarrow$ Switching monetary policy

- $\rightarrow$ Uniqueness if substantial deviation in fiscal policy: Switching fiscal policy
- $\rightarrow$ multiplicity instead if overall passive FP (MPF - LRTP unsatisfied)

Switching Monetary Policy

Substantial monetary deviation: $(\gamma_{\pi,2} = 0.90)$



Substantial deviations in monetary policy outside the MPF ⇒ Switching monetary policy

→ Uniqueness if substantial deviation in fiscal policy: Switching fiscal policy

→ multiplicity instead if overall passive FP (MPF - LRTP unsatisfied)

→ Overall Switching Policies Mix: above the straight line: one fiscal unbacking solution ⇒ wealth effects

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

Overall AM: monetary policy combination inside Monetary Policy Frontier $\Rightarrow$ only timid deviations into PM are allowed

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

Overall AM: monetary policy combination inside Monetary Policy Frontier $\Rightarrow$ only timid deviations into PM are allowed

Overall PF: fiscal policy combination inside Fiscal Policy Frontier $\Rightarrow$ only timid deviations into AF are allowed

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

Overall AM: monetary policy combination inside Monetary Policy Frontier $\Rightarrow$ only timid deviations into PM are allowed

Overall PF: fiscal policy combination inside Fiscal Policy Frontier $\Rightarrow$ only timid deviations into AF are allowed

Overall AM/PF Mix: overall AM + overall PF $\Rightarrow$ **Ricardian solution**: no wealth effects in both regimes

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

Overall switching monetary policy: monetary policy combinations outside Monetary Policy Frontier $\Rightarrow$ substantial deviations in PM

The importance of coordination: towards a new taxonomy

Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

Overall switching monetary policy: monetary policy combinations outside Monetary Policy Frontier $\Rightarrow$ substantial deviations in PM

Overall switching fiscal policy: fiscal policy combinations outside Fiscal Policy Frontier $\Rightarrow$ substantial deviations into AF

The importance of coordination: towards a new taxonomy

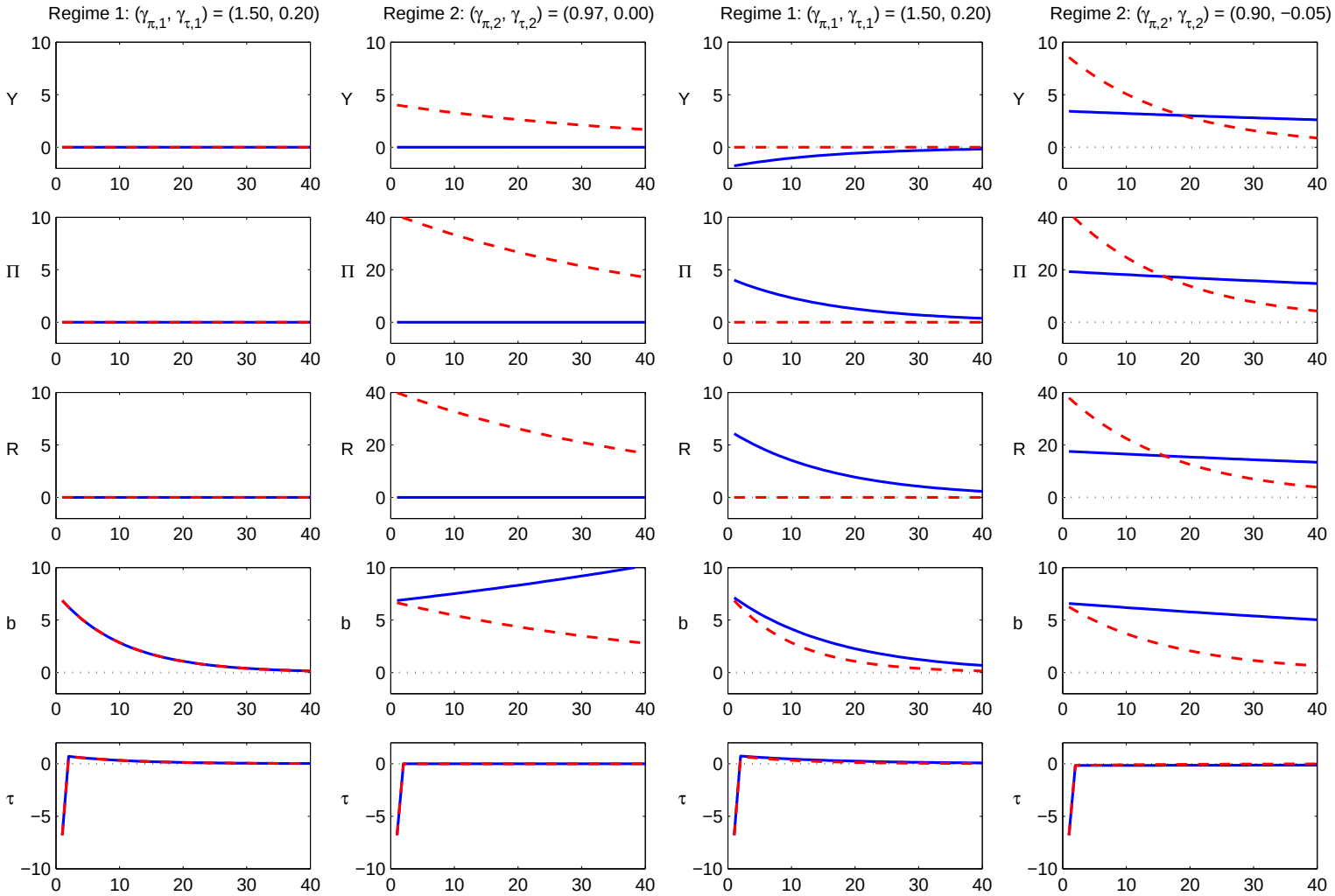
Given an AM/PF regime 1, monetary and fiscal policies need to be **overall balanced** to obtain a unique stable equilibrium:

Overall switching monetary policy: monetary policy combinations outside Monetary Policy Frontier $\Rightarrow$ substantial deviations in PM

Overall switching fiscal policy: fiscal policy combinations outside Fiscal Policy Frontier $\Rightarrow$ substantial deviations into AF

Overall SWITCHING Mix: overall switching monetary policy + overall switching fiscal policy $\Rightarrow$ **Non-Ricardian solution**: wealth effects in both regimes

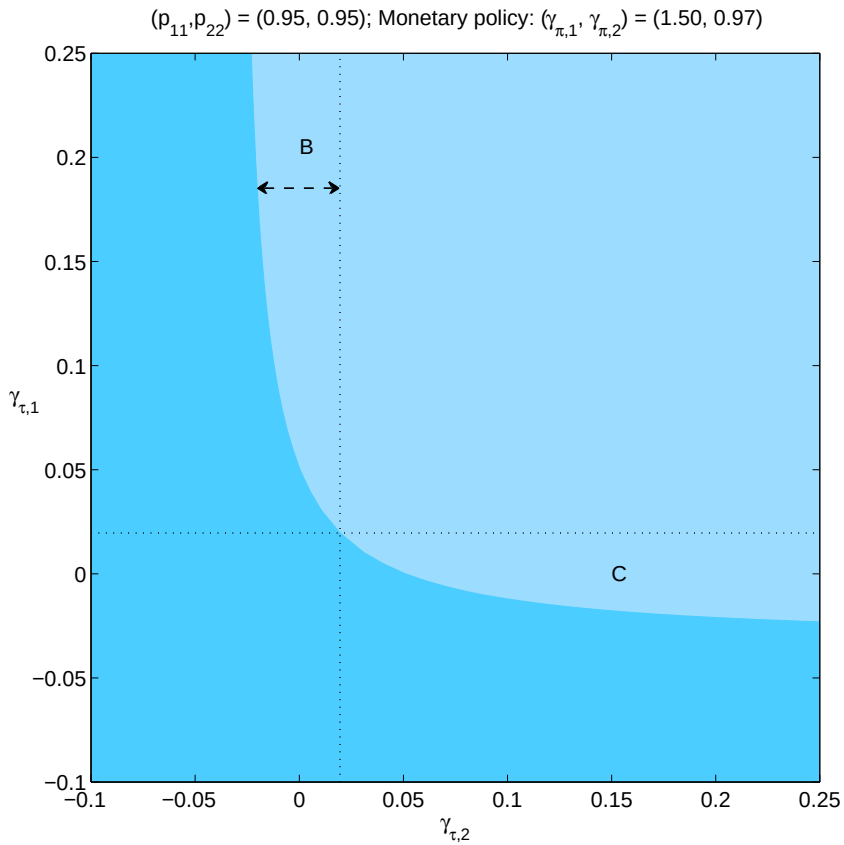
IRFs to a tax shock under MS and fixed coefficients



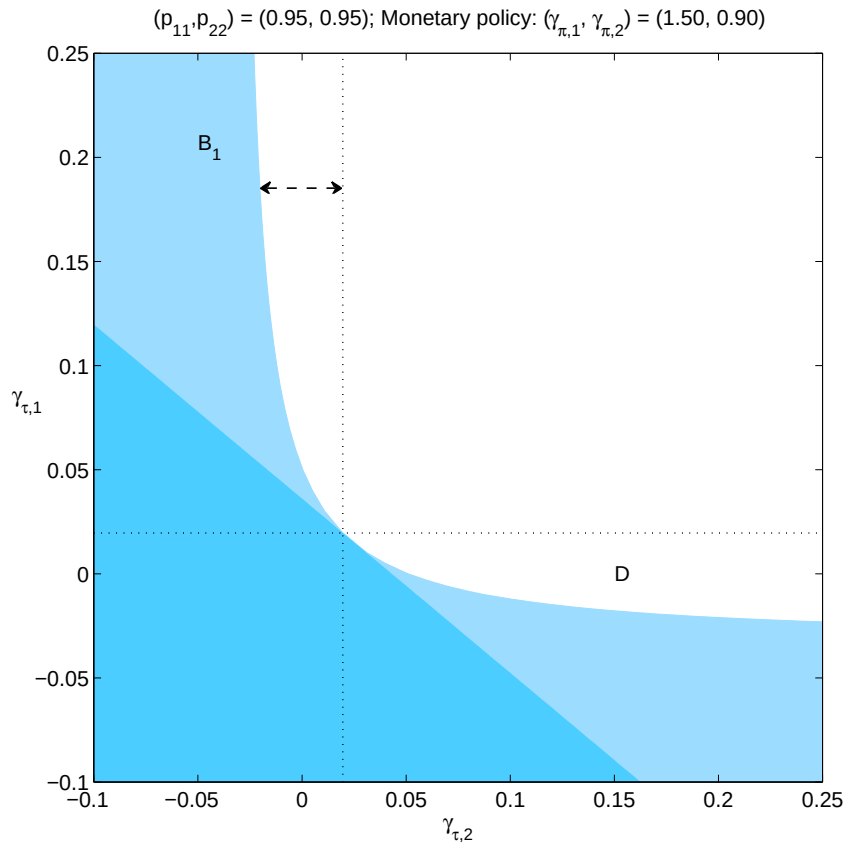
Overall AM/PF Mix Overall Switching Mix

Blue solid lines: MS; Red dashed lines: fixed coefficients

The importance of coordination



Modest deviations



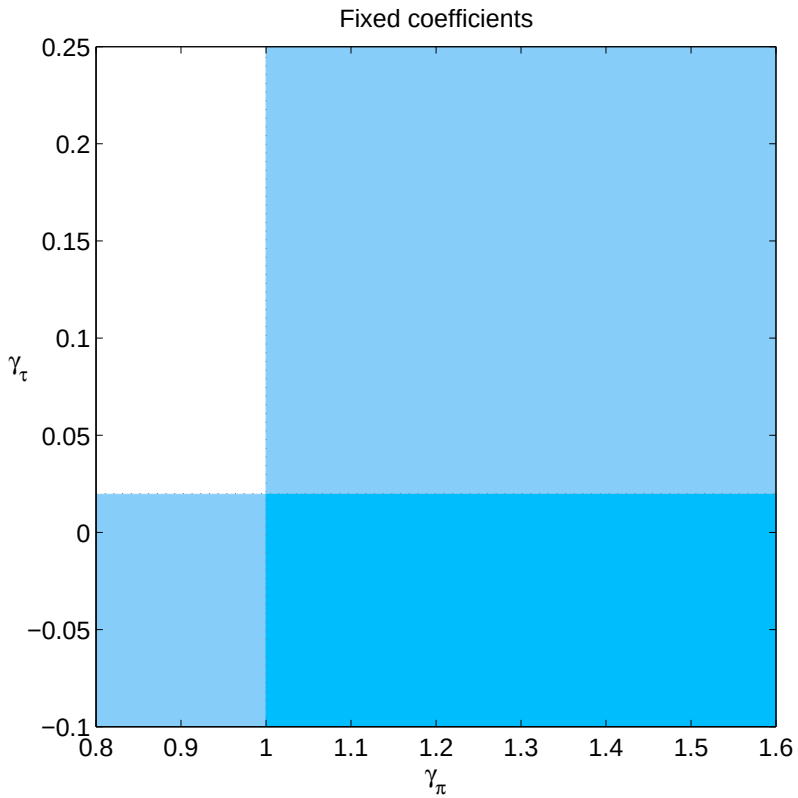
Substantial deviations

▸ original taxonomy of little use

What determines uniqueness?

