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عنوان المداخلة

Predicting Financial Crises: Myth and Reality

من إعداد الباحث

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Abstract

   Forecasting financial crises has always been one of the most controversial topics in modern finance, especially in recent years. The aim of this article is not to build a new model able to anticipate or provide some early warning signals for those crises, but to overview the existing body of literature in an attempt to show the predictive power of EWSs used. After a comparison between financial crises and financial stability, we proceed to detailed analysis of different financial crises, their indicators, triggers, and implications. We conclude with an assessment of the effectiveness of the EWSs utilized by different bodies and institutions in predicting financial turbulences. The final result is that financial crises are unpredictable and always take market participants and policymakers by surprise. These people continually ask themselves "why didn't they think of this earlier?" These are the limits of financial engineering (securitization) in a world of financial globalization.

Abbreviations

B.C. = banking crises	F.S. = financial stability
C.C. = currency crises	F.S.I. = financial soundness indicators
EWSs = early warning systems	S.M.C. = stock market crashes

Keywords: financial crises, early warning systems, forecasting financial crises, securitization, limits of financial engineering.

ملخص

يعتبر التنبؤ بالأزمات المالية من المواضيع المثيرة للجدل في المالية الحديثة، لاسيما في السنوات الأخيرة. فهذا المقال لا يهدف إلى اقتراح نموذج جديد للتوقع وإعطاء إشارات عن تلك الأزمات، ولكن لتحليل الأدبيات المتوفرة في هذا المجال بغرض إظهار القدرة التنبؤية لأنظمة الإنذار المبكر المستعملة. فبعد التفرقة بين الأزمات المالية والاستقرار المالي قمنا بدراسة مفصلة للأزمات المالية المختلفة، عواملها، دوافعها، وتداعياتها. عالجنا بعد ذلك مدى فاعلية تلك الأنظمة المستعملة من قبل مختلف الهيئات والمؤسسات بغرض التنبؤ بالاضطرابات المالية. خلصنا إلى أنه لا يمكن التنبؤ بالأزمات المالية، حيث تأتي دائما بصورة مفاجئة للجميع. ففي انتظار الأزمة القادمة يتساءل المعنيون دائما كيف أنهم لم يتمكنوا من معرفة أن هذه الأزمة أو تلك قادمة في وقت ما وبعمق معين. كما اتضح أيضا أن للهندسة المالية (التوريق) حدود في ظل العولمة المالية.

1- Introduction

   A large number of severe financial crises, such as banking crises, currency crises, market crashes, and debt crises…etc., have hit most developed, emerging, and developing countries in recent decades. Each crisis causes enormous costs in the regions concerned in terms of economic slowdown, real output losses, growth declines, bankruptcies, job losses, financial instability, and so on. That is why governments, banks, and international financial institutions invest heavily in researching early warning systems (in short: EWSs). By way of consequence, there exists now a wide range of studies and proposals to improve their forecasting power. Debates and research have also focused on tracing the triggers and impacts of those devastating crises in an environment characterized by a growing integration of economies and globalization of financial markets. By reason of the substantial costs associated with their resolution, and because they are very damaging to concerned economies, the question of how to predict financial crises has become central. Moreover, are there limits to financial engineering, especially in its main aspect: securitization? Do ratings predict financial crises?

   The rest of the paper is organized as follows. Section 2 reviews the literature. Section 3, is the main part of the paper and covers the definition of financial stability and financial crises.

It also presents different kinds of financial crises, their causes, indicators, and implications. Section 4 discusses the process of forecasting financial crises and EWS models. Section 5 concludes.

2- Background literature

There is an over-abundance of theoretical models and practical studies which analyse financial crises in general and predicting tools and models of those crises in particular. Studies attempting to identify the causes, origins, and consequences of currency crises (Kaminsky and Reinhart 1999; Jotzo 1999; Zhuang 2002; Bongini et al. 2002; Sy 2004; Apoteker and Barthélamy 2005; Kaminsky 2006; Bussiere and Fratzscher 2006; Andreou et al. 2007; Cipollini and Kapetanios 2009) mainly focuse on macroeconomic factors, vulnerability indicators, probability of crises, and exchange market pressure (EMP) index, that can predict those crises. Another list of studies focuse on banking crises, their causes, indicators as well as a framework for analyzing the soundness of individual banks, i.e. CAMELS framework (Hilbers et al 2000; Gupta 2002; Demirgüç-Kunt et al. 2006; Evans 2008;). A third list deals with stock market crashes as a regular phenomenon (Illing and Liu 2006; Novak and Beirlant 2006; Coudert and Gex 2008; Djebbar 2008; Djebbar and Merimet 2008; Chen S.S, 2009; Wang et al. 2009). A final long and expanding list emphasizes other kinds of financial crises such as twin crises, debt crises, liquidity crises, default crises, and rating agencies deficiencies and so forth (Kaminsky and Reinhart 1999; Lestano and Kuper 2003; Sy 2004; Djebbar 2004; Chen & Chen 2008; Bleaney et al 2008; Singh 2009; Cipollini and Kapotanios 2009). They try to explain what happens to the financial system, corporate sector, and to the whole economy following a financial crisis. Other researches try to discover whether it is possible to forecast this crisis or that one, focusing on the capability of EWSs in detecting vulnerabilities.

3- Financial crisis versus financial stability

Over the past three decades, there appears to be a significant gap between real and financial economies all over the world, and this disconnection has been getting wider and wider in faster paces in recent years, especially in developed and emerging countries. It is the outcome of the rapid development and expansion of the financial sector compared to different economic and non-financial sectors (the real economy), and which threatens the stability of domestic as well as global economies. The interlinkages between those economies have also led to complex interconnections between international financial systems, which have been accompanied by frequent financial disruptions and crises due to contagion effects, and therefore, financial stability (in short: FS) has become a top economic policy objective. In order to achieve and maintain this goal, public authorities provide macroeconomic, monetary, financial market, supervisory and regulatory frameworks.

3-1- Financial stability

Up to now, there is no single, widely accepted definition of FS, and many academics and practitioners have dealt with it from different angles. Some of them look at it from its opposite: financial instability, whereas others describe it in a broad manner as a characteristic of the financial system as a whole. Schinasi, for instance, defines financial stability as "a condition in which an economy's mechanisms for pricing, allocating, and managing financial risks (credit, liquidity, counterparty, market, etc.) are functioning well enough to contribute to the performance of the economy (Schinasi, 2004, p. 10)". After emphasising that finance involves human promises to pay back some specific amounts in the future, he recognises "that finance embodies uncertainties and risks (default risk, market risk, liquidity risk, ..)". This fragility in trust, mainly in financial contracts, is usually transformed into market and other financial risks, which, in turn, might extend, sometimes quickly, to the real economy. This requires intensifying supervision and surveillance by specialised bodies.

