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Sovereign bond prices, haircuts and maturity☆

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ABSTRACT

We document that creditor losses ("haircuts") during sovereign debt restructurings vary across debt maturity. In our novel dataset on instrument-specific haircuts suffered by private creditors in 1999–2020 we find larger losses on short- than long-term debt, independently of the specific haircut measure we use. A standard asset pricing model rationalizes our findings under two assumptions, both of which are satisfied in the data: increasing short-run restructuring risk in the run-up to a restructuring, and high exit yields. We relate our findings to the policy debate on restructuring procedures.

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1. Introduction

The conventional view among policy makers, practitioners and academics is that the treatment of private creditors in sovereign debt exchanges is broadly symmetric across instruments (Institute of International Finance (IIF), 2012, 2015). After all, the pari passu clause, which is commonly included in unsecured cross-border corporate and international sovereign debt contracts, provides that the debt instruments issued under such contracts will rank equally among themselves and with all other present or future unsubordinated and unsecured external debt obligations of the borrower (International Monetary Fund (IMF), 2014). More specifically, the empirical literature on sovereign debt restructurings suggests that private creditor losses ("haircuts") tend to be symmetric across debt instruments of different maturity (e.g., Sturzenegger and Zettelmeyer, 2006, 2008).

In this paper, we challenge this view. We show both empirically and theoretically that creditor losses systematically vary by maturity of debt instrument: haircuts on short-term debt tend to be higher than those on long-term debt.

We establish our results using two different measures of haircuts. The first is a conventional haircut (recovery rate) measure according to Sturzenegger and Zettelmeyer (2006, 2008, SZ hereafter), namely the present value of a new instrument relative to the synthetic present value of the old, restructured bond, which reflects both contractual payment obligations pre exchange and the exit yield of the new bond. The second is an "exchange recovery measure" which is computed based on the prices of the new and old bonds. It accounts for the capital gains and losses during the restructuring process and it can be computed for windows of different length before the actual restructuring date.

To construct the two measures, we have assembled novel datasets on instrument-specific haircuts. Our first dataset on SZ recovery rates covers 531 instruments in 44 sovereign debt restructuring episodes (33 external and 11 domestic) that involved private creditors, over the period 1999–2020. Our second dataset on exchange recovery rates covers 129 instruments in 21 sovereign debt restructuring episodes (17 external and 4 domestic) over the same period. It contains information about exchange recovery rates from 6 to 9 months prior to the announcement of a restructuring up to the exchange in monthly frequency (given availability of price data).

We establish three stylized facts. First, haircuts are larger for short- than long-term bonds if measured according to the standard SZ measure. Second, this continues to hold true when we assess haircuts based on the exchange recovery measure of capital losses. Both stylized facts are robust to controlling for characteristics of the exchanged bonds or the restructuring episodes. Our results hold in both external and domestic restructuring episodes; they hold when restructurings occur preemptively or post default; and they hold independently of the exchange method, that is whether the exchange involves a single menu of new instruments vs. different menus, or maturity extension vs. coupon reduction depending on the type of restructured bonds. The facts are also robust to controlling for instrument- and episode-specific effects and the results hold in all subsamples we consider.

The third stylized fact we report explains the negative link between maturity and exchange recovery: In the run-up to a restructuring episode, short-term bond prices tend to converge from above to long-term bond prices. Again, this fact is robust to controlling for instrument- and episode-specific effects, and it holds across different subsamples and horizons.

Next, we show that a standard asset pricing model rationalizes the three stylized facts under two assumptions: That exit yields of newly issued bonds after a restructuring exceed the coupons of old bonds that were exchanged. And that short-term restructuring risk rises in the run-up to a restructuring. The first assumption is necessary for the model to replicate the observed relationship between the SZ haircut measure and maturity. The second assumption implies convergence from above of short- to long-term bond prices.

Intuitively, a higher discount factor reduces the present value of a bond's principal payment. When the exit yield exceeds the coupon rate then the importance of this discounting effect increases with a bond's remaining maturity. Accordingly, high exit yields depress the synthetic present value of old instruments that were exchanged, and especially so for old instruments with a long maturity. As a consequence, the SZ haircut on such long-term bonds is lower.

Regarding the role of restructuring risk, the price of short-term bonds exceeds that of longer-term bonds (holding all other characteristics constant) as long as investors fear restructuring risk after the maturity date of the short-term instrument. Increasing short-term restructuring risk depresses the price of short-term bonds more strongly than of long-term bonds. In the run-up to a restructuring the prices of short-term bonds therefore exceed the prices of long-term bonds, but less and less so as the exchange approaches. Equivalently, the capital losses on short-term bonds exceed those on long-term bonds, but less and less so as the exchange gets priced in.

When we check whether the two model ingredients are borne out by the data, we find that they are: Exit yields tend to be higher than coupon rates, and short-term restructuring risk, as deduced from the prices of credit default swaps, tends to increase in the run-up to a restructuring. In fact, the two regularities turn out to be stylized facts as well across different subsamples, over different horizons, and also when we control for instrument- and episode-specific effects. We conclude that the simple asset pricing model provides a realistic and plausible explanation for our three main findings.

Our results have important implications for the policy debate on how to best design restructuring procedures. In this debate, which most recently originated in assessments of Collective Action Clauses (CACs), proposals have been made to require uniform haircuts. To analyze the consequences of such a requirement, we contrast two restructuring regimes: A regime with uniform (absolute) exchange in which all affected bondholders receive the same payoff in absolute terms, for instance because they receive the same instrument or can choose from an identical menu of instruments; and a regime with uniform haircut in which all affected bondholders suffer the same relative capital losses.

When we compare the two regimes in the theoretical model we find that replacing uniform exchange by uniform haircut could have important price implications. While it could strengthen the bargaining position of short-term bond holders and provide support to short-term bond prices in the run-up to a restructuring it might simultaneously make long-term bond prices much more sensitive to news about restructuring risk and amplify capital losses before the restructuring actually occurs.

Our paper relates to the empirical literature on creditor losses due to restructurings, specifically Eichengreen and Portes (1986, 1989), Lindert and Morton (1989), SZ, Benjamin and Wright (2013), Cruces and Trebesch (2013), and Meyer et al. (2022). Almost all studies report average haircuts for restructuring episodes. Only a few (SZ; Zettelmeyer et al., 2013) document instrument-specific haircuts for selected episodes. In contrast, we report instrument-specific haircuts for a large sample of restructuring episodes; we document novel stylized facts concerning the relationship between haircuts and maturity; and we propose an explanation for these facts.

Our paper also contributes to the theoretical literature building on Eaton and Gersovitz' (1981) classic framework and studying the maturity structure of sovereign debt.[1] In particular, our paper is related to Broner et al. (2013), Arellano and Ramanarayanan (2012), and Sánchez et al. (2018) who analyze the time variation in sovereign yield curves and expected bond returns for different maturities. These papers emphasize factors that affect default risk (such as output, sudden stop probability or investor risk aversion) but they disregard differential haircuts across maturity, assuming instead that haircuts always equal 100%. By contrast we focus on debt restructuring episodes and analyze the haircut maturity structure and its drivers, both empirically and theoretically.

Finally, our paper has implications for theoretical work on sovereign default and debt renegotiation as a bargaining game between a sovereign debtor and its creditors (see, for instance, Yue, 2010, Bai and Zhang, 2012, Benjamin and Wright, 2013, Hatchondo et al., 2014, Asonuma and Trebesch 2016). These papers aim at explaining haircuts and the duration of renegotiation and they assume that haircuts after default are symmetric across maturities. Our work shows that haircuts differ across maturities, pointing to an additional dimension of debt renegotiations and possibly additional moments for quantitative sovereign debt models to target.

The remainder of the paper is structured as follows. Section 2 defines two measures of creditor losses (haircuts), introduces our datasets, and documents the three stylized facts on haircuts, maturity and bond price dynamics. Section 3 presents a theoretical model of sovereign bond prices to rationalize the stylized facts. Section 4 explores whether two model assumptions are supported by the data and establishes that they are. Section 5 discusses the policy implications of our results. Section 6 concludes.

2. Haircuts, maturity, and bond prices

In this section we define two haircut measures, present the data and establish three novel stylized facts, which are the main findings of the paper. First, haircuts according to the standard SZ measure are larger for short-term bonds than for longer-term bonds. Second, the haircut-maturity relation also is present when we measure haircuts according to a price-based measure of capital losses. And third, the difference between the prices of shorter- and longer-term bonds decreases in the run-up to a debt exchange, with short-term bond prices converging to long-term bond prices from above.

