

T-A-C

RiskMonitor²
A Country Risk Assessment Service provided by TAC

METHOD AND RESULTS

January 2007

RiskMonitor is a comprehensive service of risk analysis applied to emerging markets, based on a sophisticated quantitative model integrating the latest development in non-linear analysis, and on 25 years of professional experience in country risk research. The predictive capacity of the service for crises in developing countries is extremely powerful.

The service includes a diversified range of products, each of which trying to meet specific operational requirements in terms of country risk monitoring. These products are distributed through a multi-channel delivery service with the highest flexibility. The service can also include customized « add-ons » to answer even more specific customers' needs.

This document describes the basis of the methodology which is the foundation of the service, as well as the results obtained on a 20-year back testing for 50 major developing countries.

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<http://www.tac-financial.com/crisk-RM-present.php>



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Key concepts

T-A-C's **RiskMonitor** (noted RM below) is an extremely powerful tool able to provide superior country risk measures to all institutions involved in business activities in emerging economies.

T-A-C has been working on country risk issues since its creation in 1991, and most economists working at T-A-C have extensive experience in dealing with macroeconomic and financial issues in developing countries. This is important as country risk is a changing concept and idea, and the potential materialisation or forms of country risks vary from time to time. Back in the 60s and early 70s, the most pressing risk was of political nature with expropriation / nationalization quite common in many developing countries. After the oil shock of the mid-70s and until the end of the 80s, the most damaging risks affecting emerging countries were related to large accumulation of foreign debt (provided mostly by commercial banks) by public borrowers and subsequent restructurings and reschedulings. Starting in the 90s, the financial aspects of crises became more dominant, in relation with the growing role of securities markets for emerging countries finance. Such transformations are here to stay, as financial techniques, political situations and international relations continue to change over time.

Any country risk tool has therefore to be able to capture quite different sources of potential shocks. In particular, it is essential not to limit the concept of country risk to financial default on external obligations as do the large rating agencies. Country risk services and analyses have to comprehensively assess potential difficulties and likelihood of economic and financial shocks in order to efficiently support decision making and risk management within banks and industrial companies.

The starting point of T-A-C's methodology is precisely the definition of three types of difficulties or shocks that can affect international operations, namely solvency issues, exchange rate risks and cyclical reversal risks. The second starting point is the willingness to distinguish between a measure of "economic quality" (a synthetic rating enabling a hierarchical positioning of countries according to risk in different areas), and signals of upcoming shocks that would be large enough to derail indiscriminately individual contracts and counterparts. We like the image of a skier in front of a foggy slope: he wants to assess the risk of going down, and surely would like to know whether the ski-run is bumpy, irregular, steep or rather flat; but he would also want to know with the greatest degree of certainty if there is a deep ravine in the middle of his foggy route. The ravine is a "full-blown crisis", and the characteristics of the ski-run are the synthetic "economic quality measures". With such objectives defined as our "targets", the proprietary methodology that is behind our RM service includes the following principles: risk as a non-linear result of economic and financial circumstances, a methodology combining quantitative results obtained from a sophisticated numerical system and qualitative analyses and a transparent and understandable process.

Risk as a non-linear result of economic and financial circumstances

RM is based on an understanding of country risk as a result of non-linear combinations of economic and financial circumstances, with threshold effects on sensitive indicators. Indeed, academic research on risks (not only country risk, but also counterparty risk or market risk) has consistently demonstrated that it is not necessary to use a very large number of economic or financial indicators to capture most of the required information about risk¹, but that the combinatorial features of a limited number of variables was the core element for risk materialisation.

In the quantitative models developed for RM, we use only 12 different economic and financial variables. Each variable is a rather complex computation of simple and standard macroeconomic indicator, but are very straightforward to understand and assess: for example, we use a variable for “economic growth”, which is computed as the per-capita GDP growth at constant prices with an accelerator / decelerator effect².

