E C O N O M I C S  B U L L E T I N

# Self-fulfilling and Fundamental Banking Crises: A Multinomial Logit Approach

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## *Abstract*

This paper uses a multinomial logit model to examine the factors associated with the occurrence of both self-fulfilling and fundamental banking crises. We find evidence indicating that the two types of crises are indeed different, and are explained by different variables. Self-fulfilling crises tend to occur when bank liabilities relative to reserves are high, when the financial system is liberalized, and for high levels of short-term debt relative to total debt. They are also associated with lending booms and government surpluses. In contrast, fundamental crises are linked to depreciations of the local currency, to financial liberalization and are negatively related to the country's level of development and quality of institutions. Also, countries that experienced multiple crises are more likely to experience fundamental crises.

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## 1. Introduction

There are two main theoretical views for the causes of banking crises. The fundamental banking crises view is that they are the consequence of poor economic performance (see Chari and Jagannathan 1988, Jacklin and Bhattacharya 1988, and Allen and Gale 1998). The self-fulfilling view is that bank runs are the result of multiple equilibria, where a panic is the realization of a bad equilibrium caused by self-fulfilling expectations (see Diamond and Dybvig 1983, Freeman 1988 and Peck and Shell 2003).

The goal of this paper is to investigate the factors that may be associated with self-fulfilling and fundamental banking crises. Fontenla (2006) finds that policy implications may be different depending on the type of crises an economy faces. Thus, identifying the particular characteristics to each type of crisis becomes critical. If banking crises are due to fundamentals, then macroeconomic stabilization policies should be crucial to prevent such occurrences. On the other hand, if a crisis is due to multiple equilibria, then policies conductive to eliminate indeterminacies and volatility may be the adequate government measure.

Previous empirical work that addresses the divergence in the theoretical literature has been mixed. Gorton (1988) finds that during 1863-1914 panics were caused by fundamentals. Demirgüç-Kunt and Detragiache (1998) confirm Gorton's findings for a sample of countries for the 1980-94 period. In contrast, Boyd, Gomis, Kwack and Smith (2001) find that banking crises may often be the outcome of bad realizations of sunspot equilibria.

In this paper, we construct an index that differentiates between the two types of crises. This allows us to use a multinomial logit model, instead of the previously used binomial logit, to investigate the determinants of self-fulfilling and fundamental banking crises. We find evidence indicating that the two types of crises are indeed different, and are explained by different variables. In particular, we find that self-fulfilling crises tend to occur when bank liabilities relative to reserves are high, for periods of rapid domestic credit growth and when the financial system is liberalized. In addition, self-fulfilling crises are associated with government surpluses and high levels of short-term debt relative to total debt. In contrast, fundamental crises are linked to depreciations of the local currency, to financial liberalization and to the country's GNP per capita. Also, countries that experienced multiple crises are more likely to experience fundamental crises. Finally, by accounting for the possibility of self-fulfilling crises, our results provide better support to existing self-fulfilling theoretical models. In particular, our results agree with the self-fulfilling theoretic models mentioned above, and more generally to financial crises models such as Calvo and Mendoza (1996), and

Cole and Kehoe (2001).

## 2. Identifying types of Crises

In order to categorize banking crises as fundamental or self-fulling we construct a banking crisis index, following similar work by Eichengreen, Rose and Wyplosz (1996) and Kaminsky and Reinhart (1999). Eichengreen, Rose and Wyplosz (1996) create an index of exchange rate speculative pressure by creating a weighted average of exchange rate changes, reserves and interest rate changes. Kaminsky and Reinhart (1999) create a similar index based on exchange rate and reserve changes.

