INFLATION AND THE FISCAL LIMIT

Todd B. Walker
Indiana University

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Introduction

• Profound uncertainty surrounds the funding of future promised transfers in the U.S. and major advanced economies
U.S. "Unfunded Liabilities"

Source: CBO Long-Term Budget Outlook (June 2009)
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## Worldwide “Unfunded Liabilities”

<table>
<thead>
<tr>
<th>Country</th>
<th>Aging-Related Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>482</td>
</tr>
<tr>
<td>Canada</td>
<td>726</td>
</tr>
<tr>
<td>France</td>
<td>276</td>
</tr>
<tr>
<td>Germany</td>
<td>280</td>
</tr>
<tr>
<td>Italy</td>
<td>169</td>
</tr>
<tr>
<td>Japan</td>
<td>158</td>
</tr>
<tr>
<td>Korea</td>
<td>683</td>
</tr>
<tr>
<td>Spain</td>
<td>652</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>335</td>
</tr>
<tr>
<td>United States</td>
<td>495</td>
</tr>
<tr>
<td>Advanced G-20 Countries</td>
<td>409</td>
</tr>
</tbody>
</table>

Net present value of impact on fiscal deficit of aging-related spending, in percent of GDP. Source: IMF
Introduction

- Profound uncertainty surrounds the funding of future *promised* transfers in the U.S. and major advanced economies

- **Unfunded liabilities** is not an economically meaningful term—inconsistent with equilibrium
  
  - The government will renege on promised transfers (i.e. “liabilities” do not exist)
  
  - The government will fund the promised transfers (i.e. liabilities are not “unfunded”)
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- CBO projects debt rising to over 700% of GDP
ROLLING PROJECTED DEFICITS INTO DEBT

Source: CBO Long-Term Budget Outlook (2009 & 2010)
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- CBO projects debt rising to over 700% of GDP
  \[ \Rightarrow \text{future policy will change...how and when?} \]
What We Do

• Draws on Davig, Leeper, and Walker (JME 2010, EER 2010)

• Rational expectations framework to study alternative ways to resolve “unfunded liabilities” problem
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  5. Outright default
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5. Outright default ⇒ Are U.S. Treasuries risk-free assets?
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  3. Sacrificing inflation target ⇒ Volatile inflation

We model a combination of 1–3, emphasizing uncertainty about which policies adjust and when policies adjust.
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• Rational expectations framework to study alternative ways to resolve “unfunded liabilities” problem

• Allow for switching among policy solutions
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• Model fiscal limit as random variable $= f(\text{fiscal variables})$
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• Allow for switching among policy solutions

• Model fiscal limit as random variable $= f(\text{fiscal variables})$

• Focus on expectational effects in otherwise standard macroeconomic DSGE model
Analytic Intuition: Simple Model

- Consider a flexible price, cashless, endowment economy
**Analytic Intuition: Simple Model**

- Consider a flexible price, cashless, endowment economy
- The consumption Euler equation reduces to the Fisher equation

\[
\frac{1}{R_t} = \beta E_t \left( \frac{P_t}{P_{t+1}} \right)
\]
**Analytic Intuition: Simple Model**

- Consider a flexible price, cashless, endowment economy
- The consumption Euler equation reduces to the Fisher equation
  \[
  \frac{1}{R_t} = \beta E_t \left( \frac{P_t}{P_{t+1}} \right)
  \]
- Transfers grow at rate $\mu$ financed by lump-sum taxes and debt
  \[
  z_t = (1 - \mu)z^* + \mu z_{t-1} + \varepsilon_t, \quad \mu < 1/\beta
  \]
Analytic Intuition: Simple Model

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- Transfers grow at rate $\mu$ financed by lump-sum taxes and debt

\[ z_t = (1 - \mu)z^* + \mu z_{t-1} + \varepsilon_t, \quad \mu < \frac{1}{\beta} \]

- Government’s Budget Constraint:

\[ \frac{B_t}{P_t} + \tau_t = z_t + \frac{R_{t-1}B_{t-1}}{P_t} \]
Analytic Intuition: Policy Specification

At time $T$ economy reaches fiscal limit
## Analytic Intuition: Policy Specification

