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## Financial reform and banking crises

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# Financial Reform and Banking Crises

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# Financial Reform and Banking Crises

## Abstract

We examine the impact of various dimensions of financial reform on the likelihood of systemic and non-systemic banking crises. Using new financial reform measures for a large sample of developing and developed countries for the period 1973 to 2002, our multivariate probit modeling results suggest that conditional on adequate banking supervision, certain dimensions of financial reform reduce the likelihood of systemic crises. We also show that after a country has reformed, the introduction of further reforms becomes easier and leads to more stable financial systems. We also find some evidence that the likelihood of non-systemic crisis increases after financial reform.

JEL Code: E44, G21, G28, F36.

Keywords: banking crises, financial reform, financial fragility.

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## 1. Introduction

Financial reform can be defined as measures aiming at the removal of non-competitive market forces in the financial sector, thereby increasing its level of liberalization. Consequently, financial reform improves financial sector development, which, in turn, may enhance economic growth. At the same time, there is some evidence that increasing liberalization induces risk-taking behavior and may cause banking crises (cf. Kaminsky and Reinhart, 1999; Mehrez and Kaufmann, 2000). However, previous studies did not consider the conditioning impact of supervisory control or the overall level of financial liberalization in analyzing the impact of reform on the likelihood of crises. Moreover, the financial liberalization data used in these studies was quite limited and rather subjective. We employ a better methodology and an extensive new data set of financial reform recently provided by Abiad *et al.* (2008) to examine the impact of financial reform on banking crises. Our findings suggest that certain dimensions of financial reform reduce the likelihood of systemic banking crises—defined as crises in which much or all bank capital has been exhausted—conditional on adequate banking supervision. This result is broadly in line with the finding of Beck *et al.* (2006) that the presence of regulatory policies and institutions that discourage competition are associated with greater banking system fragility. We also find that once a country has reformed, the introduction of further reforms becomes easier and leads to more stable financial systems. This implies that there is a “learning effect” which has also been pointed out by Abiad and Mody (2005) in a different context. Moreover, we find some evidence that the likelihood of non-systemic crises—defined as crises limited to a small number of banks—increases after financial reform enhancing liberalization. These results therefore suggest that increased competition due to the financial reform may lead to the elimination of some inefficient financial institutions.

We analyze the impact of financial reform on systemic and non-systemic banking crises in 85 countries during the period 1973 to 2002. Our data on banking crises come from Honahan and Laeven (2005). Our indicator of financial form is based on the data set of Abiad *et al.* (2008) indicating the extent to which a financial system is liberalized.<sup>2</sup> This is an extended and updated version of the

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<sup>2</sup> The dataset of Abiad *et al.* (2008) covers 91 countries and a longer period, but many other explanatory variables are not available for all countries, thereby restricting our sample.

database as used by Abiad and Mody (2005), covering various dimensions of the financial system. The measures relate to the presence of (i) credit controls and reserve requirements, (ii) interest rate controls, (iii) entry barriers, (iv) state ownership in the banking sector, (v) capital account restrictions, (vi) prudential regulation and supervision of the banking sector, and (vii) securities market policy.

We address the following research questions: (1) does financial reform, conditional on supervisory control, affect the likelihood of a systemic banking crisis, and if so, are there differences among the various dimensions of financial reform that we distinguish? (2) Does the impact of financial reform on banking crises vary at different levels of liberalization of the financial system? and (3) Are systemic and non-systemic crises affected in the same way by financial reform leading to more liberalization?

The rest of the paper is organized as follows. Section 2 provides a discussion on the determinants of banking crises and a brief literature review. It also introduces our measures for financial reform and banking crises. Section 3 describes the specification of our model and explains other explanatory variables used in our analysis. Section 4 analyses the impact of financial reform on the likelihood of systemic crises. Section 5 examines whether the impact of financial reform is conditioned by the level of liberalization. Section 6 deals with the impact of financial liberalization on non-systemic crises. Finally, section 7 offers a discussion of our results and their policy implications.

## **2. Financial reform and banking crisis**

### *2.1 Previous studies*

Demirgüç-Kunt and Detragiache (1998) analyze the relationship between banking crises and policies aimed at increasing financial liberalization using data over the period 1980-95 for 53 countries. Their findings suggest that banking crises are more likely to occur in liberalized financial systems. They also find that the impact of financial liberalization on a fragile banking sector is weaker where the institutional environment is strong. The indicator of financial reform used by Demirgüç-Kunt and Detragiache (1998) is a dummy variable taking a value of one for the first year in which some interest rates were liberalized. Although interest rate liberalization is

important, it only covers a minor part of financial sector reform. Furthermore, this indicator does account for policy reversals.

Mehrez and Kaufmann (2000) examine how absence of corruption ('transparency') affects the probability of a financial crisis. Using multivariate probit modeling for 56 countries during 1977-97, they report a higher probability of a crisis following financial reform during the following five years. Moreover, they find that the crisis probability is higher in countries with poor transparency than in countries that are transparent. Mehrez and Kaufmann (2000) provide their own dating of financial reform and construct their reform measure on the basis of these dates.

Focusing on the link between currency and banking crises, Kaminsky and Reinhart (1999) analyze 76 currency crises and 26 banking crises for 20 countries during 1970 to mid-1995. One of their main findings is that financial reform enhancing liberalization often precedes banking crises. Their proxy for increased financial liberalization is two-year lagged domestic credit growth. Again, this is a poor proxy as increased credit growth may also be caused by various other factors than financial reform and it does not capture the diversity of financial reform.

On the basis of a panel analysis, Caprio and Martinez (2000) find that government ownership of banks increases the likelihood of banking crisis. However, Barth *et al.* (2004) using cross-country analysis, do not find that government ownership is significantly associated with increases in bank fragility once they control for the regulatory and supervisory environment.

There are also various papers that do not explicitly include policies aiming at financial liberalization as a potential determinant of banking crises. A good example is the recent study by Beck *et al.* (2006) who examine the impact of bank concentration, bank regulations, and national institutions on the likelihood that a country experiences a systemic banking crisis. They use data from 1980 to 1997 for 69 countries and report that crises are less likely in economies with more concentrated banking systems. Moreover, they find that regulatory policies and institutions that discourage competition are associated with greater banking system fragility.

## 2.2 Data

The studies discussed above use different indicators of banking crises. Our indicator of banking crises is based on the Honohan and Laeven (2005) dataset that updates the work by Caprio and Klingebiel (1999), distinguishing between systemic and non-systemic banking crises that have occurred since the late 1970s. To the best of our knowledge, this is the most comprehensive database on banking crises.<sup>3</sup> In our analysis of the relationship between (systemic and non-systemic) banking crises and financial reform we use a sample of 85 countries during 1973 to 2002. This selection is primarily dictated by the availability of the financial liberalization index, to be discussed hereafter, and the availability of control variables. Table A1 in the Appendix identifies the years in which the countries in our sample had a crisis.

