THE FINANCIAL CRISIS AND THE EARLY WARNING SYSTEM MODELS

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Abstract: The term financial crisis is applied broadly to a variety of situations in which some financial institutions or assets suddenly lose a large part of their value.In the 19th and early 20th centuries, many financial crises were associated with banking panics, and many recessions coincided with these panics. Other situations that are often called financial crises include stock market crashes and the bursting of other financial bubbles, currency crises, and sovereign defaults. Financial crises directly result in a loss of paper wealth; they do not directly result in changes in the real economy unless a recession or depression follows. Each crisis causes enormous costs in the countries concerned. Thus, international financial institutions invest in researching early warning systems (EWS). The Early Warning System models can be made most useful to help sustain global growth and maintain financial stability, especially in light of the lessons learned from the current and past crises. This paper presents a short analysys of the causes of the financial crises from the period 1929-2012, the impact of the crises and the response from international policy makers (early warning systems).

JEL classification: F30, G01

Key words: financial crisis, global economy, financial system, international financial markets, international policy makers, Early Warning System models

1. REMARKS REGARDING THE FINANCIAL CRISIS

Every economic an business growth cycle begins and develops around a certain new and rather innovative product (good or service) that creates new markets for it or, at least, redefines the existing markets by extending them in order to receive this new product. Of course, the economic growth is induced and further sustained by all activities required to produce and sell this new item. Usually, besides the industries directly involved in producing the new good and service, a lot of industries like advertising, retail operators and banking might enjoy the growth induced by the success this new product has amongst consumers and/or economic players.

The big economic boom – often called the Roaring Twenties – that followed right after the World War I actually started in 1922 and met its end during the first months of 1929. Many economic players were already aware that the game was about to get over and the NYSE big crash that took place in late October 1929 was only sort of confirmation of the end of an important economic growth period of time and, unfortunately, the beginning of the most severe economic retreat the 20th century experienced. The product that initiated the growth of the Roaring Twenties was the automobile. Frankly speaking, the automobile itself was not exactly kind of "new" product. The key issue in hugely producing and selling automobiles was the big amount of innovation added in their fabrication process. The innovation in the automotive industry was directly related with the personality of

Henry Ford. He was the first who introduced the so-called assembly line which had to increase dramatically the productivity in its plants. Of course, this innovation and a lot of further other ones were the main engine that stood behind the growth in the automotive industry that drove to a generalized environment of economic and business growth. But there was not only that. The Ford and the other ones' involved in the automotive industry (Dodge Brothers, Chrysler, Oldsmobile) great success was quickly seized by the banks. We have to say that almost every business in the automotive industry started in early twenties on even earlier in the United States of America was started on credit the way that the initial cash brought by owners to provide the initial social capital was money borrowed from commercial banks. In those times money was not fiat – in fact it was gold-backed and convincing a bank to lend money was quite a difficult task for each and every potential borrower. In this respect is worth to be mentioned that, besides a strong background in business, when an entrepreneur managed to borrow money from a bank he had had a really credible story to sell to the bank. So, no wonder that not only automobiles but all the other products of the Roaring Twenties were so innovative, useful and reliable. From the initial financing the fabrication of the product itself (the automobile), no matter the costs involved in this process, due to the novelty of the product, the banks got aware that something very interesting was happening: the automobile had enjoyed so much success that producers, seizing the possibility of huge profit margins, started a fierce competition for clients. Initially, the automobile was intended only for wealthy customers. The big idea in making really huge profits was to make the automobile affordable for a lot more people. Henry Ford was the one who initiated the process and all the others follow suite. The truth is Ford Motor Company had really a lot of innovation reserves in terms of engineering but, also, in terms of business ideas as well. We are not trying here to make a history reminder for the automotive industry but are worth to be mentioned here business ideas like the dealership franchise (international franchise as well), service networks and their smart locations near the gas stations, employees profit-sharing, introducing industrial vertical integration and optimizing the balance between the vertical and horizontal fabric integration, etc. All the quality standards and business ideas that came out from automakers were quickly embraced by almost each and every economic player (telephony, electricity and electric powered devices, cinema, radio broadcasting, etc.). In brief, the whole picture of the US economy during the Roaring Twenties was kind of sound and prosperous. More else, the "American Way" was quickly embraced by all significant world economic powers of that time, especially in Western Europe. In this respect, we have to mention that, in those times of economic boom, the Soviet Union also had enjoyed a rather nice economic growth, but this issue has to be discussed separately and that because of the New Economic Policy (NEP), initiated by Lenin, the USSR was experiencing at that time. Someway, somehow, the Soviet Union experienced its own Roaring Twenties. Is worth to say that, coincidently or not, when the NEP was stopped by Joseph Stalin in 1928, things begun to get worse in the whole global economy.

