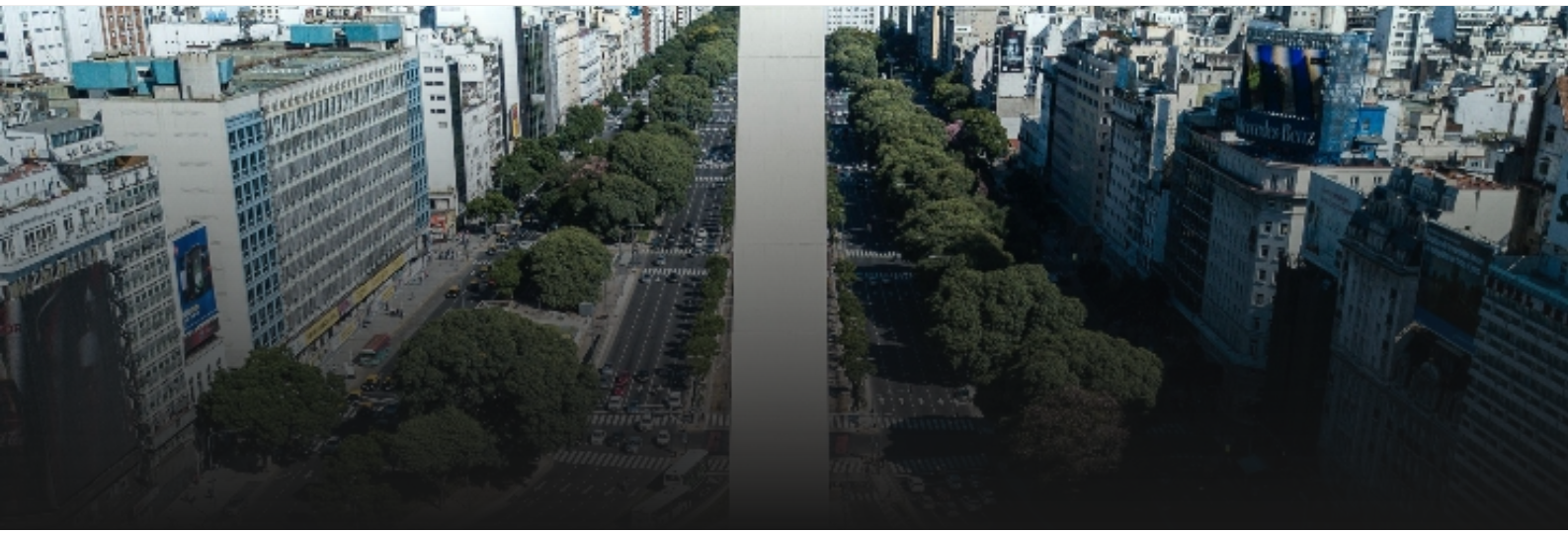


Francisco Roch Francisco Roldán April 23rd, 2021

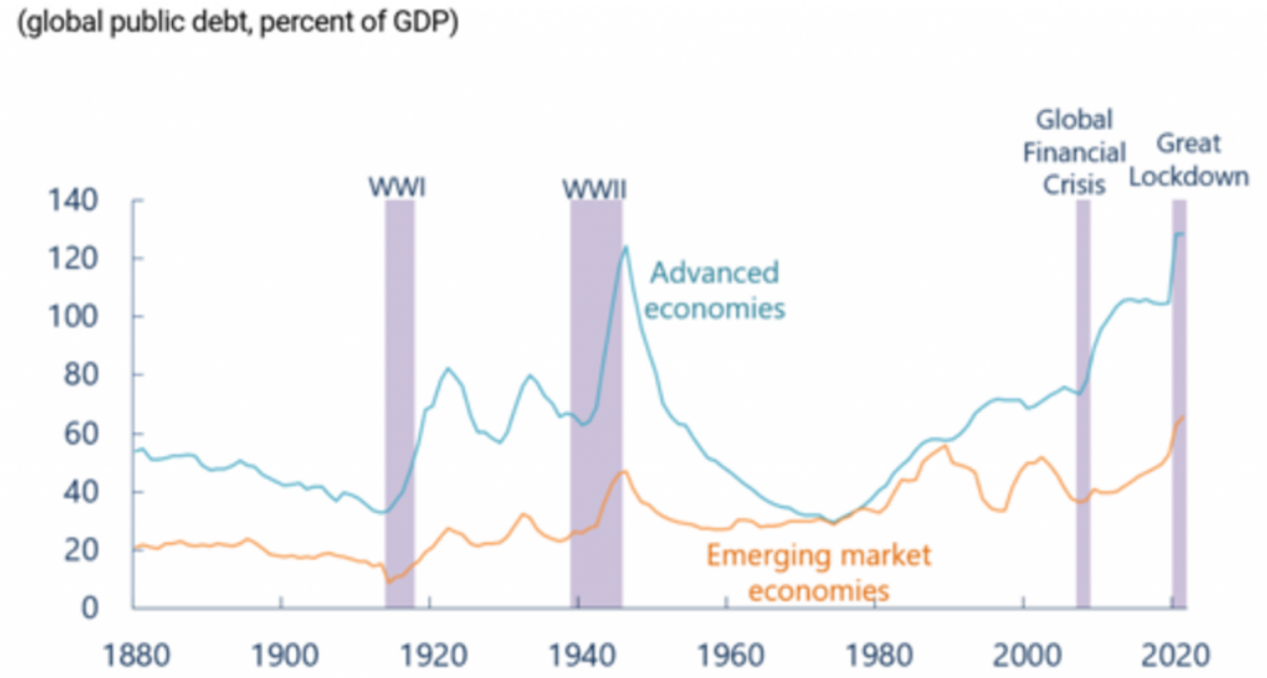
GDP-linked bonds: why so few, and why so expensive?

Estimated reading time: 4 minutes

With governments around the world facing potential strain to mount responses to COVID-19, state-contingent sovereign debt instruments that would provide automatic debt relief have come to the forefront of policy debates. ***Francisco Roch*** *and* ***Francisco Roldán*** *propose a framework to understand why such instruments have found limited success so far and propose ways to improve their design.*

In response to the COVID-19 pandemic, most economies have implemented large fiscal stimulus programs that pushed public debt to their historical highest levels (Figure 1). These developments have renewed interest in proposals for state-contingent debt instruments as a strategy to reduce the likelihood of future costly debt crises (e.g., IMF 2020). In theory, state-contingent debt instruments that allow a sovereign issuer to reduce payments when times are bad have many benefits: they decrease default risk, reduce cyclicality of fiscal policy, and improve risk sharing (Hatchondo and Martinez, 2012; Bertinatto et al. 2017 *).

Figure 1. Update of World Economic Outlook, June 2020



Sources: Historical Public Debt Database; IMF World Economic Outlook; Maddison Database Project; and IMF staff calculations