How to define timid vs. substantial deviations?

Uniqueness under fixed coefficients



AM/PF uniqueness

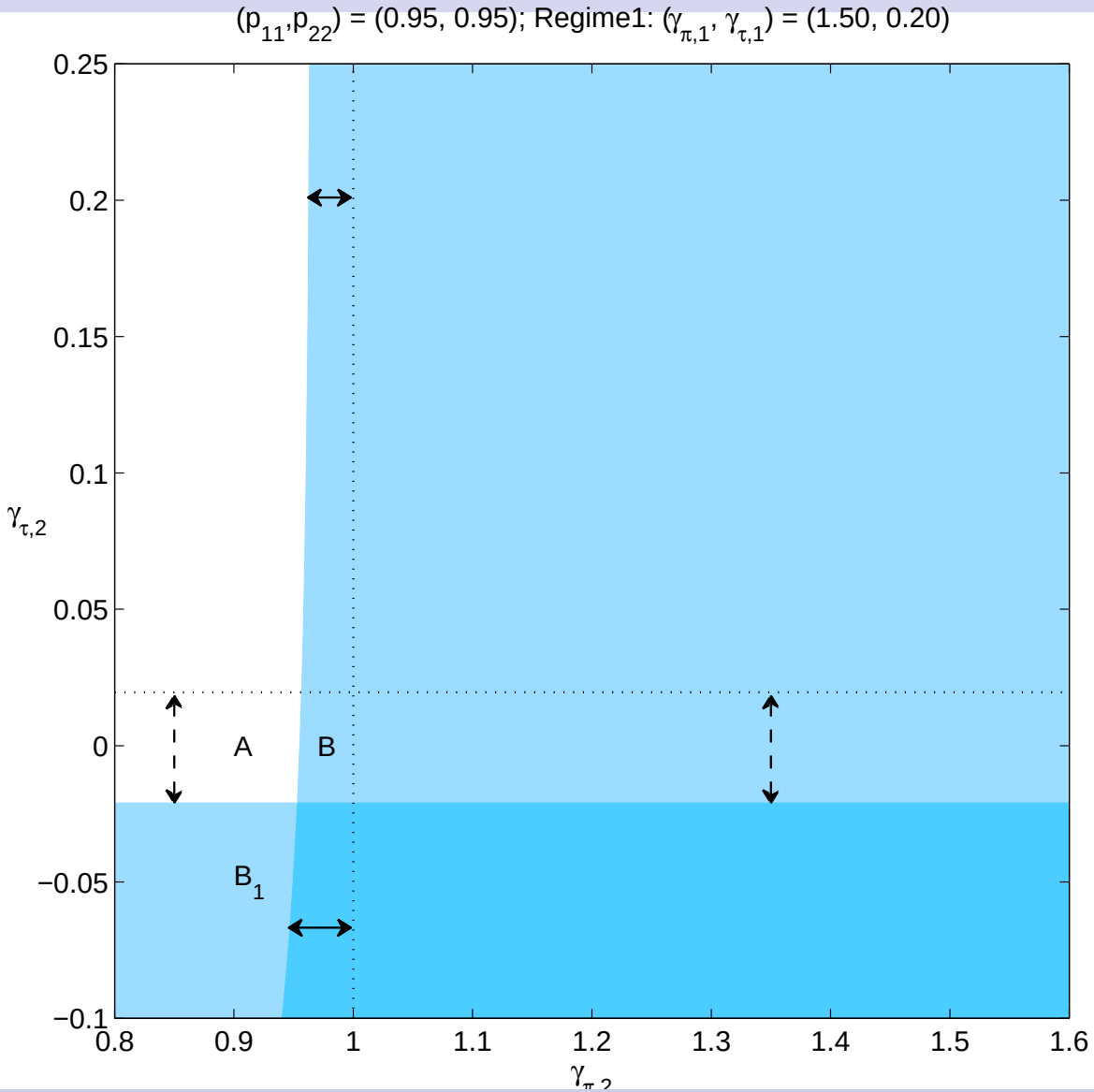
PM/AF uniqueness

PM/PF multiplicity

AM/AF no stable solutions

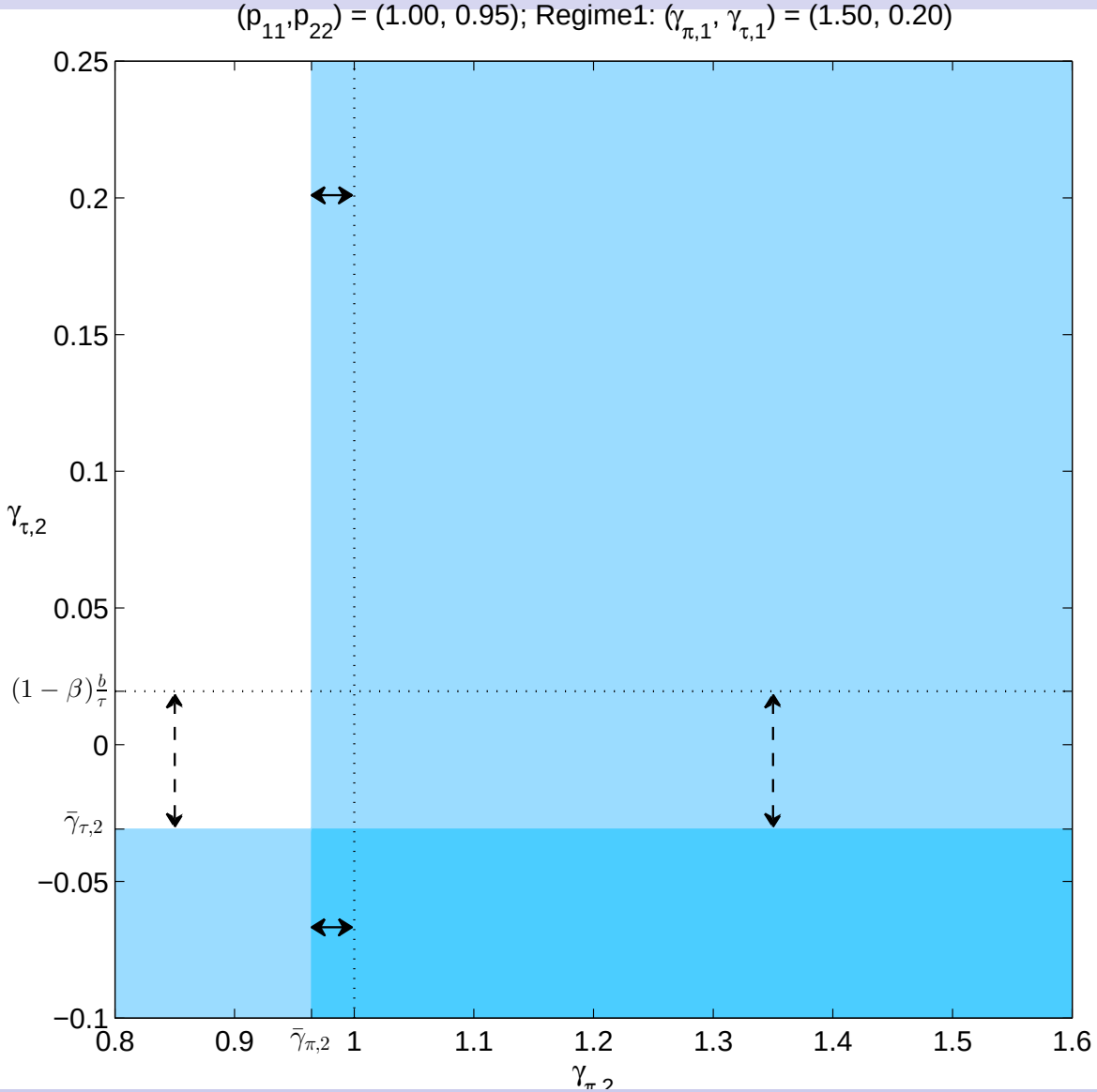
Uniqueness under regime switching

"Timid" deviations: relaxing Leeper's conditions



Uniqueness under regime switching: absorbing case

"Timid" deviations: relaxing Leeper's conditions



Uniqueness under regime switching: absorbing case

"Timid" deviations: relaxing Leeper's conditions

If regime 1 is AM/PF and absorbing, uniqueness:

Upper-right region

$$\gamma_{2,\tau} > \frac{b_{ss}}{\tau_{ss}} \left(1 - \frac{\beta}{\sqrt{p_{22}}}\right)$$

$$\gamma_{2,\pi} > \sqrt{p_{22}} - \frac{\left(1 - \beta\sqrt{p_{22}}\right)\left(1 - \sqrt{p_{22}}\right)}{\lambda}$$

Uniqueness under regime switching: absorbing case

"Timid" deviations: relaxing Leeper's conditions

If regime 1 is AM/PF and absorbing, uniqueness:

Upper-right region

$$\gamma_{2,\tau} > \frac{b_{ss}}{\tau_{ss}}\left(1 - \frac{\beta}{\sqrt{p_{22}}}\right) \qquad \text{PF: } \gamma_{\tau} > \frac{b_{ss}}{\tau_{ss}}\left(1-\beta\right)$$

$$\gamma_{2,\pi} > \sqrt{p_{22}} - \frac{\left(1-\beta\sqrt{p_{22}}\right)\left(1-\sqrt{p_{22}}\right)}{\lambda} \qquad \text{AM: } \gamma_{\pi} > 1$$

Uniqueness under regime switching: absorbing case

"Timid" deviations: relaxing Leeper's conditions

If regime 1 is AM/PF and absorbing, uniqueness:

Upper-right region

$$\gamma_{2,\tau} > \frac{b_{ss}}{\tau_{ss}}\left(1 - \frac{\beta}{\sqrt{p_{22}}}\right) \qquad \text{PF: } \gamma_{\tau} > \frac{b_{ss}}{\tau_{ss}}(1-\beta)$$

$$\gamma_{2,\pi} > \sqrt{p_{22}} - \frac{\left(1-\beta\sqrt{p_{22}}\right)\left(1-\sqrt{p_{22}}\right)}{\lambda} \qquad \text{AM: } \gamma_{\pi} > 1$$

$\rightarrow$ **timid deviations from AM and PF still grant uniqueness**

$\rightarrow$ Same intuition as for Davig & Leeper for the LRTP

Uniqueness under regime switching: absorbing case

"Timid" deviations: relaxing Leeper's conditions

If regime 1 is AM/PF and absorbing, uniqueness:

Upper-right region

$$\gamma_{2,\tau} > \frac{b_{ss}}{\tau_{ss}}\left(1 - \frac{\beta}{\sqrt{p_{22}}}\right) \qquad \text{PF: } \gamma_{\tau} > \frac{b_{ss}}{\tau_{ss}}\left(1-\beta\right)$$

$$\gamma_{2,\pi} > \sqrt{p_{22}} - \frac{\left(1-\beta\sqrt{p_{22}}\right)\left(1-\sqrt{p_{22}}\right)}{\lambda} \qquad \text{AM: } \gamma_{\pi} > 1$$

$\rightarrow$ timid deviations from AM and PF still grant uniqueness

$\rightarrow$ Same intuition as for Davig & Leeper for the LRTP

$\rightarrow$ **deviations can be larger the smaller** p_{22}

Uniqueness under regime switching: absorbing case

"Timid" deviations: relaxing Leeper's conditions

Lower-left region

$$\gamma_{2,\tau} < \frac{b_{ss}}{\tau_{ss}} \left(1 - \frac{\beta}{\sqrt{p_{22}}}\right)$$

$$\gamma_{2,\pi} < \sqrt{p_{22}} - \frac{\left(1 - \beta\sqrt{p_{22}}\right)\left(1 - \sqrt{p_{22}}\right)}{\lambda}$$

