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Loss Aversion and Search for Yield in Emerging Markets Sovereign Debt

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LOSS AVERSION AND SEARCH FOR YIELD IN EMERGING MARKETS SOVEREIGN DEBT*

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1. INTRODUCTION

Low international risk-free rates, as observed in developed countries since the most recent global financial crisis, reduce sovereign spreads for emerging markets (EM)[1]. For Shin (2013), this "decline of risk premiums for debt securities" in EM is a manifestation of a search for yield (SFY) by foreign lenders. In this paper, I show that a quantitative model of sovereign debt and default default (Arellano, 2008) can account for this empirical regularity if foreign lenders are loss-averse and have reference dependence, as in the Prospect Theory of Kahneman and Tversky (1979). In this setting, such investors search for yield in risky assets when the risk-free rate is lower than their return of reference. This change in the preference of lenders is motivated by the recent experimental evidence showing that individual investors search for yield and that such behavior is incompatible with conventional portfolio models but consistent with theories based on investor psychology, such as the Prospect Theory (Lian, Ma and Wang, 2018; Ganzach and Wohl, 2018).

A quantitative analysis with a calibrated model with loss aversion and reference dependence reveals that EM countries borrow more and increase their default risk when the international interest rate declines. Despite the greater risk, sovereign spreads fall, in line with the empirical evidence. The magnitude of the changes in average debt and spread is similar to the observed in EM in recent years of low interest rates in developed countries. A model without loss-averse lenders does not deliver such result even if their risk aversion moves perfectly with the international interest rate.

2. MODEL

In a dynamic small open economy, a central planner receives a stochastic endowment, issues debt to foreign lenders, and decides whether to default on the stock of debt every period. If he defaults, the country is excluded from international markets by a random number of periods and experiences an output loss. Equation (1) presents the preferences of the domestic representative agent. E denotes

[1] Arora and Cerisola (2001), Uribe and Yue (2006), Gonzáles-Rozada and Levy Yeyati (2008), and Foley-Fisher and Guimarães (2013).

the expectation operator, c_t is the consumption of goods in period t, β is the domestic subjective discount factor, and σ is the coefficient of constant relative risk aversion.

$$U = E\left[\sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma}}{1-\sigma}\right] \tag{1}$$

Equation (2), in which ε_t represents a white noise with standard normal distribution, describes the stochastic process of the endowment of the single good available in the economy, y_t.

$$\ln(y_t) = \rho \ln(y_{t-1}) + \eta\varepsilon_t \tag{2}$$

If the sovereign honors his obligations, d_t, he can issue new debt, d_{t+1}, and his budget constraint is (3). The price of debt, a security that pays one unit of the good in the next period if the government chooses not to default, is q_t.

$$c_t = y_t + q_t d_{t+1} - d_t \tag{3}$$

In case of default, the sovereign is in autarky, cannot borrow and consumes his endowment, y_t^a, as in (4). Equation (5) exhibits the direct output cost after a default according to the functional form proposed by Arellano (2008) frequently used in this class of model[2]. This non-linear function means that direct output costs of default start when the endowment is above a certain amount (ψ).

$$c_t = y_t^a \tag{4}$$

$$y_t^a = \begin{cases} y_t, if\ y_t \leq \psi \\ \psi,\ if\ y_t > \psi \end{cases} \tag{5}$$

International risk-free interest rate, r_t, follows a two-state Markov process with values r^* and r^{**}, with $r^* > r^{**}$ and transition probabilities π_1 (from high to low rates) and π_2 (from low to high rates). Equations (6) to (8) represent the problem in recursive form. Variables with apostrophe

[2] Aguiar et al (2016) point that an asymmetric output cost of default is indispensable if for this type of model to produce realistic values of average debt and default frequencies.

symbolize values at $t+1$. Given the debt price, the solution to this problem is represented by the policy functions for default (f), debt issuance (d'), and consumption in case of repayment (c). If the government defaults, $f=1$, otherwise, $f=0$. The parameter θ in equation (8) expresses the exogenous probability of regaining access to the international markets without debt.

Every period the sovereign decides to default or repay according to equation (6),

$$v(y,d,r) = \max_{f\in\{0,1\}}\{\, (1-f)v^R(y,d,r) + fv^D(y,d,r)\} \tag{6}$$

in which the value of repaying is expressed by

$$v^R(y,d,r) = \max_{c,d',}\{\, u(c) + \beta E_y[\, v(y',d',r')\,]\, \} \tag{7}$$

subject to (3) and $d' > 0$ and the value of defaulting is given by

$$v^D(y) = u(y) + \beta E_y[\theta v(y',0,r') + (1-\theta)v^D(y')] \tag{8}$$

subject to (4) and (5).

