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Relating Sovereign Debt Ratings to different practices of Exchange Rate Policy: an empirical analysis

A Dissertation presented in partial fulfilment of the Requirements for the Degree of Master in Monetary and Financial Economics by

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Aos meus pais*, Daniel e Regina,*

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ABSTRACT

In this thesis it is developed a research project whose objective is to identify links between the exchange rate policy of a country - fixed, intermediate and floating - and its long-term sovereign external debt, measured by sovereign ratings and assigned by Moody's and the S&P notations agencies, in two different economic periods: 1998-2002 (crisis period) and 2003-2007 (period of global recovery).

Based on a cross-section data for 81 countries, with a multivariate linear regression model and making use of three numerical scales for converting the sovereign ratings, namely the linear, the exponential and the logistic, the results show that exchange rate policy of a country largely determines its sovereign rating assigned by rating agencies. The intermediate exchange systems penalizes more the external debt quality indicators, while sovereign rating of a country is very favoured with floating exchange rate regime. The intermediate role is played by fixed exchange systems.

In general, for the crisis period analysis (May 2003), relative to the floating system, a fixed regime is penalized by 4 rating levels and an intermediate is penalized by 7 levels while the floating exchange rate regime ensures approximately 8 rating levels. In May 2008 (for the recovery period analysis), these penalties are aggravated: relative to the floating system, a fixed regime is penalized by 7 levels and an intermediate is penalized by 11 levels. The contribution of the floating exchange rate regime did not much change from one period to another, being about 8 levels in May 2003 and 9 levels in May 2008.

It is also demonstrated the high explanatory capacity of the model, especially in periods of crisis, when the evaluation criteria is more carefully defined. About 85% of the 19 regressors shown in this model are significant, for the period of crisis. In the recovery period, this percentage dropped to 58%.

However, beyond the exchange rate regimes, the economic indicators confirm their high capacity in the determination of sovereign ratings, in the two analysed periods. The socio-political factors, when combined with the exchange rate policy, contribute significantly in determining the ratings, especially in the recovery period.

For a country that has a history of default can see their sovereign rating worsened in more 2 levels (May 2003) or in more 3 levels (May 2008) when it follows an intermediate exchange rate regime.

Keywords: sovereign debt rating, *de facto* exchange rate regime, crisis period, rating scales

JEL classification: E42, G15

RESUMO

Nesta dissertação é desenvolvido um projeto de pesquisa cujo objetivo é identificar as ligações entre a política cambial de um país - fixa, intermédia e flexível - e a sua dívida soberana externa de longo prazo, medida pelo ratings soberanos atribuídos pelas duas maiores agências de notação financeira, Moody's e Standard and Poors, em dois diferentes períodos económicos: 1998-2002 (período de crise) e 2003-2007 (período de recuperação global).

Com base em dados cross-section de 81 países, num modelo de regressão linear múltipla e fazendo uso de três escalas numéricas para converter os ratings soberanos, nomeadamente as escalas linear, exponencial e logística, os resultados mostram que a política cambial de um país determina em grande medida o seu rating soberano atribuído pelas agências de rating. O regime cambial intermédio penaliza mais os indicadores de qualidade da dívida externa, enquanto que a avaliação da dívida soberana externa de um país é muito favorecida com a prática de um regime de câmbios flexíveis. O papel "intermédio" é desempenhado pela política cambial fixa.

Em geral, na análise do período de crise (maio de 2003), em relação ao regime de câmbios flexíveis, um regime fixo é penalizado em 4 níveis de rating e um intermédio é penalizado em 7 níveis, enquanto que o regime de câmbios flexíveis assegura cerca de 8 níveis de ratings. Em maio de 2008 (para a análise do período de recuperação), aquelas penalizações são agravadas: relativamente ao regime flutuante, um regime fixo é penalizado em 7 níveis e o intermédio é penalizado em 11 níveis. A contribuição do regime de câmbio flexível não muda muito de um período para outro, sendo, desta vez, igual a 9 níveis.

Também é demonstrado a elevada capacidade explicativa do modelo, especialmente em períodos de crise, altura em que os critérios de avaliação são mais cuidadosamente definidos. Cerca de 85% dos 19 regressores apresentados neste modelo são significativos, para o período de crise. No período de recuperação, esta percentagem caiu para 58%.

No entanto, além dos regimes cambiais, os indicadores económicos confirmam sua elevada capacidade na determinação de ratings soberanos, nos dois períodos analisados. Os fatores sociopolíticos, quando associados com a política cambial, contribuem significativamente na determinação dos ratings soberanos, sobretudo no período de recuperação.

Para um país que já tenha registado uma situação de *default,* poderá ver o seu rating soberano agravado em mais 2 níveis (Maio de 2003) ou em mais 3 níveis (Maio de 2008), quando praticar um regime cambial intermédio.

Palavras-chave: ratings de dívida soberana, regimes cambiais, período de crise, escalas de rating.

Códigos JEL: E42, G15

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GLOSSARY OF ABBREVIATIONS

EXP – exponential scale

FIX – Fixed exchange rate regime

FLOAT – Floating exchange rate regime

INTERM - Intermediate exchange rate regime

LIN – linear scale

LOG – logistic scale

RES – residuals of regression process

S&P – Standard and Poor's

UK – United Kingdom

USA – United States of America

WAEMU - West African Economic and Monetary Union

1. Introduction

The quality of a country's sovereign external debt, in both short and long terms, has always been associated with the "health status" of official currency and with monetary and exchange rate policies followed by the competent authorities.

The need for a country to get external funding usually arises from the fact that it has limited ability to internally generate enough accumulation savings or, in some cases, simply because it can lower financial costs of operations supported internally. The question is to which extent it is possible to lower these costs, i.e., at which level the international financial markets can assess the profile of an international borrowing authority that basically boils down on an analysis of its failure risk, as in any attempt to grant credit.

However, this assessment is not entirely easy. It turns out to be complex and often involved in speculative questions that, ultimately, could lead the country to a situation of default.

The international debt issuers that are subject to external evaluation by the markets can take private or public activities. However, major debt issuers are national governments, through T-bills and national treasury bonds issuance.

Some authors believe that good credit position of a sovereign borrower depends not only on ability but also on their readiness to liquidate its debt (see, for instance, Eaton et al., 1986, Clark 1997 and Clark, 1999).

Beyond economic and socio-political factors, the role of monetary and exchange rate fundamentals are also crucial to promote foreign monetary and financial systems of any economy. Ability to react to external shocks and credibility in the maintenance of monetary and exchange policies undertaken by the authorities (central banks) strongly affects not only the options of international creditors, but also the ability of governments to liquidate its external debt.

The constant external imbalances largely affect the external debt of a sovereign country. These trigger monetary depreciation which, in turn, affect external debt to issue in the future (probably to be issued with higher interest rates) and trigger the accumulated debt through higher interest payments due to a risk premium charged by international lenders.

The implementation of a particular exchange rate regime can systematically affect the external accounts of a country, especially in times of crisis. This is because the exposure of the economy to external shocks has as one of the main vehicles the performance of their exchange rate policy, reflecting on the quality of sovereign debt.

The effects of exchange rate policy implemented in a country on the quality of its sovereign debt and its external liabilities, through its sovereign rating, is the main motivation of this thesis. There is a need to find and quantify effects that monetary and exchange rate policy has on the domestic or external credit status of the economies, notably through:

- The inherent exchange rate risk to the foreign investments, according to the volatile behaviour of the exchange rates;
- The load on the interest and principal payments with a strong devaluation of national currency;
- The central bank's reputation around the level of speculation by investors, preventing the depletion of foreign reserves, in a capital flight context. This would ultimately increase the risk premium and push the central bank to abandon the fixed exchange rate, devaluating its currency.
- The influence that the external imbalance has on the internal and external savings and hence on the need to resort to internal or external financing. The balance of government accounts is inserted at this point. The devaluation of the currency promotes exports, reduce imports but worsens the sovereign external debt service while its valuation influences those items in reverse.

This increasing tendency to have more public debt issuers triggered the emergence of credit rating agencies that beyond the case of domestic private entities, classify the quality of the government bonds to be issued and the level of default risk, through the assignment of sovereign debt ratings. The most popular agencies in this area are Moody's and S&P. Through qualitative and quantitative criteria, these agencies set their own ranking to international investors, because they prefer international rated assets and bonds. Their evaluation criteria are usually based on economic, social and political factors.

After a cooling period of the financial crisis consequences that plagued the final years of the 90 – like in Thailand (1997), Russia (1998) and Argentina (2002) - the question of default risk has recently reappeared in the spotlight. The attention turned again to the sovereign ratings downgrades by fault of the european sovereign debt crisis effects mixed with the subprime crisis ones.

Among other factors, the recent european crisis was caused by the inefficiency of its monetary and exchange rate implementation to respond to adverse and asymmetric shocks. As a result, many countries have seen their sovereign ratings to skid in a relatively short period of time. Examples cases are Ireland, Greece and Portugal, who suffered a lot of pressure from markets, mainly due to exchange rate policy followed by the ECB, which is little "friendly" when dealing with occasional cases of need for economic growth stimulating.

Hence, this work is proposed to detect how an exchange rate policy influences the external debt quality of a country measured by its sovereign debt rating. That is, it determines what kind of exchange rate regimes is favourable (or unfavourable) in terms of default risk analysis of sovereign external debt issuers. It also intends to know if that influence is maintained during distinct periods, namely: one due to a large financial crisis and another one covering a general recovery.

To empirically assess these question, this thesis is divided into seven sections, as follows, not including this present section:

- **Section 2:** A summary of the literature is provided on the determinants of sovereign ratings and its association with the exchange rate policy tools;
- **Section 3:** It compares three variants of *de facto* exchange rate regimes classification and establishes the one that will be use throughout this thesis – the IMF classification;
- **Section 4:** - The variables of the model, the data, the rating notations and their characteristics are analysed in this section. The variables are defined in three different areas: the first contains the dummies that determine each exchange rate regime, the general government debt, the current account and the level of domestic savings of the countries. The second involves the socio-political factors: corruption, political stability and government effectiveness, which are summarized in a single indicator. The third concerns the economic variables used by Afonso (2003): per capita income, GDP growth rate, inflation, level of development and

debt-to-exports ratio. Next, in a descriptive analysis, the sovereign ratings are confronted with the three exchange rate regimes - fixed, floating and intermediate - in two different periods: one of crisis (with ratings of May 2003 and covering the period 1998-2002) and another for economic recovery (with ratings of May 2008, for the period 2003-2007). The sample comprises 81 countries: 25 developed ones and 56 developing ones.

- In **Section 5**, the methodology and mechanisms are defined. Here is specified the general model that will build over the methodology of the study on rating's economic determinants, due to Afonso (2003). It is a multiple linear regression whose dependent variable is the notations of ratings numerically processed and includes nineteen regressors distributed in three groups, in addition to the constant term: Group A contains the two dummies for the fixed and intermediate exchange rate regimes (while the floating is the benchmark regime). In group B there are twelve variables combined with exchange rate regimes and levels of government debt, public accounts, external accounts, national savings, socio-political environment and history of default. Group C, is as in Afonso (2003), containing the variables listed in the summary of the previous point. Also in this section it will be defined the scales of numeric conversion of the financial ratings that will enable the usage of regression methods: linear, exponential and logistic scales.
- The estimation results are described in **Section 6**. This section has two subparts, the first one concerning the crisis period, and the second one for the period of non-crisis. The results are interesting, for both subparts: exchange rate regimes largely determine sovereign ratings. In terms of gains or losses of rating units, the floating exchange rate regime favored more the sovereign ratings in about 8 units in the period of crisis and 9 units in the non-crisis. The practice of intermediate exchange rate regime penalized more the ratings: relative to the floating exchange rate regime, it is penalized by 7 rating levels May 2003 and it is depreciated in about 11 levels in the following analysis period. However, these two schemes have performed well in the descriptive analysis of residuals, while most of over and underestimations cases are from the ratings associated with the fixed exchange rate regime. The latter, in turn, plays an intermediary role because penalizes little the rating by about 4 levels in 2003 and 7 levels in 2008, relative to the floating exchange policy. The present results are more robust from those in Afonso (2003) and the quality of estimation is improved

especially in times of crisis - 0.92 and 0.87, for the adjusted R^2 values, respectively. Economic variables, along with exchange rate regimes, continue to determine largely the sovereign ratings. The combined variables (Group B), despite their little contribution, are most notable in determining the ratings associated with intermediate exchange rate regimes. In the recovery period, they lose strength: only socio-political factors and level of default are significant with exchange rate policy in Group B.

- Finally, the general conclusions and possible extensions of future research are presented in **Section 7**.

2. Overview of Relevant Literature

The literary scene appears very vague with regard to any association between these two major issues: default level of a country's external debt (measured by its sovereign rating) and its chosen exchange rate policy. However, it is possible to indicate some studies that have addressed (and which reached interesting conclusions) the potential factors that determine the assignment of the sovereign ratings by the rating agencies, and others that relativize the monetary and exchange environments with economic risks, which involve default risks.

Most of the existing theoretical models dealing with sovereign debt and sovereign default can be divided in two main approaches. The first one raises the question as why do sovereign debtors repay their debt, since, if they default, the lender may not have recourse to a bankruptcy code or to a legal procedure to enforce payment. Eaton and Gersovitz (1981) suggested that the willingness to maintain a good reputation and to preserve future access to credit markets constitutes an incentive for countries to repay their debt. The rationale behind this result is that a country decides to honour its debt obligation if the future cost of unavailable loans is greater than the short-term benefit of higher consumption.

On the other hand, Bulow and Rogoff (1989b) showed that, under general conditions, a small country (price taker) will decide to default if cash-in-advance contracts allow it to hedge future stochastic output and lending. Lending to small countries is made possible if additional economic, political and legal sanctions are imposed. A country rarely makes an outright default but, rather, renegotiates its original debt. Bulow and Rogoff (1989a) developed a model, based on the threat of future sanctions, in which the rescheduling of (or default on) a country's debt results from a bargaining game between creditors and the borrower. The choice made by the latter is based on an assessment of the costs and benefits of rescheduling or defaulting.

Since countries have not only domestic debt but also foreign denominated debt, the question raised above can be specified in the following manner: Why do countries pay their foreign currency debt? Kremer and Mehta (2000) argued that the more a government is indebted to foreigners the more it is incited to default. Indeed, foreign currency sovereign ratings are generally lower than domestic ratings (see, for instance, Trevino and Thomas, 2001).

However, countries may be inclined to pay their external debt for three main reasons. First, foreign creditors may seize the foreign assets (if any) if a country reneges on its debt. Second, a country may not have access to future foreign loans. Finally, default on external debt may have a negative impact on international trade (see, for example, Gibson and Sundaresan, 2001 and Rose, 2002).

Under this approach, a country trades off the costs and benefits of making debt payments or of defaulting on debt (Haque et al., 1996). The probability of default is thus an increasing function of variables inciting a country to default and it is a decreasing function of variables raising the cost of default. Sovereign credit ratings are inversely proportional to the default probability. The main economic variables considered in the literature are: per capita income, gross domestic product (GDP) growth, inflation rate, level of economic development, ratio of foreign debt to GDP, real exchange rate, and default history.

The second theoretical approach to sovereign default risk is described by Haque et al. (1996) as the debt-servicing capacity approach. In this approach, it is the unintended deterioration of the country's capacity to service its debt that could cause its default. Countries may be unable to repay their internal or external debt because they are either insolvent or illiquid. The sustainability of a debt, as a result of short-term liquidity or of long-term solvency, is likely to determine the probability of default. Sustainability may be affected, for example, by macroeconomic variables, economic policy, currency crises, short-term budget mismanagement or by internal/external shocks. The sovereign crises which occurred in recent years (South Korea, Brazil, Turkey, Russia, Ecuador, Argentina) and European debt crisis (that started in Greece, in 2010) illustrate debt-servicing difficulties, ranging from debt rescheduling to outright default that a country may face. A country may be illiquid, while being solvent if creditors decide not to reschedule/restructure short-term debts. On the other hand, excessive long-term debt may be associated with an insolvency situation. In some cases, outright default has been avoided by the intervention of the international financial institutions. However, as discussed by Roubini (2001), though it is not easy, in practice, to differentiate solvency from liquidity, several indicators allow to asses a country's sustainability.

Since agencies have recently begun to rate a large number of countries, few empirical studies examine the determinants of the sovereign credit ratings. Early examples of this literature are Feder and Uy (1985), Cosset and Roy (1991) and Lee (1993) who analysed ordinal rankings of sovereign

risk based on data provided by two international publications: Euromoney and/or Institutional Investor. The empirical evidence provided by Haque et al. (1996) indicated that the economic variables could explain a large part of the variations of the country creditworthiness ratings produced by these two magazines and the Economic Intelligence Unit. In a subsequent paper, Haque et al. (1998) found that, in accordance with Lee (1993), economic variables have more influence than political variables on sovereign ratings.

The reference paper of Cantor and Packer (1996), based on a sample including industrialized and developing countries in September 1995, suggested that among the plethora of the criteria used by Moody's and S&P, six variables are likely to explain the ratings: per capita income, GDP growth, inflation, external debt, level of economic development and default history.

Using the same methodology as Cantor and Packer, and for June 2001 data, Afonso (2003) concluded that while GDP per capita is the sole relevant variable in explaining the determinants of ratings of developed countries, external debt plays a key role for developing countries.

The study developed by Cantor and Packer was replicated by Jüttner and McCarthy (2000) for the period 1996 to 1998. The explanatory power of the Cantor and Parker model deteriorates in 1997 due to the financial crisis of the emerging markets (Thailand, Russia and Brazil, for example). Their results reveal that this relation is not stable over time.