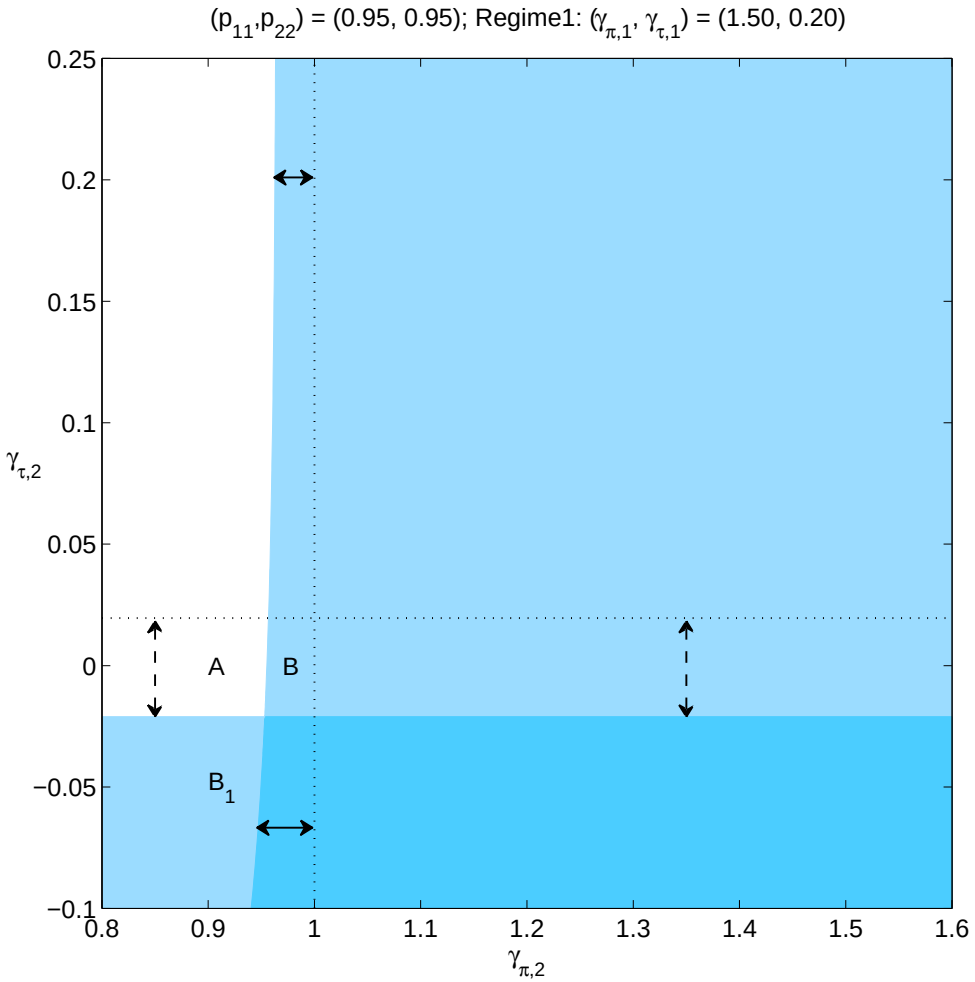
$\rightarrow$ monetary policy needs to deviate substantially from AM

$\rightarrow$ fiscal policy needs to deviate substantially from PF

$\rightarrow$ **substantial** and **coordinated** deviations to get uniqueness

Dynamic response of the model

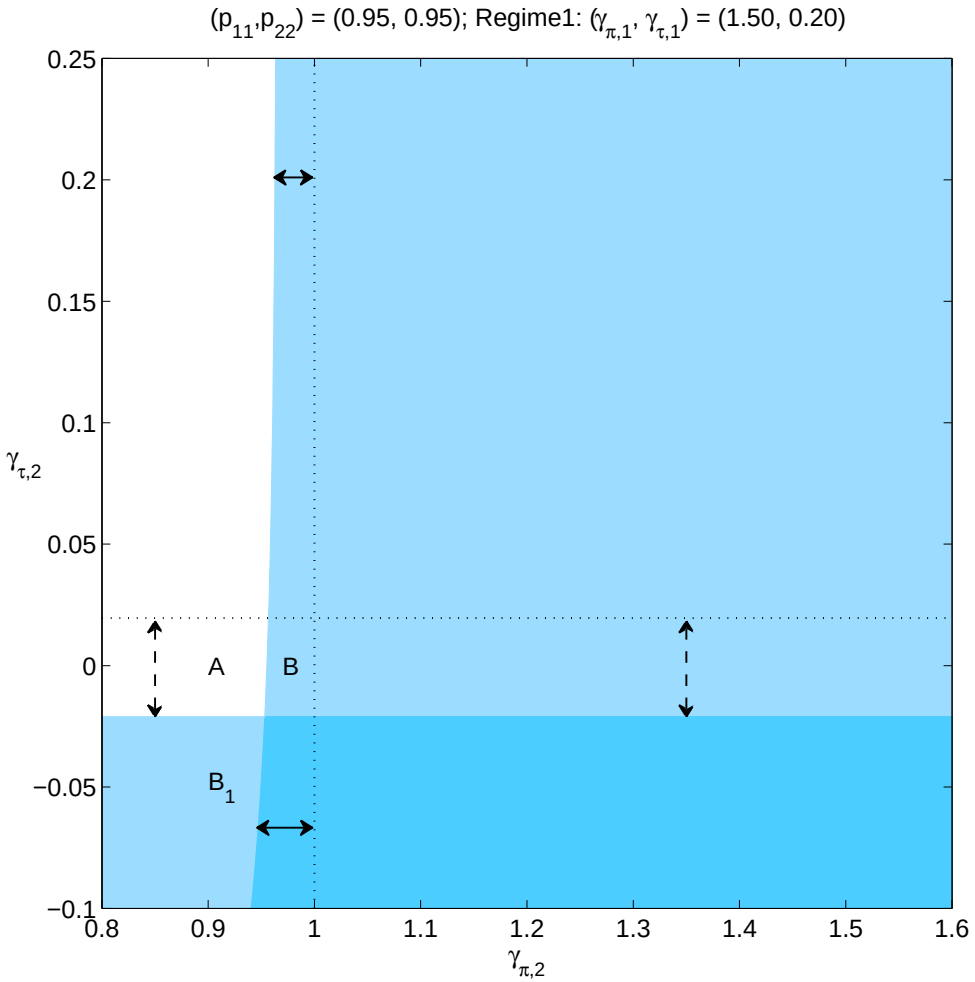
Does the two solutions B and B_1 exhibit different dynamics?



Main Intuition:
A New Taxonomy

Dynamic response of the model

Does the two solutions B and B_1 exhibit different dynamics?

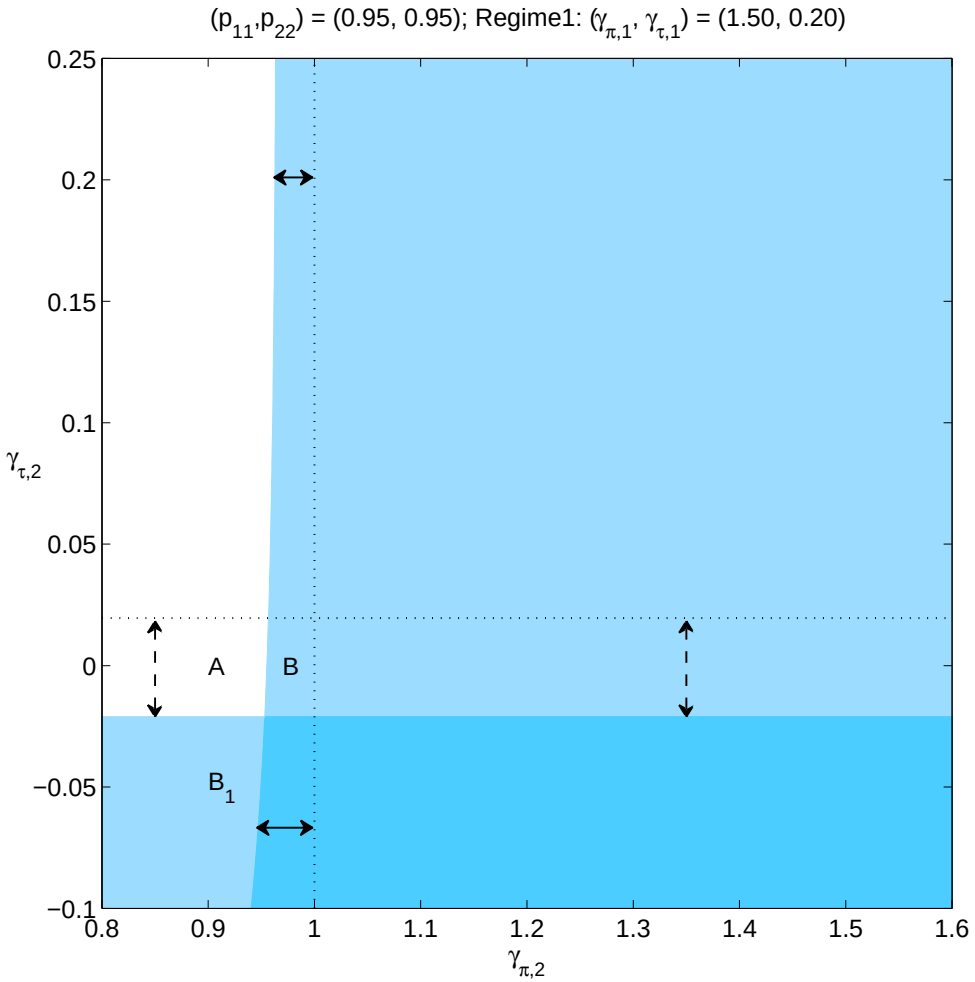


Main Intuition:
A New Taxonomy

B $\rightarrow$ Timid deviations from AM and PF

Dynamic response of the model

Does the two solutions B and B_1 exhibit different dynamics?



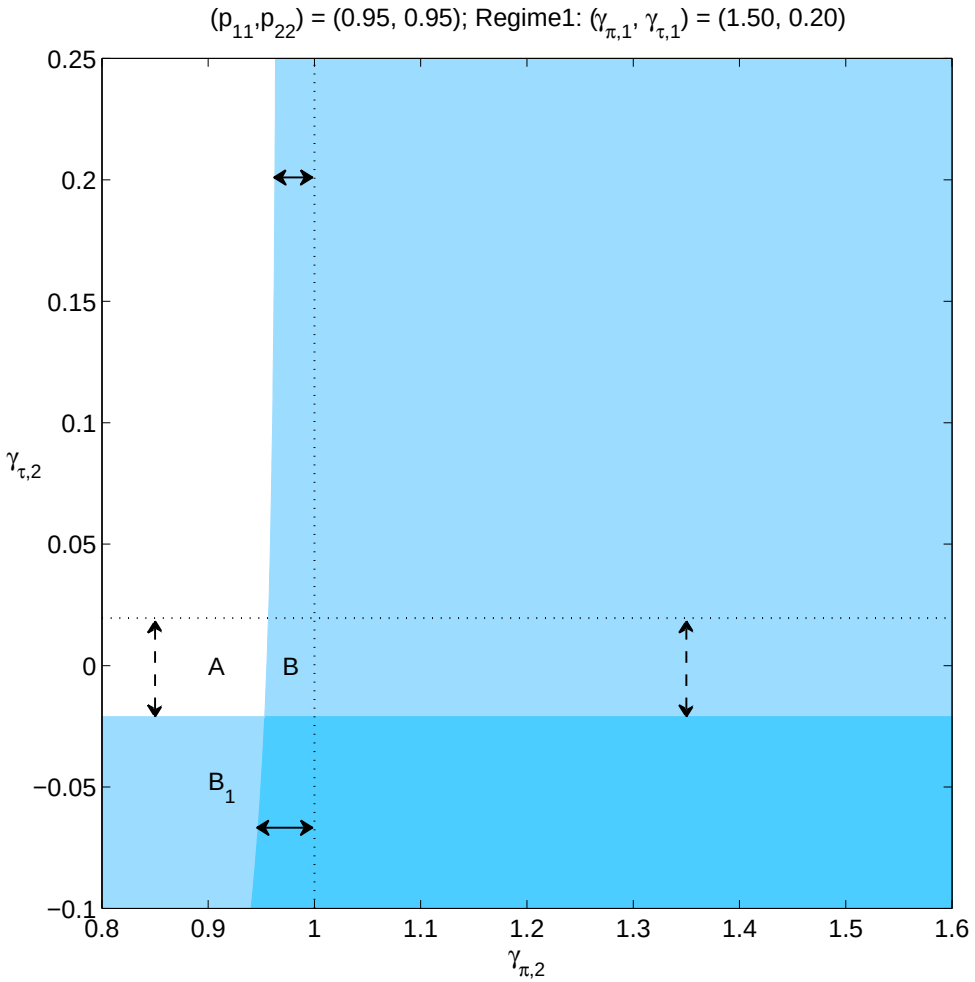
Main Intuition:
A New Taxonomy

B $\rightarrow$ Timid deviations from AM and PF

$\rightarrow$ **Overall AM/PF Mix**

Dynamic response of the model

Does the two solutions B and B_1 exhibit different dynamics?

