# Sovereign Debt Restructurings: Delays in Renegotiations with Risk Averse Creditors

Tamon Asonuma and Hyungseok Joo

IMF and Wayne State University

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# Disclaimer

- The views expressed herein are those of the authors and should not be attributed to the IMF, its Exercutive Board, or its management.

# Overview of the paper

- Empirical, theoretical and quantitative analysis of sovereign debt restructurings.
- Two main contributions to the literature on sovereign debt.
  - New dataset on creditors' GDP growth rate/risk aversion and new stylized facts on restructurings and creditors' business cycle.
  - New theoretical explanations on delays in sovereign debt restructurings due to creditors' business cycle.

# New data on creditor committees

- **New dataset on creditor committees**
  - (a) London Club process for 1975-1995: Lomax (1986) & Rieffel (2003)
  - (b) Recent restructurings for 1999-2010: Das et al. (2012)
  - (c) Case studies for recent episodes
- **Stylized Fact 1**: US and European banks have served as the committee chairs.

| | Observation | Share |
|---|---|---|
| **Restructuring with identified chairmen of the creditor committees** | **107** | |
| ***US banks*** | **57** | **53%** |
| ***European banks*** | **35** | **33%** |
| ***German banks*** | **14** | **13%** |
| UK banks | 11 | 10% |
| French banks | 10 | 9% |
| Canadian banks | 7 | 7% |
| Others (Japanese and Swiss banks) | 8 | 7% |
| **Restructuring without committees/ with unidentified chairmen** | **72** | |

# New data on creditors' business cycle and restructurings

- **Existing dataset** on debt restructurings
  - Debt restructurings with private external creditors over 1978-2010 (179 episodes).
  - Duration of restructurings (monthly frequency): Asonuma and Trebesch (2016)
  - NPV haircuts and face value reductions: Cruces and Trebesch (2013).
- **New dataset** on creditors' business cycle
  - Monthly GDP growth rate of the US and Germany: Bureau of Economic Analysis (US) & Federal Statistical Office (Germany).
  - Monthly US credit spreads and German corporate bond yields: Gilchrist and Zakrajsek (2012) financial firms & Bundesbank.
  - Average during the restructurings and levels at end of restructurings

# New data on creditors' business cycle and restructurings

Table 2: Duration, Haircuts, Face Value Reductions, Investors' GDP Growth Rates and Risk Aversion for Restructuring in 1978–2010

| | Observation | Mean | Median | std dev. | Ave. 1978–2010[3/] |
|---|---|---|---|---|---|
| **Duration of Restructurings** (# of months) | 179 | 40.8 | 18.7 | 51.4 | - |
| **NPV Haircuts** (%) | 178 | 36.7 | 31.7 | 27.2 | - |
| **Face Value Reduction** (%) | 178 | 16.5 | 0.0 | 30.3 | |
| **Investor' GDP Growth Rate Ave.**[1/] | | | | | |
| US GDP Growth Rate (%) | 179 | 3.4 | 3.4 | 1.8 | 2.8 |
| German GDP Growth Rate (%) | 179 | 2.1 | 2.2 | 1.5 | 1.9 |
| **Investor' Risk Aversion Ave.**[2/] | | | | | |
| US Credit Spreads (GZ) (%) | 104 | 1.7 | 1.7 | 0.8 | - |
| German Corporate Bond Yields (%) | 179 | 7.3 | 7.3 | 1.3 | - |

Sources: Asonuma and Trebesch (2016), Bureau of Economic Analysis (US), Cruces and Trebesch (2013), Deutsche Bundesbank, Federal Statistical Office (Germany) and Gilchrist and Zakrajsek (2012).

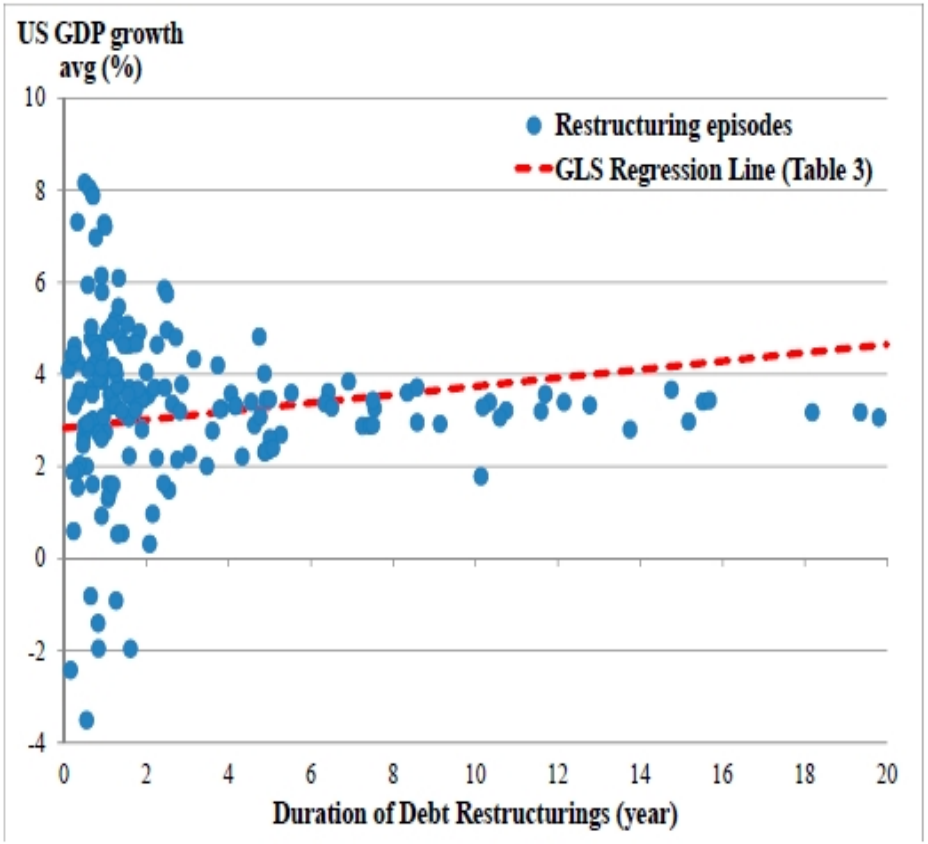
[1/] Monthly average over duration of restructurings. We transform quarterly GDP series for both the US and Germany into series in monthly frequency given a lack of comprehensive monthly GDP series covering the whole sample period.

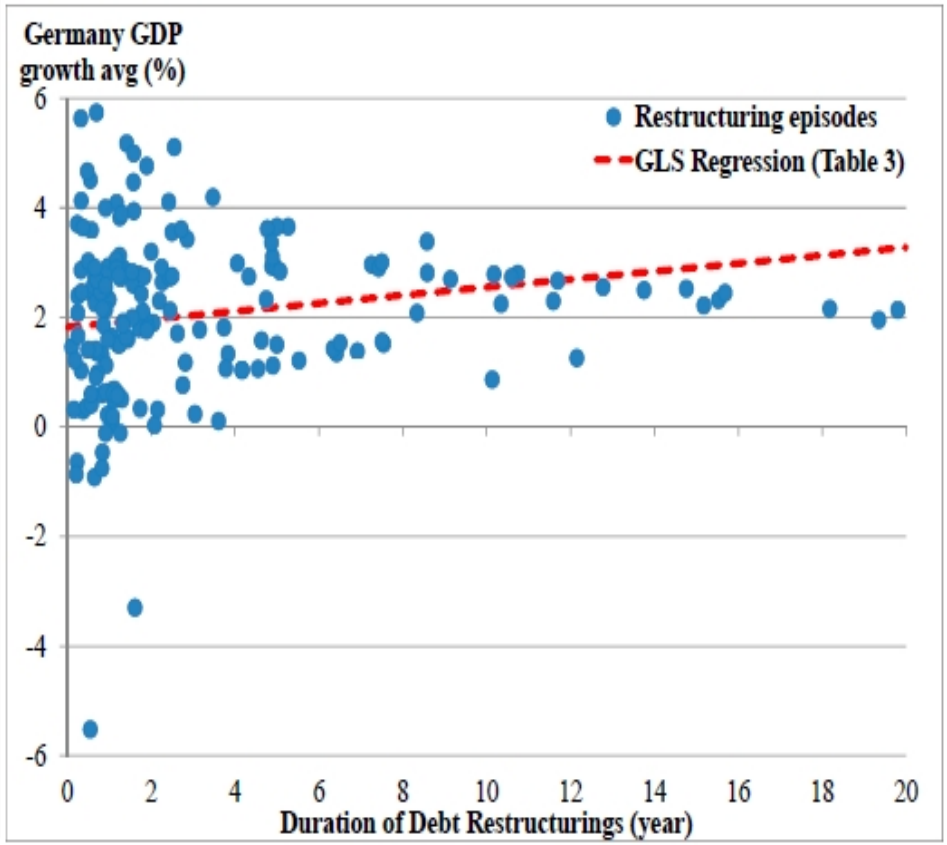
[2/] Monthly average over duration of restructurings,