As we have mentioned earlier, during the Roaring Twenties consumers were eager to get and buy industrially manufactured goods. We simply cannot call this period of time as sort of "consumerism" and that because all consumers were interested in innovation rather than accumulating goods and services as a purpose. It was genuine curiosity rather than greed.

Taking into account that the Roaring Twenties was a time of so-called monetary "gold standard" it's really amazing what big values the money speed reached. The only

explanation could be that this period of time was a rare combination of innovation, high quality fabricated products, reliability, on one hand and *productivity*, on the other hand.

The really hot picture of the Roaring Twenties sound economic times captured all domains including banks. Beyond greed, a significant majority of banks, especially in the United States seized a truly important sort of economic truth: the real, consistent and continuously created added-value was the only important key issue in igniting and maintaining growth. In fact, the added-value was the single not self consuming asset and, in this respect, was better even than gold. And, when the productivity was also present, things could have got really "explosive".

A high level of productivity had hidden and, still, hides some sort of, let's say "shortage": it needed and still needs short term financing. In the twenties of the last century, there was one single way to get short term financing: the credit, meaning borrowing money from a bank. And the banks, seizing the potential profit margins, were eager to lend money to economic players. Due to the high pace of economic growth that induced high money speed, most of banks quickly reached their credit ceiling. The only solution for firms to get money was raising capital from stock market, which was kind of doable but too much slow. This last process was slow yet because of low speed of advertising and because, at least before 1925, of rather moderate risk appetite of investors.

The solution seemed and, actually, was simple. Based on the fact that the stock market (New York stock Exchange – NYSE) was on the rise since the end of 1922 and the fiscal relaxation operated by president Harding and president Coolidge, average commercial banks started to run, at their middle office level, some sort of "new business": lending money to rather reach clients and, so, enabling them to buy stocks and, especially, to participate at the Initial Public Offers (IPOs) made by economic agents in order to raise money from investors and players operating on the stock market. This was the beginning of so-called "credit on margins" that enabled some categories of wealthy clients to "buy on margins" on NYSE.

In fact it was only the beginning of what had had to become a huge industry in seeking, finding and financing potential new sources of creating added-value. Step by step, but rather quickly, this new industry – we mean the investment banking – more than doubled between 1925 and 1929, reaching, in the middle of 1929 almost 2000 independent units (including, of course, big names like Morgan, Mellon, etc.).

Investment bankers were very much aware of the maximum of importance the added-value did have and they, also, knew very well that, even the best product on its corresponding market would have got mature and consumers would have putted a wreck in buying it – at least at the pace they had used to do right after the launch of the product on the market. The key issue here consisted and still consists in the fact that, when seizing any slow down in selling the product, commercial banks have to ease lending money to consumers wanting to buy this product on credit basis and the investment banking have, also, to ease financing its production and stop helping the producer to raise any amount of capital on the stock market, except the situation when the producer has a new and innovative product or has made significant improvements on the existing product.

But this simply cannot happen always. Innovation can only be stimulated by money rewarding research labor in product related domain and (or) in finding new business ideas. But money cannot and couldn't ever get innovation. What banking system can do is slowly financing consumption and, simultaneously, smartly financing through their investment branches innovation that creates new products and (or) improving the existing ones. The problem is that doesn't always happen. Sometimes it's greed that

intervenes, sometimes is fear or hurry. But greed is that what mostly often intervenes and that because the pace for banks in making profit isn't always the same the economic agents can reach. A bank, particularly an investment bank, simply gets done some financial operation, gets assets as bank guarantees and gets booked the profit. So, the earnings in the banking (investment banking) industry and the earnings in the rest of the economy take, somehow, different ways. Regulation is needed but, also, competence and responsibility.

