Sovereign Debt Restructurings: Delays in Renegotiations and Risk Averse Creditors∗

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Abstract

Foreign creditors’ business cycles influence both the processes and outcomes of sovereign debt restructurings. We compile two new datasets on creditor committees and on creditors’ business cycles during restructurings and find that when creditors experience high GDP growth, restructurings are protracted and settled with smaller haircuts. To explain these stylized facts, we develop a theoretical model of sovereign debt with multi-round negotiations between a risk averse debtor and a risk averse creditor. The quantitative analysis of model shows that high creditor income results in both longer delays in renegotiations and smaller haircuts. Our theoretical prediction is supported by data.

JEL Classification Codes: F34, F41, H63

Key words: Sovereign Debt; Sovereign Default; Sovereign Debt Restructuring; Delays in Negotiations; Risk Averse Creditor.

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1 Introduction

Foreign creditors’ business cycles influence both the processes and outcomes of sovereign debt restructurings. We compile two new datasets on the creditor committees and on creditors’ business cycles during restructurings with private external creditors. Our datasets show that when foreign creditors experience high gross domestic product (GDP) growth, restructurings are protracted (delayed) and settled with smaller net present value (NPV) haircuts and face-value reductions. To explain these stylized facts, we develop a theoretical model of defaultable debt that explicitly embeds multi-round debt negotiations between a risk averse sovereign and a risk averse creditor. Our quantitative analysis of the model shows that when the creditor’s income is high, restructurings are delayed and settled with smaller haircuts. Our theoretical prediction is supported by data: both a panel analysis using 111 post-default episodes and a calibration exercise for Argentine restructuring in 2001–05.

First, the paper shows two new datasets on (a) the creditor committees and (b) creditors’ business cycles at the debt restructurings with private external creditors (179 episodes over 1978–2010). On the first dataset, we compile data on the creditor committees—normally comprised of groups of 5–20 representative creditors (mostly banks)—and respective chairs who discuss exchange proposals with delegations from the debtor countries during restructurings. Our dataset shows a new stylized fact: creditors established formal committees in 131 restructuring episodes (73 percent of total episodes). This stylized fact is important to understand precisely the role of creditors in restructurings. Moreover, among these cases, 121 cases (68 percent of total cases) are successfully identified as episodes with chairmen, mostly the US and European banks.

On the second dataset, we also construct a new, comprehensive dataset on creditor GDP growth rates and risk aversion—consistent with the first stylized fact and complemented by both GDP deviation from the trend and growth rate of bank assets—at a monthly frequency during restructurings. We then combine our new data with existing dataset on the duration of restructurings from Asonuma and Trebesch (2016) and on the creditor losses from Cruces and Trebesch (2013), both of which cover the same sample of restructuring episodes.

Our consolidated datasets provide three new stylized facts on how creditors’ GDP growth rates relate to the processes and outcomes of post-default restructurings—contribute to the growing empirical literature on debt restructurings. When the creditors experience high GDP growth, restructurings: (i) are protracted i.e. have longer delays, (ii) result in lower haircuts, and (iii) have lower face-value reductions. We confirm these findings through cross-sectional regressions using 111 post-default restructuring episodes.

These empirical facts unveil a new dimension of sovereign defaults and debt restructurings which the literature has not fully explored yet. In particular, two new questions emerge: Why are restructurings protracted when the creditors experience high income? And why are agreed haircuts low when the creditors have high income? These questions challenge the current understanding in the literature in that the creditors’ negotiation stances remain unchanged by exploring differences in creditors’ negotiation stances during restructurings. To our knowledge, we are the first to shed light on the influence of the creditors’ business cycles on the processes
and outcomes of debt restructurings.

To achieve this goal, we develop a theoretical sovereign debt model with endogenous defaults and multi-round debt renegotiations with a sovereign debtor and its creditor. The basic structure of the model closely follows the recent quantitative analysis of sovereign debt—built on the classic setup of Eaton and Gersovitz (1981)—such as Aguiar and Gopinath (2006), Arellano (2008), and Tomz and Wright (2007). More specifically, in our two-country framework with the risk averse creditor similar to Arellano and Bai (2014) and Lizarazo (2013), the creditor’s surplus at the bargaining game is endogenously determined. This differs from the fixed creditor surplus in a small open economy model with the risk averse creditor (Borri and Verdelhan 2011).

What differentiates our theoretical model from standard multi-round negotiation models is the incorporation of multi-round bargaining between the risk averse debtor and the risk averse creditor. We explicitly depart from the conventional assumption of risk-neutral creditors without income uncertainty who face a fixed outside option, as in Benjamin and Wright (2009) and Bi (2008). At each period, both the sovereign and the creditor face stochastic income processes. After observing its income, the sovereign chooses to pay the debt in full or to default. When a default occurs, the debtor and the creditor negotiate a reduction of unpaid debt via multi-round bargaining. At the negotiation, one party chooses whether to propose an offer with haircuts or to pass its option. The other party decides whether to accept the proposal or to reject the offer. If the offer with haircuts is proposed and accepted, then the sovereign resumes access to the international capital market in the next period and the creditor receives the recovered debt payments. Otherwise, both parties continue the negotiation over the debt in arrears.

The key feature in our model is that the risk averse creditor decides whether to complete the exchange with the proposed recovery rates or postpone the settlement by comparing the utility value from receipt of the recovered debt payments with that of his outside option, i.e. utility value from postponing the settlement. What determines the creditor’s choice is the state-dependent consumption-smoothing motive through the recovered debt payments and the related outside option. The creditor negotiation stance differs substantially from models with risk-neutral creditors where he is indifferent to the timing of settlement.

We emphasize two new key predictions of our theoretical model. First, we show that haircuts are smaller when the creditor faces high income as observed in the data. When income is high, the creditor is less eager to recoup losses on defaulted debt in the current round of negotiations. The outside option for the creditor, defined as the utility value associated with the expected recovery rates in the future period, remains high since his high income is anticipated to persist. The creditor simply requests current recovery rates high enough to be comparable to the high

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1We focus on the situations where creditors have long-term relationships with sovereign debtors, as in the London Club restructuring and Brady bond restructuring eras (late-1970s, 1980s and 1990s). Creditors were constantly allocating a large portion of wealth to domestic investment opportunities and a fixed and (relatively) limited portion to sovereign countries.

2See also the survey by Aguiar and Amador (2014) and Aguiar et al. (2016).

3In the model with risk-neutral creditors, the present value of the recovered debt payments remains unchanged; the rate of arrear accumulation is identical to the risk-neutral creditors’ discount rate.
expected recovery rates in the future. As a consequence, the sovereign has no choice but to accept high recovery rates (low haircuts) concluding renegotiations and avoiding future expected output costs and financial exclusion.

Next, we demonstrate two mechanisms of delays, originated by two different drivers. The first mechanism is that recovery of the debtor’s income to its pre-default level takes time, which generates delays. This mechanism is explained by Benjamin and Wright (2009) and Bi (2008) who show that both the sovereign and the creditor prefer to “wait for a larger cake” i.e. wait for recovery of the debtor’s income. High output costs of defaults undermine the debtor’s repayment capacity during negotiations. This reduces the proposed recovery rates which lead to an increase in the likelihood of delaying the settlement.

The second mechanism which we show is that the creditor with high income can wait and requests high recovery rates, resulting in delays. Our model explicitly demonstrates the creditor’s state-dependent consumption-smoothing motive through recovered debt payments driven by the creditor’s income process. When the creditor’s income is high—he is reluctant to receive unfavorable recovered debt payments given the expectation of higher recovery rates in the next period—he demands higher recovery rates in the current round that are at least comparable to those high expected recovery rates. This makes it more difficult for the debtor to settle the deal when its income recovers. As a result, settlement is further delayed.

Moreover, the sovereign is more willing to default ex-ante, ceteris paribus, when the creditor’s income is low because it anticipates lower default costs generated through these two mechanisms. Our mechanism of willingness to default through renegotiations differs from an increase in borrowing costs driven by state-dependent risk aversion (Borri and Verdelhan 2011).

Our theoretical prediction that debt restructurings are protracted when creditors’ GDP growth is high is supported by the data. The panel analysis using 111 post-default episodes at an annual frequency confirms the theoretical prediction. The quantitative exercise applied to Argentina’s default and restructuring in 2001–05 replicates moment statistics that match with the data. The model predicts both longer delays in renegotiations and a high average debt-to-GDP ratio—key contributions of models with multi-round negotiations (Benjamin and Wright 2009 and Bi 2008) that models with one-round negotiations (Yue 2010) fail to explain.\footnote{Models with long maturity bonds without restructurings also account for a high average debt-to-GDP ratio, which models with one-period bonds and without multi-round renegotiations fail to explain. See Chatterjee and Eyingungor (2012, 2015), Hatchondo and Martinez (2009a), and Hatchondo, et al. (2015).}

\textbf{Literature Review} \hspace{1em} Our paper is similar to theoretical work on sovereign debt restructurings that models the outcome of default and debt renegotiation as a bargaining game between a sovereign debtor and its creditors.\footnote{Bulow and Rogoff (1989), Kvrijnykh and Szentes (2007), Yue (2010), D’Erasmo (2010), Arellano and Bai (2014), Hatchondo et al. (2014), Asonuma and Trebesch (2016), Pitchford and Wright (2012), Arellano et al. (2013), Fernandez and Martin (2014), and Asonuma (2016a).} In particular, our paper is closely related to Benjamin and Wright (2009), Bi (2008), and Bai and Zhang (2012) which embed a multi-round bargaining game to analyze delays in debt renegotiations.\footnote{Both Benjamin and Wright (2009) and Bi (2008)
explain that delays can be beneficial for both parties in that they allow the debtor to recover from a crisis first and make more resources available to settle the renegotiation. In contrast, Bai and Zhang (2012) show that delays arise due to information asymmetry between the debtor and its creditors. This paper contributes to the literature by explaining an additional channel of delays driven by foreign creditor’s state-dependent consumption-smoothing motive.\textsuperscript{7}

The second stream of literature studies sovereign debt and risk averse creditors. Among previous studies, Aguiar et al. (2016), Borri and Verdelhan (2011), and Lizarazo (2013) show that the creditors’ risk aversion allows the model to generate spreads larger than default probabilities, as observed in emerging market countries.\textsuperscript{8} Arellano and Bai (2014) and Lizarazo (2009) analyze contagion in a model in which multiple borrowers trade with common risk averse lenders. Our paper fills a gap in the literature by exploring how creditors’ business cycles influence debt restructuring processes and outcomes.

The paper also contributes to empirical literature on sovereign debt restructurings.\textsuperscript{9} On private external debt restructurings, Benjamin and Wright (2009) first document a new perspective on the relationship between restructuring delays and haircut size and Asonuma and Trebesch (2016) show that preemptive restructurings have much lower haircuts and shorter duration. Cruces and Trebesch (2013) show that restructurings involving higher haircuts are associated with significantly higher subsequent bond yield spreads and longer periods of capital market exclusion. The current paper differs from the existing literature in that we find new stylized facts on the creditor committees and creditors’ business cycles in private external debt restructurings.

\textsuperscript{6}Arellano and Bai (2014) focus on simultaneous restructurings of multiple risk averse sovereign debtors negotiating with common risk averse creditors. They model a one-round bargaining game between multiple sovereign debtors and the creditors. An outside option of the creditors negotiating with one sovereign varies endogenously through payment returns on the other sovereign’s debt, in particular whether the other sovereign is paying or defaulting/negotiating with the creditors. In contrast, our model assumes a multi-round bargaining game between a “single” sovereign debtor and the risk averse creditor and an outside option of the creditor, which is the utility value associated with expected recovery rates in the future periods. Our modeling approach is similar to observed stylized facts of longer duration of restructurings when creditors are experiencing high GDP growth.

\textsuperscript{7}Political factor could potentially be an additional driver of delays in negotiations (ongoing work by Asonuma et al. 2016). More broadly, see also Amador (2012), Chatterjee and Eyigungor (2017), Cuadra and Sapiria (2008), Hatchondo and Martinez (2009b) and Hatchondo et al. (2009) for sovereign debt and political uncertainty.

\textsuperscript{8}See also Broner et al. (2013), Arellano and Bai (2014), Pouzo and Presno (2016), Gilchrist et al. (2014), Gu (2016), Tourre (2017), and Asonuma (2016b).