Despite these well-understood advantages, state-contingent debt instruments are scarce in practice and countries have not been able to issue them at a reasonable premium. Take the GDP warrants Argentina issued as part of its 2005 debt restructuring: the premium on these instruments, after taking out default risk, were estimated to be as wide as 1200 bps at issuance and to have declined to a still high 600 bps (Costa et al. 2008). This is often interpreted as a premium for "novelty"—that investors demand a premium because they are not familiar with the instruments. Surprisingly, there is little theoretical analysis investigating the reasons behind these premia and the lack of indexation in sovereign debt markets remains a puzzle.

Why are state-contingent bonds priced so unfavourably?

In Roch and Roldán (2021), we propose a framework to rationalise the unfavourable prices of observed state-contingent debt instruments. The framework is based on a resolution of the equity premium puzzle and allows us to understand why these instruments have found limited success so far. In essence, the hinderance may be related not to what investors know that they don't know but rather what investors do not know that they do not know. We analyse how lenders' concern about model misspecification—that models may fail to alert them to the unknown unknowns—could affect the desirability of issuing state-contingent debt instruments.

We evaluate prices and welfare effects of state-contingent debt using a standard quantitative model of sovereign debt and strategic default, augmented with international lenders' preferences for robustness to model misspecification (Hansen and Sargent, 2001;

Pouzo and Presno, 2016). These lenders have in mind a statistical model to evaluate future outcomes, but do not trust it fully. Therefore, they consider possible alternative models and seek actions that would perform well under all of these models.