Some alternative definitions include:
- "Financial stability refers to conditions that harm, or threaten to harm, an economy's performance through their impact on the working of the financial system (John Chant, Bank of Canada, in: Schinasi, 2004, p. 13)".

- "The term financial stability broadly describes a steady state in which the financial system efficiently performs its key economic functions, such as allocating resources and spreading risk as well as settling payments, and is able to do so even in the event of shocks, stress situations, and periods of profound structural change (Deutsche Bundesbank Report, in: Schinasi, 2004, p. 14)".

In a nutshell, we can point out that FS is a broad term which describes a continuous situation where the financial system operates efficiently and performs its role in ensuring payments, resources allocation and pricing, mobilizing savings, managing risks, absorbing shocks, facilitating economic development and growth. It is usually accompanied by stable macroeconomic conditions, low volatility, sound financial institutions, stable financial markets and healthy financial infrastructure (accounting systems, settlement, legislation, payments, ..), enough liquidity in the economy due to effective channeling of funds and a steady level of confidence in the financial system.

Because of the interdependence between those parts of the single financial system, any disorder which takes place in any one of the components could spread to other parts of the system and might consequently lead to a financial crisis. Therefore, regulators and financial authorities try to avoid any serious disruption to the intermediation functions of the system and its components. This also shows the extreme importance of FS as a vital requirement for economic growth and development of any nation.

3-1-1- Financial Stability Analysis

As an instrument of identifying threats to the financial system stability, financial stability analysis is in its early stage of development. It covers a large spectrum of risks and vulnerabilities which characterize modern financial systems and real economies. It is based on microprudential indicators compiled at a macro-level, as well as on variables related to financial markets (including derivative markets), markets liquidity, uncertainty, volatility, risks and so on. The most important Financial Soundness Indicators (in short: FSI) are provided by the IMF (see some of them in table 1), where they were divided into Core and Encouraged indicators.

Table 1. Financial Soundness Indicators[2]

Core indicators	
Deposit-taking institutions	
Capital adequacy	. Ratio of regulatory capital to risk-weighted assets . Ratio of non performing loans net of provisions to capital
Asset quality	. Ratio of non performing loans to total gross loans . Ratio of sectoral distribution of loans to total loans
Earnings and profitability	. Return on assets . Return on equity
Liquidity	. Ratio of liquid assets to total assets . Ratio of liquid assets to short-term liabilities
Sensitivity to market risk	. Ratio of net open position in foreign exchange to capital
Encouraged indicators	
Deposit-taking institutions	. Ratio of capital to assets . Ratio gross asset position in financial

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[2] - The complete list of FSI (39 indicators) proposed by the IMF is published by : Moorehouse, A., February 2004, p. 4; available at : http://www.bankofengland.co.uk/statistics/m/s/articles; For the same list see also : Financial Stability Review, March 2005, p. 51.

	derivatives to capital
	. Ratio of trading income to total income
	. Spread between reference lending and deposit rates
	. Ratio of foreign-currency-denominated loans to total loans
Other financial corporations	. Ratio of assets to total financial system assets
	. Ratio of assets to GDP
Nonfinancial corporations	. Ratio of total debt to equity
	. return on equity
Households	. Ratio of household debt to GDP
Market liquidity	. Average bid-ask spread in the securities market
	. Average daily turnover ratio in the securities market
Real estate markets	. Real estate prices
	. Ratio of residential real estate loans to total loans

Source: IMF, in: Moorehouse, Andrew, 2004, p 4.

It seems that FSI cover financial as well as non-financial institutions and markets, even if they are primarily concerned with the financial system.

Moreover, the analytical framework to monitor FS is centered on 4 key elements:
- Monitoring of financial markets and assessing risks that will hit the financial sector using EWSs. Indicators used include financial market data and macro data.
- Macroprudential monitoring and assessment of the health of the financial system and its vulnerabilities to shocks. The tools used are FSI and stress tests.[3]
- Analysis of macrofinancial linkages attempts to understand the exposures that can cause shocks to be transmitted through the financial system to the macroeconomy.
- Monitoring of macroeconomic conditions and monitoring debts.

As far as assessment is concerned, up to date, there exists no measurement for F.S. This is because F.S. is a multifaced concept which reflects the activities of different institutions, markets and infrastructures. A large set of financial indicators has also been used in order to analyse the level of F.S., as mentioned earlier. Furthermore, experts use a larger set of indicators named Financial Stability Indicators. These include, besides the FSI, macroeconomic environment indicators and composite indicators. This shows that Financial Stability Indicators are not limited to a precise number, but that they can be extended according to the needs of the analysis[4].

On the other hand, financial instability is defined as "a situation characterized by these three basic criteria : (i) some important set of financial asset prices seem to have diverged sharply from fundamentals ; and/ or (ii) market functioning and credit availability, domestically and perhaps internationally, have been significantly distorted ; with the result that (iii) aggregate spending deviates (or is likely to deviate) significantly, either above or below, from the economy's ability to produce, (Roger Ferguson, US Federal Reserve, in: Schinasi 2004, p. 14)".

Financial instability, as the opposite of FS refers, therefore, to a state when the financial system does not perform its key functions efficiently, and consequently hinders the

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[3] - Stress tests are the techniques used to gauge financial system's resilience to shocks. Selected macroeconomic indicators are used to test quantitatively the impact of changes in particular variables such as accounting standards and disclosure requirements, the quality of supervision, the structure of the financial system and markets, and liberalization of financial institutions' portfolios and the aggregate solvency of the financial system. On the other hand Illing and Liu (2006, p. 262) define financial stress as a "gauge of the severity of disruptions to financial markets and institutions. Depending on their nature, situations of extreme stress are often referred to as crises, crashes, collapses, runs, or credit crunches". More details on stress tests are provided by: Goodhart, C.A.E., 2006, pp. 3417-8.

[4] - See an example of an extended list of Financial Stability Indicators in : Selected Financial Stability Indicators, available at : http://www.cnb.cz/en/financial_stability/fs_reports.

economy's performance. It leads to distortions in the allocation of economic resources and, ultimately, in growth and financial processes such as asset pricing, risk management, liquidity provision and allocation, lending and borrowing, saving and investment, shocks absorption, self-corrective mechanisms, and so forth.