Monfort and Mulder (2000), with a sample of twenty emerging market economies for the period 1994-1999 - which includes the Asian economic crisis of 1997 – confirmed these results and found that estimation errors display autocorrelation. Moreover, by testing a dynamic error correction, they suggested that the ratings exhibit a high degree of inertia and seem to follow a random walk (i.e., they react only to unexpected innovations in variables). However, some lagged variables (debt over exports and export growth) appear to contribute to current ratings.

Mulder and Perrelli (2001) used a panel of twenty five countries, including the emerging market economies, for the period 1992-1999. Empirical evidence shows that a static equation of six economic variables, in accordance with other studies, appears to explain a large part of the variations in ratings. Nonetheless, since their sample did not include industrialized countries, a major difference relative to other studies is that the key variable explaining ratings is the ratio of investment to GDP and not

variables such as per capita income, GDP growth and inflation. Moreover, the Asian crisis led some rating agencies to amend their methodologies in order to attach a greater importance to liquidity risk, which can be measured by the ratio of short term external debt to reserves.

On the another hand, the choice and practice of a particular type of exchange rate regime can affect, in general and to a large extent, the economic state of a country. The success (or not) of the exchange regime choice may be based on several factors such as external exposure of the country, free movement of capital, internal performance of the economy, the central bank's reputation, political and social environment, among other.

However, an inappropriate position of exchange rate policy can strongly amplify the effects of external shocks during a period of contagion. Typically, most countries have changed their currency strategy, just after periods of experienced panic. The following comparison will help to clarify this idea:

“Still, to me the truly fascinating thing about exchange rate regimes is that … they’re fascinating. They really shouldn’t be. My best friend likes tea, while I prefer coffee. While this seems immaterial, one could, in principle, figure out the reasons for our preferences, and how they affect our lives.” (Rose, 2011:22).

None of the above studies Mentioned Refers to this matter in the determination of sovereign ratings. Afonso (2003) Considered only Economic variables and the level of default. It did not take into account the levels of domestic savings and external, the vasopressin combinations of variables for different contexts of analysis and, especially, did not resort to exchange policy information to explain the assignment of ratings by Moody's and S&P. And it happened also in the subsequent studies Involving the same subject. So, from here we find the main motivation for our thesis: to find and quantify the direct effect of exchange rate regimes on sovereign ratings, as well as their combined effects with other important variables.

Complementing that idea, we present some studies that focused on exchange rate regimes in different contexts.

Regarding the importance of exchange rate practice in limiting the misalignment, Dubas (2009) concludes that, using a panel cointegration vector estimator, among the three exchange rate regimes,

the intermediate exchange rate regime is the most efficient mean to combat misalignment, especially in emerging countries. However, the practice of exchange rate policy is not as important to prevent misalignment in developing countries.

Using the Balassa-Samuelson effect, Andres and al. (1996) presented a scenario based on inflation and long-term growth. They showed that inflation and growth are positively correlated in economies with pegged currencies, that is, they found evidence that the costs of inflation on long-term growth were underestimated in samples that included countries and periods with fixed exchange rate regimes.

Edwards (2000) suggested that, under the appropriate conditions and policies, floating exchange rates can be effective and efficient. Much of the criticism of floating rates in the emerging economies seems to be based on a small number of historical episodes, or has misread the difficulties associated with super-fixed systems.

In a context of fixed exchange rate regimes, converted into a monetary union, Adão and al. (2006) concluded that only the immobility of labor would be relevant for stabilization policy. Drabek (1998), in the same framework, relates exchange rate policy with the foreign trade policy. By analyzing the state on external trade for six transition economies, they concluded that in all these economies, the rate of protection afforded domestic industry by the exchange rate has been eroded by high rates of inflation and insufficient growth in productivity. As a result, there has been pressure on governments to increase trade barriers and each country examined has had recourse to various means of restricting imports. He finally concluded that a flexible management of the nominal exchange rate would be a preferable way of dealing with the real appreciation of these countries' currencies.

Given these, this thesis will seek to better understand about potential evidence of the influence of the exchange rate regime followed by a country on its sovereign rating. Also it will seek to answer the question of whether this influence is maintained by changing economic and financial characteristics of that country (crisis period versus recovery period).

3. De facto classifications of exchange rate regimes

Regarding over exchange rate policy classification, we will use the *de facto* way, i.e., the classification of exchange rate policy that is really practiced by a country which may be different (or not) from its *de jure* classification (officially indicated). For this, we will present three distinct typologies for *de facto* exchange rate regime classification but with similar conclusions.

3.1. IMF *de facto* classification of exchange rate regimes.

Formulated in 2001 and revised in 2006, this classification combines exchange rate regimes practiced in three major areas[1]:

- **Hard peg regimes -** these regimes are characterized by fixing exchange rate against a stronger and more stable currency. Its maintenance is due to an active direct intervention by monetary authorities in the foreign exchange market, thus losing the resource of a monetary policy instrument (nominal interest rate). Examples: Eurozone members, WAEMU members, Cape Verde, Argentina (1998), Hong Kong, China.
- **Intermediate Regimes (Soft pegs and managed float)** - exchange rate floats but its movements is controlled. The monetary authorities work directly and indirectly in the exchange market. Examples: Argentina (after 2002 crisis), Taiwan, Russia (2006).
- **Independent floating regimes** - exchange rate floats freely, without any intervention of the policymakers. Its value is simply determined by the market itself. Examples: Australia, USA, UK, Japan, Canada, Russia (2001).

3.2. Exchange Policy Classification based in "foreign exchange flexibility"

For classifying the exchange rate regime practiced by each country, Guillermo and Reinhart (2002) built an index of foreign exchange flexibility based in the variances of exchange rate (σ_{ϵ}^2), nominal interest rate (σ_{i}^2) and foreign reserves (σ_{F}^2):

$$\gamma = \frac{\sigma_{\epsilon}^2}{\sigma_{i}^2 + \sigma_{F}^2}, \gamma \in [0, 1]$$

[1] See annexes I.a and I.b

Although they did not presented threshold values in their analysis, the classification is determining by the index value:

- Values close to 0 – the country follows a fixed regime or an inflation-target associated regime.
- Values close to 1 - it follows a floating regime.
- Intermediate values - the country is experiencing the phenomenon of "fear of floating" (denominated by the authors). It follows an intermediate regime (soft peg or managed float).

3.3. Exchange Policy Classification based in "volatile behaviour" of relevant variables.

Levy-Yeyati and Sturzenegger (2002), by using a cluster analysis of 183 countries, considered that the *de facto* exchange policy of a country depends on the volatile behaviour of the exchange rate (σ_ϵ), its rate of change ($\sigma_{\Delta\epsilon}$) and the foreign exchange reserves level, like is shown in Table 2.1:

Regime Classification	σ_ϵ	$\sigma_{\Delta\in}$	σ_F
Inconclusive	Low	Low	Low
Flexible	High	High	Low
Dirty Float	High	High	High
Crawling Peg	High	Low	High
Fixed	Low	Low	High

Table 2.1 - A de facto classification of exchange rate regimes, proposed by Levy-Yeyati and Sturzenegger (2002)

Given the methodological outlook to be followed during this thesis, namely annual or annual-average cross-section data, with various estimates made by period and by numerical scale conversion, it will be adopted only one of the three presented classifications. In fact, the non-availability of monthly exchange rates values, for most of the currencies of the sample countries, prevents the analysis based on the classification suggested by Guillermo and Reinhart (2002) as well as the cluster analysis developed by Levy-Yeyati and Sturzenegger (2002).

Despite the existence of annual data for the exchange rates, they do not reflect the "intermediate pathways" of its movements and, on the other hand, the difference between starting and closing values of the year is very small, making it difficult to the analysis in the context of floating or intermediate arrangements.

Hence, it will be adopted the classification established by the IMF in 2001 and revised in 2006, throughout this work. The choice of those years is related to the years that the IMF classification was introduced (2001) and revised (2006) and with their short distance in relation to the reference periods, May 2003 and May 2008, in just over a year.

4. Data, variables and their descriptive statistics

Beyond the definition of the dependent and independent variables, this section presents some statistical properties between sovereign debt ratings and exchange rate regime choice in both periods considered in the analysis, and for developed and developing countries.

4.1. Data, dependent and independent variables

The data used in this work includes:

- The sovereign debt ratings of 81 countries (dependent variable) on May 31, 2003 (for the period of crisis) and on May 31, 2008 (for the period of recovery), assigned by both Moody's and S&P[2];
- The classification of each country's exchange rate policy, given by the IMF in December 2001 (for the analysis of the crisis period) and December 2006 (for the study of the effects in the recovery period);
- The economic variables, social and political indicator and history of default, which some of them are measured as average values of the last three years and others represent only the value obtained in the immediately preceding reference period, as described in Table 3.1

Variables for exchange rate policy, government debt, domestic and foreign savings			
Variable	**Designation**	**Unit**	**Source**
FLOAT	1 – Floating exchange rate regime (for IMF), 0 – otherwise	Binary (0-1)	IMF (2001 and 2006)
FIX	1 – Fixed exchange rate regime (for IMF), 0 – otherwise	Binary (0-1)	IMF (2001 and 2006)
INTERM	1 – Intermediate exchange rate regime (IMF), 0 – otherwise	Binary (0-1)	IMF (2001 and 2006)
GOVDEB	Government's total debt/GDP (value of the last year)	Percent	Moody's
CURBAL	Current balance-to-gdp ratio, average of the last 3 years.	Percent	Moody's
DSAV	Domestic savings-to-gdp ratio, average of the last 3 years	Percent	Moody's

[2] See Annexes II.a and II.b.

Information on political and social environment			
POLSOC	Average of 3 indicators (Corruption, Political Stability and Gov. Effectiveness, 2002 and 2007)	Per cent	World Bank
Economic and default information [used by Afonso (2003)]			
DEVELOP	1 – Developed country, 0 – Developing country	Binary (0-1)	IMF
DEFAULT	1 – with default since 1975, 0 – without default	Binary (0-1)	S&P
FISCAL	Budget balance-to-gdp ratio, average of the last 3 years	Per cent	Moody's
GDPPC	Per capita GDP, values for 2002 and 2007	US$ thousand	Moody's
GDPGR	Real GDP growth, average of the last 3 years.	Per cent	Moody's
INFL	Inflation rate, average of the last 3 years.	Per cent	Moody's
DEBTX	Debt-to-exports ratio, 2002 e 2007 (developing countries)	Per cent	Moody's

Table 3.1 - Explanatory variables are grouped into three broad areas

The financial notations assigned by the two main agencies, as well as their characterization are described in Table 3.2.

The blue part concerns the investment grade ratings and the red part refers to the non-investment grade ratings. As one moves down the scale, the degree of speculation will increase as the investment risk and the probability of default.

Credit quality	Moody's/S&P notation	Debt and issuer characterization
Prime	Aaa/AAA	Bonds that are judged to be of the best quality. They the smallest degree of investment risk and are generally referred to as "gilt edged". Interest payments are protected by a large or by an exceptionally stable margin, and principal is secure.
High Grade	Aa1/AA+	Bonds that are judged to be of high quality by all standards. They are rated lower than the Aaa bonds because margins of protection may not be as large.
	Aa2/AA	
	Aa3/AA-	
Upper-medium-grade	A1/A+	Bonds that possess many favourable investment attributes. Factors giving security to principal and interest are considered adequate, but elements may be present that suggest a susceptibility to impairment any time in the future.
	A2/A	
	A3/A-	
Lower-medium-grade	Baa1/BBB+	Interest payments and principal security appear adequate for the present, but certain protective elements may be lacking or may be characteristically unreliable over any great length of time.
	Baa2/BBB	
	Baa3/BBB-	
Speculative grade	Ba1/BB+	Bonds that are judged to have speculative elements; their future cannot be considered well secured. The protection of interest and principal payments may be very moderate and thereby not well safeguarded during either good or bad times.
	Ba2/BB	
Highly-speculative grade	Ba3/BB-	Bonds that generally lack characteristics of a desirable investment. Assurance of interest and principal payments or of maintenance of other terms of the contract over any long period of time may be small.
	B1/B+	
	B2/B	
	B3/B-	
Substantial Risks	Caa1/CCC+	Bonds that are of poor standing. Such issues may be present elements of danger with respect to principal or interest payments
	Caa2/CCC	
	Caa3/CCC-	
	--- /CC	
	--- /C	
	Ca/SD	
Default	C/D	Bonds that may be in default level. The interest and capital payments assurance are inexistent/not granted.

Table 3. 2 - Moody's and S&P Rating Systems [Sources: Moody's, S&P and details extracted from Afonso (2003:57)]

4.2. Statistical properties about countries, exchange rate policy and sovereign ratings data

The variables presented above relate to data obtaining for 81 countries, 25 of them ranked as developed countries and 56 of them as developing or emerging countries, according to the classification used by the IMF. Next, we will present some statistical properties for each group of countries.

4.2.1. Sovereign Debt Ratings and Developed Countries

Twenty-five developed countries are selected: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom (UK) and United States of America (USA).

In relation to their sovereign ratings assigned by Moody's, all fall on the investment-grade scale, both in May 2003 and in May 2008. As shown in Figure 3.1, in 2003, 23 of them held the rating of not less than Aa3 (high grade or prime grade) and only two had an upper-medium assessment of their debt (Greece, Hong Kong). In 2008 the landscape has essentially remained, with only one slight change – Hong Kong is evaluated with high grade, maintaining the same position of Greece. In both periods, no country has been evaluated with a lower-medium level, i.e., with notations Baa1, Baa2 or Baa3 which are the lowest ratings of the investment-grade scale.

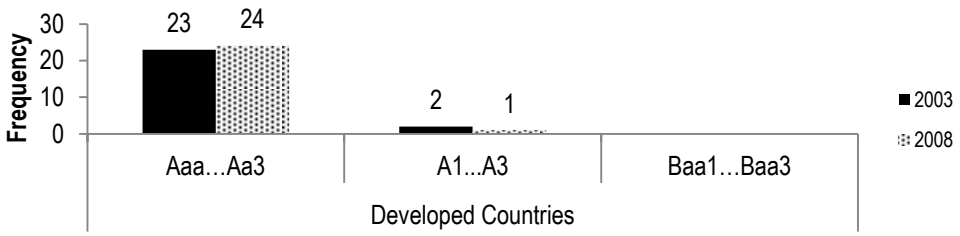

Figure 3.1 - Ratings of developed countries (source: Bloomberg)

4.2.2. Sovereign Debt Ratings and Emerging Countries

Fifty-six emerging and countries are chosen, representing all continents:

- Africa: Botswana, Egypt, Morocco, South Africa, Tunisia
- Central America: Barbados, Belize, Costa Rica, Dominican Republic, El Salvador, Jamaica, Mexico, Panama, Trinidad, Tobago.
- South America: Argentina, Bolivia, Brazil, Chile, Colombia, Paraguay, Peru, Suriname, Uruguay, Venezuela.
- East and Central Europe: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Russia, Slovakia, Slovenia, Turkey.
- Middle East: Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia.
- Asia and Oceania: China, India, Kazakhstan, South Korea, Malaysia, Mongolia, Pakistan, Papua New Guinea, Philippines, Taiwan, Thailand,

This group of countries is richer in terms of sovereign ratings distribution, assigned by Moody's, and of exchange rate policy classification, assigned by IMF, as shown in Figure 3.2.

In 2003, for the crisis period, 52% of these countries had an investment-grade rating, of which 14 held an upper-medium-grade and 13 of them had a lower-medium-grade. In the upper-medium-grade side stood out the cases of China, Czech Republic, Hungary, Israel, Korea, Poland, Qatar and Slovakia. In the lower-average level it can be highlighted the cases of Chile, Mexico, Oman, South Africa, Tunisia, Saudi Arabia and Thailand, the latter two bearing the lowest investment-grade rating (Baa3). In this subgroup of countries, only Slovenia and Taiwan deserved to be in high-investment grade rating (Aa3).

The remaining 27 emerging countries had a non-investment grade rating, divided into speculative grade (41%) and a grade associated to highly speculative/substantial risks (59%). In the first side stood out the cases of Colombia, Egypt, India, Jordan, Morocco, Panama, Philippines and Russia. In the second division are the cases of Argentina, Brazil, Romania, Turkey, Uruguay and Venezuela. Argentina boasted the worst evaluation, with the notation of Ca (one step from C - level of default), derived from the crisis recently experienced in the country, with contagion to Uruguay, Paraguay, Brazil and Venezuela (B3, Caa1, B2, Caa1, respectively). The effects of the turkish crisis of 2001

(Turkey - B1) and the Russian crisis of 1998 (with contagion effects in Romania - B2) are mirrored in this division.