[3/] Monthly average over 1978–2010.

# Stylized facts on restructurings

- **Stylized Fact 2**: Restructurings tend to be protracted when foreign creditors' income is high.



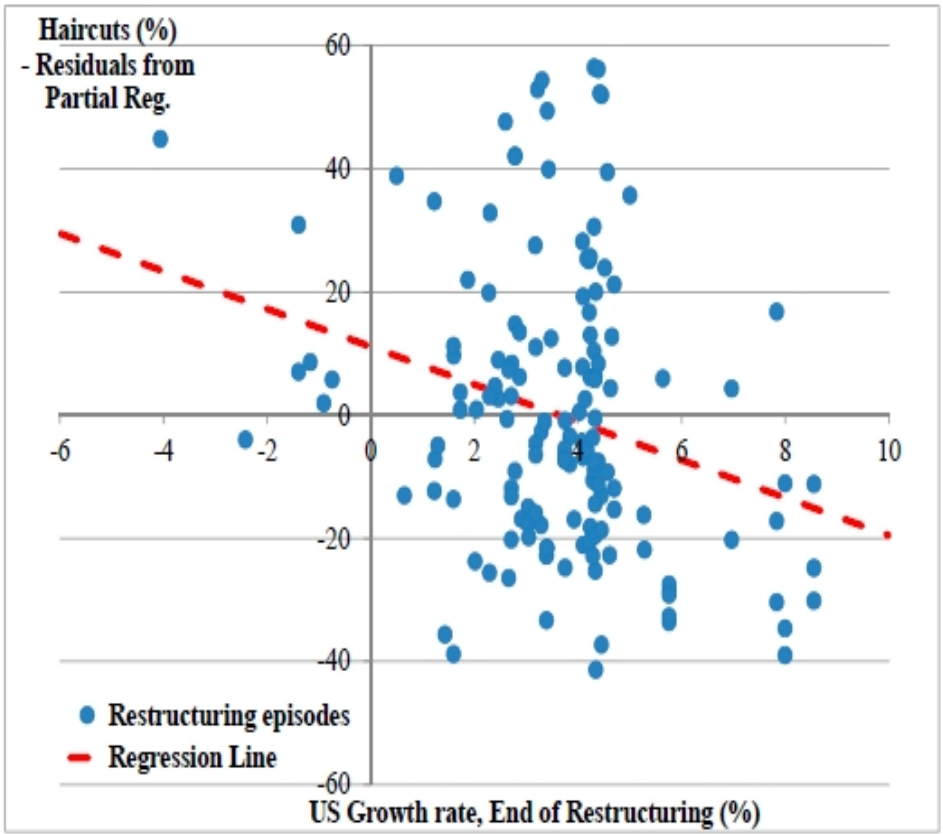
# Stylized facts on restructurings (cont.)

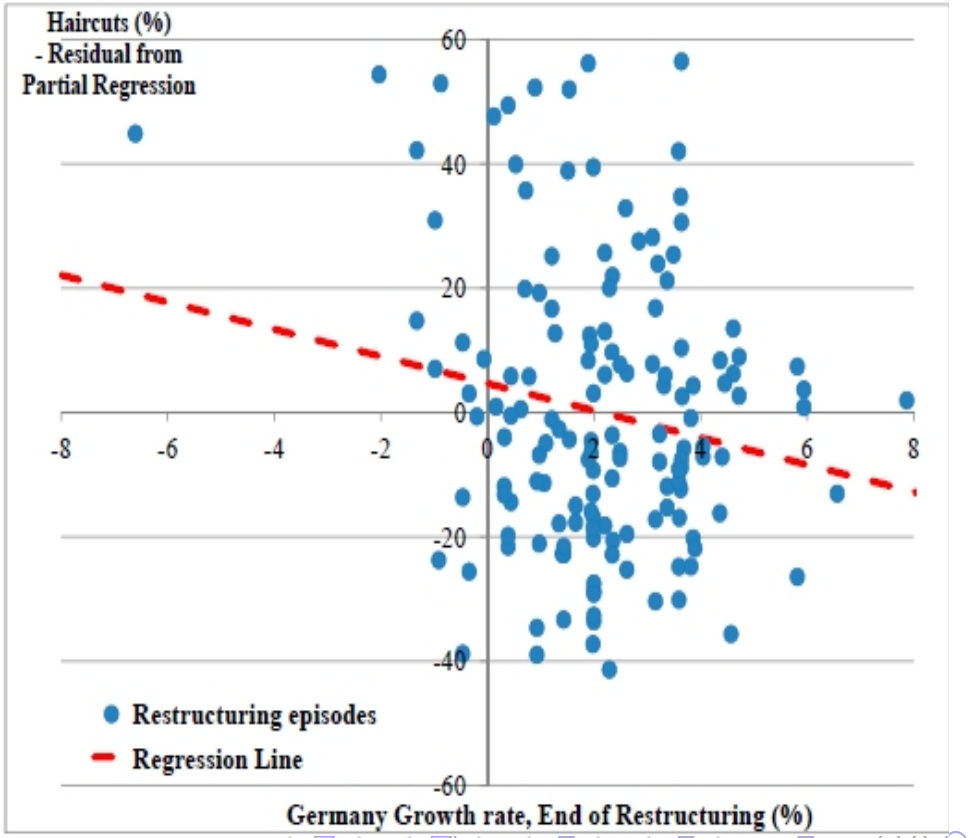
| Dependent variable: **Duration of Restructurings (year)** | **(1) US GDP Growth Rate** | **(2) German GDP Growth Rate** | (3) US Credit Spreads (GZ) | (4) German Corporate Bond Yields |
|---|---|---|---|---|
| US GDP Growth Rate, average (%)[1/] | **3.48*** | - | - | - |
| | **(1.76)** | | | |
| German GDP Growth Rate, average (%)[1/] | - | **4.62**** | - | - |
| | | **(2.27)** | | |
| US Credit Spreads (GZ), average (%)[1/] | - | - | -7.25* | - |
| | | | (4.29) | |
| German Corporate Bond Yields, average (%)[1/] | - | - | - | -3.12*** |
| | | | | (1.16) |
| GDP Deviation from Trend, end (%)[2/3/] | 1.26*** | 1.20*** | 0.99* | 0.91* |
| | (0.43) | (0.43) | (0.50) | (0.48) |
| Growth Rate of GDP Trend, end (%)[2/3/] | 8.21*** | 9.04*** | 9.83*** | 10.90*** |
| | (1.87) | (1.82) | (2.57) | (2.12) |
| External Debt/GDP Ratio, end (%)[2/] | 0.27*** | 0.29*** | 0.28*** | 0.38*** |
| | (0.07) | (0.07) | (0.09) | (0.08) |
| Export-to-debt Service Ratio, end (%)[2/] | 3.17*** | 3.44*** | 3.42*** | 4.39*** |
| | (0.69) | (0.68) | (0.76) | (0.79) |
| LIBOR 12-month, average (%)[1/] | 9.49*** | 7.85*** | 8.12** | - |
| | (2.01) | (2.09) | (2.30) | |
| LIBOR 12-month, end (%)[2/] | -12.38*** | -11.04*** | -9.17*** | - |
| | (1.86) | (1.80) | (2.09) | |
| German Gov. Bond Term Premium, average (%)[1/4/] | - | - | - | -5.06 |
| | | | | (3.34) |
| Post-default Bond Exchange [5/] | -37.44** | -36.52** | -33.70*** | -43.17** |
| | (14.50) | (14.46) | (14.81) | (16.1) |
| Sample | 152 | 152 | 93 | 157 |
| Adj-$R^2$ | 0.45 | 0.45 | 0.40 | 0.55 |
| Root MSE | 40.2 | 40.0 | 38.8 | 45.9 |