We identify a fundamental crisis when macroeconomic fundamentals are adverse, such as negative or weak GDP growth, excessively high real interest rates and high inflation. On the other hand, when GDP growth is high, and interest rates and inflation are low, we label it a self-fulfilling crisis. The banking crises index ($I_t$) is constructed by calculating a weighted average of lagged real GDP growth, real interest rates ($ri$) and inflation ($\pi$) for the systemic crises identified by Caprio et al (2005). The three components of the index are weighted by their standard deviation (denoted by $\sigma$) so that their conditional volatilities are equal.

$$I_t = \frac{GDP_{t-1}}{\sigma_{GDP}} - \left|\frac{ri_{t-1}}{\sigma_{ri}}\right| - \left|\frac{\pi_{t-1}}{\sigma_{\pi}}\right| \tag{1}$$

When this index falls below a threshold ($I_f$), we identify it as a fundamental crisis and create a dummy variable for the type of banking crises ($C$) as follows:

$$C = \begin{cases} 0 & \text{if no banking crisis occurred} \\ 1 & \text{if} \quad I_t < I_f \quad \text{fundamental banking crisis} \\ 2 & \text{if} \quad I_t \geq I_f \quad \text{self-fulfilling banking crisis} \end{cases} \tag{2}$$

For our dataset we set $I_f = 0.8$ which corresponds to GDP growth around 4%, values of real interest rates around 10% and inflation rates of 7%. Given the ad-hoc nature of this threshold, we conduct sensitivity analysis to see how lowering or raising this threshold matters. We find the conclusions to be robust. We do not report them here due to space limitations.

## 3. Estimation and Explanatory Variables

In order to investigate self-fulfilling and fundamental banking crises we regress our type of banking crises dummy $C$ against a set of explanatory variables chosen to reflect both theory and previous empirical work. We lag all variables by one period in order to rule out reverse causality. The following are the explanatory variables used in our analysis:

**Ratio of M2 to foreign reserves (RM2):** this variable is intended to measure vulnerability to capital outflows. M2 may be thought as a proxy for liabilities of the banking system. When M2 exceeds foreign reserves, a negative money demand shock, perhaps self-fulfilling, may render fixed exchange rates implausible (Calvo and Mendoza, 1996).

**Depreciation rate relative to the US dollar (DP):** this intends to capture the extent to which sharp depreciations may cause crises in countries over exposed to foreign exchange risk.

**Domestic credit growth (DMC):** this is used to account for the view that bank lending booms may precede crises.

**Government surplus to GDP (GS):** this variables signals the ability of governments to repay their debts.

**Ratio of short-term debt to total debt (ST):** high levels may generate fear of default, which becomes self-fulfilling.

**GNP per capita (GNPP):** this is considered as a proxy for the development of the financial system and quality of institutions, as these variables are thought to be positively correlated with GNP per capita.

**Financial liberalization dummy (FL):** previous empirical work finds that financial liberalization significantly increases the probability of banking crises. In general, higher capital flows may increase volatility and allow for foreign exchange risk.

**Multiple crises country dummy (MC):** according to Boyd et. al. (2001) the determinants of a crisis is different in countries that have experienced only one crisis in the last 25 years versus those that have had repeated crises.

**Fixed (FE) and floating exchange (FLE) rate dummy:** fixed exchange rates have often been linked to banking crises, because they may induce banks to excessively borrow abroad. Floating exchange rates, on the other hand, may be viewed as generating exchange risk and adding another layer of uncertainty to banks (see Eichengreen and Arteta 2002).

**Northern interest (NI) rate and OECD growth (OEG):** these two variables are included to account for real external effects, since changes in capital flows may respond to changes in world interest rates and output growth.

**Changes in terms of trade (TT):** this variable accounts for external shocks in trade that may cause financial distress.

The baseline model for the multinomial logit considers the first seven explanatory variables as follows:

$$C_t = \alpha + \beta_1 DP_{t-1} + \beta_2 RM2_{t-1} + \beta_3 DCG_{t-1} + \beta_4 GS_{t-1} + \beta_5 ST_{t-1} + \beta_6 GNPP_{t-1} + \delta_1 FL \tag{3}$$

We consider five possible specifications. The first one is given by the baseline model of equation (3). The second specification includes the dummy for countries that experienced multiple crises. The third model includes two dummy variables for floating and fixed exchange rate regimes. In the fourth model we add the terms of trade to test for external factors that may cause banking crises. The last specification includes both northern interest rates and OECD growth rates.