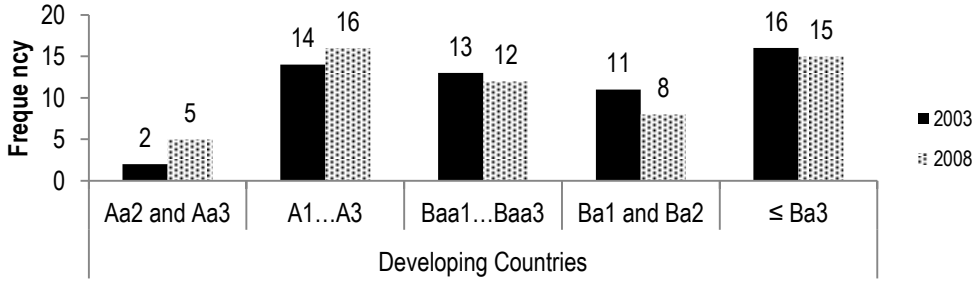

Figure 3.2 - Ratings of developing countries (source: Bloomberg)

In 2008, for the period of recovery, the number of countries with investment grade increased by 7%. Most countries saw its ratings improved, with an average increase of one notation. The most striking cases are those of Saudi Arabia (+5 ratings), Qatar (+4 ratings), Kuwait, Malaysia and Oman (+3 ratings). China, Chile and Thailand see their assessment improved by two notations. This time, Cyprus, Kuwait, Qatar, Slovenia (both with improved assessment) and Taiwan (with maintained assessment) are presented in high grade investment. The upper-medium-grade counts on Chile, Malaysia, Oman and Saudi Arabia that once held a lower-medium-grade of investment. India, Russia and Romania leave the non-investment grade, receiving the ratings of Baa3 and Baa2. Of the three, the biggest jump was recorded by Romania, which changed from B2 level (highly speculative) in 2003 to Baa3 in 2008, an increase of 5 notations.

4.2.3. Exchange rate policy and sovereign debt ratings versus level of development.

For the exchange rate policy classification of the 81 sample countries, Figure 3.3 illustrates the following scenario:

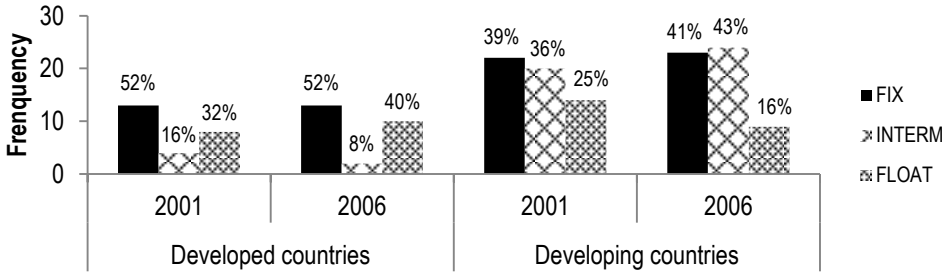

Figure 3.3 - Exchange rate regimes practiced by level of development (source: IMF)

The fixed and floating regimes were prevailing among developed countries and represented respectively 52% and 32% of the countries in 2001 and 52% and 40% of them in 2006. Group of countries with fixed exchange rates stand out all members of the Eurozone (2001 and 2006) and Hong Kong. Euro and dollar are the currencies-anchor of this subgroup.

The floating regime is commonly practiced in Australia, Canada, Japan, New Zealand, Sweden, Switzerland, UK and USA, in both periods. The subgroup of intermediate exchange rate regime is minor for advanced countries. In 2001, this type of exchange rate regime was representative in Denmark and Iceland (exchange rate bands in accordance with the euro movements) but also in Norway and Singapore (both with managed float). However, in 2006, Denmark and Singapore maintained their exchange rate policy, while the currencies of Iceland and Norway began to float freely.

In the group of emerging countries, fixed and intermediate regimes prevailed in both periods. In 2001, 75% of these 56 countries practiced a *de facto* fixed or intermediate exchange rate policy, the latter being carried out mostly by crawling bands or managed float systems. They are usual in countries that have experienced strong financial crises or that have a critical history of inflation and/or currency over-devaluation, so that it influences the movements of its exchange rate through active intervention of monetary authorities in foreign exchange market.

In 2006, the weight of the floating exchange rate policy within the emerging markets fell 16%, continuing to represent the minority case. The intermediate exchange rate regime becomes the

majority system, with the "entry" of new countries in the group devastated by financial crises of the late 90s and their contagion effects (e.g. Argentina, Malaysia, Paraguay, Papua New Guinea, Thailand). On the other hand, some countries like Tunisia, Egypt and Venezuela started to follow a policy of fixed character rather than the intermediate one, in 2006.

Figure 3.4 relates the updates of the ratings (stable, upgrade and downgrade) from May 2003 to May 2008, to the changes of exchange rate regime (maintenance or change), from 2001 to 2006, by the development level.

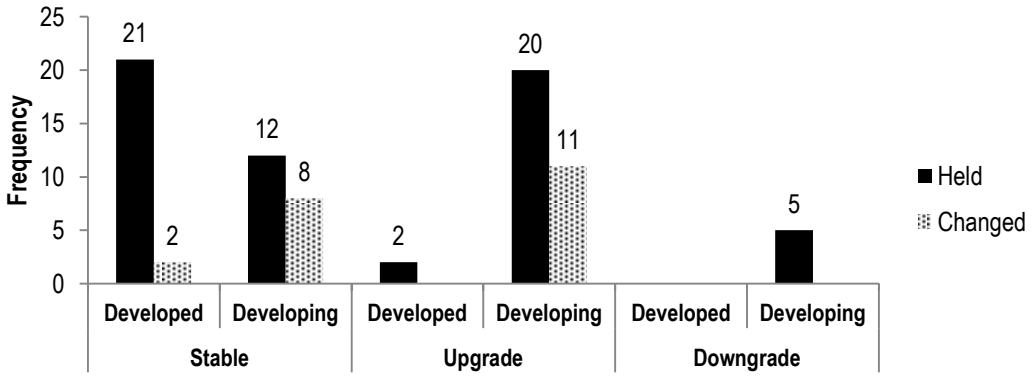

Figure 3.4 - Change in ratings versus change in practice of exchange rate policy, by level of development (sources: Bloomberg and IMF)

According to the 2006 exchange rate policy classification, 60 countries have maintained the exchange rate policy that they practiced in 2001, while 21 of them have chosen to change their exchange rate regime.

Of those that held their exchange policy, 38% are developed. Subsequently, 21 of them maintained their sovereign rating assigned by Moody's in May 2003 and only two saw their ratings to be improved in May 2008. These are the cases of Hong Kong, which went from A1 (upper medium grade) to Aa2 (high grade), and Japan that rose a position of Aa1 (high grade) to the maximum rating (Aaa). As for the emerging markets, most saw its rating improved in May 2008 (20 countries), although this group has recorded five worsening sovereign ratings: Belize (lost 4 notations), Dominican Republic and Philippines (lost three notations), Hungary and Lebanon (both cut one-notation).

In the group of 21 countries that have changed their exchange rate policy, about 90% are emerging countries. In this group, Iceland and Norway are the only represented advanced countries, changing

the intermediate system (2001) to the float system (2006), as mentioned above. However, both saw their sovereign rating unchanged (Aaa) from 2003 to 2008. Of the remaining 19 emerging countries, eight of them have replaced floating regime by intermediate regime (most significant cases of Russia, India, Thailand and Taiwan), five of them left intermediate regime and have begun to fix/to anchor their exchange rate (eg Egypt, Israel , Pakistan and Venezuela). Israel and South Africa have allowed their currencies floating freely, abandoning intermediate regime. On the other hand, brazilian real has begun to float freely (previously anchored to the dollar), while currencies of Argentina, Botswana and Malaysia have begun to fluctuate with limitations.

None of the countries, which have changed their exchange rate policy, saw its rating worsened in May 2008. Subsequently, Moody's didn't change the sovereign rating of 8 countries and gave a better rating to the other 11, compared with the scene in May 2003. The case of Brazil is highlighted here with the greatest number of ascents (gained 4 notations), from B2 (highly speculative grade) to Ba1 (speculative grade, the highest level of non-investment scale). The cases of Malaysia (from Baa1 to A1) and Russia (from Ba2 to Baa2) followed it.

In summary we may already conclude that:

- The higher the level of development of a country, the better the quality of its sovereign debt and of its foreign investments, so the better its sovereign rating;
- In general, countries with higher levels of sovereign debt prefer to pratice fixed and floating exchange rate regimes. In this case, these fixed exchange rate regimes take the form of monetary union (eg Eurozone)[3];
- The intermediate exchange rate regime is preferable within the emerging countries, ie, within countries with low levels of sovereign ratings. The fixed exchange rate regime is also widely practiced by this group of countries, but taking the form of currency board peg or conventional[3];
- In a post-crisis period, emerging countries (with lower rating levels) have a tendency to replace the extreme exchange rate regimes (fixed and floating) for intermediate exchange rate regimes, especially in the form of managed float.

[3] See Annexes I.a, I.b, II.a and II.b.

5. Methodology: Model and technical tools.

In this section we present the methodology to be followed throughout this thesis. Basically, a multivariate regression will be used where statistical significance of parameters, quality and explanatory power will be extracted. In particular, such regression and its special features will be reviewed in three different scenarios. Each scenario is associated with a numerical transformation of ratings notations, namely a linear, an exponential and a logistic one.

Note that the methodology of this study is based the one used by Cantor and Packer (1996) and, above all, by Afonso (2003), whose articles look into the determinants of sovereign ratings in relation to long-term debt.

5.1. The Starting Point

Cantor and Packer (1996) wanted to get a relationship between sovereign ratings and the overall economic environment, given by Moody's and S&P (September 1995 data) for 49 countries. They focused on the impact of eight variables: per capita income, GDP growth, inflation, external debt, indicator for economic development, indicator for default history, fiscal balance and external balance. Only the latter two showed weak explanatory power. This was justified by the authors by the "endogeneity" of fiscal policy and international capital flows on the structure of some countries, contradicting the economic development theory: developing countries with fiscal and external surpluses and developed countries with deficits. However, there was obtained very good estimation quality (adjusted R-squared ≈ 0.91) for both agencies. Only the linear scale was used to convert the range of equivalence for the two agencies systems. However, they didn't consider the situation of countries in default level and, mainly, information about exchange rate policy.

Without resorting to information from the external balance of the countries, and based on the ratings of June 2001 (Moody's and S&P) and on data from 81 countries (29 developed and 52 developing), Afonso (2003) confirmed once again the fragility of the budget balance in determining the ratings of countries and the great statistical significance of the remaining six variables: per capita income, GDP growth, inflation, external debt, level of economic development and default history. He also concluded that per capita income is what most influences the determination of long-term sovereign ratings of most developed economies. As for the external debt, in addition to other variables, it is basically

important for developing countries in determining their ratings. By using three numerical scales - linear, exponential and logistic – he found evidence that the logistic case presented a lower average error percentage, relative to the other, thus making it the ideal transformation. The adjusted R^2 indicated a good quality in both estimates at around 0.85.

He defined the model as follows, with u_i as the error term:

$$RATING_i = \alpha_0 + \alpha_1 GDPPC_i + \alpha_2 GDPGR_i + \alpha_3 INFL_i + \alpha_4 DEVELOP_i + \alpha_5 DEBTX_i + \alpha_6 FISCAL_i + u_i \quad (1)$$

Each variable was defined according to the description on Table 3.1, based on the year 2001. FISCAL was the sole not statistically significant variable for the model, so it was not considered in the next analysis.

In the present work, in addition to evaluate statistically the role that the choice of exchange rate regime plays in sovereign ratings, we intend to make a comparison of the effects between two distinct periods: a generalized critical period (1998-2002) and other broad-based recovery (2003-2007). The methodology to use is much similar to the Afonso (2003) one, based on a multivariate regression model applied to each of the three numerical transformations of ratings. It's possible to obtain about 12 different estimates - three numerical transformations for each period and for each agency. Since it could be considered an overhead of estimates, plots and tables, we chose to use sovereign ratings for only one assigned agency. The issue is: Moody's or S&P?

In Afonso (2003), he applied a pooled regression in order to study the similarity (or not) of the methods used by both Moody's and S&P, referring to the use of economic variables in the assignment of sovereign ratings. Basically, both agencies looked for to economic variables in the same way, according to the test applied. He found that, in September 2001, the correlation coefficient between the ratings of the two agencies was 0.9878, which is considered almost perfect. Thus, it's good to say that is indifferent to use data of one or the other agency because both results were much similar.

We decided start replicating the previous methodology, based on a pooled regression, by using the equation (1) for two different periods: May 2003 and May 2008. We will use the linear transformation of ratings to obtain two estimates, one for each period, pooling the ratings of the two agencies. To justify the statistical similarity (or not) over agencies, a dummy variable was inserted into the model (1

- for Moody's ratings, 0 - otherwise). The statistical significance of its parameter will dictate the choice (or not) of only one of the ratings agencies. The results presented in Table 4.1 may assist in this choice.

Variable (Code)	May 2003	May 2008
Constant	8.911663**	9.523319**
	(13.90)	*(12.38)*
MOODYS	0.407407	0.024691
	(1.23)	*(0.06)*
GDPPC	0.141178**	0.098268**
	(5.48)	*(6.22)*
GDPGR	0.193135**	0.336874**
	(2.55)	*(3.09)*
INFL	-0.114231**	-0.430915**
	(-4.94)	*(-5.39)*
DEVELOP	3.056723**	2.216702**
	(4.83)	*(2.57)*
DEBTX	-0.019016**	-0.024691**
	(-6.95)	*(-3.08)*
Adj. R^2	0.8319	0.7118
Nº of Obs.	162	162

** P-value equal to or less than 5 percent

Italic T-statistics

Table 4.1 - Results for the replica of Afonso (2003) methodology, with data for crisis period and recovery

For both periods, all parameters are statistically significant for the model, at a level below 5 percent, with the exception of the parameter relating to Moody's. This is not statistically significant in both periods, being more expressive in May 2008. It follows that there are similarities in the methodology used in both agencies. To reinforce this conclusion, we calculated the correlation coefficients between the ratings of the two agencies for both periods: 0.9744 (May 2003) and 0.9716 (May 2008). For the sake of consistency with the source of most data that support this study, the choice will fall on sovereign debt ratings assigned by Moody's (in May 2003 and May 2008).

Although the samples are different, the slight deterioration in the value of the adjusted-R^2 is evident from study to study, using the same methodology: Cantor and Packer (1996) – 0.924 (with the average calcuted from the ratings of the two agencies), Afonso (2003) - 0.8702 (in the pooled regression) and in this study - 0.8319 (May 2003) and 0.7118 (May 2008). It seems that we need to improve the methodology, focusing on a possible contribution of the exchange rate policy.

5.2. General Model

The general model to estimate is as follows:

$$RATING_i^{(j)} = \alpha_0 + \underbrace{\alpha_1 FIX_i^{(j)} + \alpha_2 INT_i^{(j)}}_{A} + \underbrace{\sum_{k=3}^{14} \alpha_k COMB_{i,k-2}^{(j)}}_{B} + \underbrace{\sum_{k=15}^{19} \alpha_k ECONOMIC_{i,k-14}^{(j)}}_{C} + v_i^{(j)} \quad (2)$$

The dependent variable, $RATING_i^{(j)}$, is the rating given to the long-term sovereign debt of country i, assigned by Moody's, in period j, transformed numerically, depending on three different scales (linear, logistic and exponential). The j-periods are two: May 2003 (2001 for the exchange rate policy), for the analysis of a crisis, and May 2008 (2006 for the exchange rate policy), for a period of recovery. $v_i^{(j)}$ corresponds to the error term of country i, in period j.

Regarding the independent variables, we consider three main components: A, B and C.

Part A, which is the major contribution of this thesis in the literature, concerns to the information on the country's currency policy choice, i.e., comprises two dummies - one following a fixed exchange rate policy and another for the case of an intermediate policy. Floating exchange rate policy is considered as "baseline", to eliminate the issue of perfect collinearity. Assuming everything else remains constant, one reads:

- $\widehat{\alpha_0}$ – the contribution of a floating exchange rate policy on sovereign rating[4];
- $\widehat{\alpha_1}$ – concerns the contribution to the sovereign rating, when it follows a fixed exchange rate policy[4], relative to the float exchange rate regime.
- $\widehat{\alpha_2}$ – the contribution of an intermediate exchange rate policy on sovereign debt rating of long-term[4], relative to the float exchange rate regime.

Part B includes a set of cross-combination variables, by associating indicators of public finances, internal and external savings and economic-political-social environment with the exchange rate policy context in which the economy operates. There are twelve combinations of variables, which are listed in Table 4.2 and whose objectives are to strengthen the study of the effects of the exchange rate policy choice effects on the determination of a sovereign rating, based on different contexts (see Table

[4] In terms of losses or gains of rating units.

3.1 for definitions). Since the combinations at the level of exchange rate policy are based on fixed and intermediate regimes, the interpretation of estimates $\widehat{\alpha_3}$, $\widehat{\alpha_4}$,…, $\widehat{\alpha_{14}}$ is similar to those at Part A.

Code	Designation	Purpose
FIX_GOVD_BAL	(1-DEVELOP)*GOVDEB*CURBAL*FIX	Combination of exchange rate policy with the level of government debt and external balance (developing countries)
INT_GOVD_BAL	(1-DEVELOP)*GOVDEB*CURBAL*INTERM	
FIX_GOVD_GR	GOVDEB*GDPGR*FIX	Examining the effects of exchange rate policy associated with the level of government debt (in an environment of economic growth).
INT_GOVD_GR	GOVDEB*GDPGR*INTERM	
FIX_DEV_SAVING	DEVELOP*FISCAL*DSAV*FIX	Examining the effects of the combination of exchange rate policy with the level of development and the level of domestic savings (government and non-government).
FIX_DPING_SAVING	(1-DEVELOP)*FISCAL*DSAV*FIX	
INT_DEV_SAVING	DEVELOP*FISCAL*DSAV*INTERM	
INT_DPING_SAVING	(1-DEVELOP)*FISCAL*DSAV*INTERM	
FIX_POLSOC	FIX*POLSOC	Combination of exchange rate regimes and social and political factors.
INT_POLSOC	INTERM*POLSOC	
FIX_DEF	DEFAULT*FIX	Effects from the association of exchange rate policy with history of default
INT_DEF	DEFAULT*INTERM	

Table 4.2 - Cross-combinations variables included in Group B

The part C is exactly a replica of the model used in Afonso (2003) i.e., the variables that were used to study the economic determinants of sovereign ratings. It includes the variable DEBTX (as he also did another version of the model with the inclusion of the variable DEFAULT) and four economic variables that showed statistical significance in his model. Those are: GDPPC, GDPGR, INFL and DEVELOP and are established in accordance with the description given above (see Table 3.1). Their marginal contributions in determining sovereign ratings are given by the respective parameters.