The combinatorial and threshold effects are integrated by grouping the indicators two-by-two to construct six Fundamental Balances. Each Fundamental Balance describes a specific set of “circumstances”, and the ability to see the movements and position of a country in such circumstances is providing the key inputs for our country risk measures. For each variable, a risk threshold is determined through a statistical analysis.

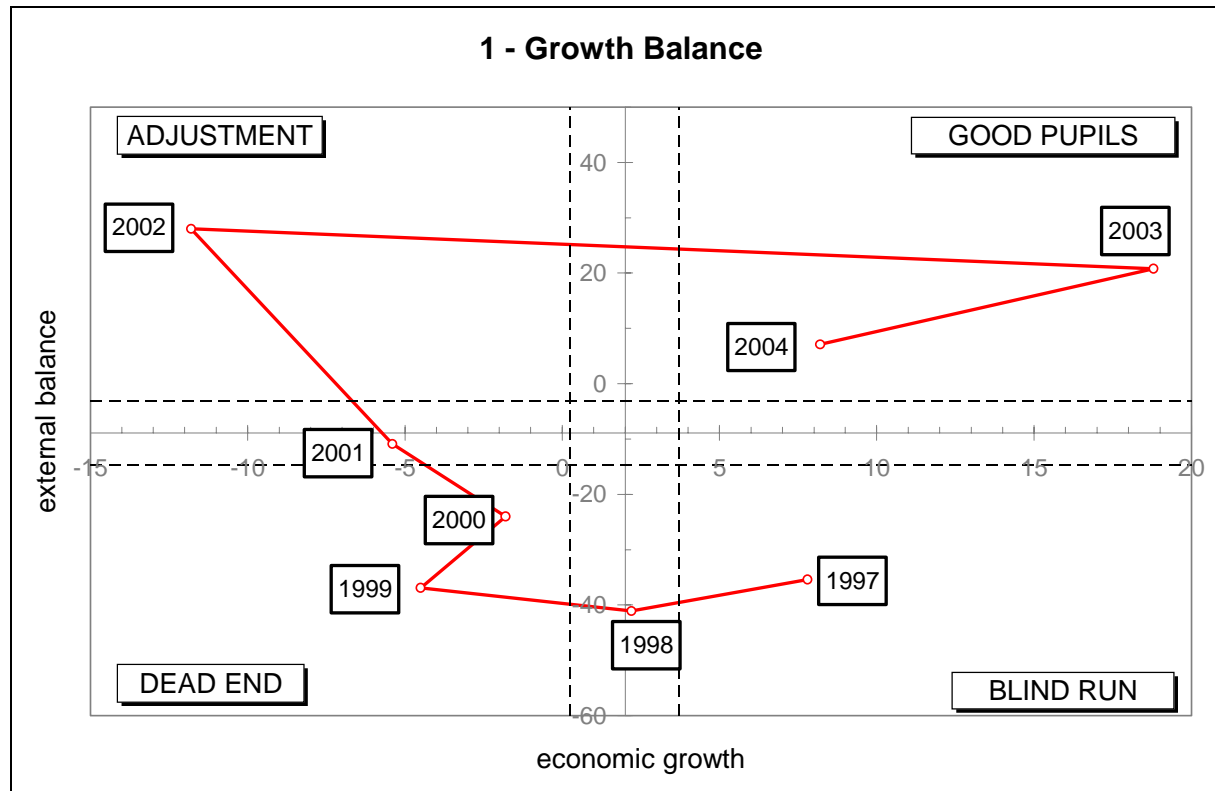
- **The Growth Balance (G1)**, measures the ability of a country to register sufficient economic growth without triggering unsustainable external imbalances
- **The Debt Balance (G2)**, measures the structural quality of a country’s external financing and its ability to balance debt with more stable inflows of direct investment.
- **The Liquidity Balance (G3)**, assesses the foreign currency situation of a country by looking at the relative level of currency reserves and the vulnerability related to the accumulation of short-term foreign currency liabilities.
- **The Foreign Exchange Balance (G4)**, looks more precisely into a key financial aspect of the country risk by measuring the relative valuation of the exchange rate in terms of international competitiveness as well as the dynamics in official foreign currency reserves against international interbank lending and domestic monetary aggregates.
- **The Cyclical Balance (G5)**, gives a view of the cyclical position of the country in a country risk perspective, and allows a measure both of the quality of the domestic economic policy and of the nature of the most sensitive risks, by looking at the de facto stance of the monetary policy and the momentum of domestic activity. Our indicators have a 3-6 quarters lead on actual evolutions.

