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

“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).
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?
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).
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  ("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?
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?
III. Resolving debt overhang problems

• 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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   - countries smooth shocks, and borrow and lend, with long-term non-contingent debt;
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   - default is costly and the country has no access to international financial markets, temporarily.

2. *Financial Stability Fund* (Fund) as a risk-neutral agent with discount \( \frac{1}{1 + r} \geq \beta \).
   - 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, \((-b)\), in state \(s\) the value of the ‘debt contract’ is:

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

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

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

- 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 \( V_a(s) > V_n^b(b, s) \) 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:
  \[
  q(s, b, b') = (1 - \delta) \frac{1 - d(s, b, b')}{1 + r} + \delta \frac{\mathbb{E} [(1 - D(s', b')) (\kappa + q(s', b', b''(s', b'))) \mid s, e^*(s, b)]}{1 + r}
  \]
- 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 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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  **moral hazard constraints** to guarantee that efforts to reduce risks are made.

- 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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• 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.

• 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 Fund contract as long term state-contingent assets

- **$S$ 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

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

s.t. \[ c + \sum_{s'|s} q(s'|s) \left( a'(s') - \delta a(s) \right) \leq \theta(s)f(n) - G(s) + (1 - \delta + \delta \kappa) a(s) \]

\[ a'(s') \geq A_b(s') \]
The Fund contract as long term 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: $W^b(A_b(s'), s) = V^a(s)$. 
Similarly, for 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. \( c + \sum_{s' \mid s} q(s' \mid s) (a'(s') - \delta a(s)) = (1 - \delta + \delta \kappa) a(s) \)

\[ a'(s') \geq A_l(s') \]
**Fund decentralization**

\[ q^* (s'|s) = \frac{1}{1 + r} \pi (s'|s) \left[ (1 - \delta + \delta \kappa) + \delta q (s') \right] \max \left\{ \frac{1 + vl(x',s')}{(1 + vb(x',s'))} \frac{1}{1 + \varphi(s'|x,s)} , 1 \right\} \]

- the *price of a one-period bond* \( q^f (s) = \sum_{s'|s} q^* (s'|s) \),
- the *implicit interest rate* \( r^f (s) = \frac{1 - \delta + \delta k}{q^f (s)} \)
- 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)

\[
\sum_{s'|s} q^* (s'|s) (a'_b(s') - \delta a'_b(s)) - (1 - \delta + \delta k) a'_b(s) = c_l(s) = \tau^*(x, s).
\]
Calibration: functions and parameters

- Utility:
  \[ \log(c) + \gamma \left( \frac{(1 - n)^{1-\sigma} - 1}{1 - \sigma} \right), \quad \text{with } \sigma = 0.69, \gamma = 1.4. \]
  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
  \[
  \theta^p(\theta) = \begin{cases} 
  \psi \mathbb{E}\theta, & \theta \geq \psi \mathbb{E}\theta \\
  \theta, & \theta < \psi \mathbb{E}\theta 
  \end{cases}
  \quad \text{with } \psi = 0.81.
  \]

- 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>$1^{st}$ 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>
<tr>
<td><strong>Volatility</strong></td>
<td></td>
<td></td>
</tr>
<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>
<tr>
<td><strong>Correlation</strong></td>
<td></td>
<td></td>
</tr>
<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

Primary surplus: IMD

Bond price: 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

-45°
$q^0$
Optimal policies for the fund: allocations and values

**Consumption of borrower: Fund**

**Labor supply of borrower: Fund**

**Value of borrower: Fund**

**Value of lender: Fund**

- e5g1
- e23g1
- e5g3
- e23g3
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, counter-cyclical with the Fund.
- 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

Productivity & G shock

Output

Consumption

Labor
**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 later the asset position becomes negative (debt).

- In contrast, there is a severe crisis and large spreads with IMD!
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))_{max}: M</th>
<th>((b'/y))_{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 \(b = 0\) (%).
- \(b^{max}\) 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

Productivity & G shock

Output

Consumption

Labor

Legend:
- Solid line: Fund
- Dashed line: IMD
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 endogenous effort

**Fund with no moral hazard**

```
Current weight of borrower
```

**Fund with moral hazard**

```
Current weight of borrower
```

```
Future weight
```

```
e_{5g2}
e_{5g2}(e_{5g1})
e_{5g2}(e_{5g3})
e_{23g2}(e_{23g1})
e_{23g2}(e_{23g3})
```
Fund Effort policies and bond prices: observable vs. non-observable effort
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 \(\Rightarrow\) 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!
THANKS!