2 Dataset, Stylized Facts and Empirical Analysis

2.1 New Dataset on Creditor Committees at Sovereign Debt Restructurings

• Stylized fact 1: Creditor committees are formed in almost 75 percent of sovereign debt restructurings.

A restructuring episode is triggered by a default on debt payments or the announcement of a debt restructuring.\(^\text{10}\) The debtor embarks on some forms of negotiation with its creditors—often creditor committees—either bilaterally or with the assistance of advisors. The negotiation can take months or even years and both parties review the debtor’s macroeconomic situation, proposed adjustments, and financing. The creditors assess the debtor’s capacity of repayment over the medium term and evaluate their expected recovery on defaulted debt depending on their total assets and total return on the overall portfolio. During negotiation, the debtor usually proposes indicative scenarios and the creditors express their views. At the end, the debtor presents a final restructuring proposal, i.e. exchange offer, to the creditors. The creditors then decide to accept or reject the offer.

In this regard, Ecuador’s debt buyback in 2008–09 is a representative episode in which both the creditors’ business cycle and political stance of the government played a critical role in negotiation.\(^\text{11}\) In November 2008, President Correa announced that an upcoming $31 million coupon payment on the 2012 bonds would be skipped. A formal default on the foreign debt was declared in December 2008. In April 2009, Ecuador launched a cash buyback offer to repurchase the two series of defaulted bonds with a base price of 30 cents on the dollar of outstanding principal. The buyback was successfully completed in June 2009. Clearly, Ecuador’s debt buyback took place amidst the global financial crisis and creditors who were suffering losses from the crisis, had little appetite for holding the distressed bonds. Indeed, Ecuador succeeded in a quick settlement with creditors (a duration of 7 months relative to an average of 48 months) despite the post-default restructuring strategy, which resulted in large creditor losses (haircut of 68 percent).\(^\text{12}\)

To explore explicitly the role of foreign creditors in restructurings, we first need to identify whether creditor committees are formed during negotiations and who are the chairmen (co-chairs) of the creditor committees at restructurings. For this purpose, we code new data on the creditor committees and the respective chairmen at private external debt restructurings over 1978–2010.

Our data on the creditor committees comprise mainly four sources: (a) a comprehensive dataset on creditor committees under the Bank Advisory Committee (London Club) process for 1975–95 from Lomax (1986) and Rieffel (2003): (b) comprehensive data on creditor committees \(^{10}\)See Das et al. (2012) for explanations on the processes of debt restructurings and Asonuma et al. (2017a, 2017b) for cases of Belize and Grenada on communication between the debtors and the creditor committees.

\(^{11}\)See Buchheit and Gulati (2009) and Porzecanski (2010) for discussion on the creditors’ business cycle and Levy-Yeyati (2011) for the government choice of unwillingness to pay.

\(^{12}\)See Asonuma and Trebesch (2016) for classification of preemptive and post-default restructurings.

We newly find that formal creditor committees are formed during negotiations in 131 debt restructuring episodes (73 percent of total 179 episodes) over 1978–2010. Among these cases, we identify 121 cases (68 percent of total cases) with chairmen (or co-chairs) of the creditor committees. An additional aspect of evidence emerges from Table 1; US banks have served as chairmen of the creditor committees for 60 restructurings, almost a half of restructurings with identified committee chairmen. European banks have covered 46 restructurings, equivalent to a third of episodes with identified chairmen. Among them, German, UK and French banks account for 16, 14 and 12 cases, respectively. Appendix A reports the creditor committees and respective chairs for 18 selective restructuring cases.

Table 1: Creditor Committees and the Respective Chairmen at Sovereign Debt Restructurings, 1978–2010

<table>
<thead>
<tr>
<th>Restructuring with the creditor committees</th>
<th>Observation</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restructuring with identified chairmen of the creditor committees</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td><strong>US banks</strong></td>
<td>60</td>
<td>49%</td>
</tr>
<tr>
<td><strong>European banks</strong></td>
<td>46</td>
<td>38%</td>
</tr>
<tr>
<td><strong>German banks</strong></td>
<td>16</td>
<td>13%</td>
</tr>
<tr>
<td>UK banks</td>
<td>14</td>
<td>11%</td>
</tr>
<tr>
<td>French banks</td>
<td>12</td>
<td>10%</td>
</tr>
<tr>
<td>Swiss banks</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Dutch banks</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Canadian banks</td>
<td>8</td>
<td>6%</td>
</tr>
<tr>
<td>Japanese banks</td>
<td>4</td>
<td>4%</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Restructuring without identified chairmen</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Restructuring without committees</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>179</td>
<td></td>
</tr>
</tbody>
</table>

13See also Buchheit (2009), Diaz-Cassou et al. (2008), and Asonuma et al. (2017a, 2017b).
2.2 New Stylized Facts on Sovereign Debt Restructurings

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

- **Stylized fact 3:** Haircuts are smaller when foreign creditors have high income.

- **Stylized fact 4:** Face-value reductions are smaller when foreign creditors have high income.

Next we shed light on the creditors’ business cycle during restructurings. Our empirical analysis uses mainly two sets of data. One of them is an existing dataset on duration, haircuts and face-value reductions for 179 private, external debt restructurings over 1978–2010 from Cruces and Trebesch (2013) and Asonuma and Trebesch (2016). As defined in Sturzenegger and Zettelmeyer (2006, 2008), the haircut is the market value of the new instruments, plus any cash payments received, to the net present value of the remaining contractual payments on the old instruments (inclusive of any principal or interest arrears) using the yield of the new instrument. In contrast, as commonly used in financial markets, the face-value (nominal) reduction is a difference in the face value between new instruments and remaining old instruments at the exchange. Asonuma and Trebesch (2016) define the duration of restructurings as the number of months from the start of distress (default or announcement of a restructuring) until the completion of the debt restructuring process (debt exchange).

The other is a newly-constructed dataset on creditors’ GDP growth rates—built on both an assumption that the committee chair is the sovereign’ largest creditor supported by Lomax (1986) and Rieffel (2003), and aforementioned stylized fact 1—and risk aversion indicators at a monthly frequency during debt restructurings. More specifically, the dataset comprises (i) US GDP growth rates from the Bureau of Economic Analysis (US), (ii) German GDP growth rates from the Federal Statistical Office (Germany), (iii) Gilchrist and Zakrajsek’s (GZ hereafter 2012) excess bond premium for US financial firms, and (iv) German term premium—a difference

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15 In contrast, financial market participants use haircut measures which compare the market value of the new debt and cash received to the sum of outstanding face value of the old debt and past due interest.

16 Lomax (1983) reports that banks which had the most substantial exposure were more prominent on the steering committees, i.e. Bank Advisory Committees (BACs) equivalently serving chairs of committees. Similarly, Lomax (2003) indicates that sovereign debtors which approached the BACs for the first time were advised to approach the bank that was the sovereign’s largest creditor and their choice of a bank to chair the committee at second time or more was the same one that chaired the last negotiation.
between 1-year and 10-year Treasury bond yields—from the Bundesbank.\footnote{Gilchrist and Zakrjasek (2012)}\footnote{For the euro zone, the credit risk indicator from Gilchrist and Mojon (2016) covers only the period 1999–2013. This substantially reduces our sample of restructurings to about 20 episodes, one-tenth of the original sample. Instead, to preserve our large sample coverage, we use term premium for German Treasury bonds.} We complement our benchmark series with GDP deviation from the trend and growth rate of bank assets in Appendix B.2. Table 2 reports the duration of restructurings, haircuts, face-value reductions, and creditors’ GDP growth rates and risk aversion which are averaged over the duration of the restructurings.

Table 2: Duration, Haircuts, Face-value Reductions, Creditors’ GDP Growth Rates and Risk Aversion for Restructurings in 1978–2010

<table>
<thead>
<tr>
<th></th>
<th>Observation</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev.</th>
<th>Average 1978–2010$^{1/}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of restructurings</strong> (# of months)</td>
<td></td>
<td>179</td>
<td>39.6</td>
<td>18.7</td>
<td>49.4</td>
</tr>
<tr>
<td><strong>Haircuts (%)</strong></td>
<td></td>
<td>178</td>
<td>36.7</td>
<td>31.7</td>
<td>27.2</td>
</tr>
<tr>
<td><strong>Face-value reductions (%)</strong></td>
<td></td>
<td>178</td>
<td>16.5</td>
<td>0.0</td>
<td>30.3</td>
</tr>
<tr>
<td><strong>Creditors’ GDP growth rate, average$^{1/}$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US GDP growth rate, average (%)</td>
<td></td>
<td>177</td>
<td>3.4</td>
<td>3.4</td>
<td>1.8</td>
</tr>
<tr>
<td>German GDP growth rate, average (%)</td>
<td></td>
<td>177</td>
<td>2.1</td>
<td>2.2</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Creditors’ risk aversion, average$^{2/}$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US excess bond premium (GZ), average (%)</td>
<td></td>
<td>104</td>
<td>0.10</td>
<td>0.95</td>
<td>0.31</td>
</tr>
<tr>
<td>German term premium, average (%)</td>
<td></td>
<td>177</td>
<td>1.19</td>
<td>1.43</td>
<td>0.96</td>
</tr>
</tbody>
</table>

$^{1/}$ Monthly average over the duration of restructurings. We transform quarterly GDP series for both the US and Germany into series at a monthly frequency given a lack of comprehensive monthly GDP series covering the whole sample period.

$^{2/}$ Monthly average over the duration of restructurings.


Asonuma and Trebesch (2016) find preemptive exchanges—negotiations take place prior to a payment default—account for 38% of all restructurings (68 cases) over 1978–2010, while post-default restructurings—the government defaults first and renegotiates its debt later—62% (111 cases). Focusing on post-default episodes, it is apparent in Figure 1 that restructurings are protracted when creditors’ income is high.\footnote{The Chicago Board Options Exchange Market Volatility Index (VIX), which is a key measure of market expectations of near-term volatility conveyed by S&P 500 stock index option prices. Due to limited coverage of this index (starting only from January 1993), our sample of restructuring episodes is drastically reduced if we use the VIX indicator. Nevertheless, we obtain similar cross-section regression results.} This is clearly the case for both average US and German GDP growth rates during restructurings as shown in panel (i) and (ii). Regression lines highlighted in red correspond to the estimated lines from regression results reported in Table 3 below. Creditors are willing to avoid a quick resolution and opt to postpone the settlement

\footnote{In addition, when the creditors’ income is high, they are less willing to sell defaulted or distressed bonds in the secondary markets and instead willing to hold anticipating high recovery rates at the exchange.}
when they have high income during renegotiations.

In a similar vein, haircuts are smaller when creditors’ income is high as presented in Figure 2. GDP growth rates for the US and Germany at the end of restructurings are negatively associated with haircuts (panel i and ii). The vertical axis indicates fractions of haircuts that are not explained by a partial regression including all explanatory variables other than creditors’ GDP growth rates. We also find a similar pattern for face-value reductions: face-value reductions are smaller when creditors’ income is high, as reported in Figure A1 in Appendix B.1.

With our combined sample of 111 post-default episodes, we apply a cross-sectional analysis to confirm how the creditors’ income influences duration, haircuts and face-value reductions. We have the following three specifications using our indicators for the creditors’ income ($\text{Creditor\_Income}_i$):

\begin{align*}
\text{Duration}_i &= c + \beta_1 \text{Creditor\_Income}_i + Z_i \gamma' + \epsilon_{i,1} \\
\text{Haircut}_i &= c + \beta_1 \text{Creditor\_Income}_i + Z_i \gamma' + \epsilon_{i,2} \\
\text{FV\_Reduction}_i &= c + \beta_1 \text{Creditor\_Income}_i + Z_i \gamma' + \epsilon_{i,3}
\end{align*}

where $\text{Duration}_i$, $\text{Haircut}_i$, and $\text{FV\_Reduction}_i$ correspond to the duration, haircut and face-value reduction of debt restructuring $i$, respectively. $Z_i$ is a vector of the other explanatory variables. To reflect the influence over the entire duration of restructurings and at the time of settlements, creditors’ income is entered with both average over the duration and level at the end of restructurings in specification (i). Similarly, to capture the effects during non-settlement periods and at the time of settlements, creditors’ income is entered with both average over the non-settlement periods and level at the end of restructurings in specification (ii) and (iii). For the choice of the other control variables, we follow the empirical literature on sovereign defaults and restructurings, particularly Kohlscheen (2009), Trebesch (2013), and Asonuma (2016a). We include: the debtors’ GDP deviation from the trend and growth rate of the GDP trend obtained by applying a Hodrick-Prescott (H-P) filter, external debt-to-GDP ratio; and export-to-debt service ratio at the end of restructurings; these are considered to be key factors in debt renegotiations. To capture the influence of global liquidity and economic outlook, we also include London Interbank Offered Rate (LIBOR) and world GDP growth rate.

