Fiscal Policy, Sovereign Risk, and Unemployment

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2016 Pacific Basin Research Conference

November 18, 2016

[1]Disclaimer: The views expressed herein do not necessarily reflect those of the Board of Governors, the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

Motivation

European Economic Recovery Plan (EERP), 2008-2009

- Stimulus Package: 1.1% of GDP (2009)

Two views on debate about fiscal stimulus during Euro zone crisis:

- Keynesian view: need for expansionary government spending in the context of constrained monetary policy.
  - Stiglitz (2011), Krugman (2015)
- Austerity view: concerns about increasing further sovereign borrowing costs.
  - Cochrane (2011), Barro (2012), Alesina and Gavazzi (2010)

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- How fiscal policy should be conducted in the presence of default risk?

This paper...

- Traditional Keynesian channel of fiscal policy

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- Traditional Keynesian channel of fiscal policy
  - Debt-financed fiscal stimulus boosts aggregate demand and reduces unemployment
- ...but increase in borrowing raises probability of debt crisis
- Study trade-off in sovereign default model extended with downward wage rigidity

Results

Macroeconomic analysis:

- State-dependent and highly nonlinear size of optimal government purchases (and fiscal multipliers)
  - For low debt, countercyclical role of government spending
  - For high debt, austerity is more desired

Normative analysis:

- Optimal fiscal policy is significantly more austere during recessions
- Implementing full employment leads to large welfare losses

Literature Review

- **Government Spending and Fiscal Multipliers:** Galí, López-Salido and Vallés (2007), Monacelli and Perotti (2008), Ravn, Schmitt-Grohé and Uribe (2012), Bilbiie, Monacelli and Perotti (2014), Kuester, Mueller, Corsetti and Meier (2014), Farhi and Werning (2014), Erceg and Linde (2012), Christiano, Eichenbaum and Rebelo (2011).

- **Downward Nominal Wage Rigidity:** Schmitt-Grohé and Uribe (2014), Na, Schmitt-Grohé, Uribe and Yue (2014)

- **Sovereign Default:** Arellano (2008), Aguiar and Gopinath (2007), Cuadra, Sánchez and Sapriza (2007), Arellano and Bai (2013)

Nest keynesian models of fiscal multipliers with sovereign default models

Baseline Model

- Two-sector (tradable and nontradable), small open economy with fixed-exchange rate regime
- Agents in SOE: rep. household, rep. firm and government
- Tradable endowment y^T and nontradable production using labor
- Labor markets feature downward nominal wage rigidity
- Government maximizes households utility using instruments:
  - one-period defaultable bonds b traded with international investors
  - lump-sum transfers τ (with ad hoc tax distortion $\Omega(\tau)$)
  - nontradable government spending g^N

Baseline Model

- Two stages the economy can be in:
  - repayment ($\eta_t = 0$): government can issue bonds
  - autarky ($\eta_t = 1$)
- In case of default, government incurs in two types of costs:
  - (temporary) exclusion from financial markets
  - direct utility loss in autarky $\psi_{\chi,t}$

Households

Households consume final good given by:

$$c = C(c^T, c^N) = [\omega(c^T)^{-\mu} + (1-\omega)(c^N)^{-\mu}]^{-1/\mu}$$

In addition, they inelastically supply $\overline{h}$ hours of work, but work h.

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \{u(c_t) + v(g_t) - \Omega(\tau_t) - \eta_t \psi_{\chi,t}\}$$

$$c_t^T + p_t^N c_t^N = y_t^T + \phi_t^N + w_t h_t - \tau_t$$

FOC yields

$$p_t^N = \frac{1-\omega}{\omega} \left(\frac{c_t^T}{c_t^N} \right)^{1+\mu}$$

Labor Market

- The labor market features downward nominal wage rigidity, modeled as in Schmitt-Grohé and Uribe (2014):

$$W_t \geq \overline{W}$$

where $\overline{W}$ is a constant lower bound on nominal wages.

