The Secondary Market as an Expediter of the Sovereign Debt Restructuring Process

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Abstract

By explicitly relying on the secondary market for the first time in any major sovereign restructuring, Argentina was at the verge of completing one of the fastest major sovereign debt restructurings ever. If it was not to be, the reason was lack of sophistication in the interpretation of the secondary market signals. However, this article shows how, in general, the secondary market plays a crucial information revelation role in shortening the timespan of sovereign debt restructurings. To see how, I consider a dynamic bargaining game with incomplete information between a government and its creditors. The creditors' reservation value is private information, and the government knows only its distribution. Delays in reaching agreements arise in equilibrium because the government uses costly delays to screen the creditors' reservation value. When the creditors trade on the secondary market, the market price conveys information about their reservation value, which lessens the information friction and reduces the restructuring timespan. I find that the secondary market tends to increase the government's restructuring payoff but decrease that of the creditors while increasing the total payoff.

1 Introduction

During the 1980s, developing countries experienced prolonged periods of financial limbo as they renegotiated debt contracts with foreign commercial banks following default. Evidence from this period suggests that reaching an agreement with creditors took an average of nine years. During the restructuring period, governments faced decreased access to global financial markets, hampering economic growth and investment. These costly and protracted negotiations, arising from the coordination failure between private creditors and sovereign debtors, became a major concern for policy makers.

As sovereign borrowing has shifted from commercial banks to the capital markets in the 1990s, a paradox occurred: as the creditor universe became more heterogeneous, sovereign debt restructurings became speedier, not more protracted, as could have been expected. Indeed, the data shows that it takes an average of one year to complete a bond restructuring.

My goal in this article is to provide an explanation for this apparent paradox, by focusing on one key factor: the role that bond markets play in revealing information conducive to a faster resolution.

My main hypothesis is that private information is one of the most important reasons for delays in reaching restructuring deals. When negotiating with creditors whose reservation value is unknown (i.e., banks), the government uses costly equilibrium delays to screen the creditors' type; greater information friction leads to lengthier negotiations. By contrast, when creditors trade before the restructuring, the secondary market conveys information about their reservation value, lessening the information friction. As a result, I posit that trading activity might shorten sovereign bond restructurings relative to their bank loan counterparts, consistent with the data.

I start by analyzing sovereign debt restructurings in the absence of a liquid and transparent secondary market. My model builds on a dynamic bargaining game with private information. When a government engages in restructuring negotiations with its creditors, the government suffers a loss in constant output and creditors can seize a fraction of that output loss. This fraction is creditors' private information and becomes their common reservation value. The government is informed only about the distribution of this reservation value and makes successive restructuring offers as a share of the output loss, which creditors choose whether or not to accept. If creditors accept, the government repays the proposed offer and avoids the output loss. Otherwise, the renegotiation continues to the next period.

Private information is key to generating delays in a perfect Bayesian equilibrium; i.e., without private information. the government proposes the reservation value and creditors accept immediately.[1] With private information, the government would need to propose the highest reservation value to ensure an immediate agreement, and would obtain the least possible payoff. A lower offer might delay the agreement when creditors indeed have a

[1] We assume that creditors always accept at their indifference level.

high reservation value, but it increases the government's payoff if the reservation value is low and the agreement is reached immediately. Thus, costly equilibrium delays arise as a screening device of the creditors' type. Moreover, the maximum restructuring timespan decreases with the precision of information on the creditors' reservation value.

Next, I analyze sovereign debt restructuring when an active and transparent secondary market is available. I allow for trading among creditors before the restructuring starts, which results in creditors receiving signals about each others' reservation prices. Together with the distribution of reservation and market prices, these signals are public information. Each creditor decides to either buy, sell or hold one additional bond and a random fraction of creditors are noisy traders who sell irrespective of the signals. After trading, creditors observe their reservation values and renegotiate with the government.