Our data on financial liberalization come from Abiad *et al.* (2008) who distinguish seven dimensions of the extent to which the financial sector has been liberalized that are graded on scale from 3 (fully liberalized) to 0 (not liberalized). Apart from distinguishing between different dimensions of financial liberalization on an annual basis, the database has the advantage that it allows for policy reversals. The first dimension of liberalization refers to credit controls and excessively high reserve requirements (referred to as credit controls henceforth) focusing on the presence of specific credit ceilings or floors, and reserve requirements. The second dimension is about interest rate controls examining whether they are administered by the government, and whether there are floors, ceilings or bands present. The third dimension is entry barriers, which is based on licensing requirements and restrictions on geographical outreach activities. The fourth dimension covers state ownership in the banking sector, i.e., the share of the assets of the banking sector controlled by state-owned banks. The fifth dimension refers to capital account restrictions and other restrictions on international capital flows. The sixth dimension captures prudential regulations and supervision of the banking sector, including compliance with the Basel standards, and executive influence on the banking supervisory agency. The final dimension refers to

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<sup>3</sup> Caprio and Klingebiel (1999) define a systemic banking crisis as a crisis in which much or all bank capital been exhausted. Honohan and Laeven (2005) use the same definition. A non-system banking crisis is a crises limited to a small number of banks. We could not use the updated dataset provided

securities market policy covering the auctioning of government securities, debt and equity market development, and openness to foreign investors.

Abiad *et al.* (2008) acknowledge that the dimension referring to the supervision and prudential regulation of banks is different from the other dimensions of financial liberalization. A higher score in this case means better (or more) regulation. So in our empirical analysis, we do not treat this as a dimension of financial liberalization. We also exclude it in calculating our overall liberalization measure, which consists of the sum of the scores of the various liberalization dimensions excluding supervision.

Figure 1 shows the growth of the different financial liberalization measures and the financial supervision measure over the period of 1973-2005, differentiating between high-income OECD countries and other countries. As follows from Figure 1, the average level of financial liberalization has increased over time, but the financial systems of high-income OECD countries are more liberalized than those of other countries in the sample and they are better supervised as well. Still, the gap between the two groups of countries has decreased over the 1973-2005 period for all liberalization dimensions, except for securities markets and capital controls. However, while financial systems in non-high-income OECD countries have been liberalized substantially, their supervisory control systems have evolved more slowly and the gap with high-income OECD countries has increased. As our results suggest that supervisory control should be complementary to financial reform enhancing liberalization, weaknesses in this respect may result in financial vulnerability.

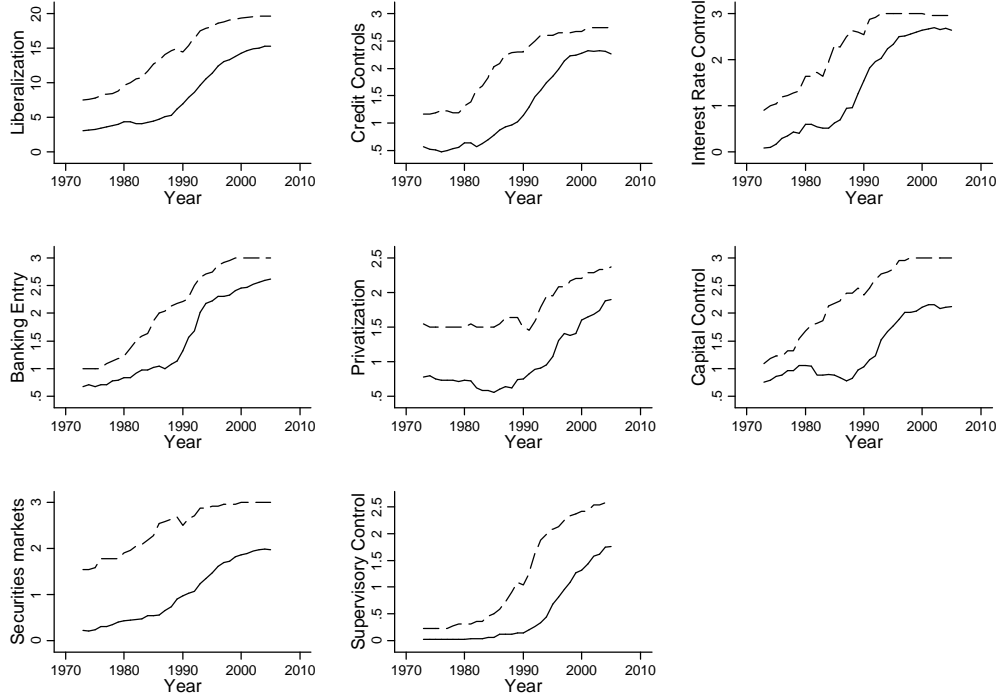
We take the change of the various liberalization measures as our indicators of financial reform. Table A2 in the appendix shows Spearman's rank correlation coefficients between the different indicators of financial reform. It follows that the various dimensions of financial reform clearly differ from one another.

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by Laeven and Valencia (2008) as it does not distinguish between systemic and non-systemic crises, while the duration of the crises is also not available.



**Figure 1. Financial liberalization and supervision in high-income OECD and other countries**



This figure presents trends in (different types of) financial liberalization and bank supervision in high-income OECD and other countries over the period 1973-2005. The dashed lines represent financial liberalization and supervisory control for high-income OECD countries while the solid lines refer to other countries in our sample.

### 3. Model specification

To analyze the impact of financial liberalization on systemic and non-systemic banking crises, we estimate the following model:

$$\begin{aligned} \mathbf{Crisis}_{i,t} = & \alpha_{i,t} + \lambda(\mathbf{Lib}_{i,0}) + \psi \left[ \sum_{t=1}^{-4} (\Delta \mathbf{Lib})_i \right] + \theta(\mathbf{Sup}_{i,t}) + \eta \left[ \sum_{t=1}^{-4} (\Delta \mathbf{Lib})_i \right] * (\mathbf{Sup}_{i,t}) \\ & + \gamma(\mathbf{Ctrl}_{i,t}) + \xi_{i,t} \end{aligned} \quad (1)$$

The dependent variable  $\mathbf{Crisis}_{i,t}$  takes a value of 1 if there is a banking crisis and zero if there is no crisis. In section 4 the dependent variable refers to systemic crisis, while in section 6 the dependent variable refers to non-systemic crisis.<sup>4</sup> The

<sup>4</sup> Following previous studies, we assume that banking crises do not lead to a new regime so that the model does not suffer from the Lucas critique. However, during a banking crisis the impact of the

likelihood of a crisis in country  $i$  at time  $t$  is a function of the initial level of liberalization ( $\mathbf{Lib}_{i,0}$ ); reform, taken here as the cumulative change in the level of any liberalization dimension over the current and last four years period ( $\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i$ ); the level of supervisory control ( $\mathbf{Sup}_{i,t}$ ); and a matrix of control variables ( $\mathbf{Ctrl}_{i,t}$ ). Following Mehrez and Kaufmann (2000), we examine the impact of reform measures taken over a five-years period on the likelihood of a banking crisis thereby minimizing potential problems of endogeneity. To check for the conditioning effect of banking supervision, we introduce an interaction term of financial reform with the level of supervision.

