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Working Paper

Rapid credit growth and current account deficit as the leading determinants of financial crises

Economics Discussion Papers, No. 2013-35

Provided in Cooperation with:
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Suggested Citation: Ganioğlu, Aytül (2013) : Rapid credit growth and current account deficit as the leading determinants of financial crises, Economics Discussion Papers, No. 2013-35, Kiel Institute for the World Economy (IfW), Kiel

This Version is available at:
https://hdl.handle.net/10419/76807

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Discussion Paper
No. 2013-35 | July 08, 2013 | http://www.economics-ejournal.org/economics/discussionpapers/2013-35

Rapid Credit Growth and Current Account Deficit as the Leading Determinants of Financial Crises

Aytül Ganioğlu

Abstract
In this study, the main purpose is to analyze the factors that stimulate the probability of financial crises. The period of analysis covers the years of 1970-2008, thereby including the impact of recent global financial crisis. The analysis aims to make a comparison for the developed and developing country financial crises separately. Panel logit estimation technique is used for the analysis which includes 24 developed and 26 developing countries, amounting to 50 countries as total. According to estimation results, current account deficit and credit expansion carry the risk of raising the probability of financial crises significantly both in advanced countries and developing countries. More specifically, credit expansions in developed countries and current account deficits in developing countries raise the probability of financial crises more strongly.

JEL C33 E51 F41 G01
Keywords Financial crisis; predictors of financial crisis; rapid credit expansion; current account deficit

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The views expressed in this paper are those of the author and do not reflect the official views of the Central Bank of Turkey. All errors are our own.

Citation Aytül Ganioğlu (2013). Rapid Credit Growth and Current Account Deficit as the Leading Determinants of Financial Crises . Economics Discussion Papers, No 2013-35, Kiel Institute for the World Economy. http://www.economics-ejournal.org/economics/discussionpapers/2013-35

Received May 24, 2013 **Accepted as Economics Discussion Paper** June 25, 2013 **Published** July 8, 2013
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1. INTRODUCTION

There has been frequent financial instability in both developed[3] and developing[4] countries accompanied by the increased global capital mobility after the collapse of the Bretton Woods system in 1971[5]. In some cases, a severe enough financial instability even led to almost complete breakdown in the functioning of the financial markets, which is called as a financial crisis. As one type of crisis may develop into another, they might also take place together[6].

There are different explanations about how crises occur. In the literature, every model has been developed in the aftermath of a new crisis in order to explain the dynamics of the crisis and desire to generalize main aspects. However, both theoretical and empirical analyses of the crises in the literature give direction to different conclusions. Since there is no single way of measuring explanatory variables in the empirical analysis, besides no agreement on which explanatory variables to include, different results are obtained as regards to the impact of explanatory variables included in the empirical analyses. Hence, these models have not been successful in generating a consensus, as apparent from controversial views in the literature. Even, there is no consensus in the literature as regards to the definition of crisis.

As a matter of fact, one cannot make generalization as to the macroeconomic conditions under which financial and currency crises have occurred. For example, in some crises such as the ones in Mexico, Thailand and Turkey, current account deficits were large

[3] The episodes in developed countries include the banking and real estate crises in the United States lasting more than a decade from the late 1970s, the major slumps in the global stock market in 1987 and 1989, the currency crisis of the European Monetary System (EMS) in 1992 and the ongoing instability in Japanese financial markets that started with the bursting of the bubble in the early 1990s (Akyüz and Cornford, 1999:15). See also Fourçans and Franck (2003)

[4] The episodes of crises in developing countries include the Southern Cone crisis of the late 1970s and early 1980s, the Mexican crisis of 1994-1995, the East Asian crisis beginning in 1997, the Russian crisis of 1998, Argentina crisis in 2001 and Turkish crises in 2000 and 2001 (Akyüz and Cornford, 1999:15).

[5] This classification of the crises as post-Bretton Woods crises belongs to Akyüz and Cornford (1999:15).

[6] During the 1970s, there was no apparent link between currency and banking crises, when financial markets were highly regulated. In the 1980s, banking and currency crises become more interlinked, as many of the countries have both currency crises and banking crises around the same time called twin crises by Kaminsky and Reinhart (1999). Then, the link between banking and currency crises began to take attention.

and unsustainable, while it was small in the crises of Indonesia and Russia. Although there were significant overvaluation of the domestic currency in the crises of Mexico, Russia, Brazil and Turkey which used exchange rate as a nominal anchor to bring inflation down, this has not always been the case, as the appreciation of currency was moderate or negligible in most East Asian countries. In addition, while large budget deficits were associated with the crises in Russia, Brazil and Turkey, the budget was balanced or in surplus in Mexican and East Asian crises. Finally, in Brazilian and Russian crises, external debt was owed primarily by the public, while primarily it was by the private sector in East Asian crises[7].

The global financial crisis has deeply influenced the views related to the interaction between macroeconomic outcomes and financial system. Among various theoretical approaches in the literature, the two diverse approaches need to be mentioned here. On the one side, it is suggested by the monetarist view of Friedman and Schwartz (1963), as well as recently dominant Neo-Keynesian synthesis of Woodford (2003) that macroeconomic outcomes are broadly independent of the performance of financial system. On the other side, it is argued by Fisher (1933), Minsky (1978), Bernanke (1983, 1993) and Gertler (1988) to varying degrees that financial system can have a strong and dominant impact on macroeconomic outcomes[8].

