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How Far Can Domestic Credit Growth Explain Speculative Attacks? Empirical Evidence from Turkey

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Abstract:

Economies are susceptible to speculative attacks regardless of whether they use fixed or floating exchange rates. Turkish experience in the last two decades constitutes one of the most prominent examples proving this verdict. It is widely accepted that there is a link between domestic credit and speculative attacks on the currency. Nevertheless, the literature on currency crises clearly lacks a country-specific study that addresses the long-run relationship between this indicator and the speculative pressure in the exchange market. This article aims at filling this gap in the literature using monthly Turkish time series data spanning the period 1984:04- 2006:11. Results of the ADF unit root tests suggest that the series are stationary. Hence, no cointegration analysis was carried out before the Granger-causality tests. Granger causality tests fail to establish a causal relationship between domestic credit and exchange market pressure.

Key words: Speculative attacks, currency crises, domestic credit

Jel codes: F30, E44

I. Introduction

Economies are susceptible to speculative attacks regardless of whether they use fixed or floating exchange rates. Turkish experience in the last two decades constitutes one of the most prominent examples proving this verdict. Various theoretical models have been devised to explain the causes and origins of speculative attacks and currency crises. The first generation models (Krugman 1979) emphasize the role of inconsistencies between fiscal, monetary and exchange-rate policies. In these models the presence of inconsistent policies generates a speculative attack against the local currency, and pushes the economy into a crisis. The degree of severity of these inconsistencies will determine the timing of the crisis. The second generation models (Obstfeld, 1986) suggest that even in the presence of consistent macroeconomic policies an economy can suffer a speculative attack. These models emphasize the role of policymaker's preferences, and suggest that the option of abandoning a fixed exchange rate regime may be an ex-ante optimal decision for the policymaker, considering that economic authorities face tradeoffs. The third generation models consist broadly of three different groups such as herd-behavior, contagion, and moral hazard. These models investigate some disputed issues such as moral hazard, herding behavior of portfolio managers, and international contagion effects that appeared through some transmission channels such as trade and financial linkages between countries.

Economies are susceptible to speculative attacks regardless of whether they use fixed or floating exchange rates. Turkish experience in the last two decades constitutes one of the most prominent examples proving this verdict. It is widely accepted that there is a link between domestic credit and speculative attacks on the currency. Excessive growth of domestic credit may serve as an indicator of the fragility of the banking system. Domestic Credit usually rises in the early phase of the banking crisis. It may be that as the crisis unfolds, the central bank may be injecting money to the bank to improve their financial situation. A larger amount of credit increases the chances of bad loans and bank failures. Higher credit also implies a larger amount of money supply. Currency crises have been linked to rapid growth in credit and the monetary aggregates. The effects of monetary policies are captured by the growth rate of domestic credit and it is usually expected to have a positive effect on currency crises. The literature on currency crises clearly lacks a country-specific study that addresses the long-run relationship between domestic credit and the speculative pressure in the exchange market. This article aims at filling this gap in the literature through cointegration and Granger-causality tests using Turkish time series data spanning the period 1984:04- 2006:11. The rest of the article is structured as follows: Section II provides a review of the related literature. Section III provides the theoretical framework. Section IV presents the data and methodology. Section V will discuss the results and the last section will point out the conclusions that emerge from the study.

II. Literature Review

The literature on currency crises include a number of empirical studies that have found domestic credit to be a one of the significant indicators of currency crises. These are, *inter alia*, Moreno (1995), Frankel and Rose (1996), Kaminsky *et al.* (1997), Berg and Pattillo (1999), Glick and Moreno (1999), Geochoco-Bautista (2000), Krkoska (2000), and Krznar (2004). To begin with, Moreno (1995) builds a linear probability model for eight Asian countries based on monthly data from 1980 to 1994. He finds that depreciation is positively associated with larger budget deficits and higher growth in domestic credit. Frankel and Rose (1996), investigate how international debt structure and external factors affect the probability of currency crises. The authors apply probit analysis on a panel of annual data for 105 developing countries for the period between 1971 and 1992. Their model identifies the significant variables as output growth, foreign direct investment/total debt, reserves, domestic credit growth, external debt and foreign interest rates. Their findings also suggest that currency crises tend to occur when the growth of domestic credit and foreign interest rates are high, and foreign direct investment and output growth are low.