The maximum restructuring timespan decreases with the introduction of the secondary market. The key transmission mechanism is the discovery of creditors' reservation values, which lessens the information friction and shortens the process. For example, when the underlying reservation value is high, creditors then to receive high signals and expect a high payoff from restructuring, leading the government to update its belief about the distribution of the reservation values, this reducing information friction and shortening the process. In the extreme case where the bond price is fully revealing, perfect information outcomes arise, and the restructuring closes immediately.

Finally, I conduct an ex post welfare analysis where outcomes arise endogenously from the dynamic bargaining game and depend on the information friction and the existence of a secondary market. A secondary market tends to increase the total and the government's payoffs, but lower the creditors' payoff through the reduction of delay and the information rent.

The theoretical framework underlying this analysis is the dynamic bargaining game with incomplete information. I adopted a sequential bargaining approach because, empirically, sovereign governments make sequential offers to the creditors during the restructuring process. Specifically, my model builds on Fudenberg et al. (1985), where the uninformed party uses costly delays to screen the type of the informed party.

This article relies on the strand of academic literature on sovereign debt restructuring focused on the coordination failure between a government and its creditors. Bulow and Rogoff (1989) and Fernandez and Rosenthal (1990) analyze the ex ante impact of restructuring outcomes from a Rubinstein bargaining game with complete information. Yue (2009) introduces a Nash bargaining game into a sovereign debt model developed by Eaton and Gersowitz (1981). In these works, there are no equilibrium delays in reaching agreement. Two more recent papers, Benjamin and Wright (2008) and Bi (2008), incorporate into the Eaton-Fersowitz model a dynamic bargaining game with uncertainty, as in Merlo and Wilson (1995). Delays arise because both the debtor country and its creditors prefer to wait for a good future shock to split a larger "pie". This article, instead, focuses on the role of information friction.

This article is organized as follows. To highlight the mechanisms affecting the restructuring outcomes, I focus on the ex post restructuring timespan in Sections 2 and 3 and on the ex post welfare implications in Section 4. In particular, Section 2 studies the restructuring timespan without the secondary market, and Section 3 analyzes it with the secondary market. In Section 4 I analyze the ex post welfare implications. Section 5 concludes.

2 Restructuring Without Secondary Market

In this section, I analyze the sovereign debt restructuring without the secondary market in a dynamic non-cooperative bargaining game with one-sided incomplete information as in Fudenberg et al. (1985). The implied restructuring outcomes will serve as a benchmark for comparison when I analyze the sovereign debt restructuring with the secondary market in the next section. To highlight the coordination problems between the creditors and the government, I abstract from inter-creditor coordination problems.

2.1 Model

There are two parties in the model: a sovereign government and a continuum of creditors of measure one. Each creditor has an equal number of bonds. At date 1, the government defaults and starts to negotiate with the creditors. Assume that the government has a deterministic output process: $y_t = y$ for any t. In each period, the government proposes a restructuring plan that specifies a per-period payment b to the creditors. The creditors decide whether or not to accept the proposal, and I assume that they accept whenever they are indifferent. If a critical mass of the creditors accept, the restructuring is done: the government has a per-period payoff of $y - b$, and each creditor has a per-period payoff of b. Otherwise, the restructuring process continues on to the next period. The government loses a fraction γ of its output[2] and the creditors can only capture a fraction s of the output loss, which is divided among them proportionally to their holdings.[3]

Both parties have a discount factor $\beta < 1$ and seek to maximize the present value of future payoffs. The government gets a per-period payoff of $(1 - \gamma)y$ regardless of whether the offer is accepted, and negotiates with the creditors to split the per-period payoff γy. Clearly, the creditors never accept an offer lower than $s\gamma y$, where s is interpreted as the creditors' reservation value in the restructuring. I assume that the creditors have private information about s, and the government observes only its distribution: s is uniformly distributed on $[s_l, s_h] \subseteq [0, 1)$. The information asymmetry can be understood as the creditors obtaining sufficient information about the government before making loans and

[2]This output loss could come from various channels: restricted access to financial markets, loss of trade credits, and/or disruption of the domestic financial sector.

