On the optimal design of a Financial Stability Fund

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Three related themes

I. Risk-sharing and stabilization policies in normal times.

II. Dealing with severe crises (i.e. achieving resilience).

III. Resolving a debt crisis (e.g. the euro ‘debt overhang’).
I. Risk-sharing in the EMU

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I. Risk-sharing in the EMU

“For all economies to be permanently better off inside the euro area, they also need to be able to share the impact of shocks through risk-sharing within the EMU.” (*Five Presidents’ Report*, 2015). How?

- with a **fiscal union budget** and fiscal automatic stabilizers?
  (% of non-smoothed GDP shocks: 20% DE; 25% US; 70% EA(15; 1978-2010); (Furceri and Zdzienicka 2015); 83% EA(19; 1995-2015) (Lanati 2016))

- with private borrowing and risk-sharing within the *European Banking Union*?

- with public fiscal stabilization by relaxing even more the *Stability and Growth Pact*?

- or wait to “the medium term, as economic structures converge towards the best standards in Europe” (*Five Presidents’ Report*, 2015)?
II. Dealing with severe crises

- The EA core-periphery divide makes risk-sharing problematic ("use defaultable debt" says J. Tirole, 2015).
II. Dealing with severe crises

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• Debt relief with *austerity plans*?
  (Crises becoming recessions?: **Greece has just entered its third recession since 2010**!)

• A crisis resolution mechanism?
II. Dealing with severe crises

- The EA core-periphery divide makes risk-sharing problematic
  (“use defaultable debt” says J. Tirole, 2015).

- Debt relief with austerity plans?
  (Crises becoming recessions?: Greece has just entered its third recession since 2010!)

- A crisis resolution mechanism? The European Stability Mechanism
  *If indispensable to safeguard the financial stability of the euro area as a whole
  and of its Member States, the ESM may provide stability support to an ESM
  Member subject to strict conditionality, appropriate to the financial assistance
  instrument chosen.*
III. Resolving debt overhang problems

• by default?
• by debt restructuring? (and further austerity?)
• by transforming sovereign debts into Eurobonds?
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• by default?
• by debt restructuring? (and further austerity?)
• by transforming sovereign debts into Eurobonds?
• by transforming short-term sovereign debt into long-term debt through the ESM?
  (the ESM is holding 50% of Greece’s sovereign debt – it amounts to 88.5% of Greece GDP– as long-term, over 30 years, unconditional debt)
Designing a *Financial Stability Fund*

- As a (constrained) optimal risk-sharing mechanism (I), which can also help with (II) and (III).
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- *An EMU is a long-term self-enforcing partnership.*
Designing a Financial Stability Fund

- As a (constrained) optimal risk-sharing mechanism (I), which can also help with (II) and (III).

- **An EMU is a long-term self-enforcing partnership.**

- Long-term contracts can provide risk-sharing and enhance borrowing & lending and investment opportunities.

- Long-term *ex-post* conditional transfers, in contrast with unconditional debt contracts with *ex-ante* (‘austerity programs’) conditions.

- Normal-times-transfers ‘build trust’, in contrast with crisis-relief-transfers which tend to create ‘stigma & resentment’.
A Financial Stability Fund as a Dynamic Mechanism Design problem

A well designed Fund must take into account 3 problems:

**The redistribution problem:** risk-sharing transfers should not become *ex-post* persistent, or permanent, transfers (Hayek’s problem).

**The moral hazard problem:** the severity of shocks may depend on which policies and reforms are implemented.

**The asymmetry problem:** there may not be an *ex-ante* ‘veil of ignorance’ and countries may start with large (debt) liabilities.
The environment

One infinitely-lived risk-averse government with

- preferences: \( U(c, n, e) \equiv u(c) + h(1 - n) - v(e) \& \beta \),
- technology: \( y = \theta f(n) \)
- and subject to productivity, \( \theta \) & government expenditure \( G \) shocks;
- governmental effort, \( e \), decreases the probability of high government expenditure realizations.
Two alternative borrowing & lending regimes

1. *Incomplete markets* with default (IMD) and a risk-free rate \( r \): \( 1/(1 + r) \geq \beta \).

