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Sovereign Risk Implications for Corporate Default Premium: Microsoft and the USA

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Chapter 1: Sovereign Risk

1.1) Definition and Components The concept of *Sovereign Risk* is assessed by the major stream of literature[1] to the risk that a government may experience default on some or all of its debt obligations or agreements, may not be able to fully refund them, or this refunding may not be happening within the contractually established payback period. Peter and Grandes define Total Risk Premium as being composed of: **Currency (Risk) Premium** or simply currency risk[2], correlated with the depreciation of the currency the instrument is denominated in; **Default (Risk) Premium**, reflecting the financial health of the borrower, negatively correlated with the Recovery Rate (RR); **Jurisdiction Premium**, reflecting all the non-financial frictions to potential business deals.

1.2) Quantitative Approaches for Measuring Sovereignty The first and immediate synthetic riskiness indicator comes from public information, provided by the rating agencies such as Moody's, S&P, and Fitch. Borrowers are aggregated into standard categories based upon assessments of both ability and willingness of a country to service its debt. A focus on ratings will be given separately in paragraph 1.3. The second output from the market to express the Sovereign Risk is the level of the Sovereign Credit Default Swaps (CDS). Hull defines CDS as: "*A contract between two parties whereby the buyer of protection makes periodic payments to the seller, and in return receives a contracted amount in case of a pre-determined credit event (such as a default)*"[3]. Although these two indicators are the most common between international investors, Canuto, Pereira and Sa Porto (2004) early recognized as a third alternative the Sovereign Spread of the Emerging Markets Bond Index Plus (EMBI+) Index,

[1] Canuto, Fonseca, Sà Porto (2004), Grandes, Peter (2005), Borensztein, Levy-Yeyati, Panizza (2007), Dailami (2010), as well as rating agencies Fitch (2001), Moody's (2001), Standard and Poor's (2001).
[2] According to Grandes and Peter, *Currency Risk* is commonly confused with *exchange risk*, arising from investors' risk aversion or from exchange rates' covariance.
[3] Concepts, Definitions, Examples by Hull (2009).

yearly produced by JP Morgan since 1995. It consists of the basket of secondary market negotiated PA bonds of a number of emerging countries, denominated in a common foreign currency[4].

1.3) Focus: The Crucial Role of Rating Agencies A research conducted by the International Monetary Fund shows that ratings are not only the result of specific statistical models that determine quantitatively the probability of a default. There are subjective elements that enter in-between, such as the willingness to pay, that may impact an investor decision of speculating or not. Hence, rating is the result of an interdisciplinary work, combining quantitative methodologies with discretionary observations by analysts[5], and worth a specific focus. An important component of Sovereign Risk, in facts, is the government's willingness to pay. This requirement inevitably introduces a degree of subjectivity into the analysis, so a complete risk assessment needs to highlight the underlying assumptions. A reduced willingness to pay could arise, for instance, from the lack of a dedicated procedure to ensure compliance agreements with the terms provided in the debt contract. Further evidence is provided by the jurisdiction constraints, previously mentioned.

Chapter 2: Corporate Default Risk

2.1) Definition and Components Any corporate institution is defined to be experiencing default when and if perceiving one of the following circumstances: "***Failure*** *of an obligor to make timely payment of principal and/or interest under contractual terms of any financial obligation. The* ***bankruptcy*** *filing, administration, receivership, liquidation, other winding up or cessation of business of an obligor. The* ***Distressed Debt Exchange*** *(DDE) of an obligation,*

[4] In September 2003, the EMBI+ included Argentina, Brazil, Mexico, Russia, Venezuela, Turkey, Philippines, Colombia, Malaysia, Bulgaria, Perù, South Africa, Panama, Ecuador, Poland, Ukraine, Egypt and Nigeria. For further details on index compilation methodology see JP Morgan (1995).

[5] Moody's ltd, 2003.

where creditors were offered securities with diminished structural or economic terms compared with the existing obligation"[6].