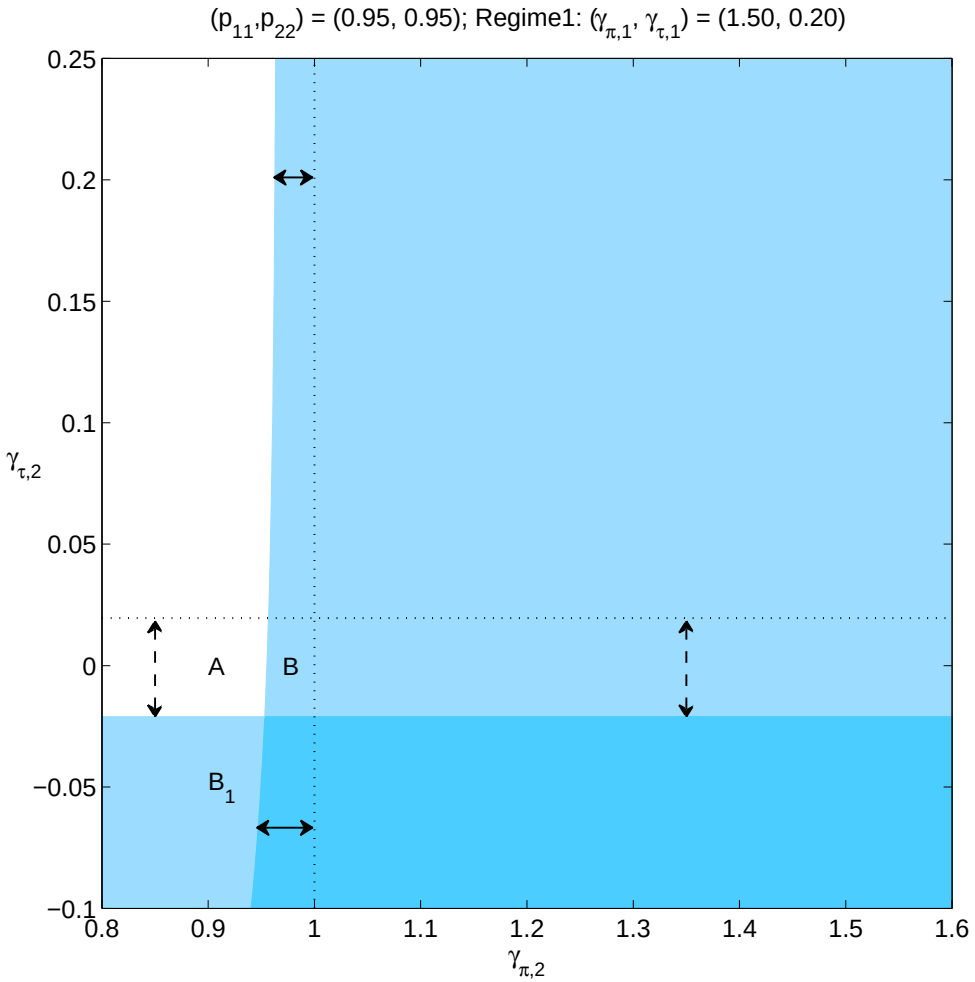


Main Intuition:
A New Taxonomy

- B $\rightarrow$ Timid deviations from AM and PF
- $\rightarrow$ **Overall AM/PF Mix**
- $\rightarrow$ **No wealth effects**

Dynamic response of the model

Does the two solutions B and B_1 exhibit different dynamics?



Main Intuition:
A New Taxonomy

B $\rightarrow$ Timid deviations from AM and PF

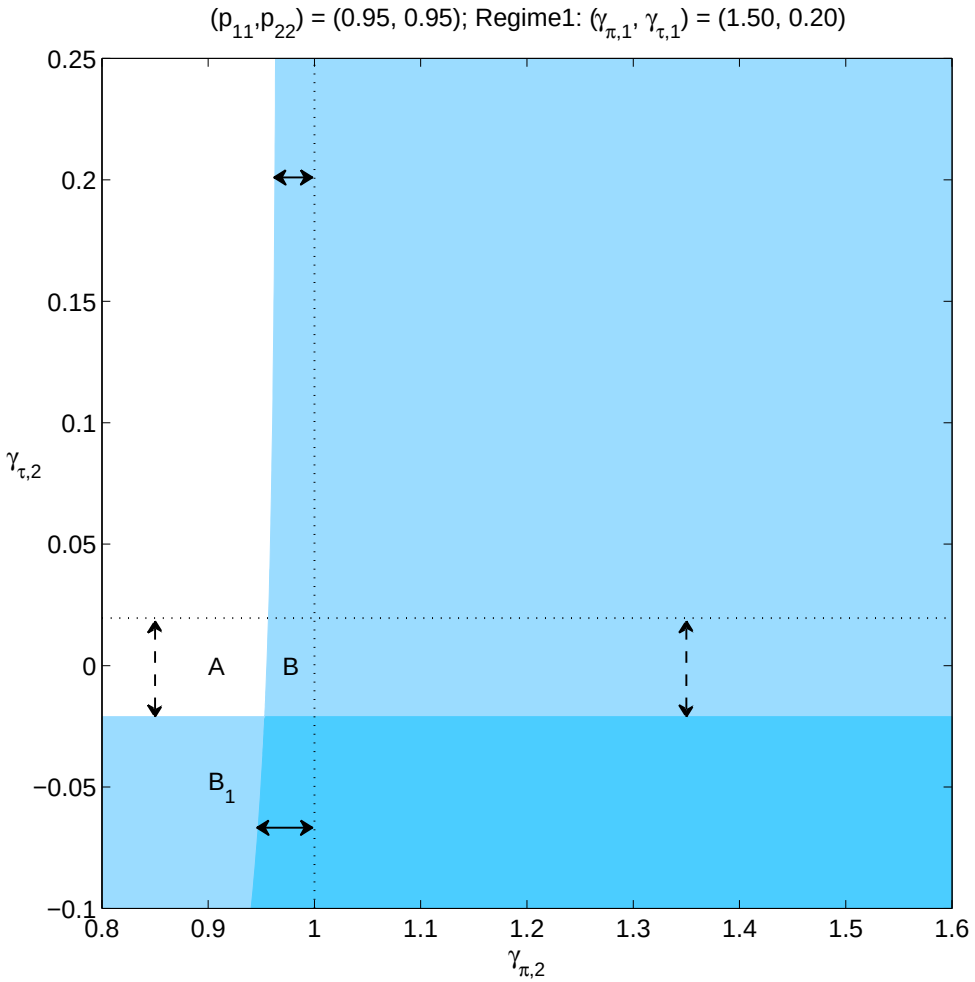
$\rightarrow$ **Overall AM/PF Mix**

$\rightarrow$ **No wealth effects**

B_1 $\rightarrow$ Substantial deviations from AM and PF

Dynamic response of the model

Does the two solutions B and B_1 exhibit different dynamics?



Main Intuition:
A New Taxonomy

B $\rightarrow$ Timid deviations from AM and PF

$\rightarrow$ **Overall AM/PF Mix**

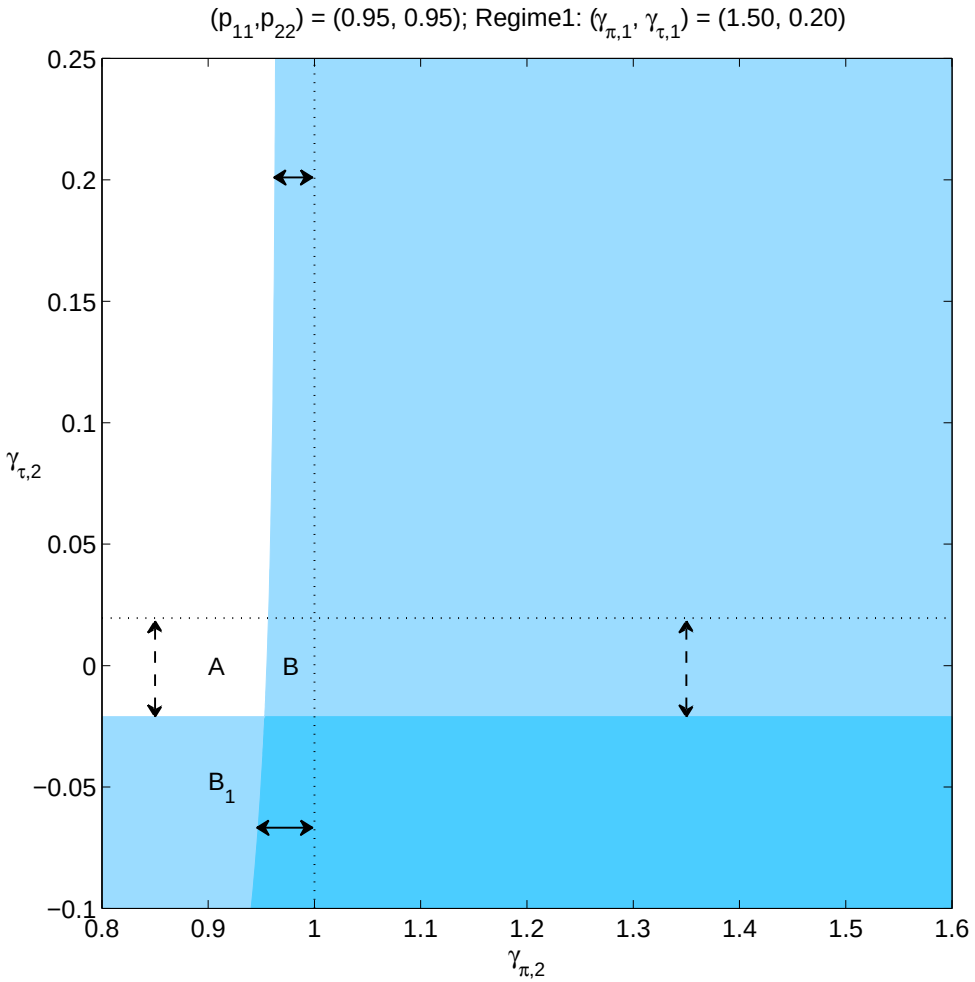
$\rightarrow$ **No wealth effects**

B_1 $\rightarrow$ Substantial deviations from AM and PF

$\rightarrow$ **Overall Switching Mix**

Dynamic response of the model

Does the two solutions B and B_1 exhibit different dynamics?