   - countries smooth shocks, and borrow and lend, with long-term non-contingent debt;
   - there can be default (full, in our case);
   - default is costly and the country has no access to international financial markets, temporarily.
Two alternative borrowing & lending regimes

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2. *Financial Stability Fund (Fund)* as a risk-neutral agent with discount $1/(1 + r) \geq \beta$.

   - a country could leave the Fund at any time, in which case is like a country who defaults in an IMD regime;
   - persistent transfers are limited by the amount of redistribution that is mutually accepted;
   - there are incentives for countries to apply policies which reduce risks.
Quantitative analysis to address questions like:

- How different would the evolution of an economy be with the Fund vis-a-vis using Debt with possible default?
  
  (e.g. How different would had been the Greek experience within a EA Fund?)

- How much would the borrower gain?

- How can very heterogeneous countries – say, in labour productivity – share risks, without incurring undesired permanent transfers?

- What is the maximum amount of a country’s debt that the Fund can absorb?
Incomplete markets with default: Long-term Bond

Following Chaterjee and Eyigungor (2012), a long-term bond is parameterized by \((\delta, \kappa)\), where

- \(\delta\) is the probability of continuing to pay out coupon in the current period.
- \((1 - \delta)\) is the probability of maturing in the current period (i.e. \(\delta = 0\) is one-period debt)
- \(\kappa\) is the coupon rate (possibly \(\kappa = 0\))

Given a constant discount rate \(r\), and no default risk, the price of a unit bond equals to

\[
q = \sum_{t=0}^{\infty} \left[ (1 - \delta) + \delta \kappa \right] \frac{\delta^t}{(1 + r)^{t+1}} = \frac{(1 - \delta) + \delta \kappa}{r + 1 - \delta}.
\]
**Incomplete markets with default**

If a borrower does not default on her outstanding debt debt, \((-b)\), in state \(s\) the value of the ‘debt contract’ is:

\[
V^b_n(b, s) = \max_{c, n, e, b'} \left\{ U(c, n, e) + \beta \mathbb{E} \left[ V^b(b', s') \mid s, e \right] \right\}
\]

\[
\text{s.t. } c + G + q(s, b, b')(b' - \delta b) \leq \theta f(n) + (1 - \delta + \delta \kappa)b,
\]

where, taking into account that default can occur next period,

\[
V^b(b, s) = \max \{ V^b_n(b, s), V^a(s) \}
\]

**Assumption:** Effort \(e\), is not observable/contractable by the market.

**Implication:** The bond price \(q(s, b, b')\) may depend on the current level of debt as \(e\) does.
Incomplete markets with default (IMD)

- The value in autarky is given by

\[
V^a(s) = \max_{n,e} \{ u(\theta^p(\theta)f(n) - G') + h(1 - n) - v(e) \\
+ \beta E [(1 - \lambda) V^a(s') + \lambda V^b(0, s') | s, e] \}
\]

- There is a ‘default penalty’ modelled as a drop in productivity, from \( \theta \) to \( \theta^p \).

- After default a government is in autarky, but can re-enter the financial (incomplete) market with probability \( \lambda \); \( \lambda \) small.
**Incomplete markets with default (IMD)**

- The choice of default: \( D(s, b) = 1 \) if \( V^a(s) > V^b_n(b, s) \) and 0 otherwise.

- The expected default rate: \( d(s, b, b') = \mathbb{E}[D(s', b') \mid s, e^*(s, b)] \)

- The price of new debt is:
  \[
  q(s, b, b') = (1 - \delta) \frac{1 - d(s, b, b')}{1 + r} + \delta \frac{\mathbb{E}[(1 - D(s', b')) (\kappa + q(s', b', b''(s', b')))]}{1 + r} 
  \]

- The ‘stationary’ interest rate on debt is: \( r^i(s, b, b') = \frac{(1-\delta)+\delta\kappa}{q(s,b,b')} - (1 - \delta) \)

- **The ‘stationary positive spread’ is:** \( r^i(s, b, b') - r \geq 0 \)
**Incomplete markets accounting**

- **Primary surplus** (we also call it transfers, \( \tau \), and **primary deficit** if negative)

\[
q(s, b, b')(b' - \delta b) - (1 - \delta + \delta \kappa)b = \theta f(n) - (c + G)
\]
The choice of effort

• Without default, in state \( s = (\theta, G) \), the optimal effort is given by:

\[
v'(e) = \zeta'(e) \beta \sum_{s'} \pi^\theta(\theta'|\theta) \left[ \pi^g(G'\mid G) - \pi^b(G'\mid G) \right] V^b(b', s'),
\]

where \( b' \) is the optimal choice of debt.