¹ See Krugman (1979), Diebold and Rudebusch (1989), Stock and Watson (1989), Obstfeld (1994), Cantor and Packer (1996), Eichengreen et al. (1996), Frankel and Rose (1996), Goldstein (1996), Goldstein and Turner (1996), Kaminsky et al. (1997, 1999), Apoteker and Barthélémy (2000, 2005), Komulainen and Lukkarila (2003).

² Everybody would agree that a higher economic growth is reducing risk, while a low development pace is increasing risks. Simultaneously, the same would consider that, for a given growth rate, the risk is higher if the country is registering a deceleration and lower if it is accelerating. Our “economic growth” indicator will therefore capture in one variable all these different elements.

- **The Banking System Balance (G6)**, gives a measure of the risks associated with imbalances in the overall banking situation of the country, through an appreciation of the links between activity and banks' health on one hand, and the dependence of domestic banks on foreign financing on the other hand.

The following chart provides an illustration of the Growth Balance.



The non-linear characteristics of our tool is further enhanced by the intensive use of non-parametric models that are precisely designed to capture complex combinations of variables.

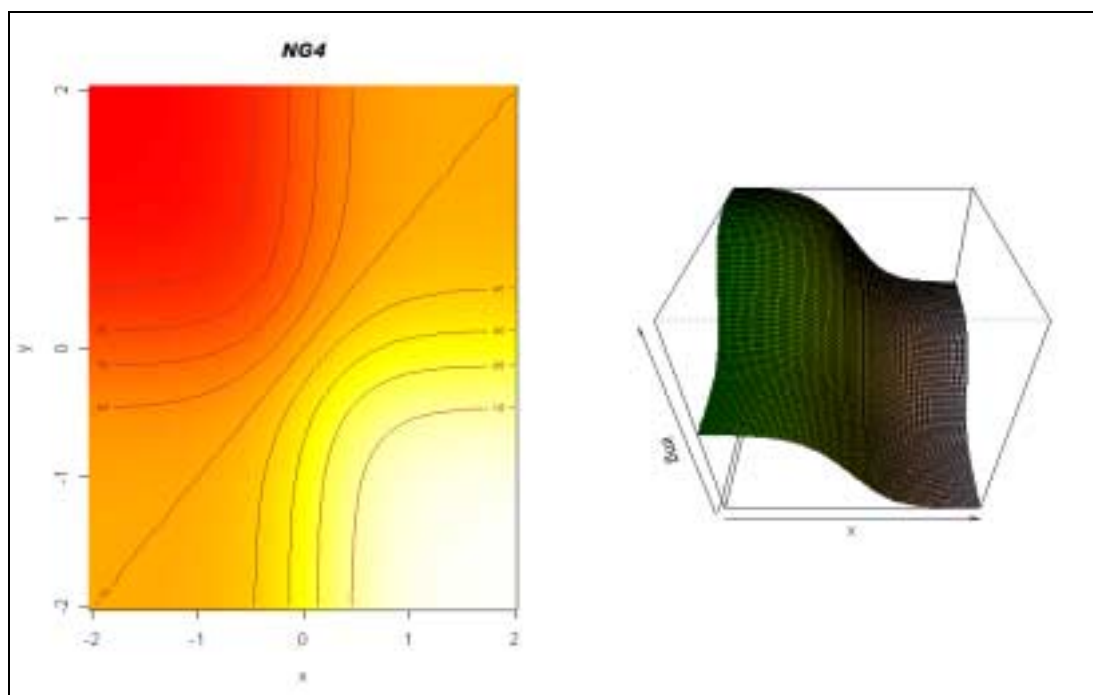
A methodology combining quantitative results obtained from a sophisticated numerical system and qualitative analyses

