

Posch, Peter N; Kalteier, Eva-Maria

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## Sovereign Asset Values and Implications for the Credit Market

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# Sovereign Asset Values and Implications for the Credit Market

Eva-Maria Kalteier, Peter N. Posch

## **Abstract.**

Using the contingent claim approach and market data on sovereign credit default swaps we assess the drivers of a country's risk perception. Deriving market-based asset values for a set of advanced economies we gain insights into the capital markets' perspectives on sovereign creditworthiness. We find the market-based asset values to be positively influenced by debt and to be an early risk indicator for economic developments. In a cross-section analysis we identify drivers of the economic risk of countries. Clustering the countries according to their debt to asset value ratios provides further insights into the market perceptions of sovereign credit risk. For example we find the asset values of countries with higher ratios react to changes in the global equity market. Countries with a lower ratio react more to the political stability within the country.

**Key words:** Sovereign Creditworthiness, Sovereign Debt Crisis, Contingent Claim Approach

**JEL Classification:** H63, G13, G15

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# 1 Introduction

In the aftermath of the financial crisis of 2007-2009 the likelihood for advanced economies to default has increased. The cumulative debt burden of countries, the slower growth due to the crisis and the immense amount of sovereign funding provided for the struggling financial sector drove some countries to the edge of defaulting. In April 2011 Standard & Poor's put a negative outlook on the US AAA rating and expressed serious concerns about the budgetary situation in the US. Within the EURO-Zone market participants coined the term PIIGS for five of the most troubled European countries: Portugal, Italy, Ireland, Greece and Spain. The political attempts to solve the sovereign debt crisis have, up to now, proven to be short lived and the relief on the financial and capital markets were quickly followed by rising concerns. One market of particular focus is the market for Credit Default Swaps (CDS). CDS are considered an important indicator of sovereign default risk as CDS spreads only assess the default risk instead of including liquidity premium or other characteristics like government bonds. Furthermore, the CDS market is leading the bond market, cf. Ericsson/Jacobs/Oviedo (2009). For example, Greek CDS spreads peaked during the crisis and Greece could not refinance itself anymore on the international capital markets and had to accept help from the European Financial Stability Facility (EFSF), a special purpose vehicle to support indebted European countries.

Acknowledging the interdependencies between financial markets and sovereign financial systems consequently leads one to question what determines sovereign risk premiums and what drives access to the international capital market for countries.

Gray/Merton/Bodie (2002) develop an innovative framework for analyzing and defining sovereign creditworthiness. By extending the Contingent Claim Approach (CCA) of Merton (1974) and Black/Scholes (1973) to countries, they aim to get a new perspective on sovereign risk drivers. The CCA or structural models in general have been developed for estimating the creditworthiness of companies and are widely used these days. The transfer to country risk requires computing sovereign asset values and the approach therefore aims to understand the fundamental factors for creditworthiness. Gray/Merton/Bodie (2007) apply the CCA approach to emerging countries like Brazil, Keller/Kunzel/Souto (2007) apply it to Turkey.

They find a high congruity between the theoretically derived risk indicators as well as risk profiles and the market risk measures for example on the CDS market. This shows again the good performance of the CCA and constitutes one basis for our analysis.

To shed more light on the market drivers of sovereign risk premiums, the approach undertaken in this paper aims to enhance Gray/Merton/Bodie (2002) by analyzing market-implied sovereign asset values as the fundamental drivers of risk premiums and deriving appropriate guidance for people in charge like politicians. As sovereign debt crises are no longer a problem only for emerging countries, we apply the framework to developed rather than emerging countries, a data selection novel in this literature.

Instead of using balance sheet information when calibrating the model, we use an observable risk indicator, the sovereign CDS spread, to derive market-based asset values. Market-based asset values give indications of the key parameters from the market participants' perspectives and not from a theoretical or accounting-based perspective. Consequently, the market-based approach leads to a better understanding of market developments.

In the literature about sovereign default a widely used indicator of the sovereign's riskiness is the probability of default (PD) derived within a CCA. We find our market-implied asset values to add information about the sovereign's default risk even when we control for the 'classical' PD estimator. Additionally, we find in the descriptive statistics analysis the country's ranking according to its mean asset value to correspond better to its mean external debt value ranking than to its mean GDP level ranking. This is also shown when the ratio external debt to asset value is used, implying market participants to positively value sovereign debt. This could be interpreted as debt being seen as an investment in the economy and a tool to smooth consumption over time. The same relations can be seen when looking at the development of the three indicators, market-implied asset values, GDP levels and external debt levels, over time. In this context another advantage of the market-based asset values is revealed: The market-implied asset values seem to have a tendency to react in advance of economic downturns. Therefore, market-implied asset values add an important additional perspective on sovereign risk premiums and might even function as an early economic development indicator.

But to get a deeper understanding of the drivers of the asset values we conduct a regres-

sion analysis and can therewith contribute to the discussion about the main determinants of sovereign risk premiums within the literature. As independent variables we include determinants of risk premiums that have shown to be significant within the literature on sovereign loan premiums, bond yields and CDS spreads.

Edwards (1984) provides one of the first analyses finding country specific fundamentals to have a significant influence on the risk premium. Extending this study Boehmer/Meggison (1990) find solvency proxies to be more important than liquidity proxies implying a higher importance of long-term growth perspectives than short-term liquidity issues. Caporale/Williams (2002) also show economic performance to highly influence long-term interest rates as well as fiscal and monetary policies. Haugh/Olliver/Turner (2009) also find fiscal policies to be important and Cebula (1998) underpins this by finding the budget deficit to increase long-term interest rates. Min (1998) finds country specific fundamentals and macroeconomic factors to have a strong influence on the sovereign risk premiums while Longstaff et.al. (2011) identify the US stock market as an indicator for the global economy to primarily drive the CDS spreads. In our analysis we can conclude solvency proxies to be more important within the framework of sovereign risk premiums than liquidity indicators although liquidity indicators also turn out to be significant. We also find very weak evidence of global indicators to have a significant influence on the market-implied asset values and therefore they seem to be of minor importance for market participants when assessing countries.