- Since Law of One Price holds and price of tradables in rest of the world is 1, it can be expressed in terms of tradables as

$$w_t \geq \overline{w}$$

- Actual hours worked cannot exceed the inelastic supply of hours:

$$h_t \leq \overline{h}$$

- Labor market closure requires slackness condition:

$$(w_t - \overline{w})\left(\overline{h} - h_t\right) = 0$$

$\Rightarrow$ if $w_t = \overline{w}$, there is involuntary unemployment $\overline{h} - h_t$

Firms

- Firms operate DRS technology to produce nontradable goods using labor (h) as single input:

$$y_t^N = F(h)$$

- They maximize profits given by

$$\phi_t^N = p_t^N y_t^N - w_t h_t$$

- Firms' optimality condition is

$$p_t^N F'(h_t) = w_t$$

Government

- Two stages the government can be in every period:
  - repayment ($\eta_t = 0$)
  - autarky ($\eta_t = 1$)
- Let χ_t denote default decision at time t:
  - repayment ($\chi_t = 0$)
  - default ($\chi_t = 1$)
- While in autarky, reentry captured by ξ_t arrives with prob. θ
- Law of motion for η_{t+1} is:

$$\eta_{t+1} = (1 - \xi_{t+1})\eta_t + \chi_{t+1}(1 - \eta_t)$$

- Government's budget constraint is:

$$p_t^N g_t^N = \tau_t + (1 - \eta_t)[b_t - q_t b_{t+1}]$$

International Investors

- International investors are risk-neutral and competitive.
- Besides the defaultable bonds, they can invest in riskless security at gross rate R
- Investors' profit maximization yields

$$q_t = \frac{1}{R}\mathbb{E}_t(1 - \chi_{t+1})$$

- Zero recovery rate on defaulted debt.

Competitive Equilibrium

Def: Given b_0, η_0, and $\{y_t^T, \xi_t\}_{t=0}^{\infty}$, govt. policy $\{g_t^N, \tau_t, b_{t+1}, \chi_t\}_{t=0}^{\infty}$, a *competitive equilibrium* is given by households and firms' allocations $\{c_t^T, c_t^N, h_t\}_{t=0}^{\infty}$, and prices $\{p_t^N, w_t, q_t\}_{t=0}^{\infty}$, such that

i. Given prices and government policy, households and firms solve their optimization problems

ii. Government budget constraint and law of motion for international credit market access hold

iii. Bond pricing equation is satisfied

iv. Nontradable goods market clears

v. Labor market equilibrium conditions hold.

We focus on Markov equilibrium.

Equilibrium Conditions

- Market clearing for nontradable goods:

$$c_t^N + g_t^N = F(h_t)$$

- Define $\mathcal{P}$ for relative demand for nontradables as:

$$p_t^N = \mathcal{P}(c_t^T, h_t, g_t^N) \equiv \frac{1-\omega}{\omega} \left(\frac{c_t^T}{F(h_t) - g_t^N} \right)^{\mu+1}$$

Government Recursive Problem

The government is benevolent and lacks commitment.

$$V(y^T, b) = \max_{\chi \in \{0,1\}} \{ (1-\chi) \underbrace{V^r(y^T, b)}_{\substack{\text{value of} \\ \text{repayment}}} + \chi \underbrace{V^d(y^T)}_{\substack{\text{value of} \\ \text{autarky}}} \}$$

Government Recursive Problem: Value of Repayment

$$V^r(y^T, b) = \max_{g^N, \tau, b', h} \{u\left(C\left(c^T, F(h) - g^N\right)\right) + v(g^N) - \Omega(\tau) + \beta \mathbb{E} V(y^{T'}, b')\}$$

subject to

$$c^T = y^T - q(y^T, b')b + b$$
$$\tau = \mathcal{P}(c^T, h, g^N)g^N + q(y^T, b')b' - b$$
$$\mathcal{P}(c^T, h, g^N)F'(h) \geq \overline{w}$$
$$(\mathcal{P}(c^T, h, g^N)F'(h) - \overline{w})(h - \overline{h}) = 0$$