Models with interactive terms cannot be interpreted directly on the basis of the coefficients of the constituent or interaction terms and their significance (Aiken and West, 1991; Brambor *et al.*, 2006; and Shehzad *et al.*, 2010). Therefore, we follow the approach suggested by Aiken and West (1991) for non-linear models. If  $\Phi$  is the standard normal cumulative distribution and  $X_{i,t}$  denotes the explanatory variables in equation (1) then the conditional mean of the crisis variable can be written as:

$$E[\Pr(\mathbf{Crisis})_{i,t} | \mathbf{X}_{i,t}] = \Phi[\alpha_{i,t} + \lambda(\mathbf{Lib}_{i,0}) + \psi[\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i] + \theta(\mathbf{Sup}_{i,t}) + \eta[\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i] * (\mathbf{Sup}_{i,t}) + \gamma(\mathbf{Ctrl}_{i,t})] = \Phi(.) \quad (2)$$

The key hypothesis to test for the marginal effect of financial reform on the probability of a crisis, conditional on supervisory control, is:

$$H_0 = \frac{\partial \Phi(.)}{\partial [\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i]} = \psi \Phi(.) + \eta \Phi(.) * (\mathbf{Sup}_{i,t}) = 0$$

$$H_1 = \frac{\partial \Phi(.)}{\partial [\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i]} = \psi \Phi(.) + \eta \Phi(.) * (\mathbf{Sup}_{i,t}) \neq 0$$

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right-hand side variables may be different than during normal times. We will address this issue later in the paper.

Where  $\psi \Phi (\cdot)$  refers to the direct marginal effect of  $\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i$  and  $\eta \Phi(\cdot)$  refers to the marginal effect of the interaction term. The stated hypothesis tests the total marginal impact of  $\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i$ , which may vary at different levels of supervisory control.

To address our second research question, we interact financial reforms with the level of liberalization. The resulting model can identify whether the impact of financial reform on systemic crises varies at different levels of liberalization. The corresponding model is:

$$\begin{aligned} \mathbf{Crisis}_{i,t} = & \alpha^{\tau}_{i,t} + \psi^{\tau} \left[ \sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i \right] + \theta^{\tau} (\mathbf{Sup}_{i,t}) + \pi(\mathbf{Lib}_{i,t}) + \eta^{\tau} \left[ \sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i \right] * (\mathbf{Lib}_{i,t}) \\ & + \gamma^{\tau} (\mathbf{Ctrl}_{i,t}) + \zeta_{i,t} \end{aligned} \quad (3)$$

If  $\Phi$  is the standard normal cumulative distribution and  $\mathbf{X}^{\Gamma}_{i,t}$  denotes all explanatory variables in equation (3), the conditional mean of the crisis variable can be written as:

$$\begin{aligned} E[\Pr(\mathbf{Crisis})_{i,t} | \mathbf{X}^{\Gamma}_{i,t}] = & \Phi \left[ \alpha^{\tau}_{i,t} + \psi^{\tau} \left[ \sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i \right] + \theta^{\tau} (\mathbf{Sup}_{i,t}) + \pi(\mathbf{Lib}_{i,t}) + \eta^{\tau} \left[ \sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i \right] * (\mathbf{Lib}_{i,t}) \right. \\ & \left. + \gamma^{\tau} (\mathbf{Ctrl}_{i,t}) \right] = \Phi(\kappa) \end{aligned} \quad (4)$$

The key hypothesis to test for the marginal effect of financial reform on the probability of a crisis, conditional on different levels of liberalization, can be derived from equation (4) as:

$$\begin{aligned} H_0 = & \frac{\partial \Phi(\kappa)}{\partial \left[ \sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i \right]} = \psi^{\tau} \Phi(\kappa) + \eta^{\tau} \Phi(\kappa) * (\mathbf{Lib}_{i,t}) = 0 \\ H_1 = & \frac{\partial \Phi(\kappa)}{\partial \left[ \sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i \right]} = \psi^{\tau} \Phi(\kappa) + \eta^{\tau} \Phi(\kappa) * (\mathbf{Lib}_{i,t}) \neq 0 \end{aligned}$$

Where  $\psi^{\tau} \Phi(\kappa)$  refers to the direct marginal effect of  $\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i$  and  $\eta^{\tau} \Phi(\kappa)$  refers to the marginal effect of the interaction term. The stated hypothesis

tests the total marginal impact of  $\sum_{i=1}^{-4}(\Delta \mathbf{Lib})_i$  which may vary at different levels of liberalization.

We include various control variables following previous studies like Kaminsky and Reinhart (1999), Beck *et al.* (2006), and Demirgüç-Kunt and Detragiache (2002). These variables include real GDP growth (one-year lagged), the rate of inflation<sup>5</sup> (change in CPI), the real interest, and the depreciation of the exchange rate. Finally, we include initial level of real GDP per capita (in US\$) to control for the level of economic development, and the initial level of financial liberalization. Table 1 summarizes the control variables and Table A3 in the appendix gives a list of our dependent and independent variables<sup>6</sup> and also provides their sources and expected signs.

Variable	Mean	Standard Deviation	Minimum	Maximum	Observations
<b>Systemic crises</b>	0.189	0.392	0	1	1459
<b>Non-systemic crises</b>	0.070	0.255	0	1	1459
<b>Liberalization (overall)</b>	11.742	6.062	0	21	1459
<b>Credit controls</b>	1.826	1.058	0	3	1459
<b>Interest rate control</b>	2.101	1.216	0	3	1459
<b>Banking entry</b>	1.912	1.131	0	3	1459
<b>Privatization</b>	1.411	1.191	0	3	1459
<b>Supervisory control</b>	0.888	0.979	0	3	1459
<b>Capital controls</b>	1.870	1.088	0	3	1459
<b>Securities markets</b>	1.734	1.076	0	3	1459
<b>Real GDP growth</b>	0.033	0.038	-0.14	0.17	1459
<b>Log (GDP/capita)</b>	8219.502	9572.304	93.01	38200.41	1459
<b>Real interest rate</b>	7.256	24.615	-97.81	789.80	1459
<b>Inflation</b>	0.104	0.130	-0.11	0.99	1459
<b>Depreciation</b>	-2.331	55.211	-1848.73	1.00	1459
<b>Economic freedom index</b>	24.919	5.432	9.56	36.85	1347
<b>Openness</b>	64.535	38.696	6.32	368.01	1436
<b>Bank concentration</b>	0.671	0.206	0.20	1.00	827
<b>Corruption</b>	3.636	1.436	0.00	6.00	1169
<b>Money and quasi-money/GDP</b>	92.444	764.187	4.70	18798.83	1188
<b>Credit to private sector/GDP</b>	0.518	0.428	0.01	3.45	1390

<sup>5</sup> The inflation rate (p) is transformed by the formula  $(p/100)/(1+(p/100))$  to reduce the influence of extreme observations.