## 4. Banking Crises Data

The data covers the period 1974-1997 for 51 developing countries, which includes the important Latin American and Asian crises of the late 90's. Following previous literature, we exclude centrally planned economies and high income OECD countries. The identification and dating of banking crises is taken from Caprio et al (2005). There are 84 systemic banking crises in our period. Since crises often last several years, we consider only the first observation for each systemic banking crisis, in order to prevent reverse causality. The data sources for the index and explanatory variables are primarily obtained from the *International Financial Statistics* (IMF), and the *World Development Indicators* (World Bank).

## 5. Results

In order to compare the multinomial approach to previous work we start by obtaining the results for a binomial logit. The binomial logit uses the same explanatory variables as in equation (3) but the dependent variable is changed to show whether there is a banking crises or not regardless of the type. Table 1 presents the solution for the baseline model and the other four specifications. The ratio of M2 to foreign exchange reserves, financial liberalization and domestic credit growth are significant across all specifications. These results confirm previous work by Demirgüç-Kunt and Detragiache (1998) and Eichengreen and Arteta (2002).

The next step is to divide crises into self-fulfilling and fundamental according to our index and solve the multinomial logit regressions. Tables 2 and 3 present the results of the five regressions outlined in the previous section. We reject the hypothesis that the coefficients of the independent variables are jointly equal to zero at the 1 percent level in all regressions. Furthermore, in the baseline regression the hypothesis that self-fulfilling and fundamental crises are equal is rejected at the 1% significance level. For the other four specifications we reject that self-fulfilling and fundamental crises are equal at least the 5% level. These results suggests that all banking crises are not alike, and perhaps both self-fulfilling and fundamental theories are correct.

In all multinomial logit regressions, the coefficient for the rate of currency depreciation is negative (appreciation) but not significant for self-fulfilling crises. In contrast, the rate of depreciation is positively associated with a higher probability of fundamental crises. The coefficient is significant at the 5% level for all specifications. Notice that for the binomial logit regressions in Table 1, depreciation shows no significant effect for most regressions.

The ratio of M2 to gross international reserves is positive and highly significant for all self-fulfilling crises, but loses significance for fundamental crises. While the significance of this variable is also picked up in the binomial regressions, the results given by accounting for both types of crises provides stronger support to self-fulfilling theoretical models such as Calvo and Mendoza (1996). The rate of domestic credit growth tells a similar story, it is positively associated with self-fulfilling banking crises while it shows no effect for fundamental crises. This supports the idea that lending booms may have played an important role in self-fulfilling events. The financial liberalization dummy is strongly significant in the binomial logit specification, and continues to be significant across both types of crises when we run multinomial logit regressions. This suggests that financial liberalization may be conducive to the existence of indeterminacies and excess volatility, and may also have direct effects on bank's balance sheets through increased competition and risk taking. Government budget surplus as a percent of GDP is positive and significant at the 5% confidence level for all self-fulfilling crises, except when the multiple crises dummy is introduced. For fundamental crises the coefficient is not significant. This result sheds light over previous empirical work that is not able to explain that budget surpluses, rather than deficits, are associated with banking crises. Our interpretation is that budget surpluses support the notion that it is not fundamentals that are causing these group of crises.

Short term debt to total debt is positive and significant at the 5% level for all self-fulfilling crises, and negative and insignificant for fundamental crises. This result provides strong

support for Cole and Kehoe (2001) theoretical model of self-fulfilling debt crises. We find support for the belief that less developed countries, or countries with weaker institutions, are more prone to fundamental crises, as proxied by GNP per capita. This variable is negative and significant at the 10% level for fundamental crises except when terms of trade changes are introduced, and shows no effect for self-fulfilling crises. When we introduce the multiple crises dummy, we find support for the idea that countries that experienced multiple banking crises are more vulnerable to fundamental crises.

## 6. Conclusions

This paper follows a multinomial logit approach to differentiate between fundamental and self-fulfilling crises. We find strong evidence indicating that the two types of crises are indeed different, and are explained by different variables. Self-fulfilling crises tend to occur when M2 relative to reserves is high, for periods of rapid domestic credit growth and when the financial system is liberalized. In addition, self-fulfilling crises are associated with government surpluses and high levels of short-term debt relative to total debt, results that are not present in the binomial logit model. In contrast, fundamental crises are linked to depreciations of the local currency, to financial liberalization and to the country's level of development as proxied by GNP per capita. Furthermore, countries that experienced multiple crises are more likely to experience fundamental crises. These results agree with theoretical models such as Diamond and Dybvig (1983), Calvo and Mendoza (1996), and Cole and Kehoe (2001).