Main Intuition:
A New Taxonomy

B $\rightarrow$ Timid deviations from AM and PF

$\rightarrow$ **Overall AM/PF Mix**

$\rightarrow$ **No wealth effects**

B_1 $\rightarrow$ Substantial deviations from AM and PF

$\rightarrow$ **Overall Switching Mix**

$\rightarrow$ **Wealth effects**

Policy Implications

Several Implications

1. Establish conditions for dynamics to exhibit wealth effects with MS changes

Policy Implications

Several Implications

1. Establish conditions for dynamics to exhibit wealth effects with MS changes
2. Timidity Trap (Krugman, 2014)

Policy Implications

Several Implications

1. Establish conditions for dynamics to exhibit wealth effects with MS changes
2. Timidity Trap (Krugman, 2014)
3. Expectation effects are asymmetric (e.g., Liu-Waggoner-Zha, 2009)

Policy Implications

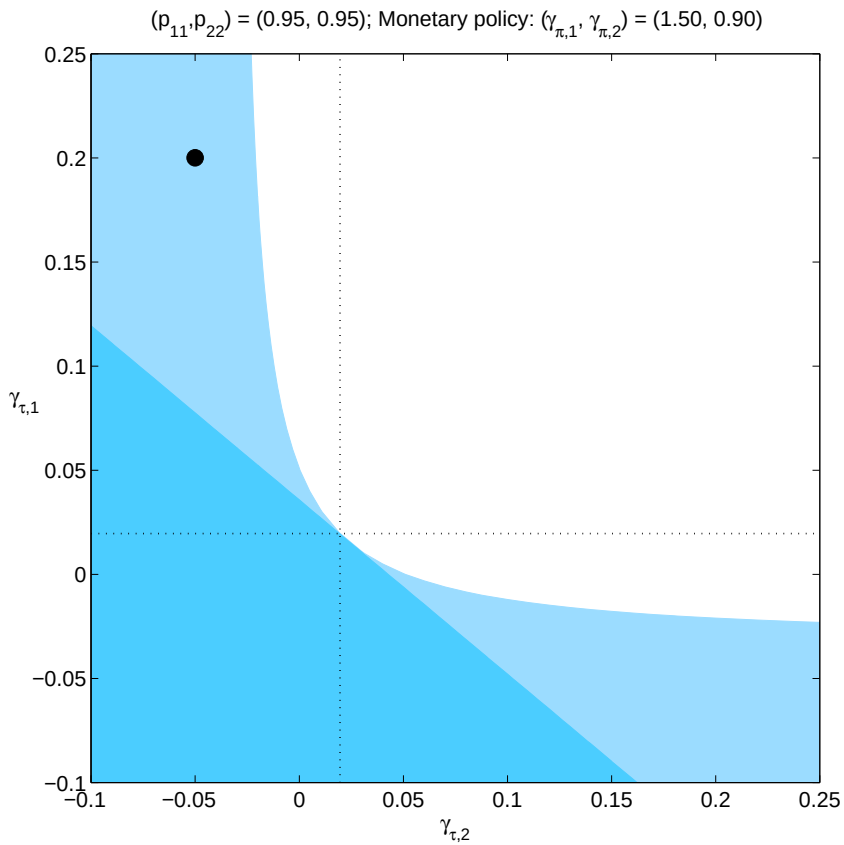
Several Implications

1. Establish conditions for dynamics to exhibit wealth effects with MS changes
2. Timidity Trap (Krugman, 2014)
3. Expectation effects are asymmetric (e.g., Liu-Waggoner-Zha, 2009)
4. Wealth effects and FTPL **is not** always at work if agents attach a positive probability of moving towards active fiscal policy (e.g., Chung-Davig-Leeper, 2007) ◂ MSS vs boundedness
   - → *overall* policy stance matters
   - → estimation and multiple equilibria

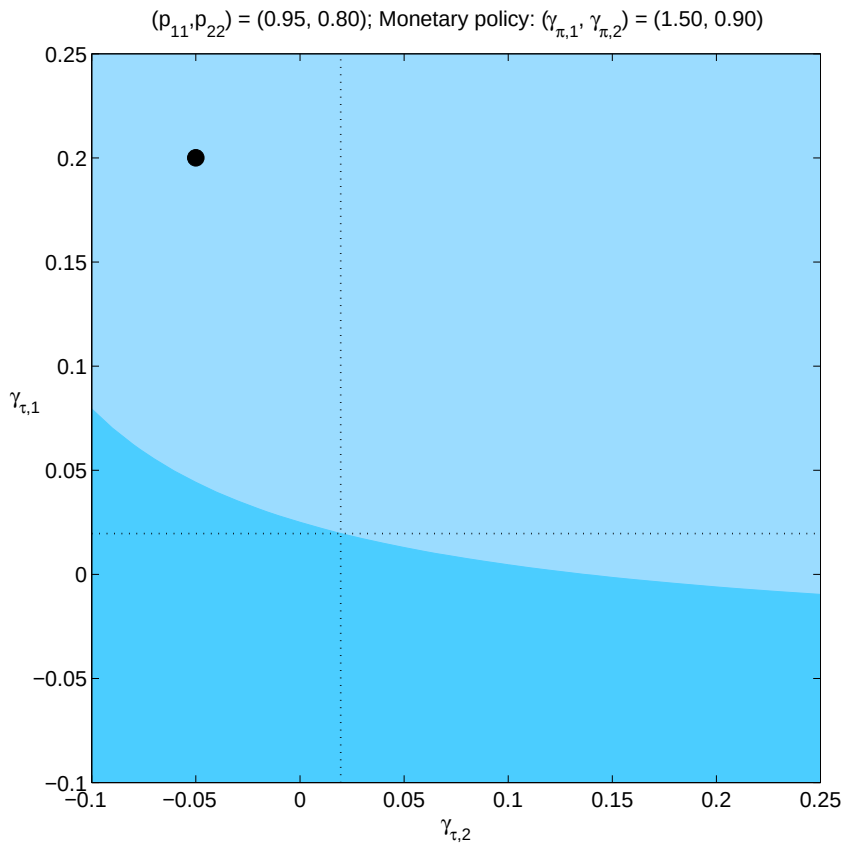
Policy Implications

Several Implications

1. Establish conditions for dynamics to exhibit wealth effects with MS changes
2. Timidity Trap (Krugman, 2014)
3. Expectation effects are asymmetric (e.g., Liu-Waggoner-Zha, 2009)
4. Wealth effects and FTPL **is not** always at work if agents attach a positive probability of moving towards active fiscal policy (e.g., Chung-Davig-Leeper, 2007) ◂ MSS vs boundedness
   - → *overall* policy stance matters
   - → estimation and multiple equilibria
5. Regime persistence is key (Bianchi and Melosi, 2013) → define "timid deviations", MPF and FPF, and type of regimes