<sup>6</sup> Data for certain variables, like bank concentration, corruption, money and quasi-money to GDP ratio, and credit to private sector, was not available for the whole period of analysis. Introducing these variables leads to a considerably smaller sample.

Table A4 in the Appendix shows the correlation matrix of the control variables, liberalization measures, and our indicators of banking crises. The table shows that the control variables are not highly correlated.

#### **4. Financial liberalization and systemic banking crisis**

##### ***4.1. Main results***

For the analysis of our first research question, i.e., what is the impact of financial liberalization on systemic banking crises conditional on supervisory control, we estimate equation (1) using a probit model with random effects.<sup>7</sup> Table 2 shows the results, while the outcomes for testing the hypotheses are shown in Figure 2.

Instead of reporting marginal effects at means, we report average marginal effects as suggested by Bartus (2005) and Cameron and Trivedi (2009). According to these authors, marginal effects computed at means are not good approximations of average marginal effects. Sample means used for the calculation of marginal effects at means might refer to either non-existent or inherently nonsensical observations. Moreover, average marginal effects are more meaningful and easy to interpret.

In column (1), we regress systemic banking crises on control variables only, without using any financial reform measure or interactions. Our findings are in line with those of previous studies and the estimated coefficients are in accordance with the expected signs as shown in Table A2. Real GDP growth, initial GDP/capita, real interest rate, the initial level of liberalization, and depreciation turn out to be significant.

In column (2), we introduce our indicator of overall financial reform. It turns out that the interaction term of overall financial reform with supervision appears significant and has a negative sign. Economically, the effect is modest but still it clearly has a negative impact on the likelihood of systemic crises and in our later tests this effect remains quite robust.

In the remaining columns of Table 2 we include the various dimensions of financial reform separately one by one. We observe that the interaction terms of

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<sup>7</sup> We cannot use conditional logit or fixed effect models, because initial GDP per capita and initial level of liberalization are time-invariant variables. Furthermore, these techniques drop those countries that did not face any crisis during the sample period. Arellano and Hahn (2007) and Green (2004) show that the probit estimator is also not well behaved in the presence of fixed effects.

supervision and reforms come up significant except for barriers to entry and securities market reforms. Moreover, all these interaction effects have negative signs.

However, as mentioned before, inference based on the coefficient of financial reform or the interaction term only is insufficient and can lead to deceptive findings.<sup>8</sup> So we provide the marginal effects of financial reforms and their confidence intervals (at 5 percent level of significance) in Figure 2. For a marginal effect of reform to be significantly positive (or negative), the marginal effect as well as the upper and lower bound should be in a positive (or negative) quadrant. As the figures show, when supervisory control improves, the effect of financial reform further reduces the likelihood of systemic crises and this effect is significant especially at higher levels of supervisory control. However, this conclusion does not hold for reforms improving bank entry and securities market reforms, which appear insignificant.

Consequently, our results suggest that most dimensions of financial reform reduce the likelihood of systemic crises, conditional on adequate banking supervision. The Wald chi-square tests and Likelihood ratio tests indicate joint significance of our models at the 1% level of significance.

How well do our models correctly predict crises? To examine this issue, we use Brier Scores.<sup>9</sup> Brier Scores can be calculated as

$$\frac{\sum_{i=1}^N \sum_{t=1}^T [Crisis_{i,t} - \Pr(Crisis)_{i,t}]^2}{N * T}$$

Where  $Crisis_{i,t}$  is the actual dummy which takes a value of 1 if there is a crisis and 0 if there is no crisis in country  $i$  at time  $t$  and  $\Pr(Crisis)_{i,t}$  is the estimated probability of a crisis in country  $i$  at time  $t$ . A perfect forecast will result in a Brier score of 0. A forecast that is always wrong will yield a Brier Score of 1, while a forecast that is correct in 50 percent will result in a Brier Score of 0.25. The Brier Score of our models is around 0.14, which indicates that our model is performing well.

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<sup>8</sup> A similar logic applies to supervisory control and its interaction terms.

## ***4.2. Endogeneity***

Even though we follow Mehrez and Kaufmann (2000) and examine the impact of reform measures taken over period prior to a crisis, the results presented in section 4.1 may suffer from an endogeneity problem, because supervisors may liberalize or reverse the liberalization of their financial systems in the wake of a crisis. We test for this problem using a two-step probit model with endogenous regressors.<sup>10</sup> Our main objective is to control for reverse causality. In order to keep the model simple, we drop the interaction terms. The results of the exercise do not suggest that our findings are caused by reverse causality.

We use two instrument variables. The first one is from the economic freedom index dataset from the Fraser Institute (Gwartney and Lawson, 2008). The economic freedom index data is available from 1970 onwards and has several dimensions of economic freedom like size of government (expenditure, taxes and enterprises), legal structure and security of property rights, access to sound money, freedom to trade internationally and regulation of credit, labor, and business. We drop those dimensions of the economic freedom index that are very similar to our financial liberalization measures. The basic intuition for using this proxy is that financial sector reforms are often part of a broader economic reform program. Secondly, we use the openness of the economy (computed as the sum of exports and imports as a percentage of GDP) as an instrument. We average both instruments over five years.

We check the validity of our instruments by the Amemiya-Lee-Newey minimum chi-square test under the null hypothesis that the used group of instruments is valid, i.e., they are uncorrelated with the error term in the structural equation. As shown in the bottom panel of Table A5 in the appendix, we cannot reject the null hypothesis indicating that our set of instrument is valid. Next, we apply the Wald test of exogeneity under the null hypothesis that the instrumented variable is exogenous. The results as shown in Table A5 suggest that none of the reform measures appears endogenous.

An alternative check on endogeneity was performed, dropping all the observations after the start of a crisis (keeping the first year only) until the end of the crisis and re-estimating the models shown in Table 2. This hardly affects our

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<sup>9</sup> See Schmidt and Griffith (1998) for a detailed discussion on Brier Scores.

main conclusions (results available on request). This approach, following Barrell *et al.* (2009), also deals with a possible objection that the impact of our control variables on the likelihood of a crisis will be different during a crisis.