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Table 1: Banking Crises: Binomial Logit Regressions

| **Variables** | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| DP | 0.17693 | 0.1168806 | 0.1816134 | 0.1570966 | 0.1705798 |
| | (0.104) | (0.266) | (0.098) | (0.144) | (0.106) |
| RM2 | 0.0436406 | 0.0382265 | 0.0428331 | 0.0457394 | 0.0537812 |
| | (0.052) | (0.095) | (0.056) | (0.044) | (0.018) |
| DMC | 0.0058132 | 0.0051465 | 0.0058602 | 0.0055762 | 0.0057089 |
| | (0.009) | (0.027) | (0.010) | (0.016) | (0.015) |
| FL | 1.716014 | 1.703842 | 1.723896 | 1.634726 | 1.881389 |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.000) |
| GS | 0.0509828 | 0.0222437 | 0.0504099 | 0.0287788 | 0.0703162 |
| | (0.254) | (0.613) | (0.257) | (0.570) | (0.119) |
| ST | 0.029232 | 0.0310086 | 0.0298204 | 0.0323952 | 0.0226192 |
| | (0.102) | (0.082) | (0.098) | (0.080) | (0.239) |
| GNPP | - 0.000059 | -0.0000674 | - 0.0000696 | -0.00005 | -0.0000498 |
| | (0.593) | (0.535) | (0.544) | (0.652) | (0.672) |
| MC | – | 0.9189972 | – | – | – |
| | – | (0.031) | – | – | – |
| FE | – | – | -0.0540256 | – | – |
| | – | – | (0.912) | – | – |
| FLE | – | – | -0.1686768 | – | – |
| | – | – | (0.747) | – | – |
| TT | – | – | – | -0.8404238 | – |
| | – | – | – | (0.616) | – |
| NI | – | – | – | – | 0.0099069 |
| | – | – | – | – | (0.020) |
| OEG | – | – | – | – | -18.96226 |
| | – | – | – | – | (0.238) |
| Obs. | 657 | 657 | 653 | 621 | 657 |
| LR $\chi^2$ | 42.25 | 46.68 | 42.12 | 40.15 | 49.88 |
| Prob $> \chi^2$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Pseudo $R^2$ | 0.1614 | 0.1784 | 0.1612 | 0.1593 | 0.1906 |

P-values in parenthesis; DP=depreciation; RM2= M2/foreign reserves; DMC=domestic credit growth; FL=financial liberalization; GS=govt.surplus/GDP; ST=short-term debt/total debt; GNPP=GNP per capita; MC=multicrisis; FE=fixed ex. rate; FLE= floating ex. rate TT= change terms trade; NI=north interest rate;OEG=north GDP growth

Table 2: Banking Crises Models 1-3: Multinomial Logit

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| **Variables** | Self-Fulfilling | Fundamental | Self-Fulfilling | Fundamental | Self-Fulfilling | Fundamental |
| DP | - 1.073958 | 0.4830678 | -1.120047 | 0.394626 | -1.146996 | 0.5136561 |
| | (0.330) | (0.013) | (0.299) | (0.034) | (0.282) | (0.011) |
| RM2 | 0.092669 | 0.0122651 | 0.0919657 | 0.0077248 | 0.0977948 | 0.0109191 |
| | (0.003) | (0.747) | (0.003) | (0.840) | (0.003) | (0.771) |
| DCG | 0.0096085 | 0.0017656 | 0.0088151 | 0.0014686 | 0.009587 | 0.0017695 |
| | (0.014) | (0.628) | (0.031) | (0.700) | (0.019) | (0.625) |
| FL | 1.678321 | 1.416992 | 1.549311 | 1.359341 | 1.467096 | 1.624925 |
| | (0.053) | (0.034) | (0.077) | (0.044) | (0.091) | (0.021) |
| GS | 0.2319527 | -0.0135162 | 0.1841148 | -0.0356503 | 0.268821 | -0.0129637 |
| | (0.037) | (0.800) | (0.111) | (0.470) | (0.026) | (0.818) |
| ST | 0.0557317 | -0.0276998 | 0.0567809 | -0.0306277 | 0.0611751 | -0.0212404 |
| | (0.034) | (0.501) | (0.028) | (0.472) | (0.030) | (0.589) |
| GNPP | 0.0000587 | -0.0006295 | 0.0000812 | -0.0006379 | 0.0000911 | -0.0006398 |
| | (0.673) | (0.088) | (0.559) | (0.077) | (0.570) | (0.087) |
| MC | – | – | 0.6748266 | 1.159765 | – | – |
| | | | (0.355) | (0.096) | | |
| FE | – | – | – | – | 0.0245935 | 0.5116356 |
| | | | | | (0.978) | (0.578) |
| FLE | – | – | – | – | 0.9928716 | -0.1590694 |
| | | | | | (0.270) | (0.873) |
| Obs. | | 650 | | 650 | | 646 |
| LR $\chi^2$ | | 60.26 | | 63.56 | | 62.64 |
| Prob $> \chi^2$ | | 0.0000 | | 0.0000 | | 0.0000 |
| Pseudo $R^2$ | | 0.2369 | | 0.25 | | 0.2466 |
| Test Self-Fulfilling=Fundamentals | | | | | | |
| $\chi^2$ | | 18.79 | | 18.82 | | 19.72 |
| Prob $> \chi^2$ | | 0.0089 | | 0.0158 | | 0.0197 |

P-values in parenthesis; DP=depreciation; RM2= M2/foreign reserves; DMC=domestic credit growth; FL=financial liberalization; GS=govt.surplus/GDP; ST=short-term debt/total debt; GNPP=GNP per capita; MC=multicrisis; FE=fixed ex. rate; FLE= floating ex. rate

Table 3: Banking Crises Models 4-5: Multinomial Logit

| | (4) | | (5) | |
|---|---|---|---|---|
| **Variables** | Self-Fulfilling | Fundamental | Self-Fulfilling | Fundamental |
| DP | - 1.111658 | 0.4448102 | -1.1474718 | 0.487923 |
| | (0.330) | (0.020) | (0.308) | (0.013) |
| RM2 | 0.0906095 | 0.017889 | 0.1008191 | 0.0135123 |
| | (0.003) | (0.640) | (0.002) | (0.725) |
| DMC | 0.009806 | 0.0015683 | 0.0095749 | 0.0016632 |
| | (0.013) | (0.669) | (0.014) | (0.658) |
| FL | 1.615514 | 1.438828 | 1.848188 | 1.42472 |
| | (0.062) | (0.031) | (0.038) | (0.038) |
| GS | 0.2258436 | -0.0286585 | 0.2458352 | -0.0088075 |
| | (0.045) | (0.625) | (0.025) | (0.867) |
| ST | 0.0567259 | -0.0272917 | 0.0491883 | -0.0283277 |
| | (0.035) | (0.508) | (0.072) | (0.502) |
| GNPP | 0.0000526 | -0.0005785 | 0.0000792 | -0.0006336 |
| | (0.707) | (0.110) | (0.587) | (0.091) |
| TT | -0.6571291 | -0.9176985 | – | – |
| | (0.836) | (0.715) | | |
| NI | – | – | 0.0080832 | 0.0022815 |
| | | | (0.222) | (0.772) |
| OEG | – | – | -10.48022 | -14.27874 |
| | | | (0.709) | (0.545) |
| Observation | | 615 | | 650 |
| LR $\chi^2$ | | 59.28 | | 62.44 |
| Prob $> \chi^2$ | | 0.0000 | | 0.0000 |
| Pseudo $R^2$ | | 0.2358 | | 0.2455 |
| Test Self-Fulfilling=Fundamentals | | | | |
| $\chi^2$ | | 18.55 | | 19.38 |
| Prob $> \chi^2$ | | 0.0175 | | 0.0222 |

P-values in parenthesis; DP=depreciation; RM2= M2/foreign reserves;
DMC=dom. credit growth; FL=financial liberalization;
GS=government surplus/GDP; ST=short-term debt/total debt;
GNPP=GNP per capita; TT= change terms trade;
NI=north interest rate; OEG=north GDP growth