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

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" … Since all credit providers can buy Sovereign Debt, Sovereign issuance will effectively compete with—and possibly crowd out—private sector credit needs."

Global Financial Stability Report (Chapter 1), IMF, October 2009

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. The most common case happens when the Public Administration (PA) holds a significant amount of funding-equivalent close-to-maturity bonds among their liabilities, but they lack of the sufficient amount of liquidity to repay them back. As a result, PA places extra bond issuances on secondary markets to compensate this need, with higher risks deriving from an over-the-counter context. What can be deducted is that the definition of Sovereign Risk includes *refinancing risk* in its broad meaning: the failure of reaching a reasonable market price or a sufficient volume incorporates the real risk of the secondary market.

However, Peter and Grandes (2005) observed that Sovereign risk may not always be strictly connected to financial parameters: it could also be used to refer to limiting regulations that restrict the possibility of local issuers to meet their obligations and of

[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).

foreign investors to speculate (e.g. free-trade restrictions). It is an indirect risk that nevertheless has an impact on a country's market credibility.

Financial institutions recognize the importance of Sovereign Risk over their operational framework. The perspective of one of these market agents, Global Asset Management (GAM), will be taken in this paper as a leading sample. In its 2012 Annual Report, GAM highlighted the importance of Sovereign Risk' various implications on the current macro-economical situation. In facts, Europe is meeting a definition of the term *Sovereign* that has been used to widely categorize the large budget deficits and very high public debt levels of a number of countries, especially Greece, Italy, Ireland, Portugal and Spain. These countries are experiencing high public debt burdens together with an increasing trend on their historically-offset net balance. When analyzing the Euro zone, large deficits are not a new, although this exponential growth trend is causing not only hazarders, but even moderate investors, to question whether the higher risk on these countries may at some point explode on difficulties to repay bonds at maturity. On a multi-period basis, this may cause difficulties for the borrowers in terms of future financial flexibility: extra-funds may not anymore be invested on safe/ risk-free PA bonds.

Furthermore, the major stream of economic literature seems to perfectly meet GAM framework. Among the main economic growth indicators, an appealing cost of funding[2] is considered a key-driver. Grandes and Peter (2005) set up an analysis by observing the following cycle: funds initially move from emerging market borrowers, attracting international capitals (both from international PA or foreign countries' firms) by

[2]Cost of funding appeal should take into consideration the local riskiness: doing business in an emerging country may pay off higher returns, but with lower success probabilities.

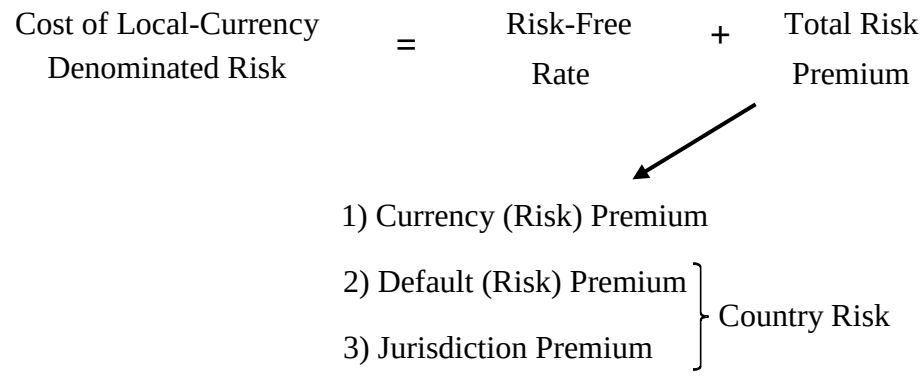
corresponding higher returns in terms of Total Risk Premium over comparable risk-free assets (generally, U.S. Treasury Bills for short sighted investments and U.S. Treasury Bonds for long sighted ones).

Being debt instruments denominated in domestic currency, the authors define Total Risk Premium as being composed of:

- Currency (Risk) Premium or simply currency risk[3] "*which reflects the risk of a depreciation or devaluation of the domestic currency. Bonds and financial assets denominated in that currency will therefore need to pay off a higher return to maintain a financial appeal towards potential investors*", as predicted.
- Default (Risk) Premium, reflecting the financial health of the borrower, negatively correlated with the Recovery Rate (RR): "*For an investor, it is the amount that offsets the extra-risk taken due to the possibility that the borrower may default, or be unable (or unwilling, in the case of a government) to service the debt in full and on time*."
- Jurisdiction Premium, alternatively denominated onshore-offshore risk premium, a consequence of differences between domestic (onshore) financial regulations and international (offshore) legal standards. This premium reflects all the non-financial frictions to potential business deals.

[3]According to Grandes and Peter, *Currency Risk* is commonly confused with *exchange risk*, arising from investors' risk aversion or from exchange rates' covariance.

Figure 1: Cost of Debt for a generic market borrower



Source: Grandes, Peter, 2005

The sum of Default Premium and the Jurisdiction Premium is often called Country Risk. Moreover, assuming the borrower in question being the government itself, this specific sum is called Sovereign Risk, the focus of this paper. An overall summary is above provided by Figure 1.

1.2) Quantitative Approaches for Measuring Sovereignty

The main two indicators in use between investors to try to forecast and assess Sovereign Risk are worth a detailed description, accurately provided in this paragraph and accompanied by the respective economic interpretations.

In order to maintain a practical view over the paper, GAM's perspective will then be accompanied by a rating agency's framework, Fitch.

According to GAM, 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. When considering the Sovereign

dimension, the approach is still similar to the corporate. These ratings take into account criteria that summarize the key economic and socio-political attributes of Sovereign entities. On a financial basis, solvency and liquidity factors evaluate the economic ability to pay, while "*political criteria such as development level of government and institutions, the degree of integration into global financial networks, and constraining forces such as social unrest are all important in assessing the willingness to pay*[4]". Misleading information or moral hazard may drive investors towards false estimations, thus rating has been widely pointed as evil for the markets. Although a focus on ratings will be given separately in paragraph 1.3, a brief summary of what rating information looks alike is provided by Figure 2.

Figure 2: Linear Transposition of Rating Scale

S&P	Fitch	Moody's	Numerical Scale
		Investment Grade	
AAA	AAA	Aaa	1
AA+	AA+	Aa1	2
AA	AA	Aa2	3
AA-	AA-	Aa3	4
A+	A+	A1	5
A	A	A2	6
A-	A-	A3	7
BBB+	BBB+	Baa1	8
BBB	BBB	Baa2	9
BBB-	BBB-	Baa3	10
		Speculative Grade	
BB+	BB+	Ba1	11
BB	BB	Ba2	12
BB-	BB-	Ba3	13
B+	B+	B1	14
B	B	B2	15
B-	B-	B3	16
CCC+	CCC+	Caa1	17
CCC	CCC	Caa2	18
CCC-	CCC-	Caa3	19
CC	CC	--	20
C	C	--	21
SD[1]	DDD[3]	Ca[4]	22
D[2]	DD	C	23
--	D	--	24

Source: Fitch, Moody's, Standard and Poor's, 2011-Year to Date

[4] Fitch ltd, 2001.

Sovereign Risk ratings are thus based mainly on economic factors. However, it has been stated that political governance factors are also important on global markets. As hinted, market is heavily influenced by rating agency actions because of their impact on actual investor behavior. The need to adhere to risk limits in portfolios, as well as the impact on general investors' psychology, creates a further indirect effect played by these agencies.

Recent happenings show that the recent downgrade of Greece from investment grade to high-yield was a big contributing factor in its government bond yields sharp rising, despite the EU established a specific Aid Package of €110B with the International Monetary Fund (IMF). GAM's 2012 Annual Report continues by observing that: "*Many investors simply had to sell out of non-investment grade bonds. For other investors, the decision to sell may have been made on the basis of a decline in sentiment toward Greek bonds*".

Avoiding considerations about the aid package contents and its effects in the near term, again GAM's report spots the importance of Greece's medium term structural problems and its ability to resolve them, doubting this last one and pointing it as the default crisis starting point. The experienced lack of trust exploded in a higher risk of default priced in, experienced by borrowing rates increases: demand for loans increased as private investors tried to accumulate liquidity to face a possible default. Being Sovereign Risk Premium essentially the yield premium that the market demands to hold a government's debt, once market participants take a less favorable view of a nation, bond yields are pushed higher. "*The increase in borrowing costs may in turn give rise to further*

deterioration in the country's finances, thereby creating a negative feedback loop for the country and its ability to borrow funds[5]*"*.

When Sovereign Risk Premium increases, the market penalizes the debt issuers for its deteriorating conditions resulting from the factors that go into yield valuations. Maintaining a practical approach, from Fitch's most recent report it is possible to evaluate these aspects applied on the current financial crisis[6].

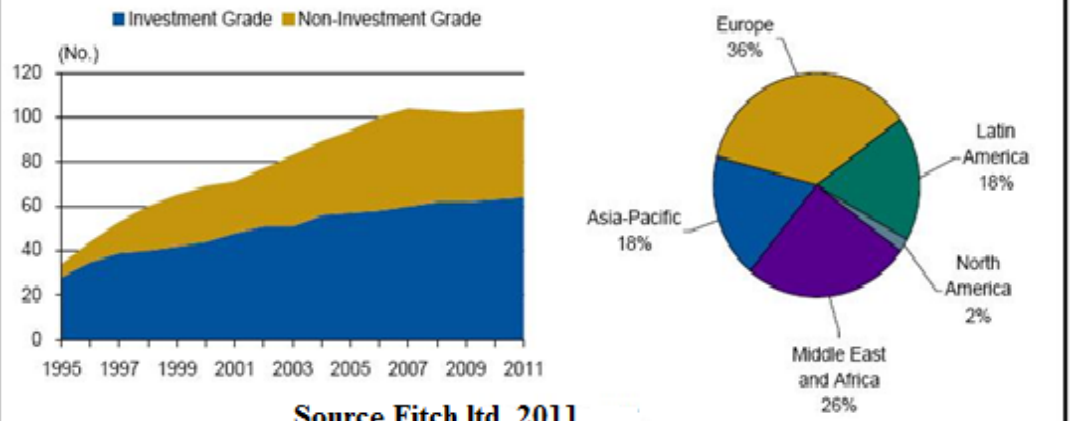
"*The Euro zone debt crisis continued to foster a sharp increase in negative rating activity among international public finance issuers in 2011, as local and regional governments (LRGs) struggled with steep revenue declines, austerity measures, and E.U. bailouts. The share of issuers affected by downgrades (23.4%) was more than double the 10.2% share downgraded in 2010, while upgrades rose up to 7.6% from only 2% a year earlier. Downgrades surpassed upgrades by a ratio of 3.1 to 1. European issuers historically have accounted for the majority of all Fitch-rated international public finance issuers. They represented 85% of rated issuers. Consequently, the region's E.U. members under mounting pressure represented all of the sector downgrades in 2011 - specifically Portugal, Spain, and Italy* (Figure 3 provides a snapshot of the mentioned trend)[7].

Since these latest countries are experiencing a weak recovery, the fiscal policy for sub-nationals agents is the real challenge, because of its direct and immediate impact. Fitch, analyzing PA expenditure cuts, sustains that they have not been drastic enough to offset public revenue downward trend. This assumption may not be an immediate criticism: many countries' LRGs are responsible for the provision of healthcare and education,

[5] GAM's Annual Report, 2012.
[6] All the data from Fitch ltd database, 2011.
[7] Fitch ltd, 2011.

elements characterized by rigid costs. Revenue growth in 2012 is expected to be muted, and therefore LRGs will have to further these cuts to enhance operating balances. Fitch expects emerging market economies to outperform European countries, highly boosted by stronger GDPs growth.

Figure 3: 2011 Updated Year-End Growth and Distribution of Sovereign Default Rates



Source Fitch ltd, 2011

The downward trend above stated began for public finance in 2009 and kept its increasing on in 2011, because of the euro zone debt crisis' propagation at a global level. Fitch downgrades were more than double prior year levels (23.4% in 2011 versus 10.2% in 2010). From its report it is observable how E.U. issuers accounted for all negative actions, most notably the 2011 Sovereign downgrades of Portugal (to 'BB+' from 'A+'), Italy (to 'A+' from 'AA-') and Spain (to 'AA-' from 'AA+'), all of which struggled with mounting debt.

International public finance upgrades increased more than threefold in 2011 (7.6%) from 2010 (2%). The rise was weighted heavily toward emerging Europe. Russia is the most significant upgrade in terms of Sovereign improvements on budgetary performances. Overall, the balance was distributed among developed Europe and single-issuer upgrades

within Canada, Colombia, and Australia. The rating distribution remained high with significant concentration on the investment grade (76%), percentages consistently spread across the year. With the same metric, Spanish and Italian Sovereign downgrades caused the most significant shift in the distribution of 'AA' ratings, from 33% to 20.7% at year-end 2011, sign of how these debts are spread across the world in terms of international investors.

The term Sovereign Risk, though, has more recently appeared in the media not only in relation to the issues with Greece and other European peripheries, but also in discussing Australia. "*For the former, it's a default probability related issue; for the latter, it's a matter of perception about how certain are the 'rules of the game' for doing business in Australia, expressing the effects introduction of a Resource Super Profits Tax as an example of heightened Sovereign (Regulatory) Risk*[8]*."*

A 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)*"[9]. The buyer of protection may be an investor who owns a government's bonds and, rather than selling them to the market prefers to 'hedge' the risk by buying a CDS. The situation is similar to a potential customer of an insurance company, who literally buys protection against a future unknown event. The premium, correspondent to the regular payments of the buyer, is expressed in basis points. Hence, CDS increases indicate the market worries about default, so the protection against such event becomes

[8] The Economist, 2010.
[9] Concepts, Definitions, Examples by Hull (2009).

more expensive. This is exactly what happened with Greek CDS levels which have been on the rise since February[10].

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, yearly produced by JP Morgan since 1995. This tool is frequently used to measure Sovereign Risk Premiums charged exclusively in the secondary bond markets. It consists of the basket of secondary market negotiated PA bonds of a number of emerging countries, denominated in a common foreign currency[11].

At a first sight, this measure seems to go beyond the extent of this paper. Although, being these markets the main target for an affirmed economy as the US, and given the composition of the index, this observation will be rejected.

The EMBI+ comprises mainly external debt paper (Eurobonds are a common example) but also traded loans and domestic bonds (again, denominated in foreign currency[12]). The index represents an average of the bond prices of secondary markets, weighted for their market capitalization.

Being Sovereign spread the difference between each country's Sovereign bond yield compared to US Treasury Bonds, considered to be the global risk-free benchmark, EMBI+ refers to Sovereign spread as *Country Risk*, while the additional yield relative to

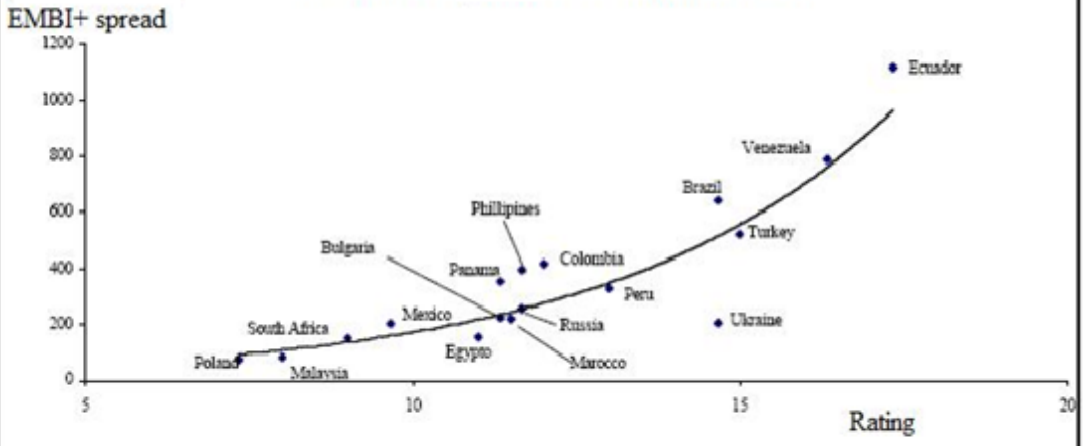
[10] Bloomberg, 2011.

[11] 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).

[12] International Monetary Fund, 2004: " *The criteria for a debt bond to belong to EMBI+ are: minimum value to expire of US$ 500M; risk rating equal or lower than BBB (S&P) and Baa 1 (Moody's); over one year to maturity the possibility of being compensated internationally through systems.*"

US government bonds is charged to compensate for the higher risk represented by the public debt securities of emerging countries. It is reaffirmed the concept that the higher the spread goes, the more the likelihood of default grows on investors deductions and expectations. Figure 4 illustrates the trend registered by the EMBI+ index in 2011.

Figure 4: EMBI+ Spread & Risk Classification, 2011



Source: J.P. Morgan, Moody's, Standard and Poor's, Fitch, 2011

As highlighted by the authors, indices like EMBI+ are characterized by intense short term volatility, and could therefore be pointed as Country Risk indicators only for unexpected breakevens. On the opposite, Sovereign Risk ratings should reflect changes on a long run scenario, since they embody PA actions along a whole year.

That being said, catastrophic events have deep consequences both on the impact and on a long lifespan, impacting Sovereign after the Unexpected Country Risk. In other words, a convergence between the two can be expected in the long term.

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[13], and worth a specific focus.

An important component of Sovereign Risk, besides the capacity to repay debtholders, 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.

Canuto, Sà Porto and Pereira (2004) reported the most effective sanction that creditors can exert in limiting the access to the international market for credit to defaulting institutions, and at the same time demanding a higher risk premium (in terms of interest rate) for those who re-access the market after a default experience.

On the other side, these institutions set some priorities up among their creditors, with priority being given towards multilateral credit institutions. Although default state may last longer periods when referring to governments, sooner or later the PA will need to access the foreign capital market again, in order to collect the necessary funding for its pending debts.

The rating process for Sovereign Risk normally comprises three stages: (i) Assessment of the economic situation of the country (ii) Quantification of the factors assessed (including

[13] Moody's ltd, 2003.

qualitative ones) and (iii) Decision on the rating, made by a vote in committee based on the data emerged from (i) and (ii)[14].

A generic analysis of the economic condition consists of a preliminary visit from the analysts to the country being assessed. By meeting the government diplomats, private sector agents and members of the political opposition, the call for more detailed information on official figures is satisfied. This induction complies to the need of practical comprehension of the fiscal and monetary policies strict and broad implications. The agencies verify clarity and consistency of these, also in the way they are managed, assessing their influence on the balance of payments and public debt historical track of records. Other sectors perspective counterbalances this official view and completes the final report, which is finally distributed to the rating-committee members together with the proposed recommendation.

In the next phase, every single parameter is discussed and assessed openly by the committee members. Every decision subsequently awarded is based on points that will sum to the final rating.

Consistency is the most important issue that is needed to be considered, especially to avoid arbitrages. Directly from Fitch 2011 report: "*The key feature in the discussions is a comparative exercise between countries with similar ratings, regardless of region of origin, aimed at avoiding inconsistencies between ratings.*" An heterogeneous composition of the committee complies to this goal: evidence is furnished by a provision of analysts from both private and public sector, specialists of different regions with different financial backgrounds.

[14] Canuto, Pereira, Sà Porto, 2004.

In its model, Fitch individuates 14 different Sovereign Risk drivers, concerning five general categories: "*political, civil and institutional risk; the real sector; the monetary and financial sector; the external sector, and finally, the fiscal sector*". Each category is marked from one (best) up to six (worst). The values of the categories are then aggregated into a single, synthetic indicator. Qualitative factors, such as the willingness to pay, are based upon the subjective experience and expertise of the committee members.

Bhatia (2002) added an important observation: ratings take into account not only the present situation of the PA, but also its ongoing financial plan. Hence, several macroeconomic forecast indicators carry significant importance as well:

- Nominal GDP per capita (commonly denominated in $US);
- Real GDP per capita growth (net on the inflation rate);
- The nominal central government result/GDP ratio[15];
- Net or consolidated debt/GDP gross expenditure on interest/gross receipts;
- Inflation (Consumer Price Index)
- Net PA external debt/Balance of Payments;
- Net external debt of the non-financial private sector/Balance of Payments.

Rating agencies place great importance on forecasts for total internal and external public debt, which result in the sustainability of the debt accumulated.

The basic scenario for sustainability simulations is based on subjective policy assessments of expert analysts, presented to members of the committee, and only then by

[15] Fitch, 2001, defines a central government as "*the federal government or central administration plus the local/state governments. It does not include state-owned financial and non-financial enterprises*".

a broader econometric forecasting model. Alternative scenarios are constructed by releasing and/or stressing the assumptions initially provided[16].

When reforms explicitly aimed to improve long term public indebtedness profile are approved, upgrades can be experienced. This was the case with S&P in 2001 when it decided to raise Mexico's rating from BB+ to BBB following approval of the tax reform. Mexico was upgraded to an investment grade right away[17].

On one side incorporating forecasts is a plus of the model, but it also has a retrospective bias in a backward induction: "*There are less tangible considerations which could have a bearing on the risk of default, such as social, historical, and political factors. The committee may conclude that the rating indicated by the model is not appropriate in the light of, for example, monetary policy management - which in turn might be influenced by a number of different factors such as the ideological shape of a given government, tight fiscal and monetary policies, social pressures, the government's popularity and its Congressional support base*." By this concept, Fitch expresses how past actions influence the committee decision, together with the intensity of potential stress situations in future legislations and whether the availability of special debt instruments is effective for dealing with these.

Other key aspects of this assessment include the relationship between the government, the IMF and other multilateral credit institutions, the institutional framework[18] and the government's ability to ensure technical support in case of further distresses.

[16] Bhatia, 2002.
[17] Standard and Poor's ltd, 2001.
[18] E.g. the existence of an effectively independent Central Bank.

As summarized by Canuto, Pereira and Sà Porto: "*After due consideration of all these points, the rating is decided by a vote. A report incorporating the majority view of the committee is then drawn up and circulated. This contains an explanation of the main factors underpinning the rating awarded and indicating the principal concerns of the agency: why the rating is high or low, and factors that could occasion an upgrade or downgrade in the rating and the prospects for the rating in different scenarios*[19]". A facultative appendix includes a selection of the macroeconomic indicators and forecasts applied for a maximum of two years.

Once a rating has been established, it is periodically reviewed. The review procedures are essentially the same as those undertaken during the first slot. Review visits are carried out every 6 or 24 months, depending on the country's propensity to financial and political changes. When a relevant unexpected fact arises, the chief analyst responsible for the particular Sovereign debtor has the faculty convene a dedicated meeting, and the extraordinary nature of the case precludes the normal stages. Even in this case, changes in the rating may or may not be experienced: the country can also just be put on the Watch List for further upcoming reviews.

The agencies do not divulge the weightings attributed on the basis of the factors which they examine in the course of determining their ratings. However, they do publish articles about the theoretical framework applied, including which are the most important variables in terms of impact.

According to the authors, while agencies stress ratings in a perspective view, these are nevertheless made up on retrospective factors: "*However positive the trend of a given*

[19] Canuto, Pereira, Sà Porto on Moody's report, 2004.

economy might be, the fundamental health of that economy continues to exert a major influence over a given government's capacity and willingness to pay".

High per-capita income PAs are generally skilled with a low risk assessment. Per-capita income is a sample macroeconomic indicator that points at the general level of economic and institutional development. Rich country governments, having more flexibility to adopt strict policies in adverse periods[20], do not have the same relevant variables to be considered in terms of rating. In fact, authorities in developed countries with a long history of economic and institutional stability have quality specific instruments for managing expected and unexpected economic shocks.

The threshold of per-capita income is set by the rating agencies on $US 5.000 in order to belong to the "speculative grade" category. However, Sovereign bonds of developing countries are not always risky, and this also counts. One example is China, a country where per capita income is under $US 1.000 but which is assessed as "investment grade" from Fitch, Moody's and S&P. The reason is that China enjoys a low gross central government debt/GDP ratio, a low total net external debt, inflation controlled and a track record of high economic growth[21].

India, like China, is a low income country with a dynamic economy, increasing population and market. However, this country is still considered to be a significant high risk debtor. Its risk assessment is affected by a low GDP per capita, high fiscal deficit of the central government (10.7% of GDP in 2011), high gross public debt/GDP ratio (77%

[20] Fitch ltd, 2011 and Bhatia, 2002.
[21] Moody's, [21] Standard and Poor's, and Fitch database ltd, 2010.

of GDP in 2011), and by the presence of several barriers to international trade, high import tariffs and low exports shares of GDP[22].

Among all the indicators, inflation rates are considered by the agencies as the main barometer for PA policies (both monetary and fiscal), and of financial, political, and institutional stability. Significant and historic financing of budget deficits via debt issuances provokes short term inflation or, in some cases, hyper-inflation. In these circumstances, the authorities generally adopt strict policies consisting of monetary contraction and expenditures reduction. This is normally implemented with the help of the (supposed) autonomous Central Bank, which reduces the monetary base from dedicated indications of the PA. If this mechanism fails, Sovereign rating decreases due to a loss of credibility of the government and its institutions. In dramatic cases, this kind of situation ends with a suspension of public debt servicing[23].

The degree of maturity exhibited by the financial markets is another relevant aspect. In countries where the financial market is well-developed and government bonds are widely spread to different classes of investors, the costs of a default are higher for the PA. On the opposite, countries where the banking system access is limited and where government creditors only consists of a small group of agents embraces less risk[24]. The reason relies on the assumptions that a higher spreading of debtholders results from a higher private/external (that is, extra) funding need. Satisfying this requirement simply means

[22] Moody's[22] Standard and Poor's, and Fitch database ltd, 2011.
[23] Standard and Poor's ltd, 2002.
[24] According to Standard and Poor's, 2002, this consideration is "*more pertinent to the risk involved in bonds in local currency, but it has important effects on ratings of obligations in foreign currency. The credibility of a defaulting government on its domestic debt is much less pronounced than that of a government that honors all its payments*."

more risks to bear. Domestic credit available for the private sector as a proportion of GDP is largely in use to this extent.

A further reason of why financial openness is important in rating assessments is put forward by Fitch, which claims that in countries with policies favoring openness industries tend to be more competitive and in tune with the external market. By contrast, the industries of protectionist countries have a tendency to be inefficient, focusing exclusively on the domestic market and undermining the generation of foreign currency, hence thereby reducing the capacity to service foreign debts. Furthermore, countries with high foreign trade content in GDP percentages generally require lower devaluations to adjust balance of payments unpredictable movements.

The most important variable in any of the analysis on the external sector is the total net external debt (gross external debt minus assets in foreign currency) in relation to current account receipts. In the past, GDP was also eventually put as divisor. The logic for defining public external debt in consistence with private external debt relies in the fact that the latter can exert pressure on the international reserves of the Central Bank. When unpredictable crisis of important firms happen, PA can exert an extraordinary takeover, so that the firm's private external liabilities are transformed into governmental liabilities[25].

Governments are generally signaled with a low rating if their financial and banking institutions fund their domestic credit expansion via foreign borrowing, or in case of

[25] Standard and Poor's, 2002.

trade agreements and real exchange rate being set as incentive to excessive growth of foreign debt as private sector's main source of finance[26].

According to Bhatia, the drivers that close the circle are the following: "*The larger the total external debt of a given country in relation to its capacity to generate foreign currency, the more onerous the servicing of this debt tends to become and the greater the risk of default by the Sovereign issuer"*. This is not always the case: some variables can work to offset the consequences of the above mentioned phenomenon. An example is provided by the current amount of international reserves in a Sovereign portfolio. Considering this level together with the debt stock, provides a more complete picture to assess Sovereign access to the (foreign) debt market.

To complete the picture of what has been assessed, evidence from a common Moody's, S&P and Fitch framework is hereby given.

In 2011, the net balance of foreign indebtedness for the United States, Australia and New Zealand records extremely high amounts, among the highest ever recorded for their reference. Non-developed countries with similar values would be equivalent to B and C rating bands. Developed economies have a good reputation in terms of foreign debt obligations fulfillment, and this is historical driver leads the investors psychology.

United States, in the specific, has almost its entire public and private external debt being denominated in their local currency, so this definitely contributes to their high rating: it appears evident how exchange rate risk is hence lowered. On the opposite Venezuela, skilled with one of the lowest foreign debt, as a country results being non-investment grade rated. In these terms, its track record shows economic and political instability over

[26] Bhatia, 2002

the past two decades. Restricted access to financial markets is thus the real reason for a low external indebtedness[27].

Shifting towards public finances, two variables are crucial to Canuto, Pereira and Sà Porto: the nominal deficit of the central government in proportion to the GDP and the government's stock of debt relative to its total receipts[28]. Sometimes, presenting serious indebtedness problems could reflect scarce government's capacity of tax collection. Also, a tax base consistently linked to specific expenditure makes it difficult to introduce fiscal adjustment when needed.

To conclude, further variables taken into account by rating agencies include the sensitivity of public debt to interest rates shifts, the average maturity period or duration of the obligations, and the cost of debt servicing in terms of average commissioning.

[27] Moody's, S&P and Fitch. Database ltd, 2011.

[28] Due to difficulties in obtaining the first of these information for developing countries, Canuto, Fonseca and Sà Porto (2004) in accordance with the major literature stream identify the relationship between Sovereign rating and gross public debt as an alternative.

Chapter 2: Corporate Default Risk

2.1) Definition and Components

Consistently with what was assessed in the previous chapter, risk-free and minimum-hurdle rates apply in the corporate world as well when assessing the definition of Corporate Default Risk. To do so, it appears logical to provide a definition of both default and risk-free rate, accompanied by data evidence with which to observe these issues.

According to the rating agency set as benchmark for this paper, any financial, corporate or public 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 or other winding up or cessation of business of an obligor.*
- *The* ***Distressed Debt Exchange*** *(DDE) of an obligation, where creditors were offered securities with diminished structural or economic terms compared with the existing obligation*"[29].

On the opposite Damodaran (2006), in accordance with the major stream of economic literature, defines a risk-free asset as: "*An asset with expected return equal to its actual return*[30]". Implicitly, the author suggests several conditions to be happening in order to meet what stated:

[29] Fitch ltd, 2012.
[30] Damodaran, "*Applied Corporate Finance: A User's Manual*", 2006.

- First and logically essential, no default risk needs to happen, which generally corresponds to a security issued by the government. Note, however, that not all governments can be viewed as default-free, especially developing ones.
- Another key factor is the uncertainty about reinvestment rates: the cash flow being in analysis is compared to a zero coupon security with the same maturity [31].

To assess a corporate behavior, the benchmark consists of where corporate invest their funds, that is on projects that, according to their forecasts, will exceed any hypothetical risk-free return. This hypothesis seems to hold: otherwise the portfolio choice would be to allocate 100% on Treasury bills and bonds, with lower returns but absolute certainty about the receipt. A logical conclusion is that the firm will instead carry over some risk, balanced by an extra-return, denominated risk-premium[32].

The extra-return implied into the premium, reflects investors' demand of compensation for investing in an average risky investment, when compared to the risk-free rate. As a general proposition, this premium should increase with the risk aversion of the investors in that market: the less desired a portfolio variance is, the higher the risk premium is going to be. Also, the wealthier the firm, the closer its risk-premium estimate should be to the market-averaged one.

One first idea is that a firm can collect public information to make assumptions about an averaged risk premium. Damodaran observes how Merrill Lynch, for example, surveys target investors on their expectations about expected returns on stocks over the year to come, and consequently use an aggregate premium value from the information collected.

[31] According to Damodaran, for instance, US Treasury Bills do not work, since: "*There is reinvestment risk. Even a 5-year Treasury bonds would not work, because the coupons will cause the actual return to deviate from the expected return. Thus, we need a 5-year zero coupon Treasury bond*".

Alternatively, investment banks and consulting firms are observed by Damodaran to be adjusting the actual premium delivered over long time periods to the expectations on it. This is realized by the use of forecast models based on market historical sensitivity track of records.

A third and more complete methodology individuated by Damodaran, consists of considering risk premium as implied in today's asset prices. These are assumed to perfectly match the entire market growth, and hence it is feasible to assume the premium being equal to the difference between the expected return on stocks considered (adjusted for the local market' volatility) and the risk-free rate (generally Treasury bills when referring to short term, Treasury bonds to long term ones).

2.2) Modeling Corporate Default Risk

While the description of models like Capital Asset Pricing Model (CAPM), Single Index Model (SIM) and APM (Arbitrage Pricing Model) goes beyond the extent of this paper[33], firms can still self-estimate the default risk. Theoretical literature on the pricing of defaultable fixed-income assets refers to credit risk pricing, and recognizes three broad approaches[34] to model these probabilities:

(i) The **Classical** or Actuarial **Approach**;

(ii) The **Structural Approach**, or Firm-Value or Option Theoretic Approach;

(iii) 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.

[32] The risk premium in charge reflects the same logic of chapter 1.
[33] For a dedicated focus, see Bodie, Kane, Marcus, 2009.

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. Typical users of this approach include the mentioned rating agencies (at least in the traditional part of their operations) and banks credit risk departments[35].

The Structural Approach is based on Merton's (1974 and sequent) assumptions. This model will be highlighted later on the paper. It relies on an analysis of the borrower's Balance Sheet and its bankruptcy code to endogenously derive the probability of default and the credit spread, based on no-arbitrage arguments and making some additional assumptions on the recovery rate and about the risk-free interest rates market access.

The Reduced-Form Approach models the probability of default as an exogenous variable, calibrated to several data. The calibration of this default probability is made with respect to the data of the rating agencies or to financial market series acting as state variables. Peter and Grandes (2005) highlight the main credit drivers for large and international corporations as:

- **Firm Leverage**: "*The higher a firm's debt in relation to the value of its assets, […] the lower its net worth and hence the closer it is to default (e.g. bankruptcy), [...] the higher default premium (e.g. spread)*".
- **Firm-Value Volatility**: "*The higher the day-to-day fluctuations in the value of the firm's assets, […] the higher the probability that the firm defaults, […] investors will ask for a higher spread*".

[34] This paragraph draws on Peter and Grandes (2005), who also draw on Cossin and Pirotte (2001).
[35] Cavallo and Valenzuela, 2007.

- The **Corporate Spread**: market based or self-estimated by the firm[36].
- **Time to Maturity**: "*The more time there is before maturity, the more opportunities the firm with the same leverage (or asset return volatility) will have to increase earnings and reduce leverage, hence the lower its default risk and spread*".

The expectations about Microsoft's coefficient for maturity concern a significantly negative value when considered stand-alone, given its consolidated experience across the markets and its solid financial track of records. Nevertheless, it seems appropriate to postpone these analytical considerations to the dedicated chapter 4**.**

2.3) Default Risk Equilibrium: Debt Advantages

When it comes to financial analysis in assessing a firm's default risk exposure, a higher debt level has been usually seen as a negative signal by the market. The reason is that rating agencies link this evidence with higher default rates, steering shareholders towards a more equity-based financial mix. However, it appears reductive not to consider all the consequences of the adoption of debt as primary source of financing.

Ever since the first version of the Modigliani-Miller model (1958), the financial structure has been spotted as irrelevant for valuing the performance of a generic firm. However, it is only with the introduction of the "Agency Theory" promoted by Jensen and Meckling (1976) that these arguments were brought in with empirical measures. In the broadest terms, at least two different advantages to an increasing debt appear quite intuitive to be listed.

[36]According to Peter and Grandes (2005), It derives from the firm's leverage, its asset volatility, the correlation between asset return shocks and interest rate shocks and the term structure of interest rates.

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[37] 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.

Both benefits can and should be quantified if firms want to make reasonable judgments on debt capacity.

The primary benefit of debt relative to equity, as mentioned earlier, is the tax advantage conferred on the borrower. The author observes that in the majority of the countries, including the United States for instance, interests paid on debt are deductible from the tax-basis, whereas cash flows on equity (such as dividends) have to be paid out of after-tax cash flows as well as personal gains. In other countries, instead, only partial protection is provided against this double taxation effect[38] by providing a tax credit directed to the investors receiving the dividends for the corporate taxes paid (Great Britain) or by imposing a percentage on the retained earnings at a higher rate to compensate the one on dividends yields (Germany).

Once the taxation scheme has been set, Damodaran highlights three ways to calculate the savings arising from debt:

- The first alternative is the sequent: in any financial year tax savings created by interest expenses can be assessed as interest expenses factorized for the marginal tax rate of the firm. Firms borrowing **$B** to finance its operations on which pays an interest rate of **r**

[37] See Jensen-Meckling (1976) or Damodaran (2006) for a modern interpretation.
[38] More precisely: "*There is double taxation when the same income gets taxed twice, once at the entity level and once at the individual level. Thus, dividends, which are paid out of after-tax corporate profits, are double taxed when individuals have to pay taxes on them, as well*" (Damodaran, 2006).

(%), and assuming a marginal tax rate of **t** being paid on income, would result in an annual tax savings from the interest tax deduction of:

Annual Interest Expense arising from the Debt = **r B**

Annual Tax Savings arising from the Interest Payment = **t r B**

- The second alternative consists of computing the present value of tax savings arising from interest payments over time. Three further assumptions are necessary: the debt is perpetual, that determines savings in terms of perpetuity; cash flows discount rate is the interest rate on the debt, reflecting the riskiness of the debt taken by the firm; finally, the expected tax rate for the firm will not vary over time, together with the firm's position of tax-payer. These being satisfied, the present value of the savings is computed by Damodaran as it follows:

Present Value of Tax Savings from Debt = t r B / r = **Marginal tax rate * Debt**

A big limitation can be observed in this method, which consists of the tax benefit from borrowing not accompanied by the one of the additional costs. It also brings a non-realistic scenario in which corporations' value increases at a same rate for any further debt increase.

- One last approach pointed by Damodaran is that the tax benefit from debt could be explicated as the difference between pre-tax and after-tax costs of debt. Being **r** the interest rate on debt, and **t** the marginal tax rate, the after-tax cost of borrowing (**kd**) would be:

After-tax Cost of Debt (kd) = **r (1 - t)**

This is an alternative scenario, since the after-tax cost of debt is now a decreasing function of the tax rate.

During the years, several approaches have been adopted from risk analysts to evaluate and safeguard firms from default. Damodaran observed that in the 1980s, while leveraged buyout was becoming more and more popular, Michael Jensen developed an innovative view for borrowing, basing its analysis on the utilization of singular firm's free cash flows, stating that better efficiency could result from their optimization[39]. Free cash flows are defined by Jensen as "*Those cash flows made on operations over which managers have discretionary spending power – they may use them to take projects, pay them out to stockholders or hold them as idle cash balances*[40]". Critics were moved towards this theoretical framework, sustaining how firms with a high level of free cash flows incoming and low debt have no incentive to be efficient their project choices or potential investments, having already such a high extra-margins against default. Hence, a first way to 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. However, this would increase the risk of default on projects with sub-standard returns. This difference between the forgiving nature of the equity commitment and the inflexibility of the debt commitment has led to a consideration of equity as a cushion to use in case of emergency, and debt as a sword, for its burdening nature.

What clearly emerges from this argument is the conflict of interest between managers and shareholders, because the first ones do not have at their best the maximization of

[39] Jensen's free cash flows are individuated by Damodaran as the operating cash flows after taxes, but before discretionary capital expenditures.

shareholder wealth. Debt could act as a possible incentive, with all of its risks being involved. Several studies have been promoted to solve this issue, both from a direct and indirect way.

Damodaran collected in his 2006 work the main streams of literature over the years that support this theory. Firms acquired by a hostile takeover generally experience a scarce performance in both accounting profitability and stock returns. Bhide (1993), for instance, observed that the return on equity for these firms was about 2.2% below their peer group, while the stock returns were about 4% less profitable compared to their peer group. This poor performance by itself does not furnish evidence for the above mentioned free cash flow hypothesis. Palepu (1986) completed the analysis by highlighting how target firms in acquisitions adopt less debt than similar firms in similar conditions. Furthermore, some data historically showed that leverage enhancements are followed by improvements in stand-alone efficiency for the firms, measured by singular values of operating margins and returns on capital.

Denis and Denis (1993) present more direct evidence on improvements in operating performance in case of a leveraged recapitalizations[41] experience. By studying 29 firms that increased in a massive way their debt, they measured a median increase in the return on assets scoring 21.5%. Major part of this gain seemed to be coming out of cutbacks in inefficient capital investments, because the median reduction for this particular category of expenditures was 35.5%. Damodaran pointed that this evidence presented above could have been experienced at the same time with a number of different assumptions. For instance, he supposed that the management guidelines might have changed for these

[40] Damodaran, 2006.

firms, so that this switch rather than the additional debt would have leaded to higher investment returns.

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[42] 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.

Direct concern when borrowing money is the intuitive increase in expected bankruptcy costs that typically follows. Especially Altman, in his 1968 "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy" analysis, computes the expected bankruptcy cost can be considered as a product of the probability of bankruptcy and the direct and indirect costs of bankruptcy.

The **probability of bankruptcy** is assessed as the statistical likelihood that a firm's cash flows will not be sufficient to compensate the promised debt obligations (either interest

[41] "*In a leveraged recapitalization, a firm borrows money and either buys back stock or pays a dividend, thus increasing its debt ratio substantially*". (Damodaran, 2005)
[42] See Fisher (1959), Altman (1968 and 1989), Bodie and Merton (1995), Giesecke, Longstaff, Schaefer and Strebulaev (2011).

or principal). While such a failure does not automatically imply bankruptcy, it does trigger default, with all of its negative consequences.

"*The **direct**, or deadweight, **cost of bankruptcy** is that which is incurred in terms of cash outflows at the time of bankruptcy. These costs include the legal and administrative costs of a bankruptcy, as well as the present value effects of delays in paying out the cash flows*[43]".

There are, however, much larger costs associated with taking on debt and therefore increasing default risk, arising prior to the bankruptcy, essentially as a consequence of the market externalities, showing that a firm is in financial trouble.

The first is the perception coming from the customers of the firm that realize the danger of possible (imminent) financial troubles. When this happens, customers may stop their transactions towards the corporate offering, given the fear that the company will go out of business.

The second indirect cost arise from the stricter terms suppliers that might start demanding to protect themselves against the possibility of default, leading to an increase in working capital and reducing cash flows.

Finally, the third cost is the difficulty that might be experienced by trying to raise new and extra capital for its projects. In case it is considered to be too much when aggregated to the existing base by both debt and equity investors, they would be reluctant to take the risk. This would lead to capital rationing constraints, and the rejection of good projects.

[43] Damodaran, 2006, on Altman's paper "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy", 1968.

The second disadvantage that can be recognized is given by the **agency costs** arising from the bondholders versus shareholders conflict when the firm enters the liquidation process after default. Some potential for disagreement is indicated by Damodaran (2006) as a principal-agent issue, drawing on Jensen's 1976 homonymous theory[44].

In terms of real costs, the manifestation may happen in two ways: in case bondholders believe the scenario of a significant chance that shareholders actions might make them worse off, they can assess this expectation into bond prices by demanding much higher interest rates on debt. Alternatively, if bondholders want to protect themselves against this threat by defining very restrictive covenants, two costs would follow: the direct cost of monitoring these covenants, which increases as the covenants become more detailed and restrictive.

Also, Damodaran indicates the existence of an indirect cost of lost investments, because the firm would not be able to take some projects, use certain types of financing, or change its payout (menu costs); this cost will also increase as the covenants becomes more restrictive, as well as for firms borrowing more and more funds.

"*Financial flexibility* *refers to the capacity of firms to meet any unforeseen contingencies that may arise (such as recessions and sales downturns) and take advantage of unanticipated opportunities (such as unforeseen advances in technology or strategy in their market), using the funds they have on hand and any excess debt capacity that they might have nurtured[45]*". One of the reasons firms do not use their debt capacity is that they like to preserve it for potential market downturns or personal business downturns, in general for times when they might need debt to meet funding needs or

[44] Jensen, 1976, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure".

specific contingencies. Firms that borrow clearly lose this flexibility and have no fallback funding for these events.

However, this behavior towards these firms further shows the importance of market externalities for investors, consisting on the fact that firms only borrow when there is a problem in act. To be complete, there could also be a trade-off between not maintaining enough flexibility (because a firm has too much debt) and having too much flexibility (by not borrowing enough).

Flexibility needs then to be quantified, and Damodaran proceeded as it follows. In case this variable is meant as an amount which is needed to allow corporations to take advantage of unpredictable investment opportunities, its value depends on two amounts.

The first is the access guaranteed to capital markets. Other things being equal, firms with unlimited access to capital markets will not need to keep high debt capacity when they could easily raise new funds needed for new investments. Access to markets goes together with market competitiveness that ensures the firm being able to reach favorable rates. Smaller firms and firms in emerging markets, on the other hand, should value financial flexibility more, since they are assumed not to be able to easily enter international capital markets.

The second is the potential growth of excess returns when investing on new projects. "*When a firm operates in a mature business where new investments, unpredictable though they might be, earn the cost of capital, there is no value to maintaining flexibility.*

[45] Damodaran, 2006 (Latest publication and revision).

Alternatively, a firm that operates in a volatile business with high excess returns should attach a much higher value to financial flexibility[46]".

According to Damodaran, this trade-off concerning debt and the alternative sources of funding could be solved by checking the changing of the firm's financing mix over the same life cycle. Typically, start-up firms and firms in rapid expansion use debt sparingly, or, in some cases they do not issue it at all. As the growth eases, and as cash flows from existing investments become larger and more predictable, it is reasonable for them to begin to use it. Debt ratios typically live their higher percentages when firms are in mature growth, and it is possible to relate this to the argument sustained in Damodaran work.

It has to be said that it is arguable that the behavior of firms at each stage in the life cycle is entirely consistent with making this trade off. In the start-up and high growth phases, the tax benefits to firms from using debt tend to be small or non-existent, because earnings from existing investments are low or negative. The owners of these firms are usually actively involved in the management of these firms, reducing the need for debt as a disciplinary mechanism.

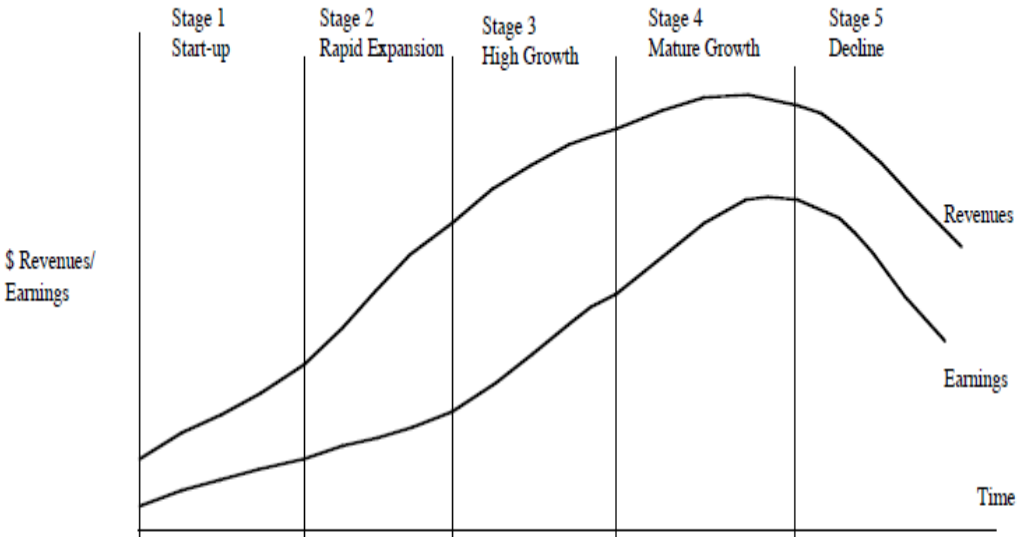
On the opposite, the author observes how low and volatile earnings increase the expected bankruptcy costs. The absence of significant existing investments or assets and the magnitude of new investments make lenders much more cautious about lending to the firm, increasing the agency costs; these costs show up as more stringent covenants or in higher interest rates on borrowing.

[46] Damodaran, 2006.

As growth eases, the trade-off seems to be solved in favor of debt. The tax benefits increase and expected bankruptcy costs decrease as earnings from existing investments become larger and more predictable. The firm develops both an asset base and a track record on earnings, which allows lenders to feel more protected when lending to the firm. As firms' market capitalization grows, the separation between owners (shareholders) and managers is more likely to increase, and the benefits of using debt as a disciplinary mechanism increase.

Anticipating what will be investigated in Chapter 4, Microsoft has large insider holdings, making the benefit of discipline that comes from debt a much smaller than its disadvantages. The trade-off at each stage in the life cycle is summarized and graphically illustrated in Figure 5.

Figure 5: Debt/Equity Trade-Off and Life Cycle



	Stage 1 Start-up	Stage 2 Rapid Expansion	Stage 3 High Growth	Stage 4 Mature Growth	Stage 5 Decline
Tax Benefits	Zero, if losing money	Low, as earnings are limited	Increase, with earnings	High	High, but declining
Added Disceipline of Debt	Low, as owners run the firm	Low. Even if public, firm is closely held.	Increasing, as managers own less of firm	High. Managers are separated from owners	Declining, as firm does not take many new investments
Bamkruptcy Cost	Very high. Firm has no or negative earnings.	Very high. Earnings are low and volatile	High. Earnings are increasing but still volatile	Declining, as earnings from existing assets increase.	Low, but increases as existing projects end.
Agency Costs	Very high, as firm has almost no assets	High. New investments are difficult to monitor	High. Lots of new investments and unstable risk.	Declining, as assets in place become a larger portion of firm.	Low. Firm takes few new investments
Need for Flexibility	Very high, as firm looks for ways to establish itself	High. Expansion needs are large and unpredicatble	High. Expansion needs remain unpredictable	Low. Firm has low and more predictable investment needs.	Non-existent. Firm has no new investment needs.
Net Trade Off	Costs exceed benefits Minimal debt	Costs still likely to exceed benefits. Mostly equity	Debt starts yielding net benefits to the firm	Debt becomes a more attractive option.	Debt will provide benefits.

Source: Damodaran, 2006

Chapter 3: Theoretical Framework: Corporate Meets Sovereign

3.1) Sunrise of the matter: Merton's 1974 Reference Model

The assessment of Sovereign Risk as one of the main credit drivers to define Corporate Default Premium is nowadays common knowledge for all the main rating agencies and firms. The magnitude of this phenomenon depends both on the penetration of Sovereign issues on the firm's core business, and of course on the rating model considered.

The extent of this chapter is to merge all the concepts introduced in the previous ones, recalling the main models that have been developed over the years, with a final focus on the modern interpretation of the Contingent Claims Approach elaborated in 2007 by Bodie, Gray and Merton. This will be the benchmark to analyze the evidence of Microsoft Corporation and the USA later on the paper.

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[47];
- The various provisions and restrictions contained in the indenture[48];
- The probability that the firm will be unable to satisfy some or all of the indenture requirements[49].

By that time, no systematic theories had been developed on the third component, which is about some bond-pricing evidence with a significant influence of the probability of

[47] The characteristics of a risk-free asset are the ones described in Chapter 2.
[48] For instance maturity date, coupon rate, call terms, seniority in the event of default, etc.
[49] The probability of default described in Chapter 2.

Default. Merton's final goal was to present a premium model which could embed a theory of the risk structure of interest rates. He adopted a meaning of the term 'risk' restrictedly to the possible gains or losses to bondholders as a result of exogenous and unpredictable changes in the probability of default, and does not include the gains or losses referred to all bonds caused by unforeseen changed in interest rates in general.

Throughout his analysis, a given term structure is assumed so that the price differentials among bonds are solely caused by differences in the probability of default. The final extent is, as perceivable, to isolate the sensitivity to default risk. Adding the hypothesis of Treasury Bonds as the only source of funding, equals to consider Default Risk as Sovereign Risk, as needed in this paper.

Assumptions Merton's model draws on Black and Scholes (1973) and Merton (1973) works about option pricing, offering a generic framework to value the debt issued by a firm. Considerations about the validity of the assumptions go beyond the goal of this paper, however they consist of:

1. No transactions costs, taxes, or problems with indivisibilities of assets.
2. Sufficient number of investors with comparable wealth levels so that each investor believes that he can buy and sell as much of an asset as he wants at the market price.
3. Exchange market for borrowing and lending at the same rate of interest.
4. Short-sales of all assets, with full use of the proceeds, are allowed.
5. Trading in assets takes place continuously in time.
6. Modigliani-Miller's theorem[50] (1958) validity.
7. Interest Rates term-structure is flat and known with certainty[51].

[50]Modigliani-Miller's theorem shows that the value of a firm is invariant to its capital structure

8. The dynamics for the value of the firm, **V**, through time can be described by a diffusion-type stochastic process with stochastic differential equation:

$$\mathbf{dV = (\alpha V - C)\, dt + \sigma V dz}$$

Where **α** is the instantaneous expected rate of return on the firm per unit time, **C** is the total dollar payouts by the firm per unit time to either its shareholders or liabilities-holders[52] if positive, and it is the net dollars received by the firm from new financing if negative,

$\boldsymbol{\sigma}^2$ is the instantaneous variance of the return cn the firm per unit time, **dz** is a standard Gauss-Wiener process.

Many of these assumptions are not necessary for the model to obtain but are chosen for expositional convenience. In particular, the "perfect market" assumptions (1) - (4) can be substantially weakened. Assumption (6) is actually proved as part of Merton's 1973 analysis and (7) is chosen so as to clearly distinguish risk structure from term structure effects on pricing. (5) and (8) are the critical assumptions: Basically, the first one requires the market for these securities to be open for trading most of time, while the second requires that price movements are continuous and that the unanticipated) returns on the securities be serially independent[53].

Hypothesis 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.

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[51]The price of a riskless discount bond which promises a payment of one dollar at time **T** in the future is **P(T) = exp[-rT]** where **r** is the (instantaneous) riskless rate of interest, the same for all time.

[52]An example is given by dividend payouts, or interest payments.

[53]Merton demonstrates in his 1973 work that this assumption is consistent with the "perfect market" assumption (1) – (4).

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.[54] Thus, the amount received by bondholders at time T is:

$$\begin{cases} D, & if\ Vt \geq D \\ Vt, & if\ Vt \leq D \end{cases}$$

Merton's key insight is that the above can be interpreted as the payoff from an option position, and option-pricing techniques can be brought to bear on the problem on pricing risky debt:

$$\text{Debtholders Payoff} = D - \max\{D - Vt, 0\}$$

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, $-\max\{D - Vt, 0\}$, is the payoff from a short put option written on the firm's assets (with strike price D and maturity date T).

This decomposition provides the first procedure to value risky-debt: identify the value **B** of the risk-free debt, and subtract from it the value **P** of the put option. The first step is straightforward, but then it appears necessary to recall Black and Scholes: Merton assumes that the value V_t of the firm follows a lognormal diffusion with constant

[54] 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.

volatility **σ** and a constant risk-free interest rate, **r**. The value of the put, at time t, may then be defined as:

$$\mathbf{P = e^{-r(T-t)} D \cdot N\left(-d + \sigma\sqrt{T-t}\right) - V_t \cdot N(-d)}$$

Where N( ) is the cumulative standard normal distribution, and

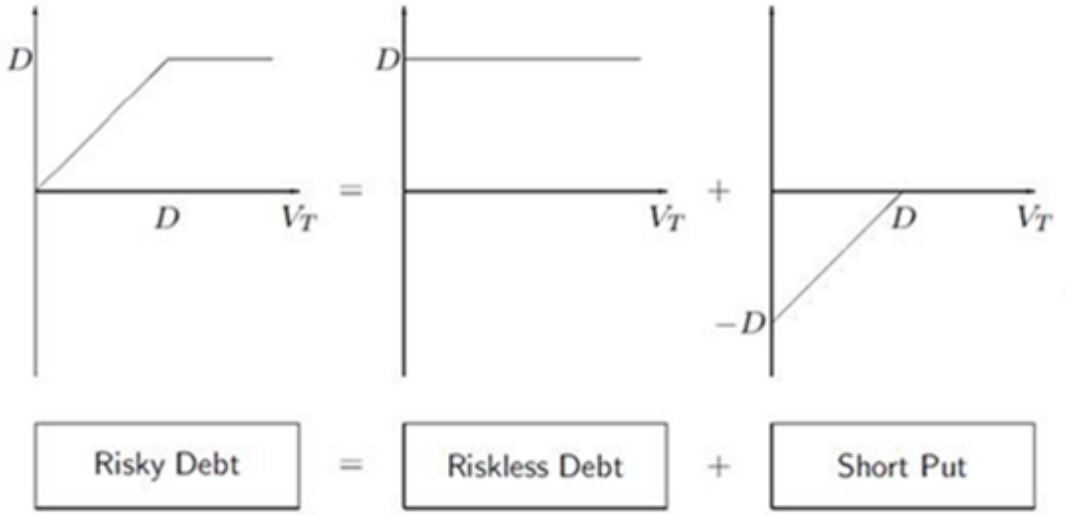
$$\mathbf{d = \frac{1}{\sigma\sqrt{T-t}}\left[\ln\left(\frac{V_t}{D}\right) + \left(r + \frac{1}{2}\sigma^2\right)\cdot(T-t)\right]}$$

Through simple algebra and options arbitrage theory (put-call parity), it is possible to demonstrate that risky debt can be identified as a long position on the firm's assets and short call option on the firm's assets with strike price D and maturity T:

$$\mathbf{Debtholders\ Payoff} = Vt - \max\{Vt - D, 0\}$$

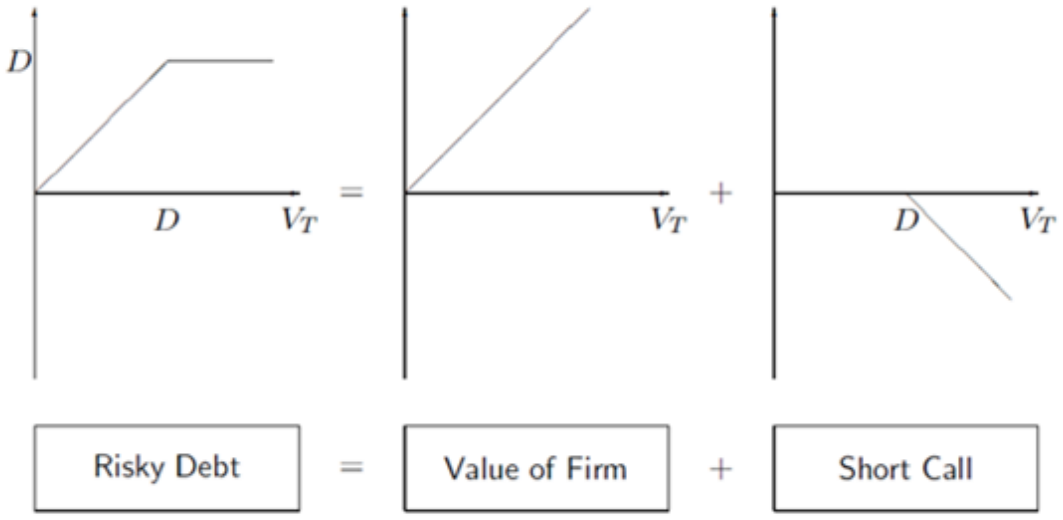
Merton identifies this second case as if debtholders would own the firm, but have sold to shareholders a call option giving them the right to purchase the firm for D. A graphical snapshot is provided by Figure 6 and Figure 7.

Figure 6: Risky Debt and Short Put Options



Source: Sundaran, 2001

Figure 7: Risky Debt and Short Call Options



Source: Sundaran, 2001

In any of these cases, the value of the option fully determines the price differential between risky and riskless debt: a higher value of the option increases the spread of the risky (Secondary Markets, OTC, also certain Corporate Bonds) over the riskless (Sovereign) ones.

In conclusion, an increase in the firm's assets volatility would determine an increase in the put value and consequently in the risky-debt spread. Vice versa, if a Sovereign risk-profile increases, then the risk-free investment increases, tightening the spread due to a lower value of the option.

3.2) Evolution of the subject: Merton's Model Adjustments

The model elaborated by Robert Merton has been the benchmark for several further studies that leaded to the more modern rating models, especially for our sample rating agency Moody's KMV. The reasons are that this model has a sound economic basis. It is a causal model, rather than using financial engineering, it uses market price information and its incorporation of equity prices make it forward looking. This last skill made it innovative if compared to default-prediction models, based on historical/accounting data, also because of a significant increment on the predictive power for rating quality.

At the same time, several critiques have been moved to Merton's model in a risk-management context. First of all, it cannot be used to value a particular tranche of corporate debt without simultaneously considering all the tranches senior to it[55]. Secondly, it is not an approach that lends itself easily to the pricing of many credit derivatives, mostly because of the complex behavior in terms of payoff of the exotic ones.

On the other side, certain critics have been overtaken during the years by an evolution of the Merton model. These were raised mostly because of its assumptions that made quite

[55] This is a consequence of the Black and Scholes Standard Normal Distribution assumption and its cumulate consideration of probabilities.

unrealistic its 'as-is implementation' in a reality context. Sundaran (2001) collected the main constraints and the relative main solutions as it follows:

i) The firm value V and its volatility σ play a key role in determining the value of the put option, although they are unobservable.

ii) Debt structure is assumed to be simple. This is in contrast with the current trend of engineered debt issuances.

Solution i) Prices of traded securities issued by the firm can be considered an efficient proxy to obtain the variables V and σ. In the specific, Sundaran supposes the firm being publicly traded with observable equity prices. Suppose $\mathbf{E_t}$ and $\boldsymbol{\sigma_{Et}}$ respectively denoting these time-t values, both easily obtainable by updated market prices and volumes.

The value E_t can be expressed itself as an option on the value of the firm, noting that the residual claimants will receive the amount left from debtholders repayment:

$$\begin{cases} Vt - D, & if\ Vt \geq D \\ 0, & if\ Vt \leq D \end{cases}$$

This is exactly the payoff of a long call on the firm's assets with strike price D and maturity t. The value of this option will clearly depend on V_t, σ (non observable variables), D, the interest rate r and the time to maturity T-t (all observable). Thus, Sundaran expresses the value f, price of the call, as:

$$E_t = f(V_t, \sigma)$$

Under the Black-Scholes assumptions, in consistence with Merton's model, the price of the derivative would be:

$$f(V_t, \sigma) = V_t \cdot N(d) - e^{-r(T-t)} D \cdot N(d - \sigma\sqrt{T-t})$$

Being equity prices observable, this can be considered as a first equation. To be able to solve for these quantities a second one is needed. But since equity is an option written on the firm value, its volatility (σ_E) is also a function (g) of V_t and σ.

$$\sigma_E = g\,(V_t, \sigma)$$

Once again, under the Black-Scholes assumptions, the second equation is easily obtainable and the model is complete as it follows:

$$g\,(V_t, \sigma) = \sigma V_t \cdot \frac{N\,(d)}{f\,(Vt\,,\sigma)}$$

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.

The first one embeds a simultaneous existence of multiple debt issues that can differ in maturity, size of coupons and seniority, and can incorporate safety covenants, sinking funds provisions and amortizations.

The idea beyond is very intuitive, although much more complex to calculate: from a simple call/put option written on the firm value, equity now becomes a compound option: if the promised payment is made (e.g. the option is exercised), the shareholders would obtain the right to proceed to the next payment; otherwise, the firm is considered in default.

Sundaram observes that when the last-but-one promised payment is made, the scenario gets back to the Merton's model, hence knowing the value of the final option it is possible to work backwards to identify the contingent value of equity and all the

outstanding debt at any of the earlier times. Recalling once again the Black-Scholes model, the scenario now involves a multivariate-normal distribution[56] to embrace all the possible default scenarios.

The complexity of this approach is mostly given by the implementation of precise and complete information on the actual debt structure. Furthermore, the problems of the non-observable firm value and volatility above stated remains, and using proxies on large scale significantly impacts Merton's model predictive power.

The second alternative consists of attempting to simplify the given debt structure to make it fit within the model, for instance replacing it with an equivalent zero-coupon structure. The idea, pursued by Merton itself in 1974, is to analyze a zero-coupon bond that has the same duration as the given debt structure to assess the firm value.

KMV models, instead, are based on the empirical observation that default tends to occur in reality when the market value of the firm's asset drops below a critical point. This point is identified by Sundaram as lying below the book value of all the liabilities and above the book value of short-term liabilities[57].

Based on this, the next step is to individuate the zero-coupon level (D) as a result of:

- Face-value of all short-term[58] liabilities;
- A fraction of the face-value of all longer-term liabilities

To ultimate this approach, the default point is used in conjunction with the firm's equity value and equity volatility, in order to identify the values of V and σ. Then, the number of

[56] If there are n promised payments, the final expression would involve an n-dimensional multivariate normal distribution. When n=1, it is the case of Merton's model.
[57] All these information are taken from KMV rating model.

standard deviation moves resulting from possible V-falls below D need to be identified. This would act coherently with the normal (cumulative) distribution assumption, defining the firm's distance to default (δ).

Finally, trough a rating historical track of records, it is possible to assess the percentage of firms with δ that defaulted within one year. This would be the Expected Default Frequency (EDF).

Analyzing cross-section the value of EDF for firms in the same economic sector, provides a value of firm-specific risk, which is possible to be hedged via securities on the market. The 100% - complement would consequently be the market-specific risk, linking Sovereign and Corporate Default.

3.3) An Innovative Scenario: Contingent Claims Approach

The recent financial crisis stressed economies' vulnerability to the global markets volatility, whether for credit, currencies or commodities. Private sector agents, like investors and corporations, consequently needed different perspectives with which predicting and managing the risks emerging from the market. Specifically, given the 'national' dimension of the current distress, Sovereign Risk reaffirmed itself as one of the main key-drivers for credit-default events.

Bodie, Gray and Merton, in 2007, proposed a new comprehensive approach to measure and analyze Sovereign Risk based on the theory and practice of Contingent Claims Analysis (CCA). A contingent claim is "*any financial asset whose future payoff depends*

[58] That is, t < 1 year.

on the value of another asset[59]". 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 public sector, together with the private, can get better off from adopting new risk indicators, improving price and volatility discovery and extend the relative intermediation. The final goal of chapter 4 will be the application of this model to Microsoft Corporation and the USA.

The authors observe how macroeconomic flows in past models were often supplemented with partial data on the government debt, and vulnerability was usually assessed with accounting ratios, such as debt to GDP. By contrast, CCA focuses on the risk-adjusted economic Balance Sheet of the Sovereign (combined government and monetary authorities) and is able to more accurately forecast the non-linear behavior of Sovereign bond prices and credit spreads.

Assumptions & Hypothesis Recalling Merton's work, it is possible to summarize the behaviors needed as:

- The values of liabilities are derived from assets;
- Assets follow a stochastic process;
- Liabilities have different priority (i.e. senior and junior claims).

These being satisfied, equity can be modeled as an implicit call option and risky debt modeled as the default-free value of debt minus an implicit put option.

[59] Bodie, Gray, Merton, 2007.

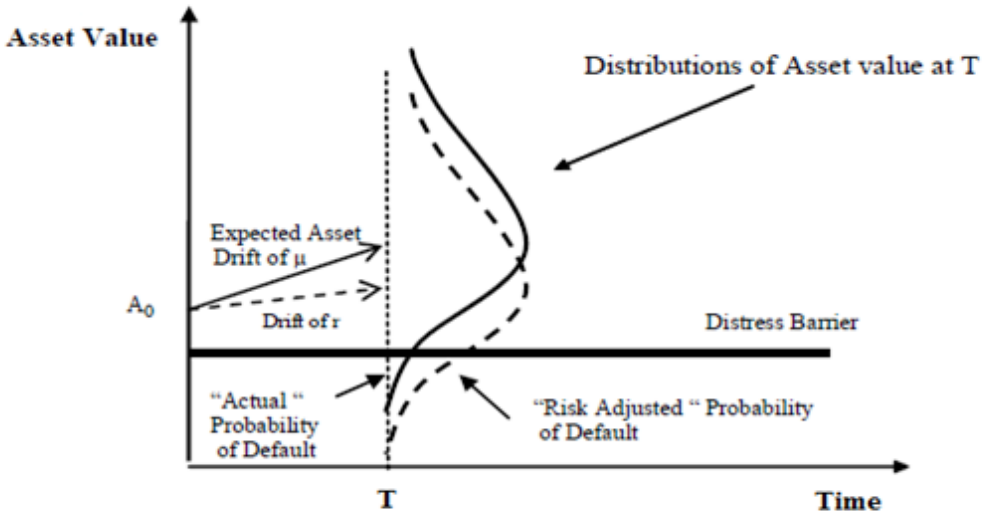
The Model According to Bodie and Gray, Balance Sheet risk is "*the key to understanding Credit Risk and default probabilities whether the Balance Sheet is of a corporation, a financial institution or a Sovereign*[60]". All of the entity's assets and liabilities are measured at their current market values, 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.

One last consideration is about the value of total assets. Bodie and Gray suggest that a financial distress might influence the incurring book values of liabilities, as well as their short-term ones. This trigger value is conceptually similar to a barrier, which represents the present level/amount of promised payments on the debt, and is commonly denoted as the sum of short-term debt, consisting of interest payments up to maturity, and half of long-term debt. The total value of all assets, due to white noises verification, might be inferior to the level of promised payments on the debt, creating distress and/or ending up in default.

Bodie and Gray begin their model by defining the value of assets at time t as **A(t)**. Assets return, in consistence with Black, Scholes and Merton model assumptions, follows a Wiener's process $\mathbf{dA / A = \mu A dt + \sigma A \varepsilon t}$ [61] where **Aμ** is the drift rate or asset return, **Aσ** is equal to the standard deviation of the asset return, and **ε** is a normally distributed white noise, with zero mean and unit variance. The probability distribution at time T is shown below in figure 8.

[60] Bodie, Gray, Merton, 2007.
[61] See Hull, 2007 on Wiener's process.

Figure 8: Probability Distribution of Asset Values and Distress Barrier



Source: Bodie, Gray and Merton, 2007

At the end of the period, the value of assets may be above the distress barrier, indicating that debt service can be made, or below the distress barrier. Hence, default occurs when assets fall to or below the barrier, B_t.

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*[62]", 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

According to Merton, it is possible to express the total market value of assets, A(t), in terms of market value of equity and market value of risky debt, J(t) and D(t). In particular, starting from the last equation:

$\mathbf{A_0=J + Be^{-r\,t}}$, where the first term is assets, the second equity value, the third the default-free value of debt at t=0 and the last one is the put option.

Now the single terms equation needs to be analyzed.

The put option's implicit value is $\mathbf{P=Be^{-rt}(N(-d_2)) - A_0(N(-d_1))}$.

The value of debt adjusted for its riskiness is $\mathbf{D=Be^{-rt} –P}$.

Equity, J, is equal to the value of a call option, $\mathbf{J=A_0N(d_1) - Be^{-r\,t}\,N(-d_2)}$, where the definition of d_2 was previously provided and $\mathbf{d_1=d_2+\sigma_A\sqrt{t}}$.

The risk-free rate is **r** and **t** is the horizon period.

The Balance Sheet The mindset needed when applying CCA is to consider the existence of several similarities between a Sovereign and a corporation Balance Sheet. In the specific Gapen, Gray, Lim and Xiao (2005) individuated, respectively:

<u>ASSETS</u> :

- For the corporations, the main component relies into the voices of cash and earnings deriving from future projects, net of related expenditures, expressed at their present value. With the due proportions in terms of firm dimension, a marginal role is played by issues like properties, plant, equipment and inventory. Finally, contingent assets from a

[62] Bodie, Gray, Merton, 2007.

parent company may be included in case of a holding structure, as well as implicit guarantees to subsidiaries.