Source: Asonuma and Trebesch (2016), Bank of England, Bureau of Economic Analysis (US), Cruces and Trebesch (2013), Deutsche Bundesbank, Federal Statistical Office (Germany), Gilchrist and Zakrajsek (2012), IMF WEO, and authors' calculation.

# Stylized facts on restructurings (cont.)

- **Stylized Fact 3**: Haircuts are smaller (recovery rates are higher) when creditors' income is high.
- **Stylized Fact 4**: Face value reductions are small when creditors are facing high income.



# Stylized facts on restructurings (cont.)

| Dependent variable: **Haircuts** (%) | **(1) US GDP Growth Rate** | **(2) German GDP Growth Rate** | (3) US Credit Spreads (GZ) | (4) German Corporate Bond Yields |
|---|---|---|---|---|
| US GDP Growth Rate, end (%)[1/] | **-3.20*** (0.96)** | - | - | - |
| German GDP Growth Rate, end (%)[1/] | - | **-2.21** (1.04)** | - | - |
| US Credit Spreads (GZ), end (%)[1/] | - | - | 6.99** (2.98) | - |
| German Corporate Bond Yields, end (%)[1/] | - | - | - | 3.33** (1.63) |
| GDP Deviation from Trend, end (%) [1/2/] | 0.22 (0.26) | 0.29 (0.26) | 0.45 (0.30) | 0.48 (0.28) |
| Per Capita US$ GDP, end (thousand US$)[1/] | -1.52 (1.32) | -1.09 (1.33) | -0.19 (1.28) | 3.26 (1.22) |
| External Debt/GDP Ratio, end (%)[1/] | 0.26*** (0.04) | 0.25*** (0.04) | 0.33*** (0.04) | 0.31*** (0.04) |
| Export-to-debt Service Ratio, end (%)[1/] | 2.26*** (0.42) | 2.32*** (0.43) | 2.53*** (0.43) | 2.46*** (0.28) |
| LIBOR 12-month, end (%)[1/] | - | - | -0.68 (0.59) | -2.13** (1.00) |
| Constant | 23.72*** (6.35) | 16.52*** (5.81) | - | - |
| Sample | 148 | 148 | 114 | 148 |
| Adj-$R^2$ | 0.33 | 0.30 | 0.78 | 0.74 |
| Root MSE | 22.6 | 23.2 | 24.0 | 23.5 |

Source: Bank of England, Bureau of Economic Analysis (US), Cruces and Trebesch (2013), Deutsche Bundesbank, Federal Statistical Office (Germany), Gilchrist and Zakrajsek (2012), IMF WEO, and authors' calculation.

# Main questions / focus of the paper

- **Main questions**

1. Why are restructurings protracted (longer delays) when the foreign creditors are experiencing high income?
2. Why are agreed haircuts (recovery rates) low (high) when the creditors are facing high income?

- **Main focus** - We analyze the role of (risk averse) foreign creditors at sovereign debt restructurings (both process and outcomes).
  - **Our theoretical innovation** - To embed explicitly multi-round renegotiations between a risk averse debtor and a risk averse creditor in a standard sovereign debt model.

# Implications of the paper

- New dataset and stylized facts on debt restructurings and creditors' business cycle
  - When creditors' income is high, restructurings tend to be protracted (delays) or settled with low haircuts (high recovery rates) and face value reductions.
- New theoretical explanations on the role of creditors at debt restructurings
  - Outcome: Haircuts are low (recovery rates are high) when creditors' income is high.
  - Processes: Two mechanisms of delays originated by two different drivers
    1. Recovery of debtor's income (BW 2009, Bi 2008)
    2. High outside option of creditors (our paper)
- The data confirms the main prediction of the model (panel regression).

# Intuition: Role of creditors at restructurings

- The creditor is risk averse and has consumption smoothing motive.
  - With high income (less financially constrainted), he/she is more patient and less eager to recoup losses on defaulted debt in current period.
  - With an outside option of high expected recovery rates, the creditor demands high recovery rates (low haircuts) at current round of negotiation.
- If the sovereign is eager to settle the deal in current period, it simply accepts high recovery rates.
  - The sovereign has enough income and opts to repay since further output costs and financial exclusions are costly for the sovereign.
- If the sovereign is less eager to settle or has limited income, it opts to delay negotiation to next period.
  - The sovereign chooses to postpone the settlement to next period since repayment of high recovery rates are costly for the sovereign who is financially constrained.

# Literature review

- Sovereign defaults and renegotiation in a classical set-up of Eaton and Gersovitz (1981)
  - Benjamin and Wright (2009), Kovrijnykh and Szentes (2007), Yue (2010), Bi (2008), Pitchford and Wright (2012), Hatchondo et al. (2014), Bai and Zhang (2010), Asonuma and Trebesch (2016), D'Erasmo (2010), Arellano and Bai (2014), Asonuma (2016a).
- Sovereign debt and risk-averse creditors
  - Borri and Verdelhan (2011), Arellano and Bai (2014), Lizarazo (2013), Broner et al. (2013), Pouzo and Presno (2011), Gilchirst et al. (2012) and Asonuma (2016b).
- Empirical analysis on sovereign debt restructuring
  - Benjamin and Wright (2009), Sturzenegger and Zettelmeyer (2006, 2008), Reinhart and Rogoff (2009, 2011), Cruces and Trebesch (2013), Asonuma and Trebesch (2016), and Diaz-Cassou, et al. (2008).