[3]Following Bulow and Rogoff (1989), I assume that the creditors seize some payoff during the restructuring to capture the idea that firms in the debtor country have to pay the creditors higher fees on they trade credits and transactions while the government is on arrears on its debt.

while monitoring the loans. The government, however, has little information about the creditors' reservation value.

All the creditors have a common reservation value, and they will either all accept or all reject an offer. Therefore, the critical mass required to close the restructuring has no impact on the restructuring outcomes. Alternatively, one can interpret the model as the restructuring between one debtor country and one creditor, since all the creditors are identical.

In each period t, the government's information set is a history of offers $h_t = \{b_1, b_2, \dots, b_{t-1}\}$ and the creditors' information set is the same history concatenated with the current offer (h_t, b_t). A system of beliefs for the government is a mapping from its information set into a probability distribution g_t over s (let G_t denote the cumulative distribution). The government's strategy maps its information set h_t into an offer b_t. The creditors' strategy maps their information set into either acceptance or rejection. We define a *perfect Bayesian equilibrium* as follows.

Definition 1. *A perfect Bayesian equilibrium is a system of beliefs for the government, and a pair of strategies for the government and the creditors, such that the government's beliefs are consistent with Bayes' rule (whenever it is applicable) and the strategies of the government and the creditors are optimal after any history given the current beliefs.*

Dynamic bargaining games typically have a plethora of equilibria.[4] In my model, however, there exists a unique Bayesian equilibrium. One key assumption behind uniqueness is that the (uninformed) government makes an offer to the (informed) creditors.[5] The other key assumption is $s_h < 1$, which implies that the restructuring is a "gap" game, in which the government can always gain from reaching an agreement. The government's sure gain is $(1 - s_h)\gamma y$. Therefore, the restructuring closes in finite periods T because the potential surplus that the government might hope to extract eventually becomes insignificant compared to the sure gain. Fudenberg et al. (1985) show that under these two assumptions the perfect Bayesian equilibrium is unique.

I next characterize the creditors' and the government 's strategies along the equilibrium path. The equilibrium has a Markov property in the sense that the government's strategy depends on its belief, updated by the last offer rejected alone, while the creditors' strategy depends only on the current offer in equilibrium. Suppose that the government proposes b_t in period t and is expected to offer b_{t+1} in the next period if the offer is rejected. The creditors will accept the offer if, and only if,

$$\frac{b_t}{1-\beta} \geq s\gamma y + \beta \frac{b_t + 1}{1-\beta}$$

[4]See Ausubel et al. (2002) for a detailed discussion.

[5]If we allow the informed party to make offers, the signaling mechanism generally leads to multiple equilibria.

That is, the creditors will accept b_t if, and only if, their reservation value is below a cutoff level $\underline{S}_{t+1}(b_t)$, given by

$$\underline{S}_{t+1}(b_t) = \frac{b_t - \beta b_{t+1}}{(1-\beta)\gamma y}$$

Given the creditors' strategy, the government understands that the creditors' reservation value is at least $\underline{S}_{t+1}(b_t)$ if the offer b_t is rejected. Therefore, the government truncates the belief from below: the updated belief in period $t+1$ is a uniform distribution on interval $[\underline{S}_{t+1}(b_t),\ s_h]$. This implies that the government's posterior belief can be characterized with one number $\underline{S}_{t+1}(b_t)$, which is the lower bound of the reservation interval.

Therefore, if the government believes that the creditors' reservation value is higher than $\underline{s}$ in period t, then the government's optimal strategy solves the following problem:

$$V_t(\underline{s}) = \max_{b_t} \left\{ \Lambda_t(\underline{s}, b_t)\frac{y - b_t}{1-\beta} + (1 - \Lambda_t(\underline{s}, b_t))[(1-\gamma)y + \beta V_{t+1}(\underline{S}_{t+1}(b_t))] \right\}, \tag{1}$$

where $\Lambda_t(\underline{s}, b_t)$ denotes the acceptance probability of offer b_t, given by $\frac{\underline{S}_{t+1}(b_t)-\underline{s}}{s_h-\underline{s}}$ under the uniform distribution. A higher offer increases the probability of acceptance but lowers the government's acceptance payoff. Taking this tradeoff into account, the government might find it optimal to delay the agreement. I denote the optimal strategy as $B_t(\underline{s})$.