On the duration of restructurings, baseline regression results (columns 1 and 2 in Table 3) show that high average creditors’ income during negotiations, measured by the average GDP growth rates for the US and Germany, leads to long duration of restructurings. When creditors have high income, they are willing to postpone the settlement to later periods. On the contrary, high creditors’ income at the time of settlement tends to reduce the duration of restructurings. For the precise impacts of creditors’ income on the timing of settlements, we rely on a panel analysis using time-series of creditors’ GDP growth rates in Section 6. As in the previous work on sovereign debt restructurings (Trebesch 2013), restructurings tend to be protracted when external debt is high and sovereigns have ample liquidity (a high export-to-debt service ratio). The debtors’ GDP deviation from the trend and growth rate of the GDP trend at the end of
Figure 1: Duration and Creditors’ GDP Growth Rates for Restructurings in 1978–2010

(i) US GDP Growth Rate

(ii) German GDP Growth Rate

Sources: Asonuma and Trebesch (2016), Bureau of Economic Analysis (US), Federal Statistical Office (Germany).
Figure 2: Haircuts and Creditors’ GDP Growth Rates for Restructurings in 1978–2010

(i) US GDP Growth Rate/1

Sources: Cruces and Trebesch (2013), Bureau of Economic Analysis (US), and Federal Statistical Office (Germany)

Note: /1 The vertical axis in two panel charts corresponds to estimated residuals from a partial regression over haircuts using explanatory variables except creditors’ growth rates.
restructurings are shown to positively influence the duration of restructurings, but this is possibly due to the fact that restructurings are completed after economic recovery (Bi 2008; Benjamin and Wright 2009). Similarly, lower average risk aversion of creditors—highly correlated with the creditors’ high income—is highly associated with long duration of restructurings (columns 3 and 4 in Table 3).

Next, haircuts are substantially reduced by an increase in creditors’ income at the end of restructurings (US and German GDP growth rates) reported in columns 1 and 2 in Table 4. Creditors receiving high income demand lower haircuts, while accepting higher haircuts when their income is low. In line with empirical findings in the sovereign debt restructuring and crisis literature (Benjamin and Wright 2009), haircuts are high if external debt is high and restructurings are lengthy. The export-to-debt service ratio exhibits a positive sign possibly because sovereigns with high liquidity (a high export-to-debt service ratio) are reluctant to accept low haircuts (high recovery rates) in exchange for regaining market access. Haircuts are lower with per capita GDP in US dollar arguably because countries that are highly developed in the US dollar terms, have a higher capacity to repay debt. GDP deviation from the trend at the end of restructurings enters as a counter-intuitive sign insignificantly, but this is possibly due to the fact that restructurings are completed after economic recovery, as mentioned previously.

Moreover, when creditors are less risk averse, they demand lower haircuts (higher recovery rates), as reported in columns 3 and 4 in Table 4. Robustness analyses using different series (GDP deviation from the trend and growth rate of bank assets) and dealing with heterogeneity across sample observations confirm the validity of our baseline results on both duration and haircuts Appendix B.2.

The same pattern is confirmed for face-value reductions (Table A2 in Appendix B.1): an increase in creditors’ income (US and German GDP growth rates) at the time of settlements remarkably reduces face-value reductions at restructurings. Creditors with high income request higher recovery rates not only in NPV terms but also in nominal terms.
<table>
<thead>
<tr>
<th></th>
<th>US GDP growth rate</th>
<th>German GDP growth rate</th>
<th>US excess bond premium (GZ)</th>
<th>German term premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>coef/se</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
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<tr>
<td>US GDP growth rate, average (%)</td>
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<td>-</td>
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<tr>
<td></td>
<td>(4.22)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>US GDP growth rate, end (%)</td>
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<td>-</td>
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<td></td>
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<td>German GDP growth rate, average (%)</td>
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<td>-</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(4.56)</td>
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<tr>
<td>German GDP growth rate, end (%)</td>
<td>-</td>
<td>-14.47***</td>
<td>-</td>
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<td></td>
<td></td>
<td>(4.23)</td>
<td></td>
<td></td>
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<tr>
<td>US excess bond premium (GZ), average (%)</td>
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<td>-</td>
<td>-46.17*</td>
<td>-</td>
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<td></td>
<td></td>
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<tr>
<td>US excess bond premium (GZ), end (%)</td>
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<td>23.37</td>
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<td>German term premium, average (%)</td>
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<td>-</td>
<td>-19.37**</td>
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<td>(8.51)</td>
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<tr>
<td>German term premium, end (%)</td>
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<tr>
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<tr>
<td>Debtor GDP deviation from trend, end (%)</td>
<td>1.49**</td>
<td>1.39**</td>
<td>1.54**</td>
<td>1.71**</td>
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<tr>
<td></td>
<td>(0.60)</td>
<td>(0.65)</td>
<td>(0.67)</td>
<td>(0.70)</td>
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<td>Debtor growth rate of GDP trend, end (%)</td>
<td>10.19****</td>
<td>13.18****</td>
<td>8.59**</td>
<td>13.93****</td>
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<td>(2.94)</td>
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<td>(3.11)</td>
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<td>0.32***</td>
<td>0.14</td>
<td>0.36***</td>
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<td>(0.09)</td>
<td>(0.10)</td>
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<td>Export/debt service ratio, end (%)</td>
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<td>3.90***</td>
<td>2.49**</td>
<td>2.98***</td>
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<td>LIBOR 12-month, average (%)</td>
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<td>0.48</td>
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<td>(3.28)</td>
<td>(2.91)</td>
<td>(3.55)</td>
<td>(2.72)</td>
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<td>LIBOR 12-month, end (%)</td>
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<td>-14.89***</td>
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<td></td>
<td>(2.59)</td>
<td></td>
<td>(3.19)</td>
<td></td>
</tr>
<tr>
<td>World GDP growth rate, end (%)</td>
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<td>16.72**</td>
<td>10.03</td>
<td>10.52*</td>
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<td>(5.97)</td>
<td>(6.70)</td>
<td>(6.18)</td>
<td>(5.63)</td>
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<td>(34.21)</td>
<td>(44.15)</td>
<td>(40.97)</td>
<td>(41.23)</td>
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Sample 89 89 62 89
Adj-$R^2$ 0.48 0.39 0.43 0.32
Root MSE 43.0 46.8 41.9 49.1

Notes: The table shows results from ordinary least square (OLS) regressions. The dependent variable is duration of restructurings (years). The main explanatory variables are US and German GDP growth rates, US excess bond premium, and German term premium. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, respectively. Standard errors are in parentheses.

1/ Monthly average over the duration of restructurings.
2/ Level at the end of restructurings.
3/ GDP deviation from the trend and growth rate of GDP trend are a percentage deviation from the trend and an annual change in the trend, respectively, obtained by applying a Hodrick-Prescott (H-P) filter to quarterly GDP series.
### Table 4: Regression Results for Haircuts

<table>
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<th>US GDP growth rate</th>
<th>German GDP growth rate</th>
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<th>German term premium</th>
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<td>coef/se</td>
<td>coef/se</td>
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<td>US GDP growth rate, non-settle, average (%)$^2/$</td>
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<td>German GDP growth rate, end (%)$^1/$</td>
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<td>-3.54**</td>
<td>-</td>
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<td></td>
<td>(1.72)</td>
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<td>-</td>
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</tr>
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<td>-</td>
<td>-</td>
<td>4.27</td>
</tr>
<tr>
<td>Duration of restructurings (years)</td>
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<td>0.20***</td>
<td>0.28***</td>
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<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.06)</td>
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<td>GDP deviation from trend, end (%)$^1/$</td>
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<td>0.12</td>
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<td>(0.29)</td>
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<td>Per capita US$ GDP, end (thousand US$)$^1/$</td>
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<td>(1.39)</td>
<td>(1.76)</td>
<td>(1.51)</td>
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<td>External debt, end (% of GDP)$^1/$</td>
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<td>0.16***</td>
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<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.05)</td>
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<td>Export/debt service ratio, end (%)$^1/$</td>
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<td>(1.71)</td>
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<td>-3.52</td>
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<td>US or Germany 1-year yield, end (%)$^1/$</td>
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<td>-</td>
<td>-2.33</td>
<td>7.91**</td>
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<td>(2.61)</td>
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<td>US or Germany 1-year yield, average (%)$^1/$</td>
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<td>-</td>
<td>-9.90***</td>
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<td>(1.71)</td>
<td>(2.97)</td>
<td>(2.42)</td>
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<td>87</td>
<td>60</td>
<td>81</td>
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<td>Adj-$R^2$</td>
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<td>Root MSE</td>
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<td>20.4</td>
<td>18.9</td>
<td>21.0</td>
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</table>

Notes: The table shows results from ordinary least square (OLS) regressions. The dependent variable is haircuts (percent). The main explanatory variables are US and German GDP growth rates, US excess bond premium, and German term premium. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, respectively. Standard errors are in parentheses.
$^1/$ Level at the end of restructurings.
$^2/$ Monthly average over the non-settlement periods (from the start to one month before the settlement).
$^3/$ GDP deviation from the trend and growth rate of GDP trend are a percentage deviation from the trend and an annual change in the trend, respectively, obtained by applying a Hodrick-Prescott (H-P) filter to quarterly GDP series.
$^4/$ Monthly average over the duration of restructuring.
3 Theoretical Model

3.1 Summary of Theoretical Findings

Our theoretical model is built for the purpose of shedding light on the role of the creditor on restructuring processes and outcomes. In particular, our model of sovereign debt embeds post-default multi-round renegotiations with a risk averse sovereign debtor and a risk averse creditor and generates the aforementioned stylized facts. To account for different economic situations of sovereign debtors and creditors, we take a two-step theoretical approach. First, we use a conventional small open economy model—aligned with Aguiar et al. (2016) and Lizarazo (2013)—as benchmark and derive main qualitative results in Section 3, 4, and 5. Then, we incorporate each of the specific assumptions used in previous studies (Arellano et al. 2017; Borri and Verdelhan 2011) in our framework and show robustness of our model in Appendix C.

The model provides main implications on the role of the risk averse creditor on both processes and outcomes of restructurings: high creditor’s income results in both longer delays in renegotiations and smaller haircuts. Our model’s key novelty is that the creditor’s state-dependent consumption-smoothing motive through recovered debt payments influences his decisions during renegotiations. When the creditor has high income, the creditor is less eager to recoup losses on defaulted debt for his consumption-smoothing motive (i.e. low marginal utility of consumption from recovered debt payments) in the current round of negotiations. Moreover, the outside option for the creditor, defined as the utility value associated with the expected recovery rates in the future period, remains high since his high income is anticipated to persist. As a result, the creditor only requests recovery rates in the current round which are high enough to be comparable to the high expected recovery rates in the next round. This makes it difficult to reach an agreement with the debtor, who suffers the costs of default in the current period resulting in delays. Otherwise, the sovereign with recovered repayment capacity—in line with Benjamin and Wright (2009) and Bi (2008)—has no option but to accept high recovery rates (small haircuts) if it prefers to settle the deal in the current period hoping to avoid further output costs and financial exclusion.