2.1. Empirical results based on SZ haircuts

2.1.1. Measure

SZ propose a haircut measure that is widely used among academics and increasingly so among policy makers and practitioners as well. SZ define the recovery rate (one minus the haircut) as the ratio of the net present values of two cash flow streams, a "new" one and an "old" one, both normalized by the face value of debt. The new cash flow stream reflects the contractually defined payments of the new debt instrument(s) received in the course of a debt exchange; the cash flows are discounted at the yield to maturity of the new instrument(s). The old cash flow stream reflects the contractually defined payments of the old debt instrument that was exchanged; these cash flows are also discounted at the yield to maturity of the new instrument(s).

Let $NPV_t(i,r)$ denote the net present value as of time t of the cash flow stream of a debt instrument i discounted at interest rate r. Moreover, let e denote the new debt instrument after the exchange. Formally, the SZ recovery rate for instrument i exchanged at date T is defined as

$$SZR_T^i \equiv \frac{NPV_T\left(e, r_T^e\right)}{NPV_T\left(i, r_T^e\right)}, \tag{1}$$

where r_T^e denotes the yield to maturity of instrument e at the time of the exchange (exit yield).

2.1.2. Data

2.1.2.1. Dataset. Our dataset on SZ recovery rates covers 44 episodes with 33 external and 11 domestic sovereign debt restructuring episodes over the period 1999–2020 that involve private creditors. Table A1 in the Online Appendix contains more detailed information. To date an episode, we rely on Asonuma and Papaioannou (2016) and Asonuma and Trebesch (2016) for domestic and external restructuring episodes, respectively. Following these authors, we define the start of an episode as the month in which a

[1] See Rodrik and Velasco (1999), Hatchondo and Martinez (2009), Jeanne (2009), Chatterjee and Eyigungor (2012), Fernandez and Martin (2014), Niepelt (2014), Hatchondo et al. (2016), Aguiar et al. (2019), Bigio et al. (forthcoming), Dvorkin et al. (2021), and Mihalache (2021).

Table 1
Scope of dataset.

	Our data	Sturzenegger and Zettelmeyer (2006, 2008)
SZ Haircuts (Recovery Rates)	***44 restructurings*** - 33 external - 11 domestic - 26 with a single menu - 18 with different menus	***15 restructurings*** - 11 external - 4 domestic - 10 with a single menu - 5 with different menus
	531 instruments - only at exchange	***239 instruments*** - only at exchange
Exchange Haircuts (Recovery Rates)	***21 restructurings*** - 17 external - 4 domestic - 12 with a single menu - 9 with different menus	
	129 instruments - from 6 to 9 months before the announcement of restructuring to the exchange	

default occurs or a distressed restructuring is announced; and the end of an episode as the month of the final agreement or of the implementation of the debt exchange.

Our dataset contains information about instrument-specific SZ haircuts as defined previously. For each old instrument *i*, we collect information on its maturity, coupon, payment type, and options. Moreover, we collect the same information for each new instrument *e* that investors received in exchange for *i*. We collect this information from sources including offering memoranda, press releases from governments, issuances database (i.e., Dealogic, Perfect Information) and credit rating agency reports (i.e., Moody's), IMF staff reports, SZ, Cruces and Trebesch (2013), Asonuma and Trebesch (2016), and Asonuma and Papaioannou (2016). For information on market yields of the instruments, we rely on financial sector databases such as Bloomberg, Datastream, and JP Morgan Markit.

The top panel of Table 1 provides information about the scope of our dataset. With data on SZ haircuts for 531 instruments in 44 restructuring episodes, it contains more than twice the number of observations than in the work of SZ. Table A1 in the Online Appendix also reports the number of instruments (bonds) in each restructuring episode.

2.1.2.2. Debt restructuring process. The debt restructuring process starts with the sovereign debtor announcing its intention to restructure or default on debt payments ("announcement of restructuring") without information disclosure on the timing or the terms of the debt exchange, before embarking on negotiations with the creditors, either bilaterally or with the assistance of legal and financial advisors**.** The negotiations can take months or even years and reflect the debtor's macroeconomic situation, proposed adjustments and financing. During this process, information about the likely timing of the actual future exchange (its execution) and its terms gradually is revealed. Once the debtor prepares a final restructuring proposal and "launches the exchange offer," the creditors decide whether to accept or reject it. If the offer is accepted, the exchange of old against new instruments takes place.

The exchange offer typically takes one of two forms. Either all creditors are offered the same set of new instrument(s), regardless of the type of the old instruments, i.e., independently of maturity, amortization profile, or coupon ("exchange with a single menu"). Or creditors are offered different menus depending on the type of debt instruments they hold ("exchange with different menus"). Table A1 in the Online Appendix reports how we classify the restructuring episodes. Our sample includes 26 episodes with an exchange with a single menu and 18 with different menus.

2.1.3. Evidence

Stylized fact 1: According to the SZ recovery rate measure, haircuts on short-term bonds are larger than those on longer-term bonds

Fig. 1 reports recovery rates according to SZ, SZR^i_T, by maturity at the time of exchange together with the regression line. The recovery rate is represented as the residual from a partial regression, i.e., as the part of the SZ recovery rate that is not explained by controls other than maturity. The figure shows that SZ recovery rates on short-term bonds are substantially lower than those on longer-term bonds.

Table 2 provides the corresponding econometric evidence. It reports the results of a cross-sectional regression of the SZ recovery rate on maturity at exchange as well as additional instrument- and episode-specific controls:

$$SZR^{i,j}_T = c + \beta_1 Maturity^{i,j}_T + \beta_2 x^{i,j} + c^j + \epsilon_{i,j} \tag{2}$$

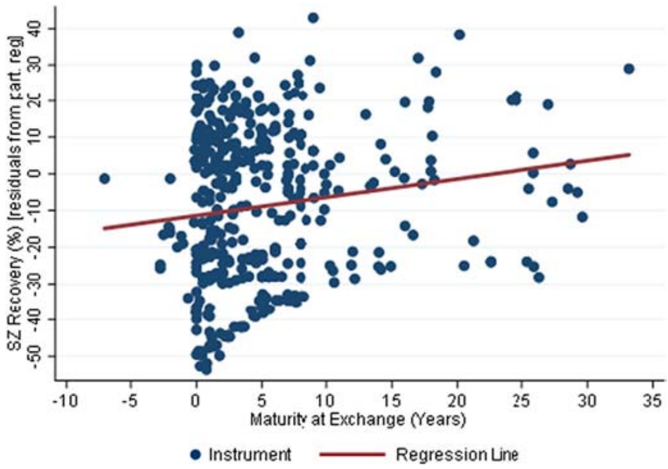

Fig. 1. SZ recovery rates and maturity.
Note: The partial regression residuals are computed from the same regression as regression (2) in Table 2 with the only difference that the variable "maturity of instrument" is not included as a regressor.

Here, $Maturity_T^{i,j}$ denotes the remaining maturity of instrument i at the date of exchange in restructuring episode j; $x^{i,j}$ is a vector of instrument-specific variables, such as the fixed coupon rate, a dummy in case of a floating coupon rate, a dummy for the type of amortization profile (amortization only at maturity ["bullet"] vs. already before maturity); and c^j is an episode-specific fixed effect. Definitions, units and sources of explanatory variables are reported in Table A2 in the Online Appendix.

The main result of Table 2 is that the coefficient on maturity is positive and significant at the one-percent level. The estimated effect is large: on average, the recovery rate on a 10-year bond is 2.9–4.1 percentage points higher than on a 1-year bond. Columns (2) and (3) also reveal the effects of other controls. Instruments with high fixed coupon rates or with floating rates exhibit lower SZ recovery rates. The sign of the effect of the amortization profile is not precisely estimated. The effects of

Table 2
Regression results with SZ recovery rate.

	SZ Recovery Rate				
	Full Sample			Subsample	
	Fixed effects model without controls	Fixed effects model with controls (Baseline)	Random effects model with controls	Single menu	Different menu
	(1)	(2)	(3)	(4)	(5)
	coef/se	coef/se	coef/se	coef/se	coef/se
Maturity of Instrument (years)	0.32***	0.45***	0.45***	0.55***	0.31***
	(0.06)	(0.07)	(0.07)	(0.10)	(0.08)
Coupon Rate (fixed, percent)		−1.41***	−1.38***	−1.56***	−1.33***
		(0.19)	(0.19)	(0.30)	(0.19)
Coupon Rate (float, dummy)		−11.84***	−11.66***	−11.16***	−15.54***
		(2.02)	(2.00)	(3.00)	(2.51)
Amortization Profile (payment before maturity, dummy)		2.10	2.27	−0.25	5.25***
		(1.54)	(1.52)	(2.33)	(1.77)
Duration of Restructuring (years)			−2.05		
			(2.49)		
Preemptive Restructuring (dummy)			13.73		
			(9.32)		
External Debt Restructuring (dummy)			6.09		
			(8.53)		
Constant	53.15***	63.71***	60.07***	62.51***	65.75***
	(0.43)	(1.51)	(11.99)	(2.34)	(1.58)
Episode Fixed Effects	Yes	Yes	No	Yes	Yes
Number of Countries	21	20	20	13	11
Number of Restructurings	44	39	39	21	18
Observations	531	468	468	252	216
Adjusted R-Squared	0.050	0.185	0.184	0.168	0.315

The table reports results of fixed and random effects OLS regressions. The dependent variable is SZ recovery rate (in %). The main explanatory variable is maturity of instrument at the time of exchange. The control variables are instrument-specific controls, restructuring-specific controls, and restructuring fixed effects. Columns (1), (2), (4) and (5) include restructuring-specific fixed effects. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors in parentheses.

restructuring-specific controls (restructuring duration, preemptive restructuring, and external debt restructuring) are only identified in the random effects specification (3); the coefficients are not significant.