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<sup>10</sup> We implement the two-step probit model with endogenous regressors and use robust standard errors for the clustering over countries.

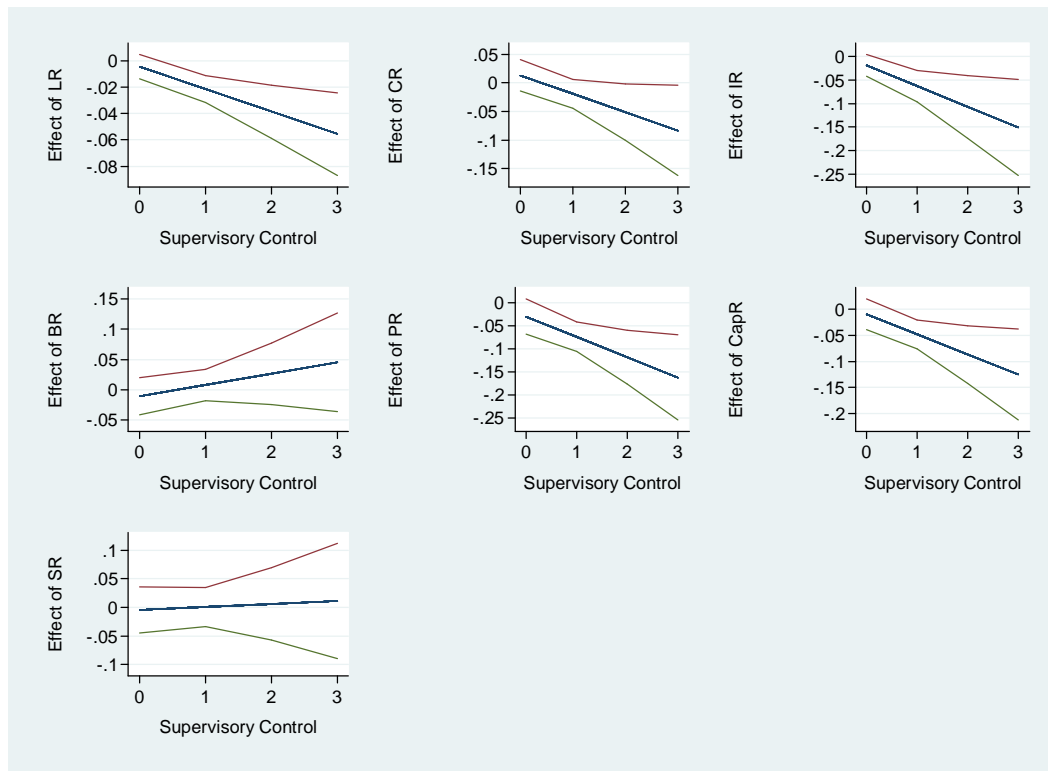


**Table 2. Effect of financial reform on systemic crises**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Real GDP growth (t-1)</b>	<i>Coefficient</i>	-1.092***	-1.136***	-1.235***	-1.158***	-1.232***	-1.103***	-1.192***	-1.227***
	<i>S.E.</i>	0.221	0.25	0.256	0.251	0.256	0.249	0.253	0.257
<b>Log (initial GDP/capita)</b>	<i>Coefficient</i>	-0.056***	-0.061***	-0.059***	-0.062***	-0.059***	-0.064***	-0.058***	-0.058***
	<i>S.E.</i>	0.02	0.021	0.02	0.021	0.02	0.021	0.02	0.02
<b>Real interest rate</b>	<i>Coefficient</i>	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	<i>S.E.</i>	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
<b>Inflation</b>	<i>Coefficient</i>	0.032	0.064	0.081	0.097	0.076	0.027	0.062	0.079
	<i>S.E.</i>	0.107	0.111	0.11	0.11	0.11	0.111	0.11	0.11
<b>Depreciation</b>	<i>Coefficient</i>	0.179**	0.142*	0.156**	0.152**	0.166**	0.160**	0.153**	0.163**
	<i>S.E.</i>	0.075	0.076	0.076	0.076	0.076	0.076	0.075	0.076
<b>Initial liberalization</b>	<i>Coefficient</i>	-0.019**	-0.021**	-0.021**	-0.019**	-0.020**	-0.020**	-0.021**	-0.020**
	<i>S.E.</i>	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
<b>Supervisory Control (SC)</b>	<i>Coefficient</i>	0.009	0.039**	0.025*	0.016	0.009	0.026*	0.024*	0.013
	<i>S.E.</i>	0.013	0.017	0.015	0.014	0.015	0.014	0.014	0.015
<b>Financial reform (overall) (LR)</b>	<i>Coefficient</i>		-0.004						
	<i>S.E.</i>		0.005						
<b>SC*LR</b>	<i>Coefficient</i>		-0.017***						
	<i>S.E.</i>		0.006						
<b>Credit controls reform (CR)</b>	<i>Coefficient</i>			0.013					
	<i>S.E.</i>			0.014					
<b>SC*CR</b>	<i>Coefficient</i>			-0.032**					
	<i>S.E.</i>			0.016					
<b>Interest rate control reform (IR)</b>	<i>Coefficient</i>				-0.019				
	<i>S.E.</i>				0.012				
<b>SC*IR</b>	<i>Coefficient</i>				-0.044**				
	<i>S.E.</i>				0.019				
<b>Banking entry reform (BR)</b>	<i>Coefficient</i>					-0.011			
	<i>S.E.</i>					0.016			
<b>SC*BR</b>	<i>Coefficient</i>					0.019			
	<i>S.E.</i>					0.017			
<b>Privatization reform (PR)</b>	<i>Coefficient</i>						-0.03		

	<i>S.E.</i>						0.02		
<b>SC*PR</b>	<i>Coefficient</i>						-0.044**		
	<i>S.E.</i>						0.019		
<b>Capital controls reform (CapR)</b>	<i>Coefficient</i>							-0.01	
	<i>S.E.</i>							0.015	
<b>SC*CapR</b>	<i>Coefficient</i>							-0.038**	
	<i>S.E.</i>							0.017	
<b>Securities markets reforms (SR)</b>	<i>Coefficient</i>								-0.004
	<i>S.E.</i>								0.021
<b>SC*SR</b>	<i>Coefficient</i>								0.005
	<i>S.E.</i>								0.021
<b>No. of Observations</b>		1559	1459	1459	1459	1459	1459	1459	1459
<b>No. of Countries</b>		85	85	85	85	85	85	85	85
<b>Wald Chi-squared</b>		72.735***	87.484***	75.001***	86.585***	72.434***	90.322***	82.027***	72.130***
<b>L Ratio Test</b>		198.398***	202.367***	201.493***	200.785***	199.773***	211.488***	202.104***	195.743***
<b>Brier Score</b>		0.142	0.14	0.142	0.141	0.142	0.141	0.14	0.142
Reported coefficients and corresponding standard errors (S.E.) are average marginal effects and have been calculated following the approach suggested by Bartus (2005).									
*** indicates significance at 1 percent level of significance, ** indicates significance at 5 percent level and * indicates significance at 10 percent level of significance.									