3-1-2- Financial system stability

The financial system is usually constituted of different financial institutions (banks, intermediaries, securities firms, insurance companies, institutional investors, ..), markets (equity markets, bond markets, derivative markets, money markets, either they are formal or informal), and infrastructures (clearance, payments and settlement circuits, legal and regulatory frameworks..).

A financial system "is in a range of stability whenever it is capable of facilitating (rather than impeding) the performance of an economy, and of dissipating financial imbalances that arise endogenously or as a result of significant adverse and unanticipated events (Schinasi, 2004, p. 8)".

So, a stable financial system is one that enhances economic performance and efficiently performs its extremely important functions, such as providing and allocating resources, mobilizing savings, ensuring liquidity to the economy and settling payments, diversifying risks, absorbing shocks, resisting them, and preventing them from having a negative effect on the real economy. In order to perform these key functions, FSI are used to monitor the financial system and detect its vulnerability to shocks and crises.

3-2- Financial crises

There exists a panoply of crises that hit from time to time an increasing number of financial systems in different areas of the world. Financial crises take many shapes and forms and have several subsets such as banking crises, currency or balance-of-payment crises, stock (or equity) market crashes, sovereign debt crises, default crises, liquidity crises, private sector debt crises and so forth. We shall limit our study to the first three: banking crises, currency crises, and stock market crashes.

3-2-1- Banking crises

According to Caprio and Klingebiel 1996, a banking crisis (BC) or financial distress happens "when a significant fraction of the banking sector is insolvent but remains open". The banking crisis or financial panic has also been defined by Colomiris and Gorton as the situation "when bank debt holders suddenly demand that banks convert their debt claims into cash to an extent that the banks are forced to suspend the convertibility of their debt into cash, (Gupta, 2002, p. 4)".

This is to say, banking crises are those situations where significant segments of the banking system become illiquid or insolvent and banks fail to fulfill their obligations toward clients, mainly getting their deposits back. They are frequently accompanied by bank runs. BCs have also become damaging, especially in developing countries that adopted financial liberalization, and therefore experienced high reversal of capital flows. On the other hand it appears that there is a strong link between banking crises and currency crises.

Demirgüç-Kunt and Detragiache (1999) propose a more precise definition to BCs or systemic risk episodes as the ones in which (Demirgüç-kunt et al., 2006, pp. 703-4; Mannaso and Mayes, 2009, p. 246):
- Non-Performing Loans (NPLs) were at least 10 % of total banking sector assets,
- Ratio of NPLs to total assets > 2% of GDP,
- Cost of rescue operations was > 2% of GDP,
- Banking problems resulted in a large scale nationalisation of banks,
- Extensive bank runs, and
- Emergency measures, such as deposit freeze, prolonged bank holidays, generalized deposit guarantees were induced.

BCs hit developed and developing countries alike (see table below), mainly since the early 1980's, and emergency measures were taken to assist the banking systems in order to limit negative effects these problems usually generate.

Table 2. Starting years of banking crises in selected countries[5]

Country	Year	Country	Year	Country	Year
Cameroon	87, 95	Jordan	1989	Norway	1987
Chile	1981	Kenya	1993	Portugal	1986
Finland	1991	Korea	1997	Senegal	1988
Ghana	1982	Malaysia	85, 97	S/ Africa	1989
India	1991	Mali	1987	Sweden	1990
Indonesia	1992	Mauritania	1984	Thailand	83, 97
Italy	1990	Mexico	82, 94	Turkey	82,91,97
Japan	1992	Nigeria	1991	USA	1980

Source: Evrensel, A.Y, 2008, p. 592.

From the previous table, we can easily notice that no economy, whatever its strength, is safe from banking distress or crises.

Causes of BCs

There is a joint role of macroeconomic, structural and specific factors that lead to banking distress. The most important of those factors are (Naamane, 2002, p. 9):
- imprudent lending decisions or excessive credit growth,
- inefficient management,
- currency crises or foreign exchange crises,
- growth slowdown or recessions,
- stock market crashes,
- capital outflows,
- terms of trade,
- cumulative fragilities in the banking system and lack of liquidity,
- asset price bubbles.

On the other hand, one commonly used framework for analysing the soundness of individual banks is the CAMELS framework. It consists of 6 main aspects of financial institutions which we summarise as follows:

. Capital adequacy, and the ability of the bank to cope with shocks,

. Asset quality. Assets should be protected from specific exposures and risks,

. Management soundness, especially in decision making,

. Earnings, to measure the bank's profitability,

. Liquidity, as an indicator of solvency,

. Sensitivity to market risk: most banks are involved in foreign exchange transactions (with related interest rate and exchange rate determination), and trading in financial markets. Those transactions and trading processes are subject to market risk which should be controlled[6].

3-2-2- Currency crises

The last two decades have witnessed an increasing number of currency crises (CCs) in both developed and developing countries. It is probably due to capital account liberalization, financial markets integration, contagion effects, technology improvements and so forth. According to Reinhart (2002), Frankel and Rose defined a CC, or a balance-of-payment crisis as it is sometimes called, as "a 25 percent or greater devaluation in a given month that is also at least 10 percent greater than devaluation in the preceding month".

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[5] - See the full table in: Evrensel, A.Y, 2008, p. 592.

[6] - For more details see Appendix 1 ; and Hilbers et al, Sept. 2000, p. 53.

Kaminsky and Reinhart (1999) proposed what is known as *exchange market pressure* (EMP) *index* or KR index, I^7. It is a weighted average of the rate of change of the exchange rate, $\Delta e/e$, and the rate of change of reserves, $\Delta R/R$, with weights such that the two components of the index have equal sample volatilities[8]:

$$I = (\Delta e/e) - (\delta_e/\delta_R)*(\Delta R/R)$$

Where δ_e is the standard deviation of the rate of change of the exchange rate,
δ_R is the standard deviation of the rate of change of reserves.

Kaminsky and Reinhart also found that, because of changes in the exchange rate enter with a positive weight and changes in reserves with negative weight, reading of this index that are three standard deviations or more above the mean are catalogued as crisis.