5.3. Numerical Scales

The transformation of rating notations on a numerical scale is necessary to include them in the model. In this thesis we consider three different numerical scales. The aim is to obtain the best performing scale in terms of adjustment quality. This analysis will be based on indicators of deviations/errors, using the adjusted-R^2 value, the calculation of the mean absolute percentage error (MAPE), the preparation of dispersion graphs and tables with comparative information.

The equivalence between rating scales, suggested by Bhatia (2002), and the numerical scales are shown in Table 4.3.

Credit quality	Moody's/S&P notation	Linear Scale	Exponential Scale	Logistic Scale
Prime	Aaa/AAA	17	23.35	3.479
High Grade	Aa1/AA+	16	20.15	2.335
	Aa2/AA	15	17.39	1.758
	Aa3/AA-	14	15.00	1.350
Upper-medium-grade	A1/A+	13	12.95	1.022
	A2/A	12	11.17	0.738
	A3/A-	11	9.64	0.480
Lower-medium-grade	Baa1/BBB+	10	8.32	0.236
	Baa2/BBB	9	7.18	0.000
	Baa3/BBB-	8	6.19	-0.236
Speculative grade	Ba1/BB+	7	5.34	-0.480
	Ba2/BB	6	4.61	-0.738
Highly-speculative-grade	Ba3/BB-	5	3.98	-1.022
	B1/B+	4	3.43	-1.350
	B2/B	3	2.96	-1.758
	B3/B-	2	2.56	-2.335
Substantial Risks	Caa1/CCC+	1	2.21	-3.479
	Caa2/CCC			
	Caa3/CCC-			
	--- /CC			
	--- /C			
	Ca/SD			
Default	C/D			

Table 4.3 - Equivalence of Scales

5.3.1. Linear Scale

This is the simplest scale to obtain and will serve as a basis for obtaining the other two numerical scales. According to the ratings scale given by Moody's, confronted with 17 positions, C is the lowest value (default level) and the highest score is Aaa (prime level).

The work of Cantor and Packer (1996) and Afonso (2003) did not take into account the countries with ratings equal to or below Caa1 (highly risky level and default level). However, in this present study, the lowest rating to be considered is the notation group below Caa1. The reason for creating this group is due to the fact that it registers a reduced number of countries that have very similar structures of debt. In May 2003, only three countries held such notation - Argentina (Ca), Paraguay and Venezuela (Caa1) - while Belize was the only country with this rating level (Caa1) in May 2008. This subgroup will assume the lowest numerical value of the linear scale, i.e. the value of 1. From there, as one moves up in the scale, each additional notation is equivalent to the unit: B3-2, B2-3, ..., 16-Aa1, Aaa-17.

It can be graphically presented as Figure 4.1.

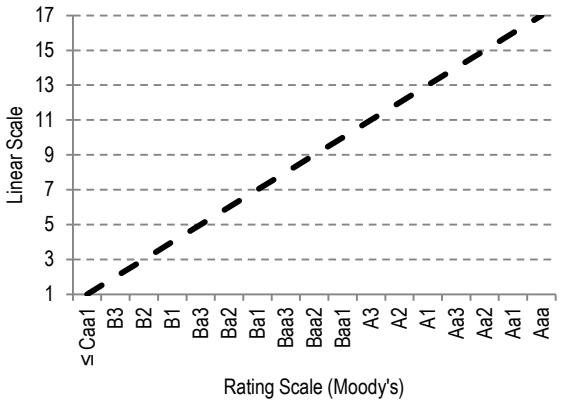

Figure 4.1 - Linear scale

5.3.2. Exponential Scale

To obtain this scale, we initially applied the following regression based on the linear scale values:

$$\ln R = \beta_0 + \beta_1 R + \omega \qquad (3),$$

with $R = 1, \dots, 17$ and ω as the error term

With coefficients values from (3), $\widehat{\beta_0} = 0.6436$ e $\widehat{\beta_1} = 0.1475$, we get the following equation:

$$Exp = ae^{bR} \qquad (4),$$

where $a = e^{\widehat{\beta_0}}$, $b = \widehat{\beta_1}$ e Exp is the rating level exponentially transformed.

With this scale, the ends of both investment and no-investment ratings grades are highly benefited as we see in Figure 4.2. However, this benefit is most significant at the upper end, from Aa2 notation. In the mid-term review, this numerical scale penalizes the rating falls, or rather, it conveys the idea that, for any country in this group that wants to achieve higher levels of classification, will have to bear a greater inertia than a country that boasts a classification closer to the extremes, regardless if it is of investment grade (or not). This does not happen with the linear scale, which assigns equal weight to each additional unit of assessment.

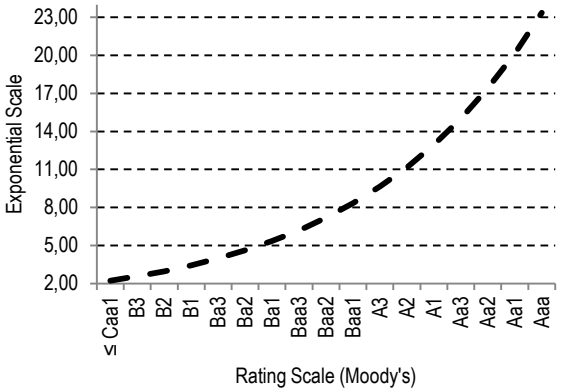

Figure 4.2 – Exponential Scale

5.3.3. Logistic Scale

This scale is based on a probabilistic standardization, with values varying between 0 and 1. The worst level of credit is concentrated at 0 while the most credible countries approach the value of 1. Each additional evaluation level is assigned to the same additional probability (slice) which, in this case is 1/17 (0.058824). However, the lowest level of credit provided will take only half of that value (0.029412), designating the other half of probability "outside". From here, one must distribute the remaining probability (0.941176) for the remaining 16 levels by adding the "slice" value to the value obtained above. That said, it meets the conditions to set the logistic scale, satisfying the following relation:

$$Log = \ln\left[\frac{R^*}{1-R^*}\right] \qquad (5),$$

with R^* representing each of the 17 normalizations, and Log the rating level logistically transformed.

As shown in Figure 4.3, this scale balances the evaluation processing of both level of investment and non-investment grade, giving more inertia to the former and benefiting the latter. The quality requirements of credit are tighter at the investment grade.

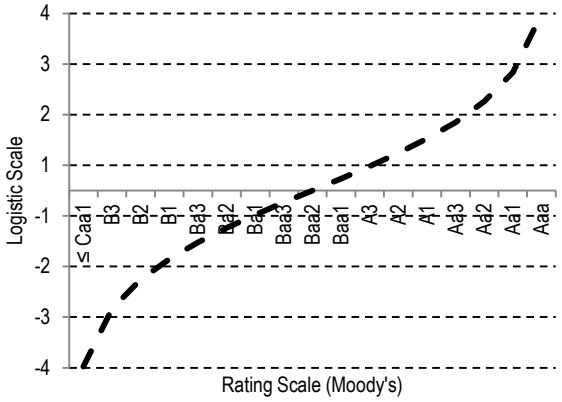

Figure 4.3 - Logistic scale

6. Model estimation and Results

As noted earlier, in the empirical analysis we will consider two distinct periods, on the allocation of ratings: May 2003 and May 2008. That is, the explanatory data relate to a horizon of ten years, from 1998 until 2007. The first five years are used for the analysis of the first period, while the five-year period 2003-2007 will support the results for the second period.

Equation (1) is estimated six times, using the Least Squares Method. The results will be presented for each period. Five-percent level will be considered to test the significance of parameters. High significance is considered when the p-value of the test is equal to or less than 5% and it's considered appropriate between 5% and 10%. Regarding the heteroskedasticity of the errors, the White Heteroskedasticity-Consistent Standard Errors are computed whenever necessary.

Moreover, the regression that has the highest percentage of ratings estimated with high accuracy will be considered the best. We proposed the following thresholds depending on the numeric scale used:

- Linear and Exponential scales $\begin{cases} \text{over or underestimated rating, if RES} \geq |1.50|, \\ \text{estimated rating with high accuracy, if RES} < |1.50| \end{cases}$
- Logistic scale $\begin{cases} \text{over or underestimated rating, if RES} \geq |0.50|, \\ \text{estimated rating with high accuracy, if RES} < |0.50| \end{cases}$

MAPE (Mean Average Percentage Error) will also be calculated to find out which regression has the highest value for that indicator. However, the three obtained values may not be comparable among themselves in order to find the best regression, due the dependent variable (numerically converted notation) not be the same for both.

6.1. Results for May 2003

Table 5.1 summarizes the results obtained for the three estimations considering the period of crisis.

Variable Code (coefficient)		REGRESSION		
		LINEAR	EXPONENTIAL[5]	LOGISTIC[5]
	Constant (α_0)	**8.331551****	**6.542193****	**-0.107857**
		9.22	*6.49*	*-0.40*
Group A	FIX (α_1)	**-3.982628****	**-6.960267****	**-2.425866****
		-2.16	*-2.06*	*-3.11*
	INTERM (α_2)	**-7.164783****	**-4.607343****	**-3.392908****
		-5.49	*-2.16*	*-6.62*
Group B	FIX_GOVD_BAL (α_3)	**0.001396****	**0.000649**	**0.000355****
		3.44	*1.12*	*2.42*
	INT_GOVD_BAL (α_4)	**0.001486***	**0.001287**	**0.000226**
		2.42	*1.34*	*0.90*
	FIX_GOVD_GR (α_5)	**-0.004168****	**-0.006359****	**-0.000694**
		-2.97	*-2.95*	*-1.16*
	FIX_DEV_SAVING (α_7)	**0.010289***	**0.023791****	**0.004893***
		1.82	*2.30*	*1.90*
	FIX_DPING_SAVING (α_8)	**-0.005425***	**-0.006024**	**-0.001019**
		-1.70	*-1.44*	*-1.06*
	INT_DPING_SAVING (α_{10})	**-0.008094****	**-0.013167****	**-0.000504**
		-2.03	*-2.24*	*-0.34*
	FIX_POLSOC (α_{11})	**0.031838**	**0.042638**	**0.017632****
		1.63	*1.22*	*2.28*
	INT_POLSOC (α_{12})	**0.072794****	**0.052389****	**0.035182****
		6.14	*2.55*	*7.51*
	INT_DEF (α_{14})	**-1.978533****	**-1.757530****	**-0.472284***
		-3.08	*-2.02*	*-1.75*
Group C	GDPPC(α_{15})	**0.221930****	**0.299048****	**0.038444**
		2.89	*2.84*	*1.56*
	GDPGR (α_{16})	**0.326887****	**0.329320****	**0.114991****
		3.63	*2.62*	*3.73*
	INFL(α_{17})	**-0.111789****	**-0.096563****	**-0.030426****
		-3.87	*-3.09*	*-3.74*
	DEVELOP (α_{18})	**8.666125****	**15.88620****	**3.118186****
		7.27	*7.66*	*5.88*
	DEBTX (α_{19})	**-0.011985****	**-0.010317****	**-0.003709****
		-4.42	*-2.97*	*-4.35*
	Adjusted R-squared	**0.9280**	**0.9285**	**0.9263**
	MAPE (percent)	**13.35**	**15.81**	**43.47[6]**
	Observations (#)	81		
	Values in Italic	T-statistics		
	**	P-value equal to or less than 5%.		
	*	P-value between 5% and 10%		

Table 5.1 – Estimation Results for May 2003

Note that all regressions have a fit that is considered very good (with adjusted r-squared over 0.90). However, the setting is slightly different with regard to the statistical significance of the parameters.

[5] With White Heteroskedasticity-Consistent Stantdard Errors.

[6]This calculation did not consider five cases whose the values are equal to zero – Barbados, Mexico, Oman, South Africa and Tunisia - with Baa2 classification (percentage error = ∞).

The table does not present the results for INT_GOVD_GR, and INT_DEV_SAVING and FIX_DEF - α_6, α_9 e α_{13} – because they haven't a p-value equal to or less than 10% in all regressions.

The constant is significant for a level below 5% for the linear and exponential scales, and takes positive values. In the logistic scale, the constant is statistically equal to zero. This means that if a country has the remaining variables in groups A, B and C equal to zero, its rating will be between Baa2 and Baa3, according to the numerical used scale. This value also represents the contribution of floating exchange rate regime in a country's sovereign rating, in a situation of *ceteris paribus* for the variables of group C.

In group A, the dummies associated with the exchange rate policy (fixed and intermediate) are significant at a level equal to or less than 5% in the three regressions, which shows a large explanatory power in determining sovereign ratings, assigned in May 2003. The interpretation of their estimates values is as follows, for the LIN (the same reasoning should be done for the other two scales:

- In the LIN – Hypothetically[7], relative to the FLOAT, the rating of a country loses about 4 levels when it has a FIX (-3.98), receiving a rating equivalent to B1 (8.33 - 3.98 = 4.35), and loses about 7 levels (-7.14), receiving one equivalent to or less than Caa1 (8.33 - 7.14 = 1.19) when it has an INTERM. Under the same conditions, the FLOAT ensures a rating of Baa3 (+8.33 levels);

We can draw from this a first preliminary conclusion: regardless of the numerical scale applied to the financial ratings, the practice of a floating exchange rate regime improves more the sovereign rating of a country[8]. This is more penalized when it follows an intermediate exchange rate regime. The fixed exchange rate regime assumes an "intermediate" role here.

Table 5.2 shows the two contributions: the Group A contribution (picked up directly in the coefficient values) and the Group B one (it is the sum of values obtained for one additional unit for each variable), according to the above mentioned conditions.

The relative contribution of Group B to the FLOAT is clearer when a country has an INTERM, being more expressive with the contribution of the INT_DEF coefficient. That is, it is remarkable the strong

[7] If all variables in Groups B are zero and the ones in Group C are in *ceteris paribus* mode, relative to the FLOAT regime.
[8] When the variables in group C are constant.

association between intermediate exchange rate regimes and countries that have a history of default that suppresses their sovereign rating. This penalty is about more 2 levels to LIN and EXP and about more 0.5 levels to LOG. Regarding the FIX's scenario, this contribution is insignificant - 0.002, 0.018 and 0.005 for LIN, EXP and LOG respectively - so the total contribution is approximately equal to the Group A contribution, when a country has no record of default.

May 2003									
Variable Code/Coefficient	**Country with FIX**			**Country with INTERM**			**Country with FLOAT**		
	LIN*	**EXP***	**LOG***	**LIN***	**EXP***	**LOG***	**LIN***	**EXP***	**LOG***
Constant [C]	8.332	6.542		8.332	6.542		8.332	6.542	
Group A									
FIX	-3.983	-6.960	-2.426						
INTERM				-7.145	-4.607	-3.392			
Group B									
FIX_GOVD_BAL	0.001		0.000						
INT_GOVD_BAL				0.001					
FIX_GOVD_GR	-0.004	-0.006							
FIX_DEV_SAVING	0.010	0.024	0.005						
FIX_DPING_SAVING	-0.005								
INT_DPING_SAVING				-0.008	0.013	-0.001			
FIX_POLSOC			0.018						
INT_POLSOC				0.073	0.052	0.035			
INT_DEF				-1.979	-1.758	-0.472			
Group C	***Ceteris paribus* (for all coefficients of this group)**								
Relative contribution of Group A to FLOAT regime	**-3.983**	**-6.960**	**-2.426**	**-7.145**	**-4.607**	**-3.392**			
Relative contribution of Group B to FLOAT regime[9]	**0.002**	**0.018**	**0.005**	**-1.913**	**-1.693**	**-0.438**			
Total (A+B)	**-3.981**	**-6.942**	**-2.421**	**-9.058**	**-6.300**	**-3.830**	**8.332**	**6.542**	**0**
(*) Values are rounded up to thousandths									

Table 5.2 – Direct and Total Contributions of exchange rate policy on sovereign ratings that are given by each type of regression

The complexity in interpreting estimates begins in group B. In all regressions, the expected signs are confirmed (relative to the FLOAT):

- Positive sign (α_3, α_4) - for the association of the external environment with the government debt of the country - if the external balance is positive, there are positive conditions to comply with the sovereign external debt. This applies to any level of foreign exchange;

[9] For unit change of each variable in Group B.

- Negative sign (α_5) – an economy that follows an exchange rate regime and that is growing through a runaway government borrowing runs the risk of inflationary pressures that may put into question the exchange rate system adopted, increasing the level of speculation of a possible devaluation of the currency in case of foreign reserves depletion by the central bank[10];
- Opposite signs, depending on the level of development (α_7, α_8 e α_{10}) – with regard to a country's domestic savings (budgetary and private savings), there is a positive trend within developed countries - that enhances the quality of its debt sovereign long-term - and a failure to generate internal savings within developing countries - which penalizes the sovereign rating - regardless of the chosen exchange rate regime;
- Positive sign (α_{11}, α_{12}) – a good political and social environment is, of course, beneficial to the creditworthiness of a country. It removes a good deal of speculative attacks and is valid for both exchange rate regimes;
- Negative Sign (α_{14}) – certainly a country that has ever lived a situation of default, will see its rating penalized. In this model, it is more significant in countries with intermediate regimes, especially in developing countries whose monetary fundamentals are weaker.