So far, the model is exactly the same one of Arellano (2008), except for the two possible values of r_t. I differ by supposing that international risk-free interest rate is r^* most of the time and that investors consider it a reference point of investment returns. Experimental results with individual investors from Lian, Ma and Wang (2018) corroborate this assumption. Additionally, as in Benartzi and Thaler (1995), foreign lenders have preferences over returns, rather than over the consumption levels that such returns help to bring. Thus, lenders consider returns higher (lower) than r^* as gains (losses). Since they are loss-averse, gains increases utility in one unit while losses decreases it in λ units ($\lambda \geq 1$). In this framework, equations (9a) and (9b) present the sovereign debt price.

If $(y,d',r') < \frac{1}{(1+r^*)}$, then:

$$E_y\left\{(1-f'(y',d',r'))\left[\frac{1}{q(y,d',r')} - (1+r^*)\right] + \lambda f'(y',d',r')[0-(1+r^*)]\right\} = \lambda[(1+r_t)-(1+r^*)]$$

(9a).

Foreign investors obtain the same utility buying risk-free (right hand side, RHS, of the equation) or risky bonds (left hand side, LHS, of the equation). On the RHS, if $r_t < r^*$, the investor considers the current risk-free return a loss. Since r_t is never higher than r^*, the RHS is at most zero, and therefore is multiplied by λ. The LHS presents the possibilities of default and repayment with respective gross returns of $\frac{1}{q(y,d')}$ and zero. In equation (9a), the current price of EM debt is supposed to be low enough to generate returns higher than the reference in case of repayment. If $r_t = r^*$, then $q(y, d', r') < \frac{1}{(1+r^*)}$ is always valid. If $r_t = r^{**}$, it is possible that the EM debt is not risky enough to yield returns as high as r^*. In this situation, the first term in the LHS is a loss and must also be multiplied by λ. In such case, equation (9b) reveals the price of EM debt and is equivalent to the standard risk-neutral pricing.

If $(y, d', r') \geq \frac{1}{(1+r^*)}$, then:

$$q(y, d') = E_y \left\{ \frac{1}{1+r_t} [(1 - f(y', d', r')] \right\}, \tag{9b}$$

This environment is a dynamic game played between the sovereign against a continuum of small identical foreign lenders. I focus on a Markov Perfect Equilibrium because agents cannot commit to future actions.

Definition. A Markov perfect equilibrium is defined by:

i) A set of value functions $v(s), v^R(s), v^D(s)$,

ii) Policy functions $f(s)$, $d'(s)$, and c(s),

iii) Bond price function $q(y, d')$,

such that

I) Given the bond price, the policy functions solve the Bellman equations (6) - (8).

II) Given the policy functions, the bond price satisfies equations (9a) and (9b).

3. CALIBRATION

The benchmark values for the parameters in the model appear in Table 1. Choices for σ, ρ, η and, θ are standard in the related literature. Since a period in the model indicates one year, I use $r^* = 0.04$ and $r^{**} = 0.02$ based on the recent behavior of the 10-Year US Treasury rate. The parameter governing the degree of loss aversion, λ, comes from experimental evidence and is usual in the behavioral economics literature (Tversky and Kahneman, 1992). The transition probabilities of the risk-free interest are $\pi_1 = 0.01$ and $\pi_2 = 0.10$ to generate, on average, 90 years with risk-free rates equal to the reference return followed by a 10-year period of low rates, resembling the recent experience of international financial markets. I calibrate the remaining two parameters (β, ψ) to produce average values of sovereign debt and spreads close to the observed in the data during periods of high-interest rates for the model without loss aversion ($\lambda = 1$). I obtain parameter values similar to those of other works in this literature. The model is solved numerically via value function iteration in a discrete state space.

Table 1 – Parameter values

Parameter	Description	Value
β	Domestic discount factor	0.80
ψ	Direct output cost of default	0.85
σ	Domestic risk aversion	2.00
ρ	GDP persistence	0.85
η	Std. deviation of innovation to GDP	0.04
θ	Probability of re-entry after default	0.50
r^*	High risk-free rate	0.04
r^{**}	Low risk-free rate	0.02
π_1	Probability of transiting to low risk-free rate	0.01
π_2	Probability of transiting to high risk-free rate	0.10
λ	Degree of Loss Aversion	2.25

4. RESULTS

Figure 2 exhibits the spread for the baseline economies with $\lambda = 1$ (panel A) and $\lambda = 2.25$ (panel B). When the international risk-free rate moves from r^* to r^{**}, spreads barely change in one case ($\lambda = 1$) and decline substantially in the other ($\lambda = 2.25$). The economy without loss aversion generates reduced average spreads during periods of low international rates (r^{**}) only if the sovereign is less indebted (and consequently is less risky) exactly at these times. In panel B, the reduction in spreads when r_t falls is more pronounced for higher debt levels, when the economy is riskier. In this case, when international rate is low, spreads do not rise as much because investors accept a smaller compensation for the risk to get returns closer to their reference rate.