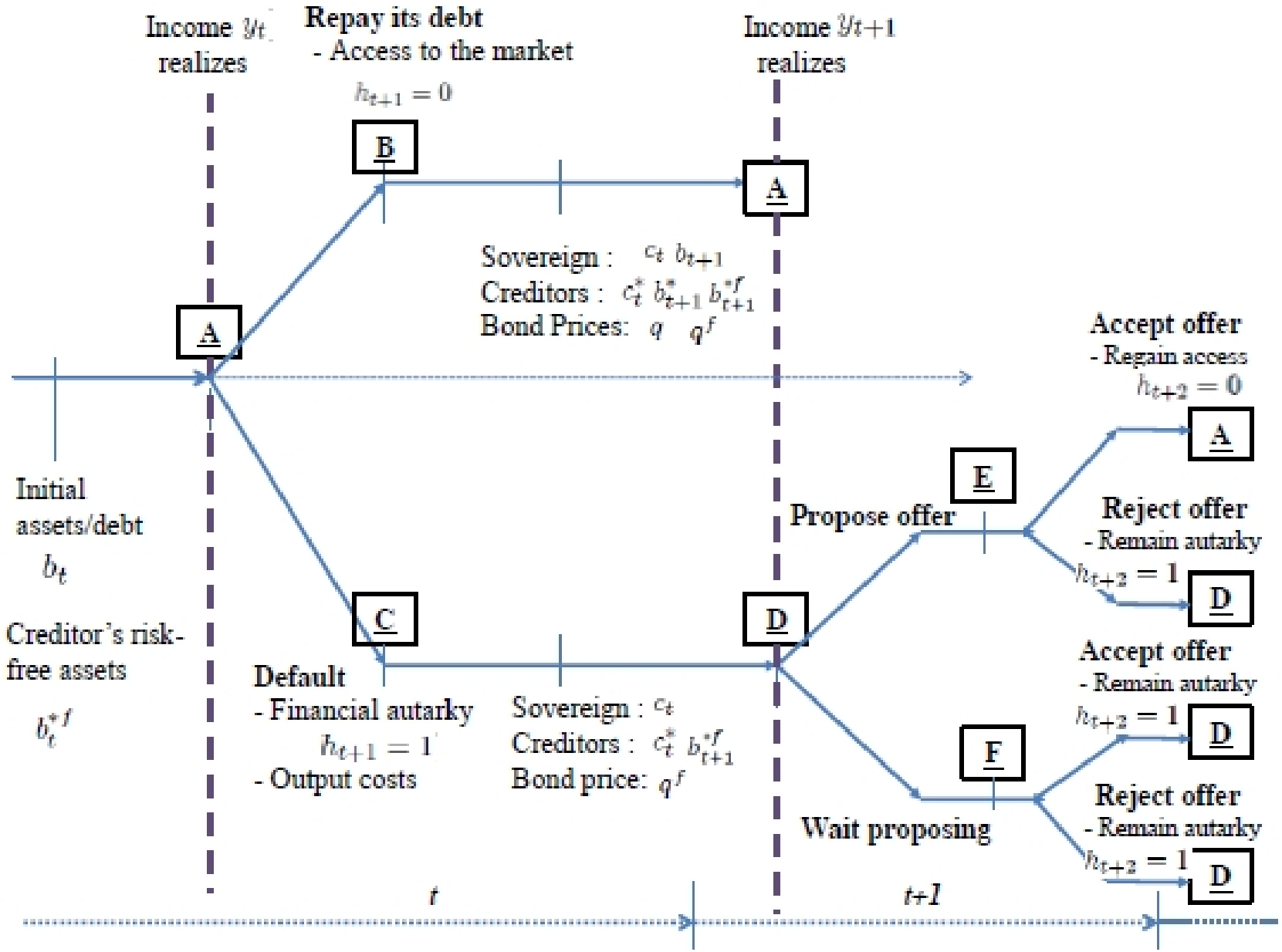
# Model: General features

- Sovereign debt defaults and renegotiation in a dynamic two-country model.
  - The sovereign's choice for default and restructuring is endogenous.
  - The negotiation delay, i.e., the sovereign's and the creditor's decision to settle or postpone the renegotiation is endogenously chosen.
  - Agreed recovery rates of restructurings are endogenous.

# Model: General features

- A risk averse sovereign debtor and a risk averse creditor
- A vector of stochastic income shocks (debtor and creditor) $y_t = \left[y_t^h, y_t^f\right]$
- Credit record $h_t$: indicating status of market access
- Incomplete capital market: exchange one-period zero-coupon bonds
- One-side commitment
- Symmetric and perfect information
- Multi-round renegotiation upon the debtor's default choice
  - The identity of proposer is randomly selected (constant probability)
  - The proposer chooses either to propose or to pass and the other party decides to accept or reject the offer.

# Model: Timing



# Model - Sovereign's problem

- Case of good credit record (market access - $h_t = 0$)
- If the sovereign has savings ($b_t \geq 0$)

$$V(b_t, b_t^{*f}, 0, y_t) = \max_{c_t, b_{t+1}} u(c_t) + \beta \int_Y V(b_{t+1}, b_{t+1}^{*f}, 0, y_t) d\mu(y_{t+1}|y_t) \tag{1}$$

$$s.t. \quad c_t + q(b_{t+1}, b_{t+1}^{*f}, 0, y_t) b_{t+1} = y_t^h + b_t$$

- If the sovereign has debt ($b_t < 0$)

$$V(b_t, b_t^{*f}, 0, y_t) = \max \left[ V^R(b_t, b_t^{*f}, 0, y_t), V^D(b_t, b_t^{*f}, 0, y_t) \right] \tag{2}$$

- Sovereign's value of repayment

$$V^R(b_t, b_t^{*f}, 0, y_t) = \max_{c_t, b_{t+1}} u(c_t) + \beta \int_Y V(b_{t+1}, b_{t+1}^{*f}, 0, y_t) d\mu(y_{t+1}|y_t) \tag{3}$$

$$s.t. \quad c_t + q(b_{t+1}, b_{t+1}^{*f}, 0, y_t) b_{t+1} = y_t^h + b_t$$

# Model - Sovereign's problem (cont.)

- Sovereign's value of defaulting (restructuring)

$$V^D(b_t, b_t^{*f}, 0, y_t) = u((1-\lambda_d)y_t^h) + \beta \int_Y \Gamma\left((1+r_t^*)b_t, b_{t+1}^{*f}, y_{t+1}\right) d\mu(y_{t+1}|y_t) \quad (4)$$

- Case of bad credit record (loss in access -$h_t = 1$)

$$V(b_t, b_t^{*f}, 1, y_t) = \Gamma\left(b_t, b_t^{*f}, y_t\right) \quad (5)$$

- Sovereign's default set

$$D(b_t, b_t^{*f}, 0) = \left\{ y_t \in Y : V^R(b_t, b_t^{*f}, 0, y_t) < V^D(b_t, b_t^{*f}, 0, y_t) \right\} \quad (6)$$

# Model - Creditor's problem

- Case of good credit record (market access - $h_t = 0$)

$$V^*(b_t, b_t^{*f}, 0, y_t) = I_{Non-Default} V^{*R}(b_t, b_t^{*f}, 0, y_t) + (1 - I_{Non-Default}) V^{*D}(b_t, b_t^{*f}, 0, y_t) \quad (7')$$

- If the sovereign repays debt,

$$V^{*R}(b_t, b_t^{*f}, 0, y_t) = \max_{c_t^*, b_{t+1}^*, b_{t+1}^{*f}} v(c_t^*) + \beta^* \int_Y V^*(b_{t+1}, b_{t+1}^{*f}, 0, y_t) d\mu(y_{t+1}|y_t) \quad (10)$$

$$c_t^* + q(b_{t+1}, b_{t+1}^{*f}, 0, y_t) b_{t+1}^* + q^f(b_{t+1}, b_{t+1}^{*f}, 0, y_t) b_{t+1}^{*f} = y_t^f + b_t + b_t^{*f}$$

# Model - Creditor's problem (cont.)

- If the sovereign defaults,

$$V^{*D}(b_t, b_t^{*f}, 0, y_t) = \max_{c_t^*, b_{t+1}^{*f}} v(c_t^*) + \beta^* \int_Y \Gamma^*((1+r_t^*)b_t, b_{t+1}^{*f}, , y_{t+1}) d\mu(y_{t+1}|y_t) \quad (11)$$

$$s.t.\ c_t^* + q^f(b_{t+1}, b_{t+1}^{*f}, 0, y_t) b_{t+1}^{*f} = y_t^f + b_t^{*f}$$

- Price of sovereign bonds

$$q(b_{t+1}, b_{t+1}^{*f}, 0, y_t) = \int_Y \beta^* \frac{v(c_{t+1}^*)}{v(c_t^*)} X d\mu(y_{t+1}, y_t) \quad (8')$$

$$X = \left[ I_{Non-Default} + (1 - I_{Non-Default})\, \gamma(b_{t+1}, b_{t+1}^{*f}, y_{t+1}) \right]$$

# Model - Creditor's problem (cont.)

- Price of risk-free bonds

$$q^f\left(b_{t+1}, b^{*f}_{t+1}, 0, y_t\right) = \int_Y \beta^* \frac{v\left(c^*_{t+1}\right)}{v\left(c^*_t\right)} d\mu\left(y_{t+1}, y_t\right) \tag{9'}$$