Kaminsky *et al.* (1997) suggests a different approach and build a signals model for twenty countries based on monthly data in the period from 1970 to 1995. The authors use a set of 15 variables capturing external balance, monetary factors, and output and equity movements, whose values are compared in the period of 24 months preceding the crisis with the values recorded in a tranquil period, so indicators are expected to issue signals 2 years ahead of the crisis. The authors find that the variables that have most explanatory power based on the noise-to-signal ratio are the deviation of real exchange rates from a deterministic trend, the occurrence of a banking crisis, the export growth rate, the stock price index growth rate, M2/reserves growth rate, output growth, excess M1 balances, growth of international reserves, M2 multiplier growth, and the growth rate of the domestic credit to GDP ratio

The approach of Kaminsky *et al.* (1997) has also been used by Berg and Pattillo (1999) to examine whether it could predict the Asian crisis using information available at the end of 1996. The authors study five European and eight emerging market economies from April

1970 to April 1995. They find that the crisis probabilities generated by this model for the period between May 1995 and December 1996 are statistically significant predictors of actual crisis occurrence over the following 24 months. They discover that the probability of a currency crisis increases when domestic credit growth is high, the real exchange rate is overvalued relative to trend, and the ratio of M2 to reserves is high.

Glick and Moreno (1999) build a probit model based on data from January 1972 to October 1997 to study the crises in Asia and Latin America. Results of their analysis suggest that reductions in real domestic credit and foreign reserves, as well as appreciation in the real exchange rate increase the probability of financial crises. Geochoco-Bautista (2000) uses a probit model based on data from the Philippines spanning the period between 1980 and 1997. Results of the regression indicate that the coefficient of short-term interest rate differential, change in international reserves, real exchange rate, and the growth of domestic credit to public sector are the significant variables in explaining the financial crisis in the Philippines.

Krkoska (2000) estimates a restricted VAR on quarterly data from 1994 to 1999 to analyze the vulnerability in transition countries. Results of the VAR reveal that overvaluation, a slowdown in the EU, as well as the gap between the current account and FDI, are the significant predictors of vulnerability in transition countries. Krznar (2004) also studies the crises in Croatia. He presents an early warning system of currency crises using both the signals approach and the probit model built for the period from January 1996 to March 2003. He identifies the significant variables as the share of public finances in GDP, the share of the current account balance of the balance of payments in GDP, inflation, the share of freely available bank reserves in total bank assets, the rate of external debt growth, the rate of growth of the M2 multiplier, the deviation of the real exchange rate from the trend, and the growth of domestic credit.

A handful of empirical work (Ucer *et al.* 1998, Kibritcioglu *et al.* 2001 and Kibritcioglu, 2004) has focused on Turkey. These studies fail to find evidence that domestic credit is a significant indicator of crises. Ucer *et al.* (1998) use the signals approach to determine the indicators that account for the Turkish financial crisis of 1994. They find 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 M2 plus government domestic debt to GNP have strong predictive power for the 1994 crisis in Turkey. Kibritcioglu *et al.* (2001) also applies the signals approach to Turkish data. The authors consider the period between February 1986 and September 1999. They find that the deviation of effective real exchange rate from its trend value, the exports to imports ratio, foreign trade balance to GDP ratio, current account balance to GDP ratio, and the short-term capital movements to GDP ratio are the major leading indicators of Turkish currency crises. Studying a wider sample, Kibritcioglu (2004) ends up with a similar conclusion. He follows the signals approach of Kaminsky *et al.* (1997) to detect the early warning signals of currency crises in Turkey. To determine major leading indicators of currency crises, he tested more than 45 variables and by using the most relevant 15 variables, constructed a composite index to estimate the probabilities of currency crises in the country. He finds that the significant variables are exports/imports, real interest rate, trade balance/GDP, crude-oil prices, stock market index, international reserves, banking sector fragility index, short-term capital inflows/GDP, and foreign exchange deposits/ M2. The next section will present the theoretical background of the empirical work that will be followed in this study.

III. Theoretical Framework

The theoretical foundation of the empirical work carried out in the present article is Dornbusch's (1987) exposition of Krugman's (1979) first generation model. The basic idea is that excessive growth in domestic credit must eventually cause an exchange rate peg to collapse. The defense of the exchange rate peg will lead to a depletion of foreign reserves held by the domestic central bank. More specifically, the rate of domestic credit expansion is bound to exceed the growth in demand for the domestic currency. Agents who are accumulating excess liquidity prefer to exchange domestic currency for foreign-denominated securities or domestic interest-bearing assets. Both scenarios lead to a depreciation of the domestic currency. In the first case, pressures stem directly from increased demand for foreign securities. In the second case, domestic bond prices will rise and their yields will fall, leading market participants to sell domestic securities and buy higher yielding foreign assets. Since the domestic central bank is committed to keeping the exchange rate fixed, it must accommodate the increased demand for foreign currency by reducing its foreign reserves. The bottom line is that the process of domestic credit expansion translates into a loss of reserves. The model's basic equations are:

$$M_t = R_t + D_t \quad (1)$$

where R is the central bank's foreign exchange reserves and D is the domestic credit component of the money supply

$$M_t/E_t = M_t/P_t = a - bw_t \quad (2)$$

which states that real money demand depends negatively on the expected (equals actual) rate of depreciation, w (via the expected rate of inflation), and also slips in the normalization that the foreign price level is fixed at unity.

$$D_{t+1} = D_t(1+x) \quad (3)$$

which states that domestic credit grows at a constant rate. Here, the real output is ignored, i.e. fixed.

Initially, with abundant reserves we have zero inflation and a pegged rate; however as D rises through time, R is falling equivalently, keeping M fixed and equal to aE while w is zero. Once the reserves run out, E will float, and we will have $M(=D)$ and E both growing at rate $x=w$. From Equation 2, we have, therefore, that at the date of collapse, real money demand falls from "a" to "a - bx". This can only fail to cause a jump up in P and E if real money supply falls by "bx". However, with rational agents, an anticipated jump in E cannot take place. Consequently, the crisis must occur before the reserves run out, to allow the required jump in M . Thus, the critical level of reserves at which collapse takes place is:

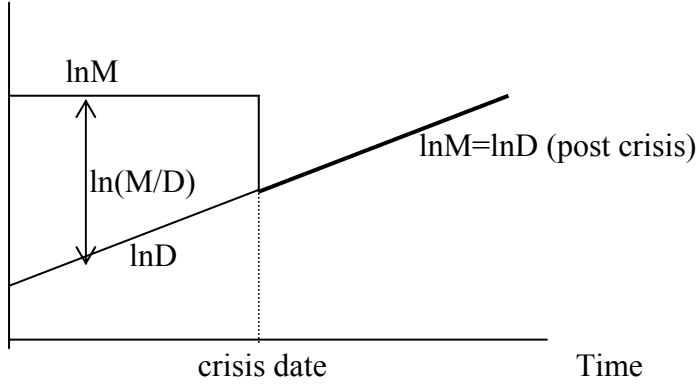
$$R^* = E_0 bx \quad (4)$$

Domestic credit at that point is given by:

$$D^* = E_0 (a - bx) \quad (5)$$

The money stock just before collapse is $M^* = E_0a$, as it must be from Equation 2, and it falls instantaneously to $E_0(a - bx)$. This model predicts that the level of reserves at which the attack on the peg occurs is higher, the higher are the sensitivity of money demand to the inflation rate and the rate of growth of domestic credit (See Figure 1).

Figure 1. Speculative Attacks



Source: Dornbusch (1987)

III. Data and Methodology

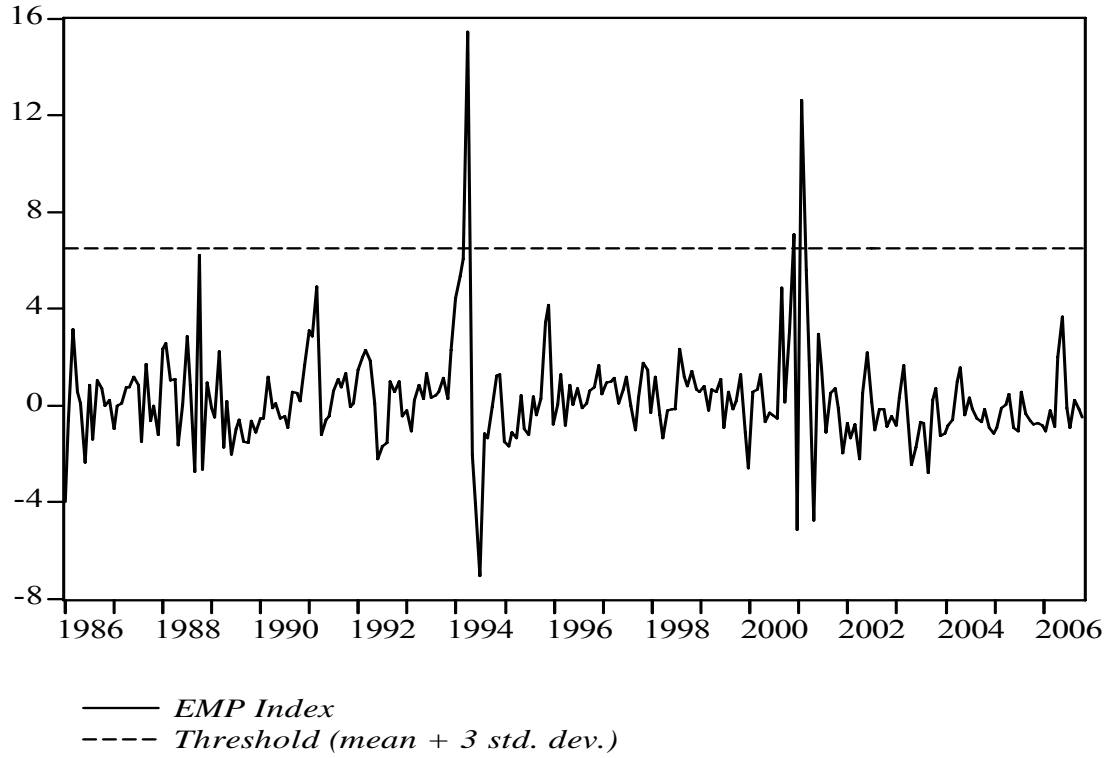
Data is obtained from the IMF's online International Financial Statistics database, spans the period 1984:04-2006:11, and is in monthly percent changes. All series are in monthly percent changes. Domestic credit is divided by GDP to give a relative figure. Quarterly GDP has been linearly interpolated to monthly series. Domestic credit is used in logarithmic returns and is in 1st differences as its graphical representation indicated exponential growth. Interest rates are the averages of 3-month nominal interest rates. Foreign exchange reserves are the Turkish Central Bank's gross foreign exchange reserves. Exchange rate is the US dollar-Turkish lira nominal exchange rate. Most studies of currency crises define the currency pressure measure in terms of the bilateral exchange rate against the US dollar. Hence we use US dollar-Turkish lira nominal exchange rate. The reason why these three variables should be considered simultaneously in such index is very well documented by Moreno and Trahan (2000). The authors explain that if a country's exchange rate is floating, or if a peg has collapsed, a sharp depreciation is a clear-cut indicator of a shift in sentiment or speculative pressure against a currency. Nevertheless, if exchange rate stability (or the peg) is maintained, pressure on the exchange rate will be reflected through the action taken by the monetary authorities. If investors want to switch away from a country's assets, the exchange rate will tend to depreciate and, in order to prevent depreciation of the currency, the central bank will either sell foreign reserves to accommodate the increased demand for foreign assets, or allow interest rates to rise (Moreno and Trahan, 2000). Particularly, including interest rates in the index enables us "to seize the full period of the turbulence, which might begin with interest rate increases defending a peg" (Eliasson and Kreuter, 2001). The index of exchange market pressure calculated according to the Equation 16 is shown in Figure 1.

$$EMP = (1/\sigma_e) * (\Delta e/e_{t-1}) + (1/\sigma_r) * (\Delta r/r_{t-1}) - (1/\sigma_{ir}) * (\Delta ir/ir_{t-1}) \quad (6)$$

Where σ_e is the standard deviation of the exchange rate, σ_r is the standard deviation of the interest rate and σ_{ir} is the standard deviation of the international reserves. The weights

attached to the three components of the index are the inverse of the standard deviation for each series, in order to equalize volatilities of the three components and to avoid any of them dominating the index (Kaminsky et al 1997). A positive value of the index measures the depreciation pressure of the currency, while a negative value of the index measures the appreciation pressure of the currency.

Figure 1 Exchange Market Pressure Index



Source: The author's calculation.

The analysis of the index of speculative pressure identified numerous periods of excessive market volatility. We find that the crisis variable successfully portrays the crisis periods that occurred in Turkey in the sample period using a crisis threshold of mean+3 Standard Deviation. We will test the causal relationships between the selected variables and the calculated EMP index. A practical way for testing for causality was proposed by Granger (1969) and popularized by Sims (1972). Testing causality, in the Granger sense, involves conducting *F*-tests to see whether lagged information on a variable *X* provides any statistically significant information about a variable *Y* in the presence of lagged *Y*. To implement the Granger test, we assume a particular autoregressive lag length *k* (or *p*) and estimate Equation 7 and Equation 8 by OLS:

$$X_t = \lambda_1 + \sum_{i=1}^k a_{1i} X_{t-i} + \sum_{j=1}^k b_{1j} Y_{t-j} + \mu_{1t} \quad (7)$$

$$Y_t = \lambda_2 + \sum_{i=1}^p a_{2i} X_{t-i} + \sum_{j=1}^p b_{2j} Y_{t-j} + \mu_{2t} \quad (8)$$

F test is carried out for the null hypothesis of no Granger causality:

$$H_0 : b_{i1} = b_{i2} = \dots = b_{ik} = 0, i = 1, 2. \quad (9)$$

where F statistic is the Wald statistic for the null hypothesis. If the F statistic is greater than a certain critical value for an F distribution, then we reject the null hypothesis that Y does not Granger-cause X , which means Y Granger-causes X . If it is also found that when regressing X on its past values and current and past values of Y , some or all of the current or past values of Y are significant, then we say that there exists feedback between the variables. Unidirectional causality exists when it can be shown that one variable Granger causes the other, but not the other way around. The definition of the Granger causality is based on the hypothesis that X and Y are stationary or $I(0)$ time series.

IV. Empirical Results

The definition of the Granger causality is based on the hypothesis that X and Y are stationary or $I(0)$ time series. Therefore, the first necessary condition to perform Granger-causality tests is to study the stationary of the time series under consideration and to establish the order of integration present. Table 1 below presents the results of the unit root test.

Table 1. Augmented Dickey-Fuller Unit Root Test Results

	Test with an intercept		Test with an intercept and trend		Test with no intercept or trend	
	ADF (Levels)	ADF (1 st differences)	ADF (Levels)	ADF (1 st differences)	ADF (Levels)	ADF (1 st differences)
DC	-3.701763	-8.826484	-4.178225	-8.792644	-3.540368	-8.849757
EMP	-13.87241	-11.68819	-13.87540	-11.66482	-13.69186	-11.71076
CV* (1%)	-3.455887	-3.455887	-3.994453	-3.994453	-2.574134	-2.574134
CV* (5%)	-2.872675	-2.872675	-3.427546	-3.427546	-1.942084	-1.942084

*MacKinnon (1996) one-sided p-values.

The lag length was determined using Schwartz Information Criteria (SIC)

As the calculated ADF statistics are larger than the MacKinnon values in levels, we can reject the null hypothesis of a unit root for both EMP Index and domestic credit. Hence we conclude it is stationary, i.e. $I(0)$. Thus, it is not necessary to run co-integration tests and we can move on to the Granger-causality tests shown in Equation 7 and Equation 8. Table 2 shows the results of these tests.

Table 2. Granger Causality Test Results (Total observations: 262)

Null Hypothesis	Wald Type F-Statistics						
	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7
DC \neq EMP	0.27360	0.07007	0.05479	0.11892	0.16194	0.13131	0.14894
EMP \neq DC	2.37651	1.52801	1.07279	1.01271	0.92798	1.12105	0.91251

** Reject the null hypothesis at the 5% level.

* Reject the null hypothesis at the 10% level.

As evident from Table 2, Granger causality tests fail to establish a causal relationship between domestic credit and exchange market pressure.

V. Conclusion

The literature on currency crises clearly lacks a country-specific study that addresses the long-run relationship between this indicator and the speculative pressure in the exchange market. This article aims at filling this gap in the literature using monthly Turkish time series data spanning the period 1984:04- 2006:11. Results of the ADF unit root tests suggest that the series are stationary. Hence, no cointegration analysis was carried out before the Granger-causality tests. Granger causality tests fail to establish a causal relationship between domestic credit and exchange market pressure. This finding supports the results derived from a different empirical methodology, signals approach, by Ucer *et al.* (1998), Kibritcioglu et al (2001) and Kibritcioglu (2004), who have also focused on the Turkish economy.

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