Figure 2 – Spread Function for the Median Output Level

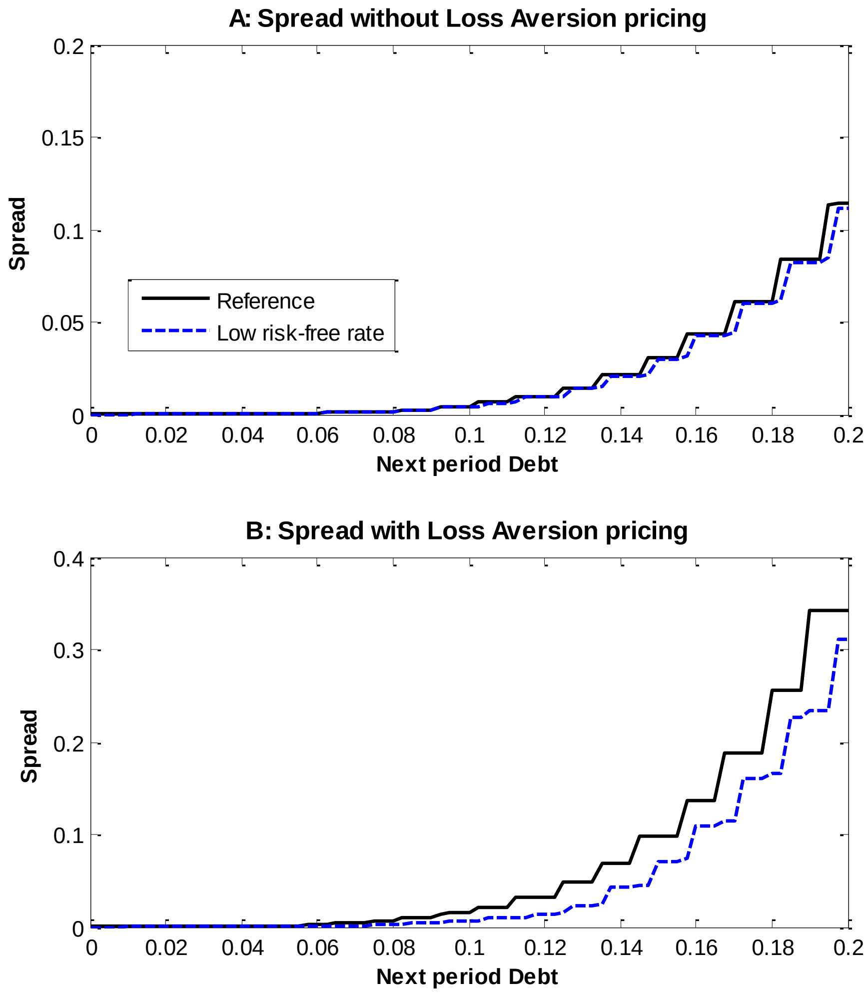

Table 2 compares statistics from emerging economies (line 1) and simulated data (lines 2 to 23). Actual data shows that indebtedness builds up and spreads reduce when international risk-free interest rates fall. This result does not emerge from the benchmark model without loss-averse lenders (line 2). In this case, when international rates reduce, EM countries borrow more, become riskier and, consequently, their spreads rise.

Table 2 – Basic Statistics: Model and Data

			When risk-free rate is *r**			**When risk-free rate is *r*****		
	Model description	**Loss Aversion**	**Default freq.**	**Average Spread**	**Average Debt**	**Default freq.**	**Average Spread**	**Average Debt**
1	**Data**	--	--	5.2	14.0	--	3.6	14.9
2	**Benchmark**	No	4.3	5.0	16.6	4.4	5.1	17.1
3	**Benchmark**	Yes	1.8	4.4	12.8	2.3	3.6	14.1
4	**π_2 = 0.20,**	No	4.3	5.0	16.6	4.5	5.3	16.7
5	**π_2 = 0.20**	Yes	1.8	4.4	12.8	2.0	3.5	13.6
6	**π_2 = 0.50**	No	4.2	5.0	16.6	4.4	5.2	16.7
7	**π_2 = 0.50**	Yes	1.9	4.4	12.8	2.0	3.3	13.4
8	**π_2 = 0.01**	No	4.3	4.9	16.6	4.5	5.3	17.2
9	**π_2 = 0.01,**	Yes	1.7	4.4	12.9	2.3	3.6	14.5
10	**β = 0.70**	No	6.2	7.7	18.6	6.4	7.9	19.1
11	**β = 0.70**	Yes	3.0	7.6	14.2	3.4	6.4	14.6
12	**β = 0.90**	No	1.9	2.1	12.0	2.3	2.6	12.8
13	**β = 0.90**	Yes	0.7	1.6	9.3	1.2	1.5	11.3
14	**β = 0.90, ψ = 0.80**	No	1.1	1.2	20.7	1.3	1.4	22.0
15	**β = 0.90, ψ = 0.80**	Yes	0.5	1.1	17.5	0.9	1.0	20.2
16	***r*****=0**	No	4.2	5.0	16.7	4.6	5.6	17.5
17	***r*****=0**	Yes	1.8	4.4	12.8	2.8	3.7	15.2
18	**λ = 1.50**	Yes	2.7	4.7	14.5	3.0	4.3	15.7
19	**λ = 3.00**	Yes	1.3	4.2	11.9	1.9	2.9	13.5
20	**κ = 7**	No	2.3	4.9	13.5	2.3	5.3	13.8
21	**κ = 7, κ = 0**	No	2.3	5.0	13.4	4.2	5.3	16.2
22	**κ = 5, κ = 0**	No	2.7	5.0	14.4	4.2	5.3	16.5
23	**κ = 3, κ = 0**	No	3.3	5.1	15.2	4.3	5.3	16.9

Note: Line 1 presents statistics for a sample of 18 emerging countries with debt and spread information available. Spread is the JP Morgan EMBI Global Composite for the periods before and after September 2011, when 10-Year US Treasury Constant Maturity Rate reaches 2% for the first time in the sample. Debt comes from Arslanalp and Tsuda (2014). Countries are Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Turkey, Ukraine, and Uruguay. Each row from 2 to 23 brings statistics calculated from 200,000 simulated observations of a different model.

However, the model with loss aversion and reference dependence (line 3) reproduces the pattern seen in the data. In this case, when the international interest rate declines, EM countries borrow more, become riskier and their spreads fall. This reduction in spreads despite the escalation of default risks is a consequence of the SFY of investors used to higher risk-free rates. Although this model is not calibrated to match average debt and spread, both statistics are still close to the observed counterparts. Furthermore, the magnitude of changes in these two variables between interest rate regimes is similar to the observed in EM recently. Beyond the statistics exhibited in Table 2, the models also perform well in other dimensions. As usual in EM data, all specifications in Table 2 display: i) counter cyclical spreads and trade balance, ii) debt and consumption positively correlated with GDP, and iii) consumption more volatile than output.

Next, I show that this conclusion is robust to changes in the values of the model parameters. Lines 4 to 9 present how the same conclusions emerge if the parameter π_2 is modified to alter the average length of the bouts of low risk-free rates. Solving the model for different values of β and ψ (lines 10 to 15) reveals that SFY only appears in models with loss aversion. Besides, spreads reductions are larger in riskier calibrations. Line 15, the case with lower default risk, shows a situation in which spreads fall only 0.1 p.p. when r_t goes from 4% to 2%. The reason is that foreign investors do not search for yield in these markets because they rarely have spreads high enough to achieve the return of reference. Distinctions between the models with and without loss aversion are even more pronounced if we assume that $r^{**} = 0$ (lines 16 and 17). Model outcomes are also qualitative invariant to the degree of loss aversion (lines 18 and 19).

To investigate if changes in risk-aversion generate SFY in the model, I replace the pricing equations, (9a) and (9b), by expressions (10) and (11). The first of them brings a reduced form stochastic discount factor, m_t, used by Arellano and Ramanarayanan (2012) in a sovereign default model. The parameter κ governs the risk premium and its correlation with the stochastic process for y_t. Positive values of κ imply that foreign lenders value more returns in states with negative income shocks in the EM economy, when default is more likely.

$$m_{t+1} = exp(-r_t - \kappa\eta\varepsilon_{t+1} - 0.5\kappa^2\eta^2) \quad (10)$$

$$q(y, d', r') = E_y\{m_{t+1}[(1 - f(y', d', r')]\} \quad (11)$$

I use $\kappa = 7$ (line 20), because the model generates the same average spread during periods of high international rates as the benchmark case (line 2). However, there is still no SFY. The next step is to assume that κ takes over two different values following the same Markov process as r_t. When $r_t = r^*$, κ is positive and lenders are risk-averse, but when r_t changes to r^{**}, lenders automatically become risk-neutral. Hence, the risk-version decreases mechanically with the risk-free rate. Rows 21 to 23 demonstrate that even such strong assumption does not produce SFY. In this case, although the risk premium disappears, EM borrow more and become much riskier to the point that their spreads increase.

5. Conclusions

EM sovereign spreads move in the same direction as international risk-free interest rates reflecting a SFY by foreign investors. I show that a quantitative model of sovereign default replicates this result if foreign lenders are loss-averse and have reference dependence. In this setting, investors buy EM sovereign bonds because they offer the opportunity to achieve their reference return, a goal higher than the current risk-free rate. Such results suggest that aspects of investor psychology might have consequences for international sovereign bonds markets.

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