We find that SZ recovery rates on short-term bonds are lower even if we restrict the analysis to subsamples of restructuring episodes. Columns (4)–(5) in Table 2, Columns (1)–(6) in Table C1 in the Online Appendix document this for the episodes with a single menu of new instruments; with different menus; with preemptive exchange; with an exchange after default; with external debt; with domestic debt; with an exchange that involves maturity extension; and with an exchange that involves a coupon rate reduction.

Focusing on the role of restructuring strategies, we find that the estimated difference in SZ recovery rates across maturity is smaller in restructurings with different menus (0.31) than in restructurings with a single menu (0.55) (columns 4–5 in Table 2). Similarly, the estimated difference is smaller in post-default restructurings (0.19) than in preemptive restructurings (0.58) (columns 1–2 in Table C1) and it is smaller in domestic debt restructurings (0.16) than in external restructurings (0.73) (columns 3–4 in Table C1). However, there is no difference between the estimated SZ recovery rates in restructurings with maturity extension vs. coupon reduction (columns 5–6 in Table C1).

Qualitatively, the result also is robust to allowing for country-specific fixed effects and when we omit Argentina's 2001 domestic and 2001–05 external restructurings as well as Greece's 2011–12 external debt restructuring (see columns 7 and 8 in Table C1 in the Online Appendix). Finally, Fig. C1 in the Online Appendix illustrates the finding in the case of Greece's 2011–12 restructuring of external debt and Dominica's 2003–04 restructuring of domestic debt.

2.2. Empirical results based on exchange recovery rates

The SZ recovery rate is difficult to relate to fundamental economic notions of capital loss because it relies on a synthetic measure rather than, exclusively, on market prices. Moreover, since this synthetic measure only is defined at the time of the exchange it provides only limited information about the factors that determine the recovery rate. Against this background, we propose a complementary measure of haircuts (recovery rates), which corresponds to the standard concept of capital loss. We show that this alternative measure yields the same stylized fact.

2.2.1. Measure

By definition, the price of a bond equals the market value of the contractually defined cash flow stream discounted at yields to maturity, plus expected recoveries conditional on restructuring. Formally, the ex-coupon price of instrument i at date t equals

$$NPV_t\left(i, r_t^i\right) + EXR_t\left(i, r_t^i\right)$$

where $EXR_t(i, r_t^i)$ denotes expected future recoveries conditional on information at date t. We may then define the "exchange recovery rate"

$$R_{t,T}^i \equiv \frac{NPV_T(e, r_T^e) + EXR_T(e, r_t^e)}{NPV_t(i, r_t^i) + EXR_t(i, r_t^i)} \tag{3}$$

as the ratio of two prices: The numerator is the price of the new instrument immediately after the exchange at date T, and the denominator equals the price of the old instrument at some date prior to the exchange, $t \leq T$.

The exchange recovery rate differs twofold from the SZ recovery rate, even if we consider $t = T$. First, the exchange recovery rate discounts all cash flows and expected recoveries with the yield curve that corresponds to the respective instrument; in contrast, the SZ recovery rate discounts the cash flows of the old instrument with the yield curve of the new instrument. Second, the exchange recovery rate accounts for expected recoveries in addition to contractually agreed payments.

The key advantage of the exchange recovery rate measure is that it is based on market prices. Accordingly, it can easily be computed in a window prior to the exchange. When instruments are no longer traded close to the time of the exchange we can still compute the exchange recovery rate based on some price earlier in time, for instance when the restructuring is announced. In our empirical analysis, we check whether the results are robust to changing the window (t,T) and we find that they are (see Table D1 in the Online Appendix).

2.2.2. Data

Our dataset on exchange recovery rates covers 21 episodes with 17 external and 4 domestic sovereign debt restructuring episodes over the period 1999–2020 that involve private creditors. Table A1 in Appendix A contains more detailed information on each specific episode. As in the case of SZ recovery rates, we rely on Asonuma and Papaioannou (2016) and Asonuma and Trebesch (2016) to date episodes. The dataset contains information about instrument-specific haircuts drawn from financial sector databases such as Bloomberg, Datastream, and JP Morgan Markit.

The bottom panel of Table 1 provides information about the scope of our dataset. With data on exchange recovery rates for 129 instruments in 21 restructuring episodes we have fewer observations than for SZ recovery rates, due to the more limited

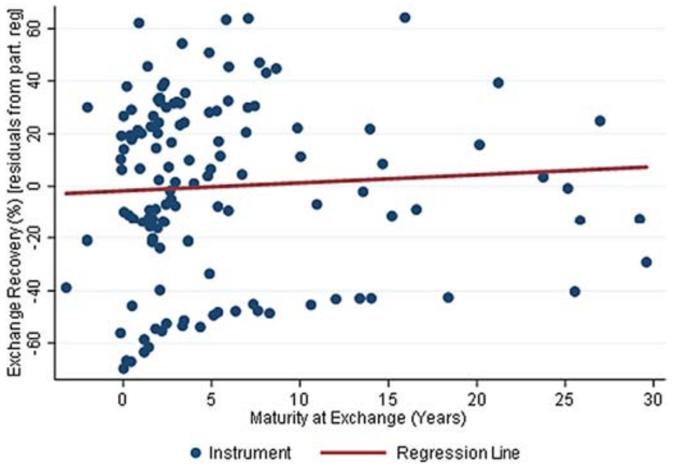

Fig. 2. Exchange recovery rates and maturity.
Note: The partial regression residuals are computed from the same regression as regression (2) in Table 3 with the only difference that the variable "maturity of instrument" is not included as a regressor.

information on bond yields and prices. Where price data is available, the dataset collects information for $R_{t,T}^{i}$ from 6 to 9 months prior to the announcement of the restructuring up to the exchange in monthly frequency.

2.2.3. Evidence

Stylized fact 2: According to the exchange recovery measure, haircuts on short-term bonds are larger than those on longer-term bonds

Fig. 2 reports exchange recovery rates, $R_{t,T}^{i}$, by maturity at the time of exchange together with the regression line. The exchange recovery rate is again represented as the residual from a partial regression. The figure shows that exchange recovery rates on short-term bonds are substantially lower than those on longer-term bonds.

The results of cross-sectional regressions that we report in Table 3 confirm the visual impression. The estimation equation is the same as before (see eq. 2) except that the dependent variable now is the exchange recovery rate. As before, the estimated effect of maturity on the recovery rate is positive, significant at the one-percent level, and large: on average, the exchange recovery rate on a 10-year bond is 9–11 percentage points higher than on a 1-year bond.

As in the case of the SZ recovery rate, instruments with high fixed coupon rates or with floating rates exhibit lower recovery rates (see columns 2 and 3 in Table 3). Pre-maturity amortization and the presence of CACs have a negative, but insignificant effect on recovery rates. In the random effects specification reported in column (3), the coefficients on preemptive restructuring and external debt restructuring are positive, but only the latter is significant.

Also as in the case of the SZ recovery rate, we find lower recovery rates on short-term bonds when we restrict the analysis to subsamples (see columns 4–5 in Table 3 and columns 1–5 in Table D1in the Online Appendix), allow for country-specific fixed effects, or omit Argentina's 2001 domestic and 2001–05 external restructurings as well as Greece's 2011–12 external debt restructuring (see columns 6 and 7 in Table D1 in Online Appendix). Fig. D1 in the Online Appendix illustrates two representative episodes: Uruguay's 2003 restructuring of external debt and Cyprus' 2013 restructuring of domestic debt. Moreover, columns (8) and (9) in Table D1 in the Online Appendix show that our results are robust to computing the exchange recovery rate at different points in time, i.e., 6 months before and after the announcement of a restructuring.

