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Early Indicators of Currency Crises. Review of some Literature

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Abstract

Financial crises have become relatively frequent events since the beginning of the 1980s. They have taken three main forms: currency crises, banking crises, or both – so called twin crises. As the number of developed economies, developing countries, and economies in transition experienced severe financial crashes researchers are trying to propose a framework for systemic analyses. That is why attempts to advance the understanding of features leading to the outbreak of financial crisis as well as the reasons of vulnerability have become more and more important. In recent years a number of efforts have been undertaken to identify variables that act as early warning signals for crises. The purpose of this paper is to provide some perspective on the issue of early warning signals of vulnerability to currency crises. In particular, it is aimed at presenting and highlighting the main findings of theoretical literature in this area.

An effective warning system should consider a broad variety of indicators, as currency crises seem to be usually associated with multiple economic and sometimes political problems. Indicators that have proven to be particularly useful in anticipating crises and received empirical support include the development of international reserves, real exchange rate, domestic credit, credit to the public sector, domestic inflation, and structure and financing of public debt. Other indicators that have found support are trade balance, export performance, money growth, M2/international reserves ratio, foreign interest rates, real GDP growth, and fiscal deficit. Many of the proposed leading indicators have been able to predict particular crises, however, only few have showed ability to do so consistently. Generally, economic models can be said to be more successful in predicting crises that erupt because of weak fundamentals, which make country vulnerable to adverse shocks. They are less likely in anticipating crises due to self-fulfilling expectations or pure contagion effects.

So far economists are only able to identify situations in which an economy could face the risk of a financial crisis. This is most because of the well-known fact that if we knew the crisis would have already occurred. Warning indicators seem to be unlikely to predict crises in precise way but their analyses can provide extended information about impending problems what enables to take preventive measures.

1. Introduction

Financial crises have become relatively frequent events since the beginning of the 1980s. They have taken three main forms: currency crises, banking crises, or both – so called twin crises. These events have led to an increased interest in the issues of financial markets problems. As the number of developed economies, developing countries, and economies in transition experienced severe financial crashes researchers are trying to propose a framework for systemic analyses. Ongoing research reveals that financial crises may have some common elements but their specific causes differ, and thus require different policy responses. That is why attempts to advance the understanding of features leading to the outbreak of financial crisis as well as the reasons of vulnerability have become more and more important.

The question arises whether it can be predicted which countries are more likely to suffer a currency crisis. In fact, preventing the occurrence of severe financial problems is undoubtedly one of the major concerns. In recent years a number of efforts have been undertaken to identify variables that act as early warning signals for crises. Growing interest in the indicators of vulnerability to crises suggests that there are believes that crises are potentially predictable. However, several episodes of financial distress indicate that markets are probably unable to foresee exchange rate crises.

Even advanced econometric methods and models estimated with historical data can foresee crises only with a degree of accuracy. Problems in currency crises forecasting are related to the following facts:

– crises are not sufficiently similar across countries to allow the generalization of past experience,

– each episode exhibits some unique characteristics,

– some features that may indicate vulnerability are not easily quantified,

– adequate data are sometimes not available,

– determinants of crises may differ significantly through time.

Very often one fact is ignored: usually crises occur by surprise. Neither our understanding of causes nor the results of empirical studies provide much hope that the effort at predicting these kind of economic crises will succeed. To a large extend it is all a matter of luck.

The purpose of this paper is to provide some perspective on the issue of early warning signals of vulnerability to currency crises. In particular, it is aimed at presenting and highlighting the main findings of theoretical literature in this area. The next section briefly discusses the definitions of currency crises and early warning systems. The

requirements, which such system should satisfy, are identified. Section 3 tries to establish the relationship between the alternative theoretical models explaining the mechanism of currency crisis as well as the possibility and probability of currency crisis prediction. The main interest of section 4 is to propose the list of potential factors and macroeconomic variables that may serve the role of early indicators. Section 5 comments on the assessment of their usefulness in policymaking and relevance in transition economies while Section 6 provides general conclusions.

2. Definitions

Although investors have known disturbances on financial markets for so many years the unique definition of currency crisis was not developed. It seems to be extremely difficult task to propose precise definition of currency crisis. There is neither a uniform definition nor a uniform description of currency crisis in the economic literature. Taking into consideration complexity of events on financial markets the main problem lies in characterizing the beginning as well as the end of crisis. Moreover, difficulties arise from the fact that in practice two kinds of situations should be considered when we refer to crises:

1. Sharp devaluation of the currency;

2. Speculative attack that was successfully defended, which means that authorities did not allow large scale devaluation, but implementation of preventive measures resulted in the severe, negative effects on real sector.

It seems that currency crisis definition cannot be formulated univocally. Only conditional approach to the issue can guarantee the reliable and useful solution. In principle, currency crisis can be identified alternatively as:

1. Decline in exchange value of currency,

2. Drastic macroeconomic policy adjustment,

3. Outflow of foreign reserves.

Some economists (W. Orlowski) [1] claim that currency crisis could be interpreted as the loss of confidence in further stability of domestic currency value. The proposition seems to be biased by some shortcomings rising doubts. First, how to define the confidence itself and required sufficient level of confidence. Second, whom such confidence should be expressed by. We can distinguish two dimensions of confidence in exchange value of currency. In the case of financial markets the loss of confidence is

[1] Note: views expressed during the seminar organised by CASE Research Foundation on issues related to currency crises.

manifested by sudden outflow of short-term capital. The decrease in demand for domestic money is another evidence of decreasing confidence. On the other hand, sudden implementation of macroeconomic policy measures and adjustment program is the symptom of government's and central bank's lack of confidence in currency stability.

In general, the developments of real exchange rate can serve as one of the main and the most helpful identification of currency crisis. Sharp devaluation of the real exchange rate or its departure from the long-term trend can be considered as the beginning of the crisis.

One should also remember that the definition of currency crisis could considerably depend on the exchange rate regime prevailing in the country. In the case of flexible exchange rate regime currency crisis will be signaled through the scale of exchange rate correction. In the case of fixed exchange rate regime the loss of international reserves in order to defend domestic currency will be identified as currency crisis. Various definitions of currency crisis are subject to intensive debate in the economic literature.

World Economic Outlook (1998) distinguishes very general definition of currency crisis when a speculative attack on the exchange value of a currency results in a devaluation (or sharp depreciation) of the currency. The authors also consider the situation, which forces the authorities to defend the currency by using large volumes of international reserves or by sharply raising interest rates.

Most popular definition of currency crisis is one given by Frankel and Rose (1996). They define a "currency crash" as a nominal depreciation of the currency of at least 25 percent in a year (the exchange rate is measured using dollar bilateral rates). To ensure that high expected rates of depreciation in high-inflation countries would be omitted from currency crashes they require that the change in exchange rate not only exceeds 25 percent, but also takes into account a 10 percent increase in the rate of depreciation.

An alternative approach is to look at behavior of the so-called speculative pressure index. Currency crises are identified as extreme values of such an index, which is a weighted average of changes in an exchange rate, international reserves and interest rates. Such definition of currency crises additionally allows including situations when authorities intervened to avert a large devaluation or the abandonment of an exchange rate peg.

Once financial crises emerge they result in distortional effects and entail large costs. They have usually been costly in various degrees but always in lost output and welfare (see Table 1). The IMF study World Economic Outlook (1998) found for the currency crises an average 4.25 percentage point cumulative loss in output growth per crisis (relative to the trend). It is worth noting that average recovery time is shorter in emerging market countries then in industrial countries but the cumulative output loss is

on average larger. Such crises may also result in significant resolution cost. In general, restructuring costs are higher in developing countries. Speculative attacks may cause severe economic recessions and high inflation, leading to deterioration of social wealth. The costs of financial crises, particularly those connected with banking sector problems, may be associated with severe negative impacts on the economic activity. Crises may lead to the misallocation and underutilisation of resources, reduction in the loans, and the contraction in credit and investment. In addition, fiscal and quasi-fiscal outlays may have to be involved in restructuring of financial sector.

Moreover, financial crises have proven to exhibit important by-products associated with increases in unemployment, and large and widespread social costs. According to analyses presented in the World Economic Outlook (1999) recent currency crises have resulted in marked rises in measured unemployment. Labor market pressures (relative increases in unemployment, downward wage adjustment, labor force migration, and labor force movement into low-paying informal sectors) have born a significant part of the short-term burden of adjustments. The approximate magnitude of social costs may also be suggested by a variety of socio-economic indicators. Recent World Bank (1999) estimates on trends in poverty show that the increases in poverty have been significant in most of the countries affected by the crises.

Table 1. Cost of Crises in Lost Output Relative to Trend

	Number of crises	Average recovery time (in years)	Cumulative loss of output per crisis with output loss (in percentage points)
Currency crises	158	1.6	7.1
Industrial	42	1.9	5.6
Emerging market	116	1.5	7.6
Banking crises	54	3.1	14.2
Industrial	12	4.1	15.2
Emerging market	42	2.8	14.0
Currency and banking crises	32	3.2	18.5
Industrial	6	5.8	17.6
Emerging market	26	2.6	18.8

Source: World Economic Outlook (1998)

In the light of above facts, which show the severity of crises, the need to identify potential causes and symptoms of currency crises is becoming more apparent. In particular, there is clearly the need to develop a warning system that would help detect

sufficiently in advance whether a country may face a crisis. Although warning indicators are rather unlikely to precisely predict crises, particularly their timing, they can provide better information about impending problems so that policymakers can take preventive actions.

Various propositions of an early warning system can be found in economic literature. The indicators that predict the most actual crises and produce the least false alarms are used as leading indicators [World Bank, 1998]. However, a uniform, well-defined set of indicators has not been identified yet. Issues related to the theory of currency crises as well as country conditions tend to be crucial in determining the significance of specific indicators.

There are some particular requirements that should be taken into account while constructing system that provides information about vulnerability to crisis. First of all, an early warning system should correctly signal crises a significant number of times. On the other hand, it should not give frequent false alarms. Moreover, such a system is expected to indicate signals of vulnerability to crises sufficiently in advance to enable countermeasures. And equally important aspect: set of economic variables potentially used, as leading indicators must exhibit the statistical significance to guarantee the confidence of prediction. Good description of problems, which economists face when defining the system of currency crisis indicators is reflected in the terminology of statistical tests. Leading crisis indicators should avoid to show Type I errors, which mean that they fail to predict crisis which occurs. The warning system would be said to face Type II errors when it predicted attacks which did not emerge. Preliminary testing of the indicators reveals that both types of errors are prevalent [Wyplosz, 1998]. The usefulness of selected variables as leading indicators is limited by the availability of timely information. In some cases information about the behavior of the variables is available only with a delay too long to make them useful as the predictors [IMF, 1998].

In recent years, a number of attempts have been taken to systematically predict which countries are more likely to suffer currency crisis. Several methodologies have been proposed to verify variables that could serve as useful early warning signals of currency crashes.

A commonly used approach suggests comparing behavior of a set of macroeconomic variables before crisis with that during tranquil times. One of the possible variations of this methodology is to monitor the stylized facts of the period preceding and following the currency crisis. The pre-crisis behavior of a variable is compared to its behavior during non-crisis periods for the same group of countries or for the group of countries in which no crisis occurred. The aim is to find variables that display anomalous before crisis but do not provide false signals of an impending crisis in normal times.

As an early warning system should indicate vulnerability to crises well in advance researchers try to narrow the list of potential leading variables to only those, which appear to have worked best. The other approach directly estimates the probability of a currency crisis using limited dependent variable econometric techniques. The advantage of this methodology is that several indicators are evaluated simultaneously. The statistically significant variables can then be used to calculate the probability that a crisis will occur at a specific time.

It is worth underlying that any system of indicators should be understood only as the identification of vulnerabilities that can give rise to a risk of crisis and not as the clear prediction of crisis. No single indicator is likely to capture the complexity of developments leading up to a crisis, which includes the elements of economic disturbances, political factors and sometimes contagion effects associated with investors' sentiment. One should remember that analytical tool in the form of early warning indicators needs to be extended with a set of country-specific information in order to more correctly assess the vulnerability to a currency crisis. A comprehensive analysis of the situation should be taken into account necessarily. Only complex approach to the issue of financial crises can give a coherent interpretation of events.

3. Currency Crises Models – Indicators Selection

Important question arises whether currency crises can be predicted ex ante with standard economic indicators. And the question immediately following is whether the degree of crisis predictability depends on the character of a currency crisis. Taking into account the alternative explanations of speculative attacks described in the academic literature it seems that the possibility to identify credible indicators or to construct useful early warning system is, to a large extent, related to the type of a theoretical model of a financial crisis.

The early literature described model referred to as the first generation or canonical model of crises. It corresponded to a situation when weak economic fundamentals resulted in a persistent loss of foreign reserves, which did not allow maintaining a fixed exchange rate regime. Krugman's paper of 1979 laid out hypothesis that currency crises were triggered by unsustainable economic policies. It emphasized an inconsistency between the maintenance of a currency peg and other domestic economic policies. In sum, canonical model showed how a peg exchange rate combined with excessively expansionary pre-crisis fundamentals push the economy into crisis [Flood, Marion, 1998].

The model delivered several findings that could be important in predicting currency crises. It suggested that the following range of factors might influence forecasting the risk of crisis:

– persistent loss of international reserves,
– government deficit (expansionary fiscal policy),
– development of credit to public and private sector (expansionary monetary policy),
– real appreciation of currency,
– current account deficit.

In the light of assumptions applied to the first generation models the above factors could be considered the potential candidates for early warning indicators. According to views expressed by some economists fundamental-driven crises can be predicted and for this kind of crises early warning signals can work [Wyplosz, 1998]. Even if the timing of a crisis cannot be predicted precisely, a crisis itself is the predictable outcome of policy inconsistencies.

More recent, the so called second generation models were extended by the idea that the authorities may decide to abandon the fixed exchange regime being concerned about the negative effects of policies required to keep the parity on the evolution of other key economic variables. Under certain conditions the cost of maintaining the regime may surpass the benefits. Second generation models showed that crisis could be self-fulfilling because there existed multiple equilibria. The existence of multiple government objectives implies a trade-off between a fixed exchange rate policy and other objectives (limitation of debt service obligations, lowering the rate of unemployment, saving banking system). Currency crises could represent not the result of a deteriorating underlying situation but instead a "jump" from one equilibrium, the pegged regime, to another, the devalued or floating regime. The exact timing of crisis would be essentially unpredictable. However, it may be possible to identify whether a country is in a zone of vulnerability, that is whether fundamentals are sufficiently weak that a shift in expectations could cause a crisis [Berg, Pattillo, 1998]. The economy's fundamentals must usually be weak along some dimensions before a shift in market sentiment can push the economy into a crisis.

This approach suggested that a variety of factors might determine the authorities' objectives and decisions. As the consequence the list of possible leading indicators can be enlarged by the following variables:

– deviation of output from a certain trend or desired level,
– high unemployment rate,
– increase in foreign and domestic interest rates,
– stock of public debt,

– banking sector problems,

– political variables.

Second generation currency crises can hardly be explained only by the unfavorable changes in macroeconomic fundamentals. Deteriorating fundamentals (sometimes only slightly) are necessary but not sufficient. Self-fulfilling crises may affect any country – with a peg exchange rate and a high degree of capital mobility – that is in the zone between "fully save" and "sure to be attacked". An important implication of self-fulfilling crises is that they are fundamentally unpredictable and anticipating financial crises may be extremely difficult [Kaminsky, Lizondo, Reinhart, 1998].

Recently noticed contagion effects have considerably influenced the achievements of currency crises theory. At least three major factors can be identified that make individual countries vulnerable to world financial instability. First, contagion effects of external financial crises are generated when there is a common systemic linkage between the country and the economy experiencing problems. The systemic linkage steams mainly from a similar regulatory and institutional framework in both countries. Crisis contagion may happen even between seemingly unlinked economies. The possible reason is that they can be perceived as a group with some common but imperfectly observed characteristics. The second factor contributing to the risk of crisis's spillover is macroeconomic linkages. Particularly, following features are helpful in explaining why currency crises tend to be clustered can be pointed out:

– worldwide common shocks inducing pressure on the currencies of several countries simultaneously,

– significant depreciation in one country leading to the negative trade spillovers, which depress the exports of trade partners owing to the loss in their price competitiveness,

– financial linkages through which the occurrence of a crisis in one country may motivate investors to rebalance their portfolios for risk management,

– shifts in investors sentiment according to which a crisis in one country can alarm financial markets to reassess other countries' fundamentals. Countries with symptoms of financial vulnerability may be subject to increased risk aversion.

There is also possible the third factor, which may play the critical role in the severity of negative effects of international financial problems. It is reflected in so called "pure contagion" effects. In very broad sense, contagion may exist in the form independent of the macroeconomic fundamentals, simply because of the supposition of relatively higher risk. Pure contagion takes place when most of international investors act in the same direction regardless of fundamentals in individual markets. In the wake of a crisis elsewhere, they may all pull out their assets from the market. For instance, in the aftermath of the Russian crisis, many hedge funds and investment

banks sold profitable assets in Poland and Hungary to cover their extensive losses in Russia [Orlowski, 1999].

The presence of contagion effects significantly influences the selection of possible early warning indicators of currency crises. The following factors may signal future instability on domestic financial market [WEO, 1999]:

– steep rise in world interest rates,

– sharp slowdown in world aggregate demand,

– decline in commodity prices,

– large changes in exchange rates between major currencies,

– bilateral trade linkages with country already affected by crisis,

– large share of short-term obligations and bank's maturity mismatch between assets and liabilities (reflecting increased risk of change in the expectations and sentiment of investors).

Both the canonical and second generation models presume that foreign exchange markets are efficient. In fact, financial markets exhibit strong anomalies. The theory of currency crises has been recently influenced by the recognition of foreign exchange markets' inefficiency. The most obvious one is the possibility of herding (Krugman). The phenomenon of herding is described as the coordinated, simultaneous actions of investors and speculators. The driving force behind that effect is asymmetric information. Individual investors act in the direction of entire group being aware that other market participants possess specific private information about market fundamentals. Herd behavior can occur because, as the number of markets grows and the share of a country's assets in the investor's portfolio declines, the payoff to gathering country-specific information is reduced. It can take place when investment fund managers are evaluated on their performance relatively to the other managers. They may simply find optimal to "follow the herd". According to World Economic Outlook (1999) these explanations are part of a broad class of models in which expectation formation in the context of imperfect and asymmetric information can explain rational herd behavior by investors.

In practice, such behavior based on sheer imitation or "bandwagon effects" have proven to be causing a lot of damage to stability of world financial markets during the Asian and the Russian crises [Orlowski, 1999]. As herding and bandwagon effects are basically psychological phenomena related to spontaneous behavior of investors it is rather difficult to assess their influence on rational currency crises prediction.

The theoretical models of financial crises available before the Asian perturbances did not pay sufficient attention to microeconomic and systemic issues underlying the increased risk of crisis situation. More recent attempts to improve the understanding of currency crises models, falling into a broad category of so called the third generation

models, have argued that the core of the problems lies in the banking system. First, the crisis has been assigned to the existence of moral hazard [Krugman, 1998]. The implicit government guarantees for bank loans to often high-risk investments can contribute to moral hazard driven lending and crisis situations. Over-guaranteed and under-regulated financial intermediaries can lead to excessive investment, which is stimulated by typical features of moral hazard behavior [Orlowski, 1998]:

– insurance from a large agent for action of smaller agents,

– small agents may generate harmful effects to whole economy and their correction may be very costly,

– these costs are usually borne by the entire economic system.

According to Krugman a way to reduce the risk of currency crises driven by moral hazard is to eliminate government subsidies and guarantees to bank loans and to regulate the financial sector.

Second, financial sector fragility has been found another factor rendering economy vulnerable to the crises. Kaminsky and Reinhart (1999) argue that financial sector problems may undermine the currency and can even give rise to the currency collapse. Following other economists [such as Velasco, 1987; Diaz-Alejandro, 1985] they point that in an important number of cases, the bailout of the banking system may have contributed to the acceleration in credit creation observed prior to the currency crises. These models stress that the bailout of troubled financial institutions financed by central bank through printing money could be as well classified as classical currency crisis prompted by excessive money creation. Usually, the beginning of banking sector problems predate the currency crisis. Thus, banking crisis can serve as the prediction of a future currency crisis. Moreover, week and fragile domestic banking system may likely be perceived as a constraint on the monetary authorities' ability and willingness to defend the currency by means of increased interest rates. Fundamental institutional weaknesses of financial sector can be induced by the systemic and structural factors: weak banking supervision and regulation, poor corporate governance practices, inadequate risk management reflected in inefficient allocation, lack of transparency in the sector.

Finally, Krugman (1999) sketches out another candidate for third generation crisis modeling, one that emphasizes two factors that have been omitted from the former works. The model intends to capture two essential elements: the role of balance sheet difficulties in constraining investment by entrepreneurs and the impact of the real exchange rate on those balance sheets. These effects can cause a potentially healthy economy to experience a self-fulfilling financial crisis. The model is characterized by multiple equilibria in which a loss of confidence can produce a financial collapse that validates investor pessimism. In order to achieve the required reversal of its current

account, the country must experience a large real depreciation. This, in turn, worsens the balance sheets of domestic firms, validating the loss of confidence. A policy that attempts to limit the real depreciation implies a decline in output instead – and this, too, can bring to the collapse of confidence.

The third generation models that in principle emphasize the role played by microeconomic factors allow formulating the list of additional indicators of approaching turbulence in financial system. It includes:

– existence of government guarantees and subsidies to bank loans, which contribute to the development of moral hazard practices,

– over-investment,

– maturity structure and currency composition of debt,

– banking sector problems reflected in changes in bank deposits, deterioration in asset quality, increase in non-performing loans, large increase in bankruptcies,

– institutional and structural weaknesses and deficiencies of financial sector.

4. Warning Indicators of Currency Crises

The previous section briefly describes several models explaining the mechanism of currency crises suggested by the theoretical literature. The theoretical models offer the selection of economic and financial indicators helpful in the analyses of vulnerability to crises. Although the theory does not give an unambiguous answer as to what the early warning system of currency crises is, the models provide useful insight as to what economic variables should indicate impending crises. Analyses on historical data suggest that the system of currency crises indicators is directly derived from a wide range of causes underlying financial problems. World Economic Outlook (1998) distinguishes the following categories of factors that could increase economy's vulnerability to financial crises:

– inconsistent domestic macroeconomic policies,

– exchange rate misalignment,

– external financial conditions (terms of trade, world interest rates),

– structure and maturity of capital flows,

– shifts in market sentiment,

– weaknesses in financial sector,

– political factors.

A variety of theoretical models point to a large number of variables that might serve as the potential indicators of vulnerability to a crisis. Kaminsky, Lizondo and Reinhart (1998) present very detailed summary and overview of various indicators. In addition, the authors propose an example of a specific early warning system. The system involves monitoring the evolution of several indicators that tend to exhibit an unusual behavior in the periods preceding a crisis. When an indicator exceeds a certain threshold value, this is interpreted as a warning signal that a currency crisis may erupt. The maximum interval of time between the signal and the crisis was established as 24 months in the case of balance-of-payments crises [2]. Thus, any signal given within the 24-months window before the crisis is considered as a good signal, while any signal outside that period is a false alarm. Decision about the narrower window (say, 12 months in the case of currency crises) would discriminate indicators that tend to give an early signal (e.g. M2/reserves) since symptoms of a crisis are sometimes evident well in advance.

The main leading indicators can be grouped into the following broad categories: domestic macroeconomic variables, external variables, public finance, foreign variables, and institutional and structural variables. The following scheme presents how particular leading indicators resulting from theoretical models of currency crises could be classified into the mentioned categories:

I. Macroeconomic Domestic Variables
  A. Monetary policy
    – Rate of domestic credit growth
    – Central bank credit to banking sector
    – Money growth
    – Gap between money demand and supply
    – M2/ international reserves
    – Real interest rates
    – Domestic inflation
    – Position of exchange rate within the official band
  B. Fiscal policy
    – Ratio of government budget to GDP
    – Budget deficit

[2] Kaminsky and Reinhart (1999) were examining the cases of banking and twin crises in attempt to offer alternative approach to the nature and origines of the crises and to evaluate their probability conditioned on signals from one or more indicators. For banking crises, any signal given within the 12-month period before the beginning of the crisis is labelled a good signal.

- – Government consumption
- – Credit to the government sector

C. Real sector
- – Real GDP growth
- – Output
- – Unemployment rate

2. External Variables

A. Current account
- – Current account to GDP
- – Current account balance
- – Trade balance
- – Terms of trade / real exchange rate

B. Capital account
- – International reserves
- – Ratio of foreign exchange reserves to monthly imports

3. Public Finance

A. Stock of debt
- – Total foreign debt
- – Public foreign debt

B. Structure and maturity of debt
- – Share of debt classified by creditor type and by interest structure
- – Short-term debt

C. Capital flows
- – Foreign direct investment vs. portfolio flows
- – Long-term vs. short-term portfolio capital
- – Fixed rate vs. floating rate borrowing
- – Domestic-currency vs. foreign-currency denomination
- – Differential between domestic and foreign interest rates

4. Global Financial Variables

A. Foreign real GDP growth

B. International interest rates

C. Commodity prices

5. Institutional and Structural Variables

A. Financial liberalization

B. Exchange controls

C. Openness

D. Trade links

E. Duration of foreign exchange regime
F. Degree of political stability

The next step is to considerably limit this long list of indicators to only those variables, which are perceived as "preferred" in predicting the probability of currency crises. Only selected indicators turn to significantly affect the probability of devaluation and to provide the most accurate signals during the period proceeding the crises. Taking into account these considerations the list can be narrowed and reformulated in the way presented in Table 2.

Table 2. "Preferred" Indicators of Currency Crises

Indicator	Comments
1. Monetary Policy	
- international reserves/base money - international reserves/GDP	The probability of devaluation within one year increases to 40 percent for countries where international reserves/base money is less than 10 percent.
- domestic inflation	Determines the mean rate at which the economy is moving toward the critical point.
- various measures of real exchange misalignment - bilateral real exchange rate deviation from trend	Increase in overvaluation of real exchange rate helps to predict crises and increases their probability. It is used to define whether the fundamentals are weak or strong.
- real interest rates - central bank credit to the banking sector	
2. Fiscal Policy	
- fiscal deficit - domestic credit to public sector/total credit	
- government consumption/GDP	Has an effect in the presence of weak fundamentals and low reserves.
- public sector debt/total debt	Increases the probability of a crash.
3. Real Sector	
- unemployment rate	Statistically significant in analyses, which estimate the probability of a successful or unsuccessful attack.
- real GDP growth	

Table 2 cd

Indicator	Comments
4. External Sector - trade balance/GDP - export growth - terms of trade	The evolution of external sector variables is significantly different for the countries affected by crisis during 3 to 1 year before devaluation.
5. Global Variables - foreign real interest rates - foreign - domestic interest rate differential - OECD growth	
6. Institutional and Structural Variables - banking crises - contagion/trade links	 Helps predict the probability of a currency crisis. A crisis elsewhere increases probability of a crisis at home economy.

Source: Based on the analyses by Kaminsky, Lizondo, Reinhart (1998)

The most doubtful part of analyses on leading indicators is the selection of those indicators which contribution to the prediction of crises was found to be statistically significant in most of the empirical studies. Table 3 summarizes the findings obtained by Kaminsky, Lizondo and Reinhart (1998). The table relates the number of studies in which particular indicator was considered and results statistically significant. In principle, the analysis enables to select statistically significant variables.

The following Table 4 very schematically describes behavior of early warning indicators that have proven to be statistically significant. It illustrates the behavior of selected variables around the time of a currency crisis eruption.

The period before a currency crisis is characterized by an excess supply of *real M1 balances*. This outcome seems to be either in line with the Krugman (1979) framework of the deficit financing or the excess liquidity may be created to support troubled financial institutions. At some point such developments become inconsistent with further maintaining of the exchange rate regime (stability) what leads to a currency crisis.

The ratio of *broad money M2 to international reserves* grows well above its norm prior to a currency crisis, with the growth rate increasing close to the crisis. The increases could be contributed to a rapid expansion in M2 and a sharp decline in foreign currency reserves. The ratio measures the banking system's ability to withstand currency pressure, as it is the inverse of the extent to which liquid domestic liabilities of the banking system

Table 3. Indicators Statistically Significant

Sector	Variable	Number of studies considered	Statistically significant results
1. Monetary Policy	– International reserves	12	11
	– M2/int. Reserves	3	3
	– real exchange rate	14	12
	– inflation	5	5
	– money	3	2
	– money multiplier	1	1
	– credit growth	7	5
	– central bank credit to banks	1	1
	– real interest rates	1	1
2. Fiscal Policy	–fiscal deficit	5	3
	– government consumption	1	1
	– credit to public sector	3	3
3. Real Sector	– real GDP growth or level	9	5
	– employment/unemployment	3	2
4. External Sector	– trade balance	3	2
	– exports	3	2
	– terms of trade	3	2
5. Global Variables	– foreign interest rates	4	2
	– domestic–foreign interest differential	2	1
	– foreign real GDP growth	2	1
6. Institutional and Structural	– banking crisis	1	1
	– financial liberalization	2	1
	– openness	1	1
	– crisis elsewhere	1	1

Source: Based on the analyses by Kaminsky, Lizondo, Reinhart (1998)

are backed by foreign exchange reserves. Since this variable in part captures the economy's ability to defend speculative pressure without a sharp correction in exchange rate, it can be viewed as an indicator of investors' confidence in the domestic financial system.

Table 4. Stylized Facts on the Behavior of Selected Indicators

Indicator	Before crisis	After crisis
1. Monetary Policy		
- M2/reserves	Strong increase and beginning of decline just before the crisis	Decline
- excess real M1 balances	Strong increase	Decline
2. Fiscal Policy		
- fiscal deficit/GDP	Increase	Improvement
3. Real Sector		
- output	Decline	Start to increase
4. External Sector		
- real exchange rate	Very strong appreciation	Devaluation
- foreign exchange reserv.	Strong decline	Start to increase
- exports	Strong deterioration	Increase
- terms of trade	Deterioration	Poor, with predisposition to improve over longer time
5. Financial Liberalization		
- M2 multiplier	Increase	Decline and remains on low level
- real interest rates	Fluctuation and decline	Increase
- domestic credit/GDP	Strong increase	Decline

Note: The pre- and post-crisis behavior is compared to the average behavior during normal periods. Observation of the 12-month percentage changes of variables, except for interest rate, real exchange rate and excess real M1 balances which are in levels.

Source: Based on the analyses by Kaminsly and Reinhart (1999)

Period proceeding a currency crisis is characterized by above normal growth in *domestic credit/GDP ratio*. Throughout this period the ratio remains well above the growth levels recorded for tranquil periods.

Prior to a crisis *real interest rates* are 1 to 2 percentage points higher (at a monthly bases) than in tranquil times. High real interest rates could reflect recent financial liberalization, tight monetary policy as a response of authorities to an overheating economy, or indicate pressure on the currency market in advance of the onset of the crisis.

Real interest rates do not return to their normal levels as the crisis deepens, what may indicate that banks keep deposit interest rates high in response to deposit withdrawals.

In the run up to a crisis the real *value of domestic currency* tends to be appreciated of about 20% relative to its norm prior to a crisis. The relative overvaluation rapidly narrows after the crisis date, reversing into the devaluation. It could be argued that initial appreciation is unlikely justified by productivity shocks or preference changes.

The appreciation of real exchange rate in the period proceeding a currency crisis is accompanied by *exports* under-performance. In the year and a half before a crisis exports growth is about 20% below the relative average for normal times. Following the reversal of the appreciation after crisis, exports start to continuously rise.

As the capital account developments are concerned the level of *foreign exchange reserves* of the central banks tends to fall by about 20% bellow normal level as early as 12 months before a crisis breaks.

The evolution of *output* growth is characterized by decline in comparison to growth rates prior to a crisis. There is also tendency for the recession to deepen as the crisis nears. Such developments reflect the overvaluation of the domestic currency, weakening terms of trade and export performance, and fiscal problems. In addition, deterioration in economic activity accompanied by high unemployment rates could indicate that the government may be unwilling to defend exchange rate regime implementing policies that could further undermine real activity.

One more macroeconomic variable that could indicate internal imbalances is the ratio of *fiscal deficit/GDP*. On average, it is higher in two years before a crisis. The bigger budget deficit may reflect higher government spending and shortfalls in revenues due to deterioration in output.

In addition, to sufficiently evaluate the indicators according to their ability to predict a crisis the literature provides some evidence as to the lead-time of a signal. The possibility to distinguish between one indicator that sends signals well before the crisis occurs and one that signals only when the crisis is imminent seems to be extremely important from the point of the policy making.

Findings presented in Table 5 show that on average, all the indicators send the first signal between a year and a year and a half before the crisis erupts. Applying time criteria they can be considered as an early warning system. The results encourage to assume that the signaling, on average, occurs sufficiently early to allow for pre-emptive policy measures. However, it is worth underlying that while leading indicators could be a useful tool for an assessment of the likelihood of a currency crisis, any such system is also subject to limitations.

Table 5. Average Lead Time

Indicator	Number of months in advance of the crisis when first signal occurs
Real exchange rate	17
Real interest rate	17
Imports	16
M2 multiplier	16
Output	16
Bank deposits	15
Excess M1 balances	15
Exports	15
Terms of trade	15
International reserves	15
Stock prices	14
Real interest differential	14
M2/international reserves	13
Lending rate/deposit rate	13
Domestic credit/GDP	12

Source: Kaminsky, Lizondo, Reinhart (1998)

5. Relevance to Transition Economies

Analyses of issues related to early warning systems of currency crises can be of special importance for the transition countries as the ongoing process of market reforms makes them especially vulnerable to financial problems. The history of transition provides several case studies of countries that experienced currency crises. Just to name some of them, the developments in Hungary in 1994, in Bulgaria and Kyrgyzstan in 1996, in Russia and Ukraine in the end of 1997 and 1998 can be mentioned.

Those examples of macroeconomic instability justify the necessity to pay special attention to the issues of crises vulnerability during economic transformation. In principle, the causes of all mentioned crises were similar. Fiscal policy was the main structural source leading to the eruption of crisis. Those countries have not solved their fiscal problems, maintaining high level of budget deficit while basing macroeconomic stabilization on short-term, foreign sources of debt financing. The risk of crisis was triggered by the inconsistency in fiscal and monetary policies.

Taking into consideration the lack of radical or rather very slow reforms of public sector it seems that transition economies may still face the scenario of currency crises originating from the first generation models. Therefore, in transition countries there is an unquestioned need to monitor the main macroeconomic variables that contribute to currency crises caused by the fundamentals. The most effective way to prevent crises occurrence is to pursue sound economic policies.

Moreover, the fact that transition economies started to participate in global capital markets might add to the factors leading to the self-fulfilling speculative attacks regardless of fundamentals. On one hand, financial liberalization increases the benefits but on the other, it may also enlarge the set of circumstances in which currency and banking crises are possible. It appears of special importance in the light of the progressing globalization process characterized by dynamic, increasing integration of financial markets particularly reflected in the freedom of short-term capital movement and capital account liberalization.

With the increased participation in the global financial markets it may be true that the risk of crises is rising, including vulnerable economies in transformation. Findings by Kaminsky and Reinhart (1999) (analyzing the links between currency crises and financial liberalization) suggest that in the 1980's and 1990's most liberalization episodes have been associated with following financial crises of varying severity. Only in a limited number of cases liberalization went smoothly and did not cause financial sector stress. Inadequate regulation and lack of supervision may play important role in explaining why deregulation and crises are so closely entwined.

The advancing liberalization of capital accounts in emerging market economies in the 1990's has led to their closer integration into world financial markets and has made them prone to external shocks. The Asian crisis has proven that there is a danger of sudden capital outflows when almost unrestricted short term capital transactions are introduced without sufficient prudential regulations of financial system.

The experience of recent disturbances proves the evidence that the process of globalization and liberalization should be well correlated with considerable financial sector development aimed at creating systems marked by sound and healthy institutions. In the case of some economies lagging in the sufficient financial sector development it may be desirable that liberalization proceeds gradually and is accompanied with some forms of restrictions in the transition to full freedom of capital flows. Movements toward the deregulation of financial sector must be undertaken with special care and attention. However, one should remember that capital controls could never be a substitute of good policies and good institutions [Dąbrowski, 2000].

To conclude, it seems that at the initial stage of transformation economies are especially vulnerable to the first generation crises related to weak macroeconomic fundamentals (mainly fiscal imbalances). Second generation models are of lower importance due to the limited openness and development of financial markets. Along with the increasing integration of transition countries into global economy on the following stages of transformation those factors start to play more significant role but always supplementary to weak fundamentals.

It appears that basing on both the findings of theoretical literature and practical experience of countries already affected by currency crises, the economies in transition may be able to design early warning systems and appropriate crisis prevention policies. Especially, the emphasis should be put on a number of measures accompanying any early warning system:

– maintenance of sound and consistent macroeconomic fundamentals,

– strengthening the institutional and legal framework of financial sector to manage and reduce the risks associated with large capital inflows,

– developing proper regulation and supervision to create a solid institutional base for capital account liberalization,

– enforcing high transparency in all types of financial and fiscal operations.

6. Concluding Remarks

Events that took place on the world financial markets during the 1990s have stimulated economists' efforts to workout the systematic approach to currency crises and speculative attacks. In the view of above, there has been growing interest in identifying the set of economic variables that can serve as an early warning system of a currency crisis. An effective warning system should consider a broad variety of indicators, as currency crises seem to be usually associated with multiple economic and sometimes political problems. Indicators that have proven to be particularly useful in anticipating crises and received empirical support include the development of international reserves, real exchange rate, domestic credit, credit to the public sector, domestic inflation, and structure and financing of public debt. Other indicators that have found support are trade balance, export performance, money growth, M2/international reserves ratio, foreign interest rates, real GDP growth, and fiscal deficit. Many of the proposed leading indicators have been able to predict particular crises, however, only few have showed ability to do so consistently. In fact, it is highly unlikely that the exhaustive list of effective

indicators would be configured. Generally, economic models can be said to be more successful in predicting crises that erupt because of weak fundamentals, which make country vulnerable to adverse shocks. They are less likely in anticipating crises due to self-fulfilling expectations or pure contagion effects.

So far economists are only able to identify situations in which an economy could face the risk of a financial crisis. This is most because of the well-known fact that if we knew the crisis would have already occurred. Warning indicators seem to be unlikely to predict crises in precise way but their analyses can provide extended information about impending problems what enables to take preventive measures. Analyses of issues related to early warning systems of currency crises appears to be of special importance for the transition countries as the ongoing process of market reforms makes them especially vulnerable to financial problems.

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