So the KR index is an indicator of CC obtained as a weighted average of the rate of depreciation of the local currency (mostly against the US dollar), and the monthly percentage changes in international reserves (or the ratio foreign reserves/ M1, Lestano and Kuper, 2003, p. 12). The construction of the index is modified later on to include a third component, i.e. the monthly changes in the interest rate, so that the indicator becomes a weighted index of the three elements (Babutsidze 2005, p. 4; Pontines and Siregar 2008, p. 346):

$$I_{i,t} = \alpha\Delta e_{i,t} + \beta\Delta(i_{i,t} - i_{USA,t}) + \gamma\Delta r_{i,t}$$

Where $\alpha + \beta + \gamma = 1$
$I_{i,t}$: the exchange market pressure index for country i in time t,
Δe : changes in the normal exchange rate
i : interest rate
Δr : changes in international reserves

Therefore, a CC or a balance-of-payment crisis takes place when a sharp depreciation of the currency occurs, substantial losses in foreign exchange reserves, and a considerable rise in interest rates are recorded, to the extent that the previous indicator, i.e. EMP index exceeds a threshold of, say, 2 or 3 standard deviations above the mean of this index. This definition includes both successful and unsuccessful attacks on a currency.

On the other hand, the severity of CCs is measured by output losses following the crises, the magnitude of the reserves losses of the central bank, and the depreciation of the domestic currency (Kaminsky 2006, p. 505). Thus, the indicator that captures the presence and severity of CC is the EMP index, which is based upon three elements : the exchange rate, foreign exchange reserves, and interest rates.

Table 3. Chronology of currency crises in selected countries[9]

Country	Year	Country	Year
Argentina	1970, 75, 86, 90, 02	Malaysia	1975, 97, 98
Brazil	1983, 89, 90, 91, 99	Mexico	1976, 82, 94
Chile	1971, 74, 76, 82, 84	Sweden	1977, 81, 82, 92
Finland	1973, 82, 91, 92	Thailand	1978, 84, 97, 98, 99, 00
Indonesia	1978, 83, 86, 97, 98	Turkey	1970, 80, 94, 01

Source : Kaminsky and Reinhart, in : Kaminsky 2006, p. 511;
and Sy, A.N.R, 2004, p. 2851.

Indicators of CCs

There is an abundant literature which treats the wide variety of indicators of CCs, where some of them are associated with financial liberalization, while others are linked to capital account, others still to current account, and another group is related to the real economy and macroeconomic conditions, and finally some indicators are linked to fiscal policy changes, and so forth. Jotzo (1999) distinguishes between 3 main categories of such indicators as follows:

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[7] - This index was first used by Gitron and Roper in 1977 (Cipollini and Kapetanios, 2009, p. 189).

[8] - More details on this topic are provided by Irène Andreou et al., Sept. 2007, p. 4.

[9] - See the full table in: Kaminsky, G.L., 2006, p. 511.

- *Macroeconomic fundamentals as indicators of vulnerability* which include: international reserves, real exchange rate, export growth, domestic credit to output ratio, and short-term debt to reserves ratio.
- *Structural characteristics* which include: structure of foreign debt, banking and financial system, institutions, market structure and business environment.
- *Changes in expectations and perceptions* which include: asymmetric information between domestic and international investors, stock market prices, portfolio investment, bond and interest rate spreads, ratings, contagion, triggers, and so on.

Kaminsky (2006), on the other hand, relates variables and indicators of CCs to the symptoms on which the various generation models focus.

Table 4. Indicators of CCs

Models	Indicators
First generation	Fiscal deficit/ GDP
	Excess real M1 balances
Second generation	Exports
	Imports
	Real exch. rate
	Terms of trade
	Output
	Dom. Real int. Rate
Third generation	Dom. Credit/ GDP
	M2/ foreign exch. Reserves
	M2 multiplier
	Bank deposits
	Stock prices
	Banking crises
Sovereign debt	Foreign debt/ exports
	S-T foreign debt/ exch. Reserves
Sudden stops	World real int. Rates
	Foreign exch. reserves

Source: Kaminsky, 2006, p. 509; and Andreou, I., 2007, p. 14.

We can easily notice that both Jotzo and Kaminsky agree on most of the variables that lead to CCs, be they classified according to their generation models or according to other standards.

3-2-3- Stock market crashes

It is usually the increasing uncertainty about the situation of firms , and particularly about their return, the economic situation in general, relevant negative information, and many other factors, as we shall see bellow, that trigger sharp declines in the overall market indices, or stock market crashes (in short: SMCs). For centuries now, SMCs are still regular phenomena and cannot be prevented. Most of SMCs in different parts of the world have been associated with deep recessions, banking panics, speculation, and severe financial instability.

Wang et al. (2009, p. 2) define a SMC as a ''sudden dramatic decline of stock prices across a significant cross-section of a stock market''. Illing and Liu (2006) define equity crises as a ''sharp decline in the overall market index. The decline can be predictive of greater expected loss, higher dispersion of probable loss (higher risk), or increased uncertainty about the return of firms''. A hybrid volatility-loss measure called CMAX is used to indentify equity-market crises (Illing and Liu, 2006, p. 246):

$$CMAX_t = \frac{x_t}{max[x \in (x_{t-j}/j = 0, 1, ..., T)]}$$

where *x* is the stock market index. The moving window is determined by T, and it is usually 1-2 years. That is, CMAX compares the current value of a variable with its maximum value over the previous T periods. The CMAX method is used to identify periods of sharp decline in the stock market, where the trigger level is chosen at either 1.5 or 2 standard deviations below the mean of the crises.

Sy (2004, p. 2860), on the other hand, centers in defining SMCs on distressed securities which can be defined as ''those publicly held and traded debt and equity securities of firms that have defaulted on their debt obligations.... A more comprehensive definition considers that distressed securities would include those publicly held debt securities selling at sufficiently discounted prices''.

As we shall see later in some detail, Coudert and Gex (2008) define a SMC as a "sharp and rapid drop in share prices or in an index" or a "substantial and lasting deviation of a share price or index from its fundamental price, followed by an adjustment period then a return to the fundamental equilibrium".

On their part, Wang et al. (2009) studied eight stock market crashes based upon the percentage decrease in the market index in each crash.

Table. 5. Stock market crashes during the period 1987-2001

Crash date	Decrease in the index, %
October 19, 1987	-17.12
October 26, 1987	-8.27
January 8, 1988	-5.51
October 13, 1989	-5.31
October 27, 1997	-6.57
August 31, 1998	-6.56
April 14, 2000	-6.66
September 17, 2001	-5.01

Wang, J. et al., 2009, p. 2.

It is interesting to note that all eight crashes have witnessed a sharp drop of more than 5% in the market index in a single day.

Hence, SMCs are most often measured by changes in some factors, such as stock market indexes, market capitalisation, trading volume, turnover ratios, new stock issuance, equity-risk premium, etc. For instance, the crash of October 1987 and its Black Monday of Oct. 19 remains one of the most striking drops ever seen in stock markets, both by its wide amplitude and its sweep over most markets worldwide. On Monday 19, 87 the DJ lost 508 points, or 22.6 % of its value (Djebbar, 1996/ 1997, pp. 135-138).