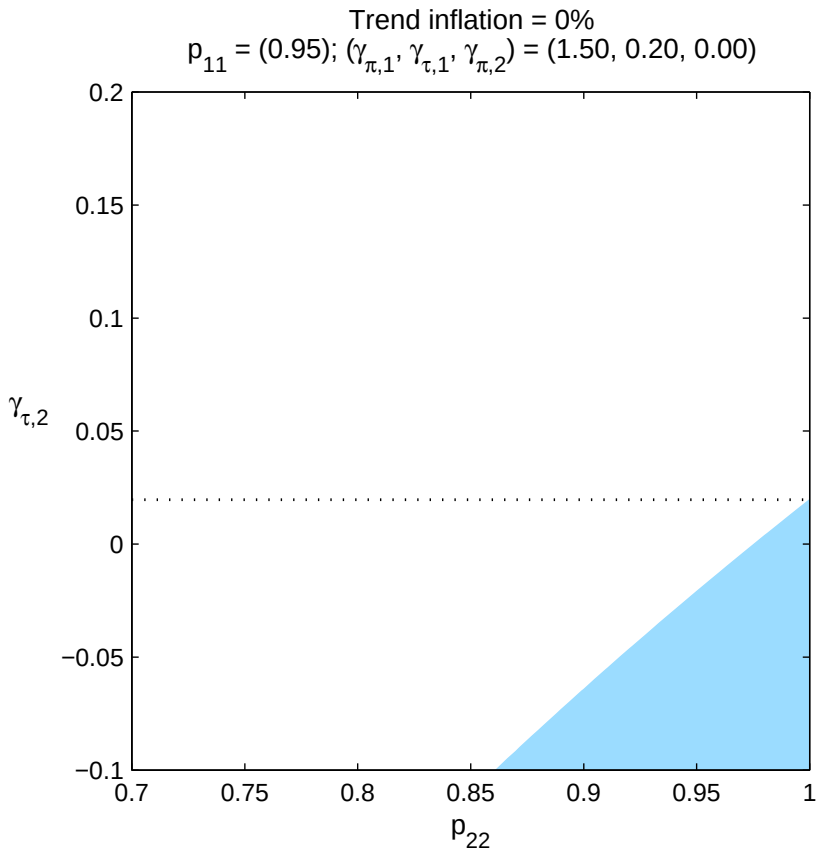


$p_{22} = 0.95$



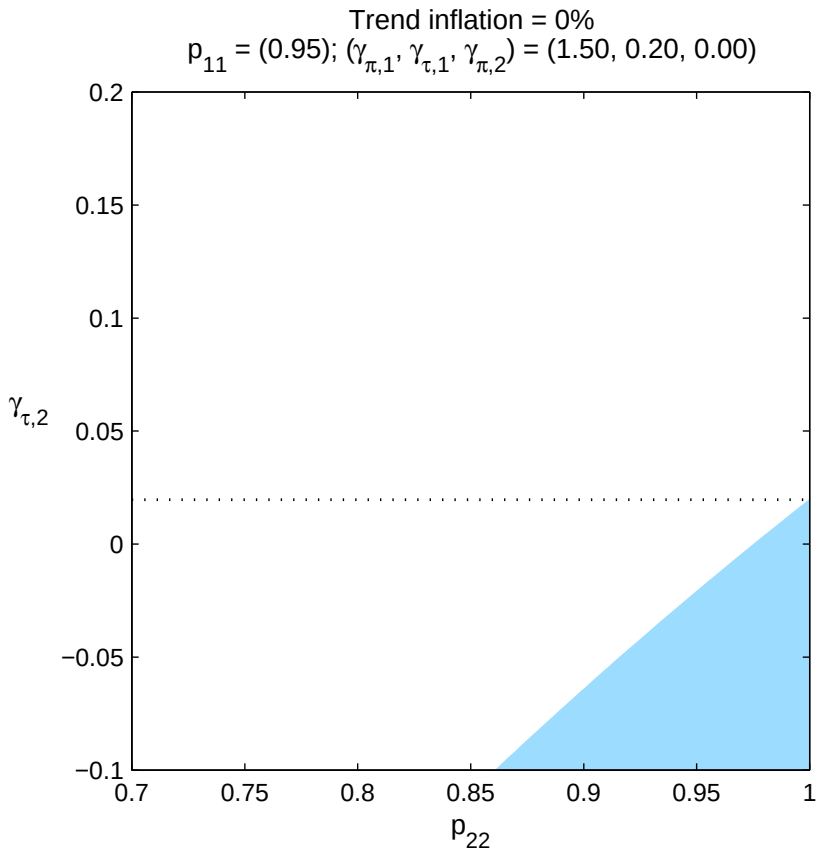
$p_{22} = 0.80$

ZLB: Matching theory and evidence



Assume expected AM/PF and now ZLB

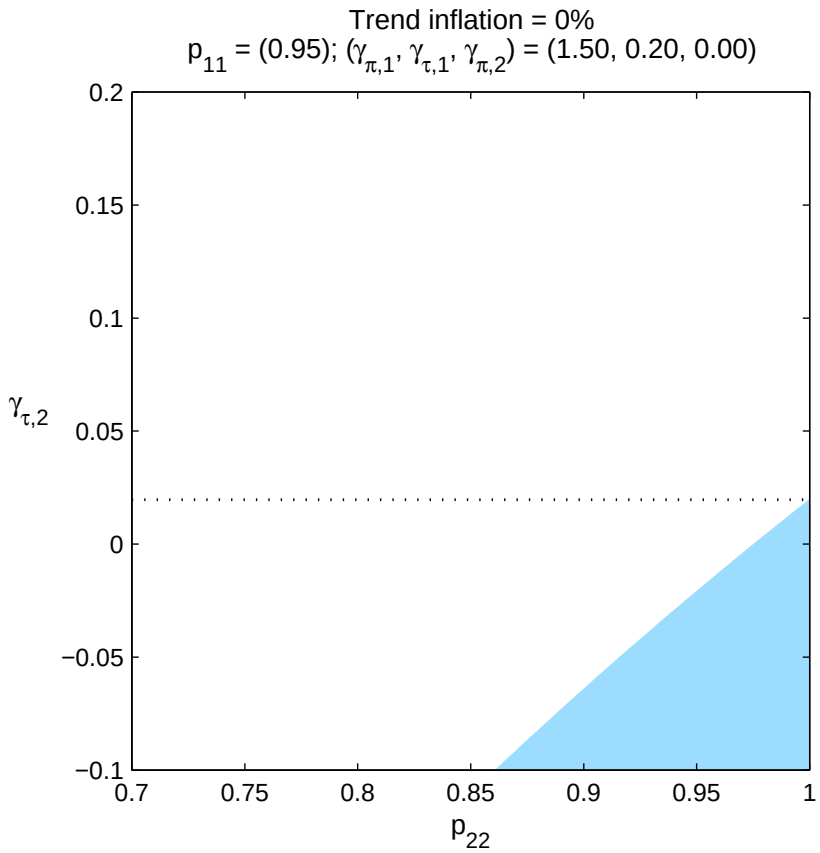
ZLB: Matching theory and evidence



Assume expected AM/PF and now ZLB

- If ZLB is short-lasting $\Rightarrow$ multiplicity irrespective of FP

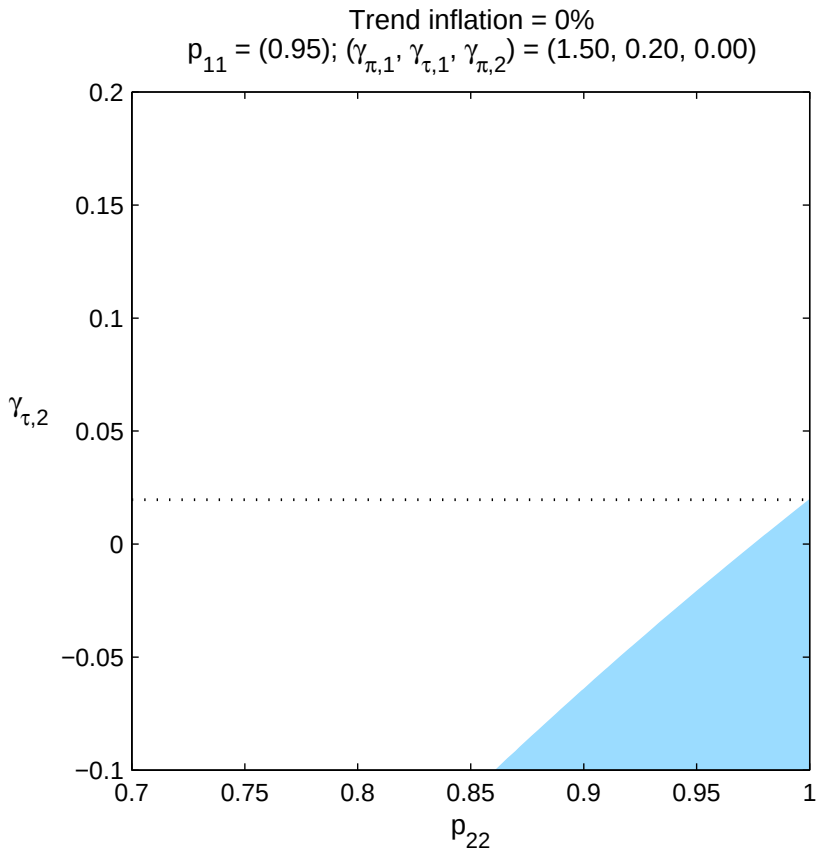
ZLB: Matching theory and evidence



Assume expected AM/PF and now ZLB

- If ZLB is short-lasting $\Rightarrow$ multiplicity irrespective of FP
- If ZLB long-lived $\Rightarrow$ Uniqueness unattainable if PF

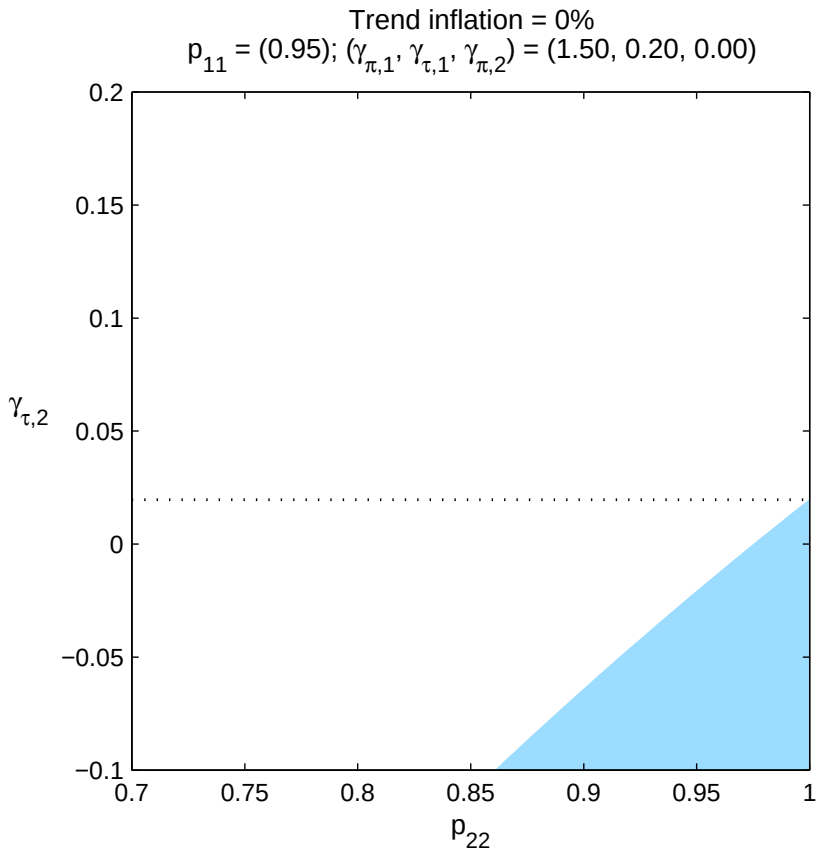
ZLB: Matching theory and evidence



Assume expected AM/PF and now ZLB

- If ZLB is short-lasting $\Rightarrow$ multiplicity irrespective of FP
- If ZLB long-lived $\Rightarrow$ Uniqueness unattainable if PF
- The more ZLB short-lived, the more active should be FP

ZLB: Matching theory and evidence

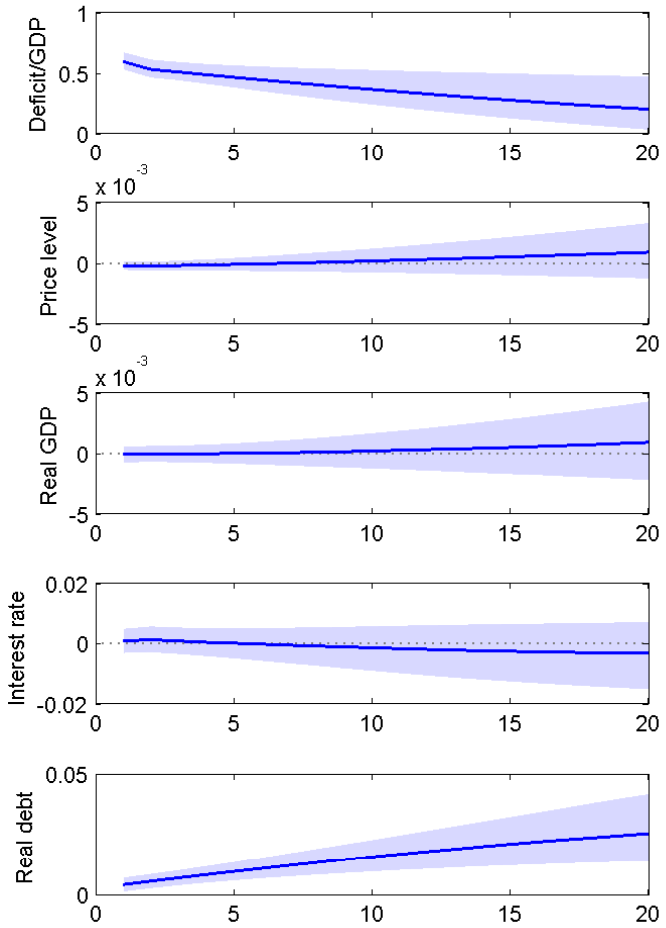


Assume expected AM/PF and now ZLB

- If ZLB is short-lasting $\Rightarrow$ multiplicity irrespective of FP
- If ZLB long-lived $\Rightarrow$ Uniqueness unattainable if PF
- The more ZLB short-lived, the more active should be FP
- Switching regime $\Rightarrow$ wealth effects

ZLB: Matching theory and evidence

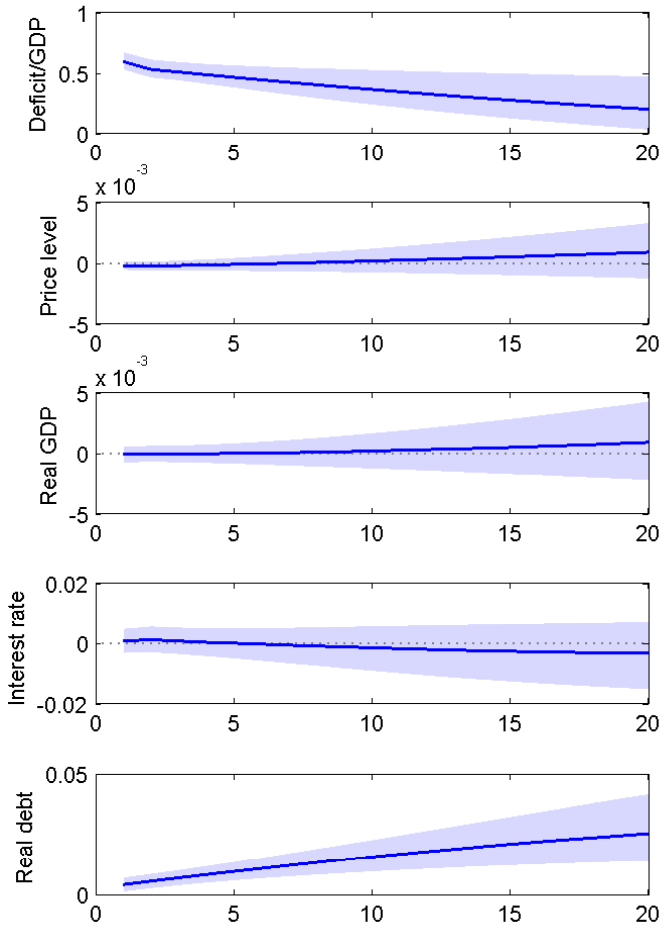
IRFs to a deficit shock from a BVAR on US data 2008q4 - 2015q4



- Output and inflation do not move, debt increases

ZLB: Matching theory and evidence

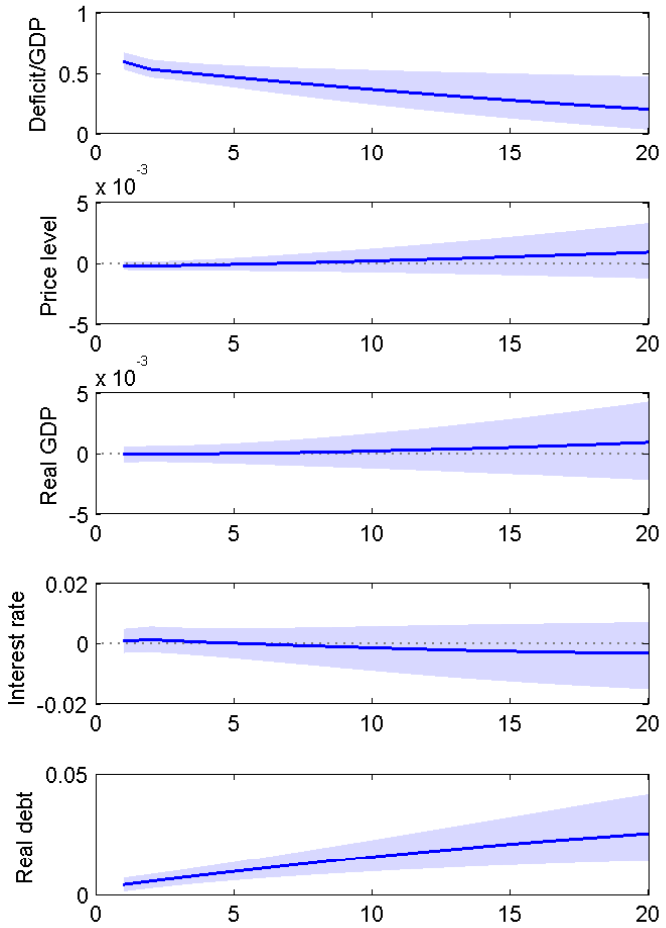
IRFs to a deficit shock from a BVAR on US data 2008q4 - 2015q4



