Do credit rating agencies piggyback? Evidence from sovereign debt ratings*

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Abstract

I argue that when more than one credit rating agency rates an asset, each one has the incentive to put a weight on the competitors rating. This piggybacking allows an agency to increase the precision of its own rating while doing less monitoring. I test this hypothesis, using annual data on sovereign debt ratings by the three main credit rating agencies for 117 countries. I show that the probability of a rating change depends on the rating differential towards its competitors, even when accounting for an observable and unobservable common information set. Further evidence from the Euro Area sovereign debt crisis suggest that agencies are also influenced by the competitor's outlook or recent rating changes.

JEL Classification: G15, G24

Keywords: sovereign debt ratings, credit rating agencies, rating transitions.

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1 Introduction

Credit rating agencies have been under fire. First, they were blamed for their role before the 2008 financial crisis, by attributing a AAA rating to mortgage backed securities that turned out to be junk. More recently, they were accused of having adapted too slowly to the deterioration of the public finances in the Euro Area and, subsequently exacerbating the Euro area sovereign debt crisis, following the severe downgrades of Greece, Ireland and Portugal.[1] These critiques have lead to increasing discussions of the CRA business model and on how to improve the regulatory framework.[2]

A number of recent papers have studied the characteristics of the credit rating game and relate them to the failure of the rating of structured credit products. Amongst others, there are three relevant elements. As issuers pay for the rating, there is a clear conflict of interest, as their payments may influence the rating (Bolton, Freixas, and Shapiro (2009)). The second issue is the *rating shopping*. If a firm dislikes its rating, it can ask to be rated by another agency. The rating shopping becomes more perverse as assets become more complex, increasing the benefits of shopping (Skreta and Veldkamp (2009). Finally, reputation is crucial for the agencies' future business and can be assessed by comparing the ratings with ex-post defaults.

These characteristics of the credit rating game are not, however, as relevant for sovereign debt ratings. Most advanced countries have their sovereign bonds rated by the three main agencies: Moodys, Standard and Poors (S&P) and Fitch; so there is no room for *rating shopping*. Also, government bonds have not increased in complexity and most of the information used to evaluate the creditworthiness, is publicly available. Second, although it is possible for a country to withdraw its rating, it seldom happens.[3] For advanced economies, most of them rated by all agencies, the threat of rating withdrawal is not credible, so the conflict of interest is not relevant. Finally, the default of a rated sovereign entity is a rare event. For instance, there has never been a country rated above BBB- by any agency, that has defaulted within 10 years. It is therefore hard to assess ex-post que quality of an agency, specially along the investment grade ratings.

[1] See review of credit rating agencies and the discussion of its critiques by de Haan and Amtenbrink (2011).

[2] See, for instance, Commission (2010).

[3] In the history of the rating agencies it has only happened twice for Moody's (Moldova and Turkmenistan) and S&P (Madagascar and Mali) and nine times for Fitch (Benin, Gambia, Iran, Malawi, Moldova, Turkmenistan, Madagascar, Mali and Papua New Guinea). In some cases a country does not even pay for the rating as many sovereign ratings are unsolicited. For instance, S&P has unsolicited ratings for: Australia, Belgium, Cambodia, France, Germany, India, Italy, Japan, Netherlands, Singapore, Switzerland, Taiwan, United Kingdom and United States of America.

Sovereign credit rating game is fundamentally different from the corporate sector which explains the lack of theoretical papers on the topic. My objective is to highlight one property of the credit rating game that is relevant for sovereign ratings: *piggybacking*. Rating agencies look at several elements when attributing a rating, such as public debt or growth. But amongst the public information, the agency knows the rating attributed by its competitors. If a rating carries some information about the creditworthiness of a country, it is optimal for an agency to incorporate it in its own rating, by putting some weight on the competitors' ratings and, perhaps, do less monitoring itself. This potential criticism of rating agencies, was best described in an IMF working paper that analysed their role during the Asian crisis (Bhatia (2002)):

> The heavy workload at the ratings agencies may result in an element of piggybacking, with analysts relying to varying degrees on research produced by the IMF, academia, investment banks, and - conceivably - other rating agencies as they seek to remain abreast of developments. (...) The concept of piggybacking does not necessarily explain the upside bias in sovereign credit ratings, but may help explain heard behaviour.

I set up a simple model to illustrate this interaction. In the model, there is no shopping for rating or conflict of interest. A credit rating agency can obtain signals of the creditworthiness of a country, at a certain cost. The agency can choose to get more signals to increase the precision of its rating. I assume that the payoff of an agency depends negatively of the possible variance of its rating. Agencies care about precision, mainly because it affects the other business areas. Usually, the sovereign rating is the ceiling for domestic corporate issuers.[4] With only one agency, there is a trade-off between the precision of the rating and the costs of monitoring. When we introduce a second agency, it is optimal for both of them to observe fewer signals and put some weight on the competitor's rating. If one agency cares little about precision, it will freeride completely and do the minimum level of monitoring. I also show that in some cases having more agencies does not increase the overall monitoring of a country, and that it can actually decrease it. Although with a different setting, this result is also found in Faure-Grimaud, Peyrache, and Quesada (2009).

Then, I provide evidence that rating agencies do piggyback. I use end-of-year data of rating for 117 countries between 1996 and 2006, as used in Afonso, Gomes, and Rother (2011),

[4] This seems to be an implicit rule of rating agencies. There are very few cases of corporate issuers with higher rating than the sovereign. One justification of this rule is that sovereign risk is a key determinant of corporate defaults. For instance, Moody's (2009) find that country risk has been twice as important as firm risk in corporate defaults during sovereign crisis episodes and more than half as important that firm risk and as important as industry risk outside crisis periods.

I test whether the probability of a rating change depends on the difference of the agency's rating relative to its competitors. The problem with this approach is that it does distinguish piggybacking from rating leadership. Rating leadership implies that all agencies respond to changes in the common information set, but that one agency reacts first. Both theories predict that, unconditionally, higher rating relative to the competitors increases the probability of downgrade and decrease the probability of an upgrade. In fact, there is evidence of this unconditional interaction. Al-Sakka and ap Gwilym (2010b) show that the rating difference relative to the competitors is an important predictor of rating changes. Also, Al-Sakka and ap Gwilym (2010a) using sovereign ratings and Guttler and Wahrenburg (2007) using corporate ratings near default, find that an agency is more likely to downgrade (upgrade) if their competitors have downgraded (upgraded) within the past 6 months. However, none of these papers include any controls in the regression, so we cannot distinguish piggybacking from leadership.

To distinguish whether the agencies are responding to the competitors or merely to changes in the common information set, I first estimate a predictive model of ratings based on current public information (macroeconomic, fiscal and external variables). I then estimate the probability of rating changes including several control variables. I also include the lagged difference of the rating relative the predicted rating of the other agencies, as well as the lagged difference relative to the model prediction of its own rating. The horserace shows that agencies are more influenced by the difference relative to the competitors, rather than their own, despite both being calculated based on the same data.

As a robustness exercise, I use daily data on sovereign debt ratings for European countries for the period between 2002 and 2010, the same as used by Afonso, Furceri, and Gomes (2011). In this way I can capture multiple rating changes within a year, that have occurred during the Euro Area sovereign debt crisis. The other advantage of using daily data is that we can include as controls information on yield spreads and stock market returns, which summarize relevant information that can predict rating changes. I estimate probit regression on the probability of rating changes and find that both the rating gap and outlooks of the competitors are significant predictors of the probability of downgrades and upgrades for all the agencies, even when we control for yield spreads and stock market returns.

2 Model

I first describe setting with one agency to provide a benchmark and then extend it to two agencies.

2.1 One Agency

Let us assume that the a country has a creditworthiness measure of c which is unknown. The credit agency have to make an assessment R. For that, it can get signals $x_i \sim N(c, \sigma^2)$. The agency can chose any number of signals t, but each signal is costly. We can think of t as the monitoring of the country. I assume total costs are given by ςt^α. If α is larger than one, the initial information is easier to get, but getting more signals becomes increasingly costly. On the other hand, α could be less than one, if they are initial costs of having a team being introduced to a country, but once it is established, more information becomes easier to get.

The defining element of the model is the payoff of the agency. As agency is paid independently of the rating it attributes, the conflict of interest does not seem to be important. I therefore assume that the rating is equal to the mean of the signals, $R = \frac{\sum_{i=1}^{t} x_i}{t}$, which is an unbiased estimator of c. So why would an agency care about monitoring the country? The main incentive to have a precise estimator is because the sovereign rating affects all other business areas. Sovereign risk is an important determinant of corporate defaults and, in the great majority of cases, the sovereign rating is the upper bound for all domestic corporate issuers. There is a clear incentive for agencies to be accurate, not only because of the possibility of default of the country (as we have seen is a rare event), but more because it affects the quality of ratings in other business areas. I assume that the payoff of the agency is negatively proportional to variance of its rating, weighted by δ. We can think of δ as some type of monetary cost associated with possible imprecise assessments. Within an agency, this weight should vary from country to country depending on its share of the agencies revenue in other business areas.[5] The objective function of the agency is therefore:

$$\begin{aligned} \max_{\{t\}} \quad & -[Var(R)\delta + \varsigma t^\alpha] \\ s.t. \quad & t \geq \tau \end{aligned}$$

where $Var(R) = \frac{\sigma^2}{t}$. The agency chooses the number of signals, above a minimum level, τ. The solution to this problem is $\bar{t}$, the optimal number of signals if the agency is alone in the market, given by $\bar{t} = (\frac{\sigma^2\delta}{\varsigma})^{\frac{1}{1+\alpha}}$. I assume that it is larger than τ to have a non-trivial interior solution. An agency does more monitoring, the higher the importance of the country

[5]Certainly, people could argue that the objectives of rating agencies are influence by other, less bright, objectives. For instance, some people have argued that rating agencies have the incentive to attribute higher sovereign ratings than their competitors to attract more business to its corporate sector. Although this is plausible, it is far beyond the scope of this paper so I prefer to show the incentive to piggyback, even in the most innocuous setting, where agencies try to do their job the best they can.

for the rest of the business areas. It is also increasing on the variance of the signals and decreasing in the costs of getting an extra signal.