I now summarize the features of the equilibrium strategies and outcomes. First, the government's offer $B_t(\underline{s})$ increases with belief $\underline{s}$ and its posterior belief $\underline{S}_t(b)$ increases with rejected offer b. Second, in equilibrium the government proposes an increasing sequence of offers $\{b_1, b_2, , ..., , b_T\}$, and the creditors accept in period t when the reservation value s falls between s_t and s_{t+1}, where $s_1 = s_t, , s_{T+1} = s_h$, and $s_t = \underline{S}_t(b_{t-1})$ for any $T = 2, , ..., T$. Clearly, higher reservation values lead to longer renegotiations and higher recoveries. Third, the creditors collect information rent; the accepted offer is always at least as high as their reservation value.

2.2 Restructuring Timespan without Secondary Market

I now move on to the main interest of this article: the timespan of the debt restructuring. In particular, I explore how the information friction impacts that timespan. I measure the degree of information friction, which I denote Ψ, as follows:

$$\Psi = \frac{1 - s_t}{1 - s_h}, \tag{2}$$

with a higher Ψ indicating a higher degree of information friction.

Let $T(s, [s_t, s_h])$ denote the restructuring timespan when the reservation value is s. I denote the maximum restructuring timespan as $\hat{T}([s_t, s_h]) = T(s_h, [s_t, s_h])$ and find that the maximum restructuring timespan increases with the degree of information friction, Ψ. The economic intuition for this result is that $1 - s_t$ is the largest possible payoff for the government, and $1 - s_h$ is the sure payoff if the government ends the renegotiation right away. A larger Ψ means that the maximum potential payoff increases relative to the sure payoff. Therefore, the government has more incentives to use costly equilibrium delays to screen the creditors' type.

Proposition 1. *The maximum restructuring timespan $\hat{T}([s_t, s_h])$ increases with the information friction Ψ; it increases as s_h increases, or as s_t decreases, or as interval $[s_t, s_h]$ shifts to the right.*

Proof. Available from the author. □

I next look at the expected restructuring timespan $\hat{T}$, which I define as:

$$\hat{T}([s_t, s_h]) = \int_{s_t}^{s_h} T(s, [s_t, s_h])dG(s). \tag{3}$$

The solution to Eq. (3) is complex but can be approximated numerically: as Ψ increases, the expected restructuring timespan also increases; i.e., the expected restructuring timespan increases with the information friction. This increasing function is jagged/discontinuous because when an increase in Ψ does not change the maximum restructuring timespan, the probability of reaching agreement increases for period 1 but decreases for any other periods, causing the expected restructuring timespan to decrease. When a further increase in Ψ drives up the maximum restructuring timespan, the expected restructuring timespan increases.

3 Restructuring with Secondary Market

I assume now that the creditors can trade in the secondary market before the restructuring starts. At this stage, the creditors have not learned their reservation value, but each of them receives a signal about it. The creditors trade their bonds in the secondary market based on this signal and the secondary market price. To highlight the role of the secondary market, I model the restructuring process the same as in the previous section. I demonstrate that the secondary market price mitigates the information friction and reduces the restructuring timespan.

3.1 Model with Secondary Market

As before, the government defaults at the beginning of period 1. In this case, however, trading occurs immediately after default, with creditors buying and selling bonds in the secondary market. I further assume that the government starts to negotiate with the remaining bondholders at the end of this period. The creditors' reservation value s is uniformly distributed on $[s_t, s_h]$, which is public information. Each creditor receives a signal z about s, where $z = s + \sigma_z \epsilon$, with ϵ uniformly distributed on $[-1, 1]$. Each creditor can either hold, sell, or buy one unit of bonds.[6] The payoff from selling is the market price p. The payoff from holding or buying depends on the expected outcome of the restructuring, conditional on the private signal z and the public information p. A random fraction α of the creditors are noisy and sell their bonds regardless of their signals. The ratio of noisy to non-noisy creditors $\alpha/(1-\alpha)$ is given by:

$$\frac{\alpha}{1-\alpha} \equiv \sigma_\mu \mu, \tag{4}$$

where μ is a random variable uniformly distributed on $[0,1]$, and $0 < \sigma_\mu < 1$.

The negotiation starts after trading in period 1. The reservation value s is revealed to all the creditors but not to the government. The government makes a proposal each period until a critical fraction κ of the creditors accept. The payoffs during the restructuring process are the same as before. My model results continue to be independent of the critical mass κ because all the creditors are ex post identical.

I restrict the trading strategy of the creditors to a *monotonic* one: the creditor buys when his signal z is more than $\hat{z}(p)$, and sells otherwise. I first define *monotonic perfect Bayesian equilibrium*, and then establish that the monotonic perfect Bayesian equilibrium exists and is unique.

Definition 2. *A monotonic perfect Bayesian equilibrium consists of a market price, the beliefs of the government and the creditors, a monotonic trading strategy for the creditors in the trading stage, and a pair of strategies for the government and the creditors and a system of beliefs for the government in the restructuring phase, such that (i) in the restructuring phase, the government's beliefs are consistent with Bayes' rule and the strategies of the government and the creditors are optimal at any history; (ii) in the trading stage, the monotonic trading strategy is optimal given the creditors' beliefs, and the beliefs of the government and the creditors are consistent with Bayes' rule; and (iii) the secondary market clears.*

Proposition 2. *There exists a unique monotonic perfect Bayesian equilibrium.*

Proof. Available from the author. □

The key reasoning for this proposition is that the secondary market influences the restructuring outcome because the government updates its belief based on the secondary market price. For any given (s, μ), the creditors' monotonic trading strategy, $\hat{z}(p)$, implies that the excess demand of non-noisy creditors, $X(p; s, \mu)$ is given by:

$$X(p; s, \mu) = (1-\alpha)[P(z > \hat{z}(p)|s) - P(z \leq \hat{z}(p)|s)], \tag{5}$$

[6] The assumption on the upper bound of trading makes my analysis simple and transparent, but it is not essential for my main findings. For details, see Section 3.4.

where $P(z > \hat{z}(p)|s)$ denotes the probability of signals above $\hat{z}(p)$; i.e., the amount of bonds demanded, and $P(z \leq \hat{z}(p)|s)$ denotes the amount of bonds supplied. The excess supply of noisy creditors is α. Since z is uniformly distributed on $[s-\sigma_z, s+\sigma_z]$, the market clearing condition implies:

$$\frac{s-\hat{z}(p)}{\sigma_z} = \frac{\alpha}{1-\alpha} = \mu\sigma_\mu \tag{6}$$

Therefore, the government infers that s is uniformly distributed on $[\hat{z}(p), \hat{z}(p)+\sigma_z\sigma_\mu]$ when observing the market price p. Together with its prior, the government updates its belief about s to be uniform on the interval $[s_l^g, s_h^g]$, where $s_l^g = max\{\hat{z}(p), s_l\}$ and $s_h^g = min\{\hat{z}(p)+\sigma_z\sigma_\mu, s_h\}$. Note that for each realization of (s,μ), there is a unique cutoff signal $\hat{z}$ that clears the market. The government then forms its restructuring strategy according to its updated belief $[s_l^g, s_h^g]$, as discussed in the previous section.

At the beginning of the restructuring process, the reservation value is known to all the bondholders. For each reservation value $s \in [s_l^g, s_h^g]$, the bondholders will obtain the following restructuring payoff $W(s, \hat{z}(p))$, given the government strategy:

$$W(s,\hat{z}(p)) = \frac{\beta^{T(s,[s_{l^g},s_{h^g}])-1} b_{T(s,[s_g,s_{h^g}])}}{a-\beta} + \sum_{t=1}^{T(s,[s_{l^g},s_{h^g}])-1} \beta^{t-1} s\gamma y \tag{7}$$

where $T(s,[s_{l^g},s_{h^g}])$ is the period in which the creditors with reservation s accept the government's offer. The restructuring payoff $W(s,\hat{z}(p))$ increases with the reservation value s because high-reservation creditors can always imitate low-reservation creditors' strategy.