Government Recursive Problem: Value of Autarky

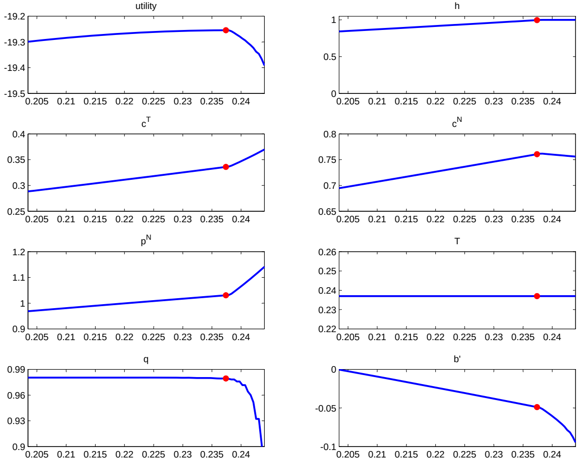
$$V^d(y^T) = \max_{g^N,\tau,h} \{u\left(C\left(y^T, F(h) - g^N\right)\right) + v(g^N) - \Omega(\tau) - \psi_\chi(y^T)$$
$$+ \beta\mathbb{E}\{(1-\theta)V^d(y^{T'}) + \theta V(y^{T'}, 0)\}\}$$

subject to

$$\tau = \mathcal{P}(y^T, h, g^N)g_t^N$$
$$\mathcal{P}(y^T, h, g^N)F'(h) \geq \overline{w}$$
$$(\mathcal{P}(y^T, h, g^N)F'(h) - \overline{w})(h - \overline{h}) = 0$$

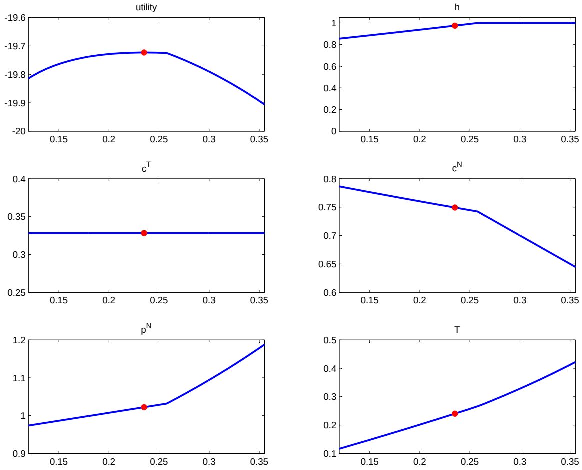
Fiscal Policy Trade-offs: Counterfactual Exercise 1

One-period deviation in g^N from optimal level with Δg^N financed with debt



Fiscal Policy Trade-offs: Counterfactual Exercise 2

One-period deviation in g^N from optimal level with Δg^N financed with taxes



Calibration: Spain 1995-2015

Annual frequency.

Functional Forms:

$$
\begin{aligned}
u(c) &= \frac{c^{1-\sigma}}{1-\sigma} \\
v(g) &= \frac{g^{1-\sigma_g}}{1-\sigma_g} \\
\Omega(\tau) &= \psi_\tau \tau^2 \\
F(h) &= h^\alpha \qquad \alpha \in (0,1) \\
\psi_\chi(y^T) &= \max\{0, \psi_\chi^0 + \psi_\chi^1 \log(y^T)\} \\
\ln y_{t+1}^T &= \rho \ln y_t^T + \sigma_y \varepsilon_{t+1} \qquad \varepsilon_{t+1} \sim i.i.d.\mathcal{N}(0,1)
\end{aligned}
$$

