Journal of Banking & Finance 37 (2013) 4217–4225

Contents lists available at ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

Sovereign credit spreads

Marliese Uhrig-Homburg *

Karlsruhe Institute of Technology (KIT), 76131 Karlsruhe, Germany

ARTICLE INFO

Article history:
Received 9 July 2012
Accepted 5 July 2013
Available online 19 July 2013

JEL classification:
F34
G12
G13
G15
H63

Keywords:
Sovereign borrowing
Credit spreads
Macroeconomic conditions

ABSTRACT

The paper develops a structural credit risk model to study sovereign credit risk and the dynamics of sovereign credit spreads. The model features endogenous default and recovery rates that both depend on the interaction between domestic output fluctuations and global macroeconomic conditions. We show that sovereigns choose to default at higher levels of economic output once global macroeconomic conditions are bad. This yields to default rates and credit spreads that are substantially higher compared to normal times. We derive closed-form expressions for sovereign debt values and default times and focus on the dynamics of sovereign credit spreads. As opposed to standard theories of sovereign debt, this paper's structural model generates much richer default patterns and non-linearities through regime-shifts in the global macroeconomic environment. Moreover, changes in the global environment reveal the interconnectedness of the financial system.

1. Introduction

The international financial crisis induced a tremendous growth of sovereign debt levels all over the world. Until recently, the risk of sovereign insolvency was viewed as a problem limited to emerging economies. Meanwhile, policymakers and market participants appear increasingly worried about current and future debt levels in some developed countries, too. Coupled with an impressive interconnectedness of the financial system, issues of sovereign debt are not only a problem of one single country or region but can suddenly become vitally important for everyone in our society, especially in times of crisis.

Standard theories of sovereign debt such as Eaton and Gersovitz (1981), Aguiar and Gopinath (2006), or Arellano (2008) predict a strong negative relation between economic output and default. Empirical evidence, in contrast, documents a much weaker and non-linear relationship. According to Tomz and Wright's (2007) long-run analysis, defaults are associated with bad times, but many times domestic output declines while countries maintain debt service and some defaults even occur when domestic output is high. The state of the local economy does affect sovereign credit spreads but as Longstaff et al. (2011) demonstrate, they are driven to a large extent by global macroeconomic forces. Moreover, sovereign defaults cluster over time as is shown in Reinhart and Rogoff's (2008) analysis of the history of financial crises. During the period 1800–2006 they document at least five pronounced peaks of sovereign defaults on external debt, the most recent involving the Latin American debt crises of the 1980s and 1990s.

To capture these stylized facts, we propose a model that considers the interaction between domestic output fluctuations and global macroeconomic conditions. Through this interaction, our structural credit risk model allows to study the quantitative impact of global macroeconomic conditions on sovereign credit risk. More specifically, conditional moments of a sovereign's local economic output growth rate change with shifts in the global macroeconomic environment. As a result, countries' default and restructuring policy depends on the state of the global economy, yielding to default rates and credit spreads that are substantially higher if the global economy is in a bad condition. This is consistent with Longstaff et al.'s (2011) conclusion that the very nature of sovereign default risk itself is heavily affected by global macroeconomic factors. Changes in the global environment reveal the interconnectedness of the financial system. In our model, a switch in global conditions can induce an immediate default even in times of rising local output levels which provides a channel to explain the default clustering phenomenon in sovereign debt markets. When global conditions are bad, the model predicts sovereign credit spreads that are much more sensitive to domestic output fluctuations, a result that fits well to adverse conditions in international debt

* Tel.: +49 721 60848183; fax: +49 721 60848190.
E-mail address: uhrig@kit.edu

0378-4266/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jbankfin.2013.07.002

markets in these times. Local output fluctuations smoothly carry over to credit spreads but through movements in global conditions the model captures jumps as well.

A number of articles has studied sovereign debt in formal models. On the one hand, there is a huge literature building on the seminal work by Eaton and Gersovitz (1981) using stochastic general equilibrium models to analyze sovereign borrowing and lending.[1] While these approaches define a recursive equilibrium and assess quantitative implications on debt and default via simulations we derive closed-form expressions for sovereign debt values and default times and focus on the dynamics of sovereign credit spreads. On the other hand, some recent approaches adopt reduced-form or structural credit risk models to study sovereign credit spreads. Duffie et al. (2003), Pan and Singleton (2008), and Longstaff et al. (2011) apply affine intensity models in their empirical studies of sovereign credit spreads. Gibson and Sundaresan (2005), Jeanneret (2013), and Andrade (2009) are among the few structural credit risk models derived for sovereign entities. In contrast to the latter ones, we propose a structural model that generates a variety of different default patterns and non-linearities through regime-shifts in the global macroeconomic environment consistent with Tomz and Wright (2007).[2]

Our work also relates to some recent studies focussing on both the effect of local and global factors on sovereign credit spreads. In their attempt to examine the relative importance of the factors, Hilscher and Nosbusch (2010) show that global factors are indeed important, but country-specific fundamentals have considerable explanatory power, too, in particular the volatility of terms-of-trade. While we do not explicitly account for changing terms-of-trade in our model, a higher volatility of terms-of-trade would naturally carry over to higher economic output growth volatility and thus increase sovereign credit spreads also in our model. Borri and Verdelhan (2011) extend the general equilibrium model of Aguiar and Gopinath (2006) and Arellano (2008) to risk-averse lenders and show how the borrowing countries default decision depends on lender's time varying risk aversion. As a result, sovereign credit spreads are exposed to the lending countries business cycle risk. While the link across countries is through the risk-premium component in their approach, we focus on the link via the default-risk component. As Longstaff et al. (2011) show, empirically both components do matter, but according to their sample of CDS spread data of developed and emerging-market countries, the link from the default-risk component is significantly stronger.