Causes of SMCs

Although it is not all clear what caused SMCs, a substantial work has been carried out to shed light on their origins. Probably the most confusing puzzle in all this is the unprecedented market increase in major world markets during periods prior to the crises. Nonetheless, crashes or collapses of global equity markets have been blamed on (Djebbar, 1996/ 1997, pp. 127-8, 146-55, 158-61; Sornette, 2003, pp. 5-7):
- imperfect computer trading systems or program trading,
- phenomenal growth of derivative markets and products,
- illiquidity due to the large flow of sell orders,
- trade and budget deficits, mainly in USA,
- overvaluation of stock markets and over-inflated equity prices, which lead to correction processes of markets,
- absence of limits on price movements,
- off-market and off-hours trading,
- response of each country's stock market to a worldwide market motion, reaction to negative information,
- contagion fuelled by financial globalisation and deregulation and interaction of financial markets,
- uninformed traders (herd behaviour), and manipulation by fully informed market makers, rumors, publishing false information and poor accounting practices, and information asymmetry,
- lack of public supervision and adequate regulation of global capital markets,
- portfolio insurance,
- volatility of capital flows, particularly short-term capital reversals (hot money),

- hedge funds and their highly leveraged strategies,
- macroeconomic fundamentals, including tight monetary policy,
- lack of international consultation, coordination, and cooperation,
- lack of investor confidence, existence of high expectations, uncertainty, and many other factors and causes.

It is also worth noting that the most important and influential factors differ from one crisis to another.

Indicators of SMCs

Bordo (2003) considers that ''a 20 percent or higher decline in prices from peak to trough as an indicator of a SMC, recessions that coincide with SMCs are defined as one or more years of a decline in real GDP''. Similarly, some market participants consider securities to reach distressed levels after losing one-third of their value.

Table 6. Selected SMCs in the UK and the USA, 1800-2002

Uk Stock price changes			US Stock price changes		
Peak	Trough	change	Peak	Trough	change
1808	1812	-54.5	1809	1814	-37.8
1835	1839	-39.1	1835	1842	-46.6
1865	1867	-24.4	1853	1859	-53.4
1909	1920	-80.5	1902	1904	-19.4
1936	1940	-59.9	1929	1932	-66.5
1971	1974	-76.6	1972	1975	-38.7
2000	2002	-26.7	2000	2002	-30.8

Source: Bordo, M., 2003.

So, financial history is rife with violent equity-market crashes. One of the most striking of these collapses is the one which occurred in 1920 (World War I effect) in Britain and caused a drop of 80 % in market indexes.

Moreover, Andreou et al., consider 5 categories of explanatory variables to SMCs:
- *a monetary variable*: the ratio of M2 to nominal GDP, an expansionary policy and/ or a decline in GDP are associated with crises,
- *a capital account variable*: the ratio of M2 to foreign exchange reserves,
- *current account variables* : real exchange rate, exports and imports, difference of exports and imports to GDP,
- *banking variables*: commercial bank deposits, the ratio of domestic credit to GDP,
- *real sector indicators*: GDP and GDP growth.

Taking all these variables and indicators as a whole, besides the sharp decline in stock market indexes, one can say that the vulnerability to a crisis is signaled when a variable deviates from its "normal" level beyond a certain threshold value.

As previously mentioned, Coudert and Gex (2008) have studied Patel and Sarkar's approach which consists of an indicator, the CMAX, that detects price levels over a given period of time (set to 24 months). This involves dividing the current price by the maximum price over the previous 2-year period. Thus, if $P_{i,t}$ is the stock price at time *t* in the country *i,* then (Coudert and Gex, 2008, p. 176):

$$CMAX_{i,t} = \frac{P_{i,t}}{\max (P_{i,t,......,P_{i,t-24}})}$$

Obviously, $CMAX_{i,t} = 1$ if $P_{i,t} = Max(P_{i,t,....,p_{i,t-24}})$. This is the case when there has been a monotonous upward trend during the preceding 24 months. Also, the more prices fall, the closer $CMAX_{i,t}$ gets to 0. Therefore an indicator of SMC is a threshold when $CMAX_{i,t}$ is extremely (abnormally) low. The threshold is generally equal to the mean less two or three standard deviations (Coudert and Gex, p. 176).

3-2-4- The 2008 financial crisis

Since the Summer of 2007, the word "subprime" has become the most repeated word everywhere and people try to know about it as much as possible, and also about its twin expression "the subprime credit". The latter refers to the extension of credit facilities to

borrowers who have weak credit histories and do not show credit worthiness. The subprime and credit crisis which erupted in august 2007 is considered to be the worst since 1929, and the first major financial crisis of the 21st century. It has triggered severe tightening in global credit markets and turbulence in global equity markets which are threatening a serious downturn of growth in the real economy all over the world, and may lead to recession in several leading economies.

Goldstein (2008, Part 1, p. 1) noted that "with subprime mortgages representing only 14 % of the stock of U.S mortgages, most observers expected rising delinquencies in this segment to be contained at moderate cost. In July 2007, Fed Chairman Bernanke estimated that credit losses associated with subprime mortgages would probably total to $50 billion to $100 billion. As we now Know, what began as a subprime crisis has proved to be wider, deeper, and more damaging than originally thought". By April 2008, we were up to over $200 billion in reported credit losses worldwide just due to subprime exposure, and by the end of 2008, those losses reached $950 billion (Goldstein 2008, Part 2, p. 6). In response, government authorities continue to implement various policies to help stabilize the global financial system, providing liquidity to major banks, easing monetary policy, and lowering interest rates.

Mortgages are "loans to individuals or businesses to purchase a home, land, or other real property. As of December 2001, there were $7.66 trillion of primary mortgages outstanding, held by various financial institutions such as banks and mortgage companies (Saunders and Cornett, 2004, p. 187).