Focusing again on the role of restructuring strategies, we find that the estimated difference in exchange recovery rates across maturity is smaller in restructurings with different menus (0.90) than with a single menu (1.25) (columns 4–5 in Table 3). Moreover, the estimated difference is higher in post-default restructurings (2.03) than in preemptive restructurings (0.82) (columns 1–2 in Table D1) and it is smaller in domestic debt restructurings (0.85) than in external debt restructurings (1.74) (columns 3–4 in Table D1). As before, the restriction to restructurings with maturity extension does not affect the estimated exchange recovery rate differential (column 5 in Table D1).

2.3. Empirical results based on bond prices

Since the exchange recovery rate is computed based on prices, we can easily follow it over time to gain insights into its drivers. This is of particular interest during the time span between the announcement of restructuring and its actual execution through debt exchange.

Stylized fact 3: The price difference between short-term and longer-term bonds decreases in the run-up to the debt exchange, and short-term bond prices converge from above to long-term bond prices

Table 3
Regression results with exchange recovery rate.

	Exchange Recovery Rate Full Sample			Subsample	
	Fixed effects model without controls	Fixed effects model with controls (Baseline)	Random effects model with controls	Single menu	Different menu
	(1)	(2)	(3)	(4)	(5)
	coef/se	coef/se	coef/se	coef/se	coef/se
Maturity of Instrument (years)	1.04***	1.22***	1.13***	1.25***	0.90***
	(0.28)	(0.27)	(0.28)	(0.34)	(0.31)
Coupon Rate (fixed, percent)		−2.71***	−1.94**	−2.06*	−1.67**
		(0.77)	(0.75)	(1.17)	(0.74)
Coupon Rate (float, dummy)		−28.70**	−15.47	−68.44***	0.21
		(11.33)	(10.27)	(18.97)	(9.65)
Amortization Profile (payment before maturity, dummy)		−13.73	−10.71	3.51	−14.75
		(8.47)	(8.15)	(12.75)	(12.78)
CACs		−8.92	−3.27	−6.20	−15.93**
(dummy)		(8.58)	(7.44)	(12.40)	(6.83)
Duration of Restructuring (years)			−0.58		
			(7.72)		
Preemptive Restructuring (dummy)			17.51		
			(15.84)		
External Debt Restructuring (dummy)			28.13**		
			(12.87)		
Constant	82.84***	109.13***	78.06***	104.69***	119.19***
	(2.31)	(6.66)	(20.35)	(8.10)	(7.79)
Episode Fixed Effects	Yes	Yes	No	Yes	Yes
Number of Countries	16	16	16	10	7
Number of Restructurings	21	21	21	12	9
Observations	129	129	129	88	41
Adjusted *R*-Squared	0.115	0.247	0.234	0.294	0.570

The table reports results of fixed and random effects OLS regressions. The dependent variable is exchange recovery rate (in %). The main explanatory variable is maturity of instrument at the time of exchange. The control variables are instrument-specific controls, restructuring-specific controls, and restructuring fixed effects. Columns (1) (2), (4) and (5) include restructuring-specific fixed effects. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors in parentheses.

To establish this stylized fact, we run panel regressions at monthly frequency of the bond price differential (or the bond price level) on time relative to the exchange date, the maturity differential (or maturity), and episode-specific controls:

$$\Delta Price_t^j = c + \beta_1 Time_t^j + \beta_2 \Delta Maturity_t^j + \beta_3 y^j + \epsilon_{j,t}$$

$$Price_t^{i,j} = c + \beta_1 Time_t^j + \beta_2 Maturity_t^{i,j} + \beta_3 y^j + \epsilon_{i,j,t}\ i = s, l \tag{4}$$

where $\Delta Price_t^j = Price_t^{s,j} - Price_t^{l,j}$ and $\Delta Maturity_t^j = Maturity_t^{l,j} - Maturity_t^{s,j}$ denote bond price and maturity differentials between short-term and long-term bonds at time t in debt restructuring j, respectively. y^j is a vector of episode-specific variables such as the duration of the restructuring, restructuring strategy (preemptive vs. post-default), and type of debt (domestic vs. external). As a robustness check for the first specification in eq. (4), we also regress the relative bond price differential on the same independent variables.

Finally, $Time_t^j$ denotes a uniformly decreasing time trend or, alternatively, time dummies. For example, when the announcement occurs a year before the actual exchange, the time trend will take a value of 12 in the month of the announcement and will decrease to 1 in the month before the exchange. In the alternative specification with the dummy variables those variables are specific to 3-month periods (e.g., one dummy for the period 1–3 months before the exchange, the next one for the period 4–6 months before the exchange, etc.).

Table 4 reports the regression results for the short-long bond price differential, the short-term bond price, and the long-term bond price, respectively. Our sample is an unbalanced panel comprised of 14 restructurings and 79 pairs of short- and long-term bonds covering the time period from 3 months prior to the start of the restructuring until 1 month before the exchange. Appendix E in the Online Appendix classifies the short- and long-term bonds in the 14 restructuring episodes. Column (1) corresponds to the specification with a time trend. It shows that the bond price differential increases with distance to the exchange. The estimated coefficient is significant at the one-percent level and indicates that bond prices converge at a rate of 1.2 percentage points per month. Column (2) corresponds to the specification with time dummies. It shows that the price differential decreases from 14.2 percentage points 10 to 12 months prior to the exchange to just 5.9 percentage points in the three months ending with

Table 4
Bond price regression results.

	Bond Price Differential		Short-term Bond Price			Long-term Bond Price			Relative Bond Price Differential
	Decreasing trend	Time dummies	Decreasing trend	Time dummies	Time dummy for entire horizon	Decreasing trend	Time dummies	Time dummy for entire horizon	Decreasing trend
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	coef/se	coef/se	coef/se		coef/se	coef/se		coef/se	coef/se
Decreasing Time Trend until the Exchange Date	1.20***		4.07***			2.93***			1.07***
	(0.06)		(0.12)			(0.11)			(0.11)
Time Dummy for the Entire Horizon prior to Exchange Date					20.88***			12.62***	
					(2.30)			(1.87)	
Time Dummy 1–3 Months until the Exchange Date		5.85***		8.61***			3.12**		
		(0.86)		(1.89)			(1.52)		
Time Dummy 4–6 Months until the Exchange Date		6.56***		18.14***			13.03***		
		(0.89)		(2.02)			(1.57)		
Time Dummy 7–9 Months until the Exchange Date		13.17***		33.25***			22.79***		
		(1.00)		(2.24)			(1.76)		
Time Dummy 10–12 Months until the Exchange Date		14.20***		44.55***			34.62***		
		(1.00)		(2.24)			(1.76)		
Time Dummy 13–15 Months until the Exchange Date		13.42***		38.25***			31.23***		
		(1.54)		(3.41)			(2.70)		
Time Dummy 16–18 Months until the Exchange Date		21.90***		44.21***			26.96***		
		(2.65)		(5.84)			(4.65)		
Time Dummy 19–21 Months until the Exchange Date		26.02***		54.97***			37.84***		
		(2.84)		(6.27)			(5.00)		
Maturity Differential (L - S, year)	0.64***	0.63***							1.00***
	(0.12)	(0.09)							(0.16)
Maturity (year)			−14.07***	−7.87***	−6.10**	−0.58**	−0.62***	−0.78***	
			(2.56)	(1.35)	(2.46)	(0.22)	(0.13)	(0.22)	
GDP Growth Rate	0.11	0.25**	2.04***	2.41***	1.56***	1.92***	1.88***	1.18***	−0.23
(percent)	(0.11)	(0.12)	(0.20)	(0.15)	(0.24)	(0.20)	(0.18)	(0.26)	(0.19)
CACs on Short-term Bonds	0.29	0.21	4.57**	4.21***	7.91***				0.79
(dummy)	(3.30)	(2.61)	(2.27)	(1.26)	(2.21)				(4.56)
CACs on Long-term Bonds	4.84	4.65*				4.19	5.50***	4.90	1.78
(dummy)	(3.36)	(2.65)				(3.24)	(1.94)	(3.24)	(4.64)
Duration of Restructuring (years)	0.63	1.29	−14.22***	−1.96	−5.91	6.95**	5.72***	2.34	1.23
	(1.79)	(1.43)	(4.88)	(2.49)	(4.69)	(3.31)	(1.99)	(3.32)	(2.49)
Strictly Preemptive Restructuring (dummy)	6.91	8.41**	−11.55	9.05**	2.73	18.88**	14.27***	8.66	6.72
	(4.65)	(3.72)	(9.21)	(4.47)	(8.73)	(8.77)	(5.23)	(8.74)	(6.48)
Weakly Preemptive Restructuring (dummy)	13.15	13.65*	−22.97	2.75	−9.88	22.29	18.77*	8.48	13.90
	(9.17)	(7.26)	(14.69)	(7.93)	(14.24)	(16.21)	(9.64)	(16.14)	(12.70)
External Debt Restructuring (dummy)	2.92	3.48**	−26.60***	−26.18***	−14.18***	−31.27***	−31.29***	−22.06***	4.79*
	(2.07)	(1.66)	(2.77)	(1.75)	(2.79)	(3.86)	(2.38)	(3.88)	(2.90)
Constant	−8.62*	−11.94***	102.29***	73.75***	68.14***	54.44***	60.31***	60.74***	−7.18
	(5.16)	(4.14)	(12.19)	(6.35)	(11.76)	(9.93)	(5.97)	(9.96)	(7.15)
Episode Fixed Effects	No	No	No	No	No	No	No	No	No
Number of Restructurings	14	14	14	14	14	14	14	14	14
Number of Pairs of Instruments	79	79	79	79	79	79	79	79	79
Observations	757	757	757	757	757	757	757	757	757
Adjusted R-Squared	0.216	0.255	0.572	0.598	0.304	0.542	0.563	0.337	0.186