Kaminsky/Pereira (1996) find income inequality and political instability to be one reason why Latin America succumbed to the crisis and others such as Asian countries did not. Berg/Sachs (1988) in addition see the agricultural sector as a guarantee for political stability. We find political stability indicators to be significant.

Our paper provides a new approach to measuring and managing sovereign creditworthiness and additionally contributes to the ongoing discussion within the literature about the main influential factors.

The remainder of the paper develops as follows. Section 2 outlines the methodology. Section 3 describes the data set used. Section 4 describes the results and Section 5 concludes.

## 2 Methodology

For the sovereign contingent claim approach, as for companies, the basis for our analysis is the balance sheet. The basic assumption behind a sovereign balance sheet is to see a country as an aggregation of the different sectors in an economy: the corporate sector, banking sector and Monetary Authorities. Table 1 shows the aggregated items on a sovereign balance sheet.

### **Table 1 around here**

On the asset side, there are national reserves and net fiscal assets (revenues – discretionary expenditures) plus other assets (e.g. shares of companies, buildings, parks, facilities, monuments, military equipment) minus guarantees to too-important-to-fail entities.

Gray/Merton/Bodie (2007) define “other assets” as tangible assets which are unlikely to be sold. However, state owned companies or motorways have been sold to private investors by governments in the past. This creates a revenue stream that can be used for example to repay debt, as Greece is currently trying to do. Consequently, tangible assets, if they are of some value to the private sector, could have a positive influence on the sovereign asset values. This is included in the theoretical approach as Gray/Merton/Bodie (2007) define net fiscal assets as “[...] the present value of stochastic future fiscal flows from taxes and revenues minus nondiscretionary expenditures.” (p.11). The tangible assets could be thought of in the same way. State-owned companies or mines create revenue streams that are included with the discounted value in the balance sheet. Land or properties are rather unlikely to be sold but if they were to be sold, they would create a one time revenue stream which would give short-term fiscal relief.

The liability side of a company’s balance sheet consists of equity and debt. To be able to apply the Merton (1974) and Black/Scholes (1973) approach the sovereign balance sheet needs to be rearranged in a similar way.

In the corporate framework equity is treated as a junior and debt as a senior claim. In the sovereign setting, as known from historic experiences, external debt is treated as a senior and domestic debt as a junior claim. Therefore, domestic debt is part of the equity and external debt is regarded as a sovereign’s debt. In addition, Base Money (M0) is a liability of the Monetary Authority within the country and therefore part of the equity. Equity is

consequently defined as M0 plus domestic debt and debt is defined as external debt. These considerations result in the stylized sovereign balance sheet in Table 1 to which the Merton theory can be applied.

Gray/Merton/Bodie (2002 & 2007) outline how sovereign asset values and asset volatilities can be derived by applying Merton's (1974) and Black/Scholes's (1973) implicit call option theory based on the balance sheet. They further explain the risk transfer between the different sectors and show how this becomes obvious when looking at a country's balance sheet as an aggregation of the different sectors within one economy. As the asset value and volatility are based on the balance sheet, the derived asset values and volatilities can be regarded as accounting-based.

Gapen et.al. (2005) provide justification for the CCA approach by calculating risk indicators and CDS spreads based on implied asset volatilities and asset values and compare these to market CDS spreads and other indicators. The calculated spreads perform well in the direct comparison. This is therefore justification for the CCA approach from an empirical point of view.

### ***Defining market-based sovereign asset values***

The Probability of Default (PD) is the leading credit risk. It gives an indication of the risk of a borrower to default given an asset value, its anticipated drift rate and a default barrier. To define the default barrier for countries is rather difficult as there is no international law defining the point of a sovereign default. But the idea behind Merton's model (1974) is that default occurs when the asset value falls below the liabilities value. The probability of this event is reflected in the PD. Another indicator for credit risk is the Recovery Rate which gives an indication of the payback for the lenders once a borrower has defaulted (Altman (2006)). The higher the payback the lower the credit risk as the loss to the lenders is limited.

The starting point for the approach is the observable market estimate of the credit risk, the CDS spread. From this spread the market-based PD can be computed through the Credit Spread triangle (cf. Lando (2004)):

$$PD = \frac{CDS \text{ spread}}{(1 - \text{Recovery Rate})} \quad (1)$$

Within the finance practice the Recovery Rate for a country is assumed to be 40% (cf. Markit (2009)).<sup>1</sup> To link the asset value to the observable market PD, the relationship established by Merton (1974) between the PD and the Distance-to-Default (DD) is used:

$$DD = \frac{\ln A + \mu(T - t) - 0.5\sigma_A^2(T - t) - \ln L}{\sigma_A \sqrt{(T - t)}} \quad (2)$$

L denotes the liabilities or external debt, T-t is the time to maturity and  $\mu$  is the drift parameter.

The DD can be obtained by applying the inverse normal distribution on the PD:  $PD = \Phi(-DD)$  where  $\Phi$  denotes the standard normal distribution function.

In equation (2) the asset value A and the asset volatility  $\sigma_A$  are part of the equation and we can derive the market-based asset values from this equation.

Within the finance literature (cf. Gapen et.al. (2005) & Gray/Merton/Bodie (2007)) it is common to define risk-neutral probabilities by setting  $\mu=r_f$ , where  $r_f$  is the risk-free rate, e.g. the 10-year-Treasury yield. To derive a one year PD we set T-t=1. These reflections lead to the following equation:

$$DD = \frac{\ln A + r_f - 0.5\sigma_A^2 - \ln L}{\sigma_A} \quad (3)$$

As neither A nor  $\sigma_A$  is observable, another equation with one or both of the unknowns is needed in order to calculate the asset value A.