Triggers of the 2008 financial crisis

The triggers with the worst effects were (Harmon and Bar-Yam, 2008; Reinhart, and Rogoff 2008; and Eichengreen, 2008):

- *securitization*; refers to the process of issuing securities on back of loans disbursed by mortgage companies for the purpose of spreading and mitigating risk. Interests on such securities are paid according to the different risk levels involved in the recovery of the underlying mortgage. Thus, your mortgage is likely to be sold to a third party who will package it with other mortgages and then issue some kind of mortgage-backed securities. Probably, the most popular kind of these instruments designed by financial engineers is the Collateralized Debt Obligations (CDOs). The risk of default is borne by the holders of those securities as interest rates got higher. Therefore, the phenomenal growth of those derivative products has resulted in the U.S residential mortgage debt default being passed on to global credit markets and have served as an accelerant to the crisis. The most surprising phenomenon is that some of the purchasers of those securities didn't understand what they where buying, the documentation was not very good, and the securities were very difficult to price,

- *Shifting in mortgage lending* toward the less creditworthy, marginal borrower. The subprime borrower is the borrower who doesn't qualify for a prime mortgage. Between 2003 and 2006, the share of subprime mortgages in total mortgage originations more than tripled (Goldstein, 2008, Part 2, p. 2). Since 2006 prices of houses started to fall below the mortgage liability attached to it. Then interest rates rose sharply and mortgage borrowers started to default causing a massive increase in foreclosures, which, in turn, led to a further fall in house prices, and hence the prices of mortgage-backed securities collapsed,

- *abolition of the uptick rule*; the selling of securities on the New York Stock Exchange (NYSE) from 1939 till June 2007 was regulated by the "uptick rule". This rule allows the selling of borrowed securities only after an increase in price (on an *uptick*). This strongly implicates the uptick rule repeal as a major contributor to the 2008 severe financial crisis,

- *lack of adequate regulation and supervision* of global capital markets, hedge funds, banks, and other financial institutions. So there was a substantial need to develop and improve the rules for supervision and management of liquidity risks,

- *principle-agent problems*. It has been found that banks which fund loans do not hold mortgages and many banks do not deal with the home-owners. Instead, banks typically outsource dealings with home-owners to independent mortgage brokers who receive fee income from both the borrower and lender. These independent brokers are usually not supervised at the federal level (Goldstein 2008, Part 2, p. 3). The result has been an explosion

of unsustainable subprime loans, principle-agent problems, defaulted mortgages and nonperforming securities,

- *shifting risky activities off balance sheet*, by applying capital requirement to bank balance sheets. The 1988 Basel Accord encouraged banks to shift risky activities off balance sheets. Those innovations encourage excessive risk taking, inadequate transparency, and weak regulatory scrutiny,

- *lack of market liquidity*. On one hand, there has been a great shortage of liquidity for a considerable number of banks and financial institutions. On the other, the problem in 2007 and 2008, for the others, was not that they had no liquidity to deploy, but they had no wish to deploy it, because of the lack of information about potential counterparties. Central banks also provided large amounts of emergency liquidity through the discount window and open market operations, and purchased illiquid securities,

- *rating agencies failure*. Rating agencies failed to assess the riskiness of different securities, and to downgrade mortgage-backed securities as the housing market, and hence the value of the underlying mortgage obligations, deteriorated. Subsequently, they aggravated the crisis by reacting with wholesale downgrades once the market collapsed. They were also too generous in providing AAA ratings which might be misleading mainly because of imperfect models used and conflicts of interest (Djebbar, 2004, pp. 71-74). A clear example is their failure to predict crises at firms such as Enron, WorldCom, and Parmalat (Güttler and Bahrenburg, 2007, p. 752). The poor performance of credit rating agencies is due, to a large part, in that it turned out that they were heavily involved into the consulting business, rather than rating activities,

- *investment strategies*. Banks and hedge funds have used short-term funding to invest in long-term derivative securities which posed some of the most striking dilemmas of the 2008 crisis,

- *lack of transparency*. The subprime crisis was aggravated by the opacity of derivative securities, banks, and listed companies. This has led to poor asset valuation methods and models; and consequently investors concluded that their holdings were riskier than previously thought, leading to panicked attempts to liquidate,

- *O.T.C. trading*. One explanation of the severity of the crisis is that brokers trade CDOs and other financial products Over-The-Counter (OTC), rather than through organized exchanges. In an organized market, there are more guarantees, more transparency and liquidity and encouragement of instrument standardization, and therefore, spreading and mitigation of risks,

- *lack of confidence* in the soundness of financial institutions, housing prices, capital market volatility, real interest rates, level of investment, risks, and financial stability. People also lost confidence in mortgage-backed securities, especially in those put in off-balance sheet in special vehicles called Special Investment Vehicles, SIVs, or conducts,

- *contagion*. Interdependence between economies and financial markets leads to the phenomenon, in which, should one market or sector experience trouble, contagion spreads from one market to another and from one sector to another. By way of consequence, and because of economic and financial globalization, the current crisis has spread worldwide at great speed,

Finally, Kaminsky (2006) in a classification of 96 crises found that 14 % of the crises are related to current account problems, 29 % are crises of financial excesses, 5 % are crises with fiscal problems, 42 % are crises of sovereign debt problems, 5 % of the crises are related to sudden stops, and just 4 % of crises are self-fulfilling crises[10].

Implications of the 2008 crisis

The weakness in global economy has been sudden, severe and widespread, and the crisis still affecting developed and developing countries alike. Since mid-2007 economic activity has declined at its fastest pace since the Great Depression of the 1930's, and unemployment is moving sharply higher on a global scale. As a result, all major developed economies and most emerging ones are in recession.

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[10] - Self-fulfilling crises are those crises which take place in economies with sound fundamentals.

As far as developing countries are concerned, the 2008 crisis's impacts were noticed in many sectors and ways, such as lower trade and trade prices, lower remittances, less foreign direct investment (FDI) and equity investment, and less capital (loans) available to countries in financial stress. Financial contagion and spillovers for stock markets also affected emerging and developing markets, especially in China, India, Russia, and Brazil. Hence both real and financial economies are affected by the crisis.

4- Forecasting Financial Crises and EWSs

An Early Warning System (hereinafter EWS) for financial crises is a combination of the above indicators outlined in various sections, and used to predict and test if a crisis occurs in a determined period of time. Each leading indicator is transformed into a binary signal: if a given indicator crosses a critical threshold it is said to send a signal that a crisis is imminent. The lower the chosen threshold, the more signals this indicator will send over time.

The major aim of the development of an EWS is to understand sources of crises and analyse the vulnerability of a country to them, or even better, to avoid their outbreak. EWSs have become an even more useful tool for policymakers in economic and financial forecasting. Bussiere and Fratzscher (2006, p. 970) consider that "in a policy perspective, EWS models that help to reliably anticipate financial crises constitute an important tool for policymakers if they are employed carefully and sensibly".