• With default \( b' = 0 \) and the optimal level of effort is given by

\[
v'(e) = \zeta'(e) \beta \sum_{s'} \pi^\theta(\theta'|\theta) \left[ \pi^g(G'\mid G) - \pi^b(G'\mid G) \right] \left[ (1 - \lambda)V^a(s') + \lambda V^b(0, s') \right].
\]
The Financial Stability Fund as a long-term contract

- We use the theory of *Recursive Contracts* (Marcet & Marimon (2017)) to characterize the optimal long-term contract, which is subject to:

  **intertemporal participation constraints** to guarantee that none of the agents wants to quit when there are still joint gains to be shared;

  **moral hazard constraints** to guarantee that efforts to reduce risks are made.
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- Transfers are conditional on: *i*) the state of economy, and *ii*) the past history of the agents in the Fund: a single statistic (the relative Pareto weights of the Planner’s problem) summarizes the history as a co-state.
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  i) the state of economy, and 
  ii) the past history of the agents in the Fund: a single statistic (the relative Pareto weights of the Planner’s problem) summarizes the history as a co-state.

• We ‘price’ these contracts as if agents where exchanging state-contingent assets subject to endogenous constraints; then histories are summarized by the asset holdings.
The Financial Stability Fund as a long-term contract

- As a planner’s problem with initial weights $\mu_{b,0}$ and $\mu_{l,0}$ for the lender and the borrower,
- where $\mu_{l,0}/\mu_{b,0}$ guarantees the ex-ante zero profit condition for the lender.
- The outside value of the borrower is $V^a(s)$, as in the IMD economy.
- $Z \leq 0$ is the ex-post outside value of the lender.
The **Financial Stability Fund** as a long-term contract

\[
\max_{\{c(s^t), n(s^t), e(s^t)\}} \mathbb{E} \left[ \mu_{b,0} \sum_{t=0}^{\infty} \beta^t \left[ U(c(s^t), n(s^t), e(s^t)) \right] + \mu_{l,0} \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \tau(s^t) \mid s_0 \right]
\]

s.t. \[
\mathbb{E} \left[ \sum_{r=t}^{\infty} \beta^{r-t} \left[ U(c(s^{r}), n(s^{r}), e(s^{r})) \right] \mid s^t \right] \geq V^{af}(s_t),
\]

\[
v'(e(s^t)) = \beta \sum_{s^{t+1}\mid s^t} \frac{\partial \pi(s^{t+1}\mid s^t, e(s^t))}{\partial e(s^t)} V^f_{b}(s^{t+1}),
\]

\[
\mathbb{E} \left[ \sum_{r=t}^{\infty} \left( \frac{1}{1+r} \right)^{r-t} \tau(s^{r}) \mid s^t \right] \geq Z,
\]

and \[
\tau(s^t) = \theta(s^t) f \left( n(s^t) \right) - c(s^t) - G(s^t), \; \forall s^t, t \geq 0.
\]
\[
\begin{align*}
\text{SP} \quad \min_{\{\gamma_{b,t}, \gamma_{l,t}, \xi_t\}} \quad \max_{\{c_t, n_t, e_t\}} \quad & E \left[ \sum_{t=0}^{\infty} \beta^t \left( \mu_{b,t} [U(c_t, n_t, e_t)] - \xi_t v'(e_t) \right) \right. \\
& \quad + \left. \gamma_{b,t} [U(c_t, n_t, e_t) - V^{af}(s_t)] \right] \\
& \quad + \sum_{t=0}^{\infty} \left( \frac{1}{1 + r} \right)^t \left( \mu_{l,t+1} [\theta_t f(n_t) - G_t - c_t] - \gamma_{l,t} Z \right) \bigg| \| s_0 \bigg] \\
\mu_{b,t+1} = \mu_{b,t} + \gamma_{b,t} + \xi_t \sum_{s_t+1|s_t} \frac{\partial \pi(s_{t+1}|s_t, e_t) / \partial e}{\pi(s_{t+1}|s_t, e_t)}, \quad & \text{with } \mu_{b,0} \text{ given, and} \\
\mu_{l,t+1} = \mu_{l,t} + \gamma_{l,t}, \quad & \text{with } \mu_{l,0} \text{ given.}
\end{align*}
\]
Normalization and new co-state $x$