- Case of bad credit record (loss in access - $h_t = 1$)

$$V^{*D}\left(b_t, b^{*f}_t, 1, y_t\right) = \Gamma^*\left(b_t, b^{*f}_t, y_t\right) \tag{12}$$

- Price of risk-free bonds

$$q^f\left(b_{t+1}, b^{*f}_{t+1}, 1, y_t\right) = \int_Y \beta^* \frac{v\left(c^*_{t+1}\right)}{v\left(c^*_t\right)} d\mu\left(y_{t+1}, y_t\right) \tag{9''}$$

# Model: Renegotiation problem

- Strategies of the proposer $i$ and the other party $j$ (for $i, j = B, L$) depending on state $(b_t, b_t^{*f}, h_t, y_t)$ and current offer:

$$\theta_i = \{1 \quad (propose)\} \quad \& \quad \theta_j = \{1 \quad (accept)\}$$

$$\theta_i = \{0 \quad (pass)\} \quad \& \quad \theta_j = \{0 \quad (reject)\}$$

- Case when the borrower B is the proposer
- If B proposes and the proposal is accepted,

$$V^{PRO}(b_t, b_t^{*f}, y_t) = u((1-\lambda_d)y_t^h + \delta_t^B b_t) + \beta \int_Y V\left(0, b_{t+1}^{*f}, 0, y_{t+1}\right) d\mu(y_{t+1}|y_t) \tag{15}$$

$$V^{*ACT}(b_t, b_t^{*f}, y_t) = \max_{c_t^*, b_{t+1}^{*f}} v(c_t^*) + \beta^* \int_Y V^*(0, b_{t+1}^{*f}, 0, y_t) d\mu(y_{t+1}|y_t) \tag{16}$$

$$c_t^* + q^f(b_{t+1}, b_{t+1}^{*f}, 1, y_t) b_{t+1}^{*f} = y_t^f - \delta_t^B b_t + b_t^{*f}$$

# Model: Renegotiation problem (cont.)

- If B postpones offering,

$$V^{PASS}(b_t, b_t^{*f}, y_t) = u((1-\lambda_d)y_t^h) + \beta \int_Y \Gamma\left((1+r_t^*)b_t, b_{t+1}^{*f}, y_{t+1}\right) d\mu(y_{t+1}|y_t) \tag{17}$$

$$V^{*REJ}(b_t, b_t^{*f}, y_t) = \max_{c_t^*, b_{t+1}^{*f}} v(c_t^*) + \beta^* \int_Y \Gamma^*((1+r_t^*)b_t, b_{t+1}^{*f}, y_{t+1}) d\mu(y_{t+1}|y_t) \tag{18}$$

$$s.t.\ c_t^* + q^f(b_{t+1}, b_{t+1}^{*f}, 1, y_t) b_{t+1}^{*f} = y_t^f + b_t^{*f}$$

# Model: Renegotiation problem (cont.)

- Equilibrium

$$\delta_t^{B*} = \arg\max V^{PRO}(b_t, b_t^{*f}, y_t) \tag{19}$$

$$s.t. \quad V^{PRO}(b_t, b_t^{*f}, y_t) \geq V^{PASS}(b_t, b_t^{*f}, y_t)$$

$$s.t. \quad V^{*ACT}(b_t, b_t^{*f}, y_t) \geq V^{*REJ}(b_t, b_t^{*f}, y_t)$$

- If both parties reach an agreement,

$$\Gamma^B(b_t, b_t^{*f}, y_t) = V^{PRO}(b_t, b_t^{*f}, y_t) \tag{20}$$

$$\Gamma^{B*}(b_t, b_t^{*f}, y_t) = V^{*ACT}(b_t, b_t^{*f}, y_t) \tag{21}$$

- Otherwise,

$$\Gamma^B(b_t, b_t^{*f}, y_t) = V^{PASS}(b_t, b_t^{*f}, y_t) \tag{20'}$$

$$\Gamma^{B*}(b_t, b_t^{*f}, y_t) = V^{*REJ}(b_t, b_t^{*f}, y_t) \tag{21'}$$

# Model: Market clearing condition

- Goods (repayment)

$$c_t + c_t^* = y_t^h + y_t^f \tag{31}$$

- Goods (default)

$$c_t = (1 - \lambda_d) y_t^h, \qquad c_t^* = y_t^f \tag{32}$$

- Bonds

$$\pi b_t + (1 - \pi)\, b_t^* = 0 \tag{33}$$

# Equilibrium

## Definitions

: A **Recursive equilibrium** is a set of functions for (A) the sovereign's value function, consumption, asset position, default set; (B) creditor's' consumption, asset position, (C) the sovereign's and creditor's settlement or delay decision functions, two sets of recovery rates (depending on the identity of proposer), the payoffs, (D) bond price functions for sovereign bonds and risk-free bonds such that

[1] The sovereign's consumption, asset position and default set satisfy the sovereign's optimization problem (1)-(6).

[2] The creditor's consumption and asset position satisfy the creditor's problem (7)-(12).

[3] Debt recovery rates and the strategies of both players solve the debt renegotiation problem (14)-(30).

[4] Market clearing conditions for bonds and goods are satisfied (31)-(33).

# Equilibrium (cont.)

- Default probability:

$$p^D\left(b_{t+1}, b_{t+1}^{*f}, 0, y_t\right) = \int_{D\left(b_{t+1}, b_{t+1}^{*f}\right)} d\mu\left(y_{t+1}|y_t\right) \tag{34}$$

- Expected recovery rates

$$\gamma\left(b_t, b_t^{*f}, y_t\right) = \int_Y \beta^* \frac{v\left(c_{t+1}^*\right)}{v\left(c_t^*\right)} X d\mu\left(y_{t+1}, y_t\right) \tag{36}$$

$$X = \left[ \begin{array}{c} \phi I_{y_{t+1} \in R^B\left(b_{t+1}, b_{t+1}^{*f}\right)} \delta_t^{B*}\left(\left(1+r_t^*\right) b_t, b_{t+1}^{*f}, y_{t+1}\right) \\ + \left(1-\phi\right) I_{y_{t+1} \in R^L\left(b_{t+1}, b_{t+1}^{*f}\right)} \delta_t^{L*}\left(\left(1+r_t^*\right) b_t, b_{t+1}^{*f}, y_{t+1}\right) \\ + \left( \begin{array}{c} \phi I_{y_{t+1} \notin R^B\left(b_{t+1}, b_{t+1}^{*f}\right)} + \\ \left(1-\phi\right) I_{y_{t+1} \notin R^L\left(b_{t+1}, b_{t+1}^{*f}\right)} \end{array} \right) \gamma\left(\left(1+r_t^*\right) b_t, b_{t+1}^{*f}, y_{t+1}\right) \end{array} \right]$$

# Equilibrium (cont.)

- Probability of settling the deal

$$p^R\left(\begin{array}{c}(b_{t+1}, b^{*f}_{t+1}\\ 0, y_t\end{array}\right) = \phi \int_{R^B(b_{t+1}, b^{*f}_{t+1})} d\mu(y_{t+1}|y_t) + (1-\phi)\int_{R^L(b_{t+1}, b^{*f}_{t+1})} d\mu(y_{t+1}|y_t) \tag{35}$$

- Risk-free interest rate

$$1 + r(b_{t+1}, b^{*f}_{t+1}, 0, y_t) = 1/q^f(b_{t+1}, b^{*f}_{t+1}, 0, y_t) \tag{37}$$

- Sovereign bond spreads

$$s(b_{t+1}, b^{*f}_{t+1}, 0, y_t) = 1/q(b_{t+1}, b^{*f}_{t+1}, 0, y_t) - 1 - r(b_{t+1}, b^{*f}_{t+1}, 0, y_t) \tag{38}$$

# Quantitative analysis - Parameters

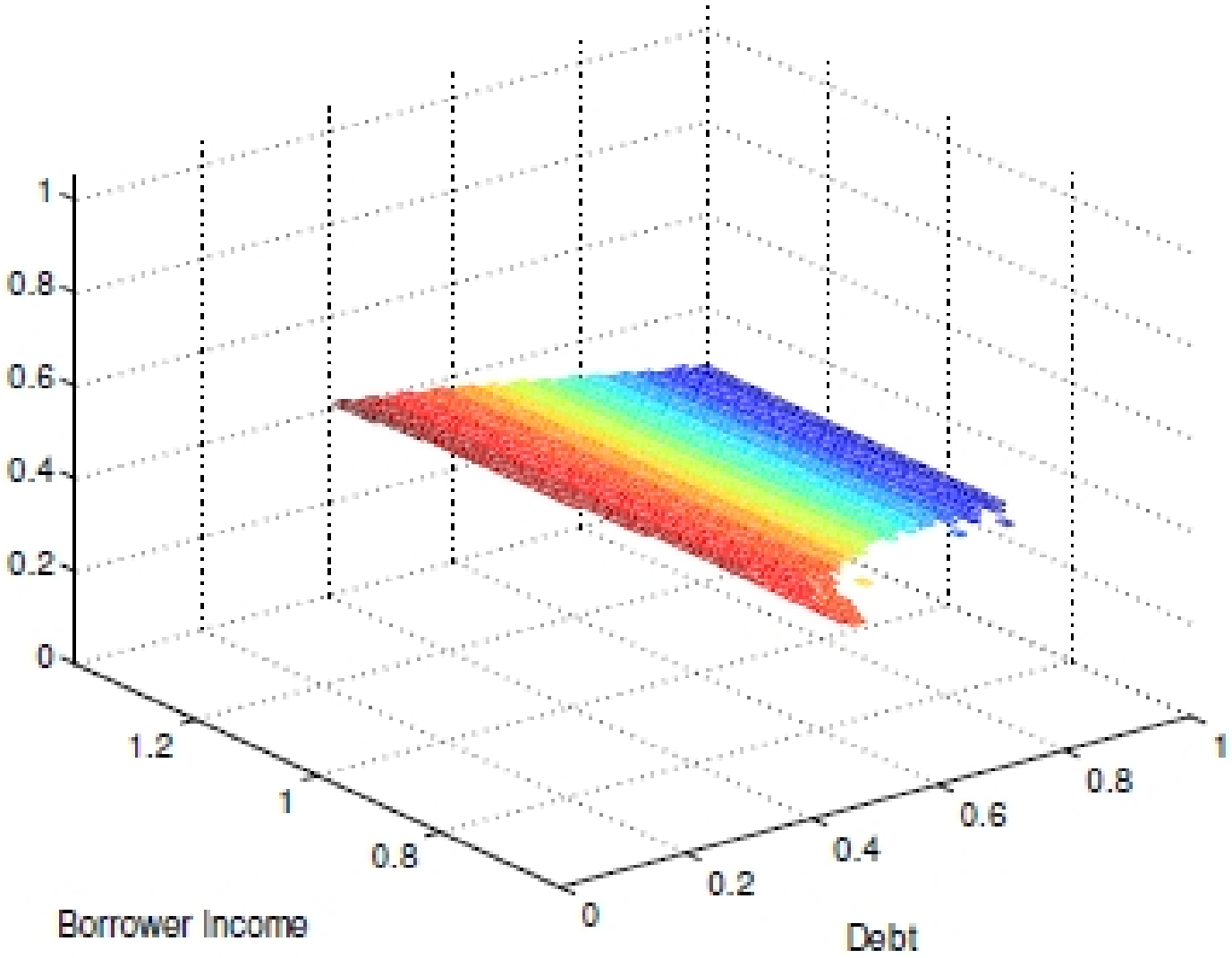
- Debtor's and creditor's growth rate - AR(1) process :
  $\log(g_t^i) = (1-\rho_g^i)\log(1+\mu_g^i) + \rho_g^i \log(g_{t-1}^i) + \epsilon_{g,t}^i$ for $i = h, f$

| Parameter | Value | Sources |
|---|---|---|
| Risk aversion | $\sigma = \alpha = 2$ | RBC Literature, Lizarazo (2013) |
| Output cost | $\lambda_d = 0.02$ | Sturzenegger (2004) |
| Bargaining power | $\phi = 0.97$ | Computed |
| Average endowment growth | $\mu_g = 0.009$ | Computed-MECON |
| ***Creditor specific*** | | |
| Discount factor | $\beta^* = 0.98$ | Lizarazo (2013) |
| Auto-correlation. of income | $\rho^f = 0.89$ | Computed-US BEA |
| Std of endowment shock | $\sigma^f = 0.012$ | Computed-US BEA |
| ***Sovereign specific*** | | |
| Discount factor | $\beta = 0.75$ | Computed |
| Auto-correlation. of income | $\rho^h = 0.65$ | Computed-MECON |
| Std of endowment shock | $\sigma^h = 0.054$ | Computed-MECON |

# Quantitative analysis - steady-state dist.

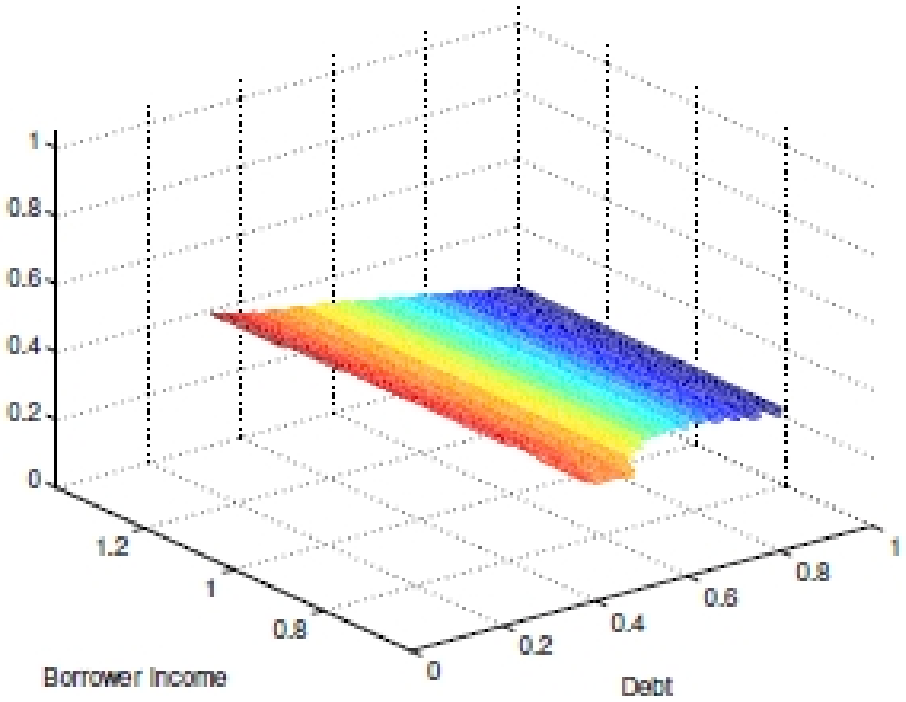
- Agreed recovery rates (%)

A. Mean creditor's income

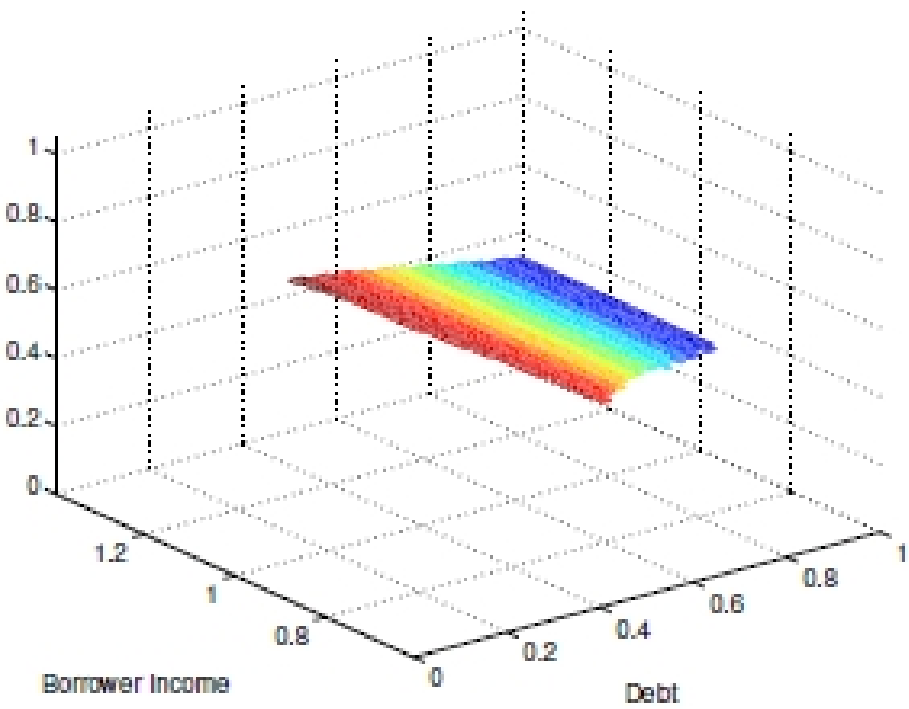


# Quantitative analysis - steady-state distribution (cont.)

B. Low creditor's income



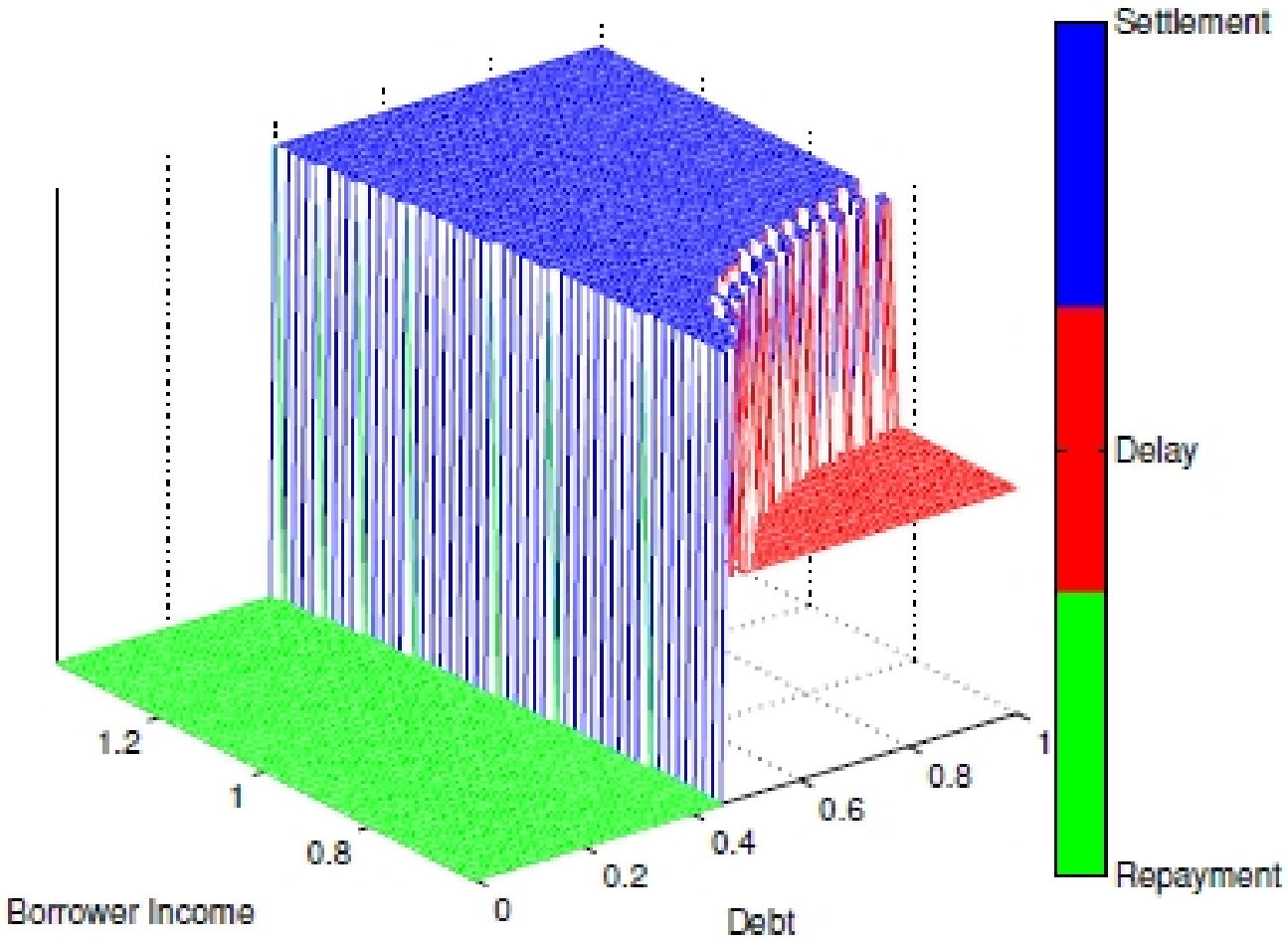

C. High creditor's income



# Quantitative analysis - steady-state dist. (cont.)

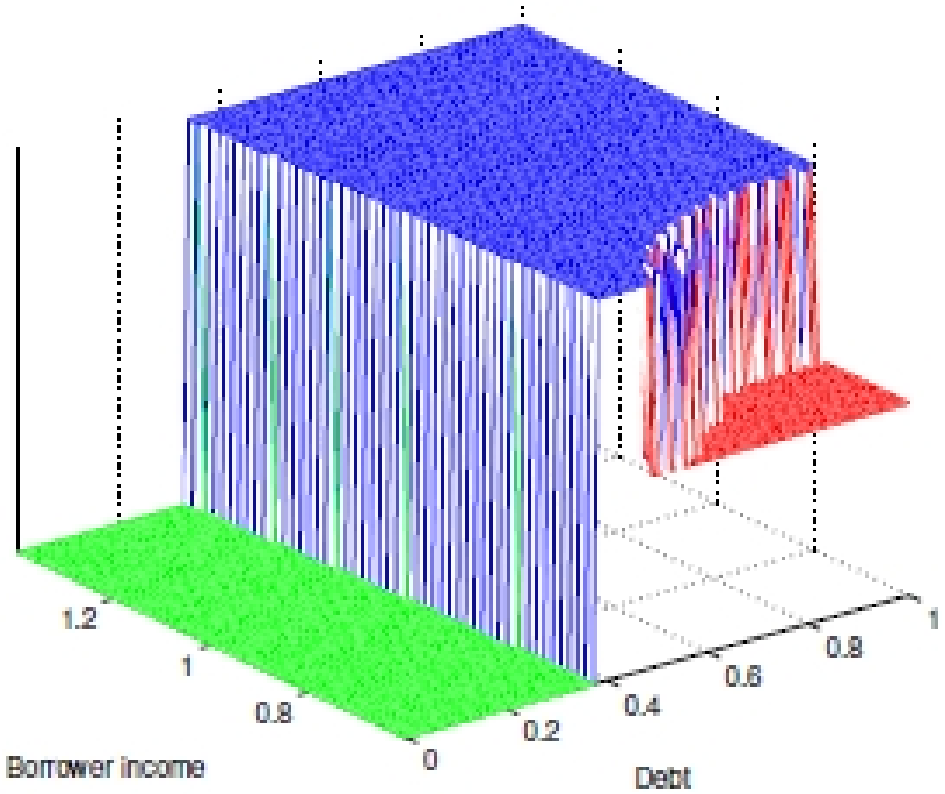
- Sovereign's choice among repayment, delay and settlement

A. Mean creditor's income

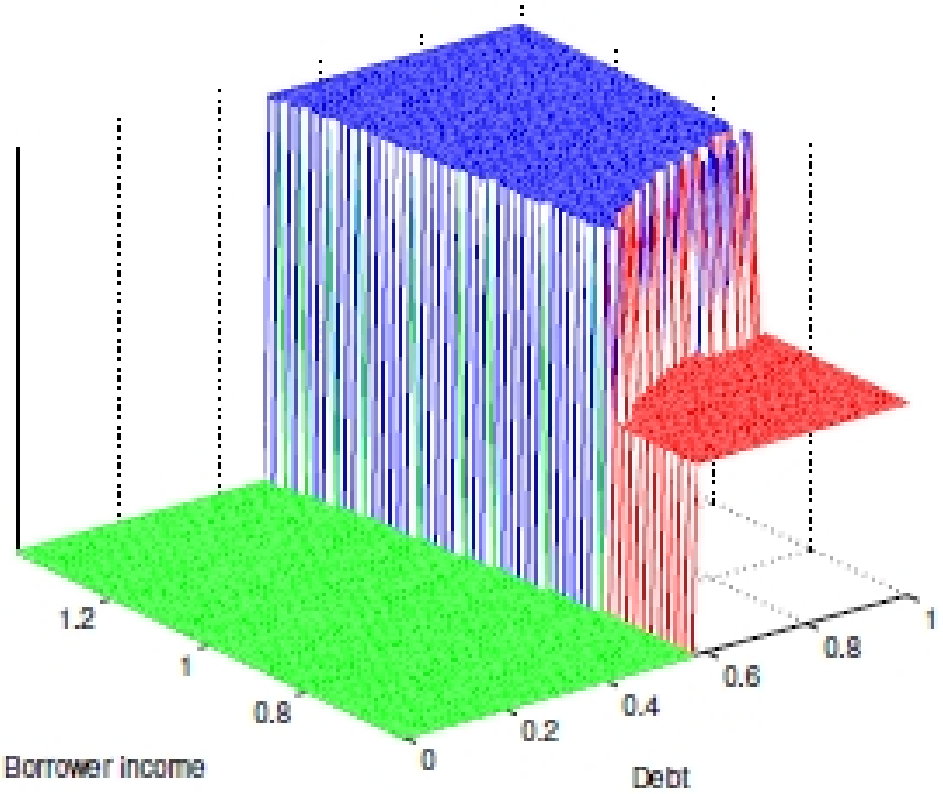


# Quantitative analysis - steady-state distribution (cont.)

B. Low creditor's income




C. High creditor's income



# Quantitative analysis - simulation

(B) Non-business Cycle Statistics

| | Data | Model | Arellano (2008) | Yue (2010) |
|---|---|---|---|---|
| **Target Statistics** | | | | |
| Default Probability (%) | 3.26 | 3.25 | 3.00 | 2.67 |
| Average Recovery Rate (%) | 25.0 | 41.8 | - | 27.3 |
| **Pre-Default Periods** | | | | |
| Average Debt/GDP ratio (%) | 45.4 | 49.7 | 5.95 | 10.10 |
| Bonds Spreads: average (%) | 9.4 | 3.6 | 3.6 | 1.9 |
| Bonds Spreads: std dev. (%) | 7.6 | 2.1 | 6.4 | 1.6 |
| Corr.(Spreads, Output) | -0.88 | -0.61 | -0.29 | -0.11 |
| Corr.(Debt/GDP, Spreads) | 0.92 | 0.12 | - | - |
| Corr.(Debt/GDP, Output) | -0.97 | -0.07 | - | - |
| Risk-free Interest Rate (%) | 1.3 | 0.3 | - | - |
| **Renegotiation Periods** | | | | |
| Average Debt/GDP ratio (%) | 130.5 | 50.0 | - | - |
| Duration of Renegotiation (quarter) | 14.0 | 5.9 | - | - |
| Debtor Output Dev. (diff. btw start & end, %) | 8.7 | 15.7 | - | - |
| Creditor Output Dev. (diff. btw start & end, %) | 1.5 | 1.4 | - | - |
| Corr.(Debt/GDP, Recovery Rates) | 0.3 | 0.4 | - | 0.3 |
| Corr.(Debt/GDP, Output) | -0.95 | -0.17 | - | - |

Sources: Arellano (2008), Datastream, IMF WEO, MECON, Yue (2010).

# Quantitative analysis - simulation (cont.)

Table 7: Comparison of Our Model with Conventional Models of Multi-round Negotiations

| | Our Model | Risk-neutral Creditors Benjamin and Wright (2009)/Bi (2008) | Small Open Economy with risk-averse Creditors Borri and Verdelhan (2011) |
|---|---|---|---|
| **Pre-Default periods** | | | |
| Average Debt/Output ratio (%) | 49.7 | 58.8 | 17.0 |
| Bonds Spreads: average (%) | 3.6 | 0.4 | 2.5 |
| Bonds Spreads: std dev. (%) | 2.1 | 0.4 | 2.4 |
| **Renegotiation periods** | | | |
| Average Debt/GDP ratio (%) | 50.0 | 60.0 | 17.1 |
| Duration of Renegotiation (quarter) | 5.9 | 4.8 | 2.0 |
| Debtor Output Dev. (diff. btw start & end, %) | 15.7 | 12.5 | 8.8 |
| Creditor Output Dev. (diff. btw start & end, %) | 1.4 | - | 1.1 |

Sources: authors' computation

# Testing the model predictions

| Dependent variable: **Completion of Restructurings** | (1) US GDP Growth Rate | (2) German GDP Growth Rate | **(3) Full model-US GDP Growth** | **(4) Full model-German GDP Growth** |
|---|---|---|---|---|
| Real GDP Growth Rate - Debtor (%) | - | - | 0.02* | 0.01 |
| | | | (0.01) | (0.01) |
| External Debt/GDP Ratio (%) | -0.55*** | -0.58** | -0.37*** | -0.60*** |
| | (0.08) | (0.08) | (0.09) | (0.08) |
| Real GDP Growth Rate US, annual (%)[1/] | -0.09*** | - | -0.07** | - |
| | (0.02) | | (0.03) | |
| Real GDP Growth Rate German, annual (%)[1/] | - | -0.07*** | - | -0.07*** |
| | | (.003) | | (0.02) |
| Term Premium (%)[2/] | - | - | 0.20*** | -0.01 |
| | | | (0.05) | (0.04) |
| Number of observations | 717 | 717 | 713 | 699 |
| Wald $\chi^2$ | 166.0 | 161.6 | 185.1 | 156.0 |
| Prob.> $\chi^2$ | 0.000 | 0.000 | 0.000 | 0.00 |

Sources: Board of Governors of the Federal Reserve System, Bureau of Economic Analysis (US), Federal Statistical Office (Germany), IMF WEO.

Notes: Standard errors are in parentheses. ***, **, * show significance at 1, 5, and 10 percent levels, respectively.

All regression results are based on least square estimations.

[1/] Annual growth rate.

[2/] Term premium on the government bonds is a difference between 1-year and 10-year bond yields.

# Conclusion

- New dataset and stylized facts on debt restructurings and creditors' income
  - When creditors' income is high, restructurings tend to be protracted (delays) or settled with low haircuts (high recovery rates) and face value reductions.
- New theoretical explanations on the role of creditors at debt restructurings
  - Outcome: Haircuts are low (recovery rates are high) when creditors' income is high.
  - Processes: Two mechanisms of delays originated by two different drivers
    1. Recovery of debtor's income (BW 2009, Bi 2008)
    2. High outside option of creditors (our paper)
- The data confirms the main prediction of the model (panel regression).