In the aftermath of the global financial crisis, a new interest sparkled about the fluctuations in monetary aggregates and credit as well as their roles in the amplification, propagation and generation of shocks especially during financial distress[9]. The view that has been influential especially after the global crisis is that expansion in credit aggregates as well as increased risk involves important information for policy makers monitoring financial and economic stability especially about the likelihood of future financial crises. Furthermore, it is

[7] Akyüz and Cornford (1999:17)
[8] For more discussion, see Schularick and Taylor (2010)
[9] Schularick and Taylor (2010)

argued that excessive credit growth generates risks such as "imbalances" and "financial instability"[10]. Adherence to the money view has been seriously called into question by the crisis. Analysis of Schularick and Taylor (2010) clearly suggests that "the credit system matters above and beyond its role as propagator of shocks as in the financial accelerator model. The credit system seems all too capable of creating its very own shocks, judged by how successful past credit growth performs as a predictor of financial crises".

Even though the association between excessive credit expansion and financial crises[11] is not new, the empirical evidences regarding this relationship are very few. Although financial crises of developing countries are examined more often in the literature[12], studies related to financial crises of developed countries are very few, since financial crises in developed countries are rather rare events. In two recent studies[13], credit booms appear as a strong predictor of financial crisis. In Schularick and Taylor (2010) study, credit booms are stronger predictor of financial crisis than monetary aggregates. In the study of Jorda and others (2010), credit boom over the previous 5 years is indicative of a heightened risk of financial crisis, and is a superior predictor of financial crisis than current account imbalances.

The main purpose of this study is to contribute to "few" empirical studies in the literature examining the financial crises of developed countries as well as introducing the impact of global financial crisis into the analysis of financial crises of developing countries. An almost standard set of macroeconomic variables are involved in the panel data estimations in this study. Additionally, we have been inspired by the study of Jorda and others (2010) to introduce "credit boom" as an explanatory variable that propagates financial crises. Our

[10] Borio and Lowe (2002, 2003); White (2004); Goodhart (2007)
[11] Kindleberger (1978); Hume and Sentence (2009); Reinhart and Rogoff (2009); Eichengreen and Mitchener (2003); Caprio and Honohan (2008)
[12] McKinnon and Pill (1997); Kaminsky and Reinhart (1999)
[13] Schularick and Taylor (2009); Jorda et. al. (2010). In both studies, the analysis covers 14 developed countries for the period of 1870-2008.

analysis differs from that of Jorda and others (2010) [14] in that number of developed countries involved in the analysis has been extended to 24 countries while the period of analysis has been restricted to the period of 1970-2008, considering the fact that dynamics of crises change substantially when we extend the period. Furthermore, we incorporate developing countries into the analysis so that we can make a comparison in terms of financial crises of developed and developing countries separately. Last but not least, sources of database are different, especially as regards the banking crises database. Hence, findings of this study have been different from that of Jorda and others (2010), especially related to the impact of credit boom on financial crises confirming a non-consensus on which explanatory variables to include in the analysis of financial crises as mentioned above.

Empirical results in this study point to the robust significance of current account deficit in leading to crises in developing countries, carrying a stronger risk of increasing the probability of financial crises than that of credit expansion. Our test results indicate that in developed countries, both current account deficit and credit expansion together with monetary expansion raises the risk of financial crises, while the credit expansion appears as having a more robust impact.

This paper is organized as follows: Section 2 discusses data and descriptive statistics. Section 3 is devoted to our empirical analysis and findings. Section 4 concludes.

[14] Their analysis covers 14 developed countries for the period of 1870-2008.

2. DATA AND DESCRIPTIVE STATISTICS

The data set has annual data for 50 countries, (24 developed[15] and 26 developing[16]) and covers the period of 1970-2008. As regards the dataset, Appendix 1 provides information about all variables by name, definition, sources and the time period that the data covered. All regressions included a standard list of macroeconomic variables. These variables are inflation rate calculated by formula ln (1+ Inflation rate) (*INF*); current account balance (% of GDP) (*CABGDP*); GDP per capita growth rate (*GDPPCGR*); GDP growth rate (*GDPGR*); real interest rate (*REALINTR*); domestic credit provided by banking sector to private sector (% of GDP) (*DOMCREDPR*); money and quasi money (% of GDP) (*M2GDP*); broad money (% of GDP) (*BROADMONEY*); percentage change in 5-year moving average of domestic credit provided by banking sector to private sector (% of GDP) (*CREDBOOM*) as the macroeconomic factors likely to lead to a crisis; as well as interaction term which is the product of domestic credit provided by banking sector to private sector (% of GDP) and current account balance (% of GDP) (*INTDOMCRCABGDP*). Source of explanatory variables is World Bank World Development Indicators database.

The dependent variable, banking crisis series are mainly based on Laeven and Valencia (2010, 2012)[17]. Detailed information about the definition of banking crisis is provided in the studies of Laeven ve Valencia (2010, 2012).

Table 2 presents descriptive statistics of independent variables. Comparison of developed and developing countries as regards the averages of variables reveals the following

[15] *Developed countries* are Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

[16] *Developing countries* are Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Kazakhstan, Latvia, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, Slovenia, Sri Lanka, Thailand, Turkey, Ukraine, Venezuela and Zimbabwe.

[17] See Appendix 2 for a detailed list of banking crises.