**Figure 2. Effect of financial reform on systemic banking crises at different levels of supervisory control**



This figure shows the marginal effect of different kinds of financial reform on the likelihood of systemic banking crises at different levels of supervisory control. It corresponds to our results in Table 2. The middle line shows the marginal effect of a particular dimension of reform, while the upper and lower lines indicate the upper and lower 95 percent confidence intervals. LR refers to overall reform, CR refers to credit control reform, IR refers to interest rate control reform, BR refers to banking entry reform, PR refers to privatization reform, while CapR refers to capital control reform, and SR refers to securities market reform.

**Table 3. Effect of financial reform on systemic crises conditional on the level of liberalization**

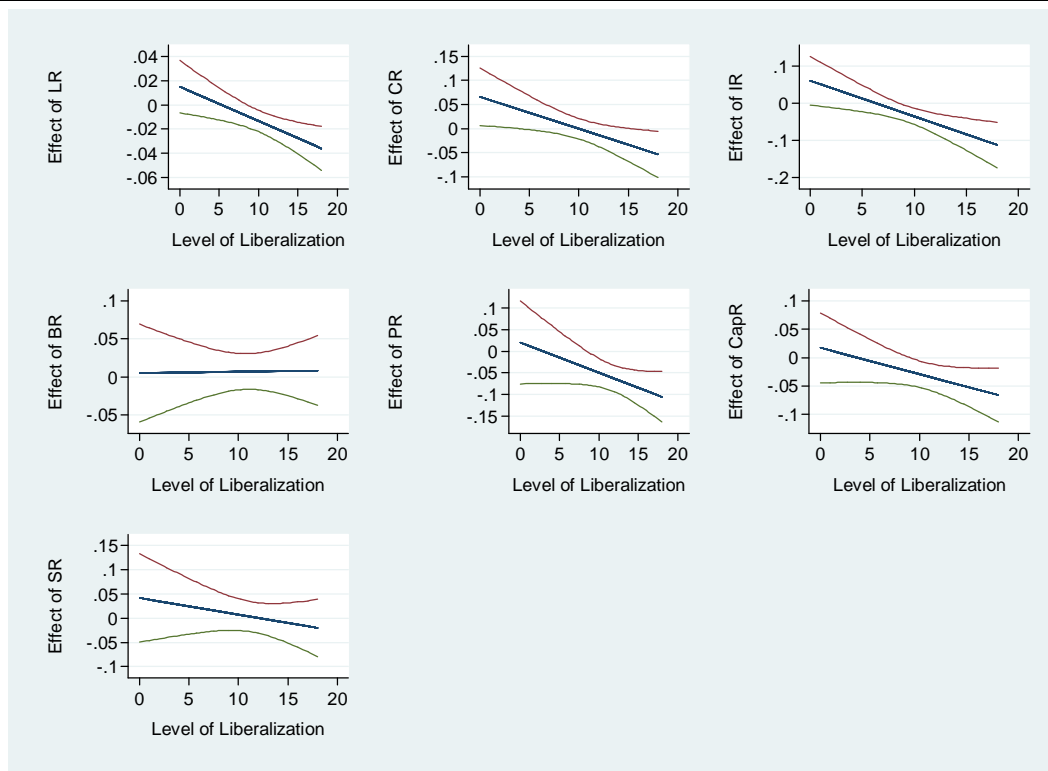
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Real GDP growth</b>	<i>Coefficient</i>	-1.034***	-1.057***	-1.141***	-1.110***	-1.161***	-1.065***	-1.108***	-1.175***
	<i>S.E.</i>	0.215	0.243	0.248	0.246	0.249	0.244	0.245	0.251
<b>Initial GDP/capita</b>	<i>Coefficient</i>	-0.076***	-0.082***	-0.074***	-0.079***	-0.075***	-0.083***	-0.077***	-0.075***
	<i>S.E.</i>	0.019	0.02	0.019	0.019	0.019	0.02	0.019	0.019
<b>Real interest rate</b>	<i>Coefficient</i>	0.002***	0.003***	0.002***	0.003***	0.002***	0.003***	0.002***	0.002***
	<i>S.E.</i>	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
<b>Inflation</b>	<i>Coefficient</i>	0.038	0.129	0.09	0.13	0.078	0.076	0.086	0.079
	<i>S.E.</i>	0.104	0.109	0.107	0.109	0.107	0.109	0.106	0.107
<b>Depreciation</b>	<i>Coefficient</i>	0.177**	0.127*	0.142*	0.128*	0.157**	0.154**	0.147**	0.156**
	<i>S.E.</i>	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
<b>Supervisory control</b>	<i>Coefficient</i>	0.007	-0.007	0.019	-0.003	0.024	0.017	0.012	0.023
	<i>S.E.</i>	0.016	0.018	0.017	0.018	0.017	0.017	0.017	0.017
<b>Level of liberalization</b>	<i>Coefficient</i>	0	0.007*	-0.001	0.003	-0.004	0	0	-0.003
	<i>S.E.</i>	0.003	0.004	0.003	0.003	0.003	0.003	0.003	0.003
<b>Financial reform (overall) (LR)</b>	<i>Coefficient</i>		0.015						
	<i>S.E.</i>		0.011						
<b>Liberalization*LR</b>	<i>Coefficient</i>		-0.003***						
	<i>S.E.</i>		0.001						
<b>Credit controls reform (CR)</b>	<i>Coefficient</i>			0.066**					
	<i>S.E.</i>			0.03					
<b>Liberalization*CR</b>	<i>Coefficient</i>			-0.007**					
	<i>S.E.</i>			0.003					
<b>Interest rate control reform (IR)</b>	<i>Coefficient</i>				0.060*				
	<i>S.E.</i>				0.033				
<b>Liberalization*IR</b>	<i>Coefficient</i>				-0.010***				
	<i>S.E.</i>				0.003				
<b>Banking entry reform (BR)</b>	<i>Coefficient</i>					0.005			
	<i>S.E.</i>					0.033			
<b>Liberalization*BR</b>	<i>Coefficient</i>					0			