3.2 General Points

Both the sovereign debtor and the creditor are assumed to be risk averse. Their preferences are shown by following utility functions:

\[ E_0 \sum_{t=0}^{\infty} \beta^t u(c_t), \quad E_0 \sum_{t=0}^{\infty} (\beta^*)^t v(c_t^*) \]

where \( 0 < \beta < 1 \) is a discount factor of the sovereign, and \( 0 < \beta^* < 1 \) is a discount factor of the creditor. \( c_t \) and \( c_t^* \) denote consumptions of two parties in period \( t \), \( u() \) and and \( v() \) are one-period utility functions, which are continuous, strictly increasing and strictly concave, and satisfy the Inada conditions. The discount factor of the sovereign reflects both pure time preference
and probability that the current government will remain in power in the next period (myopia associated with political uncertainty), whereas the discount factor of the creditor captures only pure time preference. Our assumption of the risk averse creditor is similar to the investor behavior in emerging financial markets avoiding sovereign default risk excessively.\textsuperscript{21}

In each period, the sovereign has a credit record \( h_t \in [0,1] \) which indicates whether the sovereign has maintained access to the market \( (h_t = 0) \) or whether it has lost market access due to defaults \( (h_t = 1) \). In addition, both the sovereign and the creditor receive stochastic endowment streams \( y^h_t \) and \( y^f_t \). We denote \( y_t \), a column vector of two income processes: \( y_t = [y^h_t, y^f_t] \). It is stochastic, drawn from a compact set \( Y = [y^h_{\min}, y^h_{\max}] \times [y^f_{\min}, y^f_{\max}] \subseteq \mathbb{R}^2_+ \). \( \mu(y_{t+1} | y_t) \) is probability distribution of a vector of shocks \( y_{t+1} \) conditional on previous realization \( y_t \). These goods endowed in two countries are identical and tradable. The sovereign has current account deficit (surplus)—its consumption is larger (less) than endowment—when it repays debt \( (h_t = 0) \) and issues new debt (has new savings). On the contrary, when it defaults its debt and loses market access \( (h_t = 1) \), it has the balanced current account and its consumption is equal to endowment.

Both sovereign bond and risk-free bond markets are incomplete.\textsuperscript{22} On the one hand, the sovereign can borrow and lend only via one-period, zero-coupon sovereign bonds.\textsuperscript{23} \( b_{t+1} \) denotes the amount of bonds to be repaid in the next period whose set is shown by \( B = [b_{\min}, b_{\max}] \subset \mathbb{R} \) where \( b_{\min} \leq 0 \leq b_{\max} \). We set the lower bound for the sovereign’s bond holding at \( b_{\min} > -y^h_{\max}/\tau^* \) which is the largest debt that the sovereign could repay. The upper bound \( b_{\max} \) is the high level of assets that the sovereign may accumulate.\textsuperscript{24} On the other hand, the risk averse creditor can smooth his consumption through borrowing and lending via both one-period, zero-coupon sovereign bonds and risk-free bonds. \( b^*_t \) and \( b^*_f_t \) express amounts of sovereign bonds and risk-free bonds to be repaid in the next period whose sets are shown by \( B^* = [b^*_min, b^*_max] \subset \mathbb{R} \) and \( B^*f = [b^*_f_{\min}, b^*_f_{\max}] \subset \mathbb{R} \) where \( b^*_min \leq 0 \leq b^*_max \) and \( b^*_f_{\min} \leq 0 \leq b^*_f_{\max} \).

All information on both income processes and bond issuance of two parties, and the sovereign’s credit record is perfect and symmetric. We assume \( q(b_{t+1}, b^*_f_{t+1}, 0, y_t) \) and \( q^f(b_{t+1}, b^*_f_{t+1}, h_t, y_t) \)

\textsuperscript{21}Lizarazo (2013) explains that assumption of risk averse creditors seems to be justified by characteristics of the investors in emerging financial markets. These investors are both individual and institutional investors such as banks, mutual funds, hedge funds, pension funds, and insurance companies. For individual investors, it is straightforward to assume that these agents are risk averse. For institutional investors, risk aversion may follow from two sources: regulations over the composition of their portfolio and the characteristics of the institutions’ management.

\textsuperscript{22}Following a conventional sovereign debt model, we do not consider a credit default swap (CDS) contract which provides insurance against default. See Salomao (2014) for the role of the CDS market in sovereign debt.

\textsuperscript{23}Our model of debt restructuring with one-period bonds follows Benjamin and Wright (2009), Bi (2008), Yue (2010) and Asonuma and Trebesch (2016). Relaxing the model to include long-duration bonds does not provide additional insights but increases technical difficulty to track the model. This is because old bonds are exchanged with new bonds with the same maturity and smaller outstanding (debt stock), i.e. no change in maturity structure of bonds due to an exchange (Hatchondo et al. 2013). See Hatchondo and Martinez (2009a), Arellano and Ramanarayanan (2012), Chatterjee and Eyingungor (2012, 2015), and Hatchondo, et al. (2015) for long-duration bond models without debt restructurings.

\textsuperscript{24}\( b_{\max} \) exists when the interest rates on the sovereign’s savings are sufficiently low compared to the discount factor, which is satisfied as \( (1 + \tau^*)\beta < 1 \).
to be prices of sovereign bonds and risk-free bonds with the sovereign’s asset position $b_{t+1}$, the creditors’ holding of risk-free bonds $b^s_{t+1}$, the sovereign’s credit record $h_t$, and a vector of income shocks $y_t$. Both bond prices are determined in equilibrium.

We assume that the creditor always commits to repay its debt. However, the sovereign is free to decide whether to repay its debt or to default. If the sovereign chooses to repay its debt, it will preserve access to the international capital market in the next period. On the contrary, if it chooses not to pay its debt, it is then subject to both exclusion from the international capital market and direct output costs.\(^\text{25,26}\) When a default occurs, the sovereign and the creditor negotiate a reduction of unpaid debt via a multi-round bargaining. At the renegotiation, one party who is randomly selected with exogenous and constant probability chooses whether to propose an offer with haircuts (recovery rates) or to pass its option. The other party decides whether to accept or to reject the proposal. If the offer with haircuts is proposed and accepted, then the sovereign regains access to the international capital market in the next period ($h_{t+1} = 0$) and the creditor receives recovered debt payments. Otherwise, both parties continue the negotiation over debt in arrears in the next period.

In order to avoid permanent exclusion from the international capital market and direct costs, the sovereign has an incentive to negotiate over haircuts. Similarly, the creditor is also willing to negotiate over the reduction of unpaid debt because he prefers to maximize the recovered debt payments.

### 3.3 Timing of the Model

Figure 3 summarizes the timing of decisions within each period.

1. The sovereign starts the current period with initial debt ($b_t$) and the creditor’s risk-free assets ($b^s_t$). We are in node (A).
2. A vector of income shocks ($y_t$) is realized. The sovereign decides whether to pay its debt or to default after observing its income.
3. (a) In node (B) (payment node), if payment is chosen, we move to the upper branch of the tree. The sovereign maintains market access ($h_{t+1} = 0$) and chooses its consumption ($c_t$) and the level of debt in the next period ($b_{t+1}$). Default risk is determined and the creditor also chooses his consumption ($c^*_t$) and the levels of sovereign bonds ($b^s_{t+1}$)

\(^\text{25}\)There are several estimates for output loss at the time of defaults and restructurings. Sturzenegger (2004) estimates output loss as around 2% of GDP. Asonuma and Trebesch (2016) support his finding by reporting output costs of 2.4% of GDP for post-default restructuring episodes and also find lower costs for preemptive cases. On the contrary, De Paoli, Hoggarth, and Saporta (2006) suggest that the output loss in the wake of sovereign default appears to be very large—around 7% a year on the median measure—as well as long lasting. Moreover, Levy-Yeyati and Panizza (2011) argue that default episodes mark the beginning of the economic recovery and that the negative effects of a default on output are likely to be driven by the anticipation of default prior to default event.

\(^\text{26}\)Mendoza and Yue (2012) provide micro-foundation of this conventional assumption that exclusion from credit markets leads to losses in production efficiency which result in output costs due to a lack of imported inputs and labor reallocation away from final goods production.
and risk-free bonds \((b_{t+1}^f)\) in the next period. The bond prices are determined in the 
markets. We proceed to node (A) in the next period.

(b) In node (C) (default node), if default is chosen, we move on to the lower branch of the 
tree. The sovereign suffers output costs \((\lambda_d y_t^h)\) and loses access to the international 
capital market \((h_{t+1} = 1)\). The creditor chooses his consumption \((c_t^c)\) and the level 
of risk-free bonds in the next period \((b_{t+1}^f)\). The price of bonds is determined in the 
market.

4. A vector of income shocks \((y_{t+1})\) is realized.

5. In node (D) (default node), with constant probability, the sovereign has an opportunity 
to propose an offer to its creditor. Otherwise, the creditor does. The proposer decides 
whether to propose an offer to the other party.

6. (a) In node (E) (propose node), if the proposer chooses to propose, the other party 
decides whether to accept or to reject the offer. If the other party accepts the offer, 
the sovereign regains market access in the next period \((b_{t+2} = 0)\). We move back to 
ode (A) in the next period. On the contrary, if the other party rejects the offer, the 
sovereign remains in financial autarky \((h_{t+2} = 1)\). We move back to node (D) in the 
next period.

(b) In node (F) (pass node) if the proposer opts to wait, the sovereign remains in financial 
autarky \((h_{t+2} = 1)\). We move back to node (D) in the next period.
4 Recursive Equilibrium

4.1 Sovereign’s problem

This section defines the stationary recursive equilibrium of our model. The sovereign maximizes its expected lifetime utility and its value function is denoted by \( V(b_t, b_t^{*f}, h_t, y_t) \).

First, we start with its problem when the sovereign has a good credit record \((h_t = 0)\).

For \( b_t \leq 0 \) \((h_t = 0)\) where the sovereign has debt, it decides whether to repay or to default after observing its income. If the sovereign decides to pay its debt, it chooses its consumption and the level of debt in the next period. In contrast, if it decides to default, it will be excluded from the international capital market and its credit record deteriorates to \( h_{t+1} = 1 \), with debt in arrears \( b_{t+1} = (1 + r_t^*)b_t \) in the next period where \( r_t^* \) is the risk-free interest rate. Given an option to default,

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

where \( V^R(b_t, b_t^{*f}, 0, y_t) \) is its value associated with paying debt:

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

\( s.t. \ c_t + q(b_{t+1}, b_{t+1}^{*f}, 0, y_t)b_{t+1} = y_t^b + b_t \) (2)

and \( V^D(b_t, b_t^{*f}, 0, y_t) \) is its value associated with default:

\[
V^D(b_t, b_t^{*f}, 0, y_t) = u((1 - \lambda_d)y_t^b) + \beta \int_Y V^D((1 + r_t^*)b_t, b_{t+1}^{*f}, 1, y_{t+1})d\mu(y_{t+1}|y_t)
\]

Next comes the sovereign’s problem with a bad credit record with unpaid debt arrears \((h_t = 1 \& b_t < 0)\). The country is currently excluded from the international capital market, suffering output cost and may settle on recovery rates through renegotiation with the creditor. The renegotiation process is a dynamic game that may last longer than one period. In equilibrium, this bargaining game pins down both recovery rates and length of restructurings (financial autarky). Its value of staying in financial autarky and continuing renegotiation, \( V^D(b_t, b_t^{*f}, 1, y_t) \) is an expected payoff that the debtor obtains from the bargaining which starts in period \( t \):

\[
V^D(b_t, b_t^{*f}, 1, y_t) = \Gamma(b_t, b_t^{*f}, y_t)
\]

The sovereign’s default policy can be characterized by its default set \( D(b_t, b_t^{*f}, 0) \subset Y \). It is a set of income vectors \( y_t \) at which default is optimal:

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

\(^{27}\)The case where the sovereign has strictly positive savings \((b > 0)\) is excluded. This is because the creditor optimally chooses not to borrow \((b = 0)\) from the sovereign when he can purchase risk-free bonds \((b^{*f})\) and issue debt to the sovereign with the interest rate on debt higher than that of the risk-free bonds simultaneously.
4.2 Foreign creditor’s problem

We also start from the creditor’s problem under the sovereign’s good credit record ($h_t = 0$). For $b_t \leq 0$ ($h_t = 0$) where the sovereign (the creditor) has debt (savings), the creditor optimally chooses his consumption ($c_t^*$), sovereign bonds ($b_{t+1} < 0$), and risk-free bonds ($b_t^{sf}$):

$$V^*(b_t, b_t^{sf}, 0, y_t) = 1_{\text{Non-Default}}V^{*R}(b_t, b_t^{sf}, 0, y_t) + (1 - 1_{\text{Non-Default}})V^{*D}(b_t, b_t^{sf}, 0, y_t)$$  \hfill (6)

where $1_{\text{Non-Default}}$ is an indicator function showing 1 if the sovereign does not default and 0 otherwise. $V^{*R}(b_t, b_t^{sf}, 0, y_t)$ is the value of the creditor when the sovereign does not default and $V^{*D}(b_t, b_t^{sf}, 0, y_t)$ is the value of the creditor when the sovereign opts to default:

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

s.t. $c_t^* + q(b_{t+1}, b_{t+1}^{sf}, 0, y_t)b_{t+1}^{sf} + q^f(b_{t+1}, b_{t+1}^{sf}, 0, y_t)b_{t+1}^{sf} = y_t + b_t^{sf}$  \hfill (7)

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

s.t. $c_t^* + q^f(b_{t+1}, b_{t+1}^{sf}, 0, y_t)b_{t+1}^{sf} = y_t + b_t^{sf}$  \hfill (8)

Given the sovereign’s expected default choice and expected recovery rates, we obtain the following bond price functions:

$$q(b_{t+1}, b_{t+1}^{sf}, 0, y_t) = \int \beta^* \frac{v'(c_{t+1}^*)}{v'(c_t^*)} \left[ 1_{\text{Non-Default}} + (1 - 1_{\text{Non-Default}})\gamma(b_{t+1}, b_{t+1}^{sf}, y_{t+1}) \right]d\mu(y_{t+1}|y_t)$$  \hfill (9)

$$q^f(b_{t+1}, b_{t+1}^{sf}, 0, y_t) = \int \beta^* \frac{v'(c_{t+1}^*)}{v'(c_t^*)} d\mu(y_{t+1}|y_t)$$  \hfill (10)

where $\gamma(b_{t+1}, b_{t+1}^{sf}, y_{t+1})$ is the expected recovery rate at time $t+1$ conditional on default.