Regarding the significance of the estimated coefficients, the scene changes from scale to scale. The general consensus is found in only three estimators - FIX_DEV_SAVING, INT_POLSOC and INT_DEF.

In general, it is the LIN that provides a greatest number of significant parameters. In group B, eight parameters are significant at a level below 10% (out of the twelve available), of which five are statistically significant at a level below 5%. From the results presented in Table 5.1, only the α_{11}, factors associated with political and social system of fixed exchange rates, presents itself as being not significant.

Only half of the coefficients of group B are statistically significant for the regression based on the exponential scale. The level of savings associated with external debt (α_3, α_4) is not determining the sovereign rating, in any exchange rate regime. The same happens for the level of domestic

[10] See Leao, E., Pedro R. Leão and Sérgio C. Lagoa (2009), pp 272-273.

savings in developing countries and the political and social environment, both in the context of fixed exchange rate regimes.

In the LOG, this group presents here not significant regressors, when compared to other scales. Subsequently, the more significant coefficients are related to the political-social (α_{11}, α_{12}) and the association with the external environment and the overall government debt in a context of fixed exchange rate policy (α_3).

Regarding the group of economic indicators (Group C), we can directly identify the contribution of each one in the determination of sovereign ratings by the values of their own coefficients. The expected signals of each coefficient are confirmed, as found in Afonso (2003) and in other working papers. Their justifications are given as follows:

- GDPPC (+) - The higher the income per capita of a country, the greater will be the revenues from taxes collected by the same government. On the other hand, the higher the average income, the greater the propensity to save for the private sector. Taxes and domestic savings support the government budget, directly or indirectly. Therefore, the greater they are, the lower the government's need to borrow externally, thereby reducing its exposure to the outside. It contributes directly to the credit quality of a country's government;
- GDPGR (+) - Highly indebted countries with large external financing requirements tend to need rapid growth in exports to keep pace with their debt service burden;
- INFL (-) - Under extreme conditions of monetary instability, in which central banks create money in order to finance government deficits), inflation can accelerate to “hyperinflationary” levels that undermine normal productive activity and, subsequently, undermine the level of quality in external debt.
- DEVELOP (+) - An advanced country is one that can allocate resources efficiently in non-productive areas of the economy (eg education and health) in order to guarantee high performance to the production level, which ultimately sustains this trade-off between "productive" and "non-productive". In that situation, countries reserve domestic funds (in large scale) to self-financing, so have high quality ratings of external debt.

- DEBTX (-) - The higher the weight, the greater the external imbalances of a country. There will always be the country's need for external financing in order to survive, becoming increasingly exposed to the outside.

Table 5.3 compares the results of Afonso (2003) with the current results[11]

Variable Code/Coefficient	Afonso (2003) regressions [i]		Actual regressions (for May 2003)	
	LIN	LOG	LIN	LOG
Constant	**6.8069****	**-0.6197****	**8.331551****	**-0.107857**
	9.99	*-2.09*	*9.22*	*-0.40*
Group A	These groups weren't incorporated in the Afonso (2003) model			
Group B				
Group C	This group includes the same variables that were used in the Afonso (2003) model			
GDPPC	**0.00015****	**0.0000859****	**0.221930****	**0.038444**
	4.06	*5.22*	*2.89*	*1.56*
GDPPR	**0.2533****	**0.0913***	**0.326887****	**0.114991****
	2.22	*1.84*	*3.63*	*3.73*
INFL	**-0.0674****	**-0.0293****	**-0.111789****	**-0.030426****
	-3.18	*-3.18*	*-3.87*	*-3.74*
DEVELOP	**2.8584****	**0.4475**	**8.666125****	**3.118186****
	2.78	*1.00*	*7.27*	*5.88*
DEBTX	**-0.0123****	**-0.00415****	**-0.011985****	**-0.003709****
	-4.31	*-3.34*	*-4.42*	*-4.35*
Adjisted R-square	0.8707	0.8371	0.9280	0.9263
MAPE (percent)	30.00	23.00	13.35	43.47
[i]	Results of regression with DEBTX. Moody's data, available in September 2001.			
**	P-value equal to or less than 5 percent			
*	P-value between 5 and 10 percent			

Table 5.3 – Relating Afonso (2003) results to the actual results (2003)

We note that in absolute terms, the values of the coefficients in the current regressions are more expressive than current Afonso (2003), except DEBTX. GDPPC and DEVELOP are the striking cases: their contributions on sovereign ratings were enhanced with the introduction of exchange rate regimes in the model. For example, in the linear case, DEVELOP may contribute more in May 2003 than in September 2001, with about more 6 levels.

For the calculation of MAPE, the minimal value is assigned to the LIN regression in May 2003, obtaining a reduction of more than fifty percent compared to the case of Afonso (2003).

[11] Results relate only to the LIN and LOG regressions. Afonso (2003) does not show the results regarding the EXP regression.

In other words, the introduction of the foreign exchange systems did not affect the statistical significance that was reached in Afonso (2003) results, mainly in the LIN regression, and strengthened the contribution of most economic regressors on sovereign ratings. Moreover, the fit quality was also improved, as seen previously, and the percentage errors are minimized (for the LIN case).

We tried to make combinations of exchange rate regimes with economic variables in Group C (as was done in B), but we have encountered the following problems, so we decided not to introduce them in the model:

- Combinations made with INFL altered the significance level of some coefficients in Group B, due to strong collinearity.
- The signal that was obtained for some coefficients was not convenient, especially in terms of economic theory. This is the case of the coefficient for FIX*DEVELOP*GDPPC, which were statistically significant (at 1% level) but with a negative sign.

Next, we analyse the residuals, as shown in Tables 5.4 and 5.5. The shaded values represent the ratings that are over or underestimated according to the conventional thresholds presented above.

Country	Rating	Regime	LIN	EXP	LOG	Country	Rating	Regime	LIN	EXP	LOG
Argentina	Ca	FIX	-1.08	-1.31	-0.57	Lithuania	Baa1	FIX	-0.2	-0.57	-0.21
Australia	Aaa	FLOAT	-0.05	0.33	0.16	Luxembourg	Aaa	FIX	0	0.00	-0.50
Austria	Aaa	FIX	1.11	2.73	0.77	Malaysia	Baa1	FIX	-0.95	-0.81	-0.35
Barbados	Baa2	FIX	-0.66	-2.20	-0.06	Malta	A3	FIX	-0.53	-1.22	-0.23
Belgium	Aa1	FIX	-0.45	-1.98	-0.76	Mexico	Baa2	FLOAT	0.19	-0.59	0.09
Belize	Ba3	FIX	-1.41	-1.09	-0.40	Mongolia	B1	FLOAT	-2.73	-1.89	-0.78
Bolivia	B3	INT	0.21	0.35	0.19	Morocco	Ba1	FIX	0.25	0.18	0.18
Botswana	A2	FIX	1.62	2.01	0.17	Netherlands	Aaa	FIX	1.02	2.37	0.70
Brazil	B2	FIX	-0.15	0.33	-0.09	New Zealand	Aaa	FLOAT	-0.48	0.03	0.09
Bulgaria	Ba2	FIX	-0.73	-0.50	-0.09	Norway	Aaa	INT	-0.08	0.00	-0.02
Canada	Aaa	FLOAT	-0.19	0.18	0.10	Oman	Baa2	FIX	-1.25	-1.71	-0.48
Chile	Baa1	FLOAT	1.95	1.39	0.38	Pakistan	B3	INT	-0.82	0.33	-0.27
China	A3	FIX	0.73	1.42	0.11	Panama	Ba1	FIX	0.35	-0.46	0.31
Colombia	Ba2	FLOAT	-0.08	-0.29	0.10	Papua New Guinea	B1	FLOAT	-1.25	-0.45	-0.32
Costa Rica	Ba1	INT	-0.38	-1.20	-0.16	Paraguay	Caa1	INT	0.12	0.66	-0.32
Cyprus	A2	INT	-2.12	-2.17	-0.71	Peru	Ba3	FLOAT	-1.35	-1.22	-0.23
Czech Repulic	A1	INT	0.43	0.75	0.20	Philippines	Ba1	FLOAT	-0.7	-0.93	-0.17
Denmark	Aaa	INT	0.28	0.21	0.07	Poland	A2	FLOAT	3.86	4.13	0.91
Dominican Rep	Ba2	INT	-0.26	-1.23	0.26	Portugal	Aa2	FIX	-0.24	-1.25	-0.46
Egypt	Ba1	INT	1.35	0.79	0.54	Qatar	A3	FIX	-1.51	-1.81	-0.37
El Salvador	Baa3	FIX	0.81	0.58	0.65	Romania	B2	INT	-0.69	-0.47	-0.24
Estonia	A1	FIX	1.58	2.51	0.24	Russia	Ba2	FLOAT	-1.44	-1.71	-0.39
Finland	Aaa	FIX	-1.08	0.00	-0.25	Saudi Arabia	Baa3	FIX	-1.97	-2.42	-0.07
France	Aaa	FIX	1.77	4.23	1.13	Singapore	Aaa	INT	-0.48	-0.15	-0.05
Germany	Aaa	FIX	1.56	3.73	1.04	Slovakia	A3	INT	0.16	-0.72	0.05
Greece	A1	FIX	-1.42	-4.41	-1.14	Slovenia	Aa3	INT	0.11	1.83	-0.06
Hong Kong	A1	FIX	-1.89	-3.39	-0.82	South Africa	Baa2	INT	0.92	0.42	0.13
Hungary	A1	INT	1.56	2.75	-0.03	Spain	Aaa	FIX	1.22	3.49	0.94
Iceland	Aaa	INT	0.28	0.20	0.00	Suriname	B1	INT	-1.24	-1.79	-0.07
India	Ba1	FLOAT	-0.12	-1.30	-0.33	Sweden	Aaa	FLOAT	0.1	0.37	0.13
Ireland	Aaa	FIX	-0.33	0.55	0.00	Switzerland	Aaa	FLOAT	0.55	0.61	0.15
Israel	A2	INT	0.32	-0.15	0.26	Taiwan	Aa3	FLOAT	2.24	3.97	0.76
Italy	Aa2	FIX	-0.13	-2.16	-0.65	Thailand	Baa3	FLOAT	-1.14	-1.49	-0.30
Jamaica	B1	INT	0.07	0.40	0.01	Trinidad and Tobago	Baa3	FIX	-0.99	-0.98	-0.10
Japan	Aa1	FLOAT	-0.57	-2.53	-0.95	Tunisia	Baa2	INT	0.03	-0.51	-0.13
Jordan	Ba2	FIX	0.63	1.26	0.17	Turkey	B1	FLOAT	1.72	1.22	0.49
Kazakhstan	Baa3	INT	0.69	-0.38	0.49	UK	Aaa	FLOAT	0.05	0.34	0.13
Korea	A3	FLOAT	-1.06	-1.69	-0.35	Uruguay	B3	INT	0.5	0.18	0.31
Kuwait	A2	FIX	2.59	3.31	0.60	USA	Aaa	FLOAT	0.59	0.66	0.18
Latvia	A2	FIX	2.34	2.64	0.49	Venezuela	Caa1	INT	-0.02	0.00	-0.31
Lebanon	B2	FIX	0.57	0.84	0.11						

Table 5.4 - Residuals obtained by the type of scale (May 2003 estimation)

Following the results at Table 5.5 in accordance with the information of the previous table, we can see which regression presents a greater percentage of “correct” estimated rating (see the central lines of each regression).

May 2003 estimation					
ESTIMATION	**Notch**	**N. obs**	FIX	INTERM	FLOAT
LINEAR	**≤ -1.50**	**5 (6%)**	3 (9%)	1 (4%)	1 (5%)
	]-1.50 , 1.50[	**65 (80%)**	**26 (74%)**	**22 (92%)**	**17 (77%)**
	≥ 1.50	**11 (14%)**	6 (17%)	1 (4%)	4 (18%)
EXPONENTIAL	**≤ -1.50**	**14 (17%)**	8 (23%)	2 (9%)	4 (18%)
	]-1.50 , 1.50[	**54 (67%)**	**18 (51%)**	**20 (83%)**	**16 (73%)**
	≥ 1.50	**13 (16%)**	9 (26%)	2 (9%)	2 (9%)
LOGISITIC	**≤ -0.50**	**9 (11%)**	6 (17%)	1 (4%)	2 (9%)
	]-0.50 , 0.50[	**59 (73%)**	**21 (60%)**	**22 (92%)**	**16 (73%)**
	≥ 0.50	**13 (16%)**	8 (23%)	1 (4%)	4 (18%)
Total		**81**	35	24	22

Table 5.5 - Residuals and their statistical properties

It is the regression based on the linear scale that presents the best performance. It can fit the data on average more 10% of the ratings than the other two regressions. All regressions performed better in the estimation of sovereign ratings for economies with intermediate and floating exchange rate regimes.

In general, the highest percentage of underestimation (residuals ≤ -1.50 or ≤ -0.50) and overestimation (residuals ≥ 1.50 or ≥ 0.50) relapsed on the ratings of countries with fixed exchange rates. In this area, the regression based on the exponential scale is more representative.

The class of sovereign ratings that are below the A3 notation records the highest percentage of success (see Appendix III.a). The largest deviations are noted in the upper classes of the ratings scale. This is the case of overestimated ratings of Cyprus and Hong Kong and the underestimated ratings of France, Germany, Kuwait, Poland and Taiwan, in both regressions. At the lower end, the mongolian case is clearly noted (overestimation). In the Figure 5.1 are highlighted those examples and also shown the higher estimation error cases in each regression. The cases of Portugal were estimated with high precision for all regressions and they are signed with the letter "P".

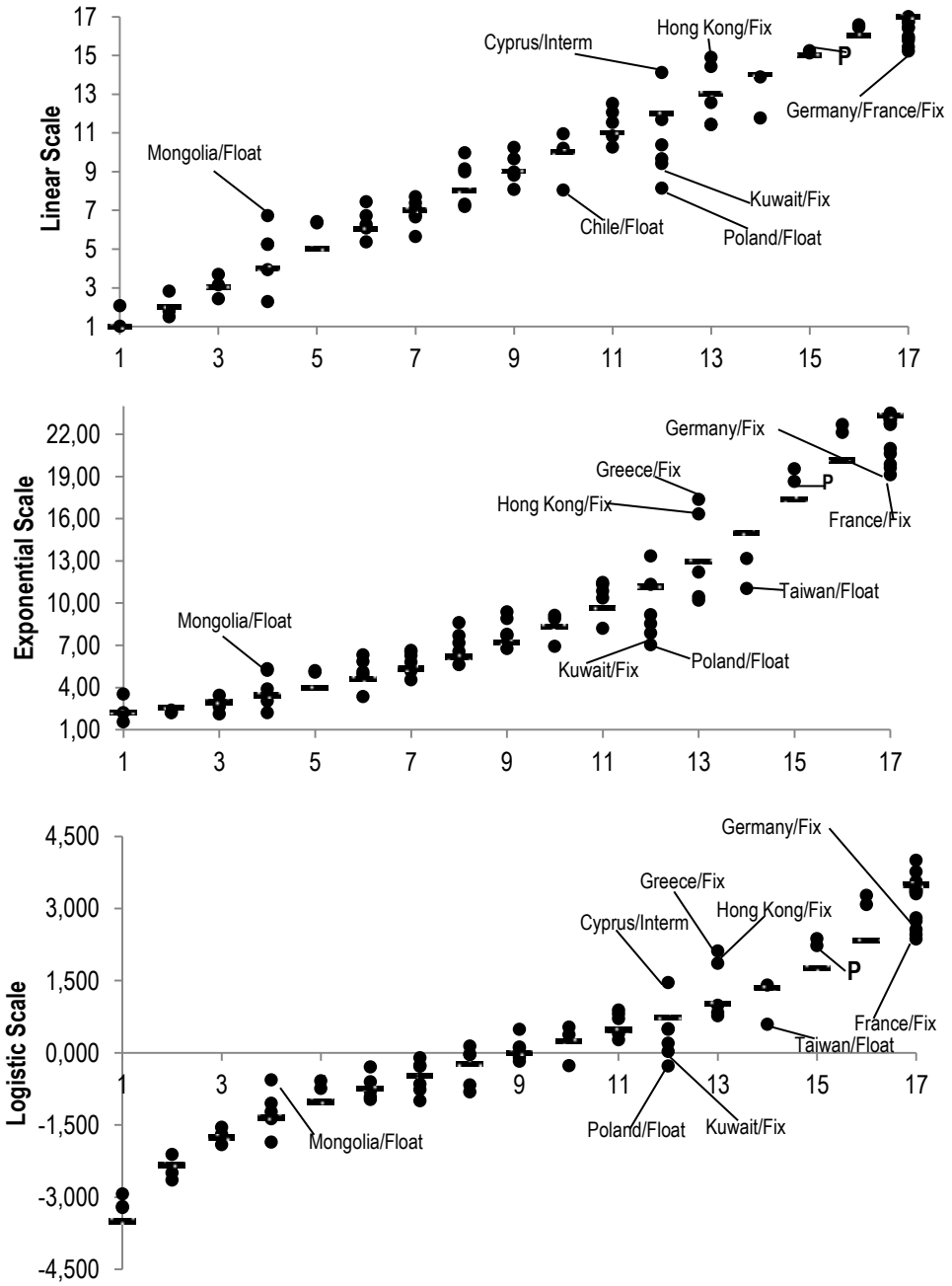

Figure 5.1 - Scatter plots of fitted ratings by type of scale (May 2003)

Next we will focus only on the LIN case. Looking at the examples of France, Germany and Finland - both with the same observed notation (Aaa) and with the same exchange rate system - the sovereign ratings of the first two cases were underestimated (at the level of Aa2) while rating of Finland was correctly estimated. To explain this fact, three differences were detected:

- In terms of government saving, Finland outperformed in the five-year period 1998-2002, compared with the two major economies of the Eurozone. In terms of GDP, the average fiscal balance of this period was 6.7% for the scandinavian country and around 1% for France and Germany.
- The ability to generate foreign savings was also stronger for Finland than for France and Germany. In the period 1998-2002, one sees Germany with an average deficit of -0.34% of GDP, followed by France and Finland with 1.54% to 7.48% respectively.
- The quality of the social-political environment of the two major powers of the Eurozone is slightly lower than the finish level.