We shall not discuss here why things in the Roaring Twenties get such an ugly turnaround starting with October 24 (Black Thursday), 1929. It was, maybe, some misfit between the aggressive FED policy and the existing situation in the real economy, or maybe it was some perverted effects of the controversial Smoot-Hawley Tariff delivered by the Hoover administration that did hit so hard the US international trade, or both or even more something else. But all this actions, all together or separately, only could have rushed the economic contraction. A lack of them could not have avoided it. Economic downturns cannot be avoided because, even when competence and good faith and smart regulation are present, the money speed always will be surpassed, at one point, by the lending speed and piling up in taking risk. Maybe – just maybe – some smarter regulation and gradual or milder measures taken by FED could only have delayed the start of the economic downturn and (or) make the recession milder. Discussions and controversy over this issue still continue and, probably will never cease. The fact was that too many economic agents and individuals as well were too much indebted and the bank assets simply started to depreciate. All this led to a credit bubble burst, but the amount of debt was so big that, in combination with the existing-in-those-times of the so-called "gold standard" that not allowed too big money speed, sparked fallouts in the banking system. Conclusion is that, at the end of the Roaring Twenties, the banks lending speed outpaced the money speed in the real economy. In other words, people and firms got indebted at faster pace they managed to make money – and, the most important, new money – from their lucrative activities. The lending-borrowing activity simply got faster than gaining speed in productivity and, even more important, than speed in implementing innovation.

Fallouts in the banking system lead the US economy into the most severe crisis of all times and, soon after, the entire industrialized world followed suite. Lack of any regulators reaction and with no government action, the economic crisis took its way until the release of Gold Reserve Act (January 30, 1934). So, as we know, the solution was kind of monetary one. The move was, actually, the end of the "gold standard" era and allowed government to print money while gold started to be treated and traded like any other commodity. It was sort of "easy money" or "cheap money" solution designed to increase the money speed, to ease pressure on banks by re-inflating assets and to re-launch credit related activities. It was a smart and innovative move from the US government (Roosevelt administration). Whether or not this measure was the only one that solved problems is kind of debatable and is subject of debate even today. The World War II (WW II) surely played its role, but capitalism is, at least sometimes, a tough if not a cruel environment.

Seizing the excesses made by the investment branches of the banks during the 1920s, the Hoover administration released (June 1933) the well-known Glass-Steagall Act. In brief, this regulation made an obvious separation between the average commercial banking activities and the investment banking activities by banning investment banks to take deposits from population. Also and very important, the Glass Steagall created the Federal Deposit Insurance Corporation (FDIC) designed to provide full deposit insurance by guaranteeing the safety of deposits in all member banks for amounts up to $2500 (1934).The measure, even though a brutal one, was essentially good and did work quite

accurately until practically it was formally "dissolved" in 1999 by the release of the Gramm-Leach-Bliley Act that repealed the famous regulation of 1933. Just to be fair, we have to say that the US government had to face a done deal that consisted in the takeover of Smith Barney investment group by Citigroup giant.

The fact of the matter is that ever since 1933 the Glass Steagall Act faced really frequent miscarriage attempts. These attempts – while they simply could not have been kind of explicit – consisted, basically, in creating different sorts of "financial products" that enabled different categories of economic players to take (sometimes serious) risks. Almost always those who created "innovative financial products" made bets on rather slow or no reaction from regulators.

After the WW II, the world has and is been economically dominated by the United States of America and the US Dollar has and is been the main trade and reserve currency.

Almost every recession in the after WW II era was treated using the same cure: cheaper money (notably the Quantitative Easing measure take by FED in 1960. Its results are, still, subject of debate and controversy). This kind of "treatment" culminated in 1971 when the Nixon administration suspended any link between gold and US Dollar and the so called "fiat money" era was inaugurated. This way the US Dollar was to be driven only by monetary and fiscal policies. Fiat money did work quite nicely ever since 1971, but its era seemed to reach its end, first in 1999 (dot com bubble burst) and, notably, during the December 2007 – June 2009 period of time (subprime mortgage crisis).