To derive the second equation, the relationship between equity and asset values defined by Black/Scholes (1973) and Merton (1974) is applied. Equity is an implied call option on the asset value and the equity volatility is related to the asset volatility. This relationship is defined in equation (4):<sup>2</sup>

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<sup>1</sup>Note that all CDS prices quoted in the market are based on this assumption, thus different recovery rate assumptions by some market participants lead to a change in the CDS spread.

<sup>2</sup>The known equation is:  $\sigma_E = \sigma_A \Phi(d_1)A/E$ . This equation can be simplified to equation (5) according to Merton (1974) with a simple boundary condition.



$$\sigma_E = \sigma_A \frac{A}{E} \quad (4)$$

where E is the equity and  $\sigma_E$  the volatility of the equity. Equity is defined as domestic debt in foreign currency terms if it is a soft currency otherwise in local currency plus the M0 as outlined above. Combining equation (3) and (4) leads to an equation with one unknown:

$$DD = \frac{\ln(A/L) - 0.5(\sigma_E(E/A))^2}{\sigma_E E/A} \quad (5)$$

The implied equation for A may have complex roots. Therefore, an approach also stated in Barth/Hodder/Stuben (2008) is applied.

A close approximation for the asset value is the sum of equity + liabilities. This approximation can be used to derive the asset volatility from equation (4). Therefore, the asset volatility is a real number and equation (4) can be solved for A as just one unknown remains:

$$A/L = \exp(DD\sigma_A - r_f + 0.5\sigma_A^2) \quad (6)$$

Equation (6) represents the asset value based on the market-approach.

As stated before, after having derived the sovereign asset value from market information, the importance and advantage of this approach has to be stated. It will be shown that the asset value has more predictive power than the PD, the leading risk indicator.

### *Regression model*

The next step is to enhance the Gray/Merton/Bodie (2007) model by statistically defining the factors driving the market-based asset value. As outlined above, we use market-based asset values and identify the drivers of these asset values via a statistical regression model to be able to gain further insights into the important factors driving sovereign credit risk premiums.

We use a model of the form  $\Delta A_{i,t} = \alpha + \beta X + \varepsilon_{i,t}$ , where A is the asset value, X is a matrix of the independent variables and  $i=1 \dots 14$  is our set of fourteen advanced economies and D denotes the difference over time.

We assume a linear relationship between the dependent and the independent variables based on the results of the plots and the F-statistics. The F-statistic significantly rejects the

hypothesis of non-linearity. This result is also supported when plotting the regressor against each individual regressed variable even though some indicate a more linear relationship than others. But there is no clear indication of another relationship and therefore we hold to the assumption of the linearity of the model.

In our data set we have 14 different countries and this fact raises the question about the behavior of the variance and whether we have differences across countries. A simple OLS regression on pooled data can be biased when the hypothesis about homogeneity of the error term is rejected. We conduct a seemingly unrelated regression allowing for contemporaneous correlations of the error terms between the different equations within the regression.

### 3 Data

We use monthly data from 2004 to 2010 for 14 developed countries.

For calculating sovereign asset values M0, external debt, domestic debt and the CDS spreads are required as outlined in Section 2.

M0 is the narrowest monetary aggregate but this aggregate is not provided per country for public access either by the IMF, the World Bank or the Eurostat database. For some of the countries M0 is available but the calculations vary. M1 is the next monetary aggregate and it is available from the World Bank which implies the same calculation and also gives an indication of the development of the monetary aggregate M0. Even though M0 and M1 do not always follow the same growth pattern it is regarded as the best approximation available. M1 data is taken from the World Bank database.

Total debt and external debt are collected from the World Bank database. Both are not available on a monthly but on a yearly basis and therefore a linear interpolation is applied to obtain monthly data. Furthermore, total debt is only available in local currency and converted by monthly exchange rates from Bloomberg.

5-year CDS spreads are collected on a daily basis from 2004-2010 from CMA and Markit and averaged to obtain monthly data. Prior to 2004 the sovereign CDS market was considered quite illiquid as private discussions with market participants has shown. Following market convention we use 10 year Treasury bond yields as a proxy for the risk-free rate.

For determining the main drivers of sovereign asset values, variables having significant influence on the creditworthiness of countries used in other studies are tested.

Table 2 shows descriptive statistics for the independent variables used.

**Table 2 around here**

Ratings have been shown to have significant influence on the risk premiums. Al-Sakka/Gwilym (2009) find indications of a sovereign rating drift, i.e. rating changes are more likely to be followed by a change in the same direction than a reversion. El-Sangi (2009) on the contrary does not find significant influence of ratings on sovereign spreads. For Reinhart (2002) ratings turn out to be very weak predictors of sovereign defaults, partly due to the endogenous nature of a country's default decision. We did not incorporate ratings as an explanatory variable as we include different macro-economic variables that in turn explain ratings. Therefore, to avoid endogeneity problems we excluded ratings. Especially as Norden/Posch (2012) have pointed out that the transparency index is a major driver of ratings.

The literature has not yet come to a common understanding about the significance of global versus local factors. As we are analyzing the underlying asset value it will be important to see if it has significant influence on the asset value. This will give an indication regarding other research results and the controversial discussion.

As a global indicator we use the MSCI World Index from Bloomberg and expect a positive sign as a strong global economy should lead to a local economic upswing especially as we are looking at developed countries.

Liquidity plays an important role as on the one hand too little liquidity makes a country more vulnerable to sudden external shocks. The country would be unable to compensate for sudden shortages of revenues. On the other hand, too much liquidity can result in inefficiency in resource allocation and lead to a reduction of the asset value as the unused resources could be used for investments to stimulate the economy instead. In times of sovereign crises revenues are declining and debt as a percentage of GDP increases. Therefore, high liquidity is expected to have a negative sign as the asset value could be better used to repay debt. Cash to taxes is used as a proxy for liquidity.