For $h_t = 1$ where the sovereign has a bad credit record, the creditor’s value function is

$$V^{*D}(b_t, b_t^{sf}, 1, y_t) = \Gamma^*(b_t, b_t^{sf}, y_t)$$  \hfill (11)

Price function for the risk-free bonds remains identical:

$$q^f(b_{t+1}, b_{t+1}^{sf}, 1, y_t) = \int \beta^* \frac{v'(c_{t+1}^*)}{v'(c_t^*)} d\mu(y_{t+1}|y_t)$$  \hfill (10')
4.3 Debt Renegotiation

The debt renegotiation takes the form of a two-player stochastic bargaining game with complete information as in Merlo and Wilson (1995). It is a multi-round stochastic bargaining game in that both the endowment processes of two parties and the identity of the proposer are stochastic. To account for the creditor’s time-variant negotiation stance during debt restructurings in the real world, our model newly assumes the risk-averse creditor whose consumption-smoothing motive is state-dependent. This assumption differentiates our paper from previous studies on a multi-round bargaining game (Benjamin and Wright 2009; Bi 2008); in their models, creditors who are risk-neutral are totally independent on when the restructuring is settled and care only recovery rates in present value terms. Thus, creditors are willing to wait for recovery of the debtor’s repayment capacity. In contrast, in our framework, the creditor’s income process influences not only outcomes, but also equally importantly timing of the settlement: when the creditor’s income is high, he is reluctant to settle the deal and to recoup losses in the current period and instead requests higher recovery rates anticipating that the settlement would be postponed and he would receive higher expected recovery rates in the future period. This results in delays in negotiations since the debtor who suffers costs of defaults cannot meet the requested recovery rates, but postpones the settlement.

In every round, a state is realized and the proposer is randomly selected. For simplicity, we assume that each player has a constant probability of being selected as the proposer in each round of the negotiation. That is, the identity of the proposer is independent of both parties’ income processes. Let \( \phi \) denote the probability that the borrower, B, can propose and \( 1 - \phi \) is the probability that the lender, L, can propose. The probability which one of the players is selected as the proposer is a parsimonious way to reflect the bargaining power obtained through one’s ability to enjoy the first-mover advantage. The proposer may either propose recovery rates or pass. If he proposes, then the other party chooses to accept or to reject the proposal. If the proposal is accepted, then the sovereign debtor immediately repays its reduced debt arrears, and then resumes access to the international capital market in the next period \((h_{t+1} = 0)\) with no outstanding debt. If the proposal is rejected, both parties repeat the bargaining game in the next period. If the proposer opts to pass, both parties proceed to the next period and continue the bargaining game.

First, we define some basic concepts of the game. A stochastic bargaining game may be denoted by \((C, \beta, \beta^*)\), where for each vector of income processes \( y \in Y \), \( C(y) \) is the set of feasible utility vectors that may be agreed upon in that state. \( \beta \) and \( \beta^* \) are the discount factors.

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28Our modeling approach of renegotiation is aligned with theoretical studies on delays and inefficiencies in bargaining e.g. Merlo and Wilson (1995, 1997), Kennan and Wilson (1993), Yildiz (2004), and Ortner (2013). While there could be other approaches of modeling a bargaining game between two parties, we follow the conventional bargaining game in Merlo and Wilson (1995) for their simplicity and tractability.

29This is because debt arrears are accumulated with the risk-free interest rate during restructuring and the creditors’ discount rate is an inverse of the risk-free interest rate.

30We assume that the proposer makes an offer that the respondent accepts when the value of proposing is higher or equal to the value of passing, and chooses to pass otherwise. This assumption can get rid of trivial source of multiplicity. See Merlo and Wilson (1995) and Ortner (2013) for the same treatment.
A payoff function is an element $\Delta(y) \in C(y)$, where $\Delta_i(y)$ is the utility to player $i$, $i = B, L$.

As in Merlo and Wilson (1995), we focus on a game with stationary strategies, that is, the players’ actions depend only on the current state $(b_t, b_t^{*f}, h_t, y_t)$ and the current offer. In equilibrium, the proposer’s strategy is to propose when the other party would accept for sure and to pass otherwise. In contrast, the other player’s strategy is to accept when the proposal is made and to reject otherwise. Therefore, we can denote the proposer $i$’s and the other party $j$’s equilibrium strategies as follows: (a) $\theta_i(b_t, b_t^{*f}, h_t, y_t) = 1$ (propose) when the proposer $i$ proposes and $\theta_j(b_t, b_t^{*f}, h_t, y_t) = 1$ (accept) when the other party $j$ accepts the offer, or (b) $\theta_i(b_t, b_t^{*f}, h_t, y_t) = 0$ (pass) when the proposer $i$ passes and $\theta_j(b_t, b_t^{*f}, h_t, y_t) = 0$ (reject) when the other party $j$ rejects the offer.$^{32}$

A stationary subgame perfect (SP) equilibrium is defined as the players’ equilibrium stationary strategies $\theta$ and $\theta^*$, and the payoff functions $\Gamma$ and $\Gamma^*$, associated with these strategies for player B and L. The expected payoff for the borrower B and lender L in period $t$, are shown as:

$$\Gamma(b_t, b_t^{*f}, y_t) = \phi \Gamma^B(b_t, b_t^{*f}, y_t) + (1 - \phi) \Gamma^L(b_t, b_t^{*f}, y_t)$$

$$\Gamma^*(b_t, b_t^{*f}, y_t) = \phi \Gamma^{*B}(b_t, b_t^{*f}, y_t) + (1 - \phi) \Gamma^{*L}(b_t, b_t^{*f}, y_t)$$

Here the superscript denotes the identity of the proposer: $\Gamma^B$ ($\Gamma^{*B}$) represents the borrower’s (lender’s) payoff when the borrower is the proposer and $\Gamma^L$ ($\Gamma^{*L}$) refers to the borrower’s (lender’s) payoff when the lender is the proposer.

First, we start from the case when the borrower B is the proposer. We denote the proposed debt recovery rates as $\delta^B_t$, the borrower’s values of proposing and passing as $V^{PRO}$ and $V^{PASS}$, and the creditor’s values of accepting offer and rejecting as $V^{*ACT}$ and $V^{*REJ}$, respectively. When the borrower B proposes and the proposal is accepted, the sovereign immediately pays agreed debt repayments $-\delta^B_t b_t$ and resumes access to the international capital market in the next period with no outstanding debt as in Bi (2008). Appendix C relaxes the assumption of full recovered debt payments at the settlement, thus allowing for net issuance as in Benjamin and Wright (2009) and shows that our main qualitative results remain robust.

$$V^{PRO}(b_t, b_t^{*f}, y_t) = u((1 - \lambda_d) y_t^h + \delta^B_t b_t) + \beta \int_Y V(0, b_{t+1}^{*f}, 0, y_{t+1}) d\mu(y_{t+1} | y_t)$$

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

$^{31}$Merlo and Wilson (1995) assume that the players have the same discount factor. But they also mention that “there is no real restriction implied by the assumption that players discount utility at a common constant rate. So long as the discounted size of the cake converges uniformly to 0, · · · player-dependent discount factors can always be represented by a discount case process with a common fixed discount factor”. So in our model we assume that the borrower and the lender have different discount factors.

$^{32}$Benjamin and Wright (2009) theoretically prove both existence and uniqueness of the equilibrium in the multi-round bargaining game over defaulted debt.
respectively. When the lender $L$ proposes, $\delta t = y_t - \delta^L t b_t + b_t^{sf}$  

(15)

When the borrower $B$ passes, both parties proceed to the next period with accumulated arrears $(1 + r_t^b)b_t$.

$$V^{PASS}(t, b_t^{sf}, y_t) = u((1 - \lambda d)y_t) + \beta \int_Y \Gamma((1 + r_t^b)b_t, b_t^{sf}, y_t + 1) d\mu(y_{t+1} | y_t)$$  

(16)

$$V^{*REJ}(t, b_t^{sf}, y_t) = \max c_t^* + q^f b_t^{sf}, y_t) b_t^{sf} = y_t^f + b_t^{sf}$$  

(17)

In equilibrium, the agreed recovery rates $\delta^B_t$ satisfy the following:\(^{33}\)

$$\delta^B_t = \arg\max V^{PRO}(t, b_t^{sf}, y_t)$$

$$V^{PRO}(t, b_t^{sf}, y_t) \geq V^{PASS}(t, b_t^{sf}, y_t)$$

$$V^{*ACT}(t, b_t^{sf}, y_t) \geq V^{*REJ}(t, b_t^{sf}, y_t)$$  

(18)

If both parties reach an agreement, two parties’ payoffs are as follows:

$$\Gamma^B(t, b_t^{sf}, y_t) = V^{PRO}(t, b_t^{sf}, y_t)$$  

(19)

$$\Gamma^B(t, b_t^{sf}, y_t) = V^{*ACT}(t, b_t^{sf}, y_t)$$  

(20)

Otherwise,

$$\Gamma^B(t, b_t^{sf}, y_t) = V^{PASS}(t, b_t^{sf}, y_t)$$  

(19')

$$\Gamma^B(t, b_t^{sf}, y_t) = V^{*REJ}(t, b_t^{sf}, y_t)$$  

(20')

The renegotiation settlement can be characterized by settlement set $R^B(t, b_t^{sf}) \subset Y$, defined as the set of vectors $y_t$ at which both parties agree on the terms.

$$R^B(t, b_t^{sf}) = \left\{ y_t \in Y : V^{PRO}(t, b_t^{sf}, y_t) \geq V^{PASS}(t, b_t^{sf}, y_t) \text{ and } V^{*ACT}(t, b_t^{sf}, y_t) \geq V^{*REJ}(t, b_t^{sf}, y_t) \right\}$$  

(21)

Similarly, when the lender is the proposer, we denote the proposed debt recovery rate as $\delta^L_t$, the borrower’s value as $V^{ACT}$ and $V^{REJ}$, and the lender’s values as $V^{*PRO}$ and $V^{*PASS}$, respectively. When the lender $L$ proposes,

$$V^{*PRO}(t, b_t^{sf}, y_t) = \max c_t^* + q^f b_t^{sf}, y_t) b_t^{sf} = y_t^f - \delta^L_t b_t + b_t^{sf}$$  

(22)

---

\(^{33}\)Off-equilibrium paths are eliminated in equilibrium.
On the contrary, if the sovereign defaults, a market clearing condition for goods is
\[ V^{ACT}(b_t, b_t^*, y_t) = u((1 - \lambda_d)y_t^h + \delta_t^L b_t) + \beta \int_Y V(0, b_{t+1}^*, 0, y_{t+1})d\mu(y_{t+1}|y_t) \] (23)