Ever since 1933 nobody have putted on doubt the essential role of the investment banks in the advanced economies. They did what they have to do in each and every significant economic period ever after 1933. There were a lot of players in this market but few of them really made history. We are talking about Shearson Smith Barney and, of course, Drexel Burnham Lambert. Speaking about Shearson Smith Barney we have to say that this investment group managed to cross through mergers and acquisitions the whole twentieth century: Shearson Hammill (1901 – 1974), Shearson Hayden Stone (1974 – 1979), Shearson Loeb Rhoades (1979 – 1981), Shearson American Express (1981 – 1984), Shearson Lehman(!) American Express (1984 – 1988), Shearson Lehman Hutton (1988 – 1990), Shearson Lehman Brothers (!!!)(1990 – 1993), Smith Barney Shearson (1993 – 1994). This last one formula resulted from the acquisition made by Primerica (predecessor of the Citigroup giant) of the already merger aggregate between Shearson and Smith Barney. It was, actually one of the first, if not the first one financial vehicle designed to directly miscarriage the Glass Steagall Act. The whole Giant Citigroup Smith Barney was directly involved during the 1990s and early 2000s in different mergers and acquisitions especially consisting in operations with stocks but also played a very significant role on the forex markets as mediator as well as market maker. The group was hit hard during the 2008 subprime crisis and lost a significant part of his prestige. We have to mention here that the Lehman Brothers branch of the initial Shearson investment group took its own way of aggressive greed and excesses and, finally, collapsed early in 2008 at the spark of the subprime mortgage crisis.

Drexel Burnham Lambert resulted from the initial merger that took place in 1973 between Burnham and Company (founded in 1935) and Drexel and Company (founded in 1940) and, little bit later, in 1976 the new group merged with William D. Witter – a market research firm – that was the American branch of Belgian investment group Bruxelles Lambert. Drexel Burnham Lambert reached its peak in the mid 1980 when created almost by itself the famous "junk bond" market. The architects of this genial move were Fred Joseph (former chief operating officer of Shearson Hamill!) and the famous (really finance

genius!) Michael Milken. Junk bond was the innovative instrument Milken created to resist against the aggressive FED policies led by Paul Volcker during the second half of 1980. Despite all negative opinions, we have to say that Drexel Burnham Lambert played a very positive role in the restructuring of the American Economy during the 1980s. Almost all economic performers of the 1990s have benefited after Drexel Burnham Lambert activities, including Microsoft and Apple as well as other big names from Sylicon Valley.

Both Shearson and Drexel made bets that even cheaper money would have continued to come. And they came. Alan Greenspan led a soft monetary policy and Ben Bernanke made maximum possible: those two quantitative easing operations (QE I and QE II).

The world economy has experienced a long era of dominance of the United States of America. This era still continues and, despite the recent treats coming from China, seems far from reaching its end. This era started right after the World War I (WW I) under the gold standard regime and now we are experiencing a pure fiat money regime. The world gives signs of healing after the subprime mortgage crisis. The so called Troubled Asset Relief Program (TARP) initiated by the Treasury Department got its job done quite nicely. Unlike the "twist operation" made by FED in 1960, QE I and QE II seem to work. The initial weakness in the US Dollar (2008 – 2010) started right after the spark of the subprime mortgage crisis as well as the surprising big amount of Collateral Debt Obligations (CDOs) the European bought from their American business partners took Europe by surprise and ignited the sovereign debt crisis. But the European Central Bank seems has learned its lesson and the European governments seems they did the same, too.

There will be no crisis in 2012. Governments and central banks have gotten their job done. But there is a real problem arising: cheap money. Starting from 1934, cheaper and cheaper money has dealt quite well with recessions; has also created technical progress but also created extreme consumerism and unacceptable social polarization. Except the late 1980 and early 1990 – the starting of the PC and Internet era – which was a result of rather "expensive money", due to the strong FED monetary policy under Paul Volcker, cheap money has created smaller and smaller added-value. All recent unorthodox open market operations conducted by central banks putted the left the entire industrialized world into a real liquidity trap.

At least for the time being, the central banks seem they played their role. Maybe it's time for governments to put on the table smart fiscal policies designed to really prize innovation and work – the only ones being able to create goods and services carrying high added-value.

2. INTRODUCTION TO EWS

"Any early warning system to detect impending dangers to the world economy must find a way of bringing together the scatter of international and national macrofinancial expertise. We at the Fund have already begun intensifying our early warning capabilities and will be strengthening our collaboration with others involved in this area."[1]

After a relative stability in the post-World War II period, the world economy has again become familiar to financial crises following the collapse of the Bretton Woods system.

[1] Letter from IMF Managing Director Dominique Strauss-Kahn to the G-20 Heads of Governments and Institutions, 2008.