Besides liquidity, an important measure regarding creditworthiness is the long-term perspective of a country. One indicator is the interest payments as a percentage of government expenses. The variable interest payments as a percentage of government expenses gives an indication as to the extent to which a country finances its wealth level through debt and how much it depends on capital markets. The respective sign should be negative as a higher ratio means lower economic capabilities.

Another measure of the long-term perspective is the unemployment rate. The unemployment rate is expected to have a positive impact as a higher unemployment rate means a lower inflation rate according to the Phillips-curve.

The overall indebtedness of a country gives insights into a sovereign’s capability to repay its debt and the long-term solvency, but also shows how investments and consumption are smoothed over time by the government. Indebtedness is measured as the ratio of total debt to GDP and external debt to GDP. Moreover, we introduce the ratio: debt to taxes. As outlined before, it is important to also compare the indebtedness of a country to its tax revenue as the government owns the tax revenues in comparison to the GDP. In general, it is measured if the income stream is too little in comparison to the debt obligation so that the risk for the lenders increases even if debt per se is seen as a necessary investment in future economic growth as the descriptive statistic showed. These proxies are therefore expected to have negative signs as an increasing ratio should imply a higher credit risk.

A further interesting indicator is the influence of political stability on the perceived market risk. As an indicator we use the Corruption Perception Index from Transparency International that scores different countries and the higher the score in the index, the lower the corruption in a country. This index has also been proved by Norden/Posch (2012) to have a strong influence on ratings. We anticipate a positive sign of the coefficient as a higher political stability score guarantees a higher probability of overcoming a sovereign debt crisis.

Table 3 shows a summary of the included independent variables and expected signs.

**Table 3 around here**

The independent variables are collected from Bloomberg, Transparency International, the World Bank as well as the IMF database and are converted to USD and interpolated,

when necessary, to the left-hand side variable's frequency.

## 4 Results

An indicator for the comparison of a country's debt burdens is total debt to GDP. The question is whether GDP is an adequate reference unit. The GDP growth can be interpreted as the return on the whole economy. But the GDP does not belong to the government in contrast to the taxes and revenues that could also give insights into the repaying capabilities of a country.

The PD is the leading variable for estimating sovereign creditworthiness, but the market-based asset values offer more insights into the drivers for creditworthiness from a market perspective than the PD, as the market-based asset values significantly contribute to the contemporary PDs. Regressing the contemporary PD on the lagged PD, the lagged market-implied asset values and controlling for the GDP change shows the market-implied asset values to significantly contribute to the contemporary PD even when the lagged PDs are included (cf. Appendix I). This implies an impact of the asset values on the contemporary PDs and provides insights into the drivers of creditworthiness and appropriate risk measures in times of sovereign debt crises. We also ensure that our asset values are not be dominated by CDS spreads or volatility, cf. a sensitivity analysis provided in Appendix II.

Table 4 gives the average market-based asset values per country together with mean GDP levels in US\$, mean external debt levels and the mean external debt to asset value ratio.

### Table 4 around here

When looking at the asset values in column 1, we can see the United States with the highest market-based asset value followed by Germany, France and Italy. Sweden, Denmark, Australia and Switzerland have the lowest asset values from the list of ranked countries. Column 2 shows the countries' mean GDPs levels. As the GDP offers an indication of a country's economic size, the GDP level should give an indication of the asset values.

The ranking of the highest asset values, United States through to Italy, are in accordance with the economic performance of the countries. But the rest of column 1 is not in accordance with column 2. Switzerland for example is the country with the lowest asset value, but with regard to GDP, Switzerland is in the middle of the selected countries. This leads one to question where the differences between our market-based asset values ranking and the

economic performance ranking come from.

First, in the framework of Gray/Merton/Bodie (2003) the asset side of the balance sheet consists of International Reserves and Net Fiscal Assets. The GDP comprises all goods and services produced within one economy and this can imply differences between the asset and GDP values.

Second, the sum of the equity and debt is an approximation of the asset value, as outlined in section 3. In addition, as the implicit option price theory is applied to calculate the market-based asset values the impact of a country's debt on the asset values and therefore on the ranking in column 1 has to be evaluated. Column 3 in Table 4 shows the mean external debt per country. Column 3 mirrors the asset value ranking in column 1 quite well, implying the debt value to have a positive influence on the asset value from a market perspective as it helps to smooth consumption over the years. The implications can be explained by the example of Portugal. Portugal has the lowest GDP, but only the 5<sup>th</sup> lowest asset value. However, it has the 5<sup>th</sup> lowest external debt value. Market participants might therefore interpret debt as an investment having a positive influence on the asset values. Besides the absolute value of debt, the debt burden in comparison to the asset value is also important, because it shows an indication of the possibilities of a country to repay its debt and consequently also its creditworthiness. We therefore calculate the external debt in relation to the asset value. This is shown in column 4 in Table 4. It shows the ranking of the market-based assets to be more in accordance with the countries ranking according to their debt. Column 4 shows those countries composing the upper band of the asset values also show a high indebtedness ratio and the countries of low asset values also make up the lower band.

But we do see some exceptions like Portugal, Spain, Greece and the Netherlands. This might back up the theory outlined in section 3 that factors other than the indebtedness level and the relative debt burden play an important role in the perceived sovereign creditworthiness.

Besides the insights offered by the mean comparison of the assets, GDP and external values, the development and relationships between these three indicators over time provide additional information. When plotting the three indicators per country for the period considered, the asset values and external debt values appear to be more volatile than the GDP. We

also see the asset value developments to be more closely related to the external debt values than to the GDP progression. This underpins the conclusions drawn from the mean value comparisons in Table 4. In addition, a tendency of the asset values to anticipate economic downturns more quickly than the GDP development can be inferred. This result is exemplified in the countries Germany, Switzerland and Portugal. Figure 1 shows the corresponding graphs.