RM is a comprehensive service that combines quantitative results and qualitative analyses derived from T-A-C's long exposure and investment in emerging economies. This truly unique combination can be described by the three following aspects:

- ❖ **RM has a highly sophisticated number crunching side**, with the use of a composite non-parametric data mining model. This is constructed by using five different quantitative tools, all of them able to identify non-linear combinations between the 12 economic and financial variables that are used in RM. Most of these models are new in economic and financial areas, but they have been used with impressive results in many other scientific disciplines requiring diagnosis tools (e.g. health, genetics, etc.). They are: Neural Networks, Support Vector Machines / Regression, Random Forest, Bagging Classification, and Recursive Partitioning (see the short

bibliography at the end of the document for further references). These non-parametric models are used to provide clear-cut Crisis Signals. All these algorithms are recognised by experts in statistical analysis as of the most powerful classification algorithms available today. A detailed presentation of these models is available in the document: "Predicting financial crises in emerging markets using a composite non-parametric data mining model" (the document is available on our website).

- ❖ **RM also uses a "normative" quantitative approach**, whereby the method looks at the six Fundamental Balances to compute a score characterising the position of any country in each Balance. This score is basically a function of the distance to the risk thresholds. Then the Country Economic Ratings are calculated as combinations of the scores through a weighted geometric average, to provide continuous measures of any country's quality. The algebraic shape of the score functions, the level of thresholds for each indicator, and the weights of the geometric average are simultaneously optimised with a genetic algorithm, one of the very few tools allowing such simultaneous optimisation on a large number of parameters. The charts below give an illustration (in 2-D and 3-D) of the optimized algebraic functions that give a score to the position of a country in a Fundamental Balance according to the distance to thresholds.



- ❖ **Last but not least, RM uses all the available qualitative information and T-A-C's experience in developing countries** to complement the quantitative analyses. For example, comments will include forecasts and estimates (while the quantitative tools use only internationally recognized and published data), political and social factors, cultural features, international relations and geopolitical issues. This qualitative analysis is most often focused on specific issues relevant for each customer.

A transparent and understandable process

Finally, RM is constructed in such a way that the “black box” phenomena usually associated with refined quantitative tools have been reduced by the systematic use of self-explanatory charts that allow the user to follow the “economist reasoning” and understand the results. We would like our customers, whether economists or not, to be able to fully “own” the results of RM, discuss the arguments and come with their own reasoned judgement, supported by a very strong quantitative instrument and fed by an independent and long-term understanding of developing countries’ issues and characteristics.

Outputs

The major features in design can be briefly described around three aspects: a clear distinction between the notions of “crisis” and “country economic ratings”, an operational distinction between three horizons and three types of difficulties or crises and an impressive statistical quality.

A clear distinction between the notions of “crisis” and “country economic ratings”

A clear distinction between the notion of “crisis” and the notion of “country economic ratings” has been made. Indeed, our academic researches and experience, as well as our parallel work on counterparty risk in emerging markets have led us to consider a “country crisis” as a shock of such a magnitude and violence that it can significantly alter contractual commitments and counterparties’ financial health in an indiscriminate way. Such “crises” have therefore to integrate not only the importance of the country’s imbalances and problems, but also the likelihood that such problems will not be overcome through a gradual and progressive manner. RM therefore provides two different sets of results:

- ❖ **Early Warning Signals** of incoming crises, defined as such major shocks: full-fledged default on external financial obligations, large and rapid depreciation of the exchange rate (more than 20% in real terms against the USD over one quarter, or 40% over two quarters, or 60% over 3 quarters), collapse in economic activity (contraction of real GDP and more than 7 points difference in GDP growth year-on-year). These Signals are the results of the most sophisticated quantitative tool ever designed so far. As explained above, we have selected the 5 most performing early signalling models over a panel of more than 15 classification algorithms. The resulting model, the **RiskMonitor** CDM-Model is able to provide two different degrees of risk for such large shocks: **Crisis Signals**, when 4 out of the 5 models give a convergent signal of economic or financial shocks, with a probability of occurrence above 90%, but possibly missing some of the potential shocks; and **Watch List Indications**, when 3 out of the 5 models give a convergent message: the quality of the signal is lower (mistakes can be made, and flags raised with no crisis afterwards), but the probability that a crisis will not be signalled is much lower.
- ❖ **Country Economic Ratings** are a normative appreciation of the macroeconomic and macro-financial qualities of the countries regarding the same types of difficulties, but without looking at the possible outcomes (crisis or no-crisis, i.e. violent adjustment or milder “muddling-through”). The Country Economic Ratings use the same 12 indicators, combined through our Fundamental Balances and associated with the computation of an algebraic score for the country’s position in each Balance. The Ratings are therefore quantitative results of optimised combinations of the six Fundamental Balances. They are graduated from 0 (best quality) to 100 (worst quality) and classified in four categories, from A (best category) to D (worst

category). A very poor level of the Country Economic Ratings is not necessarily associated with a Crisis Signal, since countries may succeed in correcting their imbalances through a progressive change that would not qualify for a full-fledged crisis. Conversely, an average or mediocre Country Economic Rating can still be associated with a Crisis Signal if the required adjustments are made through a violent shock.

An operational distinction between three horizons and three types of difficulties or crises

RM is able to distinguish between the types of economic difficulties or financial shocks, as well as between time-horizons. For each of the measures (Crisis Signals, Watch List Indications, and Country Economic Ratings), quantitative results include nine different items (plus an average as the most synthetic Country Economic Rating), as defined by the following table:

	Less than 1 year	From 1 to 3 years	From 3 to 5 years
Solvency / Default	-	-	-
Exchange rate depreciation	-	-	-
Economic activity reversal	-	-	-

An impressive statistical quality

Concerning the Signals that are determined by the application of our five non-parametric models, the traditional way of measuring the statistical performance is the one used in signalling tool. Two inter-dependant statistical computation are made: on the one hand, the predictive quality of the Signal is assessed through a signal-to-noise ratio, which looks at the correctness of the Signal; every time a Signal is switched on (a flag is raised), we look at the subsequent period and check whether the shock has indeed occurred (then, it is called a true signal), or whether it has not occurred (then, it is a wrong signal or noise). On the other hand, the ability of the signal not to miss a crisis is called the "cover" or "sensitivity" measure; every time there is a crisis, we check whether there was the correct signal before (if so, the coverage is positive) or whether we did not raise the flag (the coverage is wrong or missing). The difficulty in signalling tools is to achieve a proper balance between the two sets of assessments.

This is one reason why RM distinguishes the "Crisis Signals" from the "Watch List Indication": for the first one, the objective is to have the highest possible signal-to-noise ratio without triggering a too low cover ratio; for the Watch List Indication, we take the position of a more risk-averse behaviour and prefer to increase the cover ratio, at the cost of slightly lower signal-to-noise. The following tables provide the statistical results of RM in the 1980-2002 back-testing period for the whole sample of 50 countries (in- and out-of-estimation sample).

Statistical Performances of Crisis Signals

	Crisis Cover Ratio (%)	Signal to Noise Ratio (%)
Less than 1 year	> 55	> 97
1-3 years	> 65	> 97
3-5 years	> 60	> 97

Statistical Performances of Watch List Indications

%	Crisis Cover Ratio (%)	Signal to Noise Ratio (%)
Less than 1 year	> 85	>90
1-3 years	> 85	>90
3-5 years	> 90	>90

The following table is the perfect example of RM's quality in predicting large shocks: it illustrates the Exchange Rate Crisis Signals provided for the three different time horizons, for Thailand. The 3-5 year signal was raised in 1992-Q4, the 1-3 year signal took the relay and was raised in 1995-Q1, and the less-than-one year signal was switched on in 1996-Q4. The Thai Baht collapsed during the third and fourth quarter of 1997.