At time $T$ economy reaches fiscal limit

<table>
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<td>$t = 0, 1, \ldots, T - 1$</td>
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### Monetary Policy

$$R_t^{-1} = R_t^{*-1} + \alpha \left( \frac{P_{t-1}}{P_t} - \frac{1}{\pi^*} \right)$$

### Tax Policy

$$\tau_t = \tau^* + \gamma \left( \frac{B_{t-1}}{P_{t-1}} - b^* \right)$$
**Analytic Intuition: Policy Specification**

At time $T$ economy reaches fiscal limit

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**Monetary Policy**

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

- **Regime 2**
  \[ R_t^{-1} = R^*^{-1} \]

**Tax Policy**

- **Regime 1**
  \[ \tau_t = \tau^* + \gamma \left( \frac{B_{t-1}}{P_{t-1}} - b^* \right) \]

- **Regime 2**
  \[ \tau_t = \tau^{\text{max}} \]
# Analytic Intuition: Policy Specification

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## Monetary Policy

- **Regime 1**
  
  $$R_{t-1}^{-1} = R_*^{-1} + \alpha \left( \frac{P_{t-1}}{P_t} - \frac{1}{\pi^*} \right)$$

- **Regime 2**
  
  $$R_{t-1}^{-1} = R_*^{-1}$$

## Tax Policy

- **Regime 1**
  
  $$\tau_t = \tau_* + \gamma \left( \frac{B_{t-1}}{P_{t-1}} - b^* \right)$$

- **Regime 2**
  
  $$\tau_t = \tau_{\text{max}}$$

Fiscal limit may be *economic* (peak of Laffer curve) or *political* (intolerance of taxation)
Analytic Intuition: Polar Case 1

If Regime 1 were absorbing state (No Fiscal Limit)
Analytic Intuition: Polar Case 1

If Regime 1 were absorbing state (No Fiscal Limit)

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

(Regime 1)
Analytic Intuition: Polar Case 1

If Regime 1 were absorbing state (No Fiscal Limit)

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

(Regime 1)

\[ E_{t-1} \left( \frac{B_t}{P_t} - b^* \right) = E_{t-1}(z_t - z^*) + (\beta^{-1} - \gamma) \left( \frac{B_{t-1}}{P_{t-1}} - b^* \right) \]
Analytic Intuition: Polar Case 1

If Regime 1 were absorbing state (No Fiscal Limit)

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\frac{\alpha}{\beta} E_t \left( \frac{P_t}{P_{t+1}} - \frac{1}{\pi^*} \right) = \frac{P_{t-1}}{P_t} - \frac{1}{\pi^*}
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E_{t-1} \left( \frac{B_t}{P_t} - b^* \right) = E_{t-1}(z_t - z^*) + (\beta^{-1} - \gamma) \left( \frac{B_{t-1}}{P_{t-1}} - b^* \right)
\]

\[
\alpha/\beta > 1, \ \beta^{-1} - \gamma < 1 \Rightarrow \text{Equilibrium } \pi_t = \pi^*
\]

A Standard Monetary Equilibrium
If Regime 2 were absorbing state
**Analytic Intuition: Polar Case 2**

If Regime 2 were absorbing state

\[ E_t \left( \frac{P_t}{P_{t+1}} \right) = \frac{1}{\beta R^*} = \frac{1}{\pi^*} \]  

(Regime 2)
If Regime 2 were absorbing state

\[ E_t \left( \frac{P_t}{P_{t+1}} \right) = \frac{1}{\beta R^*} = \frac{1}{\pi^*} \]  

\[ (\text{Regime 2}) \]

\[ \frac{B_t}{P_t} = \left( \frac{\beta}{1-\beta} \right) \tau^* - E_t \sum_{j=1}^{\infty} \beta^j z_{t+j} \]
**Analytic Intuition: Polar Case 2**