### **Figure 1 around here**

The early indicator function of the market-based asset values is most obvious when looking at Switzerland. The downturn of the Swiss asset value starts in the middle of 2007 while the economic downturn starting point can be dated to mid 2008. This infers that the asset value decreases one year in advance of an economic downturn. Similar conclusions can be drawn from analyzing Germany. The German asset value follows the GDP trend till mid 2007 but then diverges from it. The asset value slightly declines and stagnates till the end of 2008 while the GDP further increases till it peaks in 2008 and then plummets. This might underpin the theory that market-implied asset values incorporate information quicker and react early with regard to the economic development of a country. But the increase of the German asset value from the end of 2008 through to the end of 2009 do not seem to be in accordance with this hypothesis as the GDP declines up to the end of 2009. To see if the asset values function as an early indicator of GDP, the developments of 2010 and 2011 have to be taken in account. In 2010 the German GDP had already started recovering and the German economy continued to perform well in 2011. Consequently, the asset values mirror the economic developments in advance. The picture is a bit different when looking at Portugal. It is quite similar to the German development but the increase of the asset values at the beginning of 2009 cannot be interpreted as the anticipation of an economic recovery as Portugal is still considered to be one of the jeopardized European countries. In general, we find that for some countries changes in asset values is a good indicator, but we cannot testify this for the whole sample.

In summary, we can say the market-implied asset values provide new insights into the market creditworthiness perception as it contributes to the contemporary PDs. Furthermore, we can conclude that the asset values are positively influenced by external debt but also

assume additional drivers due to differences in the asset value and external debt ranking (cf. Table 4). In addition, the asset values might be regarded as early indicators of an economic downturn and therefore add important value to analyzing sovereign creditworthiness.

To see which additional factors influence the market-implied asset values we conduct a cross-section regression in the first step. In the second step, we cluster the countries in two subcategories according to a median split of the external debt to asset value ratio to see if different drivers are important depending on whether this ratio is high or low.

As we have 14 countries, the first cluster comprises 7 countries, the United States, Portugal, Italy, Spain, Germany, Greece and France and the second cluster the remaining 7 countries.

We test the dependent and independent variables for unit-roots. All are stationary with first differences. The econometric model is a seemingly unrelated regression.

The results for the cross-sectional analysis are shown in Table 5:

**Table 5 around here**

Debt as a percentage of GDP is a highly significant variable with a positive sign. The expectation was that this ratio would have a negative sign. Even if debt is seen as an investment of the government to preserve economic growth, an increase in the relative debt burden was expected to reduce the asset value. The positive sign of the ratio implies that the market participants see debt as a positive and necessary investment and see no constraints regarding a debt ratio. The same rationale applies to the significant variables of debt to taxes and external debt to GDP as they also have a positive sign and this might be interpreted as robust results.

Consequently, market participants might have no concerns about the repaying capabilities of advanced economies countries. Therefore no increased credit risk is anticipated. It might be worth noticing that our data set ends in 2009. This means that possible changes in the market participants' perceptions are not yet visible in the data. It might be interesting to analyze whether the European debt crisis has changed the market perception once the data is available. The indebtedness ratio with a positive influence on the asset values might give some explanations for the circumstances leading to the European sovereign debt crisis as follows. As market participants did not show any concerns about the repaying capabilities of



countries before the financial crisis, the responsible governments might have acted according to this principle. They did not anticipate market perceptions to change and a change of perception in the end might lead to financial market access constraints for countries.

To sum up the results from the cross-section analysis, debt is seen as an important investment of the government in future economic growth, market participants show a high level of trust in the repaying capabilities of countries and consequently no pressure from the market to consolidate government expenses is recognizable.

Next we conduct the regression on the two clusters. Table 5 column 2 shows the results of the regression on the countries with the high external debt to asset values ratio and column 3 the results of the low ratios.

The results show accordance with the cross-section analysis with regard to the debt to GDP and the external debt to GDP ratio. But we also see cash to taxes to be significant with a negative sign and the MSCI Index with a negative sign. The significance of the cash to taxes ratio with a negative sign implies an accumulation of cash to be perceived as a mismanagement of resources by the responsible government. This has been expected and in addition is in line with the other results. When debt per se is seen as a positive investment there is no reason to accumulate cash for sudden economic constraints. A negative sign of the weakly significant MSCI Index is surprising. When analyzing the regression more closely the MSCI is only significant for Belgium with a negative sign and positively significant for Norway. For all other countries we do not see a strong reaction to the change in the world's equity index. A possible reason for Belgium's negative sign could be due to the control variables and the time span used.

The results for the countries with low ratios, shown in column 3, show again accordance of the significances with regard to the debt to GDP and external debt to GDP when compared to regression 1 and 2. Besides the debt to GDP and external debt to GDP ratio is the positive significance of the transparency index. The sign is as expected as the higher the score is, the less corrupt a country is, and it means more stable economic and political conditions.

The results show two common variables significant for all regressions, debt to GDP and external debt to GDP, but they also reveal a different market perception for the countries in the two clusters. This means that for countries with a high ratio the trust in the repaying

capabilities is higher than for the other countries as even the accumulation of cash as a buffer for sudden economic shocks is negatively assessed. The asset values of countries with a high ratio react negatively to an increase in the MSCI world's stock index. However the coefficient is comparably small in size and thus the economic effect not very pronounced. In contrast, for countries with low ratios only the political stability index is important in addition. Markets therefore perceive political stability in these countries as a more important indicator of credit risk.

In general it should be assumed that the market risk perception for countries in cluster 1 is different than for cluster 2 implying different policy strategies to be important, and we can conclude that the clustering provides deeper and differentiated insights into the market's creditworthiness perception.

## 4 Conclusion

We have shown a new way of deriving sovereign market-based asset values in conjunction with the implicit call option theory by Merton (1974) and Black/Scholes (1973). The market-implied asset values provide new insights into the drivers of risk premiums as they have been shown to significantly contribute to the contemporary PD even if the lagged PDs are included.

We found discrepancies between the ranked mean asset value of a country and its ranked mean economic strength (GDP level) but a strong correlation with the respective mean external debt value. This observation implied market participants to value debt as an investment increasing a country's asset value which was also underpinned by the ranking of the countries according to the external debt to asset value ratio. This conclusion could also be drawn when looking at the asset value, GDP level and external debt value over the whole period. Remarkably in the long term view there was a tendency of the market-implied asset values to anticipate economic downturns. This result highlights the value-add of market-implied asset values within the framework of understanding risk premiums but also as an overall risk indicator.

In the cross-section analysis we found the debt to the GDP ratio to increase a country's asset value as well as the debt to taxes and external debt to taxes ratio. We concluded that

the long-term indicators were more important in the market participants' perspectives than short-term, liquidity or global economic factors. These results underpin the literature on credit risk for example Edwards (1984) and Boehmer/Megginson (1990) who find local and especially solvency proxies to be most important, both of which can be considered to be long-term perspectives. To see if different factors drive the asset value of countries with a high external debt to asset value ratio than with a low ratio we split the countries according to the median of the ranking. We find some common factors but also a variation in significant variables between the two clusters. For all regressions, the debt to GDP and external debt to GDP ratio is significant with a positive influence on the sovereign asset value. In addition to these variables the MSCI Index and the cash to taxes ratio are also significant. In contrast to the cluster with the low external debt to asset value, only the transparency index is significant besides the two common variables. Therefore we can contribute to the discussion about the importance of local versus global factors by underpinning Longstaff et.al.'s (2011) results, but have to limit it as its significance highly depends on the countries examined. Regarding liquidity proxies we can support Haugh/Oliver/Turner (2009) and Cebula (1998) as our liquidity proxy is significant for the first cluster but in contrast to them, we find a negative influence of cash accumulation on the sovereign asset values. In the cluster with the low ratios we see the political stability as an important factor and therefore can underpin Kaminsky/Pereira (1996).

In summary, the market-based asset values can be used to derive further insights into the asset value and what drives creditworthiness.

## Literature

Al-Sakka, R., Gwilym, O. (2009): Heterogeneity of sovereign rating migrations in emerging countries, *Emerging Markets Review*, Vol. 10, Issue 2, pp. 151-165.

Altman, E. (2006): Default Recovery Rates and LGD in Credit Risk Modeling and Practice: An Updated Review of the Literature and Empirical Evidence, NYU working paper.

Berg, A., Sachs, J. (1988): The Debt Crisis: Structural Explanations of Country Performance, *Journal of Development Economics*, Vol. 29, No.3, p.271-306.

Black, F., Scholes, M. (1973): The pricing of options and corporate liabilities, *Journal of Political Economy*, Vol. 81, No. 3, pp. 351-367.

Boehmer, E., Megginson, W. (1990): Determinants of Secondary Market Prices of Developing Country Debt, *Journal of Finance*, Vol. 45, No. 5, pp. 1517-1540.

Cebula, R.J. (1998): An empirical analysis of the impact of federal budget deficits on long-term nominal interest rate yields, 1973.2-1995.4, using alternative expected inflation measures, *Review of Financial Economics*, Vol. 7, No. 1, pp. 55-64.

Caporale, G.M., Williams, G. (2002): Long-term nominal interest rates and domestic fundamentals, *Review of Financial Economics*, Vol. 11, No. 2, pp. 119-130.

Edwards, S. (1984): LDC Foreign Borrowing and Default Risk: An Empirical Investigation, 1976-80, *American Economic Review*, Vol. 74, No. 4, pp. 726-734.

El-Shagi, M. (2009): The role of rating agencies in financial crises: event studies from the Asian flu, *Cambridge Journal of Economics*, Vol. 34, No. 4, pp. 671-685.

Ericsson, J., Jacobs, K., Oviedo, R. (2009). The Determinants of Credit Default Swap Pre-

mia, *Journal of Financial and Quantitative Analysis*, Vol. 44, No. 1, pp. 109-132.

Gapen, M. T., Gray, D.F., Lim, C.H., Xiao, Y. (2005): *Measuring and Analyzing Sovereign Risk with Contingent Claims*, IMF Working Paper, No. WP/05/155.

Gray, D., Merton, R. C., Bodie, Z. (2002). "A New Framework for Analyzing and Managing Macrofinancial Risks." *New York University Conference on Finance and the Macroeconomy*, October.

Gray, D.F., Mertin, R.C., Bodie, Z. (2007): *Contingent Claims approach to Measuring and Managing Sovereign Credit Risk*, Special Issue on Credit Analysis, *Journal of Investment Management*, Vol. 5, No. 4, pp. 1-24.

Haugh, D., Olliver, P., Turner, D. (2009): *What Drives Sovereign Risk Premiums? An Analysis of Recent Evidence from the Euro Area*, OECD Economics Department Working Papers, No. 718.

Kaminsky, G.L., Pereira, A. (1996): *The debt crisis: lessons of the 1980s for the 1990s*, *Journal of Development Economics*, Vol. 50, No. 1, pp. 1-24.

Keller, C., Kunzel, P., Souto, M. (2007): *Measuring Sovereign Risk in Turkey: An Application of the Contingent Claims Approach*, IMF Working Paper, No. WP/07/233.

Lando, D. (2004): *Credit Risk Modeling: Theory and Application*, Princeton University Press, Princeton.

Longstaff, F.A., Pan, J., Pederson, L.H., Singleton, K.J. (2011): *How Sovereign Is Sovereign Credit Risk?*, *American Economic Journal: Macroeconomics*, Vol. 3, No. 2, pp. 75-103.

Mary E. Barth, M.E., Hodder, L.D. (2008): *Fair Value Accounting for Liabilities and Own Credit Risk*, *The Accounting Review*, Vol. 83, No. 3, pp. 629-664.

Merton, R. (1974): *On the pricing of corporate debt: the risk structure of interest rates*, *Journal of Finance*, Vol. 29, No. 2, pp. 449-470.