Parameter Values

Description		Value	Source/Target
Risk aversion, private consumption	σ	2	Standard RBC value
Risk aversion, public consumption	σ_g	2	Standard RBC value
Inverse of elasticity of substitution	$1+\mu$	1.0	Cobb-Douglas specification
Subjective discount factor	β	0.90	Standard RBC value
Labor share, nontradable sector	α	0.63	Uribe (1997)
Imported input share, tradable sector	γ	0.43	Mendoza and Yue (2012)
Inelastic supply of hours	$\bar{h}$	1	Normalization
Tax distortion parameter	ψ_τ	0.5	Volatility g^N/GDP rel. to τ/GDP
AR(1) coefficient for productivity y_t^T	ρ	0.77	Spain tradable GDP process
Standard deviation of ϵ_t	σ_y	0.029	Spain tradable GDP process
International price of imported input	p_m	1	Normalization
Gross risk-free rate	R	1.02	average German 5-yr bonds yield
Reentry probability	θ	0.2	average 5-yr autarky spell
Weight of public consumption	ψ_g	0.041	Average $g^N/GDP = 18\%$
Share of tradables	ω	0.3	Share of tradable output= 25%
Lower bound on wages	$\overline{w}$	0.65	Average unemployment= 10%
Utility loss parameter	ψ_χ^0	0.112	average Spanish 5-yr bond spread
Utility loss parameter	ψ_χ^1	1.685	volatility of Spanish bond spread

Business Cycle Statistics for Different Fiscal Regimes

Statistic	Baseline Model	No Tax Distortion	Flexible Wages
mean(spreads)	0.83	0.77	0.68
mean(b/y)	-3.16	-2.84	-10.56
mean($p^N g^N/y$)	18.29	20.95	12.29
mean(τ)	0.023	0.027	0.015
mean(h)	0.902	0.943	1
freq($h = 1$)	0.129	0.379	1
freq(default)	0.791	0.742	0.655
cor(g^N, y)	0.62	0.13	0.78
cor(g^N, h)	0.65	0.22	0
cor(y,spreads)	-0.50	-0.51	-0.66
std.dev.(y)	0.049	0.044	0.091
std.dev.(g^N)	0.030	0.060	0.007
std.dev.(c)/std.dev.(y)	0.878	0.987	0.322
std.dev.(τ)	0.008	0.015	0.009
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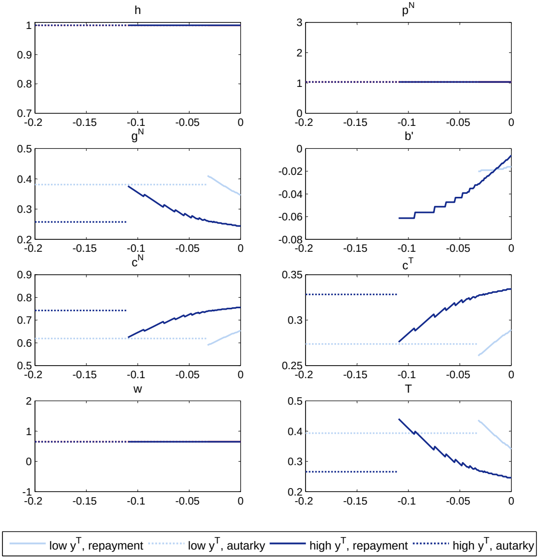
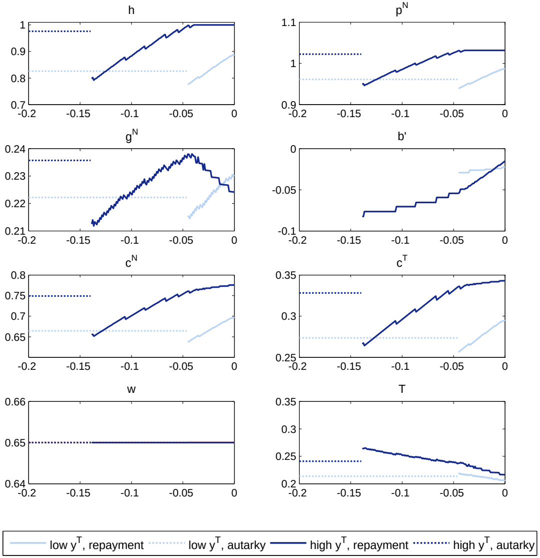
Policy Functions with Full Employment



Policy functions and prices as function of b.

Policy Functions with Optimal Government Spending



Policy functions and prices as function of *b*.