- Output and inflation do not move, debt increases
- Consistent with PM/AF regime in a overall AM/PF mix $\Rightarrow$ timid AF and indeterminate equilibrium

ZLB: Matching theory and evidence

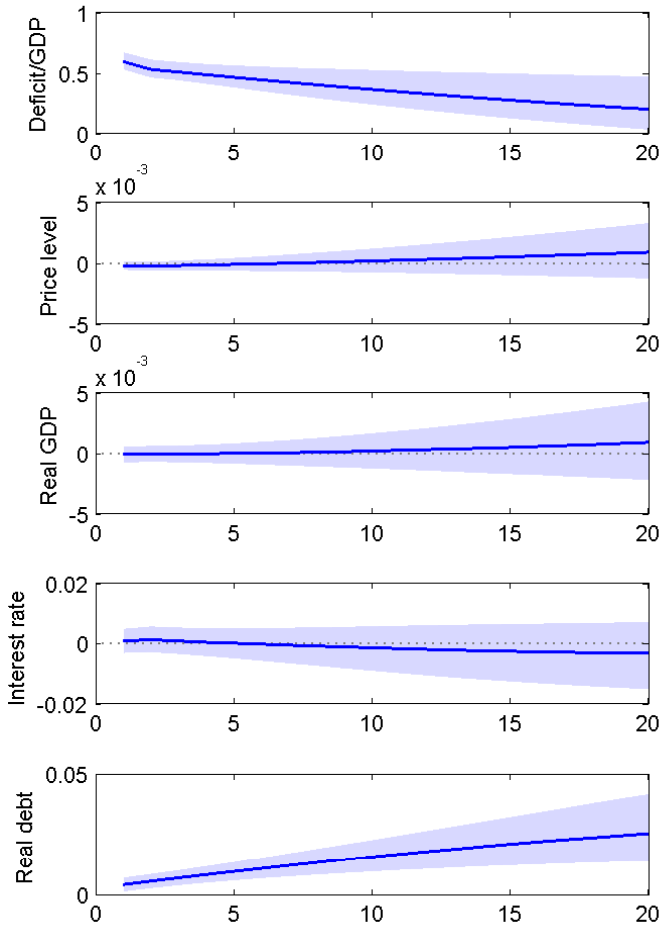
IRFs to a deficit shock from a BVAR on US data 2008q4 - 2015q4



- Output and inflation do not move, debt increases
- Consistent with PM/AF regime in a overall AM/PF mix $\Rightarrow$ timid AF and indeterminate equilibrium
- Agents coordinating on the Ricardian one

ZLB: Matching theory and evidence

IRFs to a deficit shock from a BVAR on US data 2008q4 - 2015q4



- Output and inflation do not move, debt increases
- Consistent with PM/AF regime in a overall AM/PF mix $\Rightarrow$ timid AF and indeterminate equilibrium
- Agents coordinating on the Ricardian one
- More aggressive active fiscal policy $\Rightarrow$ unique switching mix $\Rightarrow$ inflation upswing

Conclusions

In this paper we study the equilibria in a model with shifts in monetary and fiscal policy.

Research questions:

Conclusions

In this paper we study the equilibria in a model with shifts in monetary and fiscal policy.

Research questions:

- Under which conditions can monetary policy control inflation? Is fiscal policy getting in the way?

Conclusions

In this paper we study the equilibria in a model with shifts in monetary and fiscal policy.

Research questions:

- Under which conditions can monetary policy control inflation? Is fiscal policy getting in the way?

  → Long-run Fiscal Principle: timid deviation from PF to avoid wealth effects and enhance CB's controllability of inflation

Conclusions

In this paper we study the equilibria in a model with shifts in monetary and fiscal policy.

Research questions:

- Under which conditions can monetary policy control inflation? Is fiscal policy getting in the way?

  → Long-run Fiscal Principle: timid deviation from PF to avoid wealth effects and enhance CB's controllability of inflation

- Need/gain from coordination?

Conclusions

In this paper we study the equilibria in a model with shifts in monetary and fiscal policy.

Research questions:

- Under which conditions can monetary policy control inflation? Is fiscal policy getting in the way?
  - → Long-run Fiscal Principle: timid deviation from PF to avoid wealth effects and enhance CB's controllability of inflation
- Need/gain from coordination?
  - → New Taxonomy for uniqueness in MS:
    - → Overall AM/PF mix ⇒ No wealth effects
    - → Overall Switching mix ⇒ wealth effects from FTPL

Methodology

Following FRWZ, our model can be written as

$$\mathbb{E}_t \boldsymbol{f}\left(\boldsymbol{y}_{t+1}, \boldsymbol{y}_t, \boldsymbol{x}_t, \boldsymbol{x}_{t-1}, \varepsilon_{t+1}, \varepsilon_t, \boldsymbol{\theta}(s_{t+1}), \boldsymbol{\theta}(s_t)\right) = \mathbf{0}$$

$$\boldsymbol{x}_t = b_t, \qquad \boldsymbol{y}_t' = \left[Y_t, \Pi_t, \phi_t, R_t\right]', \qquad \boldsymbol{\theta}'(s_t) = \left[\gamma_\pi(s_t), \gamma_\tau(s_t)\right]'.$$

We look for recursive solutions in form

$$\begin{aligned} \boldsymbol{x}_t &= \boldsymbol{h}_{s_t}(\boldsymbol{x}_{t-1}, \varepsilon_t, \chi) \\ \boldsymbol{y}_t &= \boldsymbol{g}_{s_t}(\boldsymbol{x}_{t-1}, \varepsilon_t, \chi) \end{aligned}$$

perturbed around the non-stochastic steady state $[\bar{\boldsymbol{x}}, \bar{\boldsymbol{y}}]$. Note that the solutions are regime-dependent, while the steady state is not.

- Under regime i, the first order Taylor expansion of the solutions are

$$b_t \approx \bar{b} + h_{i,b}(b_{t-1} - \bar{b}) + \boldsymbol{h}_{i,\varepsilon}\varepsilon_t + h_{i,\chi}\chi$$
$$\boldsymbol{y}_t \approx \bar{\boldsymbol{y}} + \boldsymbol{g}_{i,b}(b_{t-1} - \bar{b}) + \boldsymbol{g}_{i,\varepsilon}\varepsilon_t + \boldsymbol{g}_{i,\chi}\chi$$

  with the partial derivatives evaluated at the steady state.

- The derivatives of $\mathbb{E}_t \boldsymbol{f}$ are equal to zero and depend on the unknown coefficients $h_{i,b}$, $\boldsymbol{h}_{i,\varepsilon}$, $h_{i,\chi}$, $\boldsymbol{g}_{i,b}$, $\boldsymbol{g}_{i,\varepsilon}$, $\boldsymbol{g}_{i,\chi}$.

- FRWZ show that the $h_{i,b}$ and $\boldsymbol{g}_{i,b}$ are the roots of a separated system of quadratic equations, unsolvable with standard methods (Gensys, etc.)

- We use Matlab's Symbolic Toolbox to get all the solutions.

Stability

We use the concept of **mean square stability** (Costa et al. 2005)

→ MSS requires the existence of

$$lim_{t\to\infty}\mathbb{E}_0\left(\begin{bmatrix}\boldsymbol{x}_t\\ \boldsymbol{y}_t\end{bmatrix}\right), \qquad \text{and} \qquad lim_{t\to\infty}\mathbb{E}_0\left(\begin{bmatrix}\boldsymbol{x}_t\\ \boldsymbol{y}_t\end{bmatrix}\begin{bmatrix}\boldsymbol{x}_t\\ \boldsymbol{y}_t\end{bmatrix}'\right)$$

→ different concept of stability w.r.t. boundedness

→ see Farmer et al. (2009) for a discussion in the context of MS-DSGEs

→ with 2 regimes and 1 state variable, the solution $(h_{1,b}, h_{2,b})$ is MSS if

$$\begin{bmatrix} p_{11}h_{1,b}^2 & (1-p_{22})h_{2,b}^2 \\ (1-p_{11})h_{1,b}^2 & p_{22}h_{2,b}^2 \end{bmatrix}$$

has all its eigenvalues inside the unit circle. ◂ Back to Methodology

Original taxonomy of little use

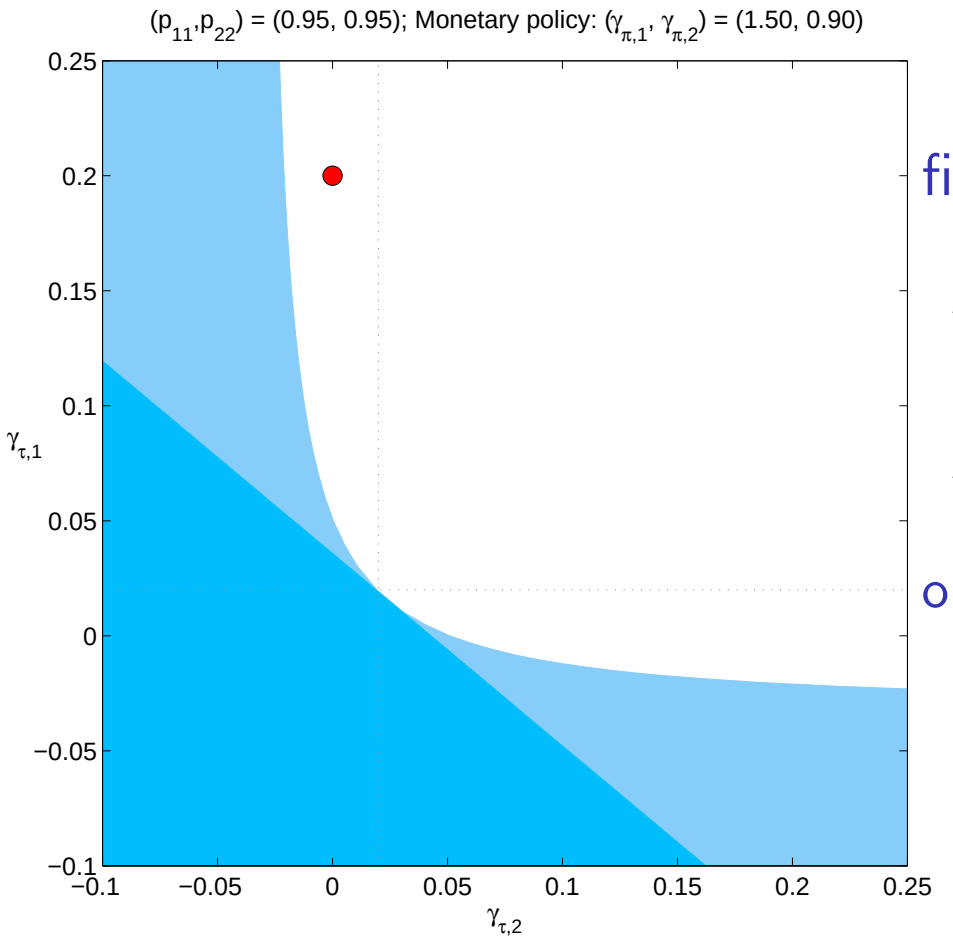
What happens when both monetary and fiscal policy shift?