When the lender passes proposing,
\[ V^{*PRO}(b_t, b_t^*, y_t) = \max_{c_t^*, b_{t+1}^*} v(c_t^*) + \beta^* \int_Y \Gamma^*((1 + r_t^*)b_t, b_{t+1}^*, y_{t+1})d\mu(y_{t+1}|y_t) \]
\[ s.t. \quad c_t^* + q^f(b_{t+1}, b_{t+1}^*, 1, y_t)b_{t+1}^* = y_t^f + b_{t+1}^* \] (24)
\[ V^{REJ}(b_t, b_t^*, y_t) = u((1 - \lambda_d)y_t^h) + \beta \int_Y \Gamma((1 + r_t^*)b_t, b_{t+1}^*, y_{t+1})d\mu(y_{t+1}|y_t) \] (25)

In equilibrium, agreed recovery rates \( \delta_t^L \) satisfy the following:
\[ \delta_t^L = \arg\max V^{*PRO}(b_t, b_t^*, y_t) \]
\[ V^{*PRO}(b_t, b_t^*, y_t) \geq V^{*PASS}(b_t, b_t^*, y_t) \]
\[ V^{ACT}(b_t, b_t^*, y_t) \geq V^{REJ}(b_t, b_t^*, y_t) \] (26)

If both parties reach an agreement, two parties’ payoffs are as follows:
\[ \Gamma^L(b_t, b_t^*, y_t) = V^{*PRO}(b_t, b_t^*, y_t) \] (27)
\[ \Gamma^L(b_t, b_t^*, y_t) = V^{ACT}(b_t, b_t^*, y_t) \] (28)

Otherwise,
\[ \Gamma^L(b_t, b_t^*, y_t) = V^{*PASS}(b_t, b_t^*, y_t) \] (27’)
\[ \Gamma^L(b_t, b_t^*, y_t) = V^{REJ}(b_t, b_t^*, y_t) \] (28’)

The renegotiation settlement can be characterized by settlement set \( R^L(b_t, b_t^*) \subset Y \), defined as the set of vectors \( y_t \) at which both parties agree on the terms.
\[ R^L(b_t, b_t^*) = \left\{ y_t \in Y : V^{*PRO}(b_t, b_t^*, y_t) \geq V^{*PASS}(b_t, b_t^*, y_t) \right\} \] (29)

4.4 Market Clearing Conditions

If the sovereign repays its debt, a market clearing condition for goods is
\[ c_t + c_t^* = y_t^h + y_t^f \] (30)

On the contrary, if the sovereign defaults, a market clearing condition for goods is
\[ c_t = (1 - \lambda_d)y_t^h, \quad c_t^* = y_t^f \] (30’)

24
A market clearing condition for the sovereign bonds is as follows:

$$b_{t+1} + b_{t+1}^r = 0$$  (31)

A market clearing condition for the risk-free bonds specifies that total supply of the risk-free bonds is zero. Appendix C explains that relaxing the zero-supply assumption does not change our main qualitative implications. This is because the creditor continues to have a consumption-smoothing motive due to uncertain income and to invest (at least a fraction of income) in sovereign bonds expecting high returns.

4.5 Equilibrium

A recursive equilibrium is defined as a set of functions for (a) the sovereign’s value function, consumption, asset position, default set, (b) the creditor’s consumption, asset position, (c) the sovereign’s and creditor’s decision functions, payoffs, two sets of recovery rates (depending on who is the proposer), and (d) bond price functions for the sovereign bonds and the risk-free bonds such that

1. the sovereign’s value function, consumption, asset position, and default set satisfy its optimization problem (1)–(5);
2. the creditor’s consumption and asset position satisfy his optimization problem (6)–(11);
3. both parties’ decisions, payoffs and recovery rates solve the multi-round debt renegotiation problem (12)–(29);
4. market clearing conditions for goods and bonds (30)–(31) are satisfied.

In equilibrium, default probability is defined by using the sovereign’s default set:

$$p^D(b_{t+1}, b_{t+1}^r, 0, y_{t+1}) = \int_{D(b_{t+1}, b_{t+1}^r)} d\mu(y_{t+1} | y_t),$$  (32)

Similarly, probability of settlement is defined by using the two settlement sets:

$$p^R(b_{t+1}, b_{t+1}^r, 1, y_t) = \phi \int_{R^B(b_{t+1}, b_{t+1}^r)} d\mu(y_{t+1} | y_t) + (1 - \phi) \int_{R^L(b_{t+1}, b_{t+1}^r)} d\mu(y_{t+1} | y_t),$$  (33)

Expected recovery rates conditional on default choice is shown as:

$$\gamma(b_t, b_t^r, y_t)$$

$$= \int_Y \beta s \frac{v'(c_{t+1})}{v(c_t)} \begin{bmatrix}
\phi \mathbb{1}_{y_{t+1} \in R^B(b_{t+1}, b_{t+1}^r)} d_t^B((1 + r_t^f)b_t, b_{t+1}^r, y_{t+1}) \\
(1 - \phi) \mathbb{1}_{y_{t+1} \in R^L(b_{t+1}, b_{t+1}^r)} d_t^L((1 + r_t^f)b_t, b_{t+1}^r, y_{t+1}) \\
\phi \mathbb{1}_{y_{t+1} \notin R^B(b_{t+1}, b_{t+1}^r)} \gamma((1 + r_t^f)b_t, b_{t+1}^r, y_{t+1}) \\
(1 - \phi) \mathbb{1}_{y_{t+1} \notin R^L(b_{t+1}, b_{t+1}^r)} \gamma((1 + r_t^f)b_t, b_{t+1}^r, y_{t+1})
\end{bmatrix} d\mu(y_{t+1} | y_t)$$  (34)
The risk-free interest rate is defined as
\[ 1 + r^*(b_{t+1}, b_{t+1}^*, h_t, y_t) = \frac{1}{q(b_{t+1}, b_{t+1}^*, h_t, y_t)} \]

The sovereign’s total spread, i.e. the difference between the sovereign’s interest rate and the risk-free rate is defined as
\[ s(b_{t+1}, b_{t+1}^*, 0, y_t) = \frac{1}{q(b_{t+1}, b_{t+1}^*, 0, y_t)} - 1 - r^*(b_{t+1}, b_{t+1}^*, 0, y_t) \]

5 Quantitative Analysis

This section provides the quantitative analysis of model. Our major findings can be summarized as follows. At the steady state distribution, we find that when the creditor’s income is high, (i) recovery rates agreed at the restructuring are higher and (ii) the sovereign is more willing to delay negotiations. Moreover, the sovereign is more willing to default ex-ante given small default costs—due to both low recovered debt payments and quick settlements—when the creditor has low income. Indeed, our model successfully replicates both long delays in renegotiations and a high average debt-to-GDP ratio—key contributions of models with multi-round negotiations.

5.1 Parameters and Functional Forms

All the parameter values and functional forms follow closely those in previous studies on sovereign debt and debt restructurings. The following constant relative risk aversion (CRRA) utility functions are used in numerical simulation:
\[ u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}, \quad v(c_t^*) = \frac{c_t^{*1-\alpha}}{1-\alpha} \]

where \(\sigma\) and \(\alpha\) express degree of risk aversion of the sovereign and the creditor, respectively. We set both \(\sigma\) and \(\alpha\) equal to 2, which is commonly used in real business cycle (RBC) studies for advanced and emerging market countries.\(^{34}\) The creditor’s discount factor is set to \(\beta^* = 0.98\) in line with Lizarazo (2013). Output loss parameter \(\lambda_d\) is assumed to be 2% following Sturzenegger (2004)’s empirical findings and theoretical models featuring symmetric lump-sum output cost of default—for example, Aguiar and Gopinath (2006), Yue (2010), or Bi (2008).

The endowment processes are calibrated to match quarterly seasonally adjusted GDP data from the Ministry of Economy and Production in Argentina (MECON) and the US Bureau of Economic Analysis (BEA) over 1993Q1–2013Q3. The data are detrended using a Hodrick-Prescott filter with a smoothing parameter of 1,600. As in previous studies (Yue 2010; Benjamin

\(^{34}\)See Lizarazo (2013) for the symmetric risk aversion assumption.
and Wright 2009; D’Erasmo 2010), we model the output growth rates of the borrower and the creditor as independent AR(1) processes:

$$\log(g^i_t) = (1 - \rho^i_g) \log(1 + \mu^i_g) + \rho^i_g \log(g^i_{t-1}) + \epsilon^i_{g,t}, \quad \text{for } i = h, f$$

(38)

where growth rate is $g^i_t = \frac{y^i_t}{y^i_{t-1}}$, growth shock $\epsilon^i_{g,t}$ is i.i.d $N(0, \sigma^2)$, and $\log(1 + \mu^i_g)$ is the expected log gross growth rate of endowment. To maintain the stationarity of the model, we assume the average growth rates for the borrower and the creditor are symmetric as in conventional international real business cycle literature: $\mu^h_g = \mu^f_g = \bar{\mu}_g$.35 Through regressions applied separately to two countries, we obtain auto-correlation $\rho^h_g = 0.65$ for Argentina and $\rho^f_g = 0.89$ for the US, average endowment growth rate $\bar{\mu}_g = 0.009$, and standard deviation of endowment growth shock $\sigma^h = 0.054$ for Argentina and $\sigma^f = 0.012$ for the US. We approximate these stochastic processes as two separate discrete Markov chains of equally spaced grids by using the quadrature method in Tauchen (1986). Moreover, Appendix D discusses the equilibrium properties for different models of income processes and confirms robustness of our baseline specifications: (i) average growth rate, (ii) German/advanced economies’ GDP, (iii) shocks on the level of GDP, and (iv) correlated income processes.

Since income shocks affect the level of endowment in a nonstationary model economy, we detrend the model by dividing by the lagged debtor’s endowment level $y^h_{t-1}$. The detrended counterpart of a variable $x_t$ is thus $\tilde{x}_t = x_t / x_{t-1}$. The equilibrium value function, bond price functions, recovery rates, and interest spreads are all evaluated at detrended values. Moreover, the market clearing condition for the sovereign bonds can be re-written as follows:

$$\pi \tilde{b}_{t+1} + (1 - \pi) \tilde{b}^*_{t+1} = 0$$

(31')

where $\tilde{b}_{t+1} = \frac{b_{t+1}}{y^h_t}$, $\tilde{b}^*_{t+1} = \frac{b^*_{t+1}}{y^f_t}$ denote debtor’s assets/debt relative to its GDP, and creditor’s assets/debt relative to his GDP, respectively. $\pi$ is the size of the sovereign debtor relative to the creditor.

Size of the sovereign relative to the creditor is set to 0.025 to reflect the ratio of US-dollar GDP of Argentina to that of the US over 1993–2012 based on the IMF’s World Economic Outlook (WEO) database. Sturzenegger and Zettelmeyer (2006) report that Argentina experienced 6 defaults in 1820–2004. We specify the sovereign’s discount factor $\beta = 0.75$—similar to those in Yue (2010) and D’Erasmo (2010)—and bargaining power $\phi = 0.97$ (the debtor – Argentina) to replicate the average annual default frequency of 3.26% and a recovery rate of 25.0% (Argentina 2001–05 restructuring).36 Appendix C explores the equilibrium properties for these key assumptions: size of the sovereign, output costs for the creditor, and stochastic bargaining power. Table

---

35If we relax this assumption i.e. allowing asymmetric trend growth rate, we cannot obtain the steady-state distribution. This is because the sovereign country is growing faster than the creditor country.

36Previous studies (Yue 2010; Bi 2008; D’Erasmo 2010; Asonuma and Trebesch 2016) use different parameter values for bargaining power. This is because no good proxy indicator corresponds to bargaining power and these values are set to replicate recovery rates specifically in their models with different assumptions (income, bargaining game, etc.).
5 summarizes the model parameters and our computation algorithm is reported in Appendix E.