If Regime 2 were absorbing state

\[ E_t \left( \frac{P_t}{P_{t+1}} \right) = \frac{1}{\beta R^*} = \frac{1}{\pi^*} \quad \text{(Regime 2)} \]

\[ \frac{B_t}{P_t} = \left( \frac{\beta}{1 - \beta} \right)^* - E_t \sum_{j=1}^{\infty} \beta^j z_{t+j} \]

\[ \alpha = 0, \, \gamma = 0 \Rightarrow \text{Actual Inflation} \]

\[ P_t = \frac{R_{t-1}B_{t-1}}{\left( \frac{1}{1-\beta} \right)^* - E_t \sum_{j=0}^{\infty} \beta^j z_{t+j}} \]

**A Standard Fiscal Equilibrium**
**Fiscal Limit: Reneging**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Monetary Policy</strong></td>
<td>( R_t^{-1} = R_t^{<em>-1} + \alpha \left( \frac{P_{t-1}}{P_t} - \frac{1}{\pi^</em>} \right) )</td>
<td>same</td>
</tr>
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<td>( \tau_t = \tau^{\text{max}} )</td>
</tr>
<tr>
<td><strong>Transfer Policy</strong></td>
<td>( z_t )</td>
<td>( \lambda_t z_t )</td>
</tr>
</tbody>
</table>

\[
E_{t-1} \left[ \frac{B_t}{P_t} \right] + \tau^{\text{max}} = E_{t-1} \lambda_t z_t + (\beta^{-1} - \gamma)(B_{t-1}/P_{t-1})
\]

\( \lambda_t \) adjusts to stabilize debt

\[
\pi_t = \pi^*
\]

A Standard Monetary Equilibrium
# Fiscal Limit: No Reneging

<table>
<thead>
<tr>
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<tr>
<td><strong>Monetary Policy</strong></td>
<td>( R_t^{-1} = R^{* -1} + \alpha \left( \frac{P_{t-1}}{P_t} - \frac{1}{\pi^*} \right) )</td>
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\[
E_t \left( \frac{P_t}{P_{t+1}} - \frac{1}{\pi^*} \right) = \frac{\alpha}{\beta} \left( \frac{P_{t-1}}{P_t} - \frac{1}{\pi^*} \right), \quad \frac{\alpha}{\beta} > 1
\]

\[
P_t = f(z_t; \gamma, \mu, \beta, \pi^*)
\]

**A New Fiscal Equilibrium Before the Limit**
Fiscal Limit: No Reneging Analytics

\[
\frac{B_0}{P_0} = E_0 \sum_{j=1}^{\infty} \beta^j s_j
\]

\[
= E_0 \sum_{j=1}^{T-1} \beta^j s_j + \left( \frac{1}{1-\beta\gamma} \right)^{T-1} E_0 \sum_{j=T}^{\infty} \beta^j s_j
\]

\[
S_t = \begin{cases} 
\tau^* - \gamma \left( B_{t-1}/P_{t-1} - b^* \right) - z_t, & t = 0, 1, ..., T - 1 \\
\tau_{\max} - z_t, & t = T, ..., \infty 
\end{cases}
\]
FISCAL LIMIT: NO RENEGING ANALYTICS

Evaluate sum from 1 to $T - 1$

$$E_0 \sum_{j=1}^{T-1} \beta^j s_j = (\tau^* - \gamma b^* - z^*) \sum_{j=1}^{T-1} \left( \frac{\beta}{1 - \gamma \beta} \right)^j$$

$$- (z_0 - z^*) \sum_{j=1}^{T-1} \left( \frac{\beta \mu}{1 - \gamma \beta} \right)^j$$

Evaluate sum from $T$ to $\infty$, letting $\tau^{\text{max}} = \tau^*$

$$E_0 \sum_{j=T}^{\infty} \beta^j s_j = E_0 \left( \frac{B_{T-1}}{P_{T-1}} \right) = \frac{\beta^T}{1 - \beta} (\tau^* - z^*) - \frac{(\beta \mu)^T}{1 - \beta \mu} (z_0 - z^*)$$
Fiscal Limit: No Reneging Analytics

Pulling it together...

\[
\frac{B_0}{P_0} = \left[ \left( \frac{1}{1 - \beta \gamma} \right)^T \frac{\beta^T}{1 - \beta} + \sum_{j=1}^{T-1} \left( \frac{\beta}{1 - \gamma \beta} \right)^j \right] (\tau^* - z^*)
\]

\[
- \gamma b^* \sum_{j=1}^{T-1} \left( \frac{\beta}{1 - \gamma \beta} \right)^j
\]

\[
- \left[ \left( \frac{1}{1 - \beta \gamma} \right)^T \frac{(\beta \mu)^T}{1 - \beta \mu} + \sum_{j=1}^{T-1} \left( \frac{\beta \mu}{1 - \gamma \beta} \right)^j \right] (z_0 - z^*)
\]
ANALYTIC INTUITION: DEBT
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Fiscal Limit Regime is Passive Monetary/Active Fiscal

Debt When Fiscal Limit at T = 50

Debt in Fixed Regime Passive Monetary/Active Fiscal

Debt–GDP Target
Analytic Intuition: Inflation

Fiscal Limit Regime is Passive Monetary/Active Fiscal

Inflation Target

Inflation in Fixed Regime Passive Monetary/Active Fiscal
ANALYTIC INTUITION: INFLATION

Fiscal Limit Regime is Passive Monetary/Active Fiscal

Inflation When Fiscal Limit at T = 50

Inflation Target

Inflation in Fixed Regime Passive Monetary/Active Fiscal
**Analytic Intuition: Expected Inflation**

- **Expected Inflation When Fiscal Limit at T = 50**
- **Inflation When Fiscal Limit at T = 50**
- **Inflation Target**
- **Fiscal Limit Regime is Passive Monetary/Active Fiscal**
- **Inflation in Fixed Regime Passive Monetary/Active Fiscal**
STRONGER RESPONSE OF TAXES TO DEBT

Debt in Fixed Regime
Passive Monetary/Active Fiscal

Debt When
Fiscal Limit at T = 50
Less Aggressive
Response of Taxes
to Debt

Fiscal Limit Regime is
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Debt When
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More Aggressive
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Debt–GDP Target
**Stronger Response of Taxes to Debt**

Fiscal Limit Regime is Passive Monetary/Active Fiscal

Inflation When Fiscal Limit at T = 50

More Aggressive Response of Taxes to Debt

Inflation When Fiscal Limit at T = 50

Less Aggressive Response of Taxes to Debt

Inflation Target

Inflation in Fixed Regime Passive Monetary/Active Fiscal
**Fiscal Limit: Implications**

- Expectations of post-limit policies determine *pre-limit* equilibrium
- Inflation and debt *not* anchored on targets
- Expectations—and equilibrium—time varying as approach limit
- Pre-limit equilibrium converges to post-limit equilibrium
- More aggressive inflation or debt targeting pre-limit raises instability
Promised Transfers in a DSGE Model

- Other Federal Non-interest Spending
- Medicare and Medicaid
- Social Security

Revenues

Model

Percentage of GDP

FULL-BLOWN MODEL

- Standard DSGE model: capital accumulation, sticky prices, distorting taxation
- Government announces path of promised transfers
- Government debt and taxes grow until the economy hits fiscal limit
- Specify a set of policies that stabilize debt after fiscal limit
- Multiple layers of policy uncertainty
Households and Firms

- Household utility depends on consumption, leisure and real balances

- Household’s budget constraint is

\[
C_t + K_t + \frac{B_t}{P_t} + \frac{M_t}{P_t} \leq (1 - \tau_t) \left( \frac{W_t}{P_t} N_t + R^k_t K_{t-1} \right) \\
+ (1 - \delta) K_{t-1} + \frac{R_{t-1} B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t} + \lambda_t \tilde{z}_t + \frac{D_t}{P_t}
\]

- Firms set prices as a markup over marginal costs (Rotemberg costly adjustment)
**Initial Period: Stationary Transfers**

**MP:** $R_t = R^* + \alpha(\pi_t - \pi^*), \quad \alpha > 1/\beta$

**FP:** $\tau_t = \tau^* + \gamma(b_{t-1}/Y_{t-1} - b^*), \quad \gamma > r$

**Transfers:** $z_t = (1 - \rho_z)z^* + \rho_z z_{t-1} + \varepsilon_t$
**Non-Stationary Promised Transfers**

**MP:** \( R_t = R^* + \alpha(\pi_t - \pi^*), \quad \alpha > 1/\beta \)

**FP:** \( \tau_t = \tau^* + \gamma(b_{t-1}/Y_{t-1} - b^*), \quad \gamma > r \)

**Transfers:** \( z_t = \mu z_{t-1} + \varepsilon_t, \quad \mu > 1 \)
FP: $\tau_t = \tau^{max}$

$$P_{L,t} = \frac{\exp(\eta_0 + \eta_1(\tau_{t-1} - \tau^*))}{1 + \exp(\eta_0 + \eta_1(\tau_{t-1} - \tau^*))}$$
FISCAL LIMIT: REGIME 1 AM/AF/PT