Original taxonomy of little use

- $\rightarrow$ the clear cut results by Leeper (1991) are lost
- $\rightarrow$ policies must coordinate to get a determinate equilibrium
- $\rightarrow$ the expectation of a stable regime in the future is not sufficient to get uniqueness

Original taxonomy of little use

Point A first Figure: AM/PF + PM/AF = multiplicity



fixed coefficients taxonomy

reg1 AM/PF:

$\gamma_{\pi,1} = 1.5, \gamma_{\tau,1} = 0.2$

reg2 PM/AF:

$\gamma_{\pi,2} = 0.9, \gamma_{\tau,2} = 0$

our taxonomy

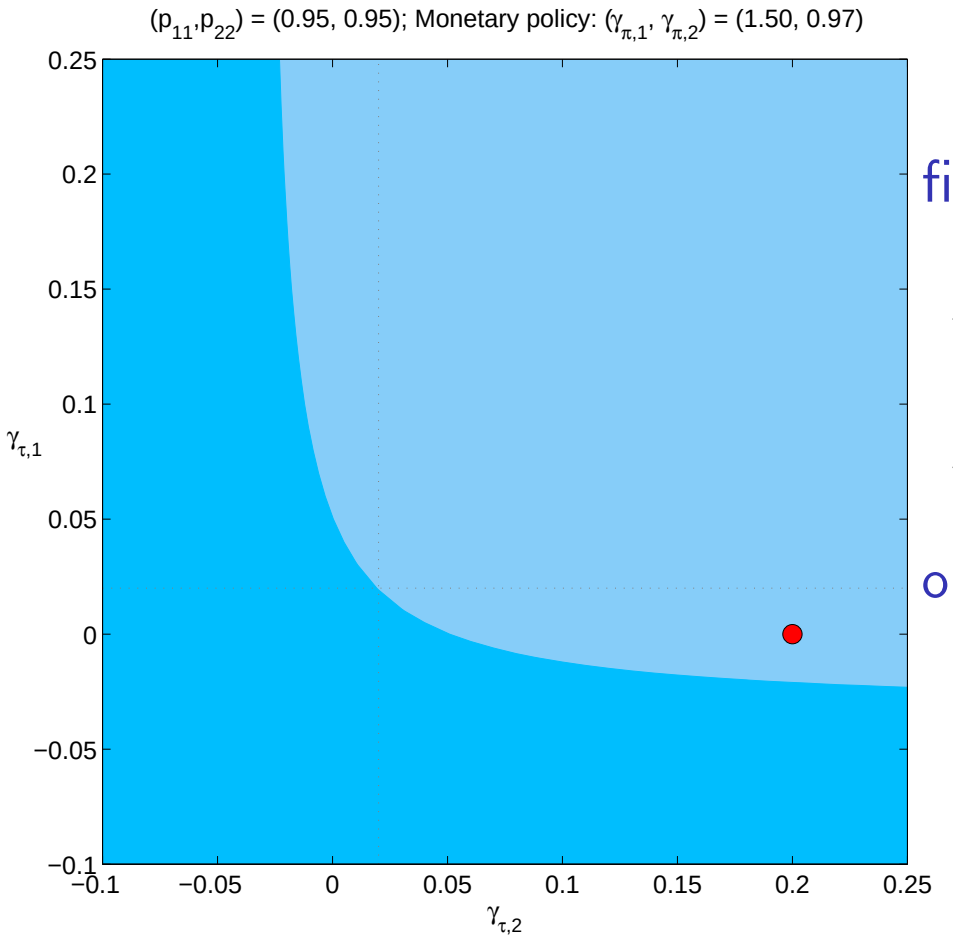
glob. switching monetary policy

+ glob. passive fiscal policy

$\rightarrow$ no coordination, multiplicity

Original taxonomy of little use

AM/AF + PM/PF = uniqueness



fixed coefficients taxonomy

reg1 AM/AF:

$\gamma_{\pi,1} = 1.5, \gamma_{\tau,1} = 0$

reg2 PM/PF:

$\gamma_{\pi,2} = 0.97, \gamma_{\tau,2} = 0.2$

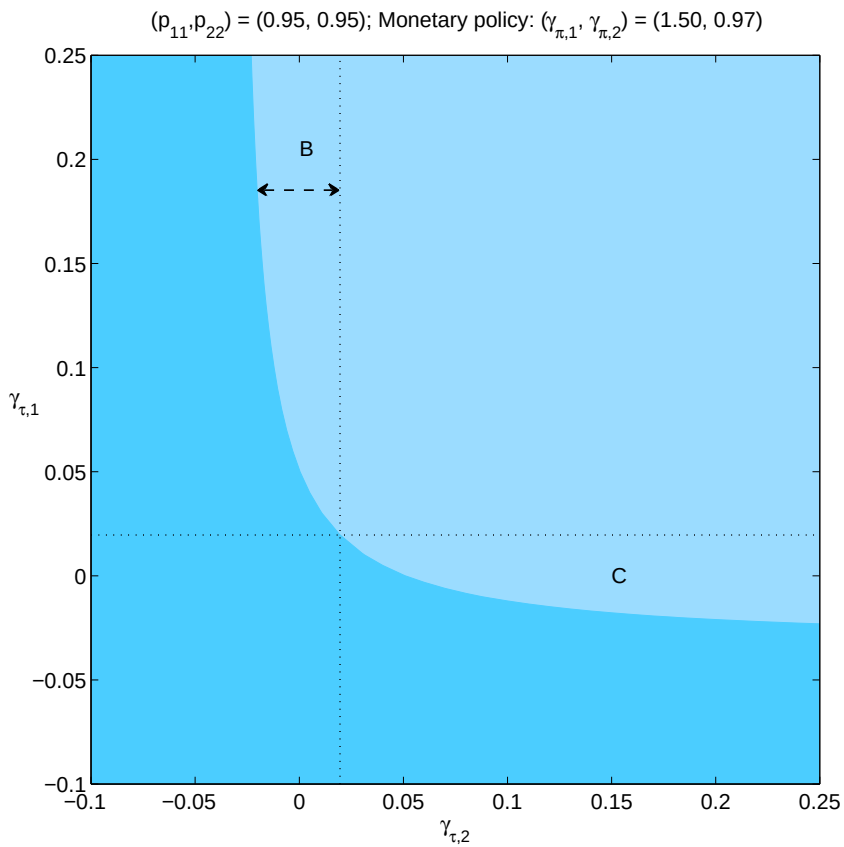
our taxonomy

glob. active monetary policy +

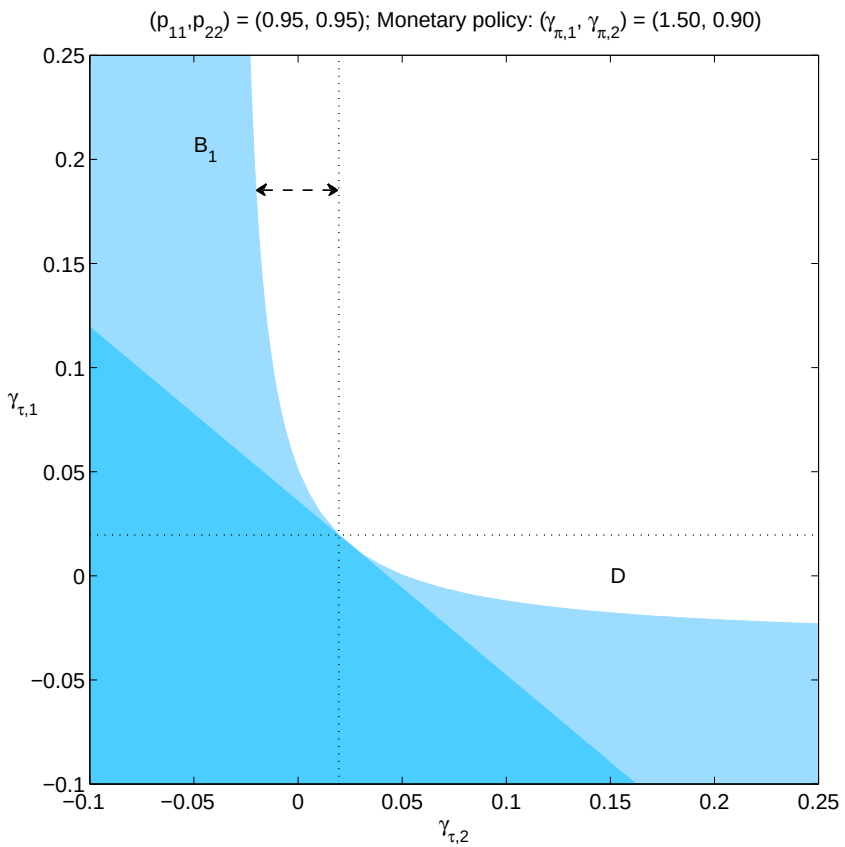
glob. passive fiscal policy

$\rightarrow$ coordination, uniqueness

Original taxonomy of little use



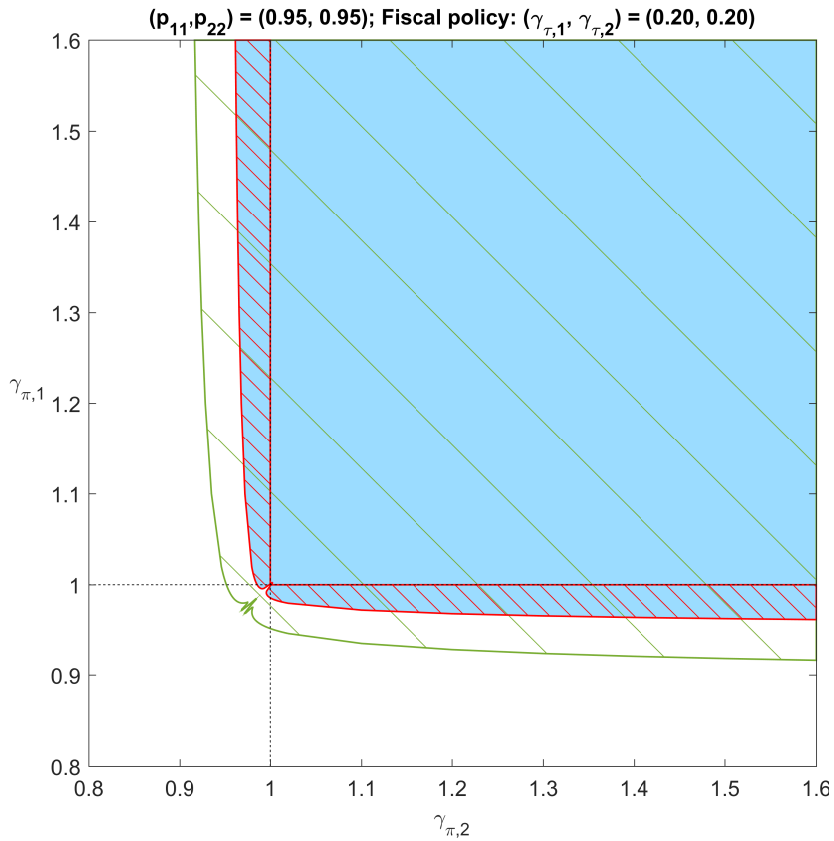
Modest deviations



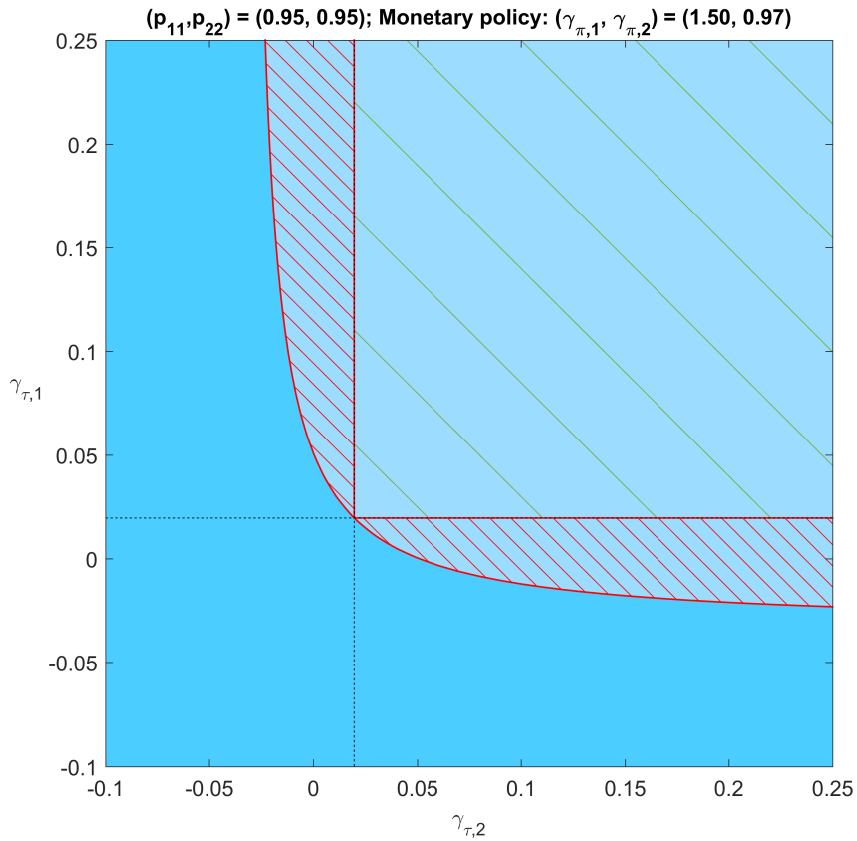
Substantial deviations

▸ back to new taxonomy

MSS vs BRS



Modest deviations



Substantial deviations

▸ back to policy implications