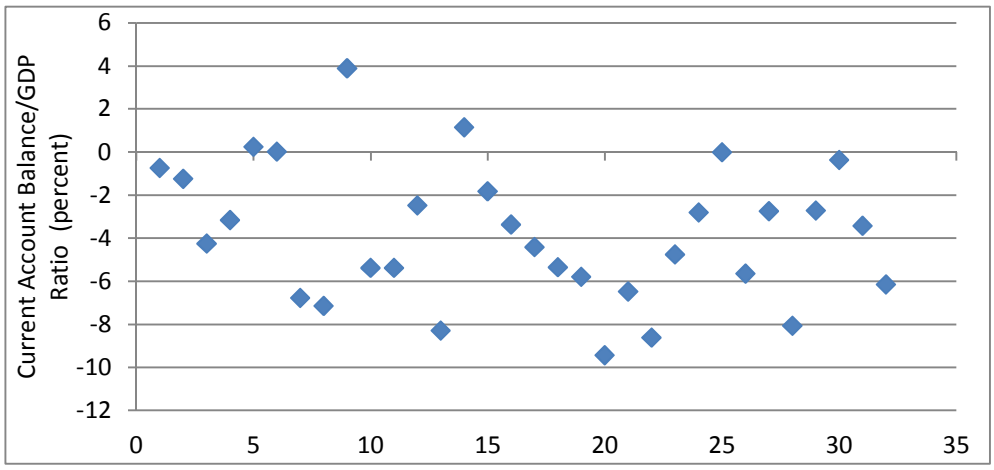
information: while average value of current account balance (% of GDP) for developed countries is -0,77 percent, it is -1,45 percent for developing countries; average value of domestic credit provided to private sector (% of GDP) is 83,6 percent for developing countries, as it falls to 46,8 percent for developed countries; average value of broad money supply (% of GDP) is 66,8 percent for developed countries, while it is 40,7 percent for developing countries; average of real interest rate is 4,69 percent for developed countries and 11 percent for developing countries. Furthermore, maximum value of *DOMCREDPR* and *M2GDP*are very high in developing countries as compared to developed countries.

Table 1: Descriptive Statistics of Independent Variables

Developed Countries					
Variable Name	***Number of Observation (N)***	***Average***	***Standard Deviation***	***Min.***	***Max.***
CABGDP	834	-0.77	4.71	-26.89	17.76
DOMCREDPR	926	83.6	48	0.03	319
M2GDP	548	79.7	47.6	15.3	242.2
BROADMONEY	616	66.8	39.24	15.3	242.2
INF	913	1.77	0.85	-2.25	5.92
GDPPCGR	934	2.37	2.5	-7.9	13.27
GDPGR	934	3.12	2.6	-7.28	13.6
REALINTR	724	4.69	6	-19.48	88
Developing Countries					
Variable Name	***Number of Observation (N)***	***Average***	***Standard Deviation***	***Min.***	***Max.***
CABGDP	729	-1.45	5.19	-22.68	19.8
DOMCREDPR	823	46.8	293	0	8404.02
M2GDP	827	70.49	423.37	6.21	7015.56
BROADMONEY	804	40.7	27.44	6.2	145.3
INF	799	2.6	1.35	-2.74	10.1
GDPPCGR	892	2.56	5.04	-31.34	18.56
GDPGR	892	4.08	5.18	-32	22.5
REALINTR	553	11	41.5	-91.7	578

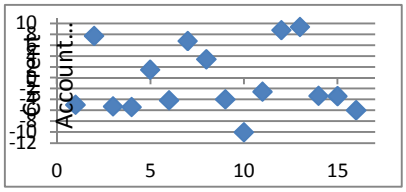
Figures 1a and 1b provide a graphical representation of the relationship between banking crisis and current account balance/GDP ratio in year preceding the crisis. Developing country group form a cluster on this scatter plot. It is observed in the Figure 1a that in the year preceding the crisis, most of the countries run current account deficits and even large ones. On the scatter for developed countries (Figure 1b), countries running current account deficits and surpluses in the year preceding the crisis are more evenly distributed.

Figures 1a: Current Account Balance/GDP Ratio (Developing Countries*)



***Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Japan, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, Sri Lanka, Thailand, Turkey, Venezuela, Zimbabwe.

Figure 1b: Current Account Balance/GDP Ratio (Developed Countries*)

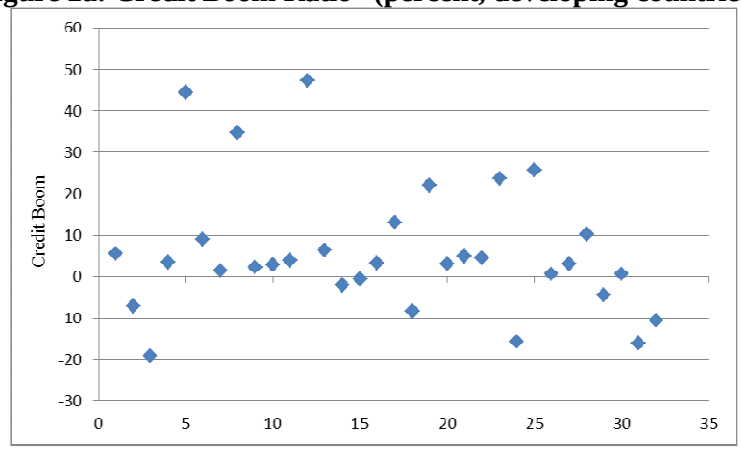


***Finland, Germany, Ireland, Israel, Japan, Korea, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, United States

Note: For each country, current account balance/GDP ratio is the one in the year preceding the banking crisis.

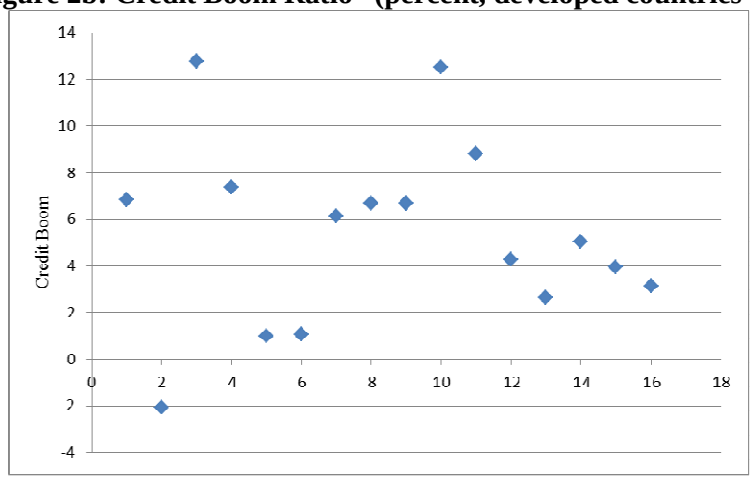
In figures 2a and 2b, the relationship between banking crisis and credit booms is searched for. Variable *CREDBOOM*, represents credit boom, which is calculated by percentage change of 5-year moving average of domestic credit provided by banking sector. In these figures, credit boom values for each country represent the value in the year preceding the banking crisis. It is observed that in most of the developing countries, credit boom ratio is generally high and positive. For developed countries, except one country[18], almost all of them have experienced credit boom in the year preceding crisis.

Figure 2a: Credit Boom Ratio* (percent, developing countries)**



****Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Japan, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, Sri Lanka, Thailand, Turkey, Venezuela, Zimbabwe

Figure 2b: Credit Boom Ratio* (percent, developed countries)**



****Finland, Germany, Ireland, Israel, Japan, Korea, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, United States

Note: For each country, current account balance/GDP ratio is the one in the year preceding the banking crisis.

[18] Credit boom ratio of Germany before the crisis of 2008.

Correlations between banking crisis and macroeconomic indicators are presented for developed and developing countries in Table 2 and Table 3. We found positive correlation between monetary aggregates like *BROADMONEY* and *M2GDP* as well as between inflation and those monetary aggregates. Furthermore, there is high positive correlation between per capita income (*GDPPCGR*) and growth rate (*GDPGR*). Signs of all correlation coefficients are as expected.

Table 2: Correlation Matrix for Developed Countries

	BANKCRISES	*CABGDP* $_{t-1}$	*CREDBOOM* $_{t-1}$	*DOMCREDPR* $_{t-1}$	*BROADMONEY* $_{t-1}$	*M2GDP* $_{t-1}$	*INF* $_{t-1}$	*GDPGR*	*GDPPCGR* $_{t-}$	*REALINTR* $_{t-1}$
BANKCRISES	1.00									
CABGDP $_{t-1}$	-0.05	1.00								
CREDBOOM $_{t-1}$	0.05	-0.24	1.00							
DOMCREDPR $_{t-1}$	0.17	0.16	0.19	1.00						
BROADMONEY $_{t-1}$	0.06	0.39	-0.07	0.79	1.00					
M2GDP $_{t-1}$	0.05	0.39	-0.07	0.78	1.00	1.00				
INF $_{t-1}$	-0.04	-0.36	0.00	-0.51	-0.58	-0.58	1.00			
GDPGR $_{t-1}$	0.02	-0.12	-0.05	-0.14	-0.19	-0.18	0.04	1.00		
GDPPCGR $_{t-1}$	0.02	-0.01	-0.08	-0.10	-0.13	-0.13	-0.05	0.96	1.00	
REALINTR $_{t-1}$	0.01	-0.12	0.09	-0.04	-0.05	-0.04	0.20	-0.01	-0.05	1.00

Table 3: Correlation Matrix for Developing Countries

	BANKCRISES	*CABGDP* $_{t-1}$	*CREDBOOM* $_{t-1}$	*DOMCREDPR* $_{t-1}$	*BROADMONEY* $_{t-1}$	*M2GDP* $_{t-1}$	*INF* $_{t-1}$	*GDPGR* $_{t-1}$	*GDPPCGR* $_{t-1}$	*REALINTR* $_{t-1}$
BANKCRISES	1.00									
CABGDP $_{t-1}$	-0.13	1.00								
CREDBOOM $_{t-1}$	0.09	-0.10	1.00							
DOMCREDPR $_{t-1}$	0.06	0.16	0.05	1.00						
BROADMONEY $_{t-1}$	-0.05	0.28	-0.07	0.83	1.00					
M2GDP $_{t-1}$	-0.05	0.28	-0.07	0.83	1.00	1.00				
INF $_{t-1}$	0.02	-0.07	0.05	-0.39	-0.47	-0.47	1.00			
GDPGR $_{t-1}$	-0.02	-0.01	0.01	0.21	0.23	0.23	-0.39	1.00		
GDPPCGR $_{t-1}$	0.00	0.00	0.05	0.21	0.22	0.21	-0.40	0.97	1.00	
REALINTR $_{t-1}$	0.01	-0.10	-0.03	-0.07	-0.08	-0.08	-0.20	0.02	0.02	1.00

3. EMPIRICAL METHODOLOGY AND FINDINGS

In this section, we examine the model, estimation technique and regression results. We work with a panel data set that contains annual observations for each country over the period 1970-2008. We later test the robustness of our results to the choice of empirical specification.

Model

We estimate the following logit specification defined as:

$$\Pr\left(\text{BANKCR}_{it} \mid X_{it-1}\right) = \begin{cases} p_{it} \; if \; \text{BANKCR}_{it} = 1 \\ 1\text{-}p_{it} if \; \text{BANKCR}_{it} = 0 \end{cases}$$

$$\text{logit}\left(E\left[BANKCR_{it} \mid X_{it-1}\right]\right) = \text{logit}(p_{it}) = \ln(p_{it}/(1-p_{it})) = \beta.X_{it-1}$$

Here *t* denotes time, *i* represents country. Dependent variable, banking crisis is a binary variable, which is used with 1 denoting the onset of a banking crisis and 0 otherwise. X_{it} is the explanatory macroeconomic variables. We used the lagged values of explanatory variables in order to minimize feedback from the crisis to the control variables. Fixed-effect panel logit estimation technique is used for the analysis. Model is estimated using two different samples –developed and developing countries.

All explanatory variables defined in the previous section are used variably in different specification of regressions. Regressors are: $CABGDP_{t-1}$, $DOMCREDPR_{t-1}$, $CREDBOOM_{t-1}$, $BROADMONEY_{t-1}$, $M2GDP_{t-1}$, $INTDOMCRCABGDP_{t-1}$, INF_{t-1}, $GDPGR_{t-1}$, $GDPPCGR_{t-1}$ and $REALINTR_{t-1}$. Credit boom, represented by *CREDBOOM*, is calculated as percentage change of 5-year moving average of domestic credit provided by banking sector to the private sector.

INTDOMCRCABGDP, is the interaction term, which is the product of domestic credit given to the private sector (percent of *GDP*) and current account balance (percent of *GDP*). In the analysis, GDP per capita (*GDPPCGR*), real interest rate (*REALINTR*), *GDP* growth rate (*GDPGR*) and inflation rate (*INF*) are used as control variables.

Table 4a and 4b present the results from panel logit regressions with fixed effects for developing countries. One of the striking results to note for developing countries is that *CABGDP, DOMCREDPR* as well as indicators related to monetary aggregates such as *BROADMONEY* and *M2GDP* have been noticed as significantly contributing to the likelihood of a banking crisis. In the first regression (1), *CABGDP*, and in the second regression (2), *DOMCREDPR*, is the sole explanatory variable. We found that high rate of current account imbalances or domestic credit extended to the private sector alone has been indicative of an increasing risk of financial crisis. Coefficient of change in credit growth over GDP (*CREDBOOM*) in regressions (4) and (11) has been found statistically significant only in the regression (4), where they are together with current account imbalances. The variable indicating credit boom (*CREDBOOM*) has lost its significance when other control variables are added to the regression. [19]

An important point to note here is that widening current account imbalances have been a significant and robust factor in raising the likelihood of financial crises as can be viewed in almost all regressions. Furthermore, two different definition of money supply - *BROADMONEY* and *M2GDP*- have been statistically significant in raising the risk of financial crises in regressions (3), (5) and (6). Nevertheless, those monetary aggregates have not been as robust as current account imbalances (*CABGDP)* or domestic credit extended to private sector (*DOMCREDPR)* in raising the probability of financial crises. On the other side,

[19] Therefore, regression results, where credit boom is not found statistically significant are not reported.

since monetary aggregates can be viewed as a proxy for credits, their impact as statistically significant risk factor on financial crises is in line with expectations.

One of the striking results here is that, domestic credits (*DOMCREDPR)* rather than credit booms (*CREDBOOM*) have been more effective in raising the probability of financial crises in developed countries on the basis of estimation results. On the other hand, since credit booms are calculated using domestic credit variable, this situation can be viewed as arising from the fact that credit booms are rather rare events in the course of the analysis.

Interaction term between current account imbalances and credit trends, *INTDOMCRCABGDP*, in the regressions (7)-(10), has a statistically significant impact in raising the probability of crises, confirming the results obtained related to current account and domestic credit. According to estimation results overall, both current account imbalances and credit trends have been robust in raising the probability of financial crises in developed countries. On the other side, a comparison as regards these two variables yields credit growth over GDP as a more robust variable.

Table 4a: Panel Regressions (Developed Countries)

Logit Fixed-Effect Model Regression
Dependent Variable: Financial Crisis

	(1)		(2)		(3)		(4)		(5)		(6)	
$CABGDP_{t-1}$	-0.13	**	-		-0.13		-0.11	*	-0.15	*	-	
	-(2.35)		-		-(1.60)		-(1.83)		-(1.80)		-	
$CREDBOOM_{t-1}$	-		-		-		0.04	*	-		-	
	-		-		-		(1.76)		-		-	
$DOMCREDPR_{t-1}$	-		0.04	***	-		-		-		-	
	-		(4.93)		-		-		-		-	
$BROADMONEY_{t-1}$	-		-		0.06	***	-		-		0.06	***
	-		-		(2.75)		-		-		(3.08)	
$M2GDP_{t-1}$	-		-		-		-		0.08	***	-	
	-		-		-		-		(3.33)		-	
$INTDOMCRCABGDP_{t-1}$	-		-		-		-		-		-	
	-		-		-		-		-		-	
INF_{t-1}	-		-		-		-		-		-	
	-		-		-		-		-		-	
$GDPGR_{t-1}$	-		-		-		-		-		-	
	-		-		-		-		-		-	
$GDPPCGR_{t-1}$	-		-		-		-		-		-	
	-		-		-		-		-		-	
$REALINTR_{t-1}$	-		-		-		-		-		-	
	-		-		-		-		-		-	
LR chi2(df)	5.42		42.18		13.50		7.68		22.78		12.14	
Prob>chi2 (p value)	0.02		0.00		0.00		0.02		0.00		0.00	

Notes : *** 1 percent significance level, ** 5 percent significance level, *10 percent significance level.

t-tests are provided in the parenthesis.

Table 4b: Panel Regressions (Developed Countries)

Logit Fixed-Effect Model Regression
Dependent Variable: Financial Crisis

	(7)		(8)		(9)		(10)		(11)	
$CABGDP_{t-1}$	-0.24	**	-0.4731	*	-0.22	*	-0.44	*	-0.13	**
	-(2.07)		-(1.87)		-(1.82)		-(1.88)		-(2.10)	
$CREDBOOM_{t-1}$	-		-		-		-		0.04	
	-		-		-		-		(1.61)	
$DOMCREDPR_{t-1}$	0.05	***	0.06	***	0.05	***	0.06	***	-	
	(4.57)		(3.30)		(4.46)		(3.30)		-	
$BROADMONEY_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
$M2GDP_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
$INTDOMCRCAB_{t-1}$	0.002	**	0.003	**	0.002	**	0.0025	**	-	
	(2.08)		(2.03)		(2.01)		(2.12)		-	
INF_{t-1}	-		0.38		0.34		0.32		-0.46	
	-		(0.44)		(0.83)		(0.36)		-(1.38)	
$GDPGR_{t-1}$	-		-		0.11		-		-	
	-		-		(0.86)		-		-	
$GDPPCGR_{t-1}$	-		0.16		-		-		-	
	-		(0.94)		-		-		-	
$REALINTR_{t-1}$	-		0.03		-		0.01		-	
	-		(0.18)		-		(0.09)		-	
LR chi2(df)	43.15		26.65		42.99		25.69		9.73	
Prob>chi2 (p value)	0.00		0.00		0.00		0.00		0.02	

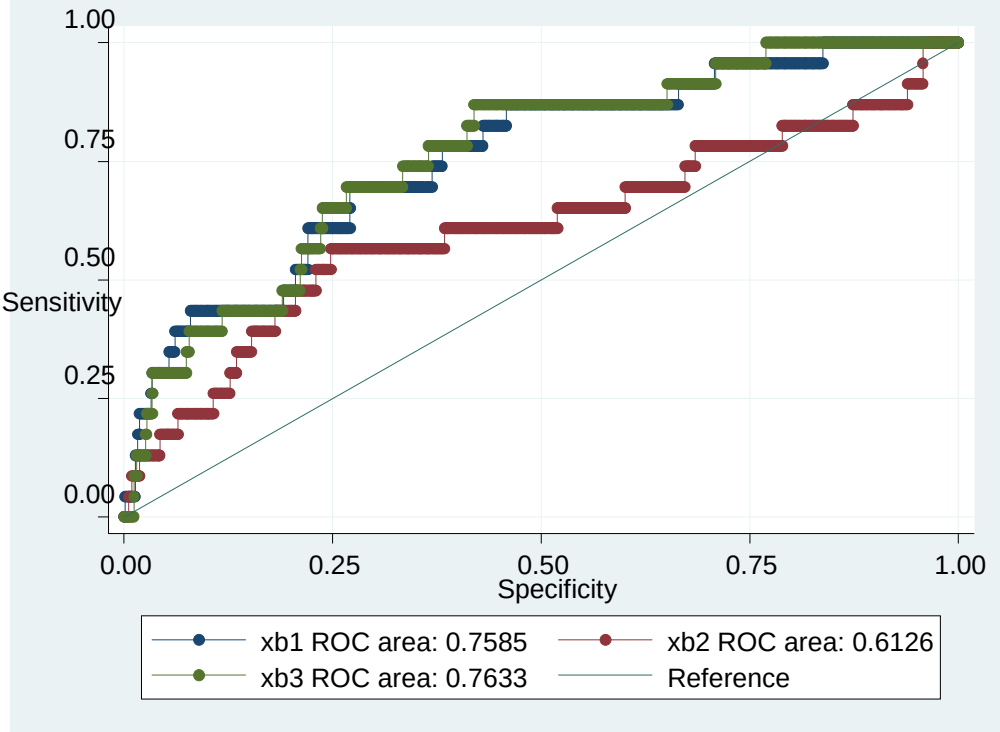
Notes : *** 1 percent significance level, ** 5 percent significance level, *10 percent significance level.

t-tests are provided in the parenthesis.

Predictive ability of the model is tested for the regressions (2), (4) and (7), using ROC curve analysis, which is shown in Figure 3. xb1 ROC area represents predictive ability of regression (2), xb2 ROC area represents that of regression (4) and xb3 ROC area shows predictive ability of regression (7). The area under the ROC curve for the regressions (2) and (7), where domestic credit extension is involved, is greater than that of regression (4), where credit boom is placed into the regression. This means that predictive ability of the model involving domestic credit extension is better than that of including credit boom. Furthermore,

integration of current account balance and interaction term to the regression (2) that involves domestic credit raised predictive ability of the model only a little. In other words, predictive ability test results confirm the conclusion from the regression analysis that higher domestic credits are better indicative of an increasing risk of financial crisis than current account imbalances in developed countries.

Figure 3: Predictive Ability Testing (Developed Countries)
ROC curve comparison



Panel logit fixed effect estimation results for developing countries are summarized in Tables 5a and 5b. Estimation results underline mainly the impact of two variables, namely current account imbalances (*CABGDP*) and domestic credit trends (*DOMCREDPR)*, for developed countries as well, as in the case of developed countries. Similar to the results obtained for developed countries, domestic credit extension is again indicative of an increasing risk of financial crisis. On the other side, for developing countries, current account imbalances are more robust in raising the probability of financial crisis than credit trends. Interaction term of *INTDOMCRCABGDP* is not found to be statistically significant. Again in contrast to

estimation results related to developed countries, credit booms are not statistically significant in raising the probability of financial crisis. Credit booms, together with current account imbalances and control variables, are found to be not statistically significant. In other words, current account imbalances seem to be the most robust indicative of an increasing risk of financial crisis.

Table 5a: Panel Regressions (Developing Countries)

Logit Fixed-Effect Model Regression
Dependent Variable: Financial Crisis

	(1)		(2)		(3)		(4)		(5)	
$CABGDP_{t-1}$	-0.16	***	-		-0.15	***	-0.16	***	-0.16	***
	-(3.67)		-		-(3.41)		-(3.58)		-(3.64)	
$CREDBOOM_{t-1}$	-		-		-		-		0.0042	
	-		-		-		-		(0.45)	
$DOMCREDPR_{t-1}$	-		0.03	***	0.03	***	-		-	
	-		(3.31)		(2.85)		-		-	
$BROADMONEY_{t-1}$	-		-		-		0.01		-	
	-		-		-		(1.04)		-	
$M2GDP_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
$INTDOMCRCAB_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
INF_{t-1}	-		-		-		-		-	
	-		-		-		-		-	
$GDPGR_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
$GDPPCGR_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
$REALINTR_{t-1}$	-		-		-		-		-	
	-		-		-		-		-	
LR chi2(df)	15.34		15.53		23.20		14.21		16.34	
Prob>chi2 (p value)	0.00		0.00		0.00		0.00		0.00	

Notes : *** 1 percent significance level, ** 5 percent significance level, *10 percent significance level. t-tests are provided in the parenthesis.

Table 5b: Panel Regressions (Developing Countries)

Logit Fixed-Effect Model Regression
Dependent Variable: Financial Crisis

	(6)		(7)		(8)	
$CABGDP_{t-1}$	-0.22	***	-0.21	***	-0.16	***
	-(3.15)		-(2.47)		-(3.47)	
$CREDBOOM_{t-1}$					0.004	
					0.41	
$DOMCREDPR_{t-1}$	0.03	***	0.02	*		
	(3.23)		(1.89)			
$BROADMONEY_{t-1}$						
$M2GDP_{t-1}$						
$INTDOMCRCAB_{t-1}$	0.001		0.001			
	(1.40)		(0.81)			
INF_{t-1}			0.10		0.14	
	-		(0.36)		(0.86)	
$GDPGR_{t-1}$	-					
	-					
$GDPPCGR_{t-1}$	-		-0.01		0.017	
	-		-(0.25)		0.42	
$REALINTR_{t-1}$	-		0.01			
	-		(0.64)			
LR chi2(df)	24.89		18.14		16.15	
Prob>chi2 (p value)	0.00		0.00		0.00	

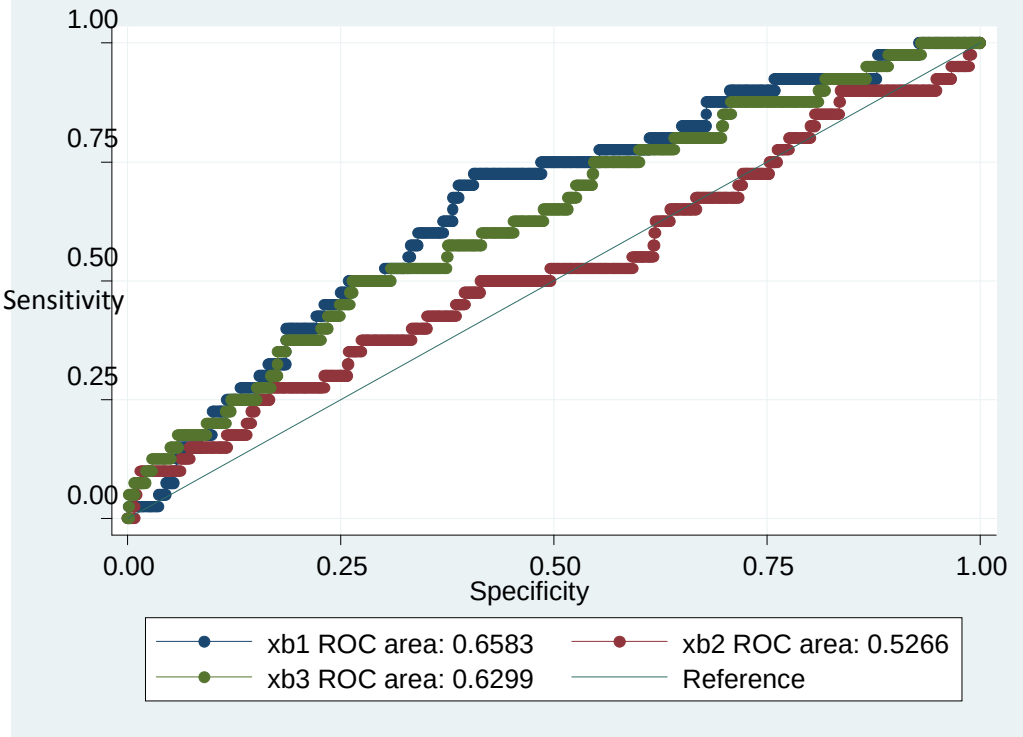
Notes : *** 1 percent significance level, ** 5 percent significance level, *10 percent significance level.

t-tests are provided in the parenthesis.

Predictive ability of regressions (1), (2) and (3) can be viewed in Figure 4. Predictive ability of regressions (1) (2) and (3) is represented by the ROC areas xb1, xb2 and xb3 respectively. Predictive ability of the model (1) having current account balance as the sole explanatory variable (xb1) is much higher than the predictive ability of the model (2) that involves only domestic credit extension as the explanatory variable (xb2). When we let current account enter into the model in regression (3), predictive ability of the model has increased

significantly, as represented by the area (xb3). Therefore, those findings support the results obtained regarding robust significance of current account imbalances in the panel logit model estimations.

Figure 4: Predictive Ability Testing (Developing Countries)
ROC curve comparison



To summarize the key results of estimation results, it is viewed that widening current account imbalances for developing countries and credit expansions for developed countries are better indicative of an increasing risk of financial crisis. As a matter of fact, both current account imbalances and high domestic credit extensions raises the probability of financial crisis in both country groups. Credit booms are found to be statistically significant in raising the probability of financial crisis only for developed countries.

2. CONCLUSION

There are different explanations about how crises occur. These models have been developed in response to changing characteristics of the crises over time, especially in the 1990s. Every model has been developed in the aftermath of a new crisis in order to explain the dynamics of the crisis and desire to generalize main aspects. However, both theoretical and empirical analysis of the crises in this period in the literature point to different conclusions. One of the main reasons of this non-consensus is that one cannot make generalization as to the macroeconomic conditions under which financial crises have occurred. Empirical analysis obtain different results as regards to the impact of explanatory variables, since there is no single way of measuring the explanatory variables, besides no agreement on which explanatory variables to include. Even, there is no consensus in the literature as regards to the definition of crisis.

In this study, factors affecting the probability of financial crisis are evaluated separately for developed and developing countries over the period 1970-2008. Together with integrating the recent global crisis into the analysis, it has been possible to question the impact of credit growth on financial crisis. Furthermore, it is aimed to question the role of current account imbalances in leading financial crisis in terms of developed countries as well in addition to the findings related to developing countries in the literature.

To summarize the estimation results, current account imbalances and credit trends have been found to be robust indicators of an increasing risk of financial crisis both in developed and developing countries. On the other side, credit trends in developed countries, current account imbalances in developing countries have been more statistically significant indicators of raising probability of financial crisis. While these are mostly confirmations of previous studies, our estimation results differentiating the role of these macro variables

separately in developed and developing countries as well as incorporating the recent financial crisis into the analysis provide insights into the determinants of banking crises in these two different country groups.

APPENDIX 1: Name and Definition of Variables and Sources

Variable Name		*Definition*	*Source*
BANKCRISIS	Systemic Banking Crisis	Dummy Variable, where 1 indicates a crisis.	Laeven ve Valencia (2010) http://www.luclaeven.com/Data.htm
INF	Inflation	Natural log of (1+ CPI Growth Rate)	World Development Indicators (WDI) online database, World Bank
CABGDP	Current Account Balance (percent of GDP)		World Development Indicators (WDI) online database, World Bank
GDPPCGR	Per capita growth rate (percent)		World Development Indicators (WDI) online database, World Bank
M2GDP	Money Supply (percent of GDP)		World Development Indicators (WDI) online database, World Bank
BROADMONEY	Broad Money Supply (percent of GDP)		World Development Indicators (WDI) online database, World Bank
GDPGR	GDP Growth Rate (percent)		World Development Indicators (WDI) online database, World Bank
DOMCREDPR	Domestic credit given to the private sector (percent of GDP)		World Development Indicators (WDI) online database, World Bank
REALINTR	Real Interest Rate (percent)		World Development Indicators (WDI) online database, World Bank

APPENDIX- 2: Banking Crises

Country	Banking Crisis (year of start)
Argentina	1980, 1989, 1995, 2001
Austria	2008
Belgium	2008
Brazil	1990, 1994
Czech Republic	1996
China	1998
Denmark	2008
Chile	1976, 1981
Colombia	1982, 1998
Egypt	1980
Finland	1991
France	2008
Germany	2008
Greece	2008
Hungary	1991, 2008
Iceland	2008
India	1993
Indonesia	1997
Ireland	2008
Israel	1977
Japan	1992, 1997
Kazakhstan	2008
Korea	1997
Letonia	1995, 2008
Malaysia	1997
Mexico	1981, 1994
Fas	1980
Netherlands	2008
Norway	1991
Peru	1983
Philippines	1983, 1997
Poland	1992
Portugal	2008
Russia	1998, 2008
Slovenia	1992, 2008
Spain	1977, 2008
Sri Lanka	1989
Sweden	1991, 2008
Switzerland	2008
Thailand	1983, 1997
Turkey	1982, 2000
Ukraine	1998, 2008
United Kingdom	2007
United States	1988, 2007
Venezuela	1994
Zimbabwe	1995

Source: Laeven and Valencia (2010:11, 2012:24-26)

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Acknowledgements

I would like to thank to Cihan Yalçın, Koray Alper and Pınar Özlü for their valuable comments.

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