Table 5: Model Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk aversion</td>
<td>$\sigma = \alpha = 2$</td>
<td>Previous studies, Lizarazo (2013)</td>
</tr>
<tr>
<td>Output cost</td>
<td>$\lambda_d = 0.02$</td>
<td>Sturzenegger (2004)</td>
</tr>
<tr>
<td>Bargaining power</td>
<td>$\phi = 0.97$</td>
<td>Computed</td>
</tr>
<tr>
<td>Average endowment growth</td>
<td>$\mu_g = 0.009$</td>
<td>Computed - Argentina GDP MECON</td>
</tr>
<tr>
<td><strong>Creditor specific</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\beta^* = 0.98$</td>
<td>Lizarazo (2013)</td>
</tr>
<tr>
<td>Auto-correlation of income</td>
<td>$\rho_f^g = 0.89$</td>
<td>Computed - US GDP US BEA</td>
</tr>
<tr>
<td>Standard deviation of endowment growth shock</td>
<td>$\sigma_f^g = 0.012$</td>
<td>Computed - US GDP US BEA</td>
</tr>
<tr>
<td><strong>Sovereign specific</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\beta = 0.75$</td>
<td>Computed</td>
</tr>
<tr>
<td>Auto-correlation of income</td>
<td>$\rho_f^h = 0.65$</td>
<td>Computed - Argentina GDP MECON</td>
</tr>
<tr>
<td>Standard deviation of endowment growth shock</td>
<td>$\sigma_f^h = 0.054$</td>
<td>Computed - Argentina GDP MECON</td>
</tr>
<tr>
<td>Relative size of sovereign</td>
<td>$\pi = 0.025$</td>
<td>IMF WEO 1993–2012</td>
</tr>
</tbody>
</table>

5.2 Numerical Results on Equilibrium Properties

First, we provide the qualitative equilibrium properties of our theoretical model for the case when the sovereign proposes. Appendix F discusses the equilibrium properties for the case when the creditor proposes—underlying mechanisms apply symmetrically and generate identical results.

Figure 4 reports agreed recovery rates when the sovereign proposes. In all panel charts, the horizontal axis is sovereign’s debt and the vertical axis is the sovereign’s (borrower’s) income. To demonstrate our new findings, three panel charts are classified according to the creditor’s income level: (i) mean (benchmark), (ii) low, and (iii) high. Our benchmark case of mean creditor’s income (panel i) replicates general patterns of recovery rates as in previous work on debt restructurings, for example Yue (2010), Bi (2008), Asonuma and Trebesch (2016), and Asonuma (2016a). Recovery rates are increasing respect to both sovereign’s assets and income: if the size of debt becomes smaller, the sovereign can pay larger portion of defaulted debt. If the sovereign’s capacity of repay is high (due to high income), it repays high recovered debt payments. The region where agreed recovery rates do not exist corresponds to either the region the sovereign opts to pay debt in full, i.e. no default, or the region where the sovereign does not agree on the deal with the creditor, i.e. no settlement shown in Figure 5.

More importantly, our model discovers one new feature of recovery rates: agreed recovery rates are low (high) when the creditor has low (high) income—lower by 5 percent (higher by 5 percent) at the levels of debt of 50 percent of GDP and mean debtor income. When the creditor’s income is low (panel ii), the creditor has a high degree of consumption-smoothing
motive by receiving recovered debt payments in the current period. Though it is not the most favorable offer, the creditor, ceteris paribus, still accepts the lower proposed recovery rates than those in the benchmark case. On the contrary, when the creditor enjoys high income (panel iii), he is more patient and is less eager to recoup losses on defaulted debt in order to smooth consumption in the current period. This is because he anticipates high expected recovery rates in the next period due to the persistency of his income. Thus, he only accepts recovery rates proposed in the current period which are preferable to or at least equivalent to high expected recovery rates in the next period. As a result, agreed recovery rates are higher than those in the benchmark case.

Figure 4: Agreed Recovery Rates

(i) Mean Creditor’s Income

(ii) Low Creditor’s Income

(iii) High Creditor’s Income

We then explore the sovereign’s choice of repayment, default/settlement, and default/delay choice in Figure 5. We follow the same presentation approach as in Figure 4 regarding to axis
and panel classifications. In our benchmark case (mean creditor’s income in panel i), we observe the common trend of the sovereign’s choice as in previous studies on multi-round negotiations (Benjamin and Wright 2009; Bi 2008). When the sovereign’s debt is low, it pays its debt in full and maintains an access to the international capital market shown in the green region (“Repayment”). Otherwise, it opts to default and proceeds to a post-default renegotiation. During financial exclusion, when its current income is low, the sovereign’s repayment capacity has not fully recovered yet. In such a case, paying recovered debt is more costly for the sovereign than suffering both financial exclusion and output costs. As a consequence, the sovereign opts to pass and waits for recovery of income corresponding to the red region (“Delay”). When its current income is high, the sovereign’s repayment capacity has fully recovered. In this case, the sovereign finds that costs of financial autarky combined with output costs in the future are higher than those of paying recovered debt payments. It proposes high recovery rates which attract the creditor and settles the deal highlighted in the blue region (“Settlement”).

More importantly, what our model explains newly in addition to the aforementioned trend in the literature is that the sovereign opts to delay (settle the deal), ceteris paribus, when the creditor’s income is high (low). In the case of low creditor’s income (panel ii), the sovereign proposes recovery rates and settles the deal even when the sovereign’s income is low as shown in the enlarged “Settlement” region in blue and the shrunk “Delay” region in red, respectively. The creditor is less patient due to his low income and more eager to recoup losses on defaulted debt to smooth consumption in the current period. As explained in Figure 4, the creditor accepts the lower proposed recovery rates than those when his income is at its mean level. Therefore, it is more likely that both parties settle the deal.

In contrast, in the case of high creditor’s income, the sovereign opts to postpone when the sovereign’s income is moderate as highlighted in the enlarged “Delay” region in red and the shrunk “Settlement” region in blue, respectively. This is because the creditor with high income is patient and reluctant to receive unfavorable recovered debt payments given the expectation of higher recovery rates in the next period. Therefore, the creditor sets a high criteria for recovery rates and makes it difficult for the sovereign to meet the criteria in the current period. The sovereign with low or moderate income finds that its repayment capacity has not been fully recovered and it decides to wait until full recovery of its income.

Additionally, the sovereign is more willing to default ex-ante given small default costs—due to both low recovered debt payments and short duration of renegotiations (associated with output costs and financial exclusion)—when the creditor’s income is low. This is reflected in the shrunk “Repayment” region in green (panel ii). Though this is qualitatively aligned with conventional models with a risk averse creditor (Borri and Verdelhan 2011; Lizarazo 2013), the main mechanism of willingness to default differs completely between ours and these models: the creditor’s state-dependent consumption-smoothing motive directly influences default costs through both settlements (recovery rates) and non-settlements (delays in renegotiations) in our model. On the contrary, how the creditor with state-dependent risk aversion perceives the riskiness of the sovereign bonds affects costs of borrowing, and in turn, indirectly influences
default costs in their models.

5.3 Simulation Exercise

Next, we provide simulation results to show how precisely our theoretical model predicts the Argentine default and restructuring in 2001–05. Following a conventional approach, this subsection applies 1000 rounds of simulations with 2000 periods per round and extracts the last 200 observations. In the last 200 samples, we withdraw 40 observations before and observations during the last default/restructuring event at the stationary distribution to compute key moment statistics.\(^{37}\)

\(^{37}\)See also Arellano (2008) and Yue (2010) for this treatment of simulation.
For the Argentine and US data, output, consumption, and the trade balance are all seasonally adjusted from the MECON and the US BEA for 1993Q1–2001Q4 (prior to default) and 2002Q1–2005Q2 during (default/restructuring), respectively. The trade balance is measured in terms of percentage of GDP. Argentine external debt data are from the IMF’s World Economic Outlook (WEO) for 1993–2001 (prior to default) and 2002–05 (during default/restructuring). Average external debt is also measured in terms of percentage of GDP.\(^{38}\) Bond spreads are from the J.P. Morgan’s Emerging Markets Bond Index Global (EMBIG) for 1997Q1–2001Q4 (prior to default). We compare our non-target statistics with those in Arellano (2008) and Yue (2010) which are commonly used as benchmark cases.

First, our theoretical model matches the business cycle statistics of the debtor—those of the creditor are reported in Appendix G—in the data as reported in panel (i) in Table 6. For pre-default periods, our model replicates volatile consumption (of the same magnitude with output volatility) and volatility of trade balance-to-GDP ratio. Both of them are prominent features of emerging market RBC models. Volatile consumption is also proved to be the case in the restructuring periods. In addition, during restructuring process, the sovereign remains in financial autarky and its trade balance is constant at zero (no volatility) in our model. However, the model fails to generate a negative correlation between trade balance and output in pre-default periods. This is because the sovereign is more willing to pay debt in full and borrow more (trade deficit) given larger default costs—due to longer delays in renegotiations—when the debtor’s income is low. This is a common by-product in models with multi-round negotiations—which does not appear in models with one-round negotiations or without negotiations—which successfully replicate both long delays in renegotiations and high debt-to-GDP ratio (Bi 2008).\(^{39}\)

We also see that non-business cycle statistics of the model match with the data as shown in panel (ii) in Table 6. First, the model successfully replicates high level of debt close to the data in pre-default periods (50 percent of GDP v.s. 45 percent in the data) and restructuring periods (50 percent v.s. 131 percent in the data).\(^{40}\) This is one of the two advantages of models with multi-round negotiations, that models with one-round negotiations (Yue 2010) or models without negotiations (Arellano 2008; Aguair and Gopinath 2006) fail to explain. Contrary to models with one-round negotiations (Yue 2010), default costs in models with multi-round negotiations are larger due to longer renegotiations (associated with output costs and financial exclusion). Therefore, the sovereign finds itself optimal to default only at the high level of debt (50 percent of GDP). Both average and standard deviation of bond spreads of 3.6 and 2.1 percent, respectively in our model—similar to those in Yue (2010)—are lower than those in the data owing to limited variation of the state-dependent stochastic discount factor of the

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\(^{38}\)The ratio of government debt service (including short-term debt) to GDP is also commonly used in the literature as an alternative measure of government indebtedness. See Arellano (2008), Yue (2010), Asomuma and Trebesch (2016).

\(^{39}\)An alternative approach to account for the negative correlation between trade balance and output is to introduce the stochastic bargaining power that depends on both the party who proposes in the current round and the current debtor’s income (Benjamin and Wright 2009).

\(^{40}\)High average debt-to-GDP ratio (131 percent of GDP) during the 2001–05 restructuring in Argentina was also influenced by sharp exchange rate depreciations (Sturzenegger and Zettelmeyer 2006).
Table 6: Simulated Business and Non-business Cycle Statistics of Model

(i) Business Cycle Statistics - Debtor

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Pre-default periods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption (std dev.)/output (std dev.)</td>
<td>1.1</td>
<td>0.99</td>
<td>1.10</td>
<td>1.04</td>
</tr>
<tr>
<td>Trade balance/output: std dev. (%)</td>
<td>1.28</td>
<td>2.00</td>
<td>1.75</td>
<td>2.81</td>
</tr>
<tr>
<td>Corr.(trade balance, output)</td>
<td>-0.87</td>
<td>0.22</td>
<td>-0.25</td>
<td>-0.16</td>
</tr>
<tr>
<td><strong>Renegotiation periods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption (std dev.)/output (std dev.)</td>
<td>1.17</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Trade balance/output: std dev. (%)</td>
<td>2.2</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Corr.(trade balance, output)</td>
<td>-0.97</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(ii) Non-business Cycle Statistics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td><strong>Target statistics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default probability (%)</td>
<td>3.26</td>
<td>3.25</td>
<td>3.00</td>
<td>2.67</td>
</tr>
<tr>
<td>Average recovery rate (%)</td>
<td>25.0</td>
<td>41.8</td>
<td>-</td>
<td>27.3</td>
</tr>
<tr>
<td><strong>Pre-default periods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average debt/GDP ratio (%)</td>
<td>45.4</td>
<td>49.7</td>
<td>5.95</td>
<td>10.10</td>
</tr>
<tr>
<td>Bond spreads: average (%)</td>
<td>9.4</td>
<td>3.6</td>
<td>3.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Bond spreads: std dev. (%)</td>
<td>7.6</td>
<td>2.1</td>
<td>6.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Corr.(spreads, output)</td>
<td>-0.88</td>
<td>-0.61</td>
<td>-0.29</td>
<td>-0.11</td>
</tr>
<tr>
<td>Corr.(debt/GDP, spreads)</td>
<td>0.92</td>
<td>0.12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Corr.(debt/GDP, output)</td>
<td>-0.97</td>
<td>-0.07</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Risk-free interest rate (%)</td>
<td>1.3</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Renegotiation periods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average debt/GDP ratio (%)</td>
<td>130.5</td>
<td>50.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Duration of renegotiation &amp; exclusion (quarters)</td>
<td>14.0</td>
<td>5.9</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>Debtor output deviation (difference between start &amp; end, %)</td>
<td>8.7</td>
<td>15.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Creditor output deviation (difference between start &amp; end, %)</td>
<td>1.5</td>
<td>1.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Corr.(debt/GDP, recovery rates)</td>
<td>0.3</td>
<td>0.4</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Corr.(debt/GDP, output)</td>
<td>-0.95</td>
<td>-0.17</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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

\(^{1/}\) A difference in output deviation between the start and the end.
creditor—due to high auto-correlation of his income. Our model moments accord with observed relationships among bond spreads, debt and output.