\[
\eta \equiv \beta(1 + r) \leq 1,
\]
\[
v_{i,t} = \gamma_{i,t}/\mu_{i,t}, \quad i = b, l,
\]
\[
\varphi_t = \frac{\xi_t}{\mu_{b,t}} \sum_{s^{t+1}|s^t} \frac{\partial \pi(s^{t+1}|s_t, e_t)/\partial e}{\pi(s^{t+1}|s_t, e_t)},
\]
\[
x_0 = \mu_{b,0}/\mu_{l,0} \text{ and } x_{t+1} = \frac{1 + v_{b,t} + \varphi_{t+1}}{1 + v_{l,t}} \eta x_t
\]

Resulting in policy functions $c(x, s), n(x, s), e(x, s)\tau(x, s)$ and $v_b(x, s), v_l(x, s), \varphi(x, s)$, satisfying

\[
u'(c(x, s)) = \frac{1 + v_l(x, s)}{1 + v_b(x, s)} x \quad \text{and} \quad \frac{h'(1 - n(x, s))}{u'(c(x, s))} = \theta f'(n(x, s)).
\]
The Financial Stability Fund as a long-term contract

The value function of the Fund contracting problem takes the form:

$$FV(x, s) = xV^{lf}(x, s) + V^{bf}(x, s);$$

where,

$$V^{bf}(x, s) = U(c(x, s), n(x, s)) + \beta \mathbb{E}\left[V^{bf}(x', s') \mid s\right]$$

and

$$V^{lf}(x, s) = \tau(x, s) + \frac{1}{1 + r}\mathbb{E}\left[V^{lf}(x', s') \mid s\right]$$

Furthermore, $$V^{bf}(x, s) \geq V^{af}(s)$$, with equality if $$v_{b}(x, s) > 0$$ and, similarly, $$V^{lf}(x, s) \geq Z$$ with equality if $$v_{l}(x, s) > 0.$$
The Financial Stability Fund as a long-term contract

\[ FV(x, s) = \text{SP} \min_{\{v_b, v_l, \xi\}} \max_{\{c, n, e\}} \left\{ x \left[ (1 + v_b) U(c, n, e) - v_b V^a_f(s) - \bar{\xi}v'(e) \right] ight\} \]

\[ + \left[ (1 + v_l) (\theta f(n) - G - c) - v_l Z \right] + \frac{1 + v_l}{1 + r} \mathbb{E} \left[ FV(x', s') | s \right] \]

where \( x' = \frac{1 + v_b + \varphi(G' | G, e)}{1 + v_l} \eta x \) and \( \varphi(G' | G, e) = \frac{\tilde{\xi} \partial \pi(G' | G, e) / \partial e}{\pi(G' | G, e)} \).
‘Decentralizing’ the *Fund* contract

Following Alvarez and Jermann (2000), we can find competitive prices to value *Fund* contracts and compare them with *IMD* contracts.
The Fund contract as long term state-contingent assets

- \textbf{S securities} parameterized by \((\delta, \kappa, s)\), where \((\delta, \kappa)\) denote the common coupon and duration probability.
- \((\delta, \kappa, s)\) only pays coupon or the maturity value in state \(s\).
- Agents hold a continuum of these portfolios

\begin{align*}
W^b(a, s) &= \max_{(c, n, e, a'(s'))} \left\{ U(c, n, e) + \beta \mathbb{E} \left[ W^b(a', s') \mid s \right] \right\} \\
\text{s.t. } c + \sum_{s'|s} q(s'|s) (a'(s') - \delta a(s)) &\leq \theta(s) f(n) - G(s) + (1 - \delta + \delta \kappa) a(s) \\
a'(s') &\geq A_b(s')
\end{align*}
The Fund as an economy with state-contingent assets