2.2) Modeling Corporate Default Risk Theoretical literature on the pricing of defaultable fixed-income assets refers to credit risk pricing, and recognizes three broad approaches[7] to model these probabilities: The **Classical** or Actuarial **Approach**; The **Structural Approach**, or Firm-Value or Option Theoretic Approach; The **Reduced-Form** or Statistical or Intensity-Based Approach. The basic principle of the Classical Approach is to assign (and regularly update) credit ratings, intended as information about the probability of default of a given counterparty. Once aggregated, a rating migration matrix results and the next step is to estimate (often independently) the value of the single contract at possible future default dates, put in practice by cumulating period-on-period probabilities. The Structural Approach is based on Merton's (1974 and sequent) assumptions. This model will be highlighted later on the paper. The Reduced-Form Approach models the probability of default as an exogenous variable, calibrated to data of the rating agencies or to financial market series acting as state variables.

2.3) Default Risk Equilibrium: Debt Advantages In the broadest terms, at least two different advantages to an increasing debt could be listed. The first is the tax benefit: interest payments on debt are tax deductible, whilst for instance cash flows on equity, considered by the major stream of literature[8] the only alternative in terms of financial source, are not. The second is the added discipline imposed on management, by the necessity to make payments on debt. This latter benefit derives from Michael Jensen, who developed an innovative view for borrowing markets, basing its analysis on the utilization of singular firm's free cash flows, stating that better efficiency could result from their optimization[9]. Hence, a first way to

[6] Fitch ltd, 2012.
[7] This paragraph draws on Peter and Grandes (2005), who also draw on Cossin and Pirotte (2001).
[8] See Jensen-Meckling (1976) or Damodaran (2006) for a modern interpretation.
[9] Jensen's free cash flows are individuated by Damodaran as the operating cash flows after taxes, but before discretionary capital expenditures.

introduce discipline into the process is to force these firms to access financial markets to fund up via debt: this action would create the necessary commitment to effectively realize interest and face value payments. Debt could act as a possible incentive, with all of its risks being involved.

2.4) Default Risk Equilibrium: Debt Disadvantages On a completely opposite perspective, the fact that issuing extra-debt implies several disadvantages emerges with no difficulties. The point of merge between all of the possible considerations on the topic relies on the corporate default risk. The idea pursued and exploited by this literature stream[10] is that borrowing a non-sustainable amount of money could lead the firm to a complete (or partial) impossibility to refund the counterparty, and hence to an eventual liquidation. Secondly, this could cause increasing agency problems arising from the conflict between the interests of shareholders and debtholders, and finally reduce the flexibility of the firm to undertake future strategic plans.

Chapter 3: Theoretical Framework: Corporate Meets Sovereign

3.1) Sunrise of the matter: Merton's 1974 Reference Model In 1974's paper "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", Robert Merton individuates three items to be determinant on the value of a particular issue of corporate debt: the required rate of return on riskless (in terms of default) debt[11]; the various provisions and restrictions contained in the indenture[12]; the probability that the firm will be unable to satisfy some or all of the indenture requirements[13]. Merton's final goal was to present a premium model which could embed a theory of the risk structure of interest rates, while isolating the sensitivity to default

[10] See Fisher (1959), Altman (1968 and 1989), Bodie and Merton (1995), Giesecke, Longstaff, Schaefer and Strebulaev (2011).
[11] The characteristics of a risk-free asset are the ones described in Chapter 2.
[12] For instance maturity date, coupon rate, call terms, seniority in the event of default, etc.
[13] The probability of default described in Chapter 2.

risk. Merton simplifies the generic firm's debt structure by consisting of a single issue. In addition, the debt is of zero-coupon form: an amount **D** is due at a specific date **T** in the future.

The Model Let $\mathbf{V_t}$ denote value of the firm's assets on any generic date **t**. When debt matures on date **T**, debtholders will receive the full face value **D** under condition that there is enough value in the firm to meet this payment ($V_t \geq D$); shareholders, having their compensation scheme subordinated, will then receive the balance $V_t - D$. However, if the value of the firm's assets at time T is insufficient to meet debtholders' claims ($V_t \leq D$), they will receive the value left, while shareholders receive nothing.[14] Thus, the amount received by bondholders at time T is:

The first item, D, can be interpreted as a time-T payoff of investing long in a default-risk-free zero coupon bond (maturing at time T with face value D). The second item, , is the payoff from a short put option written on the firm's assets (with strike price D and maturity date T).

3.2) Evolution of the subject: Merton's Model Adjustments Sundaran (2001) collected the main constraints and the relative main solutions as it follows: the firm value V and its volatility σ play a key role in determining the value of the put option, although they are unobservable; debt structure is assumed to be simple.

Solution i) Prices of traded securities issued by the firm can be considered an efficient proxy to obtain the variables V and σ. ***Solution ii)*** Capital structures are far more complex than in Merton's model. Sundaram considers two alternatives: extending the theoretical set of assumptions in order to enable Merton's model to meet new requirements, or simplify reality using market proxy.

[14] Merton assumes a costless liquidation of the firm, as well as Absolute Priority in case of Default towards bondholders (they must first be paid in full, even before savings-shares.

3.3) An Innovative Scenario: Contingent Claims Approach Bodie, Gray and Merton, in 2007, proposed a new comprehensive approach to measure and analyze Sovereign Risk based on the theory and practice of modern Contingent Claims Analysis (CCA). A contingent claim is "*any financial asset whose future payoff depends on the value of another asset*[15]". The prototypical contingent claim is an option, and thus it is evident its clear derivation from the Merton 1973 model root above described. In this approach, the sectors of a national economy are viewed as interconnected portfolios of assets, liabilities, and guarantees. The final goal will be the application of this model to Microsoft Corporation and the USA.

The Model All of the entity's assets and liabilities are measured at their current market values, disregard if assessing a Sovereign or a firm. White noises act to simulate random changes in financial inflows, outflows, and fluctuations in market prices cause uncertainty in the values of the entity's assets and liabilities. The total value of all assets, due to these processes, might be inferior to the level of promised payments on the debt, creating distress and/or ending up in default.

When default happens and monetary losses are experienced, then the debt is defined as "risky". In the CCA, Bodie and Gray calculate the value of risky debt as "*the default-free value of debt minus an implicit put option on the underlying assets with the strike price equal to the default-free value of debt*[16]", in consistence with Merton's work. Equity (the most junior claim) is modeled as an implicit call option on the assets with the strike price equal to the default-free value of the debt. Substituting into the Balance Sheet identity that total assets always equals total liabilities (including equity) and recalling Merton's fundamental equation:

Assets = Equity + Risky Debt = Equity + Default-Free Debt – Debt Guarantee(s)

= Implicit Call Option + Default-Free Debt – Implicit Put Option

[15] Bodie, Gray, Merton, 2007.
[16] Bodie, Gray, Merton, 2007.

The Balance Sheet The goal of the paper is to compare a Sovereign entity, as the US, to an affirmed corporation, as Microsoft. Hence, the construction of a similar item for a government and/or monetary authority represents the main issue for the current analysis. Bodie and Gray begin by subtracting the guarantees to the too-important-to-fail entities from the asset side. Besides these, Sovereign assets also consist of foreign reserves and net fiscal asset. Liabilities basically consist of foreign-currency denominated debt plus what they call local-currency liabilities (local-currency debt and base money). This way, default on foreign-currency debt occurs when the Sovereign assets do not cover the promised payments on the foreign-currency debt, with the 'distress barrier' set at this present value. While the promised payments, or distress barrier, are supposed to be known with a fair degree of certainty, it is much more questionable the value of Sovereign assets.