	<i>S.E.</i>					0.003			
<b>Privatization reform (PR)</b>	<i>Coefficient</i>						0.02		
	<i>S.E.</i>						0.049		
<b>Liberalization*PR</b>	<i>Coefficient</i>						-0.007*		
	<i>S.E.</i>						0.004		
<b>Capital controls reform (CapR)</b>	<i>Coefficient</i>							0.017	
	<i>S.E.</i>							0.031	
<b>Liberalization*CapR</b>	<i>Coefficient</i>							-0.005*	
	<i>S.E.</i>							0.003	
<b>Securities markets reform (SR)</b>	<i>Coefficient</i>								0.041
	<i>S.E.</i>								0.047
<b>Liberalization*SR</b>	<i>Coefficient</i>								-0.003
	<i>S.E.</i>								0.004
<b>No. of Observations</b>		1559	1459	1459	1459	1459	1459	1459	1459
<b>No. of Countries</b>		85	85	85	85	85	85	85	85
<b>Wald Chi-squared</b>		70.791***	87.377***	75.847***	86.913***	71.521***	88.965***	79.968***	72.031***
<b>L Ratio Test</b>		200.958***	209.143***	204.744***	203.713***	203.106***	212.532***	204.985***	202.360***
<b>Brier Score</b>		0.144	0.141	0.144	0.142	0.145	0.142	0.143	0.144

Reported coefficients and corresponding standard errors (S.E.) are average marginal effects and have been calculated as suggested by Bartus (2005).

\*\*\* indicates significance at 1 percent level of significance, \*\* indicates significance at 5 percent level and \* indicates significance at 10 percent level of significance.

**Figure 3. Effect of financial reform on systemic banking crises at different levels of liberalization**



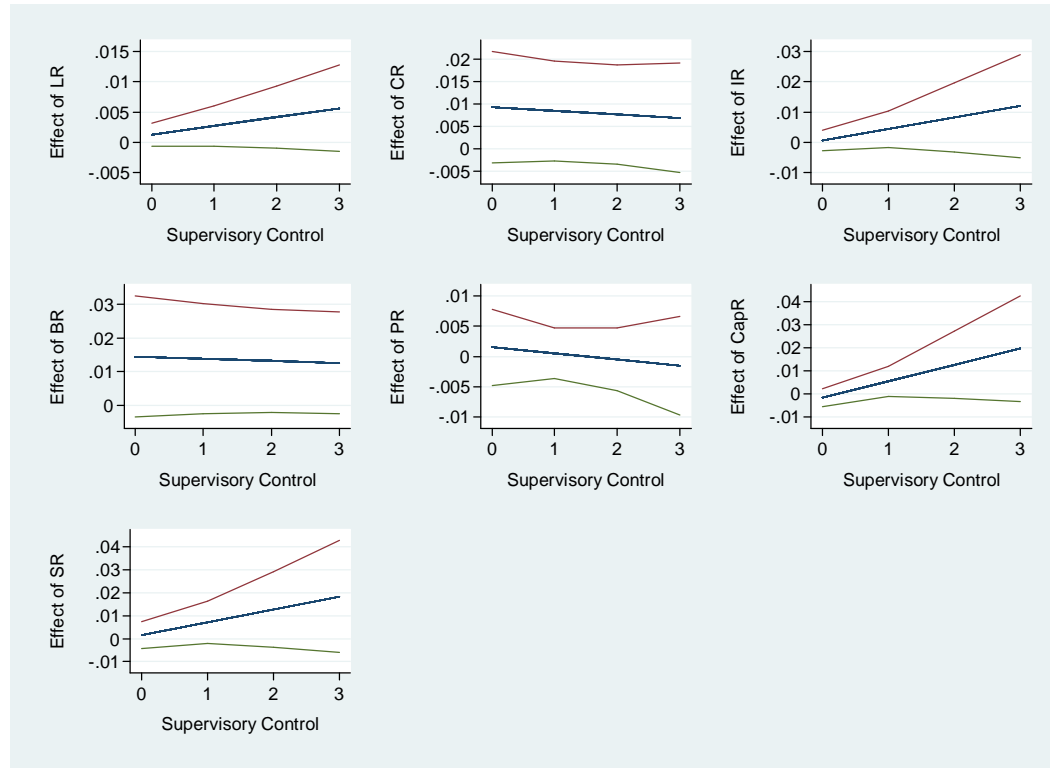
The figure shows the marginal effect of different kinds of financial reform on the likelihood of systemic banking crises at different levels of liberalization. It corresponds to our results in Table 3. The middle line shows the marginal effect of a particular dimension of reform, while the upper and lower lines indicate the upper and lower 95 percent confidence intervals. LR refers to overall reform, CR refers to credit control reform, IR refers to interest rate control reform, BR refers to banking entry reform, PR refers to privatization reform, CapR refers to capital control reform, and SR refers to securities market reform.

<b>Table 4. Effect of financial reform on non-systemic crises</b>									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Real GDP growth (t-1)</b>	<i>Coefficient</i>	-0.027	-0.029	-0.026	-0.028	-0.027	-0.036	-0.025	-0.036
	<i>S.E.</i>	0.035	0.038	0.04	0.041	0.04	0.044	0.033	0.039
<b>Log (initial GDP/capita)</b>	<i>Coefficient</i>	0	0	0	0.001	0	0.001	0	0.001
	<i>S.E.</i>	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
<b>Real interest rate</b>	<i>Coefficient</i>	0	0	0	0	0	0	0	0
	<i>S.E.</i>	0	0	0	0	0	0	0	0
<b>Inflation</b>	<i>Coefficient</i>	-0.008	-0.013	-0.004	-0.007	-0.015	-0.005	-0.005	-0.005
	<i>S.E.</i>	0.017	0.021	0.019	0.02	0.022	0.019	0.016	0.017
<b>Depreciation</b>	<i>Coefficient</i>	0.002	0.005	0.003	0.002	0.003	0.002	0.001	0.002
	<i>S.E.</i>	0.007	0.011	0.01	0.008	0.01	0.006	0.006	0.007
<b>Initial liberalization</b>	<i>Coefficient</i>	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.001
	<i>S.E.</i>	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.001
<b>Supervisory Control (SC)</b>	<i>Coefficient</i>	0.001	-0.002	0.001	0.001	0	0.001	-0.002	0
	<i>S.E.</i>	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
<b>Financial reform (overall) (LR)</b>	<i>Coefficient</i>		0.001						
	<i>S.E.</i>		0.001						
<b>SC*LR</b>	<i>Coefficient</i>		0.001						
	<i>S.E.</i>		0.001						
<b>Credit controls reform (CR)</b>	<i>Coefficient</i>			0.009					
	<i>S.E.</i>			0.006					
<b>SC*CR</b>	<i>Coefficient</i>			-0.001					
	<i>S.E.</i>			0.002					
<b>Interest rate control reform (IR)</b>	<i>Coefficient</i>				0.001				
	<i>S.E.</i>				0.002				
<b>SC*IR</b>	<i>Coefficient</i>				0.004				
	<i>S.E.</i>				0.003				
<b>Banking entry reform (BR)</b>	<i>Coefficient</i>					0.014			
	<i>S.E.</i>					0.009			
<b>SC*BR</b>	<i>Coefficient</i>					-0.001			