- Min, H.G. (1998): The determinants of Emerging Market bond spread: Do economic fundamentals matter? Policy Research Working Paper 1899, The World Bank.
- Norden, L., Posch, P.N. (2012): Sovereign credit risk and the real economy: A risk-return framework. Working Paper, Rotterdam School of Management, Erasmus University.
- Reinhart, C. (2002): Default, Currency Crisis, and Sovereign Credit Ratings, The World Bank Economic Review, 2002, Vol. 16, No. 2, pp. 151-170.
- Markit (2009): Forthcoming CDS Convention Changes: Australia, New Zealand, Emerging Markets, and Japan.

**Table 1: Stylized Sovereign Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
International Reserves	Value of Equity
Net Fiscal Assets	(Domestic Currency Debt + Base Money)
other Assets Guarantees	Foreign Currency Debt
to too-important-to-fail entities	

Adoption from Gray/Merton/Bodie (2007)

**Table 2: Descriptive statistics of the dataset.** The average of each variable and each country over the years 2004 to 2009 is shown with the standard deviation in parenthesis. Source for the data is Bloomberg, the World Bank, the IMF and Transparency International.

Country	MSCI Index	Cash/ taxes	Interest/ total expenses	Unemployment rate per cent	Debt/ GDP	Debt/ Taxes	External Debt/ GDP	Transpare Index
Australia	1274.95 (230.17)	0.07 (0.06)	3.76 (0.21)	4.82 (0.50)	0.22 (0.03)	0.88 (0.12)	0.04 (0.01)	8.69 (0.05)
Austria	1274.95 (230.17)	-0.05 (0.03)	6.83 (0.26)	4.58 (0.50)	0.66 (0.04)	3.28 (0.24)	0.55 (0.03)	8.21 (0.29)
Belgium	1274.95 (230.17)	-0.03 (0.03)	8.89 (0.69)	7.83 (0.57)	0.89 (0.05)	3.44 (0.21)	0.55 (0.06)	7.22 (0.10)
Denmark	1274.95 (230.17)	3.76 (2.04)	4.83 (1.12)	4.43 (1.10)	0.34 (0.05)	1.02 (1.35)	0.14 (0.02)	9.38 (0.09)
France	1274.95 (230.17)	-0.08 (0.03)	5.41 (0.24)	8.86 (0.70)	0.73 (0.05)	3.28 (0.24)	0.39 (0.04)	7.14 (0.25)
Germany	1274.95 (230.17)	-0.07 (0.05)	5.65 (0.18)	9.07 (1.43)	0.44 (0.02)	3.77 (0.33)	0.33 (0.03)	7.96 (0.10)
Greece	1274.95 (230.17)	-0.21 (0.06)	10.74 (0.26)	8.88 (0.88)	1.30 (0.08)	6.41 (0.46)	0.81 (0.08)	4.29 (0.36)
Italy	1274.95 (230.17)	-0.07 (0.03)	11.53 (0.49)	7.06 (0.69)	1.12 (0.06)	4.94 (0.43)	0.47 (0.03)	4.74 (0.37)
Netherlands	1274.95 (230.17)	-0.01 (0.03)	4.70 (0.33)	4.00 (0.80)	0.51 (0.04)	2.21 (0.22)	0.36 (0.04)	8.83 (0.12)
Norway	1355.02 (169.10)	21.72 (2.73)	3.01 (0.35)	3.49 (0.85)	0.44 (0.06)	1.47 (0.75)	0.35 (0.06)	8.67 (0.24)
Portugal	1274.95 (230.17)	-0.11 (0.05)	6.42 (0.41)	9.08 (0.92)	0.72 (0.05)	3.40 (0.26)	0.48 (0.06)	6.26 (0.29)
Spain	1274.95 (230.17)	-0.02 (0.16)	5.27 (0.67)	11.20 (3.89)	0.37 (0.05)	3.12 (0.59)	0.23 (0.02)	6.55 (0.31)
Switzerland	1278.97 (233.03)	0.04 (0.10)	4.36 (0.35)	3.71 (0.41)	0.25 (0.05)	2.55 (0.33)	0.06 (0.01)	9.01 (0.08)
United States	1274.95 (230.17)	-0.38 (0.27)	9.29 (0.89)	5.94 (1.87)	4.75 (0.06)	4.75 (1.07)	0.19 (0.03)	7.34 (0.11)



**Table 3: Overview of independent variables in the regression, the expected sign and explanation**

Category	Used variable	Exp. Sign	Reason
Global indicators	MSCI World Index	+	An upswing in the
Liquidity Indicators	Cash surplus/taxes	-	More cash availabil
Solvency Indicators	Interest payments/total government expense	-	The higher the ratio
	Unemployment rate	+	Higher unemployme
	Total debt/GDP	-	The ratio shows the
	Debt/taxes	-	The ratio shows the
	External debt/GDP	-	The ratio shows the
Political stability	Transparency Index	+	The higher the tran

**Table 4: Overview of market-based asset values, GDP and external debt values**

This table shows the mean asset values for each country over the years 2004-2009 as derived according to Equation (6). The mean GDP over the same time span as well as the mean external debt is reported for comparison. The rightmost columns shows the ratio of external debt over the mean asset value and serves as a classification criterion in the following cross-sectional regression.