- $q(s'|s)$ is the price of a $(\delta, \kappa, s')$ asset in state $s$,
- $a'_{b}(s')$ are the end-of-period asset (contingent claims) holdings,
- $A_{b}(s')$ is an endogenous borrowing limit: $W^{b}(A_{b}(s), s) = V^{a}(s)$. 
The Fund as an economy with state-contingent assets

The borrower’s choice satisfies

\[ q(s'|s) \geq \beta \pi(s'|s) \frac{u'(c(s'))}{u'(c(s))} (1 - \delta + \delta \kappa) + \delta \beta \pi(s'|s) \frac{u'(c(s'))}{u'(c(s))} \sum_{s''|s'} q(s''|s') , \]

with equality if \( a_b(s') > A_b(s') \), as well as the present-value budget constraint.

It reduces to the blue part when \( \delta = 0 \), i.e. one-period assets, as Arrow securities:
The Fund contract as long term state-contingent assets

Similarly, for the the lender, who receives the coupon and maturity value

\[
W^l(a, s) = \max_{(c, a'(s'))} \left\{ c + \frac{1}{1 + r} \mathbb{E} \left[ W^l(a', s') \mid s \right] \right\}
\]

s.t. \( c + \sum_{s' \mid s} q(s' \mid s) (a'(s') - \delta a(s)) = (1 + \delta + \delta \kappa) a(s) \)

\[
a'(s') \geq A_l(s') ; \quad W^l(A_l(s), s) = Z.
\]

The Euler’s equation, satisfied with equality if \( a_l(s') > A_l(s') \), is:

\[
q(s' \mid s) \geq \frac{1}{1 + r} \pi(s' \mid s) (1 - \delta + \delta \kappa) + \frac{\delta}{1 + r} \pi(s' \mid s) \sum_{s'' \mid s'} q(s'' \mid s')
\]
Asset prices

\[ q(s'|s) = \frac{1}{1 + r\pi(s'|s)} \max \left\{ \frac{u'(c(s'))}{u'(c(s))} \left[ (1 - \delta + \delta\kappa) + \delta \sum_{s''|s'} q(s''|s') \right] \right\}, \]

\[ = \frac{1}{1 + r\pi(s'|s)} \left[ (1 - \delta + \delta\kappa) + \delta \sum_{s''|s'} q(s''|s') \right] \max \left\{ \frac{u'(c(s'))}{u'(c(s))}, 1 \right\} \]

\[ = \frac{1}{1 + r\pi(s'|s)} \left[ (1 - \delta + \delta\kappa) + \delta q(s') \right] \max \left\{ \frac{u'(c(s'))}{u'(c(s))}, 1 \right\} \]
Fund decentralization

\[ q^* (s'|s) = \frac{1}{1 + r} \pi (s'|s) \left[ (1 - \delta + \delta \kappa) + \delta q (s') \right] \max \left\{ \begin{array}{l} 1 + v_l(x', s') \left( 1 + v_b(x', s') \right) \frac{1}{1 + v_b(x, s)} \, 1 \\ \frac{1 + v_l(x', s')}{(1 + v_b(x', s'))} \frac{1}{1 + v_b(x, s)} \end{array} \right\} \]

- the **price of a one-period bond** \( q^f (s) = \sum_{s'|s} q^* (s'|s) \),
- the **implicit interest rate** \( r^f (s) = \frac{1 - \delta + \delta \kappa}{q^f (s)} \)
- and the **negative spread**: \( r^f (s^t) - r \leq 0 \).
Fund accounting

- Primary surplus (we also call it transfers or primary deficit if negative)

\[
\sum_{s' | s} q^* (s' | s) (a'_b(s') - \delta a'_b(s)) - (1 - \delta + \delta k) a'_b(s) = c_l(s) = \tau^*(x, s).
\]
The dual competitive economy

The values for the borrower and the lender have a recursive form

\[
W^b(a_b, s) = U(c(a_b, s), n(a_b, s)) + \beta E \left[ W^b(a_b', s') \mid s \right]
\]

and

\[
W^l(a_l, s) = \tau(a_l, s) + \frac{1}{1 + r} E \left[ W^l(a_l', s') \mid s \right]
\]
The dual competitive economy

The values for the borrower and the lender have a recursive form

$$W^b(a_b, s) = U(c(a_b, s), n(a_b, s)) + \beta \mathbb{E}\left[W^b(a'_b, s') \mid s\right]$$

and

$$W^l(a_l, s) = \tau(a_l, s) + \frac{1}{1 + r} \mathbb{E}\left[W^l(a'_l, s') \mid s\right].$$

Mirror of

$$V^{bf}(x, s) = U(c(x, s), n(x, s)) + \beta \mathbb{E}\left[V^{bf}(x', s') \mid s\right]$$

and

$$V^{lf}(x, s) = \tau(x, s) + \frac{1}{1 + r} \mathbb{E}\left[V^{lf}(x', s') \mid s\right]$$

with $a_l(s^t) = -a_b(s^t)$. 

Calibration: functions and parameters

- Utility:

\[
\log(c) + \gamma \frac{(1 - n)^{1-\sigma} - 1}{1 - \sigma}, \quad \text{with } \sigma = 0.69, \gamma = 1.4.
\]

Production: \( f(n) = n^\alpha \), with \( \alpha = 0.566 \).

- Borrower’s discount factor \( \beta = 0.945 \), while \( r = 2.48\% \).

- The probability of returning to the IMD market after default (quit) is \( \lambda = 0.15 \); default/quit penalty

\[
\theta^p(\theta) = \begin{cases} 
\psi \mathbb{E}\theta, & \theta \geq \psi \mathbb{E}\theta \\
\theta, & \theta < \psi \mathbb{E}\theta
\end{cases}
\]

with \( \psi = 0.81 \).

- IMD long-term bond: \( \delta = 0.814 \), \( \kappa = 8.3\% \).

- **Tight** limited enforcement constraint of the Fund: \( Z = 0 \)!
A PIIGS calibration

- Annual data for PIIGS countries over 1980–2015, main source: AMECO.
- Construct labor productivity using aggregate working hours for each country; fit the productivity series with a panel Markov regime switching model; discretize the MS process into a 27-state Markov chain:
  
  Best state: $\theta_{27} \equiv e_{27}$, . . ., worst state: $\theta_1 \equiv e_1$

- Calibrate the $G$ shock with a 3-state Markov chain, featuring persistent ‘crisis’ state:
  
  Best state: $G_3 \equiv g_3$, . . ., worst state: $G_1 \equiv g_1$

- Stochastic processes calibrated to the PIIGS countries up to the euro crisis.
## Model fit

<table>
<thead>
<tr>
<th>1&lt;sup&gt;st&lt;/sup&gt; Moments</th>
<th>Data</th>
<th>Model (IMD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt to GDP ratio</td>
<td>77.29%</td>
<td>76.56%</td>
</tr>
<tr>
<td>Real bond spread</td>
<td>3.88%</td>
<td>3.76%</td>
</tr>
<tr>
<td>$G$ to GDP ratio</td>
<td>20.18%</td>
<td>19.62%</td>
</tr>
<tr>
<td>Percentile: 1 &amp; 99</td>
<td>[13.48%, 32.79%]</td>
<td>[11.56%, 33.02%]</td>
</tr>
<tr>
<td>Primary surplus to GDP ratio</td>
<td>-0.78%</td>
<td>1.30%</td>
</tr>
<tr>
<td>Fraction of working hours</td>
<td>36.74%</td>
<td>37.28%</td>
</tr>
<tr>
<td>Maturity</td>
<td>5.38</td>
<td>5.38</td>
</tr>
<tr>
<td>2\textsuperscript{nd} Moments</td>
<td>Data</td>
<td>Model (IMD)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------</td>
<td>-------------</td>
</tr>
</tbody>
</table>