	<i>S.E.</i>					0.002			
<b>Privatization reform (PR)</b>	<i>Coefficient</i>						0.002		
	<i>S.E.</i>						0.003		
<b>SC*PR</b>	<i>Coefficient</i>						-0.001		
	<i>S.E.</i>						0.002		
<b>Capital controls reform (CapR)</b>	<i>Coefficient</i>							-0.002	
	<i>S.E.</i>							0.002	
<b>SC*CapR</b>	<i>Coefficient</i>							0.007	
	<i>S.E.</i>							0.004	
<b>Securities markets reform (SR)</b>	<i>Coefficient</i>								0.002
	<i>S.E.</i>								0.003
<b>SC*SR</b>	<i>Coefficient</i>								0.006
	<i>S.E.</i>								0.004
<b>No. of Observations</b>		1559	1459	1459	1459	1459	1459	1459	1459
<b>No. of Countries</b>		85	85	85	85	85	85	85	85
<b>Wald Chi-squared</b>		4.807	41.847***	29.712***	13.269	39.391***	4.228	29.118***	18.570**
<b>L Ratio Test</b>		175.541	170.146***	168.891***	162.566	168.747***	156.234	169.283***	164.874**
<b>Brier Score</b>		0.067	0.069	0.069	0.069	0.068	0.069	0.07	0.069
Reported coefficients and corresponding standard errors (S.E.) are average marginal effects and have been calculated as suggested by Bartus (2005).									
*** indicates significance at 1 percent level of significance, ** indicates significance at 5 percent level and * indicates significance at 10 percent level of significance.									



**Figure 4. Effect of financial reform on non-systemic banking crises at different levels of supervisory control**



This figure shows the marginal effect of different kinds of financial reform on the likelihood of non-systemic banking crises at different levels of supervisory control. It corresponds to our results in Table 4. The middle line shows the marginal effect of a particular dimension of reform, while the upper and lower lines indicate the upper and lower 95 percent confidence intervals. LR refers to overall reform, CR refers to credit control reform, IR refers to interest rate control reform, BR refers to banking entry reform, PR refers to privatization reform, while CapR refers to capital control reform, and SR refers to securities market reform.

### **4.3. Robustness**

We examine the robustness of our results presented in section 4.1 in a number of ways. These tests indicate that our results are not sensitive to changes in our sample and model specification.

Firstly, we restrict our sample to non-OECD countries. It reduces our number of observations from 1459 country-year observations for 85 countries to 944 country-year observations for 61 countries. The results are presented in Table A6 in the Appendix, while the corresponding tests of the hypotheses are shown in Figure A1 in the Appendix. The interaction effect of liberalization remains significant and negative, while the tests of the hypotheses are similar to those reported in Figure 2. The only change is that the interaction of privatization and supervisory control does not appear significant, but the corresponding hypothesis test does not change.

Secondly, we change the list of control variables by adding corruption as suggested by Mehrez and Kaufmann (2000), banking concentration as suggested by Beck *et al.* (2006), and two-year lagged credit to the private sector following Kaminsky and Reinhart (1999). Moreover, we add the ratio of money and quasi-money to GDP as a control variable, following a number of studies (e.g., Beck *et al.*, 2006). In the specification where we introduce our corruption variable the period of analysis is restricted from 1984 to 2002. Corruption only appears significant at 10 percent level of significance in two models and our main results remain unaffected. When we introduce bank concentration as a control variable, the sample is reduced to 80 countries with 827 observations (against 1459 in main results). Bank concentration does not appear significant and our results hold except for credit controls reform, which becomes non-significant. When we introduce money and quasi-money, the sample of analysis is reduced to 1188 observations from 73 countries, but it does not affect our main results. The additional control variable appears insignificant. The introduction of two-year lagged credit to the private sector reduces the sample to 1370 observations from 80 countries and does not affect any of our results although the private sector credit variable appears significant. All results are available on request.

## **5. The role of the level of financial liberalization**

In this section, we argue that financial reform does not only have a direct impact on the likelihood of a crisis, but also an indirect impact. Initial reforms help various players in the financial institutions to learn about the process of liberalization and it makes the outcome of an adverse effect less likely in the aftermath of further reforms. Abiad and Mody (2005) labeled this as “Learning Effect”, albeit in a different context.

The main estimation results of equation (3) are presented in Table 3 and the graphical presentation of the testing of the hypotheses is shown in Figure 3. As shown in Table 3, the interaction effects of the level of liberalization with financial reforms appear significant with a negative sign. The overall models appear significant at 1 percent level of significance and the Brier Scores also indicate that the models are performing well.

The top-left graph in Figure 3 presents the impact of reform at different levels of liberalization. A first thing to note is that the effect of reforms on the likelihood of a crisis appears negative after a certain minimum level of liberalization has been reached. As financial systems become more liberalized, the negative impact on the likelihood of systemic crises of further financial reforms becomes significant. This suggests that financial systems learn from the process of liberalization and leads to less fragility in the long run.

The same result holds for various dimensions of reform. Removal of credit controls, interest rate controls, privatization, and capital account reform all contribute to a more stable banking sector.

## **6. Are non-systemic crises different?**

With the introduction of more competition and transparency in the financial system through market-based reforms, it is very much likely that some inefficient banks are forced to close. Therefore, it seems likely that financial reform will have a different impact on non-systemic crises than on systemic crises. So far, most previous studies do not treat systemic and non-systemic crises differently. We are not aware of studies examining the impact of financial reform on non-systemic crises, even though the effect of financial reform on non-systemic crises is likely to differ from that on systemic crises. Modeling non-systemic crises is a difficult task for two

reasons. First, there are many factors that can cause non-systemic crises depending on the heterogeneous specializations and ownership structures of banks<sup>11</sup>, and second, it is not necessary that these crises occur because of changes in macroeconomic or financial system variables. Still, we check whether financial reform affects the likelihood of non-systemic crises, thereby addressing our third research question. We estimate equation (1) using a panel probit model with non-systemic crises as the dependent variable.

The results are shown in Table 4 and the corresponding hypothesis testing outcomes are presented in Figure 4. The models appear significant as indicated by Wald Chi-squared test and the Likelihood Ratio tests, except for the models shown in columns (1), (4), and (6). The macroeconomic variables that were significant in the model for systemic crises do not appear significant. Interestingly, the marginal effect of financial reform appears positive for non-systemic crises, although it is not significant. It points to important conclusions. First, systemic and non-systemic crises are driven by different factors and should be modeled accordingly. Second, the impact of financial reform on non-systemic crisis is very different from the impact of reform on systemic crises. If anything, financial reