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Country risk ratings and financial crises 1995 – 2001: a survival analysis

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Abstract

Financial system's health is a signal of economic growth therefore it is a key indicator to investors. As a consequence, one of the main purposes of policymakers is to keep its stability as well as protect it from foreign activity. Both financial and economic activity in general are susceptible of crises, as soon as this happen a country may face default risk, which can be measured with long term debt risk rating of countries. Through this variable we propose the use the survival analysis methodology, to analyze falls rating duration and capability of macroeconomic variables to predict that event. From the analysis, we point out important differences between developed and emerging economies, with variables which stand out exchange risk and economies indebtedness.

Resumen

La dinámica del sistema financiero es una señal de crecimiento económico, por lo tanto es un indicador clave para los inversionistas. Por lo tanto, uno de los principales retos de la política económica es mantener la estabilidad así como proteger el sistema financiero de los fenómenos externos. La actividad financiera y la actividad económica son en general susceptibles a las crisis y dicho riesgo puede medirse a partir de la calificación de deuda de largo plazo. A través de esta variable proponemos aplicar el análisis de sobrevivencia, para explorar la duración de las caídas en la calificación de riesgo y la capacidad de variables macroeconómicas para predecirlas. Con ello se encontraron diferencias importantes en las economías desarrolladas y emergentes, teniendo en cuenta variables de riesgo cambiario y endeudamiento de la economía.

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INTRODUCTION

As the world globalizes, financial stability is one of the main concerns all over the world. Moreover, if one takes into account both financial system's vulnerability to foreign markets and its stability are a signal to investors, therefore bad behavior of the system do not contribute to economic growth. A key indicator of the domestic capital market's health is the credit rating given to the long term debt, which gives information of short term macroeconomic stability and payment capability at long term. Indeed, as Ratha (2008) states "sovereign risk ratings from agencies such as Fitch, Moody's, and Standard and Poor's affect capital flows to developing countries through international bond, loan and equity markets. Sovereign rating also acts as a ceiling for the foreign currency rating of sub-sovereign borrowers".

Because of what was pointed out above, the present paper presents an approximation to financial crises through sovereign risk ratings. Our analysis presents two important aspects in rating falls, which were not considered before in this kind of analysis: country's effect and falls timing; to attain these points we propose the use of a survival model. This paper uses this methodology to compute the risk function of a fall rating controlling by macroeconomics and exchange monthly variables which reflect economics' health at short and mid term for 78 countries between 1995 and 2001[1]. We exclude from the analysis variables from the real sector as they may be endogenous with country risk rating.

Authors who analyses sovereign ratings (Haque et al.: 1998, Reinhart, 2001, 2002) focus on its determinants. This study offers a step forward by analyzing determinants in time with a survival model, which was not used before in this kind of studies. This methodology also allows us to forecast crisis duration and contagion by geographic and economic regions. In the study we use a semiparametric methodology, which is better in the analysis of non-monotonic risk functions given the persistence and contagion effect.

[1] This period in which there were a world crisis, sovereign ratings changed as economic country conditions changed, these facts allows us the use of survival analysis

The paper is divided into six sections, the first is this introduction; the second is a short reference to some hypothesis and theory about financial crises; the third one summarizes the methodology; the fourth section presents the nonparametric survival analysis based on risk functions; the fifth section includes the results, and the sixth is the conclusion.

RELATED LITERATURE

As Eichengreen (1999) emphasizes, financial crisis are not new; the difference is their violence and the damage they do. According with its time, connoisseurs catalog crisis in three generations.

The first generation model, which was used to explain crises in the early 1980s, were based on the macroeconomic imbalances. To support this point, Krugman (1979) uses a simple model to show how attempts to defend a fixed exchange rate can collapse in the face of a speculative attack. He shows how the persistence balance of payments deficits[2] can push a run on the authorities' stock of international reserves and destroy their capacity to defend the exchange rate by sticking up the ability to intervene in the foreign-exchange market. The central point of this generation studies is to demonstrate how an attack collapsing the exchange rate can occur before reserves would have been exhausted otherwise and to pin down its timing. As the point here is that government exhausted the reserves and they cannot replenish them by borrowing abroad, the leading indicators of this generation of crisis are budget deficits, excessive rates of growth of money supply and dwindling reserves. Countries that are susceptible to speculative attacks may also exhibit excessive inflation, real exchange rate overvaluated and rising interest rates.

With the crisis of the early 1990s, the above symptoms were questioned, because not all the countries that succumbed, displayed large fiscal and current account deficits. In addition, as control to capitals were lifted and international markets growed, it was less possible to assume that central banks could not borrow abroad to replenish their

[2] Krugman assumed that payments imbalances and the currency crisis resulted from the tendency of governments to run expansionary monetary and fiscal policies, which are financed by printing money.

reserves. Obstfeld (1997) and Ozkan and Sutherland (1998) add the assumption that governments balance the benefits of continuing to defend the currency through tight monetary policies and high interest rates. Under these assumptions, authorities enhance their commitment to defend the currency and to maintain price stability, but the impact of high interest rates on the economy and the financial system are so high. Although there are no restrictions to capital, in these second generation models the level of reserves and the ability to get money abroad play no role in calculations. The issue here is the role played by interest rates to defend currency and therefore, its impact on depressing demand on the default of bank borrowers and on a large short term debt. The decision of defending the currency came up from an economic and political self-interest. Actually, by observing ninety-one countries over the period 1960-1996, Gourinchas *et al*. (2001) found that probability of a bank of exchange crisis increases once the country decides to adopt liberalization as a policy. They notice this may be due to an absence of regulation or to partial liberalizations based on exchange measures and not on monetary policies. Reinhart (2001) revalues liberalization notion by standing out the need of protect domestic finances from capital flows fluctuations. Thus, in second generation models the crisis depends on subtler unmeasured conditions such as the strength of the banking system, or labor market flexibility, or the prospects of economic growth and domestic political support to the government and its policies. In fact Calvo and Reinhart (1996) prove that contagion mechanism is related with a fixed exchange rate and high interest rates, and contrary of what may be thought its impact is the same whether small or big countries. Indeed contagion effect occurs easier at a regional level than in a global one, meaning affected countries not only belong to a specific geographical region but also to a specific group.

Finally, the main differences between first and second generation models is that in the latter the speculative attack can precipitate a devaluation that would not have occurred in its absence; and that capital controls can bend the balance between the collapse of the currency peg and its maintenance forever[3]. Therefore an attack that would have neither occurred nor succeeded in the presence of capital controls may do both in their absence.

[3] As in the absence of capital control restrictions, domestic interest rates equal foreign interest rate plus the expected rate of depreciation.

The crisis of the late 1990s came up with the third generation models. Based on the facts observed in Asia, where there were combined issues from the first and second generation models, connoisseurs pointed out that those models have something that was missing. Additionally, by using data from more than seventy countries during 1960-2000, Loaiza and Ranciere (2005) states that economic growth might be negative if the country faces a weak financial system in a maturation process due to moral hazard and incentive problems. Because of these new conclusions, connoisseurs proposed the third generation models which were called crony capitalism and implicit guarantees. Basically it was a moral hazard problem in which owners of banks and industrial conglomerates on one side, and political leaders on the other, develop ties of mutual dependence which left governments loath to let banks fail (Dooley: 1997 and Krugman: 1998 in Eichengreen: 1999). Once the capital account of the balance of payments was opened, the implicit guarantees provided by government to banks were a lure to foreign investors and with governments guaranteeing banks against failure, the specter of losses was removed therefore, foreign capital flooded the economy and banking system. Mackinnon and Pill (1997) argue that once this happened foreign borrowing was so excessive and funds were so poorly allocated that capital inflow may reduce the growth rates of the countries involved. Therefore the initial capital outflow with the problem that governments' guarantees can be provided only once, therefore, the relationship between bankers and politicians' guarantees provoked a populist backlash that brought the crony capitalism. As the authorities leapt to the rescue of the banking system, pumping in additional domestic credit, they were forced to disregard the constraints on liquidity implied by the commitment to peg the exchange rate.

Finally there are some authors who have focused in studying all three generations models by using whether a subjective definition of crisis (Manasse et. al.: 2003) or by seeing the correlation between credit ratings and crisis episodes (Reinhart: 2002) especially in Asia and Argentina. On a first sight both perspectives use macroeconomics and political variables to check the influence on the dependent variable (crisis or credit rating). On the other hand the authors who use ratings found not only an amazing correlation between the credit rating and sovereign default but they also found that the key determinants of ratings are macroeconomic variables meanwhile political variables have a marginal effect (Haque et. al.: 1998, Bissoondoyal-Bheenick, 2005). In addition, they found a pattern in country crises by pointing out that for most of the sample they studied previous to the debt crisis there was a currency crisis.

SURVIVAL ANALYSIS

Probability models have been the most used methodology to study the determinants of change. Later studies point out that the analysis allows the advance in mathematical and statistical tools.

The first empirical studies reckoned the probability of leaving the current state by explaining the individual characteristics at a specific moment based on binary models[4] in which the probability of maintaining the current state or changing. Thought, this method is a static approximation which does not capture nor temporality or deviation from circumstances which may affect the conditional probability of change. Therefore, by using this methodology it is not possible to answer questions such as: is there any point in time in which the chance of change is higher? or which is the probability of change the state given that the agent has been active until the present period?

Survival models are not only focused on the occurrence of the event, but also on the impact of predictable variables (constant or changing in time)[5] on the chance of change the state. The dynamic method which takes account time and individual characteristics depend on elements which are seen by traditional literature as specification errors, which do not allow an efficient estimation and, therefore, probabilities may be underestimated or overestimated. These elements may be summarized as: censoring, continuous or discrete treatment, ties and multiple causes of ending.

- Censoring: an observation is censored when it does not change in the analyzed period. Based on this fact one may define three types of censoring which are presented in Figure 1, the first (t_1) makes reference to those observations which

[4] In these models, the values of the dependent variable are 0 and it follows a particular distribution, the most commonly used are the logistic and the normal standard distributions

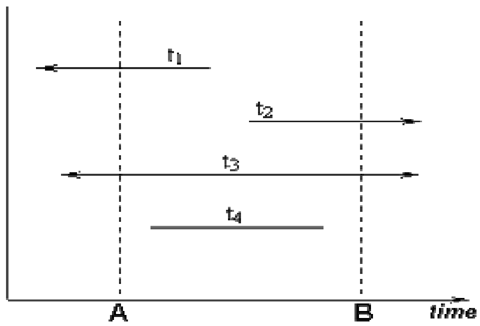
[5] The inclusion of changing variables may cause simultaneity or autocorrelation.

start the active state before the recollection period (left censoring), the second type (t_2) is the one in which once the analyzed period has ended the variables have not changed their state (right censoring), and the third type (t_3) joints left and right censoring. Finally, in t_4 there is no censoring. To solve the censoring problems, survival models allow take apart the probability analysis of being active and the probability of instant change.

- Continuous and discrete treatment: although, survival analysis may consider high frequency variables (i.e. diary) and then variable may be continuous, there are events in which the timing is so long like academic periods in college, where it is easy see that the duration variable has a discrete behavior given that the event occurs at the same frequency. With this type of data, the duration analysis must include corrections on the bias of probability.

- Ties: given the problem of discrete and continuous treatment, when there is a variable with high time intervals, it may occur that many individuals change in the same period, even though the ending of the event might be at different moments. Based on this issue, survival models allow assumptions over the whole information faced by individuals with repeated duration or the correction of the possible bias in the estimation of probabilities.

Figure 1. Censoring types



Source: Kiefer (1988)

- Multiple causes of ending: even though the reasons of change may be identified the impact may be different over individuals. Survival models which allow these distinctions are known as competing risk models.

As the advantages of survival models were shown above, it is worthwhile present basic concepts:

The first remark must be made on the dependent variable; the duration variable must be a random nonegative variable, thus it may be represented by density function $f(t)$ and by a cumulative distribution function $F(t) = P(T \leq t)$. The first function is related to the duration of the event and the second is related to the maximum duration.

Based on the functions mentioned above, one constructs the survival and the risk functions. The first function captures the probability that an individual lasts more than a specific time, which may be assessed by the survival function $S(t) = 1 - F(t) = P(T \geq t)$. The risk or hazard function, represents the instant probability of change, it means it considers the duration between the active stage and when it ends, and this may be represented as $h(t) = P(t \leq T < t + \Delta t | T \geq t) = f(t | T \geq t) = \dfrac{f(t)}{S(t)}$.

The purpose of survival models is to assess $S(t)$ and $h(t)$ based on the observed individual characteristics, to achieve it there are two kinds of survival methodologies: parametric and nonparametric estimations. To obtain $S(t)$, the methodology used is the proposed by Kaplan and Meier (1958), which is based on the nonparametric estimators of product limit, the most efficient estimator. The Kaplan-Meier estimator is given by:

$$\hat{S}(t) = \begin{cases} 1 & \text{if } t < \underline{t} \\ \prod_{t_i \leq t} \left(1 - \dfrac{d_i}{y_i}\right) & \text{if } t \geq \underline{t} \end{cases}$$

Where $\underline{t}$ is the period in which the first change occurs, y_i is the sum of individuals who may change of state at moment t_i and d_i is the number of individuals who change at moment t_i.

Based on the survival function, one may get the cumulative risk function $\Lambda(t)$ meaning the cumulative risk at specific moment; this is known as the Nelson-Aalen estimator, which accomplishes with the Kaplan-Meiers's estimator properties. The estimator is denoted by:

$$\hat{\Lambda}(t) = \begin{cases} 0 & \text{if } t < \underline{t} \\ \prod_{t_i \leq t} \dfrac{d_i}{y_i} & \text{if } t \geq \underline{t} \end{cases}$$

With $\hat{\Lambda}(t)$, one gets the instant probability of change; this is a raw nonparametric estimator of the risk function; given by:

$$\Delta\hat{\Lambda}(t) = \hat{\Lambda}(t) - \hat{\Lambda}(t-1)$$

An estimation of the smooth risk function may be made by a kernel approximation of $\Delta\hat{\Lambda}(t)$. Risk function may be achieved by using, either parametric or semiparametric estimators: the first estimators are based on the assumption that duration depends on a monotonous way from the probability of change with *weibull*, *exponencial* or *gompertz* distributions. The latest group estimators assumes that relation between survival and probability may has a nonmonotonic form, which is an advantage, not only because this more general but also because estimators are more efficient.

As in the present paper we use semiparametric estimators, we focus on some specifications on them. The pioneer model is the one proposed by Cox (1972); this assumes that risk function has a multiplicative form which allows split time effect and the probability (baseline hazard) which captures the common risk of individuals at specific time and the effect that depends on individual characteristics which is defined by a nonnegative function, by simplicity one assumes this function as an indicator exponential function, which is a lineal combination of individual characteristics. Then the Cox model can be summarizing in the function[6]:

$$h(t|\mathbf{x}_i) = h_0(t)e^{\mathbf{x}_i'\beta}$$

Where $h_0(t)$ is the common risk function or *baseline* and $e^{\mathbf{x}_i'\beta}$ is the function which points out individual characteristics´ effect on probability of change.

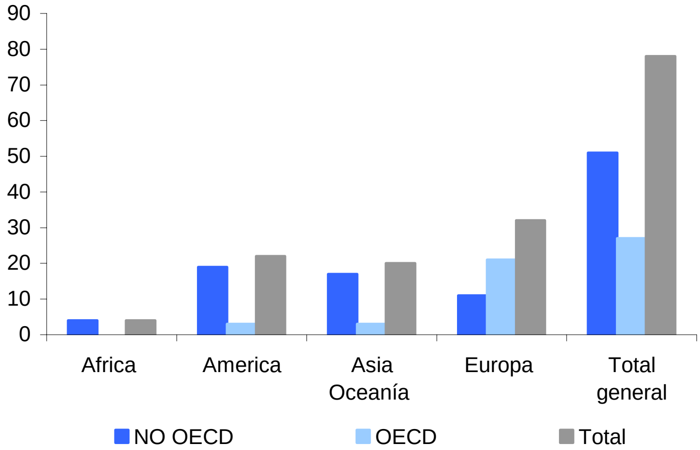
DATA AND NONPARAMETRIC ESTIMATION

The paper analyzes information of 78 countries between 1995 and 2001. Because of asymptotic properties of the models we use and the frequency of independent variables data frequency is monthly. The countries chosen were those which have sovereign risk rating during the studied period. The sample is representative among countries with

[6] One of the advantages of this approximation to the risk function is that it accomplishes the independence irrelevant alternative assumption, because risk relative function risk depends only on the individual characteristics.

capital markets more or less developed. Ratings are classified by region and by OECD members, as can be seen in Figure 2:

Figure 2. Number of countries by region and OECD

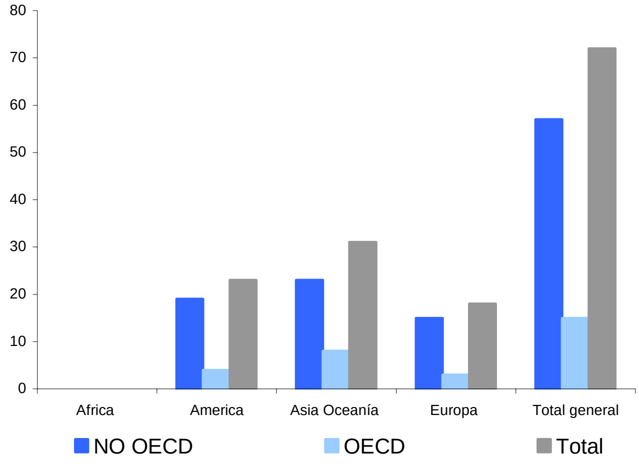


The variable we use to assess risk country is the rating given by the agency Moody to long term bond in foreign currency. The ratings go up from Aaa to C, with numeric variations from 1 to 3 and; + or – signs if the changes were minimal. By observing data ratings, we notice that meanwhile ratings higher or equal to Baa3 belong to investment scale and, lower or equal ratings to Ba1 are in speculation scale. In the analysis every fall rating is a default. In the analyzed period there were 72 ratings fall, the region with more failures is Asia Pacific, followed by America and Europe. Although African countries ratings do not fall, they confer information to survival function; therefore African information must be included. Figure 3 presents failure distribution by OECD country and region.

In contrast to other risk indicators, country risk rating from the agency Moody's not only takes account economic variables in a pure sense but also considers long term issues. Although literature does not make difference between crisis and country's decline, we must call attention to one point: we define default as any fall rating. By doing this we avoid subjective definitions of crisis like those proposed by Domaç and Martinez (2000) and Gourinchas *et al*. (2001) and we make use of the above mentioned ratings' characteristics.

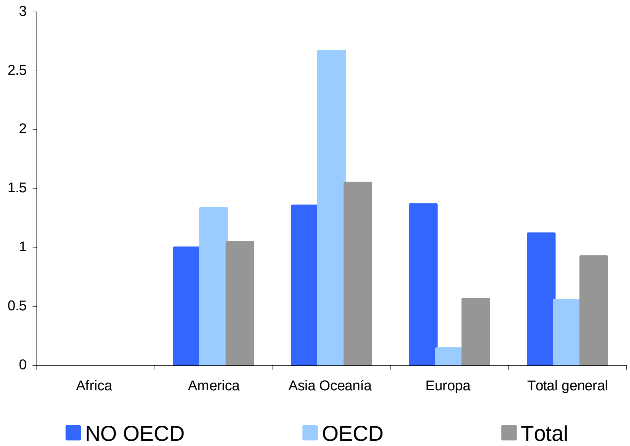
In the analysis every fall rating is a default. In the analyzed period there were 72 ratings fall, the region with more failures is Asia Pacific, followed by America and Europe.

Figure 3. Number of sovereign risk rating falls by region and OECD



As in the analysis there are countries with repeated events of ratings falling, then it is convenient verify the average of number of failures, which in turns may be used to bear out country risk intense and persistence on long term debt. These results may be seen in Figure 4, where there is evidence that in America and Asia-Oceania, the average of failures duplicates the number of Europe and the total average, this may be due to the number of OECD members in the first two regions.

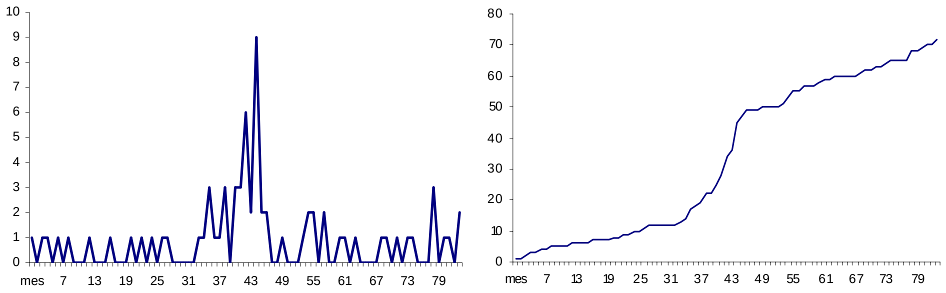
Figure 4. Average failure by region and OECD



Failures distribution is accumulated in between 1998 and 1999 with a highest number of 9 ratings failures in September of 1998 and 6 failures in July. As around these dates there is an accumulation of failures, this means there may be a persistence effect (or a contagion one). On the other side, there were no dramatic changes until 1997 but there were an outlier in 2001. Both, these results and failure cumulative function are shown in Figure 5.

Figure 5. Failure rating distribution over time

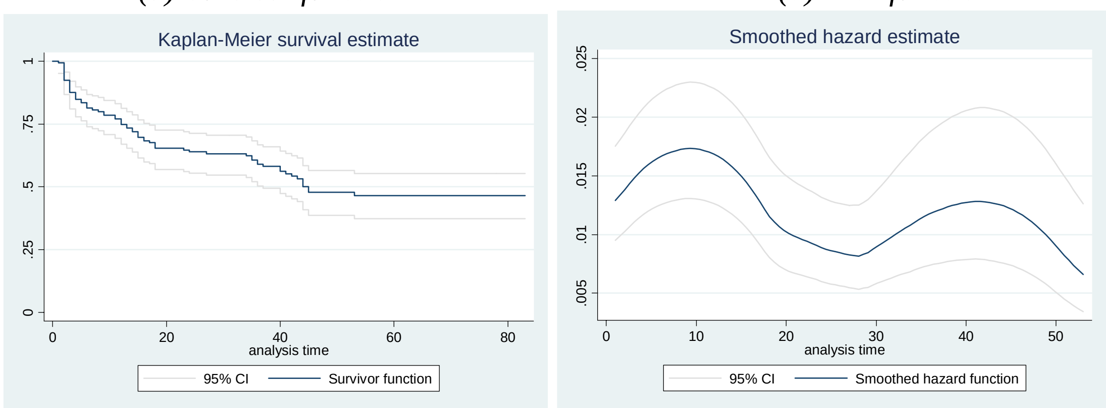
(a) Failures distribution *(b) Cumulative failures*



As was shown in the previous section, survival analysis requests both survival and risk function estimation. Therefore, Kaplan-Meier survival function and a smooth hazard function were estimated through the Kernel of epanechnikov function; these was made with the group of 78 countries (Figure 6), with the OECD countries (Figure 7) and with the countries jointed by region.

Figure 6. Risk rating survival analysis to 78 countries

(a) Survival function *(b) Risk function*

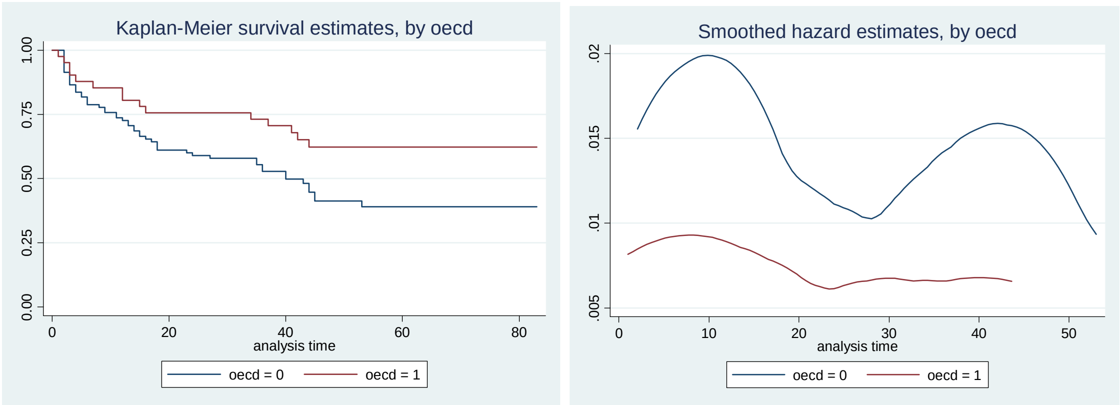


Risk rating presents two survival critic regions. During the first 18 periods, more than 30% of all countries fall. The phenomenon is explained by multiple failures and not by the crisis observed in the first years of the sample. As was seen earlier, most of the failures were in 1998, and less than 10 failures were before January of 1997. Once a country overlaps the first zone, it faces high risk levels between period 30 and 50, which is shown in 1998 financial crisis. Some countries which did not fall at the beginning, faced troubles in that year; at the same time their probability of a risk rating falling goes up after 45 periods. The presence of these countries is especially important if one takes account that every subsequent failure of any of these countries bestows information to the probabilities close to the origin, even though if the failure is caused by the crisis.

1998 crisis is seen directly in failure probabilities growth around period 45 and; obliquely by considering the replies, in the high probabilities between periods 5 and 15. An interesting regularity is that the risk function is not monotonous, which suggests that the survival model must consider semiparametric structures, this is a result of the contagion effect between 1998 and 1999, which earlier and later reduces risk change rating.

Figure 7. Risk rating survival analysis in 78 countries, by OECD classification

(a) Survival function *(b) Risk function*

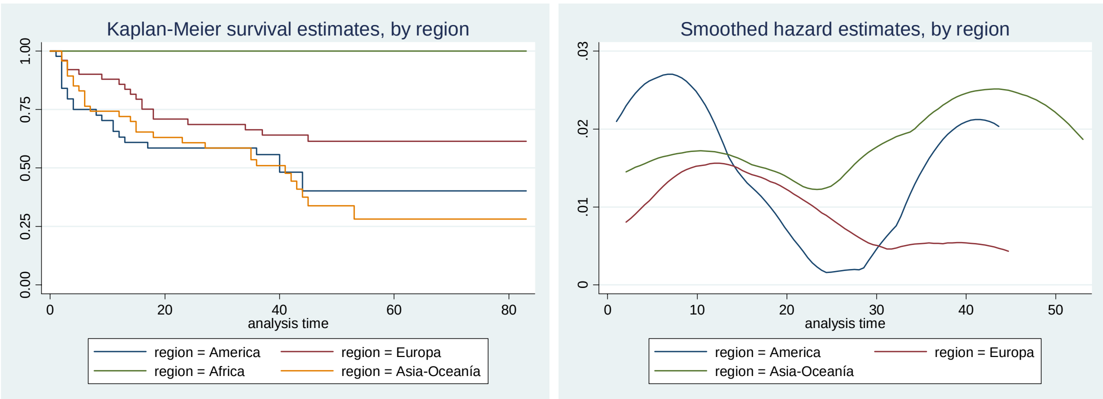


Once OECD countries are analyzed, it is found that developed countries have a lower probability of failing. Even more, apparently 1998 crisis did not caused a huge direct effect on the instantaneous probability of reducing risk rating, because most falls occurred before 20 periods. This is explained by 6 falls in Japan (40 % of falls in the group of countries). Although defaults occurred close to 1998 crisis, not all of them were in risk function around period 40, because those were replies.

In regions´ analysis, it was observed that Europe, as a group, has the lowest probability of falling followed by America and Asia - Oceania, which have important differences in time probability, being the first region prone to this phenomenon in the first periods. In Europe the biggest impact is given also by multiple falls, standing out the cases of Moldavia (4 falls) Turkey, Ukraine, Russia (3 falls each one) and Romania (2 falls). The opposite case is the one observed in Asia Pacific. Although there were countries such as Japan (6 falls), Pakistan (5 falls), Malaysian and Thailand (4 falls each one) whose replies contribute to risk function around period 20, many of them were robust at the beginning of the period and just few of them had problems in 1998. The probability of failure is greater around period 40 which suggests that in this region 1998 crisis played a key rol. America's risk function suggests that there were persistence in some falls, as in Argentina (8 falls), Colombia (4 falls), Ecuador and Venezuela (3 falls each one). When failure probabilities were estimated, these replies were as important as the direct effect of crisis.

Figure 8. Risk rating survival analysis in 78 countries, by region

(a) Survival function *(b) Risk function*



RESULTS

Bearing in mind the peculiarities of survival and risk functions presented in the previous section, models were estimated following parametric and semiparametric issues in order to explain the determinants of countries risk ratings fallings. In the first group there were used distributions like Weibull, Gompertz and exponentially; at this point it is vital stand out that these models may present bias problems since risk function is not monotonous; nevertheless the estimation is based in two reasons: first to have a reference to compare the Cox Models results and secondly, the risk function is not monotonous but it presents a decreasing tendency.

Empirical regularities suggest that financial risk, and therefore its rating, depends on exchange and credit risk, as well as on real sector stability and indebtedness level of the economy. Hence, the analysis considered five explanatory variables in order to capture these interrelations, the variables were: percentage of the quota of International Monetary Fund (IMF) loan, exchange regime, OECD participation and the variance and growth rate of international reserves. Additionally and with the purpose of captures contagion financial risk, we construct an accumulation crisis variable for each region and for the entire sample. The expected effect of the above is the following:

- *Percentage of the quota of IFM loan:* this variable captures the indebtedness state of the countries; the expected effect on risk rating is negative.
- *Exchange regime:* it is measured by a scale variable that represents the level of rigidity of the exchange system, in this 1 is the floating regime, 2 is an intermediate system and 3 is the fixed regime. The effect of this variable on risk rating is not clear, since on one side it is possible to think that a system with a floating regime is more exposed to the changes of external sector, which might accelerate any contagion effect; nevertheless, under a fixed regime the monetary authority must commit itself with reliable measures with the purpose of conserve financial system stability by monetary emission or the accumulation of reserves.
- *OECD participation$(OECD)$:* this is a dummy variable which is 1 if it is an OECD country member. The variable captures risk differences between developed and emerging economies.
- *Variance of international reserves (ser):* it is measured as the standard deviation of international reserves with a window of one year earlier and one year later of the consolidated observation. This one allows capturing the instability of the national finances and exposition to international commerce and to the monetary authority activity. The expected effect on risk rating is negative.
- *Reserves growth rate (rg):* it is measured as the annual growth of international reserves. The intuition behind the variable is tied to the payment capacity of the economy; it means a greater accumulation of reserves is a sign of positive macroeconomic behavior; therefore the expected effect is positive.
- *Crises accumulation (ca)*: this variable accumulates the number of crises by region in time, aiming to verify if probability of rating change of a specific

country has an inertial effect on rating change in the closest country(ies). Although, one should notice that transmission mechanism may be due to trading relations among countries, which in turns, are bigger among nearby countries.

In order to capture any nonlinear effect of this variable, we use a second degree polynom. To avoid correlation between a variable and its square, when the model incluyes the later, we use an ortogonal polynom generated by the crisis accumulation of each region.

Data is from International Financial Statistics from IMF (2007), excepting by exchange rate regime, which is from Reinhart and Rogoff (2002). Before the analysis of colineality among variables was verified, this was not significative as it presented in Table 1.

Table 1. Control variables matrix correlation

	% quota	**Exchange rate**	**OECD**	**S.E(Reserves)**	**Reserves growth**	**Acumulation crisis**
% quota	1.000					
Exchange rate	-0.057	1.000				
OECD	-0.163	0.133	1.000			
S.E(Reserves)	0.039	-0.056	0.200	1.000		
Reserves growth	0.088	-0.035	-0.115	0.069	1.000	
Crises accumulation	0.090	0.077	-0.169	0.063	-0.098	1.000

Then, model is specified by:

$$h(t|\mathbf{x}_i) = h_0(t)e^{\mathbf{x}_i'\beta}$$

$$\mathbf{x}_i'\beta = \beta_1 q + \beta_2 er + \beta_3 OECD + \beta_4 ser + \beta_5 rg$$

Results are shown in Table 2; it includes proportional risk models and parametric models results, the later is a reference point. The diagnostic analysis is focused exclusively on Cox proportional risk model[7]. In order to test contagion effect, we estimate a model with crises accumulation variable and without OECD variable, since the later presents a regional correlation the inclusion of both variables in the same exercise give similar information. As it is seen in the Cox column in Table 2, the model is robust on the change of regional correlation measure and contagion proxy.

[7] It is important to emphasize that the coefficients of these models follow the proposed intuitions and they also are statistically significant; additionally the models are significant at level of 5 %.

Table 2. Parametric and semiparametric survival models results

Variable	Cox(1)[8]	Cox(2)	Cox(3)	Cox(4)	Weibull	Gompertz	Exponential
% quota	0.0013	0.0011	0.0011	0.0012	0.0016	0.0014	0.0018
	(0.0006)	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Exchange rate	-0.2931	-0.3474	-0.3388	-0.3107	-0.3013	-0.2637	-0.3294
	(0.1574)	(0.1553)	(0.1551)	(0.1578)	(0.1533)	(0.1552)	(0.1512)
OECD	-0.8751			-0.8451	-1.0346	-0.9165	-1.0990
	(0.3379)			(0.3499)	(0.3336)	(0.3377)	(0.3288)
Crisis acumulation		0.0320	1.6126	0.7160	-1.0346	-0.9165	-1.0990
		(0.0151)	(1.4201)	(1.4627)	(0.3336)	(0.3377)	(0.3288)
Crisis acumulation (second degree)			-2.1936	-2.0769			
			(1.0560)	(1.0544)			
S.E(Reserves)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Reserves growth	-2.1698	-2.1605	-2.0294	-2.0433	-2.4257	-2.3156	-2.6208
	(0.4901)	(0.4888)	(0.4990)	(0.5083)	(0.4761)	(0.4617)	(0.4623)
Constant					-3.1800	-3.2985	-3.6229
					(0.4343)	(0.3357)	(0.3111)

Note: Standard errors in parentheses

The variable percentage of quota implies that an increase of 1 % in the use of the quota of IMF loan increases the probability of rating reduction 0.13 percentage points (pp); by looking at exchange rate type the exercise suggests that a more rigid exchange rate diminishes this probability in 29.3 pp[9].

OECD participation variable proves that those countries with better economic development have a probability of 58.31 pp lower than less developed and emergent countries. Considering this important difference, it is possible to think that survival functions of OECD countries are different from the others; this observation is supported by log rank and wilcoxon test, whose results are presented Table 3

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8 The test, which is based on Schoenfeld residuals, suggests that hazard proportional assumption is reached both at individual and global level; additionally, the Cox models which include control variables which change in time suggest that the time effect is not significant.

9 This variable was also specified as a dummy variable, the result does not change and shows differences between floating exchange rate and to other two regimes, but there are no significant differences between these.

Table 3. Survival function test between OECD countries and the others

Pruebas	Log Rank	Wilcoxon	Cox
χ_1^2	4.63	3.66	4.87
p-valor	0.0315	0.0557	0.0274

This result may allow doing a risk analysis for every group; nevertheless, the size of the OECD sample is very small, therefore it is possible to think that the coefficient of the variable is a good approach to this distinguishing probability. On the other hand international reserves instability presents an increase in the probability of falling of 8.6 pp for every thousand units, and growth rate diminishes probability in 88.5 pp.

In the model which includes crisis accumulation variable (Cox(2) column), the coefficients of the variables do not change dramatically. According to what we expected, accumulation variable has a positive effect, meaning that the probability of fall of a country increases 3.2 pp when neighbors' ratings fall.

As is seen in the distribution function of contagion variable (Figure 5), one may think it has a nonlinear effect[10]. In order to capture this effect and to avoid the multicolineality raised from the inclusion of variables of higher degree, we include an orthogonal polynom of second degree[11]. Contagion variable has concave form; this suggests that the effect of the variable on probability of falling is higher on lower levels of crises accumulated. The observation may be supported on Gourinchas et al. (2001) meaning there is a strong correlation between contagion and risk at short term, but it is neutralized at mid term.

By including the orthogonal polynom we isolate contagion from the OECD effect, these two variables seemed highly correlated. In the model which includes both variables (column Cox(4)) contagion variable has positive but decreasing effect, in addition it reduces the probability of rating falling in OECD countries (similar to what was obtained in the first model).

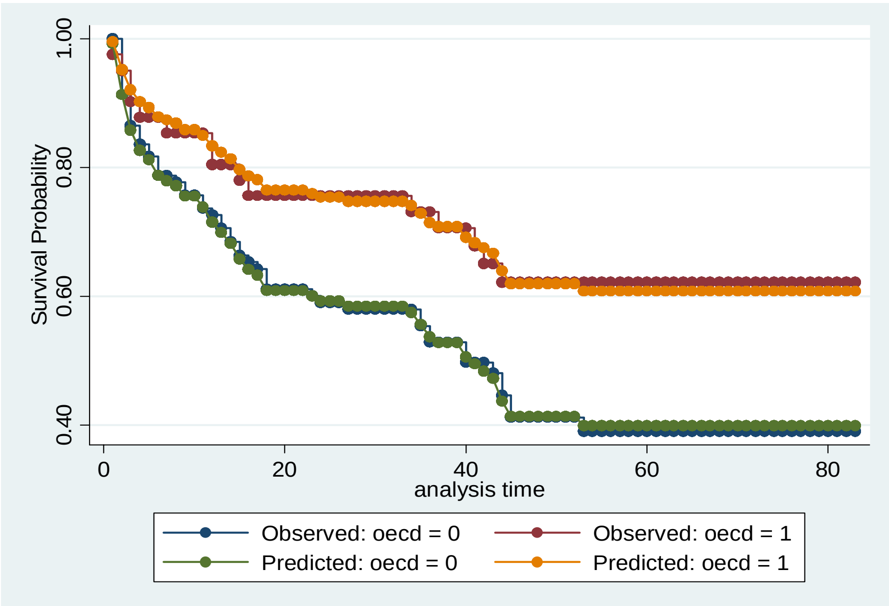
[10] Indeed after period 45, there is a strong acceleration in crises

[11] In order to capture a nonlinear effect, we include the square of the variable but it exhibited multicolineality problems. In addition we construct an spline based on time and crises accumulation but they were not significant, the same result was obtained for orthogonal polynoms of third degree.

Survival, risk and cumulative risk functions getting out from Cox model, as well as baseline estimations are in the Annex, where it is shown that the model replies the regularities observed in the graphic analysis of the previous section which shows financial falls persistence, which may be explained by replies in rating falling or region contagion effects.

To verify forecast model quality, survival function for OECD classification was estimated, both the semiparametric one and the obtained from Cox model (see Figure 9); by this estimations it is seen clearly that the model presents a good fit.

Figure 9. Observed and forecasted (Cox model) survival models by OECD classification



CONCLUSIONS

A country's long term debt risk rating is a key signal of financial system, thus it is a signal to investors, too. If the purpose is to keep this risk indicator stable, then, in order to reach the goal policy makers may use mechanisms of transmission based on monetary and exchange policy.

Literature has studied the impact of real, financial and political variables on risk ratings, the results have shown that the second group has the greatest impact; meanwhile political variables just have a limited impact (Haque *et al.*, 1998). On the other hand, as real variables are potentially endogenous with the rating, it is not possible to establish a clear causality.

Because the space-temporal characteristic of survival models, it is feasible to combine idiosyncratic country effects and time effects, which in turn is tied with financial contagion. Therefore, in the studied period (1995-2001) which was characterized by a great financial instability; through the model we conclude that an excessive indebtedness with the IMF, exchange rigidities and international reserves instability have a remarkable negative effect on risk ratings. On the other hand, by observing the results between OECD and not OECD members and among regions, we found that the higher is the GDP of a country the lower is the probability of rating fall, this event is highly correlated with contagion effects by region which in turns has important positive effect inside the model.

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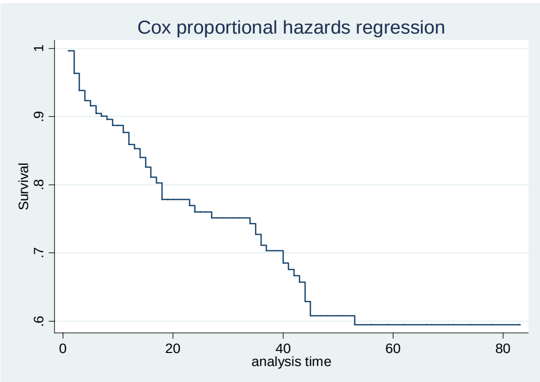
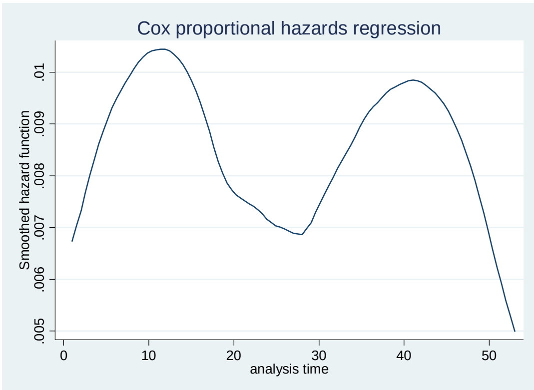
ANNEX

SURVIVAL AND RISK FUNCTIONS

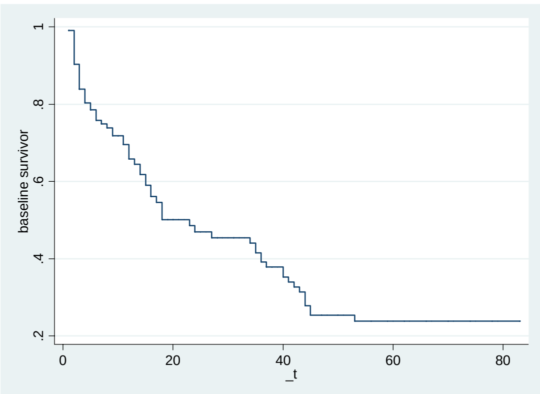
(a) Forcasted survival function



(b) Forcasted hazard function



(c) Baseline survival function



(d) Baseline hazard function