2.2 Two Agencies

With two agencies in the market, A and B, each one can get signals taken from the same distribution $x_i, y_i \sim N(c, \sigma^2)$. To make the model tractable I assume that the signals between the two agencies are not correlated.[6] The two firms might diverge in the monetary costs associated with the variance of its rating δ_A and δ_B.

The agencies play a static game of complete information, where they observe each others monitoring, weight and rating and decide simultaneously. Beside their own signals, each agency can observe the competitor's rating, which carry some information. Now, each agency chooses not only the number of signals to observe, but also the weight it puts on the other firm's rating (i.e. $R_A = \omega_A \frac{\sum_{i=1}^{t_A} x_i}{t_A} + (1-\omega_A)R_B$ for agency A). So, we can write the rating as:

$$R_A = \frac{\omega_A}{\omega_A + \omega_B - \omega_A\omega_B} \frac{\sum_{i=1}^{t_A} x_i}{t_A} + \frac{\omega_B(1-\omega_A)}{\omega_A + \omega_B - \omega_A\omega_B} \frac{\sum_{i=1}^{t_B} y_i}{t_B} \tag{1}$$

Although the payoff function of the agency is the same as before, the expression of the variance of the rating now also depends on the weights chosen by the two agencies. The problem is then:

$$\begin{array}{ll} \max\limits_{\{t\}} & -[(\frac{\omega_A}{\omega_A+\omega_B-\omega_A\omega_B})^2 \frac{\sigma_\epsilon^2}{t_A} + (\frac{\omega_B(1-\omega_A)}{\omega_A+\omega_B-\omega_A\omega_B})^2 \frac{\sigma_\epsilon^2}{t_B}]\delta_A - \varsigma t_A^\alpha \\ s.t. & t \geq \tau \end{array}$$

The optimal number of signals has an interior solution characterized by:

$$t_A^* = (\frac{\omega_A}{\omega_A + \omega_B - \omega_A\omega_B})^{\frac{2}{1+\alpha}} \bar{t}_A \tag{2}$$

The optimal number of signals collected, t_A^* is increasing in ω_A and decreasing in ω_B. When $\omega_A = 1$, it is equivalent to the monopolist solution with $t_A^* = \bar{t}_A$. When the competitor does a lot of monitoring, $t_B > \bar{t}_A^{\frac{1+\alpha}{2}} \tau^{\frac{1-\alpha}{2}} - \tau$, we have a corner solution, where the agency takes the minimum number of draws $t_A^* = \tau$. The first-order-condition with respect to the weight is:

$$\omega_A^* = \frac{\omega_B t_A}{\omega_B t_A + t_B} \tag{3}$$

[6] All the results hold as long as the signals are not perfectly correlated.

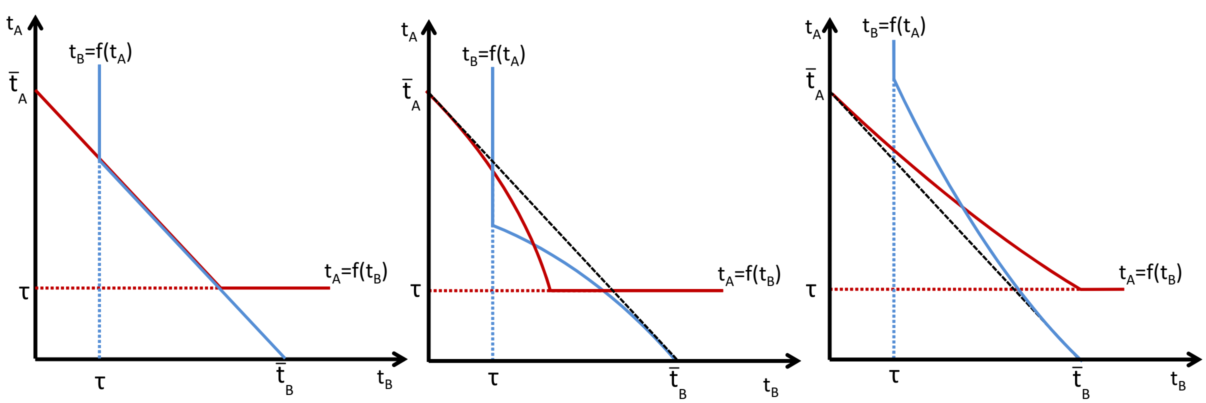
The optimal weight put by the agency on their own signals, ω_A^* is increasing with the number of draws but is decreasing the the competitors monitoring. We use the conditions to write the reaction function t_A implicitly in terms of t_B and the parameters.

$$\begin{cases} t_A = (\frac{t_A}{t_B+t_A})^{\frac{2}{1+\alpha}} \bar{t}_A & \text{if} \quad t_B < \bar{t}_A^{\frac{1+\alpha}{2}} \tau^{\frac{1-\alpha}{2}} - \tau \\ t_A = \tau & \text{if} \quad t_B \geq \bar{t}_A^{\frac{1+\alpha}{2}} \tau^{\frac{1-\alpha}{2}} - \tau \end{cases} \tag{4}$$

2.2.1 Equilibria

The agencies play a static simultaneous game and I look at Nash Equilibria. The equilibria are depicted in Figure 1 for the symmetric case where $\bar{t}_A = \bar{t}_B$. There are two types of equilibrium: one where both agencies are have an interior solution and one where one agency does the minimum level of monitoring. The exact number of equilibria depends on the cost function. If agencies are identical and costs are linear, there is an infinite number of equilibria where agencies simply share the burden of monitoring. When the costs are convex, there is only one equilibrium satisfying the interior solution for both agencies. When costs are concave, there are three possible equilibria, Two where one agency free-rides and puts a big weight on the other agency, and one where they do the same monitoring. We can state three relevant propositions regarding this game.[7]

Figure 1: Symmetric equilibria



(a) Linear costs (b) Convex costs (c) Concave costs

Proposition 1 *If $\tau > 0$, an agency always puts a positive weight on the competitors rating.*

As long as the minimum level of monitoring is not zero, agencies will always put some weight on the other agency's rating. This is independent of which type of equilibria we have.

[7] All proofs are in appendix.

The intuition is simple. As long as the competitors do a little monitoring, its rating will carry some information about the countrys creditworthiness, so it is optimal to put some weight.

By putting some weight in the competitors, agencies are freeriding, meaning that that no agency will get as many signals as if they were alone in the market. The overall number of signals can be higher, lower or equal, depending on the cost functions. If costs are linear, then all equilibria yield the same level of monitoring. If costs are concave, the overall monitoring is less than with one agency. If they are convex, there will be more monitoring. This is expressed in Proposition 2.

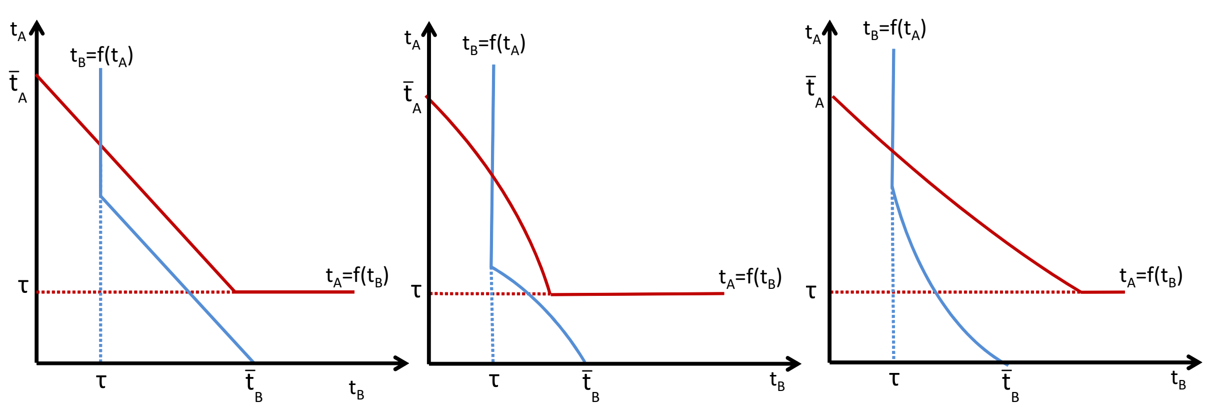
Proposition 2 *If cost are concave, the overall level of monitoring with two agencies is lower than the when there is only one agency.*

Finally, the third proposition tells us that if one agency penalizes strongly the variance of its estimator, relative to its competitor, then there will only be an equilibrium where the competitor does minimum monitoring and free rides completely. This result is illustrated in Figure 2.

Proposition 3 *If δ_A is high enough relative to δ_B, there will only be one equilibrium with $t_B = \tau$.*

The first and third proposition provide testable implications. The second proposition cannot be tested but is suggestive that in some settings having more agencies does not necessarily imply more monitoring.

Figure 2: Asymmetric Equilibria



(a) Linear costs (b) Convex costs (c) Concave costs

3 Empirical Analysis

3.1 Overview

Sovereign credit ratings are a condensed assessment of a government's ability and willingness to repay its public debt both in principal and in interests on time. The three main rating agencies attribute it in the form of equivalent qualitative codes, but measuring different things. While S&P evaluates the probability of default, Moody's evaluates the expected loss, which is the product of the probability of default and the expected loss for investors in the case of default. Fitch has a mixed approach, evaluating the probability of default but having a parallel Recovery Ratings scale. In order to access the risk of default, they analyse a wide range of elements, but not necessarily the same.[8]

Table 1 provides some statistics on ratings by agency, for the period between 1996 and 2006. Each agency rates around 100 countries, giving more that 900 end-of-year observations for Moody's and S&P and close to 800 for Fitch. The table also shows the geographic distribution of countries. I distinguish five groups: industrialized countries, Africa and Middle East, South and East Asia and Pacific, Europe and Central Asia and Latin America and Caribbean. As expected, the industrialized economies represent the biggest share of ratings. Moody's seems more concentrated in industrialized and Latin American and Caribbean countries. S&P and Fitch are more balanced, with a relative larger weight of African and Middle East countries.

S&P is the most active agency with 102 upgrades and 63 downgrades. Moody's is know to be less active and has only 93 upgrades and 47 downgrades. Fitch lies in between with 94 upgrades and 40 downgrades. The last two rows show the number of ratings in investment and speculative grade. On average 60 percent of the ratings are of investment grade. Moody's has a larger weight of investment grade ratings relative to S&P.

Table 2 compares the end-of-year rating of countries rated by any two agencies. On average there are 80 countries with a common rating for 9 years. Although the agencies

[8] S&P looks at: Political risk, income and economic structure, economic growth prospects, fiscal flexibility, general government debt burden, offshore and contingent liabilities, monetary flexibility, external liquidity and external debt burden. Moody's rates the country based on their assessment of economic strength, institutional strength, government financial strength and countries susceptibility to event risk. Finaly, Fitch has a long list of areas that determine the rating: demographic, educational and structural factors, labour market analysis, structure of output and trade, dynamism of the private sector, balance of supply and demand, balance of payments, analysis of medium-term growth constraints, macroeconomic policy, trade and foreign investment policy, banking and finance, external assets, external liabilities, politics and the state and international position.

Table 1: Ratings, upgrades, downgrades and geographic distribution by agencies (1996-2006)

	All countries		
	Moody's	S&P	Fitch
Countries$^{\$}$	93	102	95
Industrialized	24 (26%)	24 (24%)	24 (25%)
Africa and Middle East	13 (15%)	22 (22%)	21 (22%)
South and East Asia and Pacific	13 (15%)	15 (15%)	15 (16%)
European and Central Asia	18 (19%)	18 (18%)	19 (20%)
Latin America and Caribbean	23 (25%)	23 (23%)	16 (17%)
Ratings	927	941	791
Downgrades	47	63	40
Upgrades	102	137	118
Ratings by grade			
Investment (BBB- or above)	596 (64%)	577 (61%)	497 (63%)
Speculative (BB+ or below)	331 (36%)	364 (39%)	294 (37%)

Notes: $^{\$}$ *Countries rated at the end of 2006*

measure different things, look at different variables and claim to have different models, they make remarkably similar assessments. The average absolute difference is between 0.4 and 0.7 notches. More than 50 percent of the ratings attributed at the end of the year by any two agencies, have the exact same code. Only 2 percent of the observations have a difference of more than two notches. This is even more notorious between Fitch and S&P that agree on 60 percent of the ratings and where 96 percent are within one notch. The average difference is only 0.4 notches. Even if we exclude the observations with AAA and bellow B-, we get similar results.

The last row shows the average difference between agencies. Moody's on average attributes higher ratings than both Fitch and S&P, but when we exclude the AAA and bellow B- countries Fitch seems to attribute higher ratings.

Table 2: Comparison of end-of-year ratings between agencies (1996-2006)

	All countries			**Countries between B- and AA+**		
	Moody's-Fitch	Moody's-S&P	Fitch-S&P	Moody's-Fitch	Moody's-S&P	S&P-Fitch
Countries	76	88	84	58	68	66
Observations	689	822	736	489	607	560
Differences						
-2 Notches	43	43	18	43	42	13
-1 Notch	112	157	130	102	139	115
0 Notches	345	412	452	204	261	314
1 Notch	110	136	123	86	106	106
2 Notches	60	56	12	43	51	11
0 Notches	50.5%	50.1%	61.5%	41.7%	43.0%	56.1%
$\leq$ 1 Notch	82.7%	85.8%	95.8%	80.2%	83.4%	95.5%
$\leq$ 2 Notches	97.7%	97.8%	99.9%	97.8%	98.7%	99.8%
Average abs.	0.69	0.67	0.43	0.81	0.75	0.48
Average	0.07	0.04	-0.02	-0.02	-0.02	-0.02

3.2 Methodology

The natural starting point of the empirical approach is the equation suggested by the model:

$$R_i^j = \omega \bar{x}_i + (1-\omega) R_i^{-j}, \tag{5}$$

where R_i^j is the rating of agency $j \in \{M, S, F\}$ and R_i^{-j} is the average rating of its two competitors. There are several problems with estimating this equation for a cross section of countries. First, there is the endogeneity between the two ratings. We would need to find instruments: variables that one agency considers, that is not used by other agencies. This is hard to do in widely accepted way. Also, as we have shown before, the ratings between the agencies are very close, so it would be hard to persuade that the results are not spurious, unless we control for an unrealistic number of variables.

One alternative is to explore the time dimension of the data. For simplicity, the model considered a static setting were all agencies played simultaneously and looked at Nash equilibria. In reality, when agencies reevaluate a rating, they can only observe their competitors rating of the previous period. Including time subscripts in the equation (5)

$$R_{i,t}^j = \omega \bar{x}_{i,t} + (1-\omega) R_{i,t-1}^{-j}, \tag{6}$$

and subtracting the previous period rating

$$R_{i,t}^j - R_{i,t-1}^j = \omega \bar{x}_{i,t} + (1-\omega)(R_{i,t-1}^{-j} - R_{i,t-1}^j) - \omega R_{i,t-1}^j. \tag{7}$$

Equation (7) implies that the change in the ratings of an agency can be predicted by the past difference of ratings relative to the competitors. Given that the ratings change infrequently, the left hand side has many zeros, so discrete choice models are more suited. Let us define the variable *Change* that takes the value 1 if there is an upgrade, the value -1 if the country has been downgraded, and 0 if the rating has not change. We then estimate an ordered probit model of the type:

$$Change_{it}^j = \begin{cases} 1 & \text{if} \quad L_{it}^* > c_2 \\ 0 & \text{if} \quad c_2 > L_{it}^* > c_1 \\ -1 & \text{if} \quad c_1 > L_{it}^* \end{cases} \tag{8}$$

$$L_{it}^* = \omega_1 (R_{it-1}^j - R_{it-1}^{-j}) + Controls_t + \mu_{it}. \tag{8A}$$

I assume that there is no country specific error so we can estimate the model with ordered probit.[9] If agencies do piggyback, we would expect that if the rating is higher than its competitors, it increases the probability of downgrade and reduces the probability of upgrading. We can control for several observable variables, but still the past rating of the competitors might be driven by other unobservable variables that are not controlled for, and that might cause the rating of the agency to change today.

The strategy to control for a common set of unobservable variables driving the rating of all agencies has two steps. First I estimate an ordered response model of ratings based on observable variables, in the spirit of Afonso, Gomes, and Rother (2011).[10]

$$R^*_{it} = \beta X_{it} + \eta \bar{X}_i + \lambda Z_i + \epsilon_i + \mu_{it}. \tag{9}$$

$$R_{it} = \begin{cases} AAA(AAa) & \text{if} \quad R^*_{it} > c_{16} \\ AA+(Aa1) & \text{if} \quad c_{16} > R^*_{it} > c_{15} \\ AA(AA2) & \text{if} \quad c_{15} > R^*_{it} > c_{14} \\ \ldots & \\ < CCC+(Caa1) & \text{if} \quad c_1 > R^*_{it} \end{cases} \tag{10}$$

Where X_{it} is a vector of time-varying explanatory variables, $\bar{X}_i$ is the time average of these variables and Z_i is a vectors time invariant variables. I include: macroeconomic variables (GDP per capita, real GDP growth, unemployment rate, inflation), government variables (government debt, fiscal balance, government effectiveness), external variables (external debt, foreign reserves, current account balance) and other variables (default history, european union and regional dummies) and estimate the model using ordered probit.[11] I then predict end-of-year ratings of Moody's, S&P and Fitch: $\hat{R}^M$, $\hat{R}^{SP}$, $\hat{R}^F$.

In the second stage I estimate annual probability of rating changes including controls (8), but instead of the difference vis-a-vis the other agencies (R^j_{t-1}-R^{-j}_{t-1}) we include the difference of the rating towards the average predicted rating of the competitors: (R^j_{t-1}-$\hat{R}^{-j}_{t-1}$), as well as the difference of the rating relative to its own prediction (R^j_{t-1}-$\hat{R}^j_{t-1}$). We can think about

[9] This would translate into a country having always higher probability of downgrades which with a long enough time series would lead to divergence of ratings. If it makes sense to have a country effect on the average rating, it does not seem plausible to have in on the probability of rating changes.

[10] The cardinal transformation of the ratings was done following a correspondence with the qualitative codes, using a linear scale with numerical equivalents between 1 and 17. Therefore, the maximum sovereign rating takes the value 17 (corresponding to AAA for S&P and Fitch, and Aaa for Moody's) and the lower limit of one, that encompasses all rating notations below B- (for S&P and Fitch) and below B3 (for Moody's).

[11] See Afonso, Gomes, and Rother (2011) for details on the methodology and data.

the last term as an error correction mechanism.

$$L^*_{it} = \omega_1(R^j_{it-1} - \hat{R}^{-j}_{it-1}) + Controls_t + \mu_{it}. \tag{8B}$$

$$L^*_{it} = \omega_1(R^j_{it-1} - \hat{R}^{-j}_{it-1}) + \alpha_1(R^j_{it-1} - \hat{R}^{j}_{it-1}) + Controls_t + \mu_{it}. \tag{8C}$$

I estimate the models (8BC) including as controls the lagged rating (as suggested by the model), the lagged rating squared and the following variables all included in first differences: log of GDP per capita, real GDP growth, unemployment rate, inflation rate, government debt, fiscal balance, government effectiveness, external debt, foreign reserves and current account balance. As robustness, I also estimate two probit regressions separately for downgrades and upgrades.[12]

3.3 Results

The results are shown in Table 3. The first three columns of each agency only include the controls and have pseudo R^2 of 0.11, 0.16 and 0.20.[13] The following columns include the difference relative to the predicted rating of the competitors. The pseudo R^2 goes up to 0.22, 0.24 and 0.3. The variable is significant for all the three agencies and has a negative coefficient, implying that if the rating is overvalued relative to the competitors, the probability of downgrading increases and the probability of upgrading decreases. We find a similar conclusion from the separate estimations of downgrades and upgrades.

But the most revealing estimations are in the third column of each agency, where I add the difference towards its own prediction, $(R^j_{it-1} - \hat{R}^j_{it-1})$. The variable is never statistically significant in the estimation of rating changes, while the coefficient of *piggybacking* remains significant for Moody's and Fitch. In the separate regressions of upgrades and downgrades the coefficient is still significant in four cases (at least one per agency), while the error correction term is only significant in two.[14] Given that both variables were calculated based on the same data, it proves that the interdependence of ratings is not just because agencies look at the same variables, but because they do piggyback.

In limited dependent variable models, the magnitude of the coefficients tell us very little. Table 4 show the probabilities of upgrading or downgrading depending on the rating

[12]See appendix for description of variables and the results of the first stage forecasting models.

[13]The coefficients are shown in Appendix. The change of the GDP per capita and of the government budget balance are the most important determinants of rating changes.

[14]Appendix shows a table with disaggregation be agency. There is an interesting triangle with Moody's relying more on S&P, that relies on Fitch, that relies on Moody's.

Table 3: Estimations of rating changes (1993-2006)

	Moody's			S&P			Fitch		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rating changes									
$R^j_{it-1} - \hat{R}^{-j}_{it-1}$		-0.45***	-0.24**		-0.42***	-0.25		-0.52***	-0.43***
		(-5.92)	(-2.11)		(-4.28)	(-1.64)		(-5.58)	(-2.82)
$R^j_{it-1} - \hat{R}^{j}_{it-1}$			-0.24			-0.20			-0.11
			(-1.55)			(-1.20)			(-0.74)
Pseudo R^2	0.11	0.22	0.23	0.16	0.24	0.24	0.20	0.31	0.31
Downgrades									
$R^j_{it-1} - \hat{R}^{-j}_{it-1}$		0.45***	0.22*		0.54***	0.01		0.68***	0.53***
		(5.98)	(1.71)		(5.39)	(0.07)		(4.36)	(2.80)
$R^j_{it-1} - \hat{R}^{j}_{it-1}$			0.33*			0.64**			0.17
			(1.74)			(2.42)			(0.92)
Pseudo R^2	0.26	0.36	0.38	0.23	0.33	0.36	0.28	0.42	0.42
Upgrades									
$R^j_{it-1} - \hat{R}^{-j}_{it-1}$		-0.39***	-0.24		-0.36***	-0.31**		-0.45***	-0.40**
		(-4.47)	(-1.39)		(-3.07)	(-2.01)		(-4.07)	(-2.42)
$R^j_{it-1} - \hat{R}^{j}_{it-1}$			-0.17			-0.06			-0.06
			(-0.94)			(-0.30)			(-0.35)
Pseudo R^2	0.14	0.23	0.23	0.25	0.31	0.31	0.27	0.35	0.35

*Notes: The sample is from 1993 to 2006 . It includes 66 countries for Moody's (484 observations, 34 downgrades and 59 upgrades), 65 countries for S&P (497 observations, 41 downgrades and 79 upgrades) and 57 countries for Fitch (420 observations, 25 downgrades and 68 upgrades). Estimation of rating changes is with ordered probit, while for downgrades and upgrades are done using probit. Beside the lagged rating and rating squared, all regressions include as controls the change of: GDP per capita, real GDP growth, unemployment rate, inflation, government debt, fiscal balance, government effectiveness, external debt, foreign reserves and current account balance. The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively.*

Table 4: Upgrading and downgrading probabilities

	Moody's						S&P						Fitch					
	Downgrades			Upgrades			Downgrades			Upgrades			Downgrades			Upgrades		
$R^j_{it-1} - \hat{R}^{-j}_{it-1}$	1	0	-1	1	0	-1	1	0	-1	1	0	-1	1	0	-1	1	0	-1
Ordered probit																		
AAA	9.4	3.9					15.7	7.6					15.1	6.0				
AA	6.3	2.4	0.8	3.4	8.5	17.7	13.4	6.3	2.5	2.3	5.9	12.7	11.0	4.0	1.2	1.0	3.6	10.0
A	4.7	1.7	0.5	4.7	10.9	21.6	11.3	5.1	2.0	2.9	7.2	14.9	7.3	2.4	0.6	1.8	5.8	14.6
BBB	5.5	2.0	0.6	4.0	9.6	19.5	10.6	4.7	1.8	3.2	7.7	15.8	5.4	1.7	0.4	2.6	7.8	18.4
BB	9.6	4.0	1.4	2.0	5.5	12.4	11.1	5.0	1.9	3.0	7.3	15.1	4.6	1.4	0.3	3.1	8.9	20.4
B	21.5	10.8	4.6	0.5	1.7	4.8	13.0	6.1	2.4	2.4	6.1	13.0	4.7	1.4	0.3	3.0	8.8	20.2
Probit																		
AAA	1.8	0.5					4.9	1.4					4.8	1.0				
AA	2.4	0.7	0.2	2.3	5.4	11.1	6.2	1.9	0.4	1.1	2.6	5.6	5.2	1.1	0.1	0.5	1.7	4.8
A	4.1	1.4	0.4	5.4	11.1	20.4	9.0	3.0	0.8	3.1	6.6	12.5	6.5	1.4	0.2	2.3	6.0	13.4
BBB	8.0	3.1	1.0	6.8	13.6	24.0	13.5	5.0	1.4	5.1	10.2	18.0	8.9	2.2	0.3	4.5	10.6	21.1
BB	16.1	7.4	2.9	5.1	10.7	19.7	20.4	8.5	2.8	5.6	10.9	19.1	13.3	3.7	0.7	5.0	11.6	22.7
B	31.2	17.3	8.1	2.0	4.9	10.3	30.3	14.5	5.5	4.0	8.2	15.1	20.8	6.8	1.5	3.2	8.1	17.0

Notes: Based on regression in column (2), (5) and (8) from Table 3. All controls are set to 0.

difference relative to the other agencies, based on specification 8B. I set all control variables (which are included in differences) are set to zero and reproduce the exercise across the rating scale. The rating difference has a sizeable effect of the probabilities of upgrading and downgrading. If the rating is one notch above the competitors, the probability of a downgrade increases twofold for Moody's and S&P and between 3 to 4 times for Fitch. On the other hand, if the rating is bellow its competitor the probability of upgrade increases twofold for all the three agencies. For instance, a country with AA rating from Moody's has a 8.5 percent probability of being upgraded when the other agencies have the same rating, but 17.7 percent if the other agencies atribute a AA+.

3.4 Piggybacking by area and grade

The second testable implication of the model is that the weight an agency puts on its rivals depends of the relevance of the country in the rest of the business areas, and should vary from country to country. Unfortunately, this type of information is not provided by credit rating agencies. One alternative is to assume that the importance of a country might be clustered by geographic area or by grade. To test it, I estimate equation 8A and include multiplicative dummies per region and per grade (investment or speculative). Results are shown in Table 5.

As expected, the coefficient on the actual difference of the rating to the competitors has the correct sign and is significant in all but one specification (probit of downgrades for Moody's). When we break the coefficient by area, we should interpret the results with caution, as they might be driven by very few observations. All agencies seem to piggyback in most of the areas, although to different extents. The only exceptions are Moody's that does not seem to rely on other agencies for industrialized countries or Latin America and Caribbean, while S&P and Fitch do not seem to rely of other agencies in Africa. When we do a formal test of the equality of coefficients, we reject the null clearly for Moodys and for downgrades of Fitch, but for S&P we do not reject the null.

When we breakdown by grade, Moody's seems to rely more on other agencies in speculative grade and much less in investment grade. The differences are statistically significant. S&P has the opposite behaviour, although not significant. For Fitch, it seems to be more balanced.

Table 5: Estimations of rating changes by area

	Moody's			S&P			Fitch		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rating changes									
$R^j_{it-1} - R^{-j}_{it-1}$	-0.35***			-0.38***			-0.59***		
	(-4.14)			(-3.80)			(-4.68)		
$\times Ind$		-0.16			-0.41***			-0.58***	
		(-1.61)			(-3.20)			(-2.69)	
$\times Lac$		-0.22*			-0.41**			-0.93***	
		(-1.74)			(-2.26)			(-3.57)	
$\times Afr$		-0.48***			-0.02			-0.24	
		(-2.80)			(-0.08)			(-1.02)	
$\times Asi$		-0.49*			-0.35*			-0.55	
		(-1.87)			(-1.70)			(-1.48)	
$\times Eca$		-0.67***			-0.37*			-0.46**	
		(-5.60)			(-1.68)			(-2.16)	
$\times Investment$			-0.25***			-0.42***			-0.51***
			(-2.79)			(-3.94)			(-3.01)
$\times Speculative$			-0.61***			-0.30*			-0.71***
			(-3.71)			(-1.80)			(-4.36)
Pseudo R^2	0.11	0.15	0.16	0.20	0.20	0.20	0.26	0.26	0.261
Equality test		0.006	0.049		0.779	0.532		0.450	0.365
Downgrades									
$R^j_{it-1} - R^{-j}_{it-1}$	0.15			0.41***			0.69***		
	(1.27)			(3.84)			(4.47)		
$\times Ind$		-0.37*			0.39**			0.22	
		(-1.94)			(2.12)			(1.16)	
$\times Lac$		0.03			0.59***			0.87***	
		(0.13)			(3.98)			(3.93)	
$\times Afr$		-0.46			0.20			-	
		(-0.99)			(0.39)				
$\times Asi$		0.33			0.27			-0.19	
		(0.66)			(0.89)			(-0.70)	
$\times ECA$		0.50***			0.27			0.73**	
		(3.23)			(1.29)			(2.03)	
$\times IG$			0.06			0.36**			0.37**
			(0.31)			(2.33)			(1.96)
$\times SG$			0.31			0.48**			0.96
			(1.43			(3.49)			(3.51)
Pseudo R^2	0.28	0.32	0.28	0.27	0.27	0.27	0.35	0.35	0.37
Equality test		0.001	0.471		0.713	0.546		0.033	0.083
Upgrades									
$R^j_{it-1} - R^{-j}_{it-1}$	-0.53***			-0.38***			-0.53***		
	(-4.21)			(-3.38)			(-3.99)		
$\times Ind$		-0.27			-0.60***			-0.67**	
		(-1.23)			(-2.57)			(-2.55)	
$\times Lac$		-0.42**			-0.12			-0.47	
		(-2.35)			(-0.59)			(-1.44)	
$\times Afr$		-1.79***			0.18			0.12	
		(-4.67)			(0.31)			(0.38)	
$\times Asi$		-0.65*			-0.30*			-0.91**	
		(-1.86)			(-1.87)			(-2.48)	
$\times ECA$		-0.96***			-0.46**			-0.41**	
		(-4.22)			(-2.09)			(-2.00)	
$\times IG$			-0.38***			-0.52***			-0.54***
			(-2.99)			(-3.41)			(-2.98)
$\times SG$			-0.87***			-0.17			-0.50***
			(-3.90)			(-0.98)			(-2.97)
Pseudo R^2	0.22	0.25	0.24	0.29	0.30	0.30	0.31	0.32	0.31
Equality test		0.002	0.040		0.439	0.107		0.272	0.877

*Notes: The sample is from 1993 to 2006 . It includes 66 countries for Moody's (464 observations, 29 downgrades and 59 upgrades), 65 countries for S&P (484 observations, 41 downgrades and 79 upgrades) and 57 countries for Fitch (419 observations, 25 downgrades and 68 upgrades). Estimation of rating changes is with ordered probit, while for downgrades and upgrades are done using probit. All regressions include as controls the change of: GDP per capita, real GDP growth, unemployment rate, inflation, government debt, fiscal balance, government effectiveness, external debt, foreign reserves and current account balance. The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively.*

3.5 Evidence from the Euro Area debt crisis

As a robustness exercise, I use data at a daily frequency. I use the same dataset used in Afonso, Furceri, and Gomes (2011) to analyse the effects of rating announcements on yield spreads. The sample is from 1st January 2002 to 31st of October 2010 for 24 EU countries.[15] The data include the rating, outlooks and the respective announcement dates for the three agencies, 10-year government bond yields (end-of-day data from Reuters) and stock market index (from Datastream). All the description and statistics are described in detail in Afonso, Furceri, and Gomes (2011).

There are two advantages in doing this exercise. First, as we focus on the Euro area debt crisis, we have a sample capturing more downgrades. We can also examine further elements of interaction between the agencies, by including data on outlooks or dummies for past downgrades or upgrades. The second advantage is that we can include as controls high frequency variables such as government bonds yields or stock market returns that reflect the information available in the market regarding the economic and fiscal conditions of the country. If two agencies respond to the same information, it is likely that is incorporated in the market variables. For instance, if there are bad news about public debt and one agencies downgrades, yield spreads go up as they incorporate this information. Including the market variables should minimize the problem of the common unobservable information set, so we need to estimate equations 8B or 11D. The equation we are going to estimate is:

$$L^*_{it} = \omega_1(R^j_{it-1} - R^{-j}_{it-1}) + \omega_2(Out^{-j}_{it-1}) + \omega_3(Down^{-j}_{it}) + \omega_4(Up{-}j_{it}) + Controls_t + \mu_{it}, \quad \text{(11D)}$$

where Out^j_{it-1} is a variable that takes the value 1 if the country has a positive outlook and -1 if it has a negative outlook from agency j. Out^{-j}_{it-1} is the average of the outlook variable of its competitors. I also include two dummy variables, whether one of the competitors has downgraded or upgraded the country over the past 6 months. As controls I include the change in yields spreads over the past: 1 week, 1 month, 3 months, 6 months; stock market returns over the past: 1 week, 1 month, 3 months, 6 months; yield spreads volatility (6 months) and stock market returns volatility (6 months). Additionally, I also add in the regressions the lagged rating outlook of the agency, the lagged rating and its square, and two dummy variables $Down^j_{it}$ and Up^j_{it} .

[15] Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

Table 6: Estimations of rating changes (daily data)

	Moody's			S&P			Fitch		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rating changes									
$R^j_{it-1} - R^{-j}_{it-1}$	-1.14***	-1.06***	-1.24***	-0.12	-0.23	-0.23	-0.50***	-0.61***	-0.56***
	(-6.00)	(-4.97)	(-5.24)	(-0.83)	(-1.59)	(-1.61)	(-3.81)	(-3.48)	(-3.72)
Out^{-j}		0.98**	1.11***		0.67***	0.64***		0.94***	0.92***
		(2.28)	(2.70)		(5.28)	(4.63)		(3.63)	(3.74)
$Down^{-j}$			0.83**			-0.22**			-0.38*
			(2.41)			(-2.19)			(-1.74)
Up^{-j}			0.17			0.33			0.47
			(0.41)			(0.94)			(1.37)
Pseudo R^2	0.39	0.42	0.44	0.29	0.31	0.32	0.22	0.26	0.27
Downgrades									
$R^j_{it-1} - R^{-j}_{it-1}$	1.17***	1.13***	1.53***	0.14	0.23	0.23	0.22**	0.28***	0.27***
	(3.58)	(4.20)	(3.52)	(0.93)	(1.54)	(1.56)	(2.48)	(2.73)	(2.91)
Out^{-j}		-0.27	-0.38		-0.63***	-0.59***		-0.82***	-0.76***
		(-0.68)	(-1.04)		(-3.57)	(-3.29)		(-3.19)	(-2.74)
$Down^{-j}$			-1.06*			0.19			0.48**
			(-1.95)			(1.53)			(2.04)
Up^{-j}			$			$			$
Pseudo R^2	0.49	0.50	0.52	0.13	0.15	0.15	0.31	0.34	0.35
Upgrades									
$R^j_{it-1} - R^{-j}_{it-1}$	-3.15**			-0.20	-0.49	-0.65	-1.46*	-2.29***	-2.26***
	(-2.38)			(-0.50)	(-0.74)	(-0.79)	(-1.95)	(-2.83)	(-2.97)
Out^{-j}					1.27	1.51		2.13***	2.22***
					(1.17)	(1.41)		(3.17)	(2.99)
$Down^{-j}$						$$			$$
Up^{-j}						0.36			0.43
						(0.84)			(0.87)
Pseudo R^2	0.51	-	-	0.24	0.26	0.28	0.26	0.33	0.34

*Notes: The 24 countries included are Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. The sample is from June 2002 to October 2010 with a total of 39778 observations and it includes 12, 23 and 18 downgrades and 6, 8 and 18 upgrades for Moody's, S&P and Fitch. All regressions include as controls: the week, month, 3 months and six months change in the yield spread over Germany and the week, month, 3 months and six months cumulative stock market returns until the previous trading day, the 6 months standard deviation of yield spread over Germany and the stock market returns, lagged rating outlook of the agency, the lagged rating and its square, plus two dummy variables $Down^j_{it}$ and Up^j_{it}. The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. $ There was never a downgrade when one of the competitors upgraded the country within 6 months so the variable is drop and some observations not used. $$ There was never an upgrade when one of the competitors downgraded the country within 6 months so the variable is drop and some observations not used.*

Table 6 shows the estimation results of the probit estimations of upgrades and downgrades for the three agencies. The estimations with only controls is in Appendix. In all estimations if the rating is higher than the competitors, the probability of downgrading increases and of upgrading decreases. The coefficient, however, is only statistical significant for Moody's and Fitch. All agencies respond to the outlook of the competitors. Negative outlooks increase the probability of a downgrade. Finally, if a competitor has downgraded a country over the past 6 months, it is more likely to be downgraded by S&P and Fitch, but not for Moody's.

4 Conclusion and implications

This paper highlights one characteristic of the credit ratings game, that is particularly relevant in the sovereign ratings. Rating agencies can put a weight on the competitors rating, as a way to increase the precision of its own rating. This piggybacking does not necessarily introduce any systematic bias in the reported rating but it has some implications.

First, errors of one agency contaminate the rating of other agencies. Second, if ratings are reported in a categorical scale, piggybacking leads to inertia and herd behaviour. Even if one agency perceives a deterioration of the creditworthiness, it might be reluctant to act if the rivals do not. It will only downgrade if it receives a strong negative signal. On the other hand, once one agency acts, it might generate waves of subsequent adjustments. Third, if agencies are themselves averaging their ratings, investors can get wrong idea about the variance of the signals.

Is piggybacking bad? Rating agencies are suppose to make independent assessments of the creditworthiness of the country, but by putting weight on the competitors they can increase the precision of their own rating. In the end it boils down to whether this freeriding can become perverse and lead to less overall monitoring. The model suggests that this is a possibility. However, one can envisage several settings where having more agencies increase monitoring. The lack of transparency of the industry limits our ability to study the issue empirically. It is up to the policymakers to judge whether this is an acceptable feature or if it is something to be fought against. At least policymakers should be alert that promoting competition is not enough to get more monitoring of a country, if the new agencies simply foster piggybacking.

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Appendix I - Proofs

Derivation of reaction function

Rewriting equation (4) and (5):

$$t_A = (1 + \frac{\omega_B}{\omega_A} - \omega_B)^{\frac{-2}{1+\alpha}} \bar{t}_A \tag{11}$$

$$\frac{\omega_B}{\omega_A} = \omega_B + \frac{t_B}{t_A} \tag{12}$$

Substituting the two we get:

$$t_A^* = (1 + \frac{t_B}{t_A})^{\frac{-2}{1+\alpha}} \bar{t}_A \tag{13}$$

which implicitly gives the reaction function of the monitoring level in the interior solution.

Equilibrium in interior solution

Putting the reaction functions of agency A and B together, and focusing on the interior solution we get that:

$$t_A = \frac{(\bar{t}_A)^{\frac{1+\alpha}{\alpha-1}}}{[(\bar{t}_B)^{\frac{1+\alpha}{\alpha-1}} + (\bar{t}_A)^{\frac{1+\alpha}{\alpha-1}}]^{\frac{2}{1+\alpha}}} \tag{14}$$

Proof of Proposition 1

Starting with the reaction function in the interior solution

$$t_A = (1 + \frac{\omega_B}{\omega_A} - \omega_B)^{\frac{-2}{1+\alpha}} \bar{t}_A, \tag{15}$$

and substituting ω_B for agency B foc:

$$t_A = (1 + (1 - \omega_A)\frac{t_B}{\omega_A t_B + t_A})^{\frac{-2}{1+\alpha}} \bar{t}_A. \tag{16}$$

Cross-multiplying

$$t_A + t_B = \omega_A t_B (\frac{\bar{t}_A}{t_A})^{\frac{1+\alpha}{2}} + t_A (\frac{\bar{t}_A}{t_A})^{\frac{1+\alpha}{2}}, \tag{17}$$

and solving for $1 - \omega_A$ we get

$$1 - \omega_A = \frac{t_A + t_B}{t_B}(1 - (\frac{t_A}{\bar{t}_A})^{\frac{1+\alpha}{2}}) \tag{18}$$

From the reaction function (13), we can see that $\frac{t_A}{\bar{t}_A} < 1$ provided $\tau > 0$. Then $\frac{t_A}{\bar{t}_A}^{\frac{1+\alpha}{2}} < 1$ and $1 - \omega_A > 0$.

Proof of Proposition 2

As we have seen, with concave costs there are three equilibria. In the symmetric equilibrium, adding the equilibrium monitoring of the two agencies $T = t_A + t_B$ we get the expression $T = 2^{\frac{\alpha-1}{\alpha+1}} \bar{t_A}$. This is smaller the t_A if $\alpha < 1$.

If we are in the equilibrium with one corner solution, for instance $t_B = \tau$, then

$$t_A = (\frac{t_A}{\tau + t_A})^{\frac{2}{1+\alpha}} \bar{t}_A \tag{19}$$

Rearranging we get

$$\tau + t_A = t_A^{\frac{1-\alpha}{2}} \bar{t}_A^{\frac{1+\alpha}{2}} \tag{20}$$

As $t_A > 1$, if $\alpha < 1$ then:

$$\tau + t_A = t_A^{\frac{1-\alpha}{2}} \bar{t}_A^{\frac{1+\alpha}{2}} < \bar{t}_A^{\frac{1+\alpha}{2}} < \bar{t}_A \tag{21}$$

Proof of Proposition 3

If $\frac{\delta_A}{\delta_B} > x$, there will only be one equilibrium with $t_B = \tau$. We have to show that for a high enough x, no interior equilibrium exists nor an equilibrium with $t_a = \tau$. If an interior equilibrium exists, then

$$t_A = \frac{(\bar{t}_A)^{\frac{1+\alpha}{\alpha-1}}}{[(\bar{t}_B)^{\frac{1+\alpha}{\alpha-1}} + (\bar{t}_A)^{\frac{1+\alpha}{\alpha-1}}]^{\frac{2}{1+\alpha}}} \tag{22}$$

This equation can be re-written knowing that $\bar{t}_i = (\frac{\sigma^2 \delta_i}{\epsilon})^{\frac{1}{1+\alpha}}$

$$t_A = \frac{(\bar{t}_A)^{\frac{1}{1+\alpha}}}{(1 + x^{\frac{1}{1-\alpha}})^{\frac{2}{1+\alpha}}} \tag{23}$$

If the interior solution is bellow τ, the equilibrium does not exist.

$$\frac{(\bar{t}_A)^{\frac{1}{1+\alpha}}}{(1 + x^{\frac{1}{1-\alpha}})^{\frac{2}{1+\alpha}}} < \tau \tag{24}$$

Solving for x

$$x > [\bar{t}_A^{\frac{1}{2}} \tau^{\frac{1+\alpha}{-2}} - 1]^{\frac{1}{1-\alpha}} \tag{25}$$

The second step is to show that, for a high enough x there is no equilibrium with $t_A = \tau$. It is not an equilibrium, provided that $t_B + \tau < \bar{t}_A^{\frac{1+\alpha}{2}} \tau^{\frac{1-\alpha}{2}}$. Using the reaction function the second agency and assuming an interior solution for their problem:

$$t_B + \tau = (\frac{\bar{t}_B}{t_b})^{\frac{1+\alpha}{2}} t_B \tag{26}$$

Combining the equations

$$\bar{t}_B^{\frac{1+\alpha}{2}} t_B^{\frac{1-\alpha}{2}} < \bar{t}_A^{\frac{1+\alpha}{2}} \tau^{\frac{1-\alpha}{2}} \tag{27}$$

Rearranging, we get:

$$(\frac{t_B}{\tau})^{1-\alpha} < x \tag{28}$$

Appendix II - Disaggregated estimations

Table A.1: Data sources

Variable	Description	Source
Per Capita GDP	Per capita nominal GDP in US dollars (logs)	IMF (WEO)
GDP Growth	Annual growth rate of real GDP	IMF (WEO)
Unemployment Rate	Unemployment Rate	IMF (WEO)
Inflation	Annual growth rate of Consumer Price Index	IMF (WEO)
Government Debt	Central Government Debt over GDP	JP (2006)
Government balance	General government balance as percentage of GDP	IMF (WEO)
Government Effectiveness	Aggregate Governance Indicators 1996-2006	WB(AGI)
External Debt	Total debt as share of exports of goods and services	WB (GDF)
Current Account	Current account balance as percentage of GDP	IMF (WEO)
Reserves	Reserves to Imports ratio	IMF (WEO, IFS)
DEF 1	Dummy: 1 if country has defaulted since 1980	S&P
EU	Dummy: 1 If country belongs to European Union	
IND	Dummy: 1 if Industrial Countries	WB
LAC	Dummy: 1 if Latin America and Caribbean	WB
EAP	Dummy: 1 if East Asia and Pacific	WB
ECA	Dummy: 1 if Europe and Central Asia	WB
MNA	Dummy: 1 if Middle East and North Africa	WB
SAS	Dummy: 1 if South Asia	WB
SSA	Dummy: 1 if Sub-Saharan Africa	WB

Notes: WEO -World Economic Outlook; AGI - Aggregate Governance Indicators; GDF - Global Development Finance; IFS - International Financial Statistics; WB - World Bank; IMF - International Monetary Fund; JP - Jaimovich and Panizza (2006); TI - Transparent International.

Figure A.1: Number of countries rated and rating categories

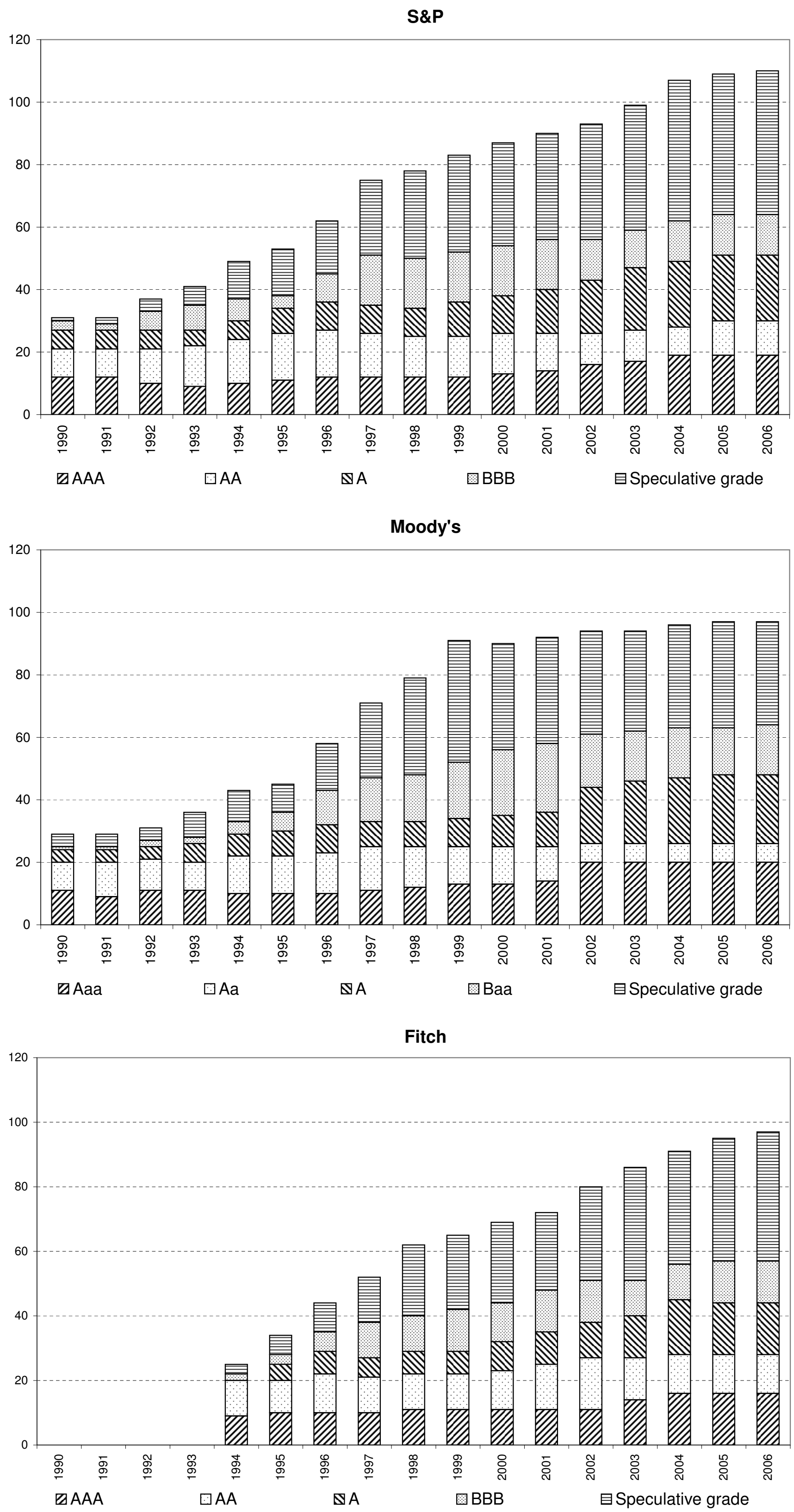

Table A.2: Forecasting models of rating levels

	Moody's		S&P		Fitch	
	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita	1.83***	(3.87)	1.36***	(3.16)	1.59***	(4.16)
GDP per capita Avg.	0.51*	(1.78)	0.59*	(1.76)	0.51*	(1.67)
GDP growth	2.71	(0.53)	2.48	(0.65)	1.65	(0.40)
GDP growth Avg.	-1.53	(-0.20)	-7.60	(-0.99)	-0.29	(-0.03)
Unemployment	-0.06	(-1.29)	-0.03	(-0.83)	-0.05	(-0.87)
Unemployment Avg.	-0.05**	(-1.99)	-0.04	(-1.59)	0.00	(-0.11)
Inflation	-1.61*	(-1.91)	-4.62***	(-2.76)	-4.22***	(-3.98)
Inflation Avg.	-1.74**	(-1.98)	-4.88***	(-2.82)	-4.37***	(-3.92)
Gov Debt	-0.01	(-0.98)	-0.03***	(-3.15)	-0.03***	(-2.90)
Gov Debt Avg.	-0.02***	(-3.50)	-0.02***	(-3.51)	-0.02**	(-2.38)
Gov Balance	6.17	(1.23)	5.18	(1.24)	2.70	(0.58)
Gov Balance Avg.	1.40	(0.21)	-2.42	(-0.36)	-0.49	(-0.07)
Gov Effectiveness	0.53*	(1.84)	0.47*	(1.78)	0.82**	(2.42)
Gov Effectiveness Avg.	1.65***	(5.03)	1.88***	(4.82)	1.68***	(4.22)
External Debt	-0.01***	(-3.99)	-0.01*	(-1.85)	-0.01**	(-2.12)
External Debt Avg.	-0.01***	(-2.66)	-0.01***	(-2.46)	-0.01***	(-3.52)
Current Account	-7.74**	(-2.38)	-5.88**	(-2.00)	-5.41	(-1.45)
Current Account Avg.	4.19	(1.19)	6.78*	(1.75)	7.30	(1.53)
Reserves	1.61***	(3.01)	0.42	(0.76)	0.60	(0.86)
Reserves Avg.	0.71	(0.79)	1.51	(1.56)	2.61***	(2.48)
Def 1	-1.09***	(-3.18)	-1.07***	(-2.96)	-1.29**	(-3.61)
EU	0.99***	(2.63)	1.03**	(2.21)	1.11***	(2.44)
IND	1.32*	(1.83)	1.65***	(2.59)	1.71*	(1.75)
LAC	-0.89***	(-2.49)	-0.78**	(-2.32)	-0.79**	(-2.19)
Cut1	-2.52	(2.22)	-2.62	(2.46)	-3.09	(2.31)
Cut2	-1.73	(2.24)	-1.79	(2.45)	-1.90	(2.35)
Cut3	-0.85	(2.26)	-0.74	(2.52)	-1.13	(2.37)
Cut4	-0.02	(2.23)	-0.07	(2.52)	-0.24	(2.42)
Cut5	0.47	(2.23)	0.74	(2.51)	0.38	(2.44)
Cut6	1.08	(2.19)	1.82	(2.54)	1.48	(2.39)
Cut7	1.95	(2.21)	2.72	(2.57)	2.65	(2.45)
Cut8	3.25	(2.22)	3.94	(2.63)	3.88	(2.51)
Cut9	3.92	(2.25)	4.81	(2.63)	4.70	(2.49)
Cut10	4.63	(2.25)	5.32	(2.63)	5.40	(2.49)
Cut11	5.29	(2.24)	6.63	(2.67)	6.86	(2.48)
Cut12	5.83	(2.19)	7.65	(2.71)	7.76	(2.58)
Cut13	6.40	(2.15)	8.26	(2.63)	7.81	(2.56)
Cut14	6.96	(2.12)	8.55	(2.67)	8.61	(2.54)
Cut15	7.74	(2.13)	9.31	(2.73)	9.61	(2.56)
Cut16	8.32	(2.16)	10.45	(2.75)	10.21	(2.57)
Observations	551		564		480	
Countries	66		65		58	
LogLik	-711.8		-715.1		-587.45	
Pseudo R^2	0.50		0.51		0.52	

*Notes: The coefficient of the variable with Avg. corresponds to the long-run coefficient ($\beta + \eta$), while the one without corresponds to the short-run coefficient β. The t statistics are in parentheses, expect for the cut-off points for which we present in parentheses the standard errors. *, **, *** - statistically significant at the 10, 5, and 1 per cent. The correspondence between the ratings and the cut-off points is specified in (10).*

Table A.3: Prediction errors of forecasting models

Estimation procedure	Obs.	Prediction error (notches) ≤ -3	-3	-2	-1	0	1	2	3	≥ 3	% Correctly predicted	% Within 1 notch*	% Within 2 notches*	Average error Abs.	
Moody's	551	4	13	42	**94**	**258**	**90**	38	11	1	46.8%	80.2%	94.7%	0.79	-0.06
S&P	564	4	12	20	**113**	**262**	**127**	21	5	0	46.5%	89.0%	96.3%	0.69	-0.04
Fitch	480	1	12	27	**86**	**229**	**100**	25	0	0	47.7%	86.5%	97.3%	0.69	-0.06

*Note: * prediction error within +/- 1 notch. ** prediction error within +/- 2 notches.*

Table A.4: Disaggregated estimations of rating changes

		Moody's			S&P			Fitch	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rating changes									
$R^j_{it-1} - \hat{R}^M_{it-1}$					-0.12	-0.04		-0.31***	-0.28***
					(-1.17)	(-0.39)		(-2.97)	(-2.59)
$R^j_{it-1} - \hat{R}^S_{it-1}$		-0.22	-0.07					-0.20*	-0.12
		(-1.36)	(-0.46)					(-1.70)	(-0.77)
$R^j_{it-1} - \hat{R}^F_{it-1}$		-0.23*	-0.16		-0.31***	-0.21			
		(-1.77)	(-1.18)		(-2.72)	(-1.54)			
$R^j_{it-1} - \hat{R}^j_{it-1}$			-0.25			-0.20			-0.13
			(-1.60)			(-1.16)			(-0.88)
Pseudo R^2	0.11	0.22	0.23	0.16	0.24	0.24	0.20	0.31	0.31
Downgrades									
$R^j_{it-1} - \hat{R}^M_{it-1}$					0.28**	0.03		0.33**	0.29*
					(2.41)	(0.23)		(1.97)	(1.94)
$R^j_{it-1} - \hat{R}^S_{it-1}$		0.55***	0.39*					0.34*	0.21
		(2.72)	(1.78)					(1.81)	(0.82)
$R^j_{it-1} - \hat{R}^F_{it-1}$		-0.05	-0.10		0.26*	-0.02			
		(-0.33)	(-0.68)		(1.74)	(-0.08)			
$R^j_{it-1} - \hat{R}^j_{it-1}$			0.30			0.64**			0.19
			(1.52)			(2.38)			(0.84)
Pseudo R^2	0.26	0.36	0.38	0.23	0.33	0.36	0.28	0.42	0.42
Upgrades									
$R^j_{it-1} - \hat{R}^M_{it-1}$					-0.01	-0.01		-0.26*	-0.24*
					(-0.10)	(-0.12)		(-1.95)	(-1.75)
$R^j_{it-1} - \hat{R}^S_{it-1}$		-0.08	0.03					-0.18	-0.14
		(-0.44)	(1.12)					(-1.30)	(-0.88)
$R^j_{it-1} - \hat{R}^F_{it-1}$		-0.30*	-0.24		-0.37***	-0.34**			
		(-0.33)	(-1.35)		(1.74)	(-2.17)			
$R^j_{it-1} - \hat{R}^j_{it-1}$			-0.19			-0.06			-0.07
			(-1.05)			(-0.32)			(-0.42)
Pseudo R^2	0.14	0.23	0.24	0.25	0.32	0.32	0.27	0.35	0.35

*Notes: The sample is from 1993 to 2006 . It includes 66 countries for Moody's (484 observations, 34 downgrades and 59 upgrades), 65 countries for S&P (497 observations, 41 downgrades and 79 upgrades) and 57 countries for Fitch (420 observations, 25 downgrades and 68 upgrades). Estimation of rating changes is with ordered probit, while for downgrades and upgrades are done using probit. The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. All regressions include as controls the change of: GDP per capita, real GDP growth, unemployment rate, inflation, government debt, fiscal balance, government effectiveness, external debt, foreign reserves and current account balance. The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively.*

Table A.5: Estimations of rating changes - Only control variables

	Rating changes			**Downgrades**			**Upgrades**		
	(Moody's)	(S&P)	(Fitch)	(Moody's)	(S&P)	(Fitch)	(Moody's)	(S&P)	(Fitch)
(R_{t-1}^j)	0.16**	-0.01	-0.05	-0.06	0.05	0.05	0.19**	0.10	0.13
	(2.49)	(-0.17)	(-0.65)	(-0.74)	(0.62)	(0.62)	(2.36)	(1.10)	(1.44)
$(R_{t-1}^j)^2$	-0.01***	0.00	0.00	0.00	-0.01	-0.01	-0.01***	-0.01**	-0.01**
	(-2.57)	(-0.18)	(0.01)	(-0.39)	(-1.42)	(-1.42)	(-3.15)	(-2.07)	(-2.42)
GDP per capita	2.25***	2.74***	3.93***	-3.17**	-2.19*	-2.19*	1.58**	3.32***	4.39***
	(3.45)	(4.41)	(5.04)	(-2.39)	(-1.79)	(-1.79)	(2.33)	(4.30)	(4.74)
GDP growth	4.17	4.04	-1.84	-7.88	-6.89	-6.89	-5.15	-7.11	-8.89
	(0.59)	(0.64)	(-0.29)	(-0.83)	(-0.71)	(-0.71)	(-0.78)	(-1.29)	(-1.12)
Unemployment	-0.11	-0.08	-0.14	-0.04	0.20*	0.20*	-0.18**	0.04	-0.03
	(-1.28)	(-1.04)	(-1.36)	(-0.35)	(1.89)	(1.89)	(-2.01)	(0.45)	(-0.29)
Inflation	-0.04	-0.38***	0.10	0.34	0.07	0.07	0.33	-0.45***	0.26
	(-0.67)	(-3.39)	(1.07)	(0.78)	(0.55)	(0.55)	(1.06)	(-5.11)	(0.98)
Gov Debt	0.01	0.00	0.01	-0.03	-0.01	-0.01	-0.02	-0.06***	-0.06**
	(0.50)	(0.03)	(0.35)	(-1.24)	(-0.65)	(-0.65)	(-1.33)	(-3.19)	(-2.42)
Gov Balance	17.21***	24.03***	22.35***	-8.11	-14.56	-14.56	22.46***	28.44***	24.76***
	(2.72)	(3.67)	(3.17)	(-0.74)	(-1.50)	(-1.50)	(2.89)	(3.60)	(2.60)
Gov Effectiveness	0.58	0.93***	1.02**	-0.37	-1.49***	-1.49***	0.97**	0.93*	1.25**
	(1.39)	(2.59)	(2.17)	(-0.52)	(-2.67)	(-2.67)	(2.25)	(1.84)	(2.42)
External Debt	-0.01	-0.01	0.00	0.01***	0.00	0.00	0.00	-0.01	0.00
	(-1.97)	(-1.42)	(-0.72)	(3.49)	(0.80)	(0.80)	(0.21)	(-1.00)	(-0.60)
Current Account	1.33	-2.49	0.16	2.88	2.45	2.45	4.37	-3.33	1.21
	(0.32)	(-0.65)	(0.02)	(0.54)	(0.39)	(0.39)	(0.86)	(-0.72)	(0.18)
Reserves	1.16	1.31	-0.96	-1.37	-1.36	-1.36	0.47	0.94	-0.89
	(1.45)	(1.51)	(-0.86)	(-1.24)	(-1.05)	(-1.05)	(0.44)	(0.78)	(-0.49)
Cut1	-0.87	-1.70	-2.22						
	(0.31)	(0.36)	(0.40)						
Cut2	2.09	1.09	0.86						
	(0.33)	(0.34)	(0.34)						
Constant				-0.74	-1.36	-1.36	-1.79	-1.33	-1.45
				(-2.27)	(-3.86)	(-3.86)	(-4.68)	(-3.21)	(-3.32)
Observations	484	497	420	484	497	420	484	497	420
Countries	66	65	57	66	65	57	66	65	57
Upgrades	59	79	68				59	79	68
Downgrades	34	41	25	34	41	25			
Pseudo R^2	0.117	0.164	0.199	0.264	0.229	0.284	0.142	0.254	0.268

*Notes: The sample is from 1993 to 2006 . The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively.*

Table A.6: Estimations of rating changes, Euro Area (Only control variables

	Rating changes			Downgrades			Upgrades		
	(Moody's)	(S&P)	(Fitch)	(Moody's)	(S&P)	(Fitch)	(Moody's)	(S&P)	(Fitch)
(R^j_{t-1})	0.04	-0.33	0.07	-0.24	0.50	0.30	0.36	-0.24	1.09***
	(0.16)	(-1.27)	(0.32)	(-0.46)	(1.04)	(0.99)	(1.37)	(-0.49)	(2.78)
$(R^j_{t-1})^2$	0.00	0.01	0.00	0.00	-0.02	-0.01	-0.02**	0.01	-0.04 ***
	(-0.06)	(1.45)	(-0.15)	(0.22)	(-1.15)	(-1.01)	(-2.14)	(0.49)	(-2.94)
Out^j_{t-1}	1.01***	1.55***	0.99***	-1.52**	-	-1.52***	0.50	1.19***	0.66**
	(6.62)	(5.83)	(6.24)	(-2.46)		(-3.98)	(1.60)	(3.32)	(2.23)
$Down^j_{t-1}$	-0.02	0.61***	0.20	-0.50***	-0.76***	-0.36*			
	(-0.14)	(2.80)	(1.08)	(-2.75)	(-2.76)	(-1.71)			
Up^j_{t-1}	-0.21	-0.58***	-0.27*						
	(-1.00)	(-3.09)	(-1.83)						
sdequi	-13.60	-26.12***	-14.55	41.37***	43.63***	26.88	42.01*	7.41	-20.50**
	(-1.23)	(-2.65)	(-1.47)	(2.58)	(4.27)	(1.56)	(1.78)	(0.35)	(-2.33)
sdyield	0.25***	0.24	0.19	-0.79	-0.58	-0.62*	-3.98***	-0.59	-1.15
	(2.86)	(1.51)	(1.52)	(-1.62)	(-1.63)	(-1.93)	(-5.15)	(-1.36)	(-1.09)
yield0	0.00	0.02	-0.06	0.02	-0.05	0.08	0.39**	0.15	0.05
	(0.06)	(0.67)	(-1.55)	(0.51)	(-0.91)	(1.46)	(2.45)	(0.78)	(0.11)
yield1	0.03	-0.02	-0.03	-0.11	-0.03	0.00	-0.46***	-0.34**	0.07
	(0.40)	(-0.39)	(-0.55)	(-1.15)	(-0.48)	(0.04)	(-4.30)	(-2.06)	(0.13)
yield3	0.01	0.08	0.04	-0.10	-0.09	-0.10*	-0.85***	0.37*	0.68
	(0.15)	(1.04)	(1.02)	(-1.37)	(-0.95)	(-1.85)	(-5.83)	(1.78)	(1.17)
yield6	-0.17***	-0.13**	-0.11***	0.33*	0.26*	0.28**	-0.30	0.35	-0.47***
	(-3.32)	(-2.33)	(-4.19)	(1.76)	(1.89)	(2.29)	(-1.10)	(1.21)	(-2.95)
equi0	0.69	3.44***	1.26	-1.00	-3.64***	-5.03**	0.51	2.09	-6.99**
	(0.56)	(3.05)	(0.62)	(-0.77)	(-2.83)	(-2.50)	(0.23)	(0.51)	(-2.14)
equi1	-0.27	-0.67	-0.27	1.59	1.22**	1.61	3.18	1.35	2.03 **
	(-0.17)	(-1.18)	(-0.38)	(1.12)	(2.43)	(1.55)	(1.31)	(0.82)	(2.35)
equi3	1.07**	0.16	0.66	-1.60***	-0.29	-1.42***	-1.47	0.59	-1.14
	(2.03)	(0.42)	(1.14)	(-3.19)	(-0.71)	(-2.65)	(-0.98)	(0.36)	(-0.77)
equi6	-0.43	0.44	0.01	0.79	-0.22	0.38	0.27	0.74	1.39
	(-0.73)	(1.32)	(0.05)	(1.28)	(-0.54)	(1.39)	(0.18)	(0.73)	(1.58)
Cut1	-3.60	-6.26	-3.28						
	(1.46)	(1.77)	(1.43)						
Cut2	4.25	2.23	4.21						
	(1.42)	(1.67)	(1.31)						
Constant				-2.21	-5.75	-6.17	-4.63	-2.58	-10.34
				(-0.71)	(-1.93)	(-2.90)	(-2.65)	(-0.83)	(-3.53)
Observations	39778	39778	39778	38990	4622	38067	37953	36586	36402
Countries	24	24	24	24	12	24	24	24	24
Upgrades	6	8	12				6	8	12
Downgrade	12	23	18	12	23	18			
Pseudo R^2	0.22	0.29	0.18	0.37	0.12	0.30	0.26	0.24	0.12

*Notes: The sample is from 1993 to 2006 . The standard errors are clustered by country. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. There was never a downgrade of a country upgraded within 6 months, so the variable "Upgrade" is dropped and 788 observations are dropped by Moody's and 1711 for Fitch. S&P only downgrades with a negative outlook, so the outlook is dropped and 35156 obs. not used. There was no upgrade in the sample with less than 6 months of a downgrade so the dummy is dropped and 1037 observations not used for Moody's, 2276 for S&P and 1665 for Fitch. There was no upgrade in the sample with less than 6 months of a downgrade so the dummy is dropped and 788 observations not used for Moody's, 916 for S&P and 1711 for Fitch.*