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Some Empirical Evidence

Gokhan Karabulut, Mehmet Huseyin Bilgin, and Ayse Celikel Danisoglu

ABSTRACT: Currency crises have become a serious threat for developing countries, especially since the financial deregulation process and the collapse of the Bretton Woods system. In the past two decades, Turkey has experienced two major currency crises. This study aims to predict the determinants of currency crises in Turkey by using an ordered probit model. According to the results, short-term debt/GDP, real exchange rate, deposit interest rates, foreign exchange reserves/imports, and credit/deposit variables are all significant in explaining currency crises in Turkey.

KEY WORDS: crises in Turkey, currency crises, ordered probit models.

Turkey experienced serious economic problems including severe economic crises in 1994 and 2001. With the liberalization of the capital account in 1989, Turkey has recorded growing fiscal and external deficits. In 1990–1994, after the Persian Gulf crisis, government authorities attempted to stimulate effective demand with expansionary fiscal policies. To maintain growth in effective demand, the authorities suppressed the exchange rate, while they freed interest rates, which caused short-term capital flows. This was intended to finance expanded domestic demand with foreign capital. Nevertheless, this process created a huge current account deficit, which provided opportunities for speculative currency attacks. Early in 1994, the government realized that the exchange rate regime was not sustainable and, after a speculative attack, exchange rates were allowed to float freely.

In January 2000, Turkey began to apply a disinflation program and experienced a currency crisis, resulting in a deep recession by the beginning of 2001. Following the crisis, the Turkish lira depreciated more than 100 percent. Some banks became insolvent, and the existing problems in the financial system became severe. In these conditions, an explanation of the crisis and its determinants is crucial.

Several important studies focus on currency crises. An early empirical study concentrating on Turkey was done by Ucer et al. (1998). Using the signaling approach, they found that the leading indicators of the 1994 crisis were short-term external debt as a percentage of the gross national product (GNP), international reserves as a percentage of financial system liabilities, the export to import ratio, excess real money balances, and central bank advances to government as a percentage of GNP. Alper (2001) identified a liquidity crisis that occurred at the end of 2000. According to the author, political instability, the International Monetary Fund's (IMF's) lack of support for the disinflation program, and the lack of a sterilization rule were the main factors that contributed to the creation of this liquidity crisis. The study concluded that the banking sector's fragility

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and related factors led to a currency crisis at the end of February 2001. Mariano et al. (2004) used a Markov regime-switching model of exchange rate movements and found that foreign exchange reserves, real exchange rates, and the credit/deposit ratio are the most important determinants of financial vulnerability. Akyürek (2006), who examined the currency crisis of 2001, indicated that a stronger banking system along with fiscal discipline could have helped to avoid the collapse. Cesmeci and Onder (2008) used three different techniques: the signaling approach, the Markov switching model, and a structural model, with monthly data for the period 1992–2004 in order to investigate the possible determinants of currency crises in Turkey. The results showed that banking crises may lead to currency crises. They also found that variables of public debt and budget balance to the gross domestic product (GDP) are important indicators of economic crises in Turkey. This study aims to estimate the determinants of currency crises in Turkey using a probit model. Following Frankel and Rose (1996), currency crises are defined as a nominal exchange rate depreciation, which exceeds specific cutoff levels.

Currency Crises in Turkey: A Brief History

Turkey's disinflation program started in accordance with the standby agreement signed with the IMF in January 2000. As Turkey has experienced large current account deficits and high chronic inflation in recent decades, the program, which was focused on solving these problems, was inevitable. In the period 1990–1994, the authorities suppressed the exchange rate, while freeing interest rates, which caused short-term capital inflows. This policy was intended to finance expanded domestic demand with foreign capital. Nevertheless, this process created a huge current account deficit and the country became vulnerable to speculative attacks. At the beginning of 1994, this regime was unsustainable, and after an attack, the exchange rates were allowed to float freely. This depreciation in 1994 caused a current account surplus. In 1998, a tight fiscal policy, augmented by the international recession caused by the Asian crisis, created a current account surplus via the decline in national income. Moreover, the ratio of domestic debt over GDP increased between 1995 and 2000.

At the beginning of the standby program, annual growth rate of the consumer price index (CPI) was 64.8 percent. The program was based on the following principles:

1. An increased gross budget surplus via applying a tight fiscal policy,
2. Income policies, emphasizing a limitation on growth rates of wages and rents, by applying a 20 percent ceiling,
3. A tight monetary policy that includes fixing domestic credit.

The monetary authorities set the targeted value of the basket, which consists of $1 plus €0.77, as the nominal anchor in a crawling peg regime, where it was decided that the annual growth rate of this currency basket would be 20 percent. The program intended for the peg policy to continue until June 2001, to be followed by the application of an expanding band system in order to transform to a free floating system at the end of 2001. In the first three months of the program, interest rates declined from 72.2 percent to 35.1 percent. Since there was a decline in both interest rates and import prices, aggregate demand did not slow down, and the decline in inflation rates was slower than expected. The high level aggregate demand was the main stimulator of the huge current account deficits. This process also caused a problem with overlending and a total credit boom.

The program was successful in fixing domestic credit. Budget deficits were fully financed by domestic borrowing during the program. However, fiscal policy could not be implemented effectively to prevent the rise in aggregate demand and to neutralize the expansionary effect of interest and exchange rates. During the program period, the net budget deficit increased approximately 5 percent per month in real terms. Large budget deficits followed by trade deficits made economic agents distrustful of the peg system. As the trade deficit increased, the economic agents believed that the probability of a devaluation also increased. Finally, at the threshold level, the large trade deficit made the agents believe that devaluation was inevitable and capital flowed out. The first speculative attack occurred on November 22, 2000. Following this, the government imposed a lump-sum tax on some consumption goods and services, and this was sufficient to reduce the budget deficit; in fact, it was not possible for authorities to prevent the impending crisis. After the November 2000 attack, interbank interest rates rose by 873 percent overnight and, consequently, the Turkish central bank lost $5 billion in two weeks. The peg was defended by high interest rates and the central bank's interventions in foreign exchange markets. In addition, the IMF provided a supplementary reserve facility of $7.5 billion, and this additional fund prevented further speculative attacks. However on February 19, 2001, a political crisis triggered the last speculative attack against the Turkish lira. Overnight interbank rates climbed by up to 6,200 percent. The central bank sold $5.36 billion to defend the peg. Nevertheless, this reserve loss was not enough to stop the speculative attack. On the basis of these developments, the central bank was no longer able to maintain the pegged currency regime, and currency was allowed to float freely on February 21, 2001.

Theoretical Background and Empirical Literature

In the economic literature, the first theoretical examples related to currency crises, later called first-generation models, were developed and introduced by Krugman (1979). These models are related to earlier work by Salant and Henderson (1978) on speculative attacks in the gold market. In these studies, currency pegs are identified as unsustainable when budget deficits are monetized. The collapse of the fixed exchange rate regimes is determined by the expectations of rational speculators when they believe that they can deplete the reserves with an attack and break the currency peg. This causes crises to begin.

In the second-generation models, starting with Obstfeld (1986, 1994), a different approach to currency crises was developed. In these models, dynamics of policy preferences became dominant in explaining currency crises. If the policy preferences are in favor of abandoning the currency peg, speculative attacks can be successful, even in sustainable currency regimes. High interest rates and unemployment play an important role in this decision. Therefore, the cost of the peg is crucial in these models.

After the experience of the Asian crisis, Krugman (1998) presented a model that focused on asset price bubbles in order to explain the cases excluded by the first-generation models. Krugman argues that a large budget deficit, which crowds out investment and stimulates consumption, would certainly cause excess demand and a trade deficit. Therefore, it is not logical to ignore the effect of the trade deficit in explaining the determinants of exchange rate movements. Defining these movements as emerging only for monetary reasons misses the main part of the relationship. Third-generation models are based on market imperfections, bailout guarantees, and overlending problems in explaining currency crises. In these models, it is argued that moral hazard leads banks to take unhedged

foreign exchange positions in order to fulfill the domestic overborrowing demands stimulated by the recovery phase of the business cycle. The banks implicitly transfer most of the currency risk to the government through the deposit insurance scheme. Even with the lack of an explicit deposit insurance scheme, banks expect the national government or international organizations to bail them out in the event of crisis. This process usually ends with a currency crisis because lenders refuse to roll over the debt.

Several empirical studies analyze currency crises by using different techniques. There are essentially two types of methodology in the literature. The first type of empirical study uses signaling models developed by Kaminsky et al. (1998) and Kaminsky and Reinhart (1999) to construct an early warning system. These studies attempt to develop an early warning system by monitoring the behavior of several indicators during the precrisis period. When an indicator exceeds a certain threshold level, this is interpreted as a warning signal of a future currency crisis. A more popular approach is to use discrete choice models in order to analyze the determinants of currency crises. Eichengreen et al. (1995) and Frankel and Rose (1996) employ probit models that use different definitions of crisis. Krueger et al. (1998) also use a probit model to examine the contagion effect of currency crises, and they provide empirical evidence in support of the idea that currency crises could be contagious. Berg and Pattillo (1999) compared the prediction performances of these two models and found that discrete choice models have better explanatory power relative to the signaling models.

The definition of a crisis is also essential in the process of predicting a crisis. Eichengreen et al. (1995) construct a weighted index that is based on the percentage of change in nominal exchange rates, international reserves, and short-term interest rates. Frankel and Rose (1996) restricted the definition and excluded international reserves and short-term interest rates in order to focus on successful currency attacks.

Empirical Results

This study uses quarterly data from 1991:4 to 2007:3, obtained from Central Bank of the Republic of Turkey. The U.S. producer price index is obtained from Federal Reserve Economic Data (FRED) (for calculating real exchange rates). The choice of variables used in the model is based on previous studies in the literature. Table 1 describes the data we employed in the model.

We define the real exchange rate as,

$$\text{exchange rate} = \frac{(d.PPI_{US})}{PPI_{TR}}$$

where d is Turkish lira (TL) per U.S. dollar, PPI_{US} is the U.S. producer price index, and PPI_{TR} is Turkey's producer price index. Both price indexes use the base year 2005:100. According to this definition an increase in real exchange rates means depreciation, while a decrease means appreciation.

Similar to Frankel and Rose (1996), we define a currency crisis as the nominal depreciation of the local currency. Short-term interest rates are not market-determined in Turkey, and reserve movements can be assumed to be a noisy measure of a currency crisis due to frequent exchange market interventions. Therefore, we exclude short-term interest rates and reserve movements from the definition. While working with binary logit/probit models, a large panel of data is more suitable to include more crisis episodes in the sample. Therefore, instead of a binary probit model, this study uses an ordered probit model for analyzing

Table 1. Variable definitions

Variables	Definition
Budget balance/GDP	The ratio of consolidated budget balance to gross domestic product at current prices.
Exports/Imports	The ratio of total exports to total imports. Exports and imports in millions of US$.
Foreign exchange reserves/Imports	The ratio of foreign exchange reserves, excluding gold, to total imports. Foreign exchange reserves and imports in millions of US$.
Istanbul Stock exchange 100 index	Istanbul Stock Exchange national-100 index.
Foreign direct investments	Net foreign direct investments in millions of US$.
Portfolio investments	Net portfolio investments in millions of US$.
Deposit interest rate	Real interest rates on 12-month deposit.
Growth rate of M2/Foreign exchange reserves	The ratio of money supply (M2) to foreign exchange reserves (growth).
Credits/Deposit	The ratio of total credits to total deposits of deposit money banks.
External debt	Gross external debt in millions of US$.
Short-term debt/GDP	Total nonperforming loans (net) of deposit money banks.
Growth rate of current account deficit	Current account deficit (growth).
Real exchange rate	$(d.PPI_{US}) / PPI_{TR}$

the determinants of currency crises of Turkey. The ordered logit and probit models were introduced by McKelvey and Zavoina (1975). A traditional linear statistical model is

$$y^* = x'\beta + \varepsilon$$

where y^* is observed. However, if y^* is unobserved, then

$$
\begin{aligned}
y &= 0 &&\text{if } y^* \leq 0 \\
&= 1 &&\text{if } 0 < y^* \leq \mu_1 \\
&= 2 &&\text{if } \mu_1 < y^* \leq \mu_2 \\
& \cdot \\
& \cdot \\
& \cdot \\
&= J &&\text{if } \mu_{j-1} \leq y^*
\end{aligned}
$$

where μ_1, μ_2, ... μ_{j-1} are threshold parameters. According to this framework, currency crises will be defined as:

$$Crisis_{it} = 1, \qquad if \quad 0.20 \leq \left(\frac{e_{t+1}}{e_t}\right) - 1 < 0.25$$

$$Crisis_{it} = 2, \qquad if \quad 0.25 \leq \left(\frac{e_{t+1}}{e_t}\right) - 1 < 0.30$$

$$Crisis_{it} = 3, \qquad if \quad 0.30 \leq \left(\frac{e_{t+1}}{e_t}\right) - 1$$

$$Crisis_{it} = 0, \qquad if \quad otherwise$$

Table 2. Ordered probit results

Variables	Coefficient	z-statistic
Exports/Imports	2.485526	1.073357
	(2.3156)	
Short-term debt/GDP	1.997830**	2.027200
	(0.9855)	
Budget balance/GDP	2.770569	1.242545
	(2.2297)	
Real exchange rate	−2.129453*	−1.734956
	(1.3873)	
Deposit interest rates	0.0508*	1.916600
	(0.0265)	
Foreign exchange reserves/Imports	−10.14097***	−3.030751
	(3.3460)	
Growth rate of M2/Foreign exchange reserves	0.0010	0.721906
	(0.0015)	
External debt	0.0001	0.676472
	(0.0002)	
Growth rate of current account deficit	0.0001	0.409565
	(0.0002)	
Nonperforming loans	0.0000	0.901433
	(0.0000)	
Portfolio investments	0.00056	0.754578
	(0.0007)	
Istanbul Stock Exchange 100 index	−0.0002	−0.263254
	(0.0008)	
Foreign direct investment	−0.0007	−0.498587
	(0.0007)	
Credit/Deposit	8.843486*	2.622287
	(3.3724)	
Pseudo R^2	0.297048	
Akaike information criterion	2.041013	
Avg. log likelihood	−0.782411	

Notes: ***,**, and * significant at 1 percent, 5 percent, and 10 percent, respectively. Standard deviations are in parentheses.

The implicit assumption of the ordered regression models is that the intervals between categories are equal. Thus, the distance between 20 percent depreciation and 25 percent depreciation of local currency is assumed to be the same as the distance between 25 percent and 30 percent. These categories are also assumed to rank from mild crisis (20 percent) to severe crisis (30 percent). Cutoff points are arbitrary.

Table 2 presents the results for the ordered probit model. According to the results, short-term debt/GDP, real exchange rate, deposit interest rates, foreign exchange reserves/imports,

and credit/deposit variables are significant in explaining currency crises in Turkey. Foreign exchange reserves/imports are also highly significant having a z-statistic of 3.03. From these results, we can observe that the probability of a crisis increases when the ratio of short-term debt to GDP and the ratio of credit to deposit rise. The impact of the ratio of credit to deposit on currency crises according to our model is similar to that discussed in Mariano et al. (2004). According to our definition, an increase in real exchange rate means depreciation. Therefore, results indicate that an appreciation of the local currency increases the probability of crisis. On the contrary, a rise in the ratio of foreign exchange reserves to imports decreases the probability of crisis. This finding is similar to the study of Ucer et al. (1998). According to our results, deposit interest rates have a positive impact on the probability of currency crises in Turkey. This is a novel finding for the empirical literature that focuses on the determinants of currency crises in Turkey. Since ordered probit coefficients are not directly interpretable, they can only indicate the relative size of the effect of a change in variables on the crisis. In this manner, the ratio of foreign exchange reserves to imports and credit to deposit are more powerful determinants of crises than the real exchange rate and short-term debt/GDP. To check the robustness of these results, we also estimate alternative models. The results are robust to the specification.

Conclusion

This study aims to predict the determinants of currency crises in Turkey. For the past two decades, Turkey has experienced two major currency crises. During the period 1990–1994, the authorities suppressed the exchange rate to maintain the sustainability of the growth in effective demand while they freed interest rates, which caused massive short-term capital inflows. During the same period, 100 percent deposit insurance guarantees were introduced to prevent the liquidation of deposits, which were reduced to a fixed level of TL50 billion in recent years. This process created a large current account deficit, and in 1994 after a speculative attack, the exchange rates were allowed to float freely. Shortly after 1994, due to high inflation, Turkey embarked upon an anti-inflationary program based on a peg regime in accordance with a standby agreement signed with the IMF in January 2000. In February 2001, Turkey experienced another speculative attack against the lira, and the currency was allowed to float freely once again. Following the crisis, the Turkish lira depreciated more than 100 percent, and some banks became insolvent.

Ordered probit model results indicate that short-term debt/GDP, real exchange rate, deposit interest rates, foreign exchange reserves/imports, and credit/deposit ratios as independent variables are significant in explaining the currency crises in Turkey. Results show that an appreciation of the local currency increases the probability of a crisis as expected. Increasing the ratio of foreign exchange reserves to imports seems to be an effective policy against currency crises. Furthermore, the probability of a crisis increases when the ratio of short-term debt to GDP and the ratio of credit to deposit rise. An excessive increase in the ratio of credit to deposit can be interpreted as a sign of overborrowing.

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