

A LEADING INDICATORS APPROACH TO THE PREDICTABILITY OF CURRENCY CRISES: THE CASE OF TURKEY

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1. Introduction

Financial crises, in general, may be attributed to the need for sudden and sharp changes in prices and/or quantities in financial markets for bonds, equities and foreign exchanges. The delay in the adjustment process increases the sharpness of the change, and hence, the degree of the crisis. In that respect, a currency crisis may be expected to occur when a speculative attack on a specific currency results in a devaluation (or a sharp depreciation) or forces the authorities to defend the exchange rate by depleting large volumes of international reserves or by sharply raising interest rates.

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In the last decade of the 20th century, several crises in financial and foreign exchange markets in Europe (1992-93), Latin America (Mexico, 1994-95) and Southeast Asia (1997-98) led economists to focus on the causes and timing of these crises. They tried to explain different experiences of countries with different economic structures and historical backgrounds by using different models, since there is no unique reason of crises. Traditional models regarding the balance of payments and currency crisis in the late 1970s and the first half of the 1980s suggest that the determinants of crises can be explained by looking at economic fundamentals, while more recent models link currency crises to self-fulfilling behaviors or contagion effects with moral hazard problem and herding behavior. Recent literature also concentrates on the determination of the indicators and the predictability of currency crises by developing statistical methods like leading economic indicators or early warning systems (e. g. Kaminsky et al. 1998).

The paper is organized as follows. In Section 2, we shortly summarize the theoretical background of the crisis models in the literature. In Section 3, we analyze the origins of crises in the European Exchange-Rate-Mechanism countries (1992-93),⁽¹⁾ Turkey (1994)⁽²⁾, Mexico (1994-95)⁽³⁾ and Southeast Asian countries (1997-98)⁽⁴⁾ in order to investigate the suitability of theoretical crisis models and to show whether there is any common cause of these crises. In Section 4, we summarize the empirical literature on the predictability of currency crises and then, examine the predictability of potential crises for the case of Turkey using the leading economic indicator methodology which was first proposed by Burns and Mitchell (1946). And finally, in Section 5, we present some concluding remarks.

(1) Eichengreen et al. (1994) deal with the ERM crisis in Europe in 1992.

(2) Ertugrul and Zaim (1996), Ozatay (1996) and Celasun (1998) focus on the 1994 financial crisis in Turkey.

(3) The Mexican peso crisis is analyzed mainly by Lustig (1995), Calvo and Mendoza (1996), Edwards (1996), Sachs et al. (1996) and Gil-Diaz (1998).

(4) Krugman (1997), Moreno et al. (1998) and Corsetti et al. (1998a and 1998b) try to illuminate the theoretical origins and (international) effects of the Asian crisis in 1997-98.

2. Theoretical Models

The theoretical models on currency crises can be classified into two generations.⁽⁵⁾ The first-generation models (Krugman 1979, and Flood and Garber 1984) accounted well for many of the currency crises in the 1970s and also for the 1982 developing-country debt crisis, but they failed to explain crises such as in Chile (1982), Europe (1992-93), Mexico (1994-95) and Asia (1997-98). Second-generation models (Obstfeld 1994) differ from the former ones since they are multiple-equilibria models. They consider an interaction between private sector and government behavior that gives rise to several possible solutions, i.e. the economy's equilibrium can jump from one solution to another.

2.1. First-Generation Models

In his seminal paper, Krugman (1979) stressed the role of the weak fundamentals as a triggering factor of currency crises. He assumed that the government budget deficits were at the root of speculative attacks on pegged exchange rates.

These models argue that the currency crises are preceded by the macroeconomic imbalances in the economy that are inconsistent with the maintenance of fixed exchange rates. According to Krugman (1979), under a fixed exchange rate regime, monetization of fiscal deficits, which creates domestic inflation, leads to an appreciation in the real exchange rate. The deteriorating effect of increasing domestic prices on the current account balance causes a gradual loss of reserves and ultimately, leads to a speculative attack against the currency. When the authorities are no longer able to defend the pegged exchange rate, they are forced to abandon the parity. The foresighted speculators would reallocate their portfolios by selling domestic currency for foreign currency before the exhaustion of reserves since they notice that the price of foreign exchange would begin rising. By doing so, they accelerate the period that ends with the abandonment of the fixed exchange rate. In that respect, these models combine a linear behavior rule by the private sector (the money demand function) with linear government behavior (domestic credit growth).

⁽⁵⁾ For theoretical models see Agenor et al. (1992), Kaminsky et al. (1998), Kruger et al. (1998) and Flood et al. (1998).

2.2. Second-Generation Models

The second-generation crisis models do not reject the role of the fundamentals in the economy. However, financial crises are not always necessarily determined by the weak fundamentals. That means that not all speculative attacks may be warranted by the weaknesses of fundamentals.

The second-generation models (Obstfeld, 1984, 1986, 1994) consider nonlinear behavior rules by one or more agents. Therefore, these nonlinearities can lead to multiple solutions. For example, a multiple equilibria exists in the foreign exchange market because of the contingent nature of the policy makers' and governments' objective function. According to these models, maintenance of the pegged exchange rates depends on the government's decision. The authorities might abandon a peg, if it were concerned that economic policies necessary to maintain the exchange rate might have adverse effects on other macroeconomic variables. In this context, these models stress the trade-offs between the benefits of a credible exchange rate peg and the costs in terms of higher interest rates, higher unemployment or lower growth of defending peg (Reisen 1998).

The recent studies of Paul Krugman (1998) and others in the aftermath of the structural financial crisis in Asia can be viewed as “third generation” of currency crisis models. These new models consider some disputed issues such as (1) moral hazard or asymmetric information problem that lead to an underpricing of the risks associated with investing in emerging markets, (2) herding behavior of bankers and portfolio managers and (3) international contagion effects appearing by some transmission channels such as trade and financial linkages between countries.

3. Country Experiences

In this section, we briefly survey selected four financial crises in the 1990s in order to demonstrate both the similarities and differences between the causes and consequences of the crises. This will help us in determining the indicators of currency crises, and hence, in constructing and implementing the leading economic indicator method for Turkey in the sixth section of our study.

3.1. The European Exchange-Rate-Mechanism Crises of 1992-93

In Fall 1992, foreign exchange markets in Europe were experienced a succession of crises. The dynamics of the exchange-rate-mechanism (ERM) crises were different from those of the crises explained by the first generation models since it could not be explained by weak fundamentals. For ERM crisis period, Eichengreen et al. (1994) found evidence against the fundamentals-based models of speculative attacks. In the ERM countries, governments had no need to monetize their budget deficits, and they were not suffering from any limitation on foreign exchange reserves. They had low and stable inflation rates both before and after the crisis. So, what caused the ERM crises?

According to the ERM of the European Monetary System, all participating countries pegged their currencies to the German Mark in a narrow range. In the aftermath of the fall of the Berlin Wall and reunification of Germany in October 1990, capital inflows were directed to the country because of the new opportunities for investors. On the other hand, the reunification of Germany caused heavy expenditures. This expansionary fiscal policy increased aggregate demand. National production expanded rapidly in 1990 and 1991. However, the economy began to overheat as demand exceeded production capabilities, so that inflation rate increased. In order to slow down inflation, the German Bundesbank conducted tight monetary policy and interest rates rose.

The capital inflows together with tight monetary policy of the Bundesbank led to the appreciation of German Mark against the US dollar. In order to maintain fixed exchange rates, other European countries pegging their currencies to the German Mark found themselves forced to match the tight monetary policy without fiscal expansion. This caused a slow down in economic growth and created unemployment. Many speculators, especially George Soros, foresaw that members of the ERM would devalue their currencies. At the final stage, the ongoing process led some countries to exit from the ERM. Britain left the ERM by devaluing pound by about 25 percent. Then, Spain and Italy devalued their currencies. These devaluations had spillover effects on some other EU countries like Republic of Ireland and Portugal due to the trade links (Eichengreen et al. 1996).

In the light of these events, the case of the ERM crisis can be explained by the second-generation models, since the government had multiple objectives some of which are conflicting with the fixed exchange rate target. In the countries concerned, the decision to abandon the pegged exchange rate system seems related to the cost of defending a peg by raising interest rates. Rising interest rates might worsen the unemployment problem. Therefore, the authorities were less willing to defend their currencies. In that respect, it seems that the decision to leave the ERM was to some extent an optimizing decision in terms of the second-generation models.

3.2. The Mexican Peso Crisis (1994-95)

During the period of 1987-93, Mexico successfully pursued major structural reforms. They were designed to liberalize foreign trade, reduce the public sector's role in the economy and eliminate the macroeconomic imbalances. Mexico's 18 commercial banks and many important public enterprises were privatized. A major tax reform was realized. Credit controls were removed and interest rates were determined freely.

These policies led to an economic recovery. Inflation was brought down from around 160 % at the end of 1987 to under 10 % in 1993. Primary fiscal deficit of 6 % of GDP was shifted to a surplus exceeding 7 % of GDP. These achievements coupled with the North American Free Trade Agreement (NAFTA) led to substantial capital inflows into the country. The Mexican peso was overvalued and the country had a very large current account deficit.⁽⁶⁾

Although the structural reforms were successful in bringing down the inflation, the use of the nominal exchange rate-based stabilization measures resulted in a real appreciation of the peso. The fact lying behind this appreciation was the differential between the domestic and foreign inflation rates. The actual inflation rate was still above the target level. On the other hand, there was a huge capital inflow to the country because of the economic recovery and the fall of the interest rates in the US. These factors also caused the currency overvaluation by attracting the foreign

⁽⁶⁾ According to Sachs et al. (1996), the widening current account deficit was the result of excess investment over savings.

capital. The real appreciation of the currency resulted in a growing disequilibrium in the current account balance in Mexico. However, it did not seem unsustainable to the government, because they thought that this growing deficit was temporary. Furthermore, it was financed by massive capital inflows.

Rising interest rates in the US and the assassination of presidential candidate Donaldo Colosio (in March 1994) had an undesirable impact on the Mexican economy. In the aftermath of this assassination, the risk premium demanded by foreign investors increased, the capital outflows began and the first sharp fall in reserves occurred. The Mexican government issued more *tesobonos*⁽⁷⁾ in order to attract investors by covering them against the risk of devaluation.

However, the huge change in the amount of tesobonos was a signal for many investors for the unsustainability of the existing exchange rate policy. This time, the Mexican monetary authorities decided to sterilize the fall in reserves by expanding domestic credit. This led to a fall in the interest rates while the interest rates in the US were high. The expansion of domestic credit increased the pressures on the peso. Because of these factors the Mexican economy became more vulnerable. The first devaluation was announced on December 20, investors panicked and ran from the Mexican peso. On December 22, the authorities switched their exchange rate policy to the floating one. The devaluation was resulted in a financial crisis with significant spillover effects on other countries in Latin America.

In the light of these events we can say that self-fulfilling expectations arising from the misperceptions about the development of economic fundamentals or political uncertainties were at the root of the Mexican peso crisis. The spillover effect of this crisis might be interpreted as a reflection of investor pessimism. Investors who believed that other emerging market economies might experience similar difficulties ran on other currencies even though fundamentals were unchanged. In their paper, Calvo et al. (1996) explain that countries with weak fundamentals were affected more from the self-fulfilling investor panic than those with strong fundamentals.

⁽⁷⁾ Tesobonos are short-term dollar-denominated government debt.

3. 1994 Financial Crisis in Turkey

Turkey experienced a severe currency crisis in early 1994. This crisis was different from those in European countries, Mexico and Southeast Asian Countries due to the fact that the exchange rate system was a managed float rather than being fixed.

In the first half of the 1990s, there were imbalances in the macro economic variables such as increasing and high public sector deficits, inadequate private savings to finance these deficits and as a result of these two deficits growing external deficit. This disequilibrium and the efforts to sustain it by inappropriate policies had some reflections to the relative prices. Some developments precipitating the crisis were observed in the foreign exchange markets.

After the financial liberalization in 1989, Turkey had attracted capital inflows due to high real interest rates. This led to an overvaluation of the Turkish Lira (TL). The appreciation of the currency and also the tariff reductions in 1989 caused current account deficits. The pressures on the exchange rate and the interest rates, and the open position of the banking system, which was around 5 billion dollars, increased the demand for dollars.

There was a run from the TL. The banks rushed to foreign exchange market to close their foreign exchange position. The Central Bank intervened the foreign exchange market in order to defend the exchange rate. As a result the Central Bank lost half of its reserves and overnight interest rates reached a record level. The open position of commercial banks declined to 1,1 billion dollars in June 1994. Finally, these developments had an impact on the parity. It was about 15000 TL/US\$ in January 1994, but jumped to 38000 TL/US\$ by the first days of April 1994.

In the first quarter of 1994, the Turkish lira (TL) depreciated by more than 50 percent against the US dollar, real output contracted by about 6 percent, annual inflation rate jumped to three digit levels (see Table 1). At the end of 1993, public sector debt stock and deficits as a percentage of GDP reached record high levels and the burden of interest payments increased. The government attempted not to impede growth prior to the local election of the governments in March 1994 and it made

an attempt to control the interest rates.⁽⁸⁾ So, there was a policy shift from bond-finance to money-finance starting from the last months of 1993. Several Treasury bill auctions were cancelled and the Treasury started to rely on short-term advances from the Central Bank. Therefore, there was a substantial real increase in Central Bank's domestic credits starting from the beginning of September 1993. The real return on Treasury bills turned to negative at the end of 1993. The cancellation of auctions increased the uncertainty in the financial markets and shook the confidence of investors. Finally the Treasury lost its ability to borrow.

Özatay (1996) argues that the 1994 currency crisis of Turkey started due to public debt mismanagement. At a time of large and rising PSBR and declining maturity of debt stock, interventions to decrease the interest rate and cancellations of auctions was a poor idea (Celasun 1998).

Table 1: Selected Macroeconomic Indicators of Turkey (in percent, 1987-1997)

Indicator	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Consumer Price Inflation	38.9	75.4	63.3	60.3	66.0	70.1	66.0	106.3	88.1	80.3	85.7
Real GDP Growth	9.8	1.5	1.6	9.4	0.4	6.4	8.1	-6.1	8.0	7.1	8.3
Current Account Balance to GNP	-0.9	1.8	0.9	-1.7	0.2	-0.6	-3.5	2.0	-1.4	-1.3	-1.4
Average Change in TL/\$ Rate	27.8	66.0	49.3	23.0	59.9	65.2	59.5	170.8	54.0	77.4	86.6
Gross Total International Reserves (Average)*	4773	5465	7251	10571	10923	13089	16342	14964	21925	24499	25446
Change in FX Reserves of the Central Bank	12.1	27.1	70.6	84.2	-19.0	4.1	42.3	-22.4	148.7	18.4	10.8
Treasury Average Auction Rate	47.5	62.9	58.8	53.0	80.0	86.5	87.5	193.2	121.8	130.1	108.5
Public Sector Borrowing Requirement/GNP	6.1	4.8	5.3	7.4	10.2	10.6	12.0	7.9	5.2	8.8	7.6
Public Foreign Debt Stock/GNP	36.1	36.2	31.7	24.8	25.8	24.8	23.6	45.4	29.2	26.6	
Public Domestic Debt Stock/GNP	23.0	22.0	18.2	14.4	14.8	17.6	17.9	20.0	17.3	21.0	21.4
Foreign Exchange Deposits/M2Y	16.8	22.9	19.7	19.3	24.8	35.2	42.5	49.4	46.9	49.4	46.9
Foreign Direct Investment (Net)*	106	354	663	700	783	779	622	559	772	612	554
Foreign Portfolio Investment (Net)*	282	1178	1386	547	623	2411	3917	1158	237	570	1634
Other Short-Term Capital Inflow (Net)*	50	-2281	-584	3000	-3020	1396	3054	-5127	3713	5945	1761

Source: Undersecretariat of Treasury, Ankara.

* In million US\$.

⁽⁸⁾ Özatay (1996) and Celasun (1998) argue that instead of trying to correct the fundamental imbalances, which cause interest rates to be so high, to control the interest rate was a policy error.

The 1994 crisis was not an unexpected event due to the fact that many economic indicators were giving warning signals. The fundamental fiscal variables were deteriorated, public sector deficit was financed by domestic credit expansion and the demand for foreign currency was increased. There was a great loss of reserves. With these characteristics, it can be said that the Turkish currency crisis fits in the first-generation models (Celasun 1998). On the other hand, the 1994 currency crisis had some features of the second-generation models. Because of the forthcoming elections, the government was reluctant to increase the interest rates in order to avoid the devaluation of the TL. In that respect, the 1994 currency crisis of Turkey might be explained by the second-generation models because of the government's objective function.

3.4. Asian Crisis of 1997-98

The Asian crisis does not fit into the Krugman's model since it was neither driven by huge fiscal deficits nor by excessive domestic credit expansion. Actually, before the crisis, most of the economic indicators were quite strong.

The inflation rate was relatively moderate in the affected countries like Thailand, Indonesia, Korea, Malaysia and the Philippines. Fiscal indicators were sound. They had high growth rates and did not suffer from substantial unemployment. However, there were few macroeconomic variables vulnerable such as high and growing current account deficits, especially in Malaysia and Thailand.

The main factors underlying the large current account deficits were as follows: (1) The devaluation of Chinese currency in 1994 which had a negative impact on the competitiveness of region countries. (2) The appreciation of dollar after mid 1995 which led to the appreciation of the currencies of the region currencies pegged to the dollar.⁽⁹⁾ (3) In 1996 a sharp decline in the demand for semi-conductors had an adverse effect on export growth of region economies. (4) The long period of stagnation in Japan led to significant decrease in the growth rate of exports of the region countries.⁽¹⁰⁾

⁽⁹⁾ By July 1997, the region currencies were mainly pegged to the US dollar.

⁽¹⁰⁾ Japan was the second important export market for the region countries with a share of 30 percent

Financial liberalization in many Asian countries in 1990s in conjunction with the strong macroeconomic fundamentals attracted investors looking for higher returns and caused a very rapid growth of net capital inflows into these countries. The growing current account deficit was financed by this large amount of foreign capital inflow. On the other hand, huge capital flows (mainly through international lending of banks) into the region countries caused an expansion of aggregate demand and considerable increase in stock and real estate prices.

The region countries were developed without having a well-functioning and robust financial system. The weaknesses in the financial system led to serious adverse selection and risky lending.⁽¹¹⁾ A large share of their lending were used in markets for real estate which incurred a “bubble” element. As much of the capital inflows were short term, the banks were borrowing from international markets in short term and lending in domestic markets in long term (Asian Development Bank 1998). There was a mismatch in the maturities of banks' assets and liabilities.

Relying on the government's guarantee both depositors and lenders (international and domestic banks) led to *moral hazard problem*. As lenders have less information than borrowers there was an asymmetric information between the market participants and hence, a moral hazard problem on the investors' parts (see Asian Development Outlook 1998). Depositors had no incentive to monitor the soundness of the banks because of the implicit or explicit deposit insurance. The lack of monitoring created moral hazard for bank managers. Another type of moral hazard problem occurred on the part of financial institutions, which had undertaken high-risk lending activities by ignoring the costs of these investment projects. Financial institutions did not hedge their funds to currency and interest rate movements. On the contrary, they believed the future bailout and took even more risk. Large amount of borrowing from abroad to finance rapid expansion made companies highly leveraged.

All these complicated structural and economic factors made region countries quite vulnerable to financial crises and led to markets' concern

(11) However, they were hidden by rapid growth, high savings and strong fiscal positions.

about the prevailing exchange rates. The real estate and stock prices fell and the companies went bankrupt. Rapid capital outflows led to investors panic. As a result, in July 1997, Thailand abandoned the fixed rate of the Baht (local currency) against the US dollar by causing consecutive devaluations in some other regional countries having similar structural weaknesses.

The Asian crisis invoked further theoretical and empirical research on causes, timing and effects of currency crises worldwide. It is neither fully completed in affected Asian countries nor prevented from spilling over to countries like Russia and Brazil. Therefore, it is difficult to evaluate the relevance of this new generation models entirely, presented by Krugman (1998) and others.

4. The Empirical Literature

Currency crises that occurred and is still affecting in various developing and developed countries led to a great deal of empirical research in this area. Their main aim is to find “early warning signals” for the crises, however the predictability of the crises is still under discussion. Although most of the time the results vary across countries, it has almost been common experience to work with a group of crisis indicators.

Before 1990s, empirical studies on currency crises were mainly focused on standard first generation models, which were thought to have significant prediction power. The underlying reason of speculative attacks was fiscal deficits financed by domestic credit creation (Flood and Marion 1998) as mentioned above. Empirical work using structural models focused on a particular country in a specific time period, so the results were far from being general. Some examples to such models are Blanco and Garber (1986) which used a version of Krugman-Flood-Garber model to predict the timing of devaluations realized as a result of speculative attacks on Mexican peso. They calculated the probability of pursuing rates exceeding the fixed rate in the next quarter.

The non-structural models used in late 1980s confirmed the role of traditional factors in predicting crisis. Edwards (1989) examined the behavior of various indicators before the devaluations and compared their patterns with those of the control group that pursued fixed exchange rate

regime during the working period. Klein and Marion (1994) performed a panel data analysis for devaluation periods in Latin American countries. They calculated the monthly probability of abandoning a pegged exchange rate increased with real overvaluation and declined with the level of foreign assets.

Frankel and Rose (1996) identified currency crises as substantial nominal currency devaluation. As pointed out this criterion would exclude instances where a currency came under severe pressure but the authorities successfully defended it by intervening heavily in the foreign exchange market, or by raising interest rates sharply, or by other means. Alternatively, an index of speculative pressure that takes into account not only the changes in exchange rate, but also movements in international reserves or interest rates that absorb pressure and moderate the exchange rate changes. This definition includes both significant currency depreciations and the actions by the authorities averted a large devaluation or the abandonment of an exchange rate peg.

Most crises that occurred in 1990s did not support the idea that fiscal and monetary deterioration precedes the crisis. This caused researchers to work with a wide variety of indicators. In most of the empirical studies aiming to predict the currency crises non-parametric tests based on the observation of the behavior of the individual series for the periods prior to crises and tranquility were employed. To our knowledge, most comprehensive study on empirical survey of currency crises is Kaminsky, Lizondo and Reinhart (1998) (KLR). They had employed the so-called "signal approach" based on monitoring the behavior of a number of indicators to observe the warning signals about the potential currency crises. They found exports, real exchange rate, international reserves, output, domestic credit, inflation, fiscal deficit and equity prices as useful indicators in predicting currency crises for a sample of 15 developing and 5 industrial countries during 1970-1995 .

Uçer, Rijkeghem and Yolalan (1998) (URY), using the same methodology for Turkey, had found that the ratio of short-term foreign debt to GNP, the ratio of exports to imports, the ratio of short-term advances to Treasury over GNP and the ratio of M2Y plus government domestic debt to GNP have strong predictive power for the 1994 crisis in Turkey rather than the indicators which take place in the study of KLR.

Eichengreen, Rose and Wyplosz (1994) applied an empirical analysis based on monitoring the behavior of macroeconomic variables for 22 countries (mostly OECD countries) for the period of 1967-1992. They found significant differences among the behavior of some variables like budget deficits, inflation, export/import ratios between the periods of speculative pressures and tranquility for the non-ERM sub-sample. However, they did not find any noticeable difference for the ERM sub-sample between periods of speculative attack and tranquility. Moreno (1995) stressed in his study covering the economies in the Asia-Pacific Basin that if no difference is found then episodes of speculative pressure might be the result of arbitrary shifts in expectations.

5. Data Description and Sources

In this study, we used monthly data for the period of 1986-1998 taken from IMF's International Financial Statistics (IFS; CD-ROM version), The Undersecretariat of Treasury and electronic data distribution system of Central Bank of the Republic of Turkey (CBRT) (<http://www.tcmb.gov.tr>).

The variables used in our study are as follows (see table 2): Broad-money (M2), M2Y (M2 plus foreign exchange deposits), domestic credits of deposit banks, nominal exchange rate (TL/\$), gross international reserves, manufacturing industry price index (1987=100), manufacturing industry production index (1992=100), short-term capital flows, current account balance, budget balance, wholesale price index (general and sub-items, State Institute of Statistics (SIS), 1987=100), consumer price index (SIS, 1987=100), deposit money bank credits to private sector, net domestic assets of the Central Bank, reserve money, interbank overnight interest rates, foreign assets of the Central Bank, foreign exchange deposits, export and import price indices, market determined exchange rates (for the period of 1986-93 from World Currency Yearbook and for 1994-98 from Daily Newspaper Milliyet), business survey data (Central Bank Tendency Surveys). Equity price index was taken from Istanbul Stock Exchange, the average auction rates from the Undersecretariat of Treasury and exports (line 70d), imports (line 71d), Treasury bill rate of US (line 60c) from IFS CD-ROM version. Since monthly GNP figures are not available monthly manufacturing industry production index was

multiplied by manufacturing industry price index in order to derive a proxy of nominal GNP.

Table 2: List of Variables

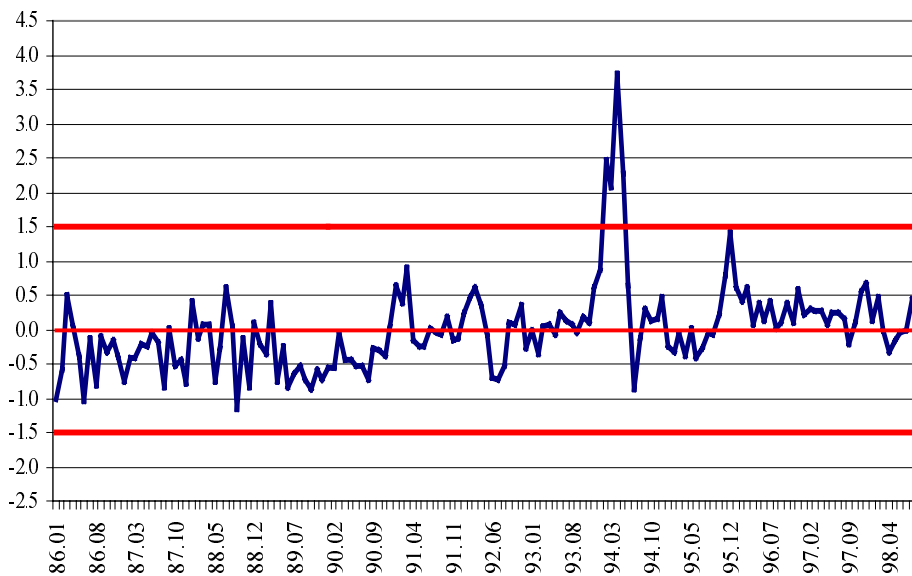
CCI	Crisis Index (Growth of nominal exchange rates, growth of Central Bank international reserves and id-if)
A1	Growth of M2 (%)
A2	Growth of Domestic Credits of Deposit Banks(%)
A3	M2/Gross International Reserves
A4	Growth of Exports (%)
A5	Growth of Imports (%)
A6	Exports/ Imports
A7	Short-Term Capital Flows/ Nominal Industrial Production
A8	Current Account Balance/ Nominal Industrial Production
A9	Budget balance/ Nominal Industrial Production
A10	Average Auction Rates (%)
A11	Public Sector WPI Inflation(%)
A12	Private Sector WPI Inflation(%)
A13	Total WPI Inflation(%)
A14	Growth of Private Sector Manufacturing Industry Price Index (1987=100)
A15	Growth of Total Manufacturing Industry Price Index (1987=100)
A16	Growth of Equity Price Index (%)
A17	CPI Inflation (%)
A18	Growth of Deposit Money Banks Credits to Private sector (%)
A19	Net Domestic Assets/Reserve Money (%)
A20	Terms of Trade (Export Prices/Import Prices) (%)
A21	Interbank Overnight Interest Rates (%)
A22	M2Y/Central Bank Foreign Assets (%)
A23	M2Y/International Reserves minus gold (%)
A24	M2Y/Foreign Assets of Monetary Authorities (%)
A25	Total Industrial Production Index (1992=100)
A26	Growth of Industrial Production Index (%)
A27	FX Deposits / M2Y (%)

Table 2 (Continued): List of Variables

CCI	Crisis Index (Growth of nominal exchange rates, growth of Central Bank international reserves and id-if)
A28	Domestic Credits of Deposit Banks/ Total Credits (%)
A29	YOUR OPINION ABOUT THE GENERAL COURSE OF BUSINESS IN YOUR INDUSTRY, COMPARED TO PREVIOUS MONTH: A-C
A30	OVER THE NEXT THREE MONTHS, OPINION ABOUT THE EXPORT POSSIBILITIES COMPARED TO PREVIOUS MONTH: A-C
A31	TOTAL AMOUNT OF ORDERS RECEIVED IN THIS MONTH: A-C
A32	AMOUNT OF MONTHLY EXPORT ORDERS RECEIVED: A-C
A33	TOTAL AMOUNT OF EMPLOYMENT: A-C (TREND OF LAST 3 MONTHS)
A34	TOTAL AMOUNT OF EMPLOYMENT: A-C (TREND OF NEXT 3 MONTHS)
A35	THE AMOUNT OF NEW ORDERS RECEIVED FROM THE DOMESTIC MARKET: A-C (TREND OF LAST 3 MONTHS)
A36	THE AMOUNT OF NEW ORDERS RECEIVED FROM THE DOMESTIC MARKET: A-C (TREND OF NEXT 3 MONTHS)
A37	THE AMOUNT OF NEW ORDERS RECEIVED FROM THE EXPORTS MARKET: A-C (TREND OF LAST 3 MONTHS)
A38	THE AMOUNT OF NEW ORDERS RECEIVED FROM THE EXPORTS MARKET: A-C (TREND OF NEXT 3 MONTHS)
A39	THE VOLUME OF OUTPUT: A-C (TREND OF LAST 3 MONTHS)
A40	THE VOLUME OF OUTPUT: A-C (TREND OF NEXT 3 MONTHS)
A41	THE VOLUME OF RAW MATERIAL STOCKS: A-C (TREND OF LAST 3 MONTHS)
A42	THE VOLUME OF RAW MATERIAL STOCKS: A-C (TREND OF NEXT 3 MONTHS)
A43	THE VOLUME OF FINISHED GOODS: A-C (TREND OF LAST 3 MONTHS)
A44	THE VOLUME OF FINISHED GOODS: A-C (TREND OF NEXT 3 MONTHS)
A45	AVERAGE UNIT COST: A-C (TREND OF LAST 3 MONTHS)
A46	AVERAGE UNIT COST: A-C (TREND OF NEXT 3 MONTHS)
A47	AVERAGE PRICE FOR THE NEW ORDERS RECEIVED FROM THE DOMESTIC MARKET: A-C (TREND OF LAST 3 MONTHS)
A48	AVERAGE PRICE FOR THE NEW ORDERS RECEIVED FROM THE DOMESTIC MARKET: A-C (TREND OF NEXT 3 MONTHS)
A49	AVERAGE PRICE FOR THE NEW ORDERS RECEIVED FROM THE EXPORT MARKET: A-C (TREND OF LAST 3 MONTHS)
A50	AVERAGE PRICE FOR THE NEW ORDERS RECEIVED FROM THE EXPORT MARKET: A-C (TREND OF NEXT 3 MONTHS)
A51	Market Determined Exchange Rate/ Official Exchange Rate

Following the literature, we define currency crises, as being an abnormal behavior of the exchange rate market index. The currency crisis index (CCI) was constructed as a weighted average of monthly exchange rate changes, the negative of monthly international reserve changes and the difference between the domestic interest rates (average auction rates of Treasury) and foreign interest rates (Treasury bill rate of US). The weights are chosen so as to equalize the variance of the three components in order to avoid any component dominate the index. When the value of this index exceeds the threshold value⁽¹²⁾ (means that when the domestic currency depreciates, international reserves decline and the interest rate increase), there is an indication of currency crises (see Graph 1).

Graph 1: The Index of Foreign Exchange Market Pressure of Turkey



(12) The threshold value is defined, as it is commonly used in literature, 1.5 times the pooled standard deviation of the calculated index plus the pooled mean.

6. Leading Economic Indicators Approach: The Case of Turkey

Leading economic indicators (LEI) method is a non-structural time series technique, which was first proposed by Burns and Mitchell (1946). It is being widely used to predict the turning points of various economic aggregates, besides econometric and structural time series models. This approach exploits the phenomenon that the cyclical movements in some variables systematically pre-date those in the other variables for sound economic reasons. “Cyclical pattern” is an abstract concept and can not be observed in any direct way. A time series can be expressed as $Y=C+S+T+I$, where C is the cyclical component, S is the seasonal component, T is the trend component, and I is the irregular component. In order to obtain cyclical component, firstly we deseasonalize the series having seasonal component by using X11-Census filter founded by the Bureau of Census of the US Commerce Department. Secondly, for the series having trend component, detrending was performed by Hodrick-Prescott ($\lambda=14400$; default for monthly data) filtering which was introduced by Kydland and Prescott (1990). In order to keep a standard, we detrend and deseasonalize all the series. As a result, we reach almost the same conclusions.

Defining the cyclical movements in both the “reference series” and the other variables is the first step in constituting the leading indicators system. “Reference series” is an economic variable or a composite index of coincident economic variables that the forecaster wishes to explain its turning points. We considered “foreign exchange market pressure index” as reference series and tried to find out the indicators signaling the crises systematically. To forecast the reference series a composite index including the leading indicators might be used via least square models. After determining the cyclical patterns of the series, the relationship between the reference series and the potential indicators are investigated. Cross-correlogram analysis is the method that compares two series not only at the turning points but also all through the sample. The cycle of a leading series exhibit a turning point before that of the reference series. In order to observe the cycles clearly some analysts prefers smoothing although this method leads to a loss of information and of possible shifts of the turning points.

Majority of the empirical work deals with multi-country analysis. In this study, like in few papers we tried to determine the facts that cause or indicate currency crises by using single country (Turkey) data. To our knowledge, the methodology used here was distinct from those used up to now.

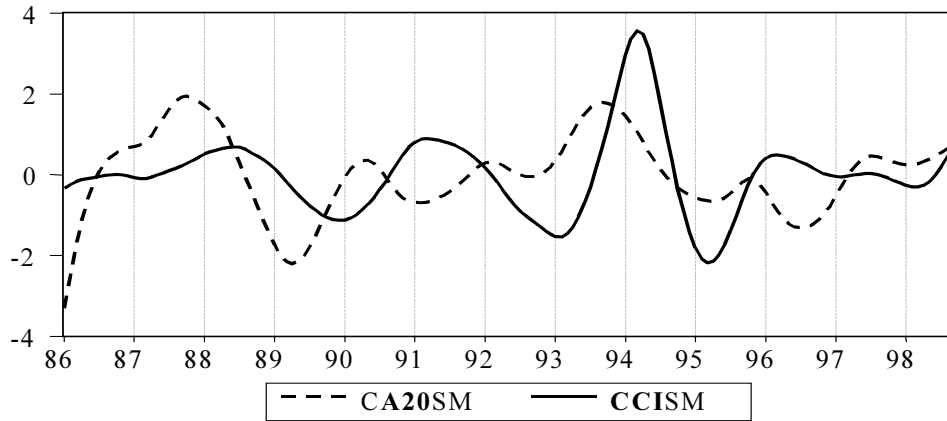
We compared the behavior of a number of indicators with that of the foreign exchange market pressure by using the leading economic indicators approach. Among 51 indicators, terms of trade (A20), market determined exchange rate over official exchange rate (A51) and some of survey data (A37 and A38), listed in Table 3, were found as leading indicators of the currency crisis index (see Graph 2). Parallel with the results of Sachs et al. (1996), Kaminsky et al. (1998), Kruger et al. (1998), and Frankel and Rose (1996) the ratio of budget deficit to GDP and the ratio of current account balance to GDP were found to be insignificant.

On the other hand, we couldn't find any relation between the following indicators and the crisis index: Growth of domestic credits of deposit banks (A2), the ratio of M2 to gross international reserves (A3), growth of exports (A4), growth of imports (A5), the ratio of short term capital flows to industrial production (A7) and the ratio of current account balance to industrial production (A8). By the way, it must be noted that also some important vulnerability indicators like the ratio of M2 over gross international reserves did not produce (A3) a significant relation. Finally, it can be said that relying solely on these methodologies will not be sufficient to predict the future financial crises, although following the patterns of critical indicators might help the policy makers for adapting their decisions accordingly.

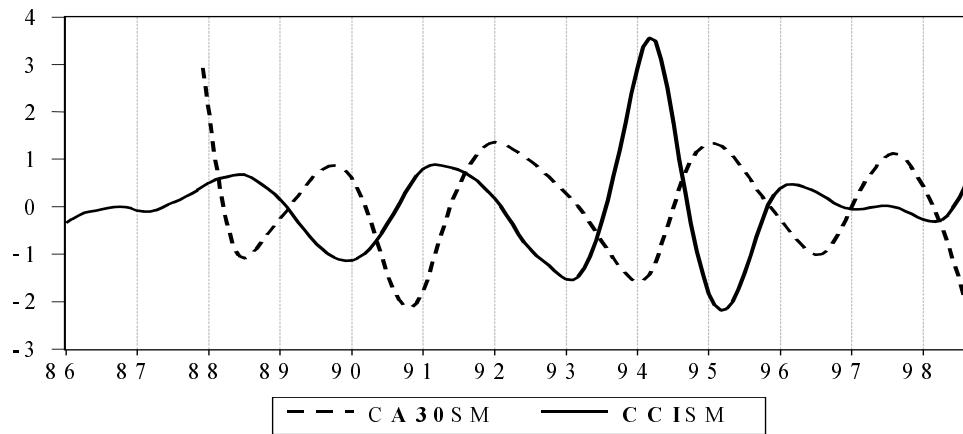
Table 3: The Results of LEI Approach

	Crisis Index	number of months	cross correlation
A1	lag	3	0,43
A2	no relation		
A3	no relation		
A4	no relation		
A5	no relation		
A6	lag	3	0,45
A7	no relation		
A8	no relation		
A9	no relation		
A10	lag	1	0,65
A11	coincident	0	0,43
A12	coincident	0	0,51
A13	coincident	0	0,53
A14	coincident	0	0,64
A15	coincident	0	0,56
A16	coincident	0	-0,31
A17	coincident	0	0,49
A18	lag	1	-0,28
A19	coincident	0	0,38
A20	lead	9	0,22
A21	coincident	0	0,7
A22	lag	1	0,35
A23	coincident	0	0,47
A24	coincident	0	0,36
A27	coincident	0	0,5
A28	coincident	0	-0,39
A30	lead	2	-0,35
A31	lag	2	-0,57
A32	lag	1	-0,22
A33	lag	2	-0,59
A34	lag	1	-0,65
A35	lag	2	-0,62
A36	lag	1	-0,63
A37	lead	1	-0,34
A38	lead	1	-0,34
A51	lead	1	0,34

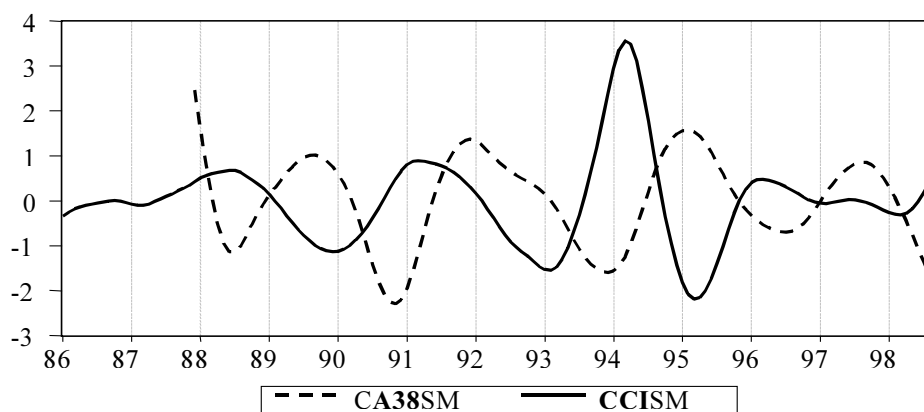
Graph 2: SELECTED RELATIONS BETWEEN THE SMOOTHED (SM) CYCLES (C) OF CURRENCY CRISIS INDEX AND LEADING INDICATORS



A20: Terms of Trade **C:** Cycle **SM:** Smoothed **CCI:** Currency Crisis Index



A30: Over the next three months, opinion about the export possibilities compared to previous month A-C



A38: The amount of new orders received from the export market, A-C (Trend of next three months)

7. Concluding Remarks

Since the causes of crises are different for each country, econometric models are always subject to serious criticisms. Cross-sectional models are also criticized as providing concurrent information rather than leading.⁽¹³⁾ These efforts are found to be helpful in understanding past crises but they are weak in predicting crises. Although models relying on time series techniques are also found to be weak in predicting crises, the leading indicators approach might be useful in constituting an early warning system. Regarding to our results, however, it can be said that *using leading economic indicators* approach in order to predict currency crises in a specific country is not as proper as a panel-data analysis for multi-country studies.

On the other hand, for crises arising from pure contagion effects or speculative attacks, early warning systems may not be helpful because they arise from unpredictable market reactions.⁽¹⁴⁾ For recent crisis experiences in Mexico (1994-95) and Asia (1997-98), it was difficult to predict crises solely looking at indicators because prior to crisis these countries had sound macroeconomic fundamentals. However, they had

⁽¹³⁾ Eichengreen and Rose (1998) and Flood and Marion (1998).

⁽¹⁴⁾ IMF Staff (1998).

weak financial system characterized by inadequate supervision and regulation, and they incurred policy shocks.

The present study could be made more powerful by including indicators related to political circumstances. However, it is obvious that including such political circumstances into the models is a difficult attempt. One shortcoming of the LEI method is the systematic relationships' among the indicators and crises index being very sensitive to structural breaks, such as policy changes. An indicator exhibiting abnormal behavior in the pre-crises period is not always a perfect evidence for a crisis. Taking this fact into account, one has to check the significance relationships between the indicators frequently.

As a result we may conclude that if the weak fundamentals (first-generation models) are at the root of the currency crises, it might be possible to predict this type of crises. However, if the crises occur because of the self-fulfilling attacks (second-generation) the prediction of this type of crises will be very difficult. Furthermore, one indicator that gives a signal for one country, might not work for another country.

In the light of the financial crises especially in emerging markets it can be said that it is necessary to put in place institutions and policies to manage and reduce the macroeconomic financial risks in countries removed restrictions on capital account movements (IMF 1998b). These countries should implement appropriate macroeconomic, exchange rate and financial policies with measures towards building a more prudent and transparent financial system. Otherwise, it should not be a surprise that they find themselves in the center of new financial and currency crises.

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