Columns 1–9 report random effects OLS regression results. The dependent variable is bond price differential (price of short-term bond - price of long-term bond) for columns 1–2, price of short-term bond for column 3–5, price of long-term bond for column 6–8, and relative bond price differential (bond price differential / price of short-term bond) for column 9. The main explanatory variables are a decreasing time trend until the exchange date (in months, decreasing to 0 at exchange), time dummies specific to 3-months periods covering the 15 months prior to the exchange, a time dummy equal one over the entire horizon prior to the exchange, maturity differential (maturity of long-term bond - maturity of short-term bond) and maturity of short-term and long-term bonds at the time of exchange. The control variables are instrument-specific and episode-specific controls. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors in parentheses.

the exchange. Both estimates are significant at the one-percent level. In either specification, we control for maturity differential and include episode-specific controls.

Columns (3) to (8) correspond to specifications with bond prices (rather than price differentials) as the dependent variable. According to the estimates reported in columns (3) and (6), short-term bond prices fall on average by close to 4.1 percentage points per month while long-term bond prices decrease by 2.9 percentage points. That is, both short- and long-term bond prices fall in the run-up to the exchange but the decline is steeper for short-term bonds. Columns (4) and (7) report similar results in the specification where we use time dummies rather than a time trend: The coefficients on the dummies are declining for both bonds but more strongly for the short-term bond. Indeed, short-term bond prices decrease by 33.3 percentage points over the last 9 months before the exchange, while long-term bond prices decrease by only 22.8 percentage points. Throughout the 21 months prior to the exchange, the estimated time dummy coefficients for short-term bonds exceed those for long-term bonds indicating higher prices for short-term bonds. Columns (5) and (8) report the results from a specification with a single time dummy for the entire horizon prior to the exchange. The estimated coefficients indicate that short-term bond prices exceed long-term bond prices in the run-up to the exchange.

When we consider relative rather than absolute bond price differentials, we find similar results (column 9).

Columns (1)–(9) also reveal the effects of other controls. Maturity differential (measured as the difference between long- and short-term maturity) affects the bond price differential positively and significantly (columns 1–2) and GDP growth has a positive and significant effect. The effect of CACs on the price differential is not significant (columns 1–2) although CACs do affect both short- and long-term price levels (columns 3–5, 7).

Fig. 3 illustrates the estimated time trends. It shows how the bond price differential (panel i) as well as short- and long-term bond prices (panel ii) typically evolve in our sample of restructuring episodes. Both panels show the residuals from partial regressions corresponding to the estimates reported in Table 4, columns (1), (3) and (6). The negatively sloped lines indicate that prices and price differentials decline in the run-up to the exchange and that short-term bond prices converge from above to long-term bond prices.

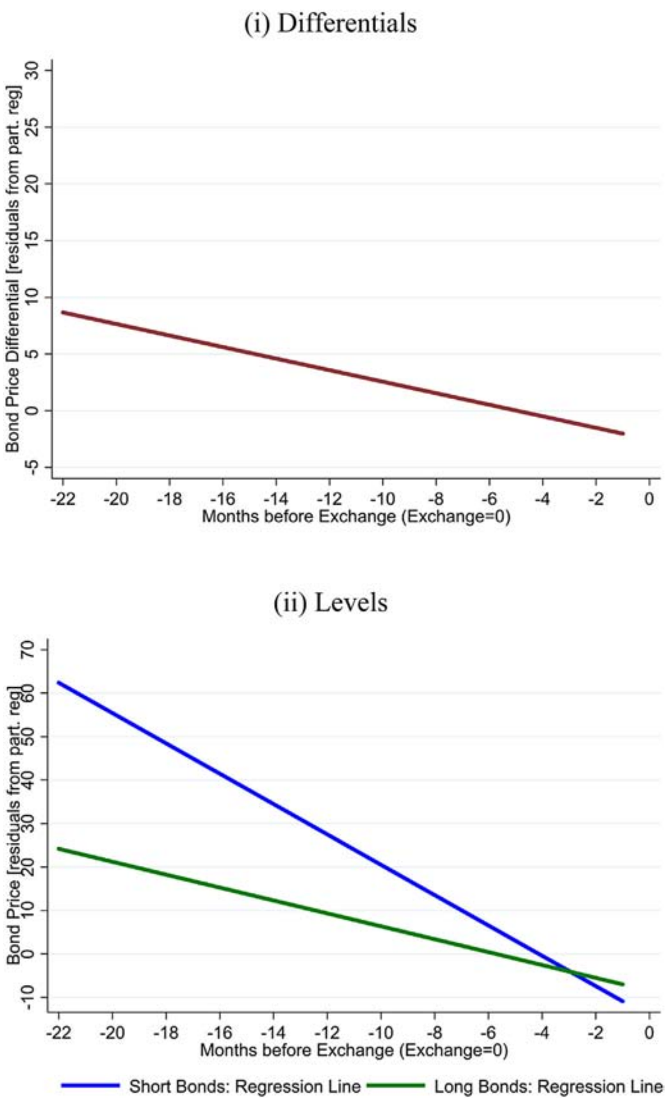

Fig. 3. Bond price differentials and levels.

The magnitude of the estimated time effects does not change much when we focus on subsamples, including a subsample of restructurings subject to CACs (see columns 1–7 in Tables E1, E2, and E3 in the Online Appendix). The only exception is the subsample of episodes with only domestic restructurings; here, both short- and long-term bond prices fall in the run-up to the exchange but the decline is steeper for long-term bonds (column 6 in Tables E2 and E3). Other than that, price convergence from above is a robust finding. The coupon rate differential affects the price differential positively and significantly (column 8 in Table E1). Public debt affects the price differential negatively and significantly, short-term bond prices negatively and significantly but long-term bond prices positively and significantly (column 9 in Tables E1, E2, and E3). Fig. E1 illustrates two country cases, Ukraine's 2000 restructuring and Greece's 2011–12 restructuring of external debt.

3. Theoretical model

We have identified three stylized facts regarding haircuts and the dynamics of bond prices between the announcement and the actual execution of a bond exchange. First, haircuts are larger for short-term bonds if measured according to the standard SZ measure. Second, this continues to hold true when we measure haircuts according to our price based measure of capital losses. And third, in the run-up to the debt exchange, the prices of short-term bonds fall more strongly than those of long-term bonds, with short-term bond prices converging to long-term bond prices from above.

To rationalize these findings we adapt a standard discrete-time asset pricing model to the specificities of sovereign debt markets. Let q_t^m denote the date-t ex-coupon price of a bond which matures at date m. The bond's contractually agreed coupon and principal payments equal c and 1, respectively. We assume that investors are risk-neutral (or that probabilities are defined with respect to risk-neutral measures) and that the risk-free interest rate is constant at gross rate $R > 1$. Moreover, we assume that conditional on a restructuring having been announced but not yet executed, the probability of execution in the subsequent period equals $1 - p$ where $0 < p < 1$; the expected recovery in case of execution equals x where $0 < x < 1$.

Let $E_t[q_T^m]$ represent the expected (as of date t) bond price conditional on no restructuring up to date T, where $t < T \le m$, and let $\pi \equiv p/R$. The bond price can then be expressed as[2]

$$q_t^m = \left(1-\pi^{T-t}\right)\varphi + \pi^{T-t}E_t\left[q_T^m\right] = \left(1-\pi^{m-t}\right)\varphi + \pi^{m-t}1 \tag{5}$$

where $\varphi \equiv [pc + (1-p)x]/(R-p)$ denotes the market value of an infinite, probability-weighted flow of coupon payments and recoveries. That is, the price equals a weighted average of the coupon-and-recoveries-flow value on the one hand and the terminal price or principal payment on the other. As the maturity date approaches, the relative weight of the latter component rises. If $q_t^m = 1$, then the coupon exactly compensates the investors for the risk they bear: φ equals one in this case or equivalently, $R = p(1+c) + (1-p)x$.