The first wave of the currency and debt crises that occurred particularly in Latin American countries in early 1980s was first followed by the 1992-1993 European exchange-rate mechanism (ERM) crisis and then by the two large-scale crisis episodes: the collapse of the Mexican peso at the end of 1994 and the consecutive financial crises in East Asia that began with the devaluation of Thai baht in July 1997 and induced a chain reaction in many Asian economies. The common characteristic of these two crises is their tendency to spread to other economies (contagion). However, the latter created much more external consequences, affecting the whole global economy, while the former had only a regional impact. The series of crises continued on with the violent devaluation of the Russian rubble in August 1998, the outbreak of the Brazilian currency crisis in early 1999 and the eruption of the Argentinean financial crisis in 2001-2002. This global economic and financial instability context of the 1990s 2000s affected the Turkish economy as well which suffered from two severe crisis episodes in April 1994 and February 2001, and two relatively less severe currency crises in May 2006 and October 2008. These striking and recurrent crisis episodes stimulated a large discussion on the theoretical specification of the crisis models on the one hand, and on the empirical analyses that aim at identifying the causes and origins of the crises on the other hand.[2]

Financial crises have not declined in number, frequency or severity over the last two decades, rather the contrary (Bordo et al., 2001). Each crisis causes enormous costs in the countries concerned. Even if many crises may help to promote overdue structural change, they are costly and it is a worthwhile objective to realize adjustments without this heavy toll. Thus, international financial institutions invest in researching early warning systems (EWS). There is now a wide range of studies available, however, without real converging results: studies vary in coverage of countries and time, they apply different methods and they may even define crises quite differently.[3]

3. SHORT REVIEW OF THE CRISIS LITERATURE

The recurrent crisis episodes since the collapse of the Bretton Woods system led to a flourishing crisis literature. Following the first wave of currency crises, in particular those that came out in Latin America in the late 1970s and the early 1980s, Krugman (1979) and Flood and Garber (1984) developed the so-called first generation crisis models in which currency crises are linked to persistent economic imbalances (large and growing fiscal deficits and/or gradual domestic credit growth) that are in conflict with a fixed exchange rate regime. Actually, the monetization of the persistent fiscal deficits in the fixed exchange rate regime leads to domestic credit growth and in parallel to gradual loss of foreign exchange reserves of the government. When the reserves stock reaches a critical threshold, investors perfectly know that the domestic exchange rate is no longer sustainable. Investors attack then the domestic currency in order to avoid capital losses due to a possible devaluation. Here, the investors' "rational" reaction triggers the currency crisis; however, the crisis would break out even in the absence of a speculative attack when the government foreign exchange reserves are "naturally" exhausted.[4]

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[2] Ali Ari, "An Early Warning Signals Approach to the Currency Crises: The Turkish Case", 2009, p.2.

[3] Daniela Beckmann, Lukas Menkhoff, Katja Sawischlewski, "Robust Lessons about Practical Early Warning Systems", Discussion Paper No. 322, 2005, ISSN: 0949-9962, p.2.

[4] Ali Ari, "An Early Warning Signals Approach to the Currency Crises: The Turkish Case", 2009, p.8.

The second-generation models were developed after the currency crises in the European Monetary System 1992-1993 and the crisis in Mexico 1994-1995. They explicitly accounted for authorities' policy options to defend the exchange rates and its related costs. Models of this generation are closely linked with the seminal work of Obstfeld (1986), who introduces the impact of rational expectations of investors into his approach. It implies that a market can reach an equilibrium with favourable as well as adverse economic fundamentals depending on the expectations of investors and their respective actions (i.e. multiple equilibria are possible). The monetary and fiscal policies are assumed to be exogenously set.[5]

In these so-called second generation models, a crisis can be triggered without ex ante significant deterioration of macroeconomic fundamentals in contrary to first generation crisis models. Therefore, even if economic policies are consistent with the fixed exchange regime, a speculative attack may occur while investors shift their expectations towards the sustainability of the exchange rate. Unlike the first generation models where policymakers are supposed to have a mechanical and simplified behavior against a speculative attack (selling international reserves and then floating the peg when the reserves stock is exhausted); in the second generation models policymakers are supposed to have an optimizing behavior by adapting their policy to the shift of the investors' anticipations. That means when policymakers face a speculative attack, they decide to maintain or to abandon the peg after comparing the costs of such policy decision. This may be defined as the government loss function. Indeed, here economic policies are not predetermined as in the first generation models, but they are adapted to the problems of the economy and to the investors' expectations about the macroeconomic fundamentals observed in period t , but also about the sustainability of the government policies in t +1. This interaction between the government and investors creates multiple equilibria that may lead to the occurrence of self-fulfilling currency crises. In these models the exact timing of the crisis is unpredictable in contrary to the first generation models.