For the commonly used threshold state-contingent bond structure (e.g., the GDP-linked warrants issued by Argentina in 2005, Greece in 2012, Ukraine in 2015, only pay when GDP growth satisfies a certain threshold), there is an "ambiguity" premium in bond spreads that can explain most of the residual labelled as novelty premium. As investors seek robust decision rules that perform well under all known and unknown unknowns, they act as if the probability of bad states is higher and demand compensation to hold bonds that do not pay when times are bad. This additional source of premia leads to welfare losses for the issuing sovereign.

A simple example

To illustrate how robustness affects bond prices, imagine a country facing the following distribution of future income:

Table 1. Hypothetical country's distribution of future income

	Crisis	Low	Normal	High	Boom
Probability	10%	20%	40%	20%	10%

Suppose first that the country issues a noncontingent bond promising to pay 1 unit regardless of future income but would default in the crisis state. Lenders should anticipate a repayment of 0 with 10% probability and a repayment of 1 with 90% probability. But robust lenders mistrust the distribution above and worry that the likelihood of a crisis is higher. They consequently end up pricing the bond with the following distorted probabilities.

Table 2. Distorted probabilities in bond prices

	Crisis	Low	Normal	High	Boom
Probability	10%	20%	40%	20%	10%
Stipulated payments	1	1	1	1	1
Default	Yes	No	No	No	No
Distorted probabilities	23%	17%	34%	17%	9%

Lenders overestimate the probability of the crisis state in which they receive no payments. Symmetrically, they underestimate the probability of the remaining states. We note that a state-contingent bond promising no repayment in the crisis state and a repayment of 1 in the remaining states (replicating the anticipated payments of the noncontingent bond) would in

our model induce the same probability distortions and therefore trade at the same price as the noncontingent bond.

Compare this noncontingent bond with a `threshold' bond which promises payments only in more favourable states. For instance, the bond stipulates a payment of 1 in states normal and above.

Table 3. Threshold bond promising payments only in more favourable states

	Crisis	Low	Normal	High	Boom
Probability	10%	20%	40%	20%	10%
Stipulated payments	0	0	1	1	1
Default	No	No	No	No	No
Distorted probabilities	18%	36%	26%	13%	7%

In this case, lenders anticipate a payment of 0 with 30% probability and 1 with 70% probability. While the distorted probability of the crisis state is now lower than it was in the case of noncontingent debt, the additional distortion pushing up the probability of the low state contributes to a larger magnification of the event of no repayment. One way to see this is that the distorted probability of normal-or-better was 61% with the noncontingent bond but is only 46% with the threshold bond. These larger distortions lead to large ambiguity spreads that ultimately make the issuer prefer the noncontingent bond.

Additional intuition for this result can be gained in the following way. Lenders want to be robust to small deviations from their assessment of probabilities of different events. An unlikely event will still be assessed to be unlikely under a small perturbation to probabilities. But there is much more scope to distort the likelihood of likely events. With noncontingent debt, the event of no-payment goes from 10% in the undistorted probability to 23% in the distorted one. For the threshold bond, it goes from 30% to 54%.