Hong Kong and Czech Republic had the same sovereign debt rating in May 2003 (A1). However, all regressions overestimated the rating of the former and correctly estimate the rating of the latter. This difference may be explained by the following:

- Hong Kong followed a fixed exchange rate policy (currency board) while the Czech Republic's policy was intermediate likely, in 2001.
- GDP per capita of Hong Kong exceeded the czech case in about 74%, in 2002;
- Hong Kong experienced deflation during 1998-2002, unlike the czech case;
- The trade balance of the european country revealed a deficit during 1998-2002 while Hong Kong recorded successive surpluses in the same period of the analysis.

Now, we will observe the cases of Cyprus (overestimation), Poland (underestimation) and Israel (correct estimation), recorded in the three regressions. For the polish case, the difference is found in GDPPC. In 2002, GDPPC in Poland accounted for about one fifth of GDPPC of each of the other two countries. Hence, that may explain the underestimation of its rating.

The overestimate of Cyprus's rating can be justified by the positive real growth of its economy, recorded during the reference period. The israeli economy achieved positive real growth of about 9%

in 2000, but suffered a slight fall in the next two years, at around 0.50%. However, Cyprus has the best indicator of socio-political environment over the remaining cases in 2002.

Looking at the bottom of the rating scale, we compare the estimated values of Mongolia (overestimation) and Jamaica (accuracy), both with the same assigned rating (B1, May 2003):

- Mongolia got a better ranking at the level of political-social than Jamaica, in 2002;
- The exchange rate regime practiced in 2001 by Jamaica is the intermediate one while the mongolian currency floated freely (confirming the highest performance of the model to estimate ratings for countries with intermediate exchange rate regimes);
- Despite having a per capita GDP below 85% of the jamaican case, Mongolia can save more domestically in 2002, in terms of GDP (11.8% vs. 24%, respectively). In addition, its average inflation was lower and its average real growth was almost the doubled in relation to the jamaican scenario.

6.2. Results for May 2008

Table 5.6 summarizes the results obtained by the three estimates performed for the overall recovery period.

Variable Code (coefficient)		REGRESSION		
		LINEAR	EXPONENTIAL[12]	LOGISTIC[12]
	Constant (α_0)	**8.521152****	**7.480032****	**-0.210491**
		6.80	*6.15*	*-0.63*
Group A	FIX (α_1)	**-6.535004****	**-6.945508****	**-3.015808****
		-3.80	*-3.02*	*-4.24*
	INTERM (α_2)	**-11.33071****	**-11.51605****	**-3.437345****
		-3.11	*-2.86*	*-3.32*
Goup B	FIX_DEV_SAVING (α_7)	**0.008267**	**0.17092***	**0.004494**
		1.15	*1.94*	*1.46*
	FIX_POLSOC (α_{11})	**0.062367****	**0.052680****	**0.025841****
		3.35	*2.19*	*3.43*
	INT_POLSOC (α_{12})	**0.095575****	**0.101265****	**0.028398****
		3.35	*2.83*	*3.85*
	INT_DEF (α_{14})	**-3.231352****	**-2.94318****	**-0.930793****
		-2.96	*-2.83*	*-3.19*
Group C	GDPPC(α_{15})	**0.096205****	**0.154480****	**0.024689****
		2.32	*3.58*	*2.42*
	GDPGR (α_{16})	**0.516275****	**0.491303****	**0.163302****
		3.63	*2.39*	*2.54*
	INFL(α_{17})	**-0.400806****	**-0.41029****	**-0.112944****
		-4.80	*-4.37*	*-4.93*
	DEVELOP (α_{18})	**9.410377****	**15.88620****	**3.812666****
		5.91	*8.74*	*5.88*
	DEBTX (α_{19})	**-0.09835**	**-0.01415***	**-0.002974**
		-1.22	*-1.76*	*-1.24*
	Adjusted R-square	**0.8545**	**0.9273**	**0.8758**
	MAPE (percent)	**23.47**	**19.21**	**48.84**[13]
	Observations (#)	81		
	Values in Italic	*T-Statistics*		
	**	P-value equal to or less than 5%.		
	*	P-value between 5% and 10%		

Table 5.6 - Estimation results for May 2008

The period of analysis goes from 2003 to 2007 in order to estimate the ratings assigned by Moody's in May 2008, a period that is recorded a recovery in the global economy. In all regressions, the obtained signals for the coefficients confirm the one obtained above.

The quality of the estimation is good for all regressions, with an adjusted r-square above 0.85. In general, it can be said that the explanatory power of the model reduced during the recovery period,

[12] With White Heteroskedasticity Consistent Standard Errors.
[13] This calculation did not consider four cases for which the values are zero – Barbados, Kazakhstan, Russia and Tunisia - with Baa2 classification (percentage error = ∞).

when compares to 2003. Many of the coefficients, especially in group B, were no longer significant in May 2008.

However, once again, the key coefficients (group A) showed to be determinant in assessing the sovereign credit quality. In all regressions, the coefficients α_1 and α_2, concerning exchange rate policy choice, are statistically significant at a level not exceeding 1%.

The constant term (α_0) is not significant just for the regression based on the logistic scale, i.e., once again, for the LOG regression, the rating is set to zero (Baa2) when all regressors are zero. But it is still determining the classification based on two other scales. The scenario is little change over the May 2003 one. In the case of null regressors, the adjusted rating is equivalent to Baa2 for both the LIN and EXP regressions. Regarding the contribution of the floating exchange rate regime in sovereign rating, with regressors in A and B equal to zero and the ones in C in *ceteris paribus* mode, it is about 9 (LIN) or 7 (EXP) rating units.

The reading mode of the estimated values is maintained:

- In linear scale - The adjusted rating is equivalent to B3 (8.52 - 6.53 = 1.99) for a country with fixed exchange rate regime or equal to or less than Caa1 (7.48 - 11.51 = -4.03, assuming the lowest vale of the scale is 1), when he has an intermediate exchange rate regime[14];
- In exponential and logistic scale – For both fixed and intermediate exchange rate policy, the adjusted rating is equal to or less than Caa1[14] (see values for Direct Contribution, in table 5.7).

It is in group B where is more noticeable the weakness of the model. Many of the combined variables have lost their explanatory power on the determination of sovereign ratings in all regressions, especially those that are related to domestic, budgetary and foreign savings (results not shown in the table 5.6).

The social-political environment gained more strength in the explanation of the ratings for the period now discussed, regardless of the chosen exchange rate regimes. As for the history of default, its association with intermediate exchange rate regimes remains crucial in assessing the external debt of a sovereign country, with a contribution more enhanced than in May 2003.

[14] When the variables in group B are null and the ones in group C are in *ceteris paribus* mode.

Table 5.7 summarizes the contributions of the variables in A (where all B variables are zero and the ones in C are in *ceteris paribus* mode) and the total contributions (just with the variables in C *ceteris paribus* mode).

May 2008									
Variable Code/Coefficient	**Country with FIX**			**Country with INTERM**			**Country with FLOAT**		
	LIN*	**EXP***	**LOG***	**LIN***	**EXP***	**LOG***	**LIN***	**EXP***	**LOG***
Constant	**8.521**	**7.480**		**8.521**	**7,480**		**8.521**	**7.480**	
Group A									
FIX	-6.535	-6.946	-3.016						
INTERM				-11.330	-11.516	-3.437			
Group B									
FIX_DEV_SAVING		0.171							
FIX_POLSOC	0.062	0.053	0.026						
INT_POLSOC				0.096	0,101	0,028			
INT_DEF				-3.231	-2.943	-0.931			
Group C	***Ceteris paribus* (for all coefficients of this group)**								
Relative contribution of Group A to FLOAT regime	**-6.535**	**-6.946**	**-3.016**	**-11.330**	**-11.516**	**-3.437**			
Relative contribution of Group B to FLOAT regime[15]	**0.062**	**0.224**	**0.026**	**-3.135**	**-2.842**	**-0.906**			
Total (A+B)	**-6.473**	**-6.722**	**-2.99**	**-14.465**	**-14.358**	**-4.343**	**8.521**	**7.480**	**0**
*Values are rounded up to thousandths									

Table 5.7 - Direct and Total Contributions of exchange rate policy on sovereign ratings that are given by each type of regression

Relative to the FLOAT, the contribution of the fixed exchange rate regime in the sovereign ratings aggravated compared to May 2003 - 7 levels vs 4 levels in the LIN. In this context, the combined regressors continue to contribute little to the ratings, although the values have increased from 2003 to 2008.

Relative to the FLOAT, the INTERM also sees its contribution worsening from 2003 to 2008, from 7 levels to 11 levels, with the linear scale. In this context, the cross-contribution almost doubled from 2003 to 2008. This result is interesting because the number of regressors statistically significant reduced at the group B in May 2008. Once again INT_DEF is the main responsible for that, aggravating the penalization from 11 to 14 levels.

[15] For unit change of each variable in Group B.

Economic variables reaffirming its importance in the determination of sovereign ratings from rating agencies, except DEBTX, with their coefficients statistically significant at a level equal to or less than 5%. It is to enhance the strength of the dummy's level of development - DEVELOP - which comes to value the sovereign rating of a developed country by about 9 levels (linear scale) and 16 levels (exponential scale). The value of this coefficient, estimated by the logistic scale (3.81) is equivalent to 9-linear-scale levels.

Table 5.8 compares the current results (2008) with the results obtained in Afonso (2003).

Variable Code/Coefficient	Afonso (2003) regressions ǂ		Actual regressions (for May 2008)	
	LIN	LOG	LIN	LOG
Constant	**6.8069****	**-0.6197****	**8.521152****	**-0.210491**
	9.99	*-2.09*	*6.80*	*-0.63*
Group A	These groups weren't incorporated in the Afonso (2003) model			
Group B				
Group C	This group includes the same variables that were used in the Afonso (2003) model			
GDPPC	**0.00015****	**0.0000859****	**0.096205****	**0.024689****
	4.06	*5.22*	*2.32*	*2.42*
GDPPR	**0.2533****	**0.0913***	**0.516275****	**0.163302****
	2.22	*1.84*	*3.63*	*2.54*
INFL	**-0.0674****	**-0.0293****	**-0.400806****	**-0.112944****
	-3.18	*-3.18*	*-4.80*	*-4.93*
DEVELOP	**2.8584****	**0.4475**	**9.410377****	**3.812666****
	2.78	*1.00*	*5.91*	*5.88*
DEBTX	**-0.0123****	**-0.00415****	**-0.09835**	**-0.002974**
	-4.31	*-3.34*	*-1.22*	*-1.24*
Adjisted R-square	0.8707	0.8371	0.8545	0.8758
MAPE (percent)	30.00	23.00	23.47	48.84
ǂ	Results of regression with DEBTX. Moody's data, available in September 2001.			
**	P-value equal to or less than 5 percent			
*	P-value between 5 and 10 percent			

Table 5.8 - Relating Afonso (2003) results to the actual results (2008)

We know that the period assessed by Afonso (2003) involves the emergence of the asian and the russian crises (1997-1998) and the foretaste of the argentinean one (2001) while 2003-2008 it is a period of global economic recovery. Thus, although almost all economic variables maintain their statistical significance since 2001 (except DEBTX) in all scales, the real growth (GDPPR) contributes now in determining the sovereign ratings, in about 50 percent more compared to September 2001. The contribution of GDPPC, despite being lower than in May 2003, is higher to that obtained by

Afonso (2003). A curious fact is the contribution of INFL in the current period, which almost quadrupled since 2001. It may be a sign that the rating agencies have been becoming more "skeptic" about inflationary processes, even when accompanied by strong real growth. The contribution of INFL almost cancels the contribution of GDPGR in situations of equal rate.

The weight of the economic development contribution in the ratings is becoming more expressive over time. Though it is slightly higher than in May 2003, in both regressions, continues to be around three times the value obtained with September 2001 data.

Unlike what happened in 2003, the quality of estimation obtained in 2008 for the two regressions is very similar to that obtained in Afonso (2003), with an average adjusted R2 of 0.86. That is, a slight deterioration in the quality of estimation over in 2003 turns out to "equalize" the quality of estimation obtained with September 2001 data. Once again there is evidence that it is necessary to make an updating of the rating methodologies, depending on the economic involved period and with new arguments.

The 2008-MAPE for LIN regression increased over 2003 but still lower than the 2001-MAPE. This does not happen in the case of LOG regression that, as in May 2003, saw its value aggravated by about 50%. The non-introduction of the countries with similar rating to or less than Caa1 in the sample (that would eliminate the value of 0 in the logistic scale) may be the cause of the low value of its MAPE in 2001.

Next, we present the residuals obtained in the three regression and some subsequent statistical properties (tables 5.9 and 5.10).

Country	Rating	Regime	LIN	EXP	LOG	Country	Rating	Regime	LIN	EXP	LOG
Argentina	B3	INT	-1.02	0.59	-0.61	Lithuania	A2	FIX	1.05	1.00	0.25
Australia	Aaa	FLOAT	-0.04	0.05	0.00	Luxembourg	Aaa	FIX	0	-0.18	-0.52
Austria	Aaa	FIX	0.36	2.22	0.48	Malaysia	A1	INT	1.7	1.91	0.48
Barbados	Baa2	FIX	-0.35	-1.26	-0.07	Malta	A1	FIX	1.09	1.15	0.23
Belgium	Aa1	FIX	-0.23	-1.25	-0.63	Mexico	Baa1	FLOAT	0.86	0.11	0.24
Belize	Caa1	FIX	-4.95	-2.45	-2.13	Mongolia	B1	INT	-1.05	-0.75	-0.21
Bolivia	B3	FIX	-2.98	-2.02	-1.21	Morocco	Ba1	FIX	0.01	-1.31	0.00
Botswana	A2	INT	0.08	-0.26	-0.03	Netherlands	Aaa	FIX	0.49	1.80	0.51
Brazil	Ba1	FLOAT	-1.36	-1.71	-0.26	New Zealand	Aaa	FLOAT	-0.04	0.20	0.04
Bulgaria	Baa3	FIX	1.15	0.10	0.53	Norway	Aaa	FLOAT	0.9	0.42	0.19
Canada	Aaa	FLOAT	-0.26	-0.18	-0.06	Oman	A2	FIX	-0.2	-1.43	-0.21
Chile	A2	FLOAT	2.48	2.57	0.62	Pakistan	B1	FIX	0.34	1.12	0.28
China	A1	FIX	1.51	2.65	0.59	Panama	Ba1	FIX	-1.38	-1.74	-0.40
Colombia	Ba2	INT	-1.63	-1.89	-0.30	Papua New Guinea	B1	INT	-3.63	-3.09	-0.82
Costa Rica	Ba1	INT	0.72	-0.45	0.30	Paraguay	B3	INT	1.01	0.35	0.07
Cyprus	Aa3	INT	-0.85	-0.79	-0.26	Peru	Ba2	INT	-0.79	-1.38	-0.04
Czech Repulic	A1	INT	0.06	-0.24	-0.04	Philippines	B1	FLOAT	-4.85	-3.92	-1.32
Denmark	Aaa	INT	0	0.00	0.00	Poland	A2	FLOAT	1.56	1.79	0.36
Dominican Rep	B2	INT	-2.73	-2.02	-0.81	Portugal	Aa2	FIX	0.11	-1.72	-0.44
Egypt	Ba1	FIX	2.58	3.30	1.02	Qatar	Aa2	FIX	-2.15	-2.28	-0.46
El Salvador	Baa3	FIX	1.17	0.20	0.66	Romania	Baa3	INT	1.69	0.61	0.60
Estonia	A1	FIX	0.42	0.52	-0.07	Russia	Baa2	INT	3.83	2.95	1.18
Finland	Aaa	FIX	0	-0.18	-0.54	Saudi Arabia	A1	FIX	2.2	1.78	0.79
France	Aaa	FIX	1.8	3.68	1.10	Singapore	Aaa	INT	0	0.00	0.00
Germany	Aaa	FIX	1.21	3.16	0.85	Slovakia	A1	INT	0.09	0.10	-0.09
Greece	A1	FIX	-1.23	-4.04	-0.80	Slovenia	Aa2	INT	-0.47	1.20	-0.02
Hong Kong	Aa2	FIX	-2.24	-2.84	-1.01	South Africa	Baa1	FLOAT	1.47	1.01	0.38
Hungary	A2	INT	1.9	1.48	0.49	Spain	Aaa	FIX	1.89	3.60	1.16
Iceland	Aaa	FLOAT	0.44	0.32	0.06	Suriname	B1	FIX	-2.77	-2.73	-0.44
India	Baa3	INT	0	2.47	0.99	Sweden	Aaa	FLOAT	-0.4	-0.41	-0.12
Ireland	Aaa	FIX	-0.2	0.90	0.14	Switzerland	Aaa	FLOAT	-0.32	-0.43	-0.10
Israel	A1	FLOAT	1.35	1.61	0.33	Taiwan	Aa3	INT	0.22	0.99	0.10
Italy	Aa2	FIX	0.78	-1.86	-0.31	Thailand	Baa1	INT	0.84	-0.05	-0.19
Jamaica	B1	INT	-0.32	0.35	-0.08	Trinidade and Tobago	Baa1	FIX	-0.36	-0.94	-0.31
Japan	Aaa	FLOAT	0	-0.18	-0.20	Tunisia	Baa2	INT	-0.41	-1.24	-0.07
Jordan	Ba2	FIX	1.16	0.59	0.27	Turkey	Ba3	FLOAT	-2.61	-2.14	-0.62
Kazakshtan	Baa2	INT	0.05	-0.21	0.03	UK	Aaa	FLOAT	1.48	0.53	0.15
Korea	A2	FLOAT	1.11	0.69	0.26	Uruguay	B1	INT	-2.7	-2.69	-0.67
Kuwait	Aa2	FIX	0.23	1.02	0.01	USA	Aaa	FLOAT	0.15	0.21	0.05
Latvia	A2	FIX	2.37	2.67	0.59	Venezuela	B2	FIX	0.28	0.05	0.05
Lebanon	B3	FIX	-0.28	0.03	0.06						