In the trading stage, each creditor calculates the expected restructuring payoff based on both the market price p and his own signal z. This implies that the creditors have better information about the underlying reservation value than the government. Specifically, the updated belief of a creditor with signal z is uniform on $\left[s_{l^c(z)}, s_{h^c(z)}\right]$, where $s_{l^c(z)} = max\{z-\sigma_z, s_{l^g}\}$ and $s_{h^c(z)} = max\{z+\sigma_z, s_{h^g}\}$. Therefore, the expected payoff, denoted by $W^e(\hat{z})(p), z)$, is given by:

$$W^e(\hat{z}(p), z) = \int_{s_l^c(z)}^{s_h^c(z)} \frac{W(s,\hat{z}(p))}{s_h^c(z)-s_l^c(z)} ds \tag{8}$$

A higher signal z implies that the reservation value s is likely to be higher. Therefore, the expected restructuring payoff increases with signal z.

The creditors decide on their trading strategy based on their expected restructuring payoffs. For a creditor with signal z, the payoff to sell is p, the payoff to hold is $W^e(\hat{z}(p), z)$, and the payoff to buy is $-p+2W^e(\hat{z}(p), z)$. At price p, the cutoff creditor $\hat{z}(p)$ is indifferent between selling or buying,; i.e.,

$$p = W^e(\hat{z}(p), \hat{z}(p)) \tag{9}$$

Since the expected payoff from restructuring increases monotonically with signal z, the creditors with higher signals (weakly) prefer buying to selling, and vice versa.

Therefore, Eqs. (6) and (9) characterize the monotonic perfect Bayesian equilibrium of the model. Due to discrete time periods, for any given p, there might be multiple cutoff signals which satisfy Eq. (9). For each realization of (s, μ), however, there is a unique cutoff signal $|hayz$ which satisfies Eq. (6) and clears the market. This cutoff signal $\hat{z}$ characterizes the equilibrium monotonic trading strategy and also determines the equilibrium price p^*. Fixing μ, an increase in s will result in an increase in p^* because a high s generates high signals and increases the expected restructuring payoff. Fixing s, an increase in μ results in a decrease in p^* because a large supply of bonds from noisy traders drives down the secondary market price.

3.2 Restructuring Timespan with Secondary Market

Next, I characterize the maximum restructuring timespan with the secondary market. For each pair of realization $(s.\mu)$, the government updates its belief of the creditors' reservation value to interval $[s_l^g, s_h^g]$, where $s_l^g = max\{\hat{z}, s_l(p), s_l\}$. $s_h^g = min\{\hat{z}(p) + \sigma_z\sigma_\mu, s_h\}$, and $\hat{z}(p) = s - \mu\sigma_z\sigma\{mu$ is given by the market-clearing condition. Let's denote this interval as $\Omega(s, \mu)$. The restructuring timespan is given by $T(s, \Omega(s, \mu))$ and, accordingly, i denote the maximum restructuring timespan as:

$$\hat{T}^M([s_t, s_h]) = \max{(s, \mu)}\{T(s, \Omega(s, \mu))\}$$

We can now evaluate the impact of the secondary market on the maximum restructuring timespan. Not surprisingly, we find that the maximum restructuring timespan is shorter with the secondary market than without it; i.e., $\hat{T}^M 9[s_l, sh]) \leq \hat{T}([s_l, s_h])$. The key to this result is that as long as the secondary market price is somewhat informative, the government will form an updated belief, which is more precise than its ex ante belief and which results in a shortened maximum restructuring timespan. In addition, as creditors' signals become more precise or as the amount of noise is reduced, the restructuring timespan is also decreased. Consider an extreme case of the *perfect secondary market* where there is no noise. In this case, the secondary market price is fully revealing, and the restructuring always ends in one period. These findings are summarized in the following proposition:

Proposition 3. *(i) The maximum restructuring timespan with the secondary market is shorter than or equal to that without the secondary market; (ii) The maximum restructuring timespan with the secondary market decreases as σ_μ and σ_z decrease. In particular, there is no restructuring delay when there is no noise; i.e., $\sigma_\mu = 0$ or $\sigma_z = 0$.*

Proof. Available from the author. □

We then can illustrate the impacts of the secondary market on the expected restructuring timespan, given by:

$$\bar{T}^M([s_l, s_h]) = \int_0^1 \int_{s_l}^{s_h} T(s, \Omega(s, \mu)) dG(s) d\mu$$

In the absence of a secondary market, the expected restructuring timespan depends only on the ex ante information friction Ψ. With a secondary market, this timespan also depends on the distribution of the reservation value. Consider two non-overlaping intervals with the same Ψ. After trading, the government updates its belief to be $\Omega(s, \mu)$, which in general has a fixed length $\sigma_z \sigma_\mu$. As the underlying state (s, μ) shifts $\Omega(s, \mu)$ to the right, the information friction rises, as does the restructuring timespan. Therefore, the expected restructuring timespan tends to be longer for the interval on the right.

3.3 Extensions

I now relax the model's assumption on the trading limit (one unit) and show that the implications of the secondary market on the restructuring timespan are robust. Suppose that each creditor can buy at most $M \geq 1$ units of bonds in the secondary market. In this case, the creditors either sell their one-unit bond or buy M bonds. The excess demand of the non-noisy creditors is given by:

$$X(s, p) = (1 - \alpha)(P(z > \hat{z}(p)|s)M - P(z \leq \hat{z}(p)|s))$$

In equilibrium, the excess demand of non-noisy traders equals the supply of the noisy traders, α. Therefore, we have the following relationship between the underlying state (s, μ) and the cutoff reservation price, $\hat{z}(p)$:

$$s = \hat{z}(p) - \frac{M-1}{M+1}\sigma_z + \frac{2}{M+1}\sigma_z \sigma_\mu \mu.$$

Under the assumption that the noise, μ, is uniformly distributed on $[0, 1]$, the government updates its belief of s to $[s_l^g, s_h^g]$, where $s_l^g = max\{s_l, \hat{z}(p) - \frac{M-1}{M+1}\sigma_z\}$ and $s_h^g = min\{s_h, \hat{z}(p) - M - 1M + 1\sigma_z + 2M + 1\sigma_z\sigma_\mu\}$. Therefore, the government's information becomes more precise with the secondary market, which reduces the restructuring timespan. In addition, the maximum restructuring timespan decreases as the trading limit M increases. Therefore, the noisy trader disappears, and the secondary market price reveals that $s = \hat{z}(p) - \sigma_z$. Under this belief, the government offers $s\gamma y$ during the restructuring period, and the agreement is reached immediately.

4 Ex Post Welfare Implications

In this section, I first analyze the ex post welfare implications in the cases with and without the secondary market. The secondary market tends to increase the total ex post welfare by reducing costly restructuring delays. It also tends to reduce the expected welfare of the creditors while increasing that of the government.

Since both the creditors and the government are risk-neutral, welfare is equivalent to the payoff in the model. The maximum ex post restructuring payoff is the present value of the potential output loss; i.e. $\gamma y 1 - \beta$. I analyze both the total expected restructuring payoff and the division of the total payoff between the creditors and the government for the cases with and without the secondary market.

I first consider the case without the secondary market. For any ex ante prior $[s_l, s_h]$, the total restructuring payoff, as a share of the maximum restructuring payoff, is given by:

$$w = \int_{s_l}^{s_h} [s + \beta^{T(s,[s_l,s_h])-1}(1-s)]dG(s),$$

where $T(s,[s_h,s_h])$ denotes the agreement period for reservation value s under the optimal strategy. The total restructuring payoff equals the maximum payoff when there is no restructuring delay for any s. Otherwise, the total payoff is lower than the maximum payoff. I refer to the difference between these two payoffs as the *ex post efficiency loss.*