Extended Framework: Firms' Credit Frictions

- Goal: generate fiscal multipliers larger than one
- Extensions to baseline model:
  - production of tradable goods using imported inputs m
  - working capital required to pay m in advance
  - firms' collateral constraint on intra-period loans
- Firms maximize profits by solving

$$\max_{m_t, h_t} A_t^T F^T(m_t) + p_t^N F^N(h_t) - p_m m_t - w_t h_t$$

$$p_m m_t \leq \kappa_t \left(A_t^T F^T(m_t) + p_t^N F^N(h_t) \right)$$

where productivity A_t^T and financial shock κ_t follow Markov processes.

- We assume κ_t can take only two values: $0 < \kappa_L < \kappa_H$

Alternative Framework for Firms

Optimal Policy with Collateral Constraint

- Presence of collateral constraint gives rise to **financial channel** of fiscal policy
- By putting upward pressure on p^N, fiscal stimulus helps
  - reduce unemployment (Keynesian channel)

    $\rightarrow$ expand production frontier for nontradables
  - boosts market value of firms' collateral enhancing borrowing capacity (financial channel)

    $\rightarrow$ expand production frontier for tradables

▸ Optimal policy functions

Concluding Remarks

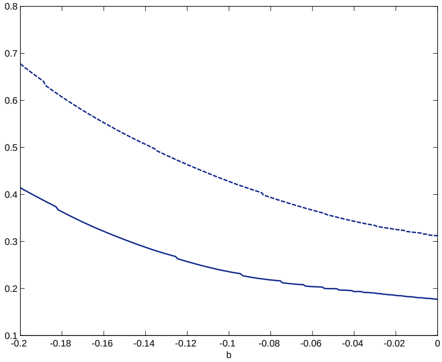
- We provide a framework which combines a Keynesian channel (with a financial channel) of fiscal policy.
  - austerity plans vs. fiscal stimulus
- The optimal size of government spending can be large and typically nonlinear in the state of the economy.
- Agenda:
  - introduce long-term debt
    - ★ role for commitment to austerity
    - ★ fiscal rules/automatic stabilizers
  - work out credit channel extension
  - conduct empirical work on the impact of fiscal policy on firms' credit conditions

Welfare Analysis: Optimal vs. Full-Employment Policy

Given CRRA preferences with $\sigma = 2$, the welfare gain expressed as increase in current private consumption is

$$\lambda(s) = \frac{\Delta V(s)}{c^{FE}(s)^{-1} - \Delta V(s)}$$

with $\Delta V(s) \equiv V(s) - V^{FE}(s)$.



Credit Chain Model with Corporate Default Risk

- 3 types of goods: tradable (T), nontradable (NT) and imported.
- Mass one of islands:
  - Within each island, mass one of identical NT firms
  - Islands differ on productivity z_{Ni}.
  - Output is homogeneous across islands.
- Mass one of T firms with identical technology:

$$y_T = m^{\gamma_T}$$

- NT firms use T good as single input:

$$y_{Ni} = z_{Ni}\tilde{y}_{Ti}^{\gamma_N} \quad \text{in island } i$$

- Households can buy T and NT in competitive final-goods markets
- T sold to NT firms as intermediate input
  - one-to-one matching to an island

Credit Chain Model: Credit Allocation

- Inputs paid before production takes place using credit:
  - All credit consists of intraperiod loans denominated in units of T good
  - Always assigned before idiosyncratic shock is realized
- T firms borrow from risk-neutral foreign investors to purchase m:
  - Pay interest rate r_T
- T firms supplying input to NT firms extend loans to them:
  - Pay interest rate r_N
- No commitment: firms can default
- In the event of default, lender seizes firm and its claims
  - Entails cost given by fraction μ_D of vale recovered

Credit Chain Model: NT Firms

- After realization of z_{Ni}, given $\tilde{y}_{Ti}$, NT firm in island i chooses to repay ($\delta_{Ni} = 0$) or default ($\delta_{Ni} = 1$):
  - Value of repayment: $\pi_{Ni} = p_N z_{Ni} \tilde{y}_{Ti}^{\gamma_N} - (1 + r_N)\tilde{y}_{Ti}$
  - Value of repayment: $\pi_{Ni} = 0$