Table 5.9 - Residuals obtained by the type of scale (May 2008 estimation)

May 2008 estimation					
ESTIMATION	**Notche**	**N. obs**	**FIX**	**INTERM**	**FLOAT**
LINEAR	**≤ -1.50**	**11 (14%)**	5 (14%)	4 (15.5%)	2 (10%)
	]-1.50 , 1.50[	**58 (72%)**	**25 (69%)**	**18 (69%)**	**15 (80%)**
	≥ 1.50	**12 (15%)**	6 (17%)	4 (15.5%)	2 (10%)
EXPONENTIAL	**≤ -1.50**	**16 (20%)**	9 (25%)	4 (15%)	3 (16%)
	]-1.50 , 1.50[	**50 (62%)**	**18 (50%)**	**19 (73%)**	**13 (68%)**
	≥ 1.50	**15 (18%)**	9 (25%)	3 (12%)	3 (16%)
LOGISITIC	**≤ -0.50**	**13 (16%)**	7 (19%)	4 (15%)	2 (11%)
	]-0.50 , 0.50[	**54 (67%)**	**19 (53%)**	**19 (73%)**	**16 (84%)**
	≥ 0.50	**14 (17%)**	10 (28%)	3 (12%)	1 (5%)
Total by period		**81**	36	26	19

Table 5.10 - Residuals and their statistical properties

The estimation based on the linear scale remains the more accurate role in the adjustment of individual ratings, despite decreasing from the prior period. It correctly estimates 72% of the 81 sovereign rating - 7.5% more than the other regressions, in average. Once again, the exponential scale had the worst performance.

The intermediate and floating exchange rate regimes continue to show the best performance in terms of hits by all three regressions, this time with greater impact for the second one.

With regard to the class of ratings where are more under and overestimated cases, the scenario has two senses in 2008. In general, most of the overestimated values happened at lower levels of ratings, below Ba1 (see Appendix III.b). These are the cases of Belize, Bolivia, Dominican Republic, Papua New Guinea, Philippines and Uruguay, which had their ratings overestimated in all regressions, Belize being the case most striking, with an absolute error of about 5 levels (linear scale) . On the other hand, underestimated values fall on the upper echelons of the ratings (above A1). These are the cases of Chile, France, Latvia, Saudi Arabia and Spain, in the three regressions applied. Figure 5.2 illustrates the two different scenarios.

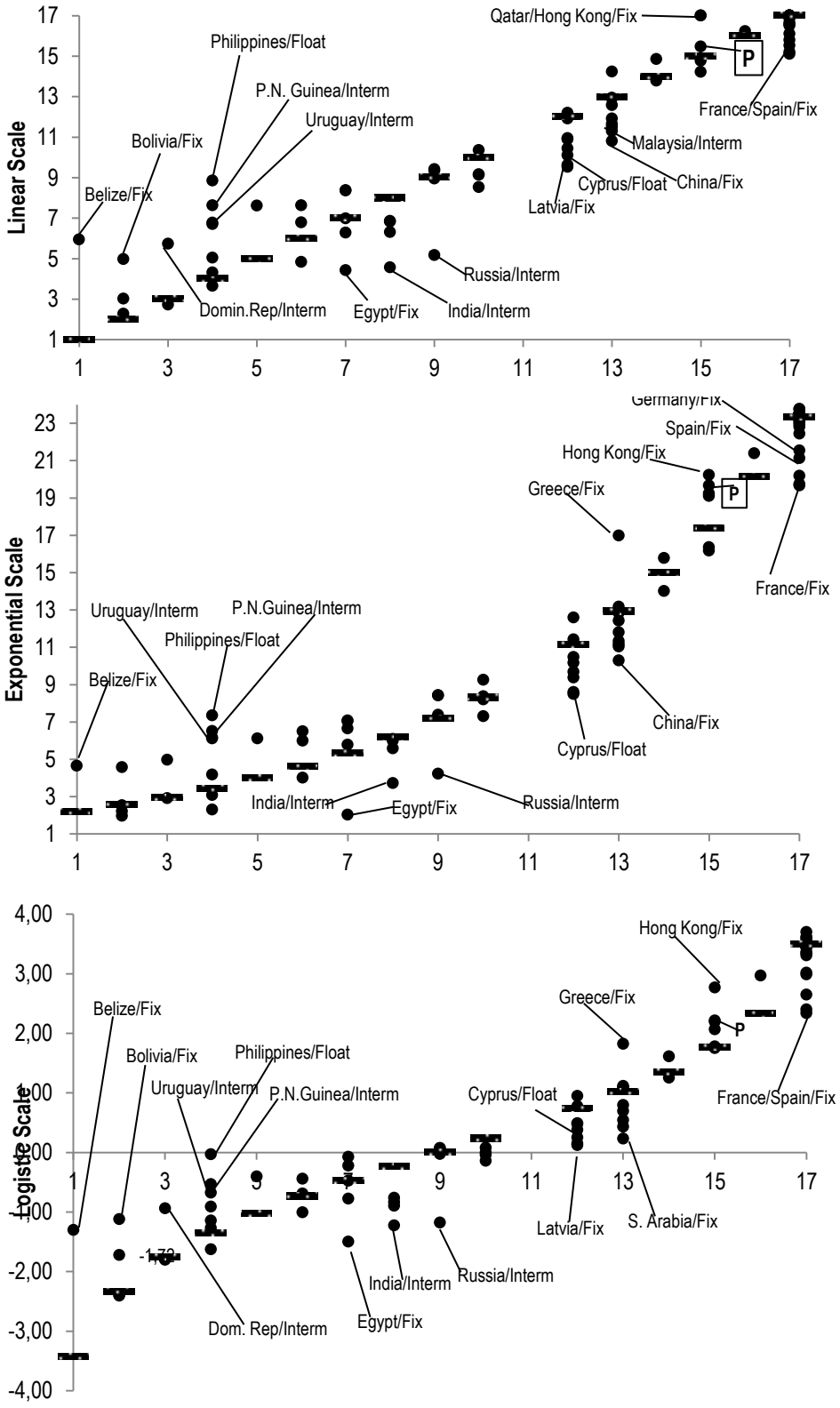

Figure 5.2 - Scatter plots of fitted ratings by type of scale (May 2008)

The case of Belize is the most striking, in all scenarios. Its estimation error reaches 5 levels. Comparing this one to the lebanese case (correct estimation), both having the same rating level and following the same exchange rate policy orientation, here are the main differences:

- In 2005-2007, Belize had an average real growth of 3.3%, while Lebanon has grown only 1.7% on average;
- The structure of the belizean domestic savings represents 15.5% of GDP in 2007, contrary to the weak ability to generate internal savings of Lebanon (-5.9% of GDP);
- The lebanese debt-to-ratio (DEBTX) was 39% higher than the belizean one, in 2007;
- In 2007, the lebanese government was more indebted than the belizean one - 158% and 85% in terms of GDP, respectively;
- The index of the socio-political of Belize was almost twice the lebanese one (42% and 22% respectively).

Therefore, one can say that there were speculative reasons, which are not captured by this model, and that led Moody's to cut drastically the sovereign rating of Belize. Analysts of that rating agency justified the assigned rating basing on the following July 2007 statements:

"… the Caa1 foreign currency government bond rating and stable outlook reflect a very high risk of default despite the substantial liquidity relief that was provided as a result of this February's restructuring. The Caa1 rating and Moody's assessment of a low risk of a payments moratorium in the event of a government bond default are the basis for the B2 foreign currency country ceiling for bonds. (…) The country's macroeconomic performance was remarkably favorable in 2006, despite the developments that eventually forced the government to restructure its foreign currency obligations. "GDP growth reached 5.8%, well above the 3.5% recorded in 2005, mostly driven by exports, especially oil, and fueled by double-digit growth in credit to the private sector" [16].

At the other extreme, there is an underestimation of France and Spain notations (-2 levels). They are compared with the case of Ireland whose rating was correctly estimated, which makes part of the same monetary area and shares the Aaa level with them. Among the three cases, Spain has the lowest per capita income (32.5 thousand dollars, in 2007), the worst political and social index (average 67%), and a current account deficit more pronounced (about -8.8 % of GDP). For its part, France has

[16] See http://www.moodys.com/research/Moodys-Issues-Annual-Report-on-Belize--PR_137375

the worst budget balance (0.9% of GDP in 2007), the highest percentage of government debt (about 64% of GDP in the same period) and a real economic growth lower than the other two cases (1.9% on average). These features are likely appropriate to justify the underestimation of these two sovereign ratings.

7. Conclusion

This thesis finds evidence on the importance of exchange rate policy on the sovereign long-term debt ratings, assigned by rating agencies.

Related to the methodology used in Afonso (2003), we conclude that the two agencies with the highest market shares in the business did not bring very substantial differences in terms of criteria to base their decisions. So, the development of this study was followed by using the evaluation made by Moody's, for two different periods, always focusing on the role of exchange rate policy chosen and practiced by each country of the sample.

Like in Afonso (2003), the methodology is based in a multivariate linear regression where the dependent variable is the notations of ratings numerically processed, and with nineteen regressors distributed for three groups, in addition to the constant term: Group A contains the two dummies for the fixed and intermediate exchange rate regimes (while the floating is the basic scheme). In Group B are created twelve variables combined with exchange rate regimes and levels of government debt, public accounts, external accounts, national savings, socio-political environment and history of default. Group C, is neither nothing more nor less than the model of Afonso (2003), containing five economic variables: GDP per capita, GDP growth rate, inflation, level of development and debt-to-exports ratio. The data concern a sample of 25 developed and 56 emerging countries, in two different periods: May 2003 (for the crisis period of 1998-2002) and May 2008 (for the recovery period of 2003-2007). The notations of the ratings were numerically converted by three different scales: linear, exponential and logistic.

The main conclusions are focused primarily on four core units: exchange rate policy, economic and socio-political factors, specific period (crisis or recovery) and the scaling scheme. The marginal contributions are given period to period.

In both periods, the exchange rate policy followed by countries showed to be very crucial for sovereign ratings definition. The intermediate exchange rate regime is the one that more penalizes the rating of the sovereign debt of countries, especially in the context of emerging countries. Typically, this arrangement is chosen by the more sceptical countries, in terms of performance and vulnerability of their currencies. In May 2003, relative to FLOAT, this scheme is penalized by about 7 ratings levels on

the LIN, 5 level on the EXP, and 3 levels with the LOG. In May 2008, its direct penalty is generally accentuated, devaluing the sovereign ratings about 11 levels (LIN). Regarding the cross-marginal contribution, it is more sensitive (negatively) on the ratings of countries with this type of exchange rate regime, particularly when linked to the history of default. Its contribution went from -2 to -3 levels, from 2003 to 2008.

The fixed exchange rate regime turns out to play an intermediate role, penalizing little the ratings assigned by Moody's, relative to FLOAT, in both periods. Since the euro and the dollar are the anchor currency chosen by the vast majority of countries in the sample with this type of schemes, some credibility is attributed to this policy, since they are stable currencies, from countries with strong and credible information (USA and the Euro Zone). It's penalised by about 7 levels, being greater than in 2003 (with the linear scale). In this case, the cross-marginal contribution does not much change.

The performance of the FLOAT in both periods is due to the fact that this system has greater incidence in countries with stronger sovereign debt structures and stronger saving ability, so that ultimately values more the sovereign debt rating. A country that uses this type of exchange rate regime is guaranteed to approximately 8 and 9 levels in its sovereign rating, respectively in May 2003 and May 2008.

As happened to other agencies, Moody's proved to be stricter with the classification criteria in May 2003 (crisis) than in May of 2008 (recovery). In the first period, to support better the role of exchange rate policy, some cross-combined regressors were statistically significant for determining the ratings, such as saving environment experienced internally and externally, the level of governmental expenditure accompanied with economic growth, political-social and failure registration of the countries.

However, for the period of recovery due to the general improvement in economic indicators, some of those regressors lost significance in explaining the sovereign ratings, assigned in May 2008. Only the social-political environment and the history of failure remained significantly loyal to the definition of the rating process, mainly when associated with an intermediate exchange rate regime.

It is confirmed the relevance of the economic indicators in the definition of sovereign ratings, following the methodologies of Cantor and Packer (1996) and Afonso (2003). However, it is shown that there is

a continuing need to reset the evaluation models, according to specific features of the analysed period. The value of adjusted R-square improved with the contribution of exchange rate regimes, especially in May 2003: 0.86 (June 2001)[17], 0.93 (May 2003)[17] and 0.86 (May 2008)[17].

A good numerical scale conversion of assigned ratings can help to achieve results more consistent with the facts. Although there are slight difference in the results from one period to another, the linear and exponential scales showed the lowest values in terms of average percentage deviations in both periods: respectively 13.35% and 15.81% (May 2008), 23.47% and 19.21% (May 2008). The logistic scale lacks some robustness of quality because it presented itself good in the descriptive level of residuals, which has not happened in terms of percentage analysis of the errors, the value of the MAPE was the highest one, in both periods: 48.47 percent (May 2003) and 48.84 percent (2008).

In general, INTERM and FLOAT have had a better performance in the estimates based on these three scales in the two periods considered. Regarding the ratings of countries with the first regime, they were correctly estimated around 80% and 72% by the LIN regression in 2003 and 2008, respectively. The LOG regression estimated correctly about 73% and 67% of them respectively in 2003 and 2008. 67% and 62% are the percentage values of correct estimation to EXP regression, the being considered worst results. In the field of FLOAT, the LIN regression correctly estimated about 77% and 80% of the ratings, while the LOG one hits 73% and 84% of them, respectively in 2003 and 2008. Once again the worst results are for EXP regression: 73% and 68% respectively.

In particular, the highest percentages of overestimated and underestimated values are based on FIX. In 2003, the LIN, EXP and LOG regressions overestimated by 9%, 17% and 11% of the ratings to this scheme, respectively. In 2008, these percentages were 14%, 25% and 19%. In the field of underestimations, in 2003, the values were 17% (LIN), 26% (EXP) and 23% (LOG). These values were increased in 2008: 17% (LIN), 25% (EXP) and 28% (LOG). We could say that this type of system eventually hold a hybrid character, since it is used by both the more developed countries (through monetary unions) and emerging countries (through currency board arrangement), due to trading conventions and monetary stability. This turns out to give an "intermediate" role to the influence of practicing FIX on the quality of sovereign debt of a country.

[17] Average of adjusted R-squared values for LIN and LOG regressions.

For future research, it is proposed to develop the question of the influence of exchange rate flexibility on the sovereign ratings following the topics described at Calvo and Reinhart (2002) and at Levy-Yeyati and Sturzenegger (2002), both presented in Section 2. Whatever the type of exchange rate regime practiced, more or less flexibility in the exchange rate in a given period can influence the service of external debt of a country, reflecting on the calculation of its sovereign rating.

Another question that would be interesting is the study of the relationship between monetary policy goals outlined by central banks and the definition of their respective countries sovereign ratings. That is, to see which goals (to be achieved) would have a greater impact on the quality of sovereign debt in an economy: the inflation target, monetary rule, currency board or dual objective of real growth and inflation stabilization.[18]

[18] See Leao, E., Pedro R. Leão and Sérgio C. Lagoa (2009), pp 262-293.

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Useful links

- The IMF Exchange rate classification:
  2001 - http://www.imf.org/external/np/mfd/er/index.asp.

  2006 - http://www.imf.org/external/np/mfd/er/2006/eng/0706.htm;

- Moody's Statistical Handbook (Country Credit), May 2008:
  http://www.moodys.com/login.aspx?lang=en&cy=global&ReturnUrl=http%3a%2f%2fwww.moodys.com%2fviewresearchdoc.aspx%3fdocid%3dPBC_133011%26lang%3den%26cy%3dglobal

- Sovereigns Rating List (S&P):
  http://www.standardandpoors.com/ratings/sovereigns/ratings-list/en/us/;jsessionid=GlmLPZJLbyVLXL7LTdvRfyQd50dL0Qk4q0lV2JhrvzN3jhvWN5T2!-798729601?subSectorCode=39&start=50&range=50

Appendix

Annex I.a – Summary of IMF exchange rate classification (2001 and 2006)

Generic Regime	Currency arrangement	Description	Sample Countries (2001)	Sample Countries (2006)
Hard pegged/ Fixed exchange rate	*Exchange arrangements with no separate legal tender*	The currency of another country circulates as the sole legal tender (formal dollarization), or the member belongs to a monetary or currency union in which the same legal tender is shared by the members of the union. Adopting such regimes implies the complete surrender of the monetary authorities' control over domestic monetary policy.	Eurozone (12), Panama	Eurozone (12), El Salvador, Panama
	Currency board	A monetary regime based on an explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfillment of its legal obligation.	Argentina, Bulgaria, Hong Kong, Estonia, Lithuania	. Bulgaria, Hong Kong, Estonia, Lithuania
	Conventional Peg	The country pegs its currency within margins of ±1 percent or less vis-à-vis another currency; a cooperative arrangement, such as the ERM II; or a basket of currencies, where the basket is formed from the currencies of major trading or financial partners and weights reflect the geographical distribution of trade, services, or capital flows.	Belize, Barbados, China, El Salvador, Jordan, Lebanon, Malaysia, Oman, Qatar, Saudi Arabia, Trinidad and Tobago, Botswana, Kuwait, Latvia, Malta, Morocco	Belize, Barbados, Bolivia, China, Egypt, Jordan, Kuwait, Latvia, Lebanon, Malta, Oman, Pakistan, Qatar, Saudi Arabia, Suriname, Trinidad and Tobago, Morocco, Venezuela
Intermediate exchange rate (Soft pegged)	*Pegged exchange rates within horizontal bands*	The value of the currency is maintained within certain margins of fluctuation of more than ±1 percent around a fixed central rate or the margin between the maximum and minimum value of the exchange rate exceeds 2 percent.	Denmark, Cyprus, Iceland	Denmark, Hungary, Slovenia, Cyprus, Slovakia
	Crawling Peg	The currency is adjusted periodically in small amounts at a fixed rate or in response to changes in selective quantitative indicators, such as past inflation differentials vis-à-vis major trading partners, differentials between the inflation target and expected inflation in major trading partners.	Costa Rica, Tunisia, Bolivia, Egypt	Botswana, Costa Rica

Annex I.b - Summary of IMF exchange rate classification (2001 and 2006)

Intermediate exchange rates (managed floating)	*Exchange rates within crawling bands*	The currency is maintained within certain fluctuation margins of at least ±1 percent around a central rate—or the margin between the maximum and minimum value of the exchange rate exceeds 2 percent—and the central rate or margins are adjusted periodically at a fixed rate or in response to changes in selective quantitative indicators.	Israel, Hungary, Uruguay, Venezuela	
	Managed Float	The monetary authority attempts to influence the exchange rate without having a specific exchange rate path or target. Indicators for managing the rate are broadly judgmental (e.g., balance of payments position, international reserves, parallel market developments), and adjustments may not be automatic. Intervention may be direct or indirect.	Jamaica, Slovenia, Czech Republic, Pakistan, Romania, Dominican Republic, Norway, Paraguay, Singapore, Slovakia, Suriname, Kazakhstan	Argentina, Jamaica, Tunisia, Uruguay, Mongolia, Colombia, Czech Republic, Peru, Romania, Thailand, Dominican Republic, India, Kazakhstan, Malaysia, Papua N. Guinea, Paraguay, Russia, Singapore
Floating Exchange rate	*Independently floating*	The exchange rate is market-determined, with any official foreign exchange market intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than at establishing a level for it.	Colombia, Mongolia, Peru, Philippines, Australia, Brazil, Canada, Chile, New Zealand, Poland, South Africa, Sweden, Thailand, United Kingdom, South Korea, Mexico, Papua N. Guinea, Russia, India, Japan, Switzerland, USA, Turkey	Australia, Brazil, Canada, Chile, Iceland, Israel, Korea, Mexico, Norway, New Zealand, Philippines, Poland, South Africa, Sweden, Turkey, United Kingdom, Switzerland, USA, Japan

Annex II.a - Scenario of May 2003 (2001 for exchange rate regimes)

Country	Moody's	S&P	Regime	Country	Moody's	S&P	Regime
Argentina	Ca	SD	FIX	**Lithuania**	Baa1	BBB+	FIX
Australia	Aaa	AAA	FLOAT	**Luxembourg**	Aaa	AAA	FIX
Austria	Aaa	AAA	FIX	**Malaysia**	Baa1	BBB+	FIX
Barbados	Baa2	A-	FIX	**Malta**	A3	A	FIX
Belgium	Aa1	AA+	FIX	**Mexico**	Baa2	BBB-	FLOAT
Belize	Ba3	B+	FIX	**Mongolia**	B1	B	FLOAT
Bolivia	B3	B	INT	**Morocco**	Ba1	BB	FIX
Botswana	A2	A	FIX	**Netherlands**	Aaa	AAA	FIX
Brazil	B2	B+	FIX	**New Zealand**	Aaa	AA+	FLOAT
Bulgaria	Ba2	BB+	FIX	**Norway**	Aaa	AAA	INT
Canada	Aaa	AAA	FLOAT	**Oman**	Baa2	BBB	FIX
Chile	Baa1	A-	FLOAT	**Pakistan**	B3	B	INT
China	A3	BBB	FIX	**Panama**	Ba1	BB	FIX
Colombia	Ba2	BB	FLOAT	**Papua New Guinea**	B1	B	FLOAT
Costa Rica	Ba1	BB	INT	**Paraguay**	Caa1	SD	INT
Cyprus	A2	A	INT	**Peru**	Ba3	BB-	FLOAT
Czech Repulic	A1	A-	INT	**Philippines**	Ba1	BB	FLOAT
Denmark	Aaa	AAA	INT	**Poland**	A2	BBB+	FLOAT
Dominican Rep	Ba2	B-	INT	**Portugal**	Aa2	AA	FIX
Egypt	Ba1	BB+	INT	**Qatar**	A3	A-	FIX
El Salvador	Baa3	BB+	FIX	**Romania**	B2	BB-	INT
Estonia	A1	A-	FIX	**Russia**	Ba2	BB	FLOAT
Finland	Aaa	AAA	FIX	**Saudi Arabia**	Baa3	A	FIX
France	Aaa	AAA	FIX	**Singapore**	Aaa	AAA	INT
Germany	Aaa	AAA	FIX	**Slovakia**	A3	BBB	INT
Greece	A1	A	FIX	**Slovenia**	Aa3	A+	INT
Hong Kong	A1	A+	FIX	**South Africa**	Baa2	BBB	INT
Hungary	A1	A-	INT	**Spain**	Aaa	AA+	FIX
Iceland	Aaa	A+	INT	**Suriname**	B1	B-	INT
India	Ba1	BB	FLOAT	**Sweden**	Aaa	AA+	FLOAT
Ireland	Aaa	AAA	FIX	**Switzerland**	Aaa	AAA	FLOAT
Israel	A2	A-	INT	**Taiwan**	Aa3	AA-	FLOAT
Italy	Aa2	AA	FIX	**Thailand**	Baa3	BBB-	FLOAT
Jamaica	B1	B+	INT	**Trinidade and Tobago**	Baa3	BBB	FIX
Japan	Aa1	AA-	FLOAT	**Tunisia**	Baa2	BBB	INT
Jordan	Ba2	BB-	FIX	**Turkey**	B1	B-	FLOAT
Kazakshtan	Baa3	BB+	INT	**UK**	Aaa	AAA	FLOAT
Korea	A3	A-	FLOAT	**Uruguay**	B3	SD	INT
Kuwait	A2	A+	FIX	**USA**	Aaa	AAA	FLOAT
Latvia	A2	BBB+	FIX	**Venezuela**	Caa1	CCC+	INT
Lebanon	B2	B-	FIX				

Annex II.b - Scenario of May 2008 (2006 for exchange rate regimes)

Country	Moody's	S&P	Regime	Country	Moody's	S&P	Regime
Argentina	B3	B+	INT	**Lithuania**	A2	A-	FIX
Australia	Aaa	AAA	FLOAT	**Luxembourg**	Aaa	AAA	FIX
Austria	Aaa	AAA	FIX	**Malaysia**	A1	A-	INT
Barbados	Baa2	BBB+	FIX	**Malta**	A1	A	FIX
Belgium	Aa1	AA+	FIX	**Mexico**	Baa1	BBB+	FLEX
Belize	Caa1	B	FIX	**Mongolia**	B1	BB-	INT
Bolivia	B3	B-	FIX	**Morocco**	Ba1	BB+	FIX
Botswana	A2	A	INT	**Netherlands**	Aaa	AAA	FIX
Brazil	Ba1	BBB-	FLOAT	**New Zealand**	Aaa	AA+	FLEX
Bulgaria	Baa3	BBB+	FIX	**Norway**	Aaa	AAA	FLEX
Canada	Aaa	AAA	FLOAT	**Oman**	A2	A	FIX
Chile	A2	A+	FLOAT	**Pakistan**	B1	B	FIX
China	A1	A+	FIX	**Panama**	Ba1	BB+	FIX
Colombia	Ba2	BB+	INT	**Papua New Guinea**	B1	B+	INT
Costa Rica	Ba1	A	INT	**Paraguay**	B3	B	INT
Cyprus	Aa3	A+	INT	**Peru**	Ba2	BB+	INT
Czech Repulic	A1	A	INT	**Philippines**	B1	BB-	FLEX
Denmark	Aaa	AAA	INT	**Poland**	A2	A-	FLEX
Dominican Rep	B2	B+	INT	**Portugal**	Aa2	AA-	FIX
Egypt	Ba1	BB+	FIX	**Qatar**	Aa2	AA-	FIX
El Salvador	Baa3	BB+	FIX	**Romania**	Baa3	BBB-	INT
Estonia	A1	A	FIX	**Russia**	Baa2	BBB+	INT
Finland	Aaa	AAA	FIX	**Saudi Arabia**	A1	AA-	FIX
France	Aaa	AAA	FIX	**Singapore**	Aaa	AAA	INT
Germany	Aaa	AAA	FIX	**Slovakia**	A1	A	INT
Greece	A1	A	FIX	**Slovenia**	Aa2	AA	INT
Hong Kong	Aa2	AA	FIX	**South Africa**	Baa1	BBB+	FLEX
Hungary	A2	BBB+	INT	**Spain**	Aaa	AAA	FIX
Iceland	Aaa	A	FLOAT	**Suriname**	B1	B+	FIX
India	Baa3	BBB-	INT	**Sweden**	Aaa	AAA	FLEX
Ireland	Aaa	AAA	FIX	**Switzerland**	Aaa	AAA	FLEX
Israel	A1	A	FLOAT	**Taiwan**	Aa3	AA-	INT
Italy	Aa2	AA+	FIX	**Thailand**	Baa1	BBB+	INT
Jamaica	B1	B	INT	**Trinidade and Tobago**	Baa1	A	FIX
Japan	Aaa	AA	FLOAT	**Tunisia**	Baa2	BBB	INT
Jordan	Ba2	BB	FIX	**Turkey**	Ba3	BB-	FLEX
Kazakshtan	Baa2	BBB-	INT	**UK**	Aaa	AAA	FLEX
Korea	A2	A	FLOAT	**Uruguay**	B1	BB-	INT
Kuwait	Aa2	AA-	FIX	**USA**	Aaa	AAA	FLEX
Latvia	A2	BBB+	FIX	**Venezuela**	B2	BB-	FIX
Lebanon	B3	CCC+	FIX				

Annex III.a - Residuals and statistical properties, by type of rating (May 2003 estimation)

ESTIMATION	REGIME	2003 - Errors and Statistics								
		Notche/Residual thresholds								
		]-1.50 , 1.50[			≤ -1.50 or -0.50 (Log)			≥ 1.50 or -0.50 (Log)		
		Aaa to A3	Baa1 to Baa3	≤ Ba1	Aaa to A3	Baa1 to Baa3	≤ Ba1	Aaa to A3	Baa1 to Baa3	≤ Ba1
LINEAR	FIX	12	6	8	2	1	0	6	0	0
	INTERM	8	3	11	1	0	0	1	0	0
	FLOAT	9	2	6	0	0	1	2	1	1
	Total	**29**	**11**	**25**	**3**	**1**	**1**	**9**	**1**	**1**
EXPONENTIAL	FIX	6	4	8	5	3	0	9	0	0
	INTERM	7	3	10	1	0	1	2	0	0
	FLOAT	7	3	6	2	0	2	2	0	0
	Total	**20**	**10**	**24**	**8**	**3**	**3**	**13**	**0**	**0**
LOGISTIC	FIX	8	6	7	5	0	1	7	1	0
	INTERM	9	3	10	1	0	0	0	0	1
	FLOAT	8	2	6	1	0	1	2	1	1
	Total	**25**	**11**	**23**	**7**	**0**	**2**	**9**	**2**	**2**

Annex III.b - Residuals and statistical properties, by type of rating (May 2008 estimation)

ESTIMATION	REGIME	2008 - Errors and Statistics								
		Notche/Residual thresholds								
		]-1.50 , 1.50[			≤ -1.50 or -0.50 (Log)			≥ 1.50 or -0.50 (Log)		
		Aaa to A3	Baa1 to Baa3	≤ Ba1	Aaa to A3	Baa1 to Baa3	≤ Ba1	Aaa to A3	Baa1 to Baa3	≤ Ba1
LINEAR	FIX	15	4	6	2	0	3	5	0	1
	INTERM	8	4	6	0	0	4	2	2	0
	FLOAT	12	2	1	0	0	2	2	0	0
	Total	**35**	**10**	**13**	**2**	**0**	**9**	**9**	**2**	**1**
EXPONENTIAL	FIX	9	4	5	5	0	4	8	0	1
	INTERM	9	4	6	0	0	4	1	2	0
	FLOAT	11	2	0	0	0	3	3	0	0
	Total	**29**	**10**	**11**	**5**	**0**	**11**	**12**	**2**	**1**
LOGISTIC	FIX	10	2	7	5	0	2	7	2	1
	INTERM	10	3	6	0	0	4	0	3	0
	FLOAT	13	2	1	0	0	2	1	0	0
	Total	33	7	14	5	0	8	8	5	1

Annex IV.a – Correlation matrix for LIN (May 2003)

Matrix	LIN	GDPPC	DSAV	INFL	GDPGR	FISCAL	GOVDEB	DEBTX	CURBAL	POLSOC	DEVELOP	DEFAULT	FIX	INTERM	FLOAT
LIN															
GDPPC	80,74%														
DSAV	34,78%	34,14%													
INFL	-44,54%	-30,92%	-11,14%												
GDPGR	17,90%	-5,75%	29,18%	-14,66%											
FISCAL	24,12%	37,21%	26,98%	-6,06%	2,36%										
GOVDEB	-25,06%	-6,71%	-40,89%	1,00%	-46,85%	-7,24%									
DEBTX	-78,62%	-61,04%	-30,65%	31,88%	-27,60%	-20,39%	31,77%								
CURBAL	23,95%	37,47%	68,05%	-11,54%	0,54%	61,03%	-27,89%	-20,06%							
POLSOC	86,03%	74,92%	27,68%	-35,75%	1,76%	17,56%	-18,90%	-64,66%	12,59%						
DEVELOP	79,29%	84,42%	15,48%	-26,34%	-10,55%	20,10%	2,42%	-60,86%	15,71%	70,91%					
DEFAULT	-60,32%	-4,71%	-29,59%	36,15%	-26,22%	-10,42%	8,10%	59,55%	-4,73%	-52,96%	-40,80%				
FIX	13,17%	1,23%	15,99%	-31,08%	19,54%	14,87%	-0,45%	-12,47%	8,23%	17,42%	12,96%	-25,25%			
INTERM	-21,15%	-7,78%	-14,84%	26,54%	-13,75%	-9,61%	1,57%	12,86%	-11,99%	-15,88%	-18,10%	18,60%	-54,61%		
FLOAT	6,68%	-6,10%	-2,74%	7,60%	-7,72%	-6,73%	-1,08%	0,84%	2,94%	-3,25%	3,20%	13,76%	-54,00%	-39,66%	

Annex IV.b – Correlation matrix for LIN (May 2008)

Matrix	LIN	GDPPC	DSAV	INFL	GDPGR	FISCAL	GOVDEB	DEBTX	CURBAL	POLSOC	DEVELOP	DEFAULT	FIX	INTERM	FLOAT
LIN															
GDPPC	77,03%														
DSAV	33,56%	30,20%													
INFL	-58,87%	-38,29%	4,84%												
GDPGR	-32,72%	-31,29%	31,76%	53,75%											
FISCAL	29,67%	44,51%	30,93%	4,87%	-4,57%										
GOVDEB	-9,21%	-2,77%	-43,40%	-23,06%	-48,01%	-13,94%									
DEBTX	-63,38%	-56,74%	-30,30%	53,06%	48,19%	-12,84%	-3,05%								
CURBAL	17,64%	24,75%	75,38%	-3,36%	13,11%	45,85%	-23,69%	-31,54%							
POLSOC	84,55%	73,13%	18,36%	-50,82%	-35,79%	18,75%	-3,68%	-51,73%	1,11%						
DEVELOP	73,12%	78,33%	3,93%	-49,89%	-52,92%	19,60%	17,75%	-67,24%	2,32%	68,62%					
DEFAULT	-58,76%	-8,29%	-27,38%	37,29%	26,75%	-9,21%	-8,54%	39,34%	-7,50%	-51,11%	-40,80%				
FIX	3,85%	19,10%	-0,36%	0,94%	4,60%	9,70%	2,56%	-7,45%	5,71%	-1,83%	10,16%	-15,52%			
INTERM	-27,69%	-12,93%	9,75%	22,50%	22,53%	-21,59%	-11,06%	16,82%	-1,94%	-21,03%	-34,49%	5,58%	-61,50%		
FLOAT	26,00%	-18,22%	-10,33%	-25,89%	-30,22%	12,41%	9,19%	-9,80%	-4,55%	25,31%	26,09%	12,05%	-49,51%	-38,06%	