3.4) Risk Management Implications: Corporate versus Sovereign High-level assumptions will be tested to be consistent with standard risk exposure measures: probability of default, credit spread (interpreted as risk premium) and the sensitivity of the CCA-based options on their underlying asset. The probability of default is the probability that $A_t \leq B_t$, identified by the authors as: Prob ($A_t \leq B_t$) = Prob $\{A_0 \exp [(\mu_A - \sigma^2_A / 2) t + \sigma_A \varepsilon \quad] \leq B_t \}$ = **Prob ($\varepsilon \leq - d_{2,\mu}$)**

Credit spread (**s**) is the premium required to compensate for the expected loss, calculated as:

s = y_t – r = – —— –

One last risk measure is the sensitivity of the implicit option to the underlying asset, introduced by option theory pricing, which is the value of delta. Literally, it represents "*the change in the value of an option as the value of the underlying asset changes*[17]". Deriving from the Black-Scholes model the formulas for delta, for a generic put option the authors observe that Δ=**$N(d_1)$ -1**.

[17] Hull, 2009.

Chapter 4: Microsoft and the USA: Empirical Findings

4.1) Framework: Candidates Balance Sheet In order to properly apply the Contingent Claims model, it is necessary to re-engineer the candidates Balance Sheet. At a corporate level, an updated version must be provided at least yearly (as a legal requirement) to its share and debt holders. The construction of a similar item for a government and/or monetary authority represents the main issue for the current analysis. Bodie and Gray begin by subtracting the guarantees to the too-important-to-fail entities from the asset side. Besides these, Sovereign assets also consist of foreign reserves and net fiscal asset. Liabilities basically consist of foreign-currency denominated debt plus what they call local-currency liabilities (local-currency debt and base money). The CCA to evaluate any corporation or Sovereign entity Balance Sheet is provided by Figure 11

Figure 11: CCA Balance Sheets for Sectors - Risk Management Framework

Corporate Sector Balance Sheet

Assets	Liabilities
Corporate Assets	Debt (=Default-free value of debt minus implicit put option)
	Equity (Implicit call option)

Public Sector Balance Sheet

Assets	Liabilities
Foreign Reserves	Financial Guarantee (Implicit put option)
Net Fiscal Asset and Other Assets	Foreign Debt (Default-free value of debt minus implicit put option)
Value of Monopoly on Issue of Money	Base Money and Local-currency Debt (Implicit call options)

Source: Bodie, Gray and Merton, 2007

4.2) The Model: Two-stage Contingent Claims Approach The real innovation of a two-stage CCA consists of valuing an asset by estimating the only two claims (Sovereign assets value and volatility) from the information implied in the current prices. Summarizing, the

authors combine in these model money and Sovereign local-currency debt together to get local currency liabilities (LCL). Book value of foreign-currency denominated debt is used to define the distress barrier Sovereign B_S. A simple two claim CCA framework is then used to calibrate the model for Sovereign assets, V_S, and assets volatility σ_S:

$$LCL_{\$} = V_{\$\,S}\, N(d_1) - Be^{-rf\,t} N(d_2)$$

Bodie and Gray individuate a second equation that links equity and equity volatility to the same five parameters:

$$LCL_{\$} = M + B_{d\,\$,\,t=0} = [(M_{LC}\, e^{-rd\,t} + B_d)\, e^{-rf\,t}] / X_f$$

Local-currency liabilities are again assimilated to 'shares', while the value of money and local-currency debt times the exchange rate is like the market capitalization of the Sovereign. The volatility of the local-currency liabilities comes from the volatility of the exchange rate and the volatility of the quantities of money and local-currency debt (issued or repurchased). Furthermore, LCL is a call option of Sovereign assets in foreign currency terms, V_S, with strike price tied to the distress barrier for foreign-currency denominated debt, B_f, derived from the promised payments on foreign-currency debt and interest payments up to time t.

The volatility of the local-currency liabilities is hence a function of M_{LC}, base money in local currency terms; r_d domestic interest rate; r_f foreign interest rate; domestic currency denominated debt is B_d (derived from the promised payments on local-currency debt and interest payments up to time t); X_F forward exchange rate; σ_{Xf} volatility of forward exchange rate; σ_d volatility of domestic debt in local currency terms; , $\rho_{Dd\,Xf}$ the correlation of forward exchange rate and volatility of domestic debt in local currency terms; $\rho_{M\,DD\,\$}$ the correlation of money (in foreign currency terms) and local currency debt (in foreign currency terms); σ_{MLC} volatility of money (in local currency terms); σ_M volatility of

money (in foreign currency terms); and, $\sigma_{Dd\$}$ volatility of local currency debt (in foreign currency terms). Summarizing, the two key equations relating assets and local currency liabilities are:

$$LCL_{\$} = V_{\$S} N(d_1) - Be^{-rft}$$

$$LCL_{\$} * \sigma_{\$LCL} = V_{\$S} \sigma_{\$Sovereign} N(d_1)$$

Again, similarly to the Merton model, these can be used to calculate the two unknowns: Sovereign assets value and Sovereign asset volatility, representing the two claims. Bodie, Gray and Merton note that if the exchange rate is floating the volatility comes largely from the exchange rate, otherwise there is little or no volatility in the exchange rate but, to keep the exchange rate stable, more money and local-currency debt must be issued and bought back (via sterilization operations).

4.3) Candidates Performance: Empirical Testing and Final Assessments

Figure 12: Microsoft versus Federal Reserve Contingent Claims analysis (Data in SUSB)

		Microsoft	Federal Reserve
Time Horizon	t	5	5
Risk-Free Rate	r	1,88%	1,88%
Assets return Volatility	σS, σA	6,6%	47,3%
Assets Value (net of Guarantees)	A (2012)	$ 121	$ 2.865
Risky Debt	B (2012)	$ 55	$ 2.811
Junior Debt, Local Currency Liabilities	E , LCL (2012)	$ 66	$ 55
	d1	-1,733	-1,689
	d2	-1,881	-2,748
Probability of Default	N (-d2)	0,0029	0,0036
Delta*	N (d1) - 1	-2,37	-2,73
Spread**	Basis Points	407	584
	Fitch Rating	AAA	AA+

* Positions need to be re-allocated in terms of '000's.
Real positions are 0,0000029 and 0,0000036 of a short put positioning.
** Calculated on a '000's consistent term for the Assets, Debt and Equity (or Local Currency Liabilities) amounts.

Software Platform: Bloomberg, 2012

The three default risk indicators chosen, all seem to indicate that the trust of the market into Microsoft Corporation is more than justified. It is legit to go through all of them to explain the calculations. Probability of default is the statistical relevance that the value of assets could fall under the total value of Liabilities, and hence of the Distress Barrier. The data needed in this case were the volatility of the assets return, computed via historical data on a time horizon of five years, the risk-free rate and the past 2007-2012 performances of the two entities. Applying the relative formula, Microsoft resulted in a slightly better result, with a +0.07% when compared to the US. The interpretation in terms of policy recommendations should be implemented with the due regarding to the fact that the US accounts for more than just a sole industry. Delta, in this case, is the hedging position on the put option written on the value of the entity, required to compensate with a short position on the Liabilities. Again, having +0.36 on the US Fed, means that less risk is implied in undertaking this kind of strategy, since a smaller portion of underlying assets is needed to be held. Finally, the credit spread on the risk-free rate confirms that Microsoft moves around 400 basis points (‘000 of the common basis points, a simplification due to the large amounts) of extra return on its assets value, lower than the US that scored around 584. The intuition behind this issue is clear: corporate default premium is lower than the (supposed-to-be) risk-free rate of the US.

Conclusion

The conclusions to draw from CCA are immediate. Corporate Default Premium is possible to experience lower level than the expected return on a Sovereign issuance, in the case of a two staged claim: assets value and their relative volatility. Also, being Microsoft a US based company, the influence of this localization in a country that is characterized by a higher level of riskiness parameters is of undoubted importance, so the implications are in this case reversed: it is not the Sovereign entity to contribute in the corporate risk assessment, but vice versa.

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