**Volatility**

<table>
<thead>
<tr>
<th>Expression</th>
<th>Data</th>
<th>Model (IMD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma(C)/\sigma(Y)$</td>
<td>1.49</td>
<td>1.47</td>
</tr>
<tr>
<td>$\sigma(N)/\sigma(Y)$</td>
<td>0.92</td>
<td>0.69</td>
</tr>
<tr>
<td>$\sigma(G)/\sigma(Y)$</td>
<td>0.91</td>
<td>0.86</td>
</tr>
<tr>
<td>$\sigma(PS/Y)/\sigma(Y)$</td>
<td>0.65</td>
<td>0.80</td>
</tr>
<tr>
<td>$\sigma(\text{real spread})$</td>
<td>1.53%</td>
<td>0.93%</td>
</tr>
</tbody>
</table>

**Correlation**

<table>
<thead>
<tr>
<th>Expression</th>
<th>Data</th>
<th>Model (IMD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho(C, Y)$</td>
<td>0.88</td>
<td>0.76</td>
</tr>
<tr>
<td>$\rho(N, Y)$</td>
<td>0.67</td>
<td>−0.13</td>
</tr>
<tr>
<td>$\rho(PS/Y, Y)$</td>
<td>−0.29</td>
<td>0.11</td>
</tr>
<tr>
<td>$\rho(G, Y)$</td>
<td>0.35</td>
<td>0.07</td>
</tr>
<tr>
<td>$\rho(\text{real spread, } Y)$</td>
<td>−0.35</td>
<td>−0.29</td>
</tr>
<tr>
<td>$\rho(G_t, G_{t-1})$</td>
<td>0.94</td>
<td>0.94</td>
</tr>
</tbody>
</table>
Optimal policies
Optimal policies for incomplete markets with default

Future debt: IMD

Bond price: IMD

Primary surplus: IMD

Labor supply: IMD
Optimal policies for the fund (in assets)

- Value of future debt: Fund
- Bond price: Fund
- Primary surplus: Fund
- Labor supply: Fund
Optimal policies for the fund: Pareto weights and assets

Future weight of borrower: Fund

Bond price: Fund

Asset holding: Fund

Primary surplus: Fund
Optimal policies for the fund: allocations and values
Comparing the economies in normal times
IMD vs. Fund Business Cycle Paths: shocks and allocations

Productivity & G shock

Output

Consumption

Labor
IMD vs. Fund Business Cycle Paths: shocks and assets

Productivity & G shock

Primary surplus

Asset holding

Bond spread
Contrasting paths...

• Repeated defaults [in grey] in the IMD economy, no quits with the Fund.

• Positive spreads ‘anticipating’ default when debt is relatively high, and just a small episode (at the end) of negative spreads.

• Default episodes mostly driven by productivity shocks: productivity drops + (relatively) large debt levels.

• Larger amount of ‘borrowing’ with the Fund.

• Primary surpluses tend to be pro-cyclical in the IMD economy (as they often have been), counter-cyclical with the Fund (as they should be).

• Smoother consumption and, correspondingly, more volatile asset holdings and primary deficits with the Fund.
Comparing the economies in times of crisis
IMD vs. Fund: combined shock impulse-responses: allocations
IMD vs. Fund: combined shock impulse-responses: assets

Productivity & G shock

Primary surplus

Asset holding

Bond spread
Contrasting a severe crisis...

- With an unexpected ‘one-period’ worst \((\theta, G)\) shock the Fund clearly dominates:
  - With a relatively large asset position (implicit insurance) the country can afford higher consumption with lower labor at the beginning (recall that the borrower is relatively more impatient),
  - even if at first there is a drop of output (larger than in the IMD economy) and later the asset position becomes negative (debt).

- In contrast, there is a severe crisis and large spreads in the IMD economy!
Contrasting debt contracts and Fund contracts

- Efficiency, calls for smooth consumption decay (impatience), and labour responding monotonically to productivity.

- The Fund achieves these to the extent that limited enforcement constraints allow (e.g. they set a lower bound on consumption decay).

- IMD is less efficient; in particular, when borrowers are close to their borrowing/default constraints.

- Fund contracts are able to exploit better the existing asset trading possibilities (e.g. more borrowing with the Fund than with IMD).
Contrasting *debt contracts* and *Fund contracts*

- Persistent crisis and bad shocks exacerbate the differences between *debt contracts* and *fund contracts*.