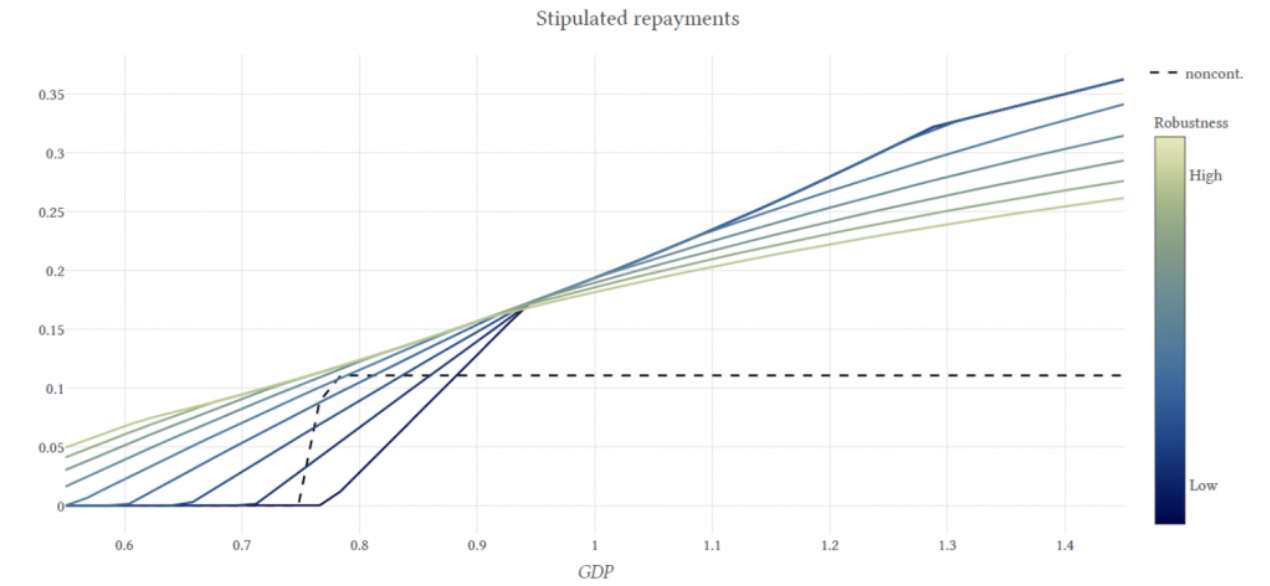
Design matters

Because of robustness on the part of lenders, details in the structure of stipulated repayments matter. With rational expectations, modifying a bond structure in a way that keeps expected repayments the same does not affect its price. With robustness, however, variation in expected repayment enables different probability distortions. These then feed into ambiguity premia and contribute to higher spreads.

The optimal design of state-contingent debt depends on the investors' degree of robustness. With stronger preference for robustness, the optimal debt structure features less

contingency, lower slopes, and an avoidance of regions with zero or low stipulated repayments (Figure 2). This sharply illustrates the tradeoffs in the debt-design problem when facing robust lenders. The government would like to minimise the contingency in stipulated repayments in order to prevent probability distortions. But the government also needs to minimise another source of contingency given by default risk ex-post. In low states, the government promises as much as it can credibly commit to repay. This tradeoff limits the scope for risk-sharing available to the government. In contrast to the commonly used threshold bond, the optimal design generates substantial welfare gains, although these gains are decreasing in the level of robustness.

Figure 2. Optimal debt design



Conclusion

Robustness helps explain the prices of state-contingent debt. We link the typical design of these instruments to their prices: thresholds in good times, with no payments whatsoever for a large share of possible contingencies, are particularly susceptible to the probability distortions (or endogenous pessimism) of robust lenders. Our model calibrated to data with noncontingent debt only can account for the prices of state-contingent bonds issued by Argentina in its 2005 debt restructuring. Our findings rationalise the little use of these instruments in practice and shed light on their optimal design. This provides valuable lessons as interest in these instruments peaks again with governments around the world facing higher debt levels and an uncertain economic outlook due to COVID-19.

** Bertinatto, L., Gomtsyan, D., Sandleris, G., Sapriza, H., and Taddei, F. (2017). 'Indexed Sovereign Debt: An Applied Framework'. Mimeo.*

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Notes:

- *This blog post is based on 'Uncertainty Premia, Sovereign Default Risk, and State-Contingent Debt'. IMF Working Paper 2021/076.*
- *The post expresses the views of its authors, and do not necessarily represent those of the IMF, its executive board or management, LSE Business Review or the London School of Economics.*
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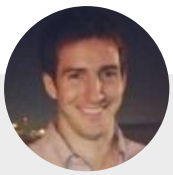

Francisco Roch

Francisco Roch is an economist in the systemic issues division at the IMF Research Department. While on leave from the IMF during 2017-19, he was deputy manager of the Research Department at the Center for Latin American Monetary Studies (CEMLA), in Mexico. He holds a Ph.D. from the University of Chicago and has been at the IMF since 2012.

Francisco Roldán

Francisco Roldan is an economist in the European Department at the IMF. He holds a Ph.D. from New York University and has been at the IMF since 2019.

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