The government's expected restructuring payoff, as a share of the maximum restructuring payoff, is given by:

$$w_g = \int_{s_l}^{s_h} [\beta^{T(s,[s_l,s_h])-1}\Big(1 - \frac{b_{T(s,[s_l,s_h])}}{\gamma y}\Big)dG(s),$$

where $b_{T(s,[s_l,s_h])}$ denotes the per-period repayment for each reservation value s. The creditors' expected payoff, as a share of the maximum restructuring payoff, is given by:

$$w_c = \int_{s_l}^{s_h} \Big[s + \beta^{T(s,[s_l,s_h])-1}\Big(1 - \frac{b_{T(s,[s_l,s_h])}}{\gamma y} - s\Big)\Big]dG(s),$$

For each s, the first term in the integral is the creditors' payoff regardless of whether agreement is reached, and the second term is the additional payoff when the restructuring concludes. I refer to the second term as the creditors' *information rent.*

I next consider the restructuring welfare with the perfect secondary market, where the price is fully revealing and the restructuring concludes right away. The total restructuring payoff equals the maximum restructuring payoff, and there is no ex post efficiency loss. Moreover, the creditors receive a per-period payoff equal to their ex post reservation value, still under the assumption that the creditors accept an offer whenever they're indifferent, which implies that the information rent is zero. Therefore, the creditors receive a lower expected payoff, while the government receives a higher one with the perfect secondary market than without the secondary market. These results are summarized in the following proposition:

Proposition 4. *The perfect secondary market has no ex post efficiency loss. Moreover, the government expects a higher payoff, while the creditors expect a lower payoff, under the perfect secondary market than without the secondary market.*

Proof. Available from the author. □

Finally, I examine the restructuring welfare in the case with an imperfect secondary market. The government's expected restructuring payoff, as a share of the maximum restructuring payoff, is given by:

$$w_g^M = \int_0^1 \int_{s_l}^{s_h} \beta^{T(s,\Omega(s,\mu))-1}\Big(1 - \frac{b_{T(s,\Omega(s,\mu))}}{\gamma y}\Big) dG(s) d\mu,$$

where $\Omega(s, \mu)$ denotes the government's updated belief of the creditors' reservation value. The creditors' expected payoff, as a share of the maximum restructuring payoff, is:

$$w_g^M = \int_0^1 \int_{s_l}^{s_h} \Big[s + \beta^{T(s,\Omega(s,\mu))-1}\Big(1 - \frac{b_{T(s,\Omega(s,\mu))}}{\gamma y}\Big) - s\Big] dG(s) d\mu,$$

The total restructuring payoff w^M is the sum of w_c^M and w_g^M.

Since there are no closed-form solutions for the optimal strategies, I study numerically the impact of an imperfect secondary market on the restructuring payoffs. Since the secondary market reduces the information rent, the creditors' expected payoff is the highest in the case without the secondary market, lowest in the case with the perfect secondary market, and intermediate in the case with an imperfect secondary market. The opposite is true for the government's expected restructuring payoff. Since it tends to reduce the restructuring timespan, the secondary market increases the total restructuring payoff.

5 Conclusion

Sovereign debt restructurings are protracted affairs and lengthy negotiations are costly: until an agreement is reached governments cannot resume international borrowing and their creditors cannot realize their investment returns. Therefore, it is important to understand the causes of these delays.

This article emphasizes the effect of information friction in producing delays and the role of the secondary market in reducing them. When negotiating to restructure its debt, the government might prefer to have costly delays if the creditors' reservation value is private information. Though a low restructuring offer might cause costly delays in reaching an agreement, it might also increase the government's payoff if the creditors turn out to have a low reservation value. The more severe the information friction, the longer the maximum restructuring timespan. The secondary market might then reduce the restructuring timespan by lessening the information friction through price revelation.

I also find that the secondary market has important ex post welfare implications, including an increase in the total payoff (by reducing delays and the efficiency loss), and increasing the government's payoff while decreasing the creditors' one (through the reduction of the creditors' information rent). These implications are consistent with the empirical finding that sovereign debt restructurings are on average much shorter for liquid bonds than for illiquid bank loans.