Crisis signals of the CDM-Model on Thailand from 1991 to 1997

	Les than 1 year	From 1 to 3 years	From 3 to 5 years
1991			
1992			Warnings
1993			Crisis signal
1994		Warnings	Crisis signal
1995		Crisis signal	Warnings
1996	Crisis signal	Crisis signal	
1997	- The exchange rate policy was abandoned on July 2 -		

Concerning the Country Economic Ratings, the quality is determined by the ability of the result to announce relative improvements versus deteriorations for the economic variable that is the relevant target. Here, the targets are the ratings given by Standard & Poor's, the variation of the exchange rate, and the change in GDP growth, respectively for

Solvency, Exchange Rate and Activity Ratings. The Ratings will therefore indicate a relative probability of deterioration (or improvement) over the horizon period. The Ratings are measured on a continuous scale from 0 (best situation) to 100 (worst situation). A Rating below 30 is usually associated with positive developments, while a Rating above 50 indicates a very negative situation.

Political risk

T-A-C has constructed Political Risk ratings aiming at capturing the risks to a foreign investor that is created by the country's political situation, regulatory environment and law enforcement. The Political Ratings are based on information provided once a year by the World Bank, and uses 6 key indicators:

- Voice and Accountability
- Political Stability
- Government Effectiveness
- Regulatory Quality
- Rule of Law
- Control of Corruption

The data is homogenized and statistically normalized on a scale from 0 (best score) to 100 (worst score). The Political Risk Rating is computed as a simple mean average of the 6 scores.

Business Potential

Entrepreneurship and business is based on risk-taking and T-A-C is very adamant that risk measures should always be associated with the right measures of what could justify to take such risks. At a corporate or banking level, this is done by confronting risk with expected returns, while at the macroeconomic level, this should be done by comparing risk levels with the business potential offered by developing countries.

T-A-C's Business Potential measures aim at providing such a macro view by looking at opportunities offered by emerging market through four different angles:

- The potential for global development, based on the size, growth and maturity of the emerging market;
- The potential for exporters, based on the integration of the country in international trade flows and the growth of imports;
- The potential for corporate relationships, based on the density and profitability of the domestic corporate sector, the easiness and transparency of business transactions;
- The potential for financial activities, based on banking and financial market developments and size, as well as on regulatory aspects;

T-A-C's Business Potential measures use 54 basic indicators, which are statistically homogenized and normalized. The variables include:

- Economic and socio-economic indicators, like demographics, GDP growth and size, external trade, standard of living, ...
- Development indicators pertaining to health, education levels, ...

- Financial indicators, e.g. size of domestic financial markets, foreign participation, size of local banks, equity market characteristics ...
- Microeconomic indicators like the number of large companies, their profitability, ...
- Business environment indicators (labor market, easiness to create or close companies, corruption, ...).

These indicators are derived mostly from World Bank's databases, but are also completed with data provided by the IMF, the United Nations, Standard & Poor's, The Banker and the UNCTAD.

More details about the RiskMonitor models, methodology and overall results have been published in the Nov 2005 Country Risk issue of the 'Emerging Market Review' (Emerging Markets Review, 2005, vol. 6, issue 4, pages 363-375).

The document is available upon request or on the Elsevier website at:

<http://dx.doi.org/10.1016/j.ememar.2005.09.002>

Appendix : Track record of T-A-C's Country Risk Service

T-A-C's track record regarding the ability to correctly anticipate difficulties and crises in emerging markets is attested by what our customers say (see separate leaflet) and by the statistical performance of the quantitative models used in the service. It can also be illustrated by the observation of our outputs and results for a couple of the past decade's major country risk events.