    $\rightarrow$ Default decision: $\delta_{Ni} = 1$ if $z_{Ni} \leq \bar{z} \equiv \frac{1+r_N}{p_N} \tilde{y}_{Ti}^{1-\gamma_N}$
- Before realization of z_{Ni}, NT firm chooses $\tilde{y}_{Ti}$
- Households diversify all idiosyncratic risk

  $\rightarrow \tilde{y}_{Ti} = \text{argmax } \mathbb{E}\pi_{Ni}$

Credit Chain Model: T Firms

- At the end of period, T firm j repays or not $(1 + r_T)p_m m_j$
- If T firm chooses to sell in final-goods market ($\varphi_j = 0$):
  - Profits are $\pi^F_{Tj} = m_j^{\gamma_T} - (1 + r_T)p_m m_j$

    $\rightarrow$ optimality: $m^{F*}_{Tj} = \left(\frac{\gamma_T}{p_m(1+r_T)}\right)^{\frac{1}{1-\gamma_T}}$
- If T firm chooses to sell in intermediate-goods market ($\varphi_j = 1$):
  - After realization of z_{Ni}, given m_{Tj},
    - ⋆ If N firm of island i defaults ($\delta_{Ni} = 1$), T firm defaults ($\delta_{Tj} = 1$)
    - ⋆ If N firm of island i repays ($\delta_{Ni} = 0$), T firm repays ($\delta_{Tj} = 0$)

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- If T firm chooses to sell in intermediate-goods market ($\varphi_j = 1$):
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    - If N firm of island i defaults ($\delta_{Ni} = 1$), T firm defaults ($\delta_{Tj} = 1$)
    - If N firm of island i repays ($\delta_{Ni} = 0$), T firm repays ($\delta_{Tj} = 0$)
  - Before realizations of z_{Ni}, expected profits of T firm are

$$\mathbb{E}\pi^I_{Tj} = (1 - \mathbb{E}\delta_{Ni})(1 - \delta_{Ti})((1 + r_N)m_j^{\gamma_T} - (1 + r_T)p_m m_j)$$

$\rightarrow$ optimality: $m^{I*}_{Tj} = \left(\frac{\gamma_T(1+r_N)}{p_m(1+r_T)}\right)^{\frac{1}{1-\gamma_T}}$

- T Firm j is indifferent between selling final or intermediate T good:

$$\pi^{F*}_{Tj} = \mathbb{E}\pi^{I*}_{Tj}$$

Credit Chain Model: T Goods

- Consequently, in equilibrium

$$1 + r_N = \left(\frac{1}{1 - F(\underline{z})}\right)^{1-\gamma_T}$$

- Finally, consumption of tradable good is

$$c_T = Y_T - (1 + r_T)M_T - \tilde{y}_T^* - p_N(\tilde{y}_T^*)^{\gamma_N} \int_0^{\underline{z}} z_{Ni} dF(z_{Ni})$$

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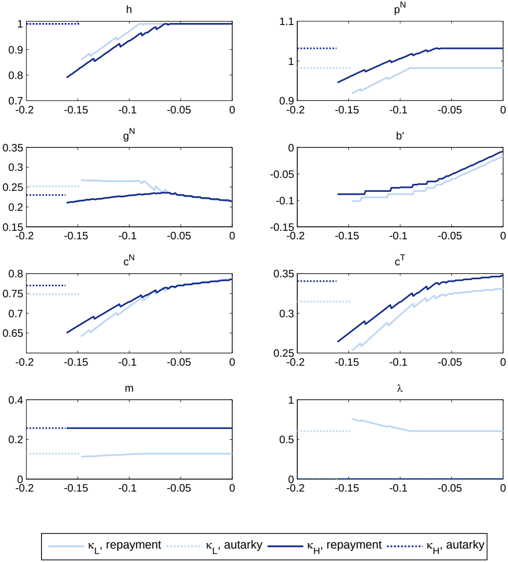
- A higher p_N:
  - reduces $\underline{z}$ and thus borrowing costs r_N and r_T
  - increases demand for m and thus output of tradables
  - expected profits in T sector are higher boosting consumption of tradables

Back



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