- When considering a Sovereign entity, the reference point is a consolidated Balance Sheet. In this context, international reserves and present value of the fiscal surplus, net of the related expenditures, are the major portion of the asset side. These elements may increase due to contingent financing arrangements, as well as reduced by the cost of the mentioned guarantees to financial institutions or other too-important-to fail entities. National economies also embrace land and other assets, but this are unlikely to be sold and hence producing revenues, so are not included in this definition of asset.

LIABILITIES :

- Firms liabilities are for the major part characterized by voices of debt, either senior or subordinated, and of equity. This last determines the market capitalization, equal to equity price multiplied by issued shares number.
- Sovereign liabilities mostly are categorized into foreign currency debt. National economies also possess local currency debt and base money, which multiplied by the exchange rate contributes in determining the value of domestic currency liabilities expressed in foreign currency.

Another merging point deriving from the similarities of the Balance Sheet is represented by the default risk definition and implications. While the single definitions have been provided in the previous chapters, the authors general framework from which moving a CCA analysis is the sequent:

- ***Corporate default***. Corporate sector defaults trigger a bankruptcy process, that some country legally define and some others lack to do, generating fraudulent jurisdictional

conflicts. In general, creditors are assigned to their claim towards firm assets based on the standardized seniority of liabilities in the firm's capital structure. Being debt senior to equity in the firm liabilities structure, bondholders have major legal claims to residual (and recovered) assets in the event of default. Senior bondholders might choose several methods to exercise their control post default. In some cases, they liquidate remaining assets in order to obtain cash payments to compensate the loss. In other cases, bondholders choose to replace the governance structure of the management while receiving new claims in the form of equity.

- ***Sovereign default*** On the opposite, Sovereign defaults do not explicitly trigger a bankruptcy process equally applying across different countries. Some instances of Sovereign default can be assimilated as restructuring processes whereby pre-default liabilities are traded for post-default liabilities. This is a restructuring process where Sovereign liabilities holders do not receive legal claims comparable to ownership of Sovereign assets in the event of default (that is, bondholders are not supposed to assume the controllership of policy apparatus, possess public sector entities, or liquidate assets). Instead, Sovereign debt holders have a priority claim on restructured debt, characterized of a lower value in the event of default.

Lastly, the authors explicit a brief consideration in terms of a valuation perspective. "The present value of the expected loss in the Sovereign setting is associated with receiving restructured debt of lower value after default. In the corporate setting it is associated with post-default cash payouts or new claims at lower value. Bondholders in both cases value their claims at their default-free value minus the present value of expected loss, which can be estimated using an implicit put option".

It appears then clear how most of the uncertainty relies onto the Sovereign entity issues estimation. Bodie and Gray identify three main key drivers: the value of Sovereign assets, their volatility and the distress barrier.

Beginning from the first one, the value of the Sovereign foreign-currency debt to the holders of such debt is assumed by the authors to depend on the default-free value (that is, the effective amount of promised payments) and also on losses if the Sovereign default on its obligations. Any time a lender subscribes a loan to a Sovereign, an implicit guarantee of that loan is generated to offset this risk. To see how, they introduced the following identity:

Risky Sovereign Debt ≡ Default-free Debt – Implicit Guarantee

The authors moved an important observation to recall Merton's model: "*Lending to Sovereigns thus consists of two functionally distinct activities: pure default-free lending and the bearing of default risk by the lender. This implicit guarantee embedded in the risky debt is equal to the expected losses from default, which depends on the value and volatility of Sovereign assets. Thus risky debt value can be seen as contingent on (stochastic) Sovereign assets*[63]"

Making a parallelism with a corporate dimension, foreign-currency debt can be viewed as a "senior claim" and the local-currency liabilities as a "junior claim." Seniority of Sovereign liabilities is not determined via legal status as in the corporate sector, but it could be deducted from an analysis of the behavior of government policymakers during stress-pushing periods. In these times, governments often put significant efforts to maintain a high liquidity degree on their foreign-currency debt, effectively making such

debt senior if compared to domestic currency liabilities in portfolio. The payment of foreign-currency debt requires an acquisition of foreign currency amounts, which the government has a very limited capacity to produce. On the other hand, much more flexibility is incorporated to issue, repurchase, and restructure local-currency debt.

3.4) Risk Management Implications: Corporate versus Sovereign

Now the goal of this paper is to compare a Sovereign entity as the US, to a corporation as Microsoft. This implies a double extent: first, the possibility to set a homogeneous framework for risk management assessments. When referring to Microsoft, the choice is driven by the necessity of choosing a firm with a relevant market capitalization, avoiding misperceptions driven by an eventual mismatching in terms of industry sizing. Secondly, to provide an alternative to the Credit Default Swap standard approach[64], applying Hull's 2009 hypothesis on the Black, Scholes and Merton's 1974 model to both agents.

The CCA 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:

$$\text{Prob}\ (A_t \leq B_t) = \text{Prob}\ \{A_0 \exp[(\mu_A - \sigma^2_A / 2)\, t + \sigma_A\, \varepsilon \sqrt{t}\,] \leq B_t\} = \mathbf{Prob\ (\varepsilon \leq - d_{2,\mu})}$$

Since $\varepsilon \sim N(0,1)$, the "actual" probability of default is $\mathbf{N\ (-\ d_{2,\mu}\ )}$, where $\mathbf{d_{2,\mu}} = \dfrac{ln\left(\frac{A_t}{B_t}\right) + \left(\mu_A - \sigma_A^2/2\right) t}{\sigma_A\ \varepsilon\sqrt{t}}$ and N( ) indicates the cumulative standard normal distribution.

[63] Bodie, Gray, Merton, 2007.
[64] Hull, 2009.

The assets return probability distribution used in Bodie and Gray's CCA is not the "actual" one but the "risk-adjusted" or "risk-neutral" probability distribution, which substitutes the risk-free interest rate for the actual expected return in the distribution[65]. This risk-neutral distribution is the dashed line in Figure 8 with expected rate of return r, the risk-free rate. The "risk-adjusted" probability of default calculated using the "risk-neutral" distribution is essentially larger than the actual one for all assets having an actual expected return (**μ**) greater than the risk-free rate **r** (so that a positive risk premium is embedded when investing in the firm's value).

Risk-adjusted probability of default is $\mathbf{N(-\,d_2)}$, with $\mathbf{d_2} = \dfrac{ln\left(\frac{A_t}{B_t}\right)+\left(r-\sigma_A^2/2\right)t}{\sigma_A \varepsilon\sqrt{t}}$

The calculations of the "actual" probability of default go beyond the extent of CCA. Although, combining the analysis with an equilibrium model of underlying assets' expected returns, it would be possible to produce consistent estimates for expected returns on all derivatives, conditional on the assumptions. This way would not be necessary to formulate hypothesis about the expected returns of CCA.

Now, a credit spread (**s**) is the premium required to compensate for the expected loss. To get the formula for the spread, the authors initially define the yield-to-maturity for the risky debt D is $\mathbf{y_t}$, and then $\mathbf{e^{-yt}} = \dfrac{D}{B} = \dfrac{Be^{-rt}-P}{B}$. This can be used to get the spread:

$$\mathbf{s = y_t - r} = -\frac{1}{t}\ln\left(1-\frac{P}{Be^{-rt}}\right) = -\frac{1}{t}\ln\left(N(d_2)+\left(\frac{A}{Be^{-rt}}\right)N(d_1)\right)$$

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

[65] Hull, 2009.

"*the change in the value of an option as the value of the underlying asset changes*[66]". Delta is thus an appropriate measure of the risk in both risky debt and of a financial guarantee.

Deriving from the Black-Scholes model the formulas for delta, for a generic put option the authors observe that $\Delta=\mathbf{N(d_1)\ -1}$. The risk-neutral or, better, risk-adjusted default probability is $N(-d_2)$, while the actual is $N(-d_{2,\mu})$. This causes that:

$$d_{2,\mu} - d_2 = \frac{\mu_A - r}{\sigma_A}\sqrt{t}\text{, and}$$

$$\frac{\mu_A - r}{\sigma_A} = \lambda$$

This latest value is pointed as the market price of risk. The actual probability of default can thus be expressed as $N(-d_2 - \lambda\sqrt{t})$.

[66] Hull, 2009.

Chapter 4: Microsoft and the USA: Empirical Findings

"A country's government has the power to tax firms, impose foreign exchange controls, or seize firm assets. If the government's repayment capacity falls, it is more likely to exercise one or more of these rights, which in turn will lower the firm's repayment capacity"

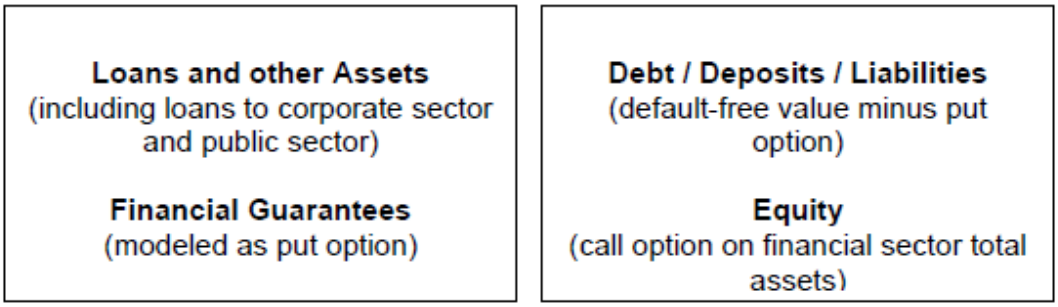
Durbin and Ng, "The Sovereign Ceiling and Emerging Market Corporate Bond Spreads." Journal of International Money and Finance 24: 631-49, 2005

4.1) Framework: Candidates Balance Sheet

This chapter is meant to test the efficiency related with a hypothetical implementation of the Contingent Claims Approach in terms of default risk management policies. In the specific, the corporate entity candidate will be Microsoft Corporation, one of the most successful and renowned technology companies of the modern world, developing products that help to better facilitate the way people work, communicate, and play. The US-based company was founded in 1975 and is publicly traded on the NASDAQ stock exchange in New York under the ticker (MSFT). Microsoft will be cross-section analyzed together with its reference country, the United States. The first step will be to consider the proper baseline, consisting of the relative Balance Sheets elements definition for both of the entities. Also, the aggregation of these data will be put into practice to obtain a universally valid CCA Balance Sheet, recalling Merton 1974 Model in a modern view to compare a Sovereign entity with a corporation. Finally, default risk indicators introduced in the previous chapter will be calculated to test the evidence shown by this paper's reference rating agency, Fitch, which recently marked Microsoft with an (AAA) rating, meaning a safer investment than one in the US, ticked down at (AA+).

As stated, to begin it is necessary to define and re-engineer the candidates Balance Sheets, in order to make them suitable for a CCA analysis. At a corporate level, an updated Balance Sheet must be provided at least yearly (as a legal requirement) to its share and debt holders. The Contingent Claim approach to evaluate any corporation' Balance Sheet is represented by Figure 9.

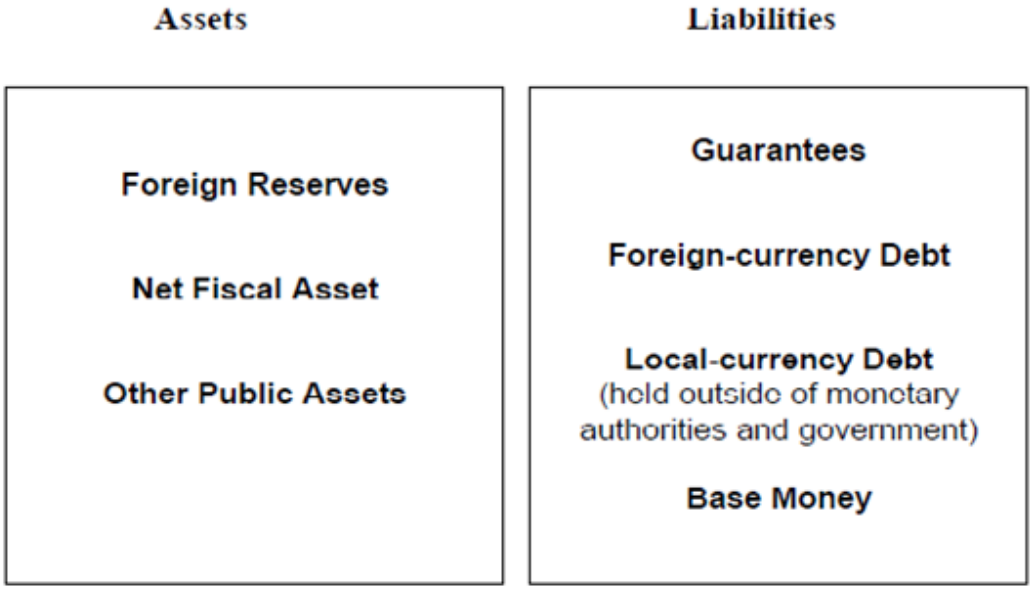
Figure 9: Stylized CCA Balance Sheet for the Corporate Sector



Source: Bodie, Gray and Merton, 2007

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. Figure 10 provides a snapshot from which the first considerations could be drawn. 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).

Figure 10: Stylized CCA Balance Sheet for the Public Sector



Source: Bodie, Gray and Merton, 2007

The authors provided an accurate description of all of the elements embracing each standard category. These are the relative definitions:

- ***Foreign reserves*** These represent the Net International Reserves held by the public sector.
- ***Net Fiscal Asset*** All the items related to fiscal assets and liabilities in terms of taxes, revenues or expenditures. In the specific, the authors divide the expenditures in two categories: discretionary and non-discretionary expenditures. These last are related to defense, education, core infrastructure, welfare, etc. that will not be dismissed before quitting on the debt repayment. Under a hypothetical financial distress happening, the government keeps the non-discretionary expenditures and cuts the superfluous discretionary ones. The net fiscal asset[67] are obtained by reducing the present value of

[67] The value of assets of an operating firm can be considered as the present value of stochastic future cash flow from income minus net new investment expenditures to create that income. For the public sector, the net

non-discretionary expenditures of the present value of taxes and revenues , that the authors consider similar to the present value of the primary fiscal surplus over time (the present value of fiscal surplus minus interest payments).

- ***Other Public Assets*** The last and residual features concern the investment of equity shares in public enterprises, revenues from the various Public Administration's monopolies, deals concerning the issue of money and many more financial as well as non-financial assets. Assets might not be embedded into the definition of 'economic', that according to the authors is "of direct or indirect value generating". In this case, if they will not be sold with a high degree of certainty, or become part of fiscal revenues (as per public land related elements) they would be included in a dedicated accounting statement in order to make them count, although their attendance to the a pure economic Balance Sheet will not be necessary.

On the liabilities side, the definitions are the following:

- ***Base money*** Base money represents a pure liability for the monetary division, or authority, of a Public Administration, and thus deserves to be included into the liabilities on the CCA Sovereign Balance Sheet. It consists of the current amount of currency made available for the public in circulation, plus all the bank reserves (legally required bank reserves as well as excess reserves and vault cash)[68].

fiscal asset is the present value of stochastic future fiscal flows from taxes and revenues minus nondiscretionary expenditures.

[68] Base money is defined by the authors as "*High-powered money or reserve money*". Evidence of amounts historically held demonstrates that it is the main liability of the monetary authorities. Once distributed, it is common knowledge to define that it is "multiplied" by the banking system: the multipliers relate base money to standard categories and amounts as M1, M2, etc. When a country enters into a currency union (for example by merging with another Sovereign or accessing the Euro zone) base money is traded in exchange of foreign currency reserves.

- ***Local-currency debt*** The authors literally define this recipient as "*Local-currency debt of the government and monetary authorities, held outside of the monetary authorities and the government*".
- ***Foreign-currency debt*** Similarly, this issue represents the Sovereign debt denominated in foreign currency. Usually foreign investors are its major holders.
- ***Guarantees*** Given the importance of certain industries for the financial health of a country, this last is required to assume some implicit or explicit financial guarantees towards these "too-important-to-fail" banks, other financial institutions or contingent pension/social obligations.

Intuitively, default on foreign-currency debt occurs when the Sovereign assets do not cover the promised payments on it, with the previously defined distress barrier set at this present value. While the promised payments and the distress barrier itself are supposed to be known with a fair degree of certainty, it is much more questionable the value of Sovereign assets. A visual summary of what has been defined to conduct the CCA analysis is provided by Figure 11.

According to Bodie and Gray, foreign-currency debt could be modeled as default-free value of foreign currency debt minus an implicit put option, consistently with the assumptions of the previous chapter. Sovereign local-currency debt is similarly modeled as an implicit call option, given some certain 'equity-like' features: "*money and local-currency debt can be issued in large amounts even if this causes dilution/reduction in their value. In this sense, base money and local-currency debt are similar to shares on a Sovereign Balance Sheet. An excessive issue of these shares can cause inflation and price changes, similar to the case where excessive issue of corporate shares dilutes existing*

holders' claims and reduces the price per share on a corporate Balance Sheet[69]". The local-currency liabilities times the exchange rate is like the market cap of the Sovereign in the international financial market.

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

Financial guarantees are considered 'risk-transfers' across different economy sectors. The explicit or implicit guarantee for the too-important-to-fail banks or financial institutions is modeled by the authors by assimilating them to put options, with the economic Balance Sheets used to demonstrate the interdependence among sectors. If one sector is long on certain implicit options, another is going to be short on the same implicit options.

Sovereign Balance Sheet assumes two different types of implicit put options. The first is the implicit faculty associated with the foreign-currency debt: "*the holders of risky debt are short on this put option and the Sovereign is long*[70]". The second type of implicit put option is associated with the guarantee to too-important-to-fail financial institutions and other entities: the government is short on this put option and the financial sector is long.

[69] Bodie, Gray, Merton, 2007.

4.2) The Model: Two-stage Contingent Claims Approach

The real issue of CCA is deriving an accurate estimate for the market value and volatility of Sovereign assets, leading to the final goal of this paper. While the levels and amounts of contractual debt are relatively easy to determine from Balance Sheet information, the same is not true when measuring the value of Sovereign assets or its volatility. There are several ways to value an asset:

- From observed market prices (of all, or part) of the assets.
- From a comparable or adjusted comparable.
- From an implied value, where the Balance Sheet relationships between assets and liabilities allow the observed prices to be used to obtain this implied value of assets.

The first method is straightforward but difficult to apply, since only few components of Sovereign assets have directly observable market prices[71]. The second method is low-realistic: future cash flows and their relative discount rate are difficult to project. CCA's innovation avoids these observations by estimating Sovereign asset value and volatility through an indirect path. Information based on observable values of the liability side of the Balance Sheet is used, applying the contingent claim relationship between liabilities on assets.

CCA implicitly assumes that market participants' perspectives on prices incorporate the forward-looking information about economic developments of the PA. This assumption does not necessarily imply that the market perfectly predicts its assessment of Sovereign Risk, but that it constantly reflects the best available collective forecast circa expectations

[70] Bodie, Gray, Merton, 2007.
[71] International reserves are both observable and have a market value, although the remaining items lack observable market-priced values.

of market agents. Implementing CCA to derive the implied Sovereign asset value and volatility requires several steps and assumptions, starting from the observed prices and volatilities of market-traded securities.

In the Merton Model for firms, banks and non-bank financials with traded equity the following two equations are used to link A, asset value, and σ_A, asset volatility. Traded equity is E, modeled as an implicit call option which is a function of assets A, volatility of assets σ, distress barrier B, risk-free rate r, and the time horizon t:

$$E = A_0 N(d_1) - Be^{-rt} N(d_2)$$

N indicates the cumulated normal distribution, and d(.) assumes the same value shown in the previous chapter. The second equation that links equity and equity volatility to the same five parameters and that is needed to solve the system is:

$$A^* \sigma_A = E^* \sigma_E * N(d_1)$$

The value and volatility of equity is observable, as well as the distress barrier, which is derived from the book value of debt, risk-free rate and time horizon. As hinted, these equations should be solved for the two unknowns, asset value and volatility, that represent the two claims assumed by the authors.

Since the market value of Sovereign assets cannot be observed directly, a similar calibration procedure can be used for the Sovereign Balance Sheet to estimate implied assets and asset volatility. The prices in the international markets (including foreign currency market), together with information from domestic market prices, provide the market information for the value and volatility of certain liabilities on the public sector Balance Sheet. CCA Balance Sheet has liabilities structured in a way that we can observe

the market value of the junior claims and the distress barrier of foreign-currency debt so as to be able to adapt the Merton Model to the Sovereign[72].

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:

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

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

[72] On a simplified Sovereign Balance Sheet, Bodie and Gray identify the local-currency debt of the government, held outside of the monetary authorities, and base money as local-currency liabilities which are modeled as a

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:

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

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

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).

There is thus higher volatility in the quantities of local-currency liabilities from the issue and repurchase operations as the counterpart to less volatility in the exchange rate[73]. The calibrated parameters of the Sovereign CCA Balance Sheet can be used to obtain quantitative Sovereign risk measures. These include risk exposures for risky debt, such as

call option on the Sovereign assets, with the default barrier derived from the foreign currency debt.

distance-to-distress, probabilities of default, spreads on debt, the sensitivity of the implicit put option (i.e. expected losses) to the underlying asset (the delta), and other measures. A large component of the spread on Sovereign foreign currency debt has been previously identified in this paper as the credit default spread. This credit spread on Sovereign foreign currency debt is a function of:

(i) Ratio of Sovereign asset, $V_{\$S}$, to the default barrier, B_f

(ii) Volatility of Sovereign assets, $\sigma_{\$S}$

(iii) Horizon and risk-free interest rate.

As the ratio of asset to distress barrier declines and/or $\sigma_{\$S}$ increases, the spread increases in a non-linear way and can become sharply higher. A decline in foreign currency reserves, lower fiscal revenues, and/or a rise in the foreign debt default barrier will increase spreads. According to the authors Risk managers working in modern financial institutions would find it difficult to analyze the risk exposure of their financial institutions if they relied solely on their income and cash flow statements and did not take into account (mark-to-market) Balance Sheets or information on their institution's derivative or option positions. As introduced at the beginning of this chapter, country risk analysis that relies only on a macroeconomic flow-based approach is deficient in a similar way, because given that traditional analysis does not take into account the volatility of assets.

Merton observes that when the volatility of assets in the Sovereign CCA Balance Sheet equation is set to zero, the values of the implicit put and call options go to zero. Similarly, if the volatility of the assets of the too-important-to-fail financial institutions is set to zero, the implicit put options and contingent financial guarantees go to zero as well.

[73]The authors provide an analogy:" *A firm that tries to fix its stock price must issue and repurchase shares with*

4.3) Candidates Performance: Empirical Testing and Final Assessments

Moving to the concrete application of the model, a general framework of the 2012 experience is hereby provided. Microsoft, as it is possible to observe from their 2012 Balance Sheet, experienced a revenue growth of $73.7B, with cash flow from operations scoring $31.6 B, an increase of 17% from the prior year[74]. In addition, $10.B have been returned to shareholders through stock buybacks and dividend. All the details and historical performances of the post-crisis scenario (2007-2012) are accurately provided in the Annex, with the proper snapshot directly taken from the 2012 Microsoft Annual Report. At the same time, all the historical and updated information concerning the US Federal Reserve are publicly available on the relative website on a weekly basis.

A little distinction. When referring to market risk, Microsoft uses a standard value-at-risk ("VaR") model to estimate and quantify it. VaR is "*the expected loss, for a given confidence level, in the fair value of our portfolio due to adverse market movements over a defined time horizon*[75]". The implementation of a VaR model does not reflect probability-weighted losses in fair value, including "*other-than-temporary*" losses in fair value in accordance with accounting principles generally accepted in the United States ("U.S. GAAP"), but is considered a first risk management tool to evaluate the potential exposure of the firm.

The VaR is calculated as the total loss that will not be exceeded at the 97.5 percentile confidence level or, alternatively stated, the losses could exceed the VaR in 25 out of 1,000 cases. Several risk factors are not captured by the model adopted by Microsoft,

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the result that the 'market cap', shares times stock price, still has volatility".

[74] Source: Microsoft Balance Sheet, 2012.

[75] Microsoft Annual Report, 2012.

including liquidity, operational and legal risk. Figure 12 sets forth the one-day VaR for substantially all of Microsoft positions as of June 30, 2012 (with a comparison to the previous year).

Figure 12: Microsoft Var – June 2012 Update (Data in $USM)

	June 30, 2012	June 30, 2011	Year Ended June 30, 2012		
Risk Categories			**Average**	**High**	**Low**
Foreign currency	**$ 98**	$ 86	**$ 173**	**$ 229**	**$ 84**
Interest rate	**$ 71**	$ 58	**$ 64**	**$ 73**	**$ 57**
Equity	**$ 205**	$ 212	**$ 194**	**$ 248**	**$ 165**
Commodity	**$ 18**	$ 28	**$ 20**	**$ 29**	**$ 15**

Source: Microsoft, 2012

According to Microsoft' internal model calculations, Total one-day VaR for the combined risk categories was $292 million at June 30th, 2012 and $290M at June 30th, 2011. The total VaR is 26% less at June 30, 2012, and 25% less at June 30, 2011, than the sum of the separate risk categories in the above figure due to the diversification benefit of the combination of risks[76]. While this analysis conducted does not apply to a Sovereign entity, CCA will help furnishing a common framework to both. In order to maintain consistency, the FED Balance Sheet of the same period of time as of Microsoft fiscal year closure will be considered.

The choice of applying the CCA approach to a post-crisis scenario automatically set the time horizon to a five year, hence the relative Balance Sheets of the years 2007-2012 has been taken into account. The reason to pursue is the sequent: first of all an impact of the crisis might have influenced the different policies adopted to face it and minimize the losses. For instance, while Microsoft decided to carve-out the dividends returned to its

[76] Source Microsoft Annual Report, 2012.

shareholders, the US Government decided to reduce the amounts of reserves and increment taxation. Being these two elements not homogeneous, the extent of the analysis will focus on the latest observations. Secondly, the latest the analysis, the more Microsoft can be considered a stable-growth firm, as described in Chapter 2, and so the more similar can be assumed to be to a Sovereign entity. Starting the data consideration, Bloomberg indicates a risk-free rate of 1.88% as per end of 2011, and this makes it for the second assumption made.

Starting to consider the real total value of assets (A_{2012}), Microsoft experienced a constant growth to get to the current $USM 121.271, while the United States growth had a very high boost in 2009, more than doubling its value from $USM 894.212 to $USM 2.027.327. Risk-free Liabilities, being the "most senior" among the passive side of the Balance Sheet had the same relative trending, with the due proportions to the total assets amount. Thus, the most junior claim (J_{2012} for Microsoft and $LCL_{\$,2012}$ for the US) simply followed. Results of the CCA approach are showed by Figure 12, representing the MS Excel screenshot of the analysis conducted via Bloomberg Platform. Again, all the data are provided in the Annex.

Focusing on the calculation details about the correct amount of Sovereign assets to be considered, it is important to explicitly define the amount of the Guarantees to the too-important-to-fail entities. The final extent is to contribute to the proper re-engineering on the amount of risky debt to a risk-free equivalent. The total amount of guarantees assumed consists of the Balance Sheet voices "Net Portfolio Holdings of Maiden Lane LLC I, II, II", "Items in process of collection" and "Bank premises". Although they count for a relatively small portion ($USB 1.046), their precise imputation determines changes

in the calculation of d(1) and d(2), the values from which computing the cumulative normal distribution for the risk indicators.

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

		Microsoft	Federal Reserve
Time Horizon	t	5	5
Risk-Free Rate	r	1,88%	1,88%
Assets return Volatility	σ_S, σ_A	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 (-d_2)	0,0029	0,0036
Delta*	N (d_1) - 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, as stated in Chapter 3, 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. The circumstances of the global crisis seem to embrace what is explicitly defined by the authors: "*The public sector's financial distress or default can transmit risk to the financial system. When the banking sector is holding a significant proportion of government securities, and there is a negative shock to the government financial position, it can have a detrimental impact on the banks. The government's implicit guarantee is also likely to increase. This, in turn, makes the government financial position worse, creating a compounding effect, which may result in the government's failure to honor its guarantee obligations and cause a collapse of the banking system*[77]".

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. The authors' interpretation in terms of economic literature is the sequent "*The value of (risky) local currency debt is influenced by the risk that the government may dilute (or inflate away) part of the value or the debt, or may forcibly restructure some of the debt. The 'dilution/inflation risk premium' is an extra premium demanded by the holders of local currency debt*". Reading this together with the results shown as per Figure 21, contributes

[77] Bodie, Gray, Merton, 2007.

in assessing the predominance of Microsoft in terms of efficiency about the first claim assumed.

Moving to the second claim, Bodie, Gray and Merton (2007) observe how: "*The volatility of the public sector asset is heavily influenced by exchange rate and fiscal volatilities. In the crisis periods, the fiscal volatility and exchange rate volatility can combine to produce a higher volatility of the Sovereign asset. This means that the risk premium on local currency debt is very likely to be higher and lead to an increase Sovereign spreads on foreign currency debt*".

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.

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.

Conclusions

This paper's final extent is to apply an alternative approach, denominated Contingent Claims Approach and directly deriving from the Bodie, Gray and Merton model. This innovative view provides a natural framework for analysis of mismatches between an entity's assets and liabilities, such as currency and maturity mismatches on Balance Sheets, driven by the so called Claims. The real innovation of this approach is represented by the application to a Sovereign entity, with a parallel transposition of the (corporate) risk intuitions and implications. The model applied in the paper is two-staged, hence the only two unobservable values have been Sovereign assets value and the relative volatility. However, these information are implied into the observable prices on the market and solved via Option Theory assumptions, in consistence with the Merton Model.

The two entities chosen were Microsoft, US-based company founded in 1975 and publicly traded on the NASDAQ stock exchange in New York under the ticker (MSFT), cross-section analyzed together with its reference Sovereign, the United States. Final goal was to derive the riskiness of the candidates, testing whether a corporation could in facts result with a higher rating than a country itself, as reported by the reference rating agency Fitch. The three chosen indicators (probability of default, delta, spread) all seem to confirm this outcome, thus CCA results to be an efficient proxy of the rating models. Finally, the most important implication is that Microsoft, being an American based company, has a higher rating than the country itself: in the major part of the cases the size of the American economy guarantees a low default risk probability; here though, the corporate dimension here seems to take over and be damaged from Sovereign, that scores a lower rating.

Annex: Microsoft and Federal Reserve Historical Balance Sheets (2007-2012)

In this first annex, a reconciliation of the last five years (2007-2012) Balance Sheets for Microsoft has been conducted, re-engineering in terms of Total Assets (or so called A, to the extent of the analysis), Total liabilities (D) and the residual Equity value (E). All the data are provided on the Microsoft Annual Report database. The data are provided in $USM.

Similarly to what has been done for Microsoft, this was the data provided by the Federal Reserve database. In order to maintain consistence, even though the frequency with which the US provides this data is higher than for a corporation (that is, yearly versus weekly), the release dates were chosen to be the closest possible to the fiscal year closure. As stated in Chapter 4, Maiden Lane LLC influence has been left as an explicit voice and not conglomerated, in order to highlight its direct impact on defining the risky debt. The data are provided in $USB.

MICROSOFT CORPORATION BALANCE SHEETS

(In millions)

		2007	2008	2009	2010	2011	2012	
A								
	Cash and Cash Equivalents	6111	10339	6076	5505	9610	6938	
	Short Term Investments	17300	13323	25371	31283	43162	56102	
		$ 23.411	**$ 23.662**	**$ 31.447**	**$ 36.788**	**$ 52.772**	**$ 63.040**	Cash
	Accounts Receivable	11338	13589	11192	13014	14987	15780	
	Inventories	1127	985	717	740	1372	1137	
	Deferred Income Taxes	1899	2017	2213	2184	2467	2035	
	Other	2393	2989	3711	2950	3320	3092	
		$ 40.168	**$ 43.242**	**$ 49.280**	**$ 55.676**	**$ 74.918**	**$ 85.084**	Current Assets
	Property, Equipment, net of deprec.	4350	6242	7535	7630	8162	8269	
	Equity	10117	6588	4933	7754	10865	9776	
	Goodwill	4760	12108	12503	12394	12581	13452	
	Intangible Assets	878	1973	1759	1158	744	3170	
	Other	2898	2640	1878	1501	1434	1520	
		$ 63.171	**$ 72.793**	**$ 77.888**	**$ 86.113**	**$108.704**	**$ 121.271**	Total Assets
L & SE								
	Accounts Payable	3247	4034	3324	4025	4197	4175	
	Current Portion of Long Term Debt	0	0	2000	1000	0	1231	
	Accrued Compensation	2325	2934	3156	3283	3575	3875	
	Income taxes	1040	3248	725	1074	580	789	
	Short-term unearned revenue	10779	13397	13003	13652	15722	18653	
	Securities lending payable	2741	2614	1684	182	1208	814	
	Other	3622	3659	3142	2931	3492	3151	
		$ 23.754	**$ 29.886**	**$ 27.034**	**$ 26.147**	**$ 28.774**	**$ 32.688**	Current Liabilities
	Long-term debt	0	0	3746	4939	11921	10713	
	Long-term unearned revenue	1867	1900	1281	1178	1398	1406	
	Deferred income taxes	0	0	0	229	1456	1893	
	Other long-term liabilities	6453	4721	6269	7445	8072	8208	
		$ 32.074	**$ 36.507**	**$ 38.330**	**$ 39.938**	**$ 51.621**	**$ 54.908**	Liabilities
8381	Common Stock	60557	62849	62382	62856	63415	65797	
	Retained Earnings	-29460	-26563	-22824	-16681	-6332	566	
		$ 31.097	**$ 36.286**	**$ 39.558**	**$ 46.175**	**$ 57.083**	**$ 66.363**	Stockholder's Equity
		$ 63.171	$ 72.793	$ 77.888	$ 86.113	$108.704	$ 121.271	

	Wednesday Jun 27, 2012		Wednesday Jun 29, 2011
Assets		*Assets*	
Gold certificate account	11,037	Gold certificate account	11,037
Special drawing rights certificate account	5,2	Special drawing rights certificate account	5,2
Coin	2,135	Coin	2,114
Securities, repurchase agreements, and loans	2,617,851	Securities, repurchase agreements, and loans	2,655,462
Securities held outright [1]	2,612,993	Securities held outright [1]	2,642,617
U.S. Treasury securities	1,666,530	U.S. Treasury securities	1,617,060
Bills [2]	18,423	Bills [2]	18,423
Notes and bonds, nominal [2]	1,570,357	Notes and bonds, nominal [2]	1,524,358
Notes and bonds, inflation-indexed [2]	67,915	Notes and bonds, inflation-indexed [2]	65,296
Inflation compensation [3]	9,835	Inflation compensation [3]	8,984
Federal agency debt securities [2]	91,484	Federal agency debt securities [2]	116,704
Mortgage-backed securities [4]	854,979	Mortgage-backed securities [4]	908,853
Repurchase agreements [5]	0	Repurchase agreements [5]	0
Loans	4,858	Loans	12,845
Net portfolio holdings of Maiden Lane LLC [6]	2,423	Net portfolio holdings of Commercial Paper Funding Facility LLC [6]	0
Net portfolio holdings of Maiden Lane II LLC [7]	18		
Net portfolio holdings of Maiden Lane III LLC [8]	12,59	Net portfolio holdings of Maiden Lane LLC [7]	23,849
Net portfolio holdings of TALF LLC [9]	845	Net portfolio holdings of Maiden Lane II LLC [8]	12,538
Items in process of collection	166	Net portfolio holdings of Maiden Lane III LLC [9]	24,244
Bank premises	2,364	Net portfolio holdings of TALF LLC [10]	757
Central bank liquidity swaps [10]	27,059	Preferred interests in AIA Aurora LLC and ALICO Holdings LLC [11]	0
Other assets [11]	184,01		
		Items in process of collection	238
Total assets	$ 2.865.698	Bank premises	2,21
		Central bank liquidity swaps [12]	0
Liabilities		Other assets [13]	131,518
Federal Reserve notes, net of F.R. Bank holdings	1,067,917		
Reverse repurchase agreements [12]	83,737	Total assets	$ 2.869.167
Deposits	1,639,014		
Term deposits held by depository institutions	0	Liabilities	
Other deposits held by depository institutions	1,491,988	Federal Reserve notes, net of F.R. Bank holdings	985,788
U.S. Treasury, General Account	117,923	Reverse repurchase agreements 14	66,607
U.S. Treasury, Supplementary Financing Accour	0	Deposits	1,741,700
Foreign official	1,578	Term deposits held by depository institutions	5,087
Other	27,526	Other deposits held by depository institutions	1,622,395
Deferred availability cash items	956	U.S. Treasury, general account	105,582
Other liabilities and accrued dividends [13]	19,405	U.S. Treasury, supplementary financing account	5
		Foreign official	126
Total liabilities	$ 2.811.029	Other	3,511
		Deferred availability cash items	1,478
Capital accounts		Other liabilities and accrued dividends 15	20,619
Capital paid in	27,334		
Surplus	27,334	Total liabilities	2,816,193
Other capital accounts	0		
		Capital accounts	
Total capital	$ 54.669	Capital paid in	26,487
		Surplus	26,487
		Other capital accounts	0
		Total capital	52,974

	Wednesday Jun 30, 2010		Wednesday Jun 24, 2009
Assets		*Assets*	
Gold certificate account	11,037	Gold certificate account	11,037
Special drawing rights certificate account	5,2	Special drawing rights certificate account	2,200
Coin	1,975	Coin	1,779
Securities, repurchase agreements, term auction		Securities, repurchase agreements, term auction	
credit, and other loans	2,127,703	credit, and other loans	1,632,511
Securities held outright 1	2,059,878	Securities held outright	1,217,044
U.S. Treasury securities	776,989	U.S. Treasury securities (1)	653,193
Bills 2	18,423	Bills (2)	18,423
Notes and bonds, nominal 2	712,023	Notes and bonds, nominal (2)	586,963
Notes and bonds, inflation-indexed 2	41,125	*Notes and bonds, inflation-indexed (2)*	42,803
Inflation compensation 3	5,417	Inflation compensation (3)	5,004
Federal agency debt securities 2	164,762	Federal agency debt securities (2)	96,626
Mortgage-backed securities 4	1,118,127	Mortgage-backed securities (4)	467,226
Repurchase agreements 5	0	Repurchase agreements (5)	0
Term auction credit	0	Term auction credit	282,808
Other loans	67,825	Other loans	132,659
Net portfolio holdings of Commercial Paper		Net portfolio holdings of Commercial Paper	
Funding Facility LLC 6	1	Funding Facility LLC (6)	124,032
Net portfolio holdings of Maiden Lane LLC 7	28,498	Net portfolio holdings of LLCs funded through	
Net portfolio holdings of Maiden Lane II LLC 8	15,763	*the Money Market Investor Funding Facility (7)*	0
Net portfolio holdings of Maiden Lane III LLC 9	23,208	Net portfolio holdings of Maiden Lane LLC (8)	25,885
Net portfolio holdings of TALF LLC 10	506	Net portfolio holdings of Maiden Lane II LLC (9)	15,961
Preferred interests in AIA Aurora LLC and ALICO		Net portfolio holdings of	
Holdings LLC 11	25,733	Maiden Lane III LLC (10)	20,159
Items in process of collection	264	Items in process of collection	479
Bank premises	2,235	Bank premises	2,202
Central bank liquidity swaps 12	1,245	Central bank liquidity swaps (11)	119,430
Other assets 13	90,928	Other assets (12)	71,653
Total assets	$ 2.334.296	*Total assets*	$ 2.027.327
Liabilities		Liabilities	
Federal Reserve notes, net of F.R. Bank holdings	904,13	Federal Reserve notes, net of F.R. Bank holdings	867,273
Reverse repurchase agreements [14]	67,223	Reverse repurchase agreements (13)	71,941
Deposits	1,289,799	Deposits	1,031,267
Term deposits held by depository institutions	1,152	*Depository institutions*	745,173
Other deposits held by depository institutions	972,337	U.S. Treasury, general account	78,847
U.S. Treasury, general account	87,615	U.S. Treasury, supplementary financing account	199,939
U.S. Treasury, supplementary financing account	199,965	Foreign official	2,212
Foreign official	1,214	Other	5,096
Other	27,516	Deferred availability cash items	2,557
Deferred availability cash items	2,212	Other liabilities and accrued dividends (14)	6,395
Other liabilities and accrued dividends [15]	14,729		
		Total liabilities	1,979,431
Total liabilities	2,278,094		
		Capital accounts	
Capital accounts		Capital paid in	24,248
Capital paid in	26,62	Surplus	21,256
Surplus	25,798	Other capital accounts	2,392
Other capital accounts	3,784		
		Total capital	47,896
Total capital	56,202		

	Wednesday Jun 25, 2008		Wednesday Jun 27, 2007
Assets		*Assets*	
Gold certificate account	11,037	Gold certificate account	11,037
Special drawing rights certificate account	2,200	Special drawing rights certificate account	2,200
Coin	1,333	Coin	938
Securities, repurchase agreements, term auction		Securities, repurchase agreements, and loans	810,684
credit, and other loans	773,949	Securities held outright	790,497
Securities held outright	478,796	U.S. Treasury (1)	790,497
U.S. Treasury (1)	478,796	Bills (2)	277,019
Bills (2)	21,740	Notes and bonds, nominal (2)	474,672
Notes and bonds, nominal (2)	412,392	Notes and bonds, inflation-indexed (2)	34,459
Notes and bonds, inflation-indexed (2)	39,171	*Inflation compensation (3)*	*4,347*
Inflation compensation (3)	5,494	*Federal agency (2)*	*0*
Federal agency (2)	0	Repurchase agreements (4)	20,000
Repurchase agreements (4)	129,750	Loans	187
Term auction credit	150,000	Items in process of collection	3,686
Other loans	15,402	Bank premises	2,039
Items in process of collection	1,213	Other assets (5)	38,291
Bank premises	2,154	Total assets	$ 868.875
Other assets (5)	102,325		
Total assets	$ 894.212	Liabilities	
		Federal Reserve notes net of FR Bank holdings	775,052
Liabilities		*Reverse repurchase agreements (6)*	*30,134*
Federal Reserve notes, net of FR Bank holdings	787,963	*Deposits*	*20,574*
Reverse repurchase agreements (6)	42,049	Depository institutions	16,221
Deposits	17,387	U.S. Treasury, general account	4,039
Depository institutions	12,833	Foreign official	97
U.S. Treasury, general account	4,208	Other	218
Foreign official	100	Deferred availability cash items	3,838
Other	246	Other liabilities and accrued dividends (7)	6,131
Deferred availability cash items	2,628	Total liabilities	835,730
Other liabilities and accrued dividends (7)	3,797		
Total liabilities	853,824	Capital Accounts	
		Capital paid in	*16,111*
Capital accounts		*Surplus*	*15,398*
Capital paid in	19,877	Other capital accounts	1,636
Surplus	18,486	Total capital	33,145
Other capital accounts	2,024		
Total capital	40,387		

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