The outbreak of the 1997 Asian crisis led to a reorientation of the crisis models. Several theoretical studies were then conducted in order to explain the characteristics of these violent and contagious crisis episodes that resulted largely from the banking sector weaknesses in a financially liberalized economy. In this sense, some modelers put forward the structural distortions such as implicit or explicit public guarantees and inadequate banking regulation system in the worsening of the financial vulnerability (Krugman, 1998 and Corsetti, Pesenti and Roubini, 1999). Others focus on the self-fulfilling nature of the Asian crisis by modeling the dynamics of the financial instability based on the Diamond and Dybvig (1983) bank runs model (Chang and Velasco, 1998, 2001). Some others formalize a financial fragility, due to an increase of short-term foreign debt, which may contribute to the occurrence of a financial crisis. The depreciation of the domestic currency deteriorates then the balance sheets of the firms whose bankruptcies lead to economic contraction (Krugman, 1999 and Aghion, Bacchetta and Banerjee, 2000). Finally, some make efforts to combine these different approaches (Irwin and Vines, 1999, 2003, Schneider and Tornell, 2000, Burnside, Eichenbaum and Rebelo, 2004). The very high costs of crises in terms of economic contraction, unemployment, and necessary financial restructuration process for the public sector (and also for the private investors in terms of

[5] Michael Heun, Torsten Schlink, "Early warning systems of financial crises – implementation of a currency crisis model for Uganda", no. 59, HfB - Business School of Finance & Management, 2004, p.14.

capital losses) have led to a proliferation of empirical studies (developed mainly by scholars, international financial institutions, central banks and investment banks) beside the theoretical models that have tended to explain crisis mechanism. These empirical models have aimed to predict crises by assessing their potential economic and financial determinants, and also in some cases by measuring political risks and developments in global economy. These studies have been also used by policymakers to prevent future crises by detecting their causes earlier. In this sense, they have been frequently called 'early warning systems' that are likely to inform policymakers (and investors as well) about the occurrence of a crisis in a near future.[6]

4. PRACTICAL EARLY WARNING SYSTEM MODELS

What is an early warning system? An early warning system consists of a precise definition of a crisis and a mechanism for generating predictions of crises. Different researchers have adopted alternative approaches to address a number of conceptual and practical issues that arise concerning both the definition of a crisis and the means of predicting it.[7]

Previous early warning systems of currency crises have used methods that fall into two broad categories. One approach extracts early signals from a range of indicators (Kaminsky and Reinhart, 1999, Kaminsky, Lizondo and Reinhart, 1998, Goldstein, Kaminsky and Reinhart, 2000), whereas the other uses logit models (Frankel and Rose, 1996, Eichengreen, Rose and Wyplosz, 1995, Berg and Pattillo, 1999b).

The leading indicators approach first developed by Kaminsky and Reinhart (1996), and Kaminsky, Lizondo and Reinhart (1998) considers vulnerability indicators and transforms them into binary signals: if a given indicator crosses a critical threshold, it is said to send a signal. For instance, if the current account deficit (expressed as a percentage of the GDP) falls below a given threshold, this particular indicator flashes a red light. In the Kaminsky-Reinhart approach the level is chosen after a grid search that minimizes the noise-to-signal ratio. This approach represented a major contribution to the literature when it appeared. Yet, as discussed in a book review of Goldstein, Kaminsky and Reinhart (2000), it is not without pitfalls (Bussiere, 2001).

If one is willing to work with discrete choice models with continuous variables on the right-hand side, logit and probit models provide a valuable framework, especially in view of one of their characteristics.[8]

Others methods have been also used for developing early warning systems: OLS approach of Sachs, Tornell and Velasco (1996) and of Bussière and Mulder (1999a, 1999b), artificial neural network of Nag and Mitra (1999), Fisher discriminant analysis of Burkart and Coudert (2000) and Markov-switching approach of Abiad (1999, 2003).

The design of an early warning system requires considering the scope of the model (country coverage, choice of explanatory variables, and time dimensions), the definition of

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[6] Ali Ari, "An Early Warning Signals Approach to the Currency Crises: The Turkish Case", 2009, p.9-10.

[7] Hali J. Edison, ""Do indicators of financial crises work ? An evaluation of an early warning system", International Finance Discussion Papers no. 675, Board of Governors of the Federal Reserve System, July 2000, p.4.

[8] Matthieu Bussiere, Marcel Fratzscher, "Towards a new early warning system of financial crises", Working Paper no. 145, European Central Bank, Working Paper Series, may 2002, p. 10-11.

a crisis (the statistical dating of the crises) and the statistical methodology (signal extraction versus probit analysis).[9]

Regardless of the method adopted, the empirical models construct first a crisis index as the dependent variable in order to identify crisis episodes. Some modelers describe currency crises as large depreciation or devaluation episodes (Frankel and Rose, 1996 and Kumar, Moorthy and Perraudin, 2003 inter alia), while some others consider currency crises as instances where a currency come under severe speculative pressure (Eichengreen et al., 1994, 1995, 1996 and Kaminsky et al., 1998 inter alia). This second currency crisis definition takes into account both the situations where speculative attacks lead to currency devaluation and where the authorities successfully defend the currency by intervening in the foreign exchange market and/or rising domestic interest rates.

After defining crisis dating mechanism, the next step of constructing an EWS consists in selecting the adequate methodology. The non parametric signaling approach aims to monitor whether some key variables tend to behave unusually prior the onset of a crisis. They firstly build a crisis index and secondly transform the early warning indicators of the model into binary signals by defining an "optimal" threshold for each indicator.[10]

Kaminsky (1999) puts forward the analysis by constructing leading composite indicators as a weighted sum of the signaling indicators, where each indicator is weighted by the inverse of its noise-to-signal ratio. These composite indicators provide some information on the vulnerability of an economy to an upcoming crisis.

Kaminsky et al (1998) use the signal approach to predict currency crises for a sample of five industrial and 15 developing countries during the years 1970–1995. In their study, an indicator exceeding a specified threshold is interpreted as a warning signal that a currency crisis may take place within the following 24 months. They find that variables with the greatest explanatory power include exports, deviation of the real exchange rate from trend, the ratio of broad money to reserves, output, and equity prices. The signal approach is further applied in Kaminsky (1999) and Brüggemann and Linne (2002a). Perhaps the most careful attempt to craft an early-warning system is found in Goldstein et al (2000).[11]

However, as Edison (2003) states, the interpretation of the conditional probability of a future crisis based on the values of the composite indicators remains difficult. Besides, contrary to logit/probit non linear regressions, the signaling approach does not let itself to statistical tests and the estimated probabilities are less directly derived. Moreover, on looses some information when threshold levels are set for the indicators; for instance, an indicator does not give any signal even though it derives unusually from its trend, because it is just below the threshold, also once an indicator crosses the threshold, one cannot observe how deteriorated the indicator is. However, this approach presents an important advantage of giving policymakers an easily interpretable picture of problems of the economy by showing clearly which indicators exceed the calculated threshold level.[12]

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[9] Daniela Beckmann, Lukas Menkhoff, Katja Sawischlewski, "Robust Lessons about Practical Early Warning Systems", Discussion Paper No. 322, Oktober 2005, ISSN: 0949-9962, p.3.

[10] Ali Ari, "An Early Warning Signals Approach to the Currency Crises: The Turkish Case", 2009, p. 11-13.

[11] Tuomas Komulainen, Johanna Lukkarila, "What drives financial crises in emerging markets?", International Conference on Policy Modeling (EcoMod), Istambul, 2003, p.3.

[12] Ali Ari, "An Early Warning Signals Approach to the Currency Crises: The Turkish Case", 2009, p.13.

Some of the problems in the signal approach are solved with limited dependent or discrete-choice models. This method uses logit or probit functions and the predicted outcome, i.e. probability of crises, is constrained between zero and one.

The discrete-dependent-variable approach (or non linear regressions) evaluates directly the conditional probability of a crisis given a set of early warning indicators (that are not transformed into binary signals and are included into the econometric analysis in linear way) contrary to the signaling approach which aims to observe the unusual behavior of the individual indicators (transformed to binary signals) before the onset of a crisis and to evaluate ability of each indicator in forecasting crisis episodes.

This approach has the advantage of summarizing the information about the crisis probability in one easily interpretable number (0 in case of non crisis and 1 in case of the crisis). In addition, it considers all the early warning indicators simultaneously in a multivariate framework, observes marginal contribution of an each indicator and thus allows discarding the insignificant ones from the analysis. Furthermore, this approach lends itself to standard statistical tests that measure robustness of the estimation results. However, in this approach the interpretation of the estimated coefficients of the indicators remains difficult because of the non linear nature of the model. Also, unlike the signaling approach, it is unable to rank indicators according to their ability of forecasting accuracy.

Among the earliest studies of this type, Eichengreen et al (1996) use data from 1959 through 1993 for industrial countries to characterize the common causes for currency crises and illuminate the contagious nature of currency crises. Frankel and Rose (1996) use a probit model to estimate the probability of crisis in an annual sample of 105 developing countries covering the period 1971–1992. They note that currency crises tend to occur when growth of domestic credit and foreign interest rates are high, and FDI and output growth are low. Kumar et al (2002) concentrate on forecasting crises and use logit model to study currency crises in 32 developing countries during the years from 1985 to 1999. They evaluate forecasts on an out-of-sample basis, estimating the model for one part of the sample, and then forecasting crashes in the remaining sample period. Their model has relatively good forecasting power.[13]

The third step in the construction of an EWS consists in selecting a set of potential crisis determinants. In that sense, one surveys both the theoretical crisis literature and the former empirical studies that put forward some potential key crisis factors. Regardless of the methodology adopted and/or countries and period of the sample selected, some indicators generally emerge as informative and significant in predicting crisis episodes: overvaluations of the domestic currency, high ratios of M2 to foreign exchange reserves, domestic credit growths, high ratios of short-term debt to foreign exchange reserves, and also outbreak of a crisis in another country (contagion). This shows the fact that –as stated in Arias 2003– in order to explain crisis episodes, particularly those that came out in the late 1990s, one needs to combine the determinants underlined in the so-called first, second and third generation crisis models.[14]

[13] Tuomas Komulainen, Johanna Lukkarila, "What drives financial crises in emerging markets?", International Conference on Policy Modeling (EcoMod), Istambul, 2003, p.4.

[14] Ali Ari, "An Early Warning Signals Approach to the Currency Crises: The Turkish Case", 2009, p.14.

5. CONCLUSION: TO A NEW EARLY WARNING SYSTEM?

The Early Warning System models can be made most useful to help sustain global growth and maintain financial stability, especially in light of the lessons learned from the current and past crises.

But one criticism we often hear about EWS in the past is that the system is often good in replicating the last crisis but is less useful in anticipating future crises. A key reason for this is the way the EWS models have been calibrated to fit the explanation for the last crisis, and hence, becomes less useful for anticipating future crises when circumstances or the risk factor change.

Therefore, the new EWS to be useful, it must have the ability to anticipate the nature of future crises with certain accuracy. This, of course, is going to be a demanding task, but it is this quality that the EWS process needs to have. This is because without certain degree of accuracy, it will be difficult to persuade policymakers to collectively become engaged in addressing certain risk and vulnerabilities.

The task could be easier achieved if the focus of EWS is narrowed down to the really important systemic issues i.e, the issues that have high-global impact but are beyond the capabilities of market and individual economies to monitor and make assessment. This include the robustness of the key global financial markets and infrastructure, risk relating to the systemically-important large economies and the operations of the internationally-important financial institutions.

The focus of EWS should expand beyond macro-misalignments based on historical relationships to include assessing the robustness and the resiliency of the systemically-important markets, system, and institutions. This means the key objective of EWS will not be to forecast future crises per se, but to identify vulnerabilities in the most important areas in advance, especially those risks that are not covered by market data or by the surveillance process elsewhere.

For EWS to be effective and comprehensive, it should be done at two levels to cover both the global dimension and the country-specific dimension of risk.

The focus of the EWS at the country-level also needs to expand beyond detecting and avoiding local macro-misalignments, and to include assessment of the resiliency and robustness of the domestic economy and financial system to withstand large external shocks. The key point here is that, even with good policies, crisis can happen to an economy if the externally-induced factors overwhelm the abilities and the robustness of the domestic economy to cope with.

The value of early warning is that warning leads to the needed actions being taken in advance. This means the EWS process should serve to facilitate actions to deal with the important risk and issues by the relevant parties. To serve this end, credibility and effectiveness of the EWS depends on appropriate degree of transparency of the structural models and its appropriateness to the context, whether national or markets, as much as its track record.[15]

[15] Bandid Nijathaworn: "The role of Early Warning Systems in economic policy formulation", IMF High-level seminar "Early Warning Systems and Their Role in Surveillance", Singapore, 9 February 2010.

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