More importantly, the model generates average restructuring duration of 5.9 quarters, substantially longer than that in models with one-round negotiations (Yue 2010) but still shorter than that in the data (14 quarters). This is the other advantage of multi-round negotiations and driven by both recovery in repayment capacity (Benjamin and Wright 2009; Bi 2008) and the creditor’s state-dependent consumption-smoothing motive. These two drivers match with the data: both the debtor’s and the creditor’s income is higher at the end of restructuring than one at the start (15.7 percent v.s. 8.7 percent in the data for the debtor and 1.4 percent v.s. 1.5 percent in the data for the creditor).

5.4 Comparison with Models of Multi-round Negotiations

Table 7 contrasts selected moments in our model with those in previous models of multi-round negotiations. We consider two cases: (i) a risk-neutral creditor in line with Benjamin and Wright (2009) and Bi (2008), and (ii) a small open economy model with a risk averse creditor as in Borri and Verdelhan (2011). To generate moments comparable to ours, we embed two assumptions of the risk-neutral creditor and fixed creditor’s income for the case (i) and one assumption of the creditor’s consumption relying only on his income, not on the debtor’s debt payments ($\pi = 0$) for case the case (ii) in our model leaving all other parameters unchanged.

In comparison of our model with the case (i), the most crucial is a substantial difference in duration of restructuring between our model and models with the risk-neutral creditor (5.9 quarters in our model v.s. 4.8 quarters). While recovery of the debtor’s income drives delays in renegotiations symmetrically in two models shown by positive changes in debtor output deviation (15.7 percent in our model v.s. 12.5 percent), the creditor’s state-dependent consumption-smoothing motive driven by an improvement in the risk averse creditor’s income (1.4 percent) is present only in our model generating further delays. Higher bond spreads and standard deviation of spreads in our model than those in the models with the risk-neutral creditor (3.6 & 2.1 percent in our model v.s. 0.4 & 0.4 percent) are driven by the creditor’s state-dependent risk appetite with volatile income as in Lizarazo (2013).

Next, when we contrast our model with the case (ii), the difference in duration of renegotiation becomes more severe (5.9 quarters in our model v.s. 2.0 quarters). The small open economy model with the risk averse creditor does not generate any delays as in models with one-round negotiations (Yue 2010; Asonuma 2016a)—2 quarters are minimum length of negotiations in the current set-up. This is because in the small open economy model, the risk averse creditor’s business cycle influences only indirectly and marginally through his stochastic discount rate, but not directly through proposed recovery rates and his outside option in the current round. The risk averse creditor’s surplus at the bargaining game does not reflect the debtor’s repayment capacity changing over both the debtor’s income realization and the random selection of proposers. Appendix H reports that there is no delay region at any levels of the creditor’s income. A further and equally important consideration is low average debt-to-GDP ratio in pre-default
Table 7: Comparison of Our Model with Models of Multi-round Negotiations

<table>
<thead>
<tr>
<th></th>
<th>Our Model</th>
<th>Models with risk-neutral creditor (case i)</th>
<th>Small open economy model with the risk averse creditor (case ii)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-default periods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average debt/GDP ratio (%)</td>
<td>49.7</td>
<td>58.8</td>
<td>17.0</td>
</tr>
<tr>
<td>Bond spreads: average (%)</td>
<td>3.6</td>
<td>0.4</td>
<td>2.5</td>
</tr>
<tr>
<td>Bond spreads: std dev. (%)</td>
<td>2.1</td>
<td>0.4</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Renegotiation periods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average debt/GDP ratio (%)</td>
<td>50.0</td>
<td>60.0</td>
<td>17.1</td>
</tr>
<tr>
<td>Duration of renegotiation &amp; exclusion (quarters)</td>
<td>5.9</td>
<td>4.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Debtor output deviation (difference between start &amp; end, %)(^1)</td>
<td>15.7</td>
<td>12.5</td>
<td>8.8</td>
</tr>
<tr>
<td>Creditor output deviation (difference between start &amp; end, %)(^1)</td>
<td>1.4</td>
<td>-</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Source: Author’s computation

\(^1\) A difference in output deviation between at the start and at the end.

periods (17.0 percent of GDP), similar to that in models with one-round renegotiations. As it is less costly to default due to no delays in renegotiations, the debtor is willing to default at low level of debt (Figure A9 in Appendix H). Clearly, the small open economy model eliminates advantages of multi-round negotiations and brings the results similar to those in the models with one-round negotiations.

5.5 Robustness Check

The creditor’s output volatility and persistency, output costs and bargaining power are key parameters pinning down the debt restructuring processes and outcomes. Table 8 reports how changes in these parameter values keeping other parameter values constant influence the main statistics. A decrease in the creditor output volatility from the benchmark case reduces duration of renegotiation (3.7 quarters). As the creditor’s income process becomes less volatile, the creditor is more willing to settle the deal with lower recovery rates (39.3 percent). This case resembles to that of models with a risk-neutral creditor and no income uncertainty. In contrast, an increase in volatility also leads to shorter duration of renegotiation (2.5 quarters). Though it seems counter-intuitive, what plays behind is the creditor’s precautionary motive to reach an agreement quickly given high uncertainty on his income process.

When the creditor’s income becomes more persistent (more mean reverting), duration of renegotiation gets longer (shorter) and recovery rates get higher (lower). The creditor has a limited consumption-smoothing motive through receipt of recovered debt payments in the current round as he expects high recovery rates in the future period.

An increase in output costs leads to shorter duration of renegotiation (5.7 quarters). Despite high level of debt at restructurings, the debtor is more willing to reach an agreement with lower recovery rates since non-settlement associated with both larger output costs and financial exclusion is more costly. When the debtor is less likely to be selected to be a proposer, restructurings become protracted (6.2 quarters). The creditor’s state-dependent consumption-smoothing motive plays a larger role resulting in delays in renegotiations.
6 Empirical Analysis: Testing Theoretical Prediction

The main finding from the theoretical model is that when the creditor’s income is high, debt restructurings are delayed and settled with low haircuts. So far in Section 5, the model is calibrated only to the case of Argentina’s default and restructuring in 2001–05. Next, Section 6 applies our theoretical prediction to a large sample of both countries and restructuring episodes. For this purpose, we assess the drivers of delays and agreed haircuts in renegotiations by applying a multinomial logit model with annual data.

Our dataset is an unbalanced panel comprised of 111 post-default restructuring episodes in 60 countries (both emerging market and low-income countries) for the duration for each episode i.e. from the start of restructurings to the completion of exchanges. Following the original classification in Asonuma and Trebesch (2016), we treat two restructuring events separately when one sovereign debtor is negotiating with different creditors over different debt instruments. In this regard, our panel includes the overlapping periods of restructurings for the sovereign debtor.

As in an empirical analysis in Asonuma and Trebesch (2016), we construct our data at an annual frequency, due to data availability for GDP growth rates and debt for the restructuring countries. Our dependent variables are a binary variable for the completion of restructurings—1 for completion and 0 otherwise—and haircuts—non-zero haircuts (in percent) for completion and 0 otherwise. To be consistent with our theoretical model, the set of explanatory variables comprises real GDP growth rates for the sovereign debtor, the US and Germany (the creditor), public and publicly guaranteed (PPG) external debt (in percent of GDP), and the US and German term premium. To control for liquidity and the investors’ risk appetite in the global market, our specification includes term premium of the US and German Treasury bonds.

Table 9 summarizes our multinomial logit regression results. First, the results show that high creditors’ GDP growth rates (the US and Germany) decrease the likelihood of completion of restructurings in the same year (columns 1 and 2). Second, we also find that high creditors’
GDP growth rates reduce the agreed haircuts (columns 3 and 4). Both results are in line with our theoretical findings. Moreover, restructurings are likely to be settled and agreed haircuts are low when PPG external debt remains at a low level and the debtor experiences high GDP growth (columns 1–4). An increase in investors’ risk appetite, proxied by the term premium, enters as a counter intuitive sign possibly due to high correlation with GDP growth rate (columns 1–4).

In summary, our panel logit regression results confirm the main prediction from the theoretical model: debt restructurings are delayed and settled with low haircuts when creditors’ GDP growth rate is high.

Table 9: Logit Regression Results

<table>
<thead>
<tr>
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<th>Debt settlement (binary)</th>
<th>Haircuts (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>US GDP growth rate</td>
<td>German GDP growth rate</td>
</tr>
<tr>
<td></td>
<td>coef/se</td>
<td>coef/se</td>
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</tbody>
</table>
| US GDP growth rate, current, (%)
  | -0.126***                | -0.126***      | -0.126***                | -0.126***                |
| (0.03)                         | (0.03)                   | (0.03)       | (0.03)                   | (0.03)                   |
| German GDP growth rate, current, (%)
  | -0.128***                | -0.128***      | -0.128***                | -0.128***                |
| (0.034)                        | (0.034)                  | (0.034)      | (0.034)                  | (0.034)                  |
| PPG external debt, lagged, (% of GDP)
  | -0.003***                | -0.006***      | -0.003***                | -0.006***                |
| (0.001)                        | (0.001)                  | (0.001)      | (0.001)                  | (0.001)                  |
| Debtor GDP growth rate, current, (%)
  | 0.026**                  | 0.022*        | 0.026**                  | 0.022*                   |
| (0.012)                        | (0.012)                  | (0.012)      | (0.012)                  | (0.012)                  |
| US or German term premium, current, (%)
  | -0.313***                | -0.032        | -0.313                   | -0.032                   |
| (0.057)                        | (0.048)                  | (0.057)      | (0.048)                  | (0.048)                  |
| Episode-specific fixed effects | No                       | No           | No                       | No                       |
| Number of episodes             | 93                       | 93           | 93                       | 93                       |
| Number of observations         | 522                      | 522          | 522                      | 522                      |
| Wald χ²                        | 186.82                   | 104.51       | 186.82                   | 104.51                   |
| Prob.> χ²                      | 0.497                    | 0.208        | 0.497                    | 0.208                    |

Notes: The table shows results from random effects multinomial logit regressions. The dependent variables are the debt settlement (binary choice) and haircuts (percent). The main explanatory variables are US and German GDP growth rates. PPG external debt (in percent of GDP) is lagged by one year. The other explanatory variables are in current year. Significance levels denoted by *** \( p < 0.01 \), ** \( p < 0.05 \), * \( p < 0.10 \), respectively. Robust standard errors in parentheses.

1/ Public and publicly guaranteed external debt. Lagged level in terms of GDP.
2/ Term premium is a difference between 1-year and 10-year bond yields.
7 Conclusion

The current paper explores the role of foreign creditors at sovereign debt restructurings. We newly code two datasets on the creditor committees and on creditors’ business cycles during restructurings. Our compiled data show that when foreign creditors experience high GDP growth rates, restructurings are protracted and settled with smaller haircuts and face-value reductions. We embed multi-round debt negotiations between a risk averse sovereign and a risk averse creditor in an otherwise standard sovereign debt model to replicate these stylized facts. The quantitative analysis of the model shows that high creditor income results in both longer delays of renegotiations and smaller haircuts. Our theoretical prediction is supported by data through both a panel analysis and a calibration exercise for Argentine case.

On the basis of better understanding of how foreign creditors respond during debt restructurings, we will potentially explore additional restructuring options (proposals) contingent on the creditors’ business cycles for sovereign debtors. With these restructuring options, the sovereign debtors could attract the creditors and facilitate efficient negotiations avoiding lengthy delays which have been costly for the debtors. This in turn, might potentially be beneficial for the creditors: the creditors might welcome the debtors’ proposals which meet their demands and be more willing to engage with the debtors.
References


[38] Gu, G., 2016, “A Tale of Two Countries: Sovereign Default, Trade and Terms of Trade,” manuscript, UC Santa Cruz.