MP: $R_t = R^* + \alpha(\pi_t - \pi^*), \quad \alpha > 1/\beta$

FP: $\tau_t = \tau^{max}$

Transfers: $\lambda_t z_t = \lambda_t \mu z_{t-1} + \lambda_t \varepsilon_t$

$q = 0.5$

Regime 1
Fiscal Limit: Regime 2 PM/AF/AT

MP: $R_t = R^*$

FP: $\tau_t = \tau^{max}$

Transfers: $z_t = \mu z_{t-1} + \varepsilon_t$

$1 - q = 0.5$
FISCAL LIMIT: SWITCH BETWEEN REGIMES

MP: \( R_t = \begin{cases} \frac{R^*}{R^*} + \alpha (\pi_t - \pi^*), & \alpha > 1/\beta \\ R^* \end{cases} \)

FP: \( \tau_t = \tau^{\text{max}} \)

Transfers: \( z_t = \begin{cases} \lambda_t \mu z_{t-1} + \lambda_t \varepsilon_t \\ \mu z_{t-1} + \varepsilon_t \end{cases} \)
COUNTERFACTUAL EXPERIMENTS

• Layers of uncertainty call for a probabilistic description of outcomes

• Report equilibrium transition paths conditional on particular realizations of policies
  • decision rules based on true probability distributions
  • agents always place probability on alternative future regimes
  • these are counterfactual exercises that induce policy regime surprises every period
PRE-LIMIT AS TRANSFERS GROW

- Dominant forces are rising debt and taxes
- Rising tax rates discourage labor effort and reduce consumption
- Inflection point in dynamics arises at limit, $\tau_{max}$
- Capital falls when $\tau_t < \tau_{max}$, then rises when $\tau_t > \tau_{max}$, in expectation of a future reduction in tax rates
PRE-LIMIT AS TRANSFERS GROW

Conditional on not triggering fiscal limit
**Post-Limit Reneging** $(\lambda_t < 1)$

- Monetary policy is active, but can’t stabilize inflation

- Agents believe can return to regime without reneging, but with passive monetary policy $\Rightarrow E_t \pi_{t+k}$ rises while $R_t$ falls in response to drop in $\pi_t$
Post-Limit Reneging ($\lambda_t < 1$)

- Low real rates reduce savings & increase consumption
- Capital stock declines

![Graph showing capital stock and ex-ante real rate over time.](image)
Post-Limit Passive Monetary Policy

- Monetary policy is passive and $\lambda_t = 1$
- Agents still believe can move to reneging regime
Post-Limit Passive Monetary Policy

- Possibility of reneging in future increases savings and postpones consumption
- Drives capital accumulation
**Debt Dynamics**

- Large jump in the price level at the fiscal limit generates stark differences in real debt levels
Wide Range of Possible Outcomes

Range of possible outcomes for macro variables due to uncertainty about future policy. Dashed blue lines are 25th and 75th percentile bands; solid red lines are 10th and 90th percentile bands.
**Inflation Has a Fat Tail**

Left scale: average paths of inflation (solid red line) and 10-year-ahead expected inflation (dashed red line); Right scale: average paths of inflation (solid black line) and 10-year-ahead expected inflation from 0.5 percent tail of distribution (dashed black line).
Conclusions

• Profound uncertainty surrounds the future financing of promised transfers

• Fiscal pressures will likely impair efforts to achieve any inflation objective
  
  • Expected inflation will rise faster than inflation if households believe the economy may hit the fiscal limit

• In the presence of a fiscal limit, effects of the limit kick in even during “normal” times

• Underscores that to understand an intrinsically “fiscal issue,” must integrate monetary policy