We are interested in the dynamics of short- and long-term bond prices, q_t^s and q_t^l respectively, where $t \le s < l$. The bonds pay the same coupon and are exposed to the same risk (p and x). Suppose that a restructuring has been announced (as is the case in each episode of our dataset) such that prices are below par because $\varphi < 1$ and $E_t[q_s^l] < 1$. Letting $\Delta_t^{s,l} \equiv q_t^s - q_t^l$ denote the price difference we have the following result:

Result 1: $\Delta_t^{s,l}$ is strictly positive: $q_t^s > q_t^l$.

Intuitively, the risk that the restructuring occurs only after date s (reflected in $E_t[q_s^l] < 1$) lowers q_t^l relative to q_t^s.

Consider next the effect of the passage of time on bond prices, absent any news about p or x. We have the following result[3]:

Result 2: Absent news, q_t^m and $\Delta_t^{s,l}$ increase as time proceeds: $\partial q_t^m/\partial t > 0$ and $\partial \Delta_t^{s,l}/\partial t > 0$.

Intuitively, as time goes by and the maturity date approaches, the bond price converges from its depressed value to the price at maturity, which equals one. Moreover, the effect on the price of a short-term bond is stronger than on the price of a long-term bond. This implies *divergence* of short- and long-term bond prices between the announcement and the actual execution of a restructuring, in contrast with the stylized fact documented earlier. To reconcile the model with the data we introduce news about $1 - p$, the conditional restructuring probability. We assume that this probability increases at the "short end," between dates t and s. Differentiating $\Delta_t^{s,l}$ with respect to $1 - p$, holding $E_t[q_s^l]$ fixed, yields the following result[4]:

Result 3: $\Delta_t^{s,l}$ decreases as short-term restructuring risk increases: $\partial \Delta_t^{s,l}/\partial(1-p) < 0$.

Intuitively, the expected price difference at date s equals $1 - E_t[q_s^l] > 0$. Holding this expected price difference constant the discounted (by π^{s-t}) expected price difference decreases as p falls. Result 3 implies that increased restructuring risk at the short end generates price convergence between short- and long-term bonds as we observe it in the data. Moreover, since $q_t^s > q_t^l$ and $\partial \Delta_t^{s,l}/\partial(1-p) = \partial q_t^s/\partial(1-p) - \partial q_t^l/\partial(1-p) < 0$, we have:

Result 4: Short-term bond prices approach long-term bond prices from above as short-term restructuring risk increases.

In conclusion, the simple model can rationalize the second stylized fact and, under the assumption that conditional restructuring risk increases at the "short end," also the third stylized fact.

Next, we turn to the first stylized fact which concerns the SZ haircut measure. Recall that this measure is based on a comparison of the discounted values of two payment streams: The contractually agreed payments of the old instrument and the

2 Note that $q_t^m = [pc + (1-p)x]/R(1 + \pi + \ldots + \pi^{T-t-1}) + \pi^{T-t}E_t[q_T^m]$ or, equivalently, $q_t^m = [pc + (1-p)x]/R(1 + \pi + \ldots + \pi^{m-t-1}) + \pi^{m-t}$. Moreover, $\varphi \equiv [pc + (1-p)x]/(R-p) = [pc + (1-p)x]/R(1 + \pi + \pi^2 + \ldots)$.

3 Note that $q_{t+1}^m - q_t^m = (1-\varphi)(\pi^{m-t-1} - \pi^{m-t}) \propto \pi^{m-t} > 0$. Also, $\Delta_{t+1}^{s,l} - \Delta_t^{s,l} = (q_{t+1}^s - q_t^s) - (q_{t+1}^l - q_t^l) \propto \pi^{s-t} - \pi^{l-t} > 0$.

4 Note that $\Delta_t^{s,l} = \pi^{s-t}(1 - E_t[q_s^l])$. For fixed $E_t[q_s^l]$ an increase in $1 - p$ therefore lowers $\Delta_t^{s,l}$. When the conditional restructuring probability also changes in the long term then $E_t[q_s^l]$ changes as well and the effect of $1 - p$ on $\Delta_t^{s,l}$ is ambiguous.

contractually agreed payments of the new instrument, both discounted at the exit yield, $\tilde{R}$. Let $\tilde{q}_t^m$ denote the present value associated with the old instrument:

$$\tilde{q}_t^m = \left(1-\tilde{R}^{-(T-t)}\right)\tilde{\varphi}+\tilde{R}^{-(T-t)}E_t\left[\tilde{q}_T^m\right] = \left(1-\tilde{R}^{-(m-t)}\right)\tilde{\varphi}+\tilde{R}^{-(m-t)}1, \tag{6}$$

where $\tilde{\varphi} \equiv c/(\tilde{R}-1)$. Condition (6) follows from condition (5) when we set $p = 1$ and replace R by $\tilde{R}$. The SZ haircut for a short-term bond with maturity date s exceeds the haircut for a long-term bond with maturity date $l(l > s)$ if and only if $\tilde{q}_t^s > \tilde{q}_t^l$ (because both bonds are exchanged against the same new (set of) instrument(s)). Accordingly, the model implies the first stylized fact if and only if it implies $\tilde{q}_t^s > \tilde{q}_t^l$. Consider the case of an exit yield that exceeds the coupon of the old instrument, $\tilde{R}-1 > c$ (see Sturzenegger and Zettelmeyer, 2008). The model then implies $\tilde{q}_t^s > \tilde{q}_t^l$ and thus the following result:

Result 5: With high exit yields ($\tilde{R}-1 > c$), haircuts according to the SZ measure are decreasing in maturity.

This result is driven by the fact that a later maturity date reduces the present value of the bond's principal payment. The effect dominates the counteracting effect due to prolonged coupon payments when the discount factor is sufficiently high ($\tilde{R}-1 > c$) such that $\tilde{\varphi} < 1$.

In conclusion, our simple model therefore also rationalizes the first stylized fact under the assumption that exit yields are high.

4. Empirical tests of the model's assumptions

We have shown that basic theory can explain the three stylized facts if we assume that short-term restructuring risk rises in the run-up to a restructuring and exit yields are higher than coupon rates. We now establish that these two assumptions are borne out by the data. Accordingly, the model provides a realistic and plausible explanation for the three key stylized facts.

4.1. Exit yields on new bonds

Stylized fact 4: Exit yields on new bonds are higher than coupon rates on old bonds.

Fig. 4 documents the fact. It plots exit yields on the vertical axis against coupon rates on the horizontal axis for our sample of restructurings. The figure shows that exit yields are systematically higher than (fixed) coupon rates.

Table 5 presents the corresponding statistical tests, i.e., t-statistic tests on the difference between exit yields of new bonds and fixed coupon rates of old bonds. Column (1) shows results for all bond instruments with fixed non-zero coupon rates, while columns (2) and (3) show results for subsamples of restructurings with a single menu of new instruments and different menus, respectively. The main result of Table 5 is that exit yields of new bonds tend to exceed the coupon rates of the old bonds. The difference between the two rates is significant at the one-percent level, and quantitatively large: exit yields are higher by around 5 percentage points.

Approximately the same holds true in subsamples of restructuring episodes where the exchange involves a single menu of new instruments or different menus; the exchange occurs preemptively or after default; and the sovereign restructures external debt or domestic debt (see columns 2–3 in Table 5 and columns 1–4 in Table F1 in the Online Appendix).

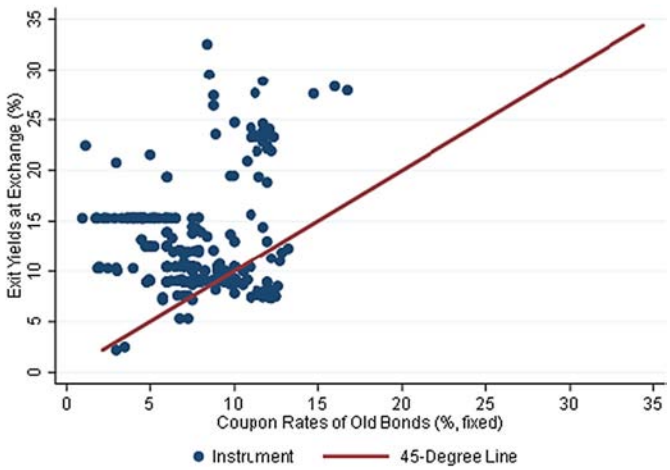

Fig. 4. Exit yields on new bonds and coupon rates of old bonds.
Note: Bonds with floating rates and zero-coupon bonds are excluded.

Table 5
Coupon rates vs. exit yields: statistical tests.