- With the same underlying shocks, *recessions* are likely to be more severe with *incomplete markets*.

- With the same underlying shocks, there can be frequent episodes of *positive spreads and defaults* in the *IMD* economy, while harmless *negative spreads and no quits* with the *Fund*. 
Welfare gains and absorbing capacity
### Welfare gains and absorbing capacity

<table>
<thead>
<tr>
<th>Shocks ((\theta, G_c))</th>
<th>Welfare Gain</th>
<th>((b'/y)_{\text{max}}): M</th>
<th>((b'/y)_{\text{max}}): F</th>
</tr>
</thead>
<tbody>
<tr>
<td>((\theta_l, G_h) = (0.148, 0.038))</td>
<td>8.90</td>
<td>1.71</td>
<td>97.42</td>
</tr>
<tr>
<td>((\theta_m, G_h) = (0.299, 0.038))</td>
<td>7.03</td>
<td>107.55</td>
<td>187.16</td>
</tr>
<tr>
<td>((\theta_h, G_h) = (0.456, 0.038))</td>
<td>4.68</td>
<td>217.43</td>
<td>336.77</td>
</tr>
<tr>
<td>((\theta_l, G_l) = (0.148, 0.025))</td>
<td>7.87</td>
<td>1.84</td>
<td>101.89</td>
</tr>
<tr>
<td>((\theta_m, G_l) = (0.299, 0.025))</td>
<td>6.56</td>
<td>111.40</td>
<td>187.93</td>
</tr>
<tr>
<td>((\theta_h, G_l) = (0.456, 0.025))</td>
<td>4.46</td>
<td>217.80</td>
<td>334.47</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>6.53</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Welfare gains are expressed in consumption equivalent terms at \(b = 0\) (%).
- \(b^{\text{max}}\) is the maximum level of country indebtedness expressed as the percentage of GDP in a given financial environment (Markets or Fund).
Comparing economies starting with high debt (100% Debt/GDP)
IMD vs. Fund in highly indebted economy: debts and spreads

**Productivity & G shock**

**Primary surplus**

**Debt/Output**

**Bond spread**
IMD vs. Fund in highly indebted economy: allocations
Contrasting paths of highly indebted countries...

- The debt overhang problem is resolved with **default** in the **IMD** economy and, in fact, **there is no debt overhang problem**, and **no quits** with the **Fund**.

- There are **Positive spreads** ‘anticipating’ default when debt is relatively high in the **IMD** economy, and there is a small episode of **negative spreads** at the beginning with the **Fund**.

- Larger amount of ‘borrowing’ with the **Fund**.
Accounting for moral hazard problems
Fund Pareto weight policies with observable and non-observable effort

Fund with no moral hazard

Fund with moral hazard
Fund Effort and bond price policies: observable vs. non-observable effort

Fund with no moral hazard

Fund with moral hazard

Effort

Bond price
Summary

Even with very limited redistribution, the Fund can improve efficiency significantly, with respect to debt financing.

I. The Fund can provide the risk-sharing that it is achieved by taxes & transfers in federal systems.

II. Costly default events may be prevented and severe crises are less likely and/or better handled.

III. The Fund is able to absorb significantly more debt than the markets.

The Fund requires commitment in normal times to avoid time-inconsistency in difficult times. It can also account for moral hazard problems without great distortions.
Next Steps

- To simplify the conditionality to help the implementability of the Fund.
- To assess the welfare cost of moral hazard and check whether the market or the fund provide better incentives for prudent policies.
- To show that the Fund can be implemented with heterogeneous partners $\implies$ there is no need to wait ‘for economic structures to converge’ in order to implement a ‘a mechanism of fiscal stabilisation for the euro area as a whole’.
- To contrast the Fund with the current ESM eligibility & conditionality, and with other proposals of ‘EA risk-sharing mechanisms’ and of ‘debt overhang resolution’.
- To address the question: can a market for fund contracts be developed?
There is no future for the EMU, it will involve too much redistribution!

Using dynamic mechanism design, there should be a future for the EMU!
ADEMU
A Dynamic Economic and Monetary Union
THANKS!