1. Overview

The following tables show when a *Watch List* or a *Crisis Signal* was raised for a representative sample of recent country crises.

Argentina 2002

Year	< 1 year	1 to 3 years	3 to 5 years
1997	-		Crisis Signal
1998	-		Crisis Signal
1999	-	Crisis Signal	Crisis Signal
2000	-	Crisis Signal	Crisis Signal
2001	Crisis Signal	Crisis Signal	Crisis Signal
2002	Exchange Rate Crisis		

Brazil 1999

Year	< 1 year	1 to 3 years	3 to 5 years
1994	-	-	Crisis Signal
1995	-	-	Crisis Signal
1996	-	Crisis Signal	-
1997	-	Crisis Signal	-
1998	Crisis Signal	-	-
1999	Exchange Rate Crisis		

Indonesia 1998

Year	< 1 year	1 to 3 years	3 to 5 years
1993	-	-	Crisis Signal
1994	-	-	Crisis Signal
1995	-	Crisis Signal	Crisis Signal
1996	-	Crisis Signal	-
1997	Crisis Signal	Watch List	-
1998	Exchange rate & Cyclical Crises		

Korea 1998

Year	< 1 year	1 to 3 years	3 to 5 years
1993	-	-	Watch List
1994	-	-	Crisis Signal
1995	-	Crisis Signal	Crisis Signal
1996	-	Crisis Signal	-
1997	Crisis Signal	Crisis Signal	-
1998	Exchange rate & Cyclical Crises		

Mexico 1995

Year	< 1 year	1 to 3 years	3 to 5 years
1991	-	-	Watch List
1991	-	-	Crisis Signal
1992	-	Crisis Signal	Crisis Signal
1993	-	Crisis Signal	-
1994	Crisis Signal	Crisis Signal	-
1995	Exchange rate & Cyclical Crises		

Peru 1998

Year	< 1 year	1 to 3 years	3 to 5 years
1993	-	-	Crisis Signal
1994	-	-	Crisis Signal
1995	-	Crisis Signal	Crisis Signal
1996	-	Crisis Signal	-
1997	Crisis Signal	-	-
1998	Cyclical Crisis		

Thailand 1997

Year	< 1 year	1 to 3 years	3 to 5 years
1991	-	-	-
1992	-	-	Watch List
1993	-	-	Crisis Signal
1994	-	Watch List	Crisis Signal
1995	-	Crisis Signal	Watch List
1996	Crisis Signal	Crisis Signal	-
1997	Exchange rate crisis		

Turkey 1999

Year	< 1 year	1 to 3 years	3 to 5 years
1994	-	-	Crisis Signal
1995	-	Watch List	Watch list
1996	-	Crisis Signal	Crisis Signal
1997	-	Crisis Signal	Crisis Signal
1998	Crisis Signal	Crisis Signal	Crisis Signal
1999	Cyclical Crisis		

Venezuela 2002

Year	< 1 year	1 to 3 years	3 to 5 years
1997	-	-	Crisis Signal
1998	-	-	Crisis Signal
1999	-	Crisis Signal	Crisis Signal
2000	-	Crisis Signal	Watch List
2001	Watch List	Crisis Signal	-
2002	Cyclical Crisis		

2. Illustration on Argentina 1999-2002

When the crisis erupted in Argentina in January 2002, it looks as if everybody had announced it beforehand. However, if we assume that any corporate or investment decision needs at least a couple of quarters advance warning, then the proper signals should have been available in the fourth quarter of 2000.

The following table and chart are illustrating that none of the largest risk analysis providers did show a "crisis signal" until the summer or the end of 2001.