On the other hand, and above all, crises are costly (entailing high costs) to the whole economy and EWSs may help in reducing that burden. In this context, Allen shows that "over the past 120 years crises have been followed by economic downturns lasting on average from 2 to 3 years and costing 5 to 10 per cent of GDP (Allen, 2003, p. 17)".

As far as components are concerned, Beckmann et al. (2006, p. 164), consider that the "universe of proposed EWSs thus stretches over five dimensions: variables, sample period, sample countries, crisis definition and method applied. Each EWS is a combination regarding those five dimensions". Those variables comprise of course a set of macroprudential indicators and business cycles, and the method applied is usually an econometric model.

4-1- Risks to the financial system

Great technological developments, especially in the field of IT (information Tech.), market interdependence and consequently contagion effects, introduction and use of sophisticated financial instruments and securitization phenomenon have resulted in many risks to the entire financial system. We summarize the most important of these risks in the following (Schinasi, 2005):
- reduced transparency and limited access to information.
- market dynamics. i.e., the globalization of finance has led to many problems related to herding behaviour, the huge volume of transactions which take place daily, firms relying ever more heavily on markets to raise funds.
- moral hazard. The presumption that the public sector will intervene and reduce crises undermines market discipline and creates moral hazard, in that it weakens the incentive for market participants to act prudently.
- systemic risk. This has shifted from the banking sector to capital and derivative markets.

Risks to the financial system might be either endogenous or exogenous, thus either from inside the system or from the real economy. Exogenous sources of risk are harder to control compared to endogenous ones.

Table 7. Some possible sources of financial instability[11]

Endogenous	Exogenous
Institutions-based	Macroeconomic disturbances
Financial risk	Economic environment risk

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[11] - The complete list of possible sources of financial instability is published by: Schinasi, G.J, 2005, p. 6.

. credit . interest rate	Policy imbalances
. market . currency	
. liquidity	
Operational risk	
Information tech. weaknesses	
Capital adequacy risk	
Market-based	**Events**
Counterparty risk	Natural disasters
Asset price misalignment	Political developments
Run on markets	Large business failures
. credit . liquidity	
Contagion	
Infrastructure-based	
Clearance, payments, and settlment system risk	
Infrastructure fragilities	
. legal . accounting	
. regulatory . supervisory	
Collapse of confidence leading to runs	
Domino effect	

Source: Garry J. Schinasi, 2005, p. 6.

4-2- EWS models

Financial crises incur large costs which render the construction of a monitoring tool, i.e., an EWS, very important.

4-2-1- Constructing EWS models

To construct an EWS model for currency crises, for instance, Zhuang and others point out that there are two approaches that have been widely used (Zhuang 2002, p. 2; Asian Development Bank, 2002, p. 4):

-signaling approach. It involves monitoring a set of high frequency leading indicators that tend to behave differently prior to a crisis and examining whether they individually or collectively have reached "threshold" values that are historically associated with the onset (or heightened probability) of a financial crisis. Thus, the vulnerability to a crisis is signaled when a variable deviates from its normal level beyond a certain threshold value.

-the approach that uses probit/ logit models. Probit/ logit EWS models (known as qualitative response models) are multivariate and allow testing of statistical significance of explanatory variables. A common feature of all existing EWSs is the use of fundamental determinants of the domestic and external sectors as explanatory variables. They compare the pre-crisis observations (behavior of fundamentals) both during tranquil periods and crisis/ post-crisis periods[12].

According to the signaling approach, most literature suggests that building an EWS involves the following steps (Yap, 1998, pp. 7, 8; Gupta, 2002, p. 11; Zhuang, 2002, pp. 3-7):

Step 1. Defining the crisis. i.e., is it a currency crisis, a banking crisis, a stock market crash or other types of crises?

Step 2. Selecting a set of leading indicators. Examples of these predictors of different crises are real exchange rate, trade balance/ GDP, foreign reserves, short-term debt/ reserves, real interest rate overvaluation, industrial production, stock prices, domestic credit/ GDP, financial liberalization, exports .. etc[13]. For each indicator three forms of specifications are considered: level, change, and deviation from its trend. Indicators are expected to predict crises within a period of time known as the "signaling horizon". A signal that is followed by a crisis within a reasonable period of time, say 12 or 24 months, is called a good signal (true warning signal)

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[12] - Since the independent variable is a binary variable (0 = no crisis, and 1 = crisis), one can use the logit model.

[13] - More leading indicators are provided in Tab. 7, Tab. 4, and Appendix 1.

while a signal not followed by a crisis within that interval of time is called a false signal or noise (false warning signal).

Step 3. Choosing the leading indicators' thresholds. Zhuang (2002) considers that, "for each indicator, a threshold divides its distribution into a region that is considered normal and a region that is considered abnormal and associated with a heightened probability of crises. If the observed outcome of an indicator falls into the abnormal region, that indicator is said to be sending a warning signal".

Step 4. Computing the indicators' respective noise-to-signal ratio[14], i.e. the ratios of false signals to true ones.

Step 5. Choosing the threshold values that minimize the noise-to-signal ratios. The greater the number of leading indicators signaling a crisis, the higher the probability that such a crisis would actually occur.

4-2-2- Predicting power of EWSs

As we have discussed above, EWS models estimate probabilities of crises to occur. High probabilities signal crises and, vice versa, low probabilities signal stable periods. Therefore, how predictable are those crises? Do EWS models have the ability to forecast those crises? Do those models generate substantial number of false alarms and missed crises? What is the prediction horizon within which EWSs can perform?

In answering these questions, the current EWS models show mixed results in terms of forecasting accuracy. Jotzo, for instance, emphasized that "the market index could be regarded as a clear leading indicator for a currency crises in the case of Thailand before the 1997/ 98 Asian financial crisis. The Bangkok index began an interrupted decline about 18 months before the crisis. The price index for financial sector shares declined even more steeply over the same period (Jotzo 2002, p. 29)". This suggests that investors had started pulling out of Tai equity long before the crisis, and that there was particular awareness of financial sector problems. Bussiere and Fratzscher (2006, p. 970) also concluded that "moving from a binomiary logit model to a multinomial model has improved the predictive power of the EWSs substantially, where they become a powerful tool for policy makers. Moreover, a recent study presents evidence that a significant number of industry portfolios' returns forecast stock market movements (Chen 2009, p. 211). Finally, Beckmann et al., (2006, p. 165), show that "EWSs have robust forecasting power, and changes in core fundamentals signal future problems and thus help policy-makers to prevent crises".

In contrast, many academics recognize that a large proportion of financial crises still remain unpredicted, although they have developed a considerable number of models and measures of different variables associated with those crises. Sornette, for instance, concluded that "stock market crashes are often unforeseen by most people, especially economists (Amadeo, 2009, p. 5)". Bussiere and Fratzscher (2006, p. 968) also noticed the "failure of models to predict crises in subsequent episodes". Sharma (1999, p. 42) also concludes that "the holy grail of crisis prediction may be intrinsically unattainable and a successful prediction model is unlikely to exist in efficient markets".

Another proof that the existing EWSs cannot predict financial crises is that rating agencies[15] (as providers of analyses and forecasts) failed as well in forecasting any of the previous turmoils, including that of 2008/ 2009. Eichengreen (2008, p. 11) showed that they "failed adequately to distinguish between the riskiness of different securities. They also failed (because of imperfect models used), to downgrade mortgage-backed securities as the housing market and hence the value of the underlying mortgage deteriorated. They then aggravated the crisis by reacting with wholesale downgrades once the market collapsed". Goldstein (2008, Part 2, p. 4) also considers rating agencies as suspicious and partly accountable for the 2008 crisis: "because of their poor performance, they rated those mortgage-backed securities as

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[14] - More details about that ratio is provided by Zhuang, 2002, pp. 5, 6.

[15] - Rating agencies are organisations which give rating to companies, banks, and governments issuing bonds and other securities. Global leading agencies such as Moody's, S&P, and Fitch provide more sophisticated services and products such as forecasting, research and risk analysis, sovereign credit ratings, foreign currency ratings, investment data, valuation, analyses, and opinions.

triple A, the securities that have the lowest default probabilities. So there wasn't really an independent credit assessment from the credit rating agencies". Mora (2006, p. 2042) also noticed that "rating agencies have been criticized for failing to predict the Asian crisis, and for exacerbating the crisis when they downgraded the Asian countries in the midst of the financial turmoil". They have also been criticized for rating methods that are not sufficiently transparent (Djebbar 2004, pp. 75, 76).

Güttler and Wahrenburg (2007, p. 752) pointed out the agencies' "failure to predict the crises at firms such as Enron, WorldCom, and Parmalat, which has cast a cloud over the chining future of those agencies in recent years". Therefore, those agencies should be reformed, supervised and rated. One final incident worthy of mention was the late downgrading of Enron by Moody's and S&P before its collapse in late 2001. This probably represents one of the most serious errors to be committed by a rating agency (Güttler and Wahrenburg, p. 766)[16].

5- Concluding remarks

This paper emphasizes whether EWSs and other models have been useful in forecasting financial crises, i.e. currency crises, banking crises, and stock market crashes. Existing EWSs show mixed results in terms of predicting accuracy. Although some scholars assert that EWSs have robust forecasting power in some cases, most studies prove that financial crises are often unpredictable and come unexpectedly in most times, for the simple reason that macroeconomic flows, financial markets, growth, and other economic conditions look good before any crash. Facts also strongly back this viewpoint, particularly when we keep in mind that, even some specialized institutions in the forecasting industry, such as rating agencies, failed in predicting previous crises, both in timing and severity. Predicting Financial crises, however, is like predicting an earthquake, and because the next crisis will always be different (different nature of crises), forecasting financial crises becomes nearly impossible. This proves the fact that financial engineering does have several limitations, especially as far as mass securitization (its risks to financial stability and costs exceed its benefits) and financial innovation in general, are concerned.

Nevertheless, governments and financial authorities should strengthen their surveillance system in order to detect macroeconomic, financial, and corporate sector vulnerabilities as early as possible. Moreover, an appropriate reform of the system of supervision and regulation of financial institutions, such as hedge funds, has become an urgent challenge. Before the 2008 crisis, there was no rigorous enforcement of disclosure and transparency rules in those institutions. As far as banks are concerned, Short-term borrowing should be replaced or penalized relative to longer-term funding.

Conflict of interest at credit rating agencies should also be eliminated or at least reduced by separating the rating and consulting business, like what happened with the accounting industry after Enron. Furthermore, financial authorities should move derivative trading from over-the-counter markets toward organized exchanges where safeguards are stronger, and regulation and supervision techniques are better. The best way to implement this is to establish clearing houses that have money to cover risks. Finally, restoring confidence is a prerequisite for a return to normalcy. In the meantime, we are awaiting the onset of next crisis.

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[16] - In the summer of 2002, John Diaz, a managing director at moody's Investors Service, was called before a US Senate subcommittee investigating the collapse of Enron. The senators wanted to understand why Moody's said that the energy trader's debt was investment grade in late October of that year – only to see the company default on its bonds four weeks later as it declared bankruptcy, (Sam Jones, When junk was gold, Financial Times, 17 Oct. 2008).

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Appendix 1. Macroprudential indicators

Aggregated microprudential indicators	
Capital adequacy	**Earnings and profitability**
Aggregate capital ratios	Return on assets
Frequency distribution of capital ratios	Return on equity
	Income and expense ratios
Asset quality	Structural profitability indicators
Lending institutions	**Liquidity**
Sectoral credit concentration	Central bank credit to fin. inst'ns
Foreign-currency-denom. Lending	Deposits in relation to monetary aggregates
Nonperforming loans and provisions	Segmentation of interbank rates
Loans to public sector entities	Loan-to-deposit ratios
Risk profile of assets	Maturity structure of assets and liabilities
Connected lending	Measures of secondary market liquidity
Leverage ratios	**Sensitivity to market risk**
Borrowing entity	Foreign exchange risk
Debt-equity ratio	Interest rate risk
Corporate profitability	Equity price risk
Other indicators of corp. Conditions	Commodity price risk
Household indebtedness	**Market-based indicators**
Management soundness	Market prices of fin. instruments
Expense ratios	Indicators of excess yields
Earnings per employee	Credit ratings
Growth in number of fin. inst'ns	Sovereign yield spreads
Macroeconomic indicators	
Economic growth	Ex rate sustainability
Aggregate growth rates	Ex rate guarantees
Sectoral slumps	**Lending and asset price booms**
Balance of payments	Lending booms
Current account deficit	Asset price booms
Foreign exch reserve adequacy	**Contagion effects**
External debt (inc. Mat stru're)	Fin market correlation
Terms of trade	Trade spillovers
Composition and maturity of capital flows	**Other factors**
	Directed lending and investment
Interest and exchange rates	Gvmn't rescourse to banking system
Volatility in inter and exch rates	Arrears in the economy
Level of domestic real int rate	

Source : Evans et al. in : Hilbers et al, 2000, p. 54.