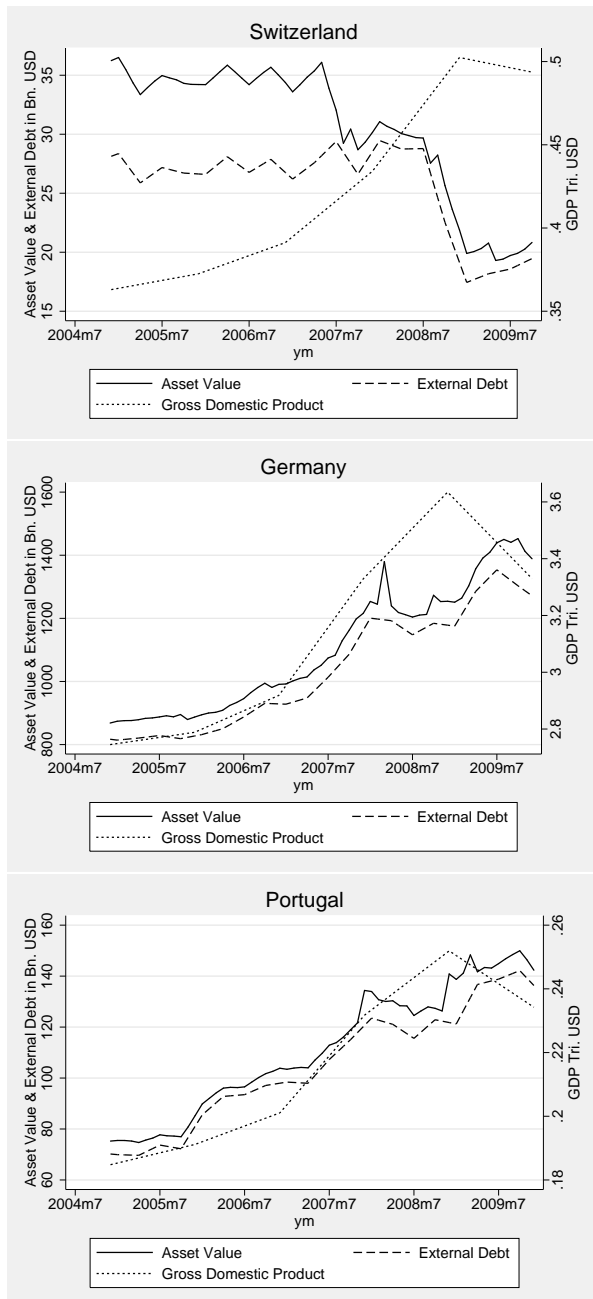
Country	Mean Asset Value bn USD	Mean GDP bn USD	Mean External Debt bn USD	External Debt/Mean Asset per cent
Australia	0.040	0.821	0.034	0.848
Austria	0.212	0.349	0.193	0.909
Belgium	0.260	0.431	0.239	0.915
Denmark	0.043	0.292	0.039	0.917
France	1.038	2.428	0.955	0.919
Germany	1.103	3.140	1.034	0.937
Greece	0.257	0.289	0.237	0.922
Italy	1.001	1.993	0.939	0.940
Netherlands	0.302	0.734	0.263	0.868
Norway	0.221	0.319	0.113	0.506
Portugal	0.112	0.217	0.105	0.943
Spain	0.325	1.330	0.306	0.940
Sweden	0.073	0.416	0.064	0.875
Switzerland	0.030	0.423	0.026	0.851
United States	2.541	13.400	2.567	1.009

**Table 5: Cross-section regression** The dependent variable is the first-differenced asset value and the independent variables are the MSCI Index, transparency index, interest in % of expense, unemployment rate, cash to total taxes, debt to GDP, debt to taxes all in first differences. In Regression 1 is cross-section, in Regression 2 only countries of cluster one are included and in Regression 3 only countries from cluster 2. Estimation is done with a seemingly unrelated regression. Z-statistics are in parentheses and \*\*\*, \*\*, \* indicate significance on a 1%, 5% and 10% levels.

Model	1	2	3
	(cross-section)	(high ratio)	(low ratio)
	$\Delta A$	$\Delta A$	$\Delta A$
$\Delta$ MSCI Index	-18.35 (-1.32)	-45.45* (-1.80)	-6.47 (-0.90)
$\Delta$ Transparency index	19,491.85 (0.48)	26,773.92 (0.40)	61,571.11*** (2.47)
$\Delta$ Interest expenses/total expenses	-21,211.45 (-1.49)	11,790.39 (0.38)	-775.76 (-0.11)
$\Delta$ Unemployment rate	-1,835.43 (-0.28)	-4,827.53 (-0.46)	-5,144.86 (-1.35)
$\Delta$ Cash/Total Taxes	-611.67 (-0.20)	-799,471.66*** (-2.98)	-931.43 (-0.86)
$\Delta$ Debt/GDP	91,578.07* (1.86)	309,131.33*** (2.97)	90,950.93*** (2.81)
$\Delta$ Debt/Taxes	77,685.62*** (3.86)	-80,569.77 (-1.36)	-4,222.44 (-0.20)
$\Delta$ External Debt/GDP	603,975.48*** (6.69)	772,378.26*** (4.53)	417,230.72*** (9.50)
Constant	2,987.33*** (3.44)	5,722.15*** (3.47)	785.21* (1.89)
Observations	803	420	383
Adj. R-squared	0.12	0.13	0.24

**Figure 1: Asset values, external debt and GDP development from 2004-09 for Switzerland, Germany and Portugal**

In the 3 different figures the asset value and external debt value in billion US\$ (right scale) and the GDP in trillion US\$ (left scale) are shown for the time from 2004-09.



## Appendix I: Predictive power of the market-based asset values with regard to the PD and GDP

In the Regression the dependent variable is the PD and the independent variables are the one-month lagged and second-differenced GDP, the one-month lagged and first-differenced asset value (A) and the one-month lagged PD. Estimation is done with a fixed-effect model and robust standard errors. T-statistics are in parentheses and \*\*\*, \*\*, \* indicate significance on a 1%, 5% and 10% levels.

	PD <sub>t</sub>
PD <sub>t-1</sub>	0.637*** (14.71)
$\Delta_2 GDP_{t-1}$	0.000 (-0.71)
$\Delta A_{t-1}$	0.000* (1.88)
Constant	0.035*** (7.9)
R	0.393
Number of observations	824
Rho	0.072

## Appendix II: Sensitivity analysis of sovereign asset values

Four new asset values are calculated by changing the CDS spreads and asset volatility by +10% and -10%. The percentage changes of the newly calculated asset values to the actual asset values are calculated.

**Sensitivity analysis of the sovereign asset values**