Risk information provided by some of the largest risk analysis institutions

	Standard & Poor's (1)	Institutional Investor's (2)	EIU (3)
Oct., 1999	BB	42.4 (rank 59 / 145)	C
Apr., 2000	BB	43.0 (rank 60 / 145)	C
Jan., 2001	BB-	45.8 (rank 65 / 145)	C
Jul., 2001	B	39.8 (rank 68 / 145)	D
Oct., 2001	CC	34.7 (rank 73 / 145)	D
Jan., 2002	SD	34.7 (rank 73 / 145)	E

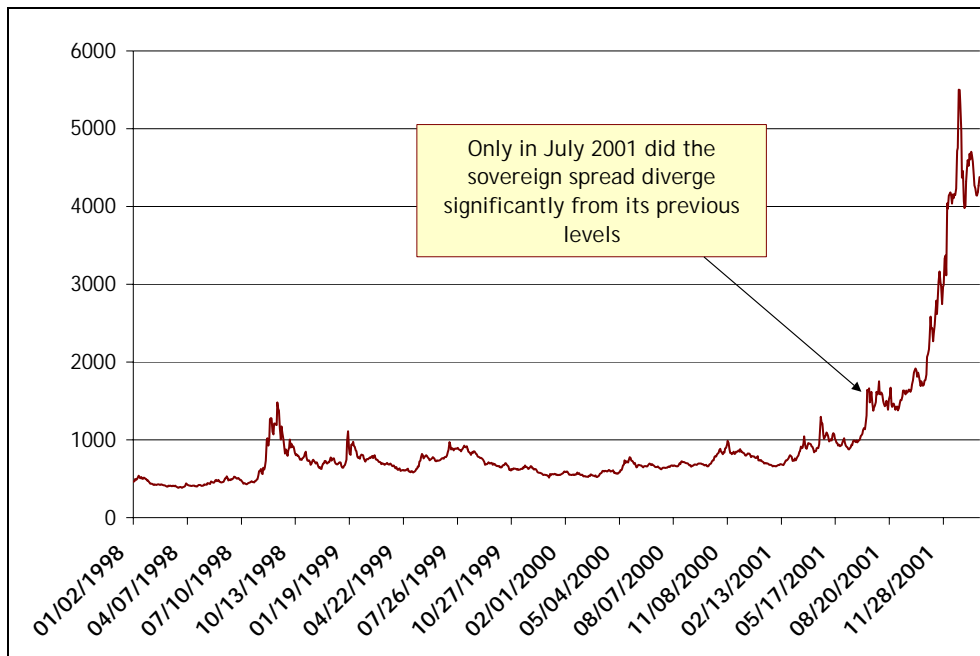
(1) - Standard & Poor's Long-Term Foreign Currency Ratings are expressed in terms of categories (AAA, AA, A, BBB, BB, ...) The highest rating is AAA (not vulnerable to non payment), CC is currently highly vulnerable to non payment, and SD is a non payment default.

(2) - Institutional Investor's Country Credit Ratings. These ratings lie in the interval 0 (which is the best possible rating for a country) to 100 (which is the worst rating). The 145 countries covered by Institutional Investor's Ratings are classified twice a year, in September and March.

(3) - EIU Country Risk Ratings (from A to E, E being the signal of crisis)

Even the much talked-about predictive ability of the market to announce difficulties is not evident when looking at Argentina's spreads on sovereign bonds.

Sovereign spread on Argentina's USD international bonds (EMBI - JP Morgan)



Conversely, we are very proud that our RiskMonitor system was able to deliver the right signals with the right time-horizon, for the exchange rate collapse and the abandonment of the currency peg as well as for the default and limitations to foreign currency transfers abroad.

Risk information provided by TAC RiskMonitor

Year	< 1 year	1 to 3 years	3 to 5 years
1997	-		Crisis Signal
1998	-		Crisis Signal
1999	-	Crisis Signal	Crisis Signal
2000	-	Crisis Signal	Crisis Signal
2001	Crisis Signal	Crisis Signal	Crisis Signal
2002	Exchange Rate Crisis		

The ability to provide correct time-profile for such non-linear events is particularly important because it allows companies (industrial or financial) to correctly plan and even benefit from such crises.

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