		Pair: Exit Yields - Coupon Rates, Non-zero Coupon Rates		
		Baseline	Single menu	Different menu
		(1)	(2)	(3)
		coef/se	coef/se	coef/se
Mean		4.76	7.52	2.44
Standard Error		0.37	0.68	0.26
95% Confidence Interval	Lower	4.04	6.17	1.92
	Upper	5.48	8.86	2.95
t-statistics		12.96	11.02	9.39
Degree of Freedom		353	161	191
Prob(T > t)		0.00***	0.00***	0.00***
Observations		354	162	192
Number of Restructurings		37	22	15

Columns 1–3 report t-statistic test results. The pair variables are exit yields of new instruments and fixed coupon rates of non-zero coupon rates old instruments. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

4.2. Restructuring risk

Stylized fact 5: Short-term restructuring risk increases in the run-up to the exchange.

To establish this last fact, we estimate the term structure of restructuring risk in those restructuring episodes for which Credit Default Swap (hereafter CDS) spreads over different horizons are available. The main inputs for the estimates are the CDS spread curve and the US Treasury bill yield curve, which proxies for the risk-free term structure. Following Ranciere (2002), we assume no arbitrage, risk neutrality, and perfect foresight with respect to recovery face values, i.e., time-invariant recovery face values.

More specifically, we use annual yield curve data and linear interpolations to construct estimates of the CDS spread curve for horizons between 1 and 120 months, at monthly frequency. We then use no arbitrage conditions to derive the forward default spread curve. This curve measures the implied one-month ahead conditional restructuring risk. Finally, we use the risk-neutrality assumption and perfect foresight on recovery face value to derive the implied one-month ahead conditional restructuring probability. Online Appendix B contains a step-by-step explanation of the methodology.

Fig. 5 reports our conditional restructuring probability estimates at the one-year horizon for two cases: Ecuador's 1999–2000 external debt restructuring and Greece's 2011–12 external debt exchange. In either case, the conditional short-term restructuring probability increased substantially in the run-up to the exchange.

Table 6 provides econometric support. It reports the results of panel regressions at monthly frequency of the conditional restructuring probability at the one-year horizon on a decreasing time trend and episode-specific controls:

$$Prob_t^j = c + \beta_1 Time_t^j + \beta_2 y^j + \epsilon_{j,t} \tag{7}$$

where $Prob_t^j$ denotes the monthly conditional restructuring probability over the one-year horizon at time t in debt restructuring j; $Time_t^j$ denotes the decreasing time trend introduced in Section 2.3; and y^j denotes the same vector of episode-specific controls as in Section 2.3. Our hypothesis is that β_1 is negative, i.e., that short-term restructuring risk rises as the exchange approaches.

Table 6 shows results for the unbalanced panel of 12 restructurings covering the time period from 3 months prior to the start of a restructuring to 1 month before the exchange where CDS spreads over different horizons are available. The main finding is that the conditional restructuring probability increases in the run-up to the exchange. This effect is significant at the one-percent level, and quantitatively large: over 6 months the restructuring risk increases by 20 percentage points. Regarding the effect of restructuring-specific controls, the duration of restructuring turns out to reduce the conditional restructuring probability, possibly because restructuring probability gradually increases for restructuring episodes with longer duration.

We observe the same pattern when we use two- rather than one-year restructuring probability measure, as reported in columns (3)–(4) in Table 6. The increase in short-term restructuring probability is approximately the same under the assumption of time-variant recovery face values as reported in Table G1 in the Online Appendix. Figs. G1 presents restructuring probabilities in the case of time-variant recovery face values for the same two episodes (Ecuador 1999–2000 and Greece 2011–12).

5. Discussion: uniform exchange vs. uniform haircut

Our finding that haircuts on short-term bonds are systematically higher than on long-term bonds raises the question whether alternative restructuring protocols, specifically arrangements with more uniform haircuts, could be beneficial. Such arrangements would impose a uniform recovery *rate* across all affected instruments rather than a uniform exchange or *absolute* recovery. In the policy debate among academic researchers and policy makers this question has been discussed (International Monetary Fund (IMF), 2014, Gelpern et al., 2016), most recently in the context of CACs and particularly, aggregate CACs (“single limb” CACs) that the International Capital Market Association (ICMA) sets as a new standard (International Capital Market Association (ICMA), 2015).

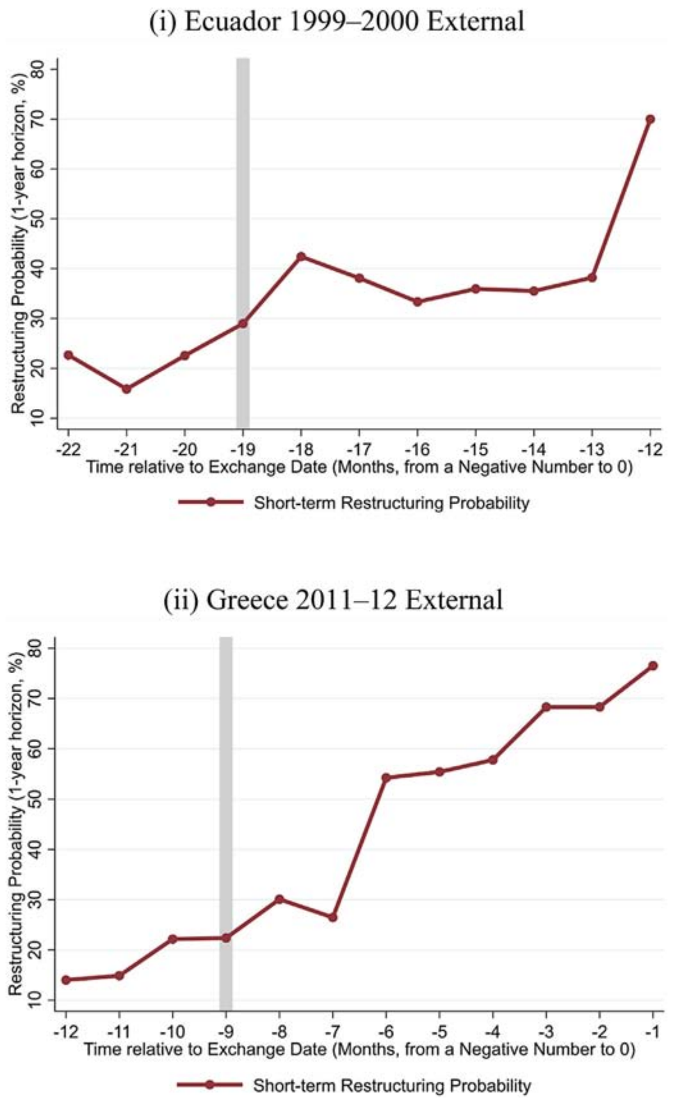

Fig. 5. Restructuring probability: constant recovery face value.
Note: Grey bars indicate the date of the announcement of restructuring.

The argument in favor of a uniform haircut restriction is that it could protect minority bondholders in the face of shifts from "double limb" to "single limb" clauses. Under single limb clauses votes are simply aggregated across all bond classes while conventional double limb or series-by-series clauses require majorities both among members of a creditor class and in the aggregate. As a consequence, the shift to single limb clauses could leave specific creditor classes exposed to larger risks. In particular, it could open the possibility for creditors of long-term bonds with a super majority to impose harsher haircuts on short-term bond creditors. A uniform haircut requirement could limit these risks.

The discussion about uniform haircuts also relates to the legal concept of *pari passu* and its interpretation in a large body of sovereign debt literature. As it turns out, that interpretation sometimes is too simplistic. As legal scholars as well as International Capital Market Association (ICMA) (2015) have recently re-clarified, *pari passu* (which means "equal ranking") prevents that during a restructuring episode one type of debt is subordinated to another one; but it does not require that all creditors are paid ratably, i.e., at the same time on the same terms.[5] As a consequence a restructuring rule imposing uniform haircuts rather than uniform exchange across creditors would be consistent with the *pari passu* clause.

[5] While some controversy emerged after the *NML v. Argentina* decision on what *pari passu* means, and whether it requires that all creditors are always paid ratably the issue has now largely been resolved. Buchheit and de la Cruz (2018) argue that *pari passu* does not require all creditors to be paid ratably, consistent with ICMA's (2015) Pari Passu clause for sovereign debt contracts which states: "The Bonds rank and will rank without any preference among themselves and equally with all other unsubordinated External Indebtedness of the Issuer. It is understood that this provision shall not be construed so as to require the Issuer to make payments under the Bonds ratably with payments being made under any other External Indebtedness."

Table 6
Restructuring probability regression results.

	Restructuring Probability 1-year Horizon (%) Constant Recovery Face Value		Restructuring Probability 2-year Horizon (%) Constant Recovery Face Value	
	Random effects model	Random effects model with controls	Random effects model	Random effects model with controls
	(1)	(2)	(3)	(4)
	coef/se	coef/se	coef/se	coef/se
Decreasing Time Trend until the Exchange Date	−3.32***	−3.35***	−3.25***	−3.28***
	(0.38)	(0.39)	(0.36)	(0.36)
Duration of Restructuring (years)		−1.60		−1.42
		(7.78)		(7.69)
Strictly Preemptive Restructuring (dummy)		−2.85		−2.25
		(14.12)		(13.96)
Constant	81.28***	84.32***	77.20***	79.78***
	(6.97)	(13.38)	(6.79)	(13.17)
Episode Fixed Effects	No	No	No	No
Number of Restructurings	12	12	12	12
Number of Time Periods (months)	5–20	5–21	5–21	5–21
Observations	159	159	159	159
Wald Chi-Squared	74.55	75.46	80.58	81.43
Adjusted R-Squared	0.366	0.366	0.381	0.381

Columns 1 and 2 report random effects OLS regression results. The dependent variable is the conditional restructuring probability at the 1-year horizon (%). The main explanatory variable is the decreasing time trend until the exchange date (in months, decreasing from a positive number to 0 at exchange). The control variables are episode-specific controls. Significance levels denoted by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors in parentheses.

To assess possible consequences of a uniform haircut we extend the model developed in Section 3. Rather than assuming a fixed recovery x on all restructured maturities, as we did in Section 3, we now assume that the post restructuring payoff of an instrument equals the instrument's price pre restructuring multiplied by a factor that is common to all maturities. The haircut thus is uniform as well and equals one minus the factor.

Fig. 6 compares the price dynamics of short- and long-term bonds over a period of six months under to the two alternative restructuring protocols. We assume that under the conventional protocol the recovery for both maturities equals $x = 0.25$ while under the uniform-haircut protocol the recovery equals 0.6 times the price in the previous period, i.e., the uniform haircut in this alternative protocol equals 40%. We choose these values because they imply that the expected recovery on a portfolio consisting of a pair of short and long bonds over the first six months is approximately the same under the two protocols.

The top left panel of Fig. 6 illustrates the price paths of the short-term bond and the top right panel the price paths of the long-term bond, with solid lines representing prices under the original protocol and dashed lines representing prices under the uniform-haircut protocol. The shift to uniform haircuts has minor effects on short-term bond price dynamics because the short-term price mainly is anchored by the repayment at the near maturity date. In contrast, the shift strongly reduces the price of long-term debt, which is no longer anchored by the fixed recovery as it is under the original protocol. As a consequence, short- and long-term bond prices no longer converge.

The third panel displays the implied haircuts. Under the uniform-haircut protocol they are constant and equal to each other by construction, at 40% (indicated by the dashed line). Under the original protocol, in contrast, the haircut on the long-term bond is smaller than on the short-term bond for the reasons discussed in Section 3.

We conclude from this simple exercise that the price implications of moving from uniform exchange to uniform haircuts could be substantial. While such a move could strengthen the bargaining position of short-term bond holders and provide support to short-term bond prices in the run-up to a restructuring it might simultaneously make long-term bond prices much more sensitive to news about restructuring risk and amplify capital losses before the actual restructuring occurs.

6. Conclusion

This paper analyzes private creditor losses (haircuts) across sovereign debt instruments during restructuring episodes. Contrary to conventional wisdom, we find that creditors are not treated equally: Haircuts on short-term debt tend to be larger than on longer-term debt. This holds true independently of whether we compute haircuts according to the standard SZ measure or a price-based measure of capital losses. Our new comprehensive dataset also reveals that, in the run-up to a debt exchange, prices of short-term bonds converge from above to those of longer-term bonds. A standard asset pricing model rationalizes these stylized facts under the assumption that exit yields exceed coupon rates and short-run restructuring risk increases in the run-up to a restructuring. As we show, these assumptions are borne out by the data.

Our findings have direct implications for the theoretical sovereign debt literature, which typically assumes that haircuts are symmetric. As we show in this paper, the data reject this assumption. Our findings are also relevant for a host of policy issues

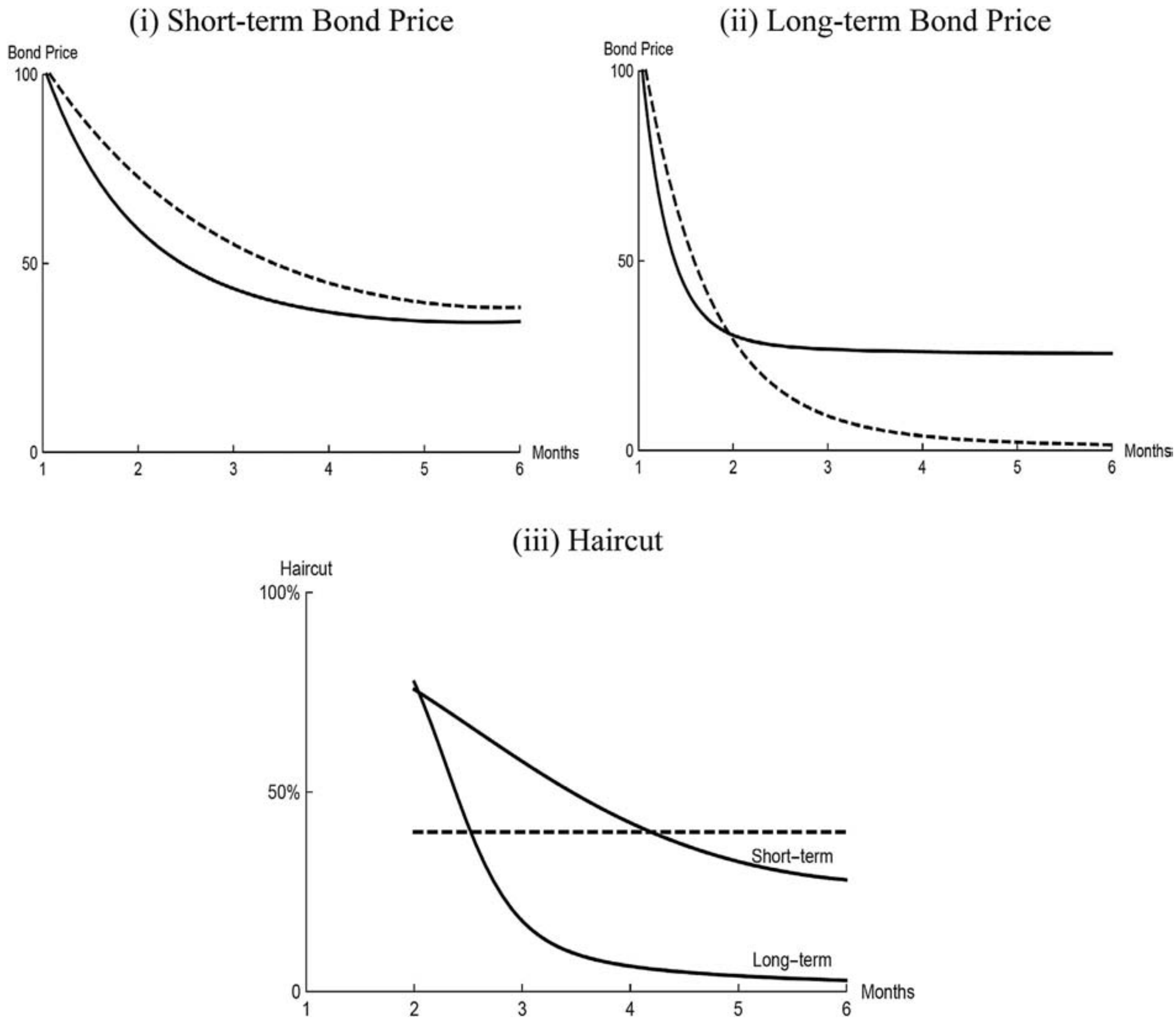

Fig. 6. Uniform exchange vs. uniform haircut: bond price dynamics.
Note: The simulation is based on the following assumptions: The coupon c on all bonds equals 5% and the risk-free rate $R-1$ 1% annually; the maturity of the short- and the long-term bond initially equals 10 and 36 months, respectively; in month $t=1, 2, \ldots$ investors anticipate a monthly conditional restructuring probability of $1-p$ with $p=(0.9)^{t-1}$.

including, but not limited to, *pari passu* and CACs; the negotiation process during debt restructuring episodes; the value at risk of debt securities of different maturity (and thus, of financial institutions which hold these securities); or debt management more broadly. Specifically, the simple model that rationalizes our empirical findings suggests that a shift from uniform exchange to uniform haircuts as recently proposed could be problematic because of its wide ranging implications for bond prices.

Data availability

JIE-Asonouma-Niepelt-Ranciere (Original data) (Mendeley Data).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jinteco.2022.103689.

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