The remainder of the paper is organized as follows. Section 2 presents the model framework. Section 3 characterizes sovereign's default policy. In Section 4, we derive explicit expressions for sovereign debt values, endogenous recovery rates, and default probabilities, and also analyze the dynamics of sovereign credit spreads. Section 5 discusses empirical implications. Finally Section 6 concludes.

2. Model framework

Our continuous-time economy is populated by a sovereign country that faces two types of macroeconomic shocks. One the one hand, the flow of economic output Y_t fluctuates continuously over time according to the process

$$dY(t) = \mu_z Y(t)\, dt + \sigma_z Y(t)\, dw$$

where μ_z is the expected growth rate, σ_z is output growth volatility, and w is a standard Brownian motion. On the other hand, large shocks come from movements in the state z of the global economy, which is either good ($z = 1$) or bad ($z = 2$). The state variable z determines the first and second moments of output growth rates, μ_z and σ_z, respectively. Naturally, the expected growth rate is higher in the good state, $\mu_1 > \mu_2$. To keep the model tractable, we assume that z follows a 2-state time-homogeneous Markov chain with transition rates p_z.

Note that we capture the global macroeconomic environment by the drift, while the local economic condition is represented by IID shocks. Studies on international business cycles show that there is indeed evidence for a distinct world business cycle. Moreover, fluctuations in the world component are clearly more persistent than country-specific components. Also the covariance among the factors is not too strong.[3] Thus, in our continuous-time setting it seems natural and convenient as a starting point to represent major worldwide economic events in form of a persistent change in expectation and specific shocks to the country through a white noise process.

Similar to Kulatilaka and Marcus (1987) we assume that the country has committed itself to a given investment program and has financed part of it with foreign debt. The output Y therefore includes all advantages stemming from the existence of foreign debt, an example of which are export earnings resulting from an investment in some export technology that had to rely on external financing. For simplicity, we consider an infinite maturity debt contract with a continuous coupon stream c until default or restructuring. This assumption excludes an explicit time dependence of security prices.[4] When issuing debt, the sovereign country promises a perpetual debt service. However, ex post it can be in the sovereign's interest to default on its coupon payments. Indeed, as is standard in the sovereign debt literature, we assume that the sovereign continues debt servicing only in order to avoid a costly default. Once contractual payments are not made, we consider default as an outcome of a bargaining process between the parties involved. This reflects the lack of formal bankruptcy regulations, an issue that has long troubled economists and policymakers.

More formally, at each point in time the sovereign country decides whether to continue debt servicing or to default. The trigger level is determined endogenously in our model capturing the idea that to some extent a sovereign default is a strategic decision.[5] If negotiations fail, future output is reduced to αY with $\alpha \in [0,1)$. The proportional output loss captures the notion that a sovereign default has negative implications on output due to the loss of market access, increase in the cost of future finance, and direct output costs in the spirit of Cohen and Sachs (1986), Arellano (2008) or Bolton and Jeanne (2009). In addition, creditors may seize a small fraction β of output leaving $(\alpha - \beta)Y$ to the sovereign country.

De Paoli et al. (2009) find some evidence that countries that restructure their debts face lower output losses than those that do not. Thus, instead of a costly default, both parties might be better off in a restructuring game: First, successful renegotiations are likely to preserve a larger part of the countries prevailing output level with a direct effect on the countries wealth. Second, creditors do not simply lose almost all of their investment but through renegotiating they take advantage of maintaining the country's well-established international trade relations to some extent.[6]

[1] Recent papers include Aguiar and Gopinath (2006), Arellano (2008), Yue (2010), and Borri and Verdelhan (2011).

[2] Following Jarrow et al. (1997), regime-switching models have often been used to capture non-linear changes in the probabilities of credit-rating transitions. Only recently they have also been used in the modeling of defaultable bond prices in the context of corporate debt. See Hackbarth et al. (2006) or Bhamra et al. (2010).

[3] See Gregory et al. (1997) and Kose et al. (2003).

[4] An alternative would be to rely on the finite-maturity debt structures in a stationary environment such as Leland and Toft (1996) or Leland (1998).

[5] For corporate debt, structural models with endogenous default triggers have been derived by Leland (1994) and Fan and Sundaresan (2000), and others. For a comparison of sovereign debt and otherwise identical corporate debt contracts in such frameworks see Gibson and Sundaresan (2005).

[6] Reduced benefits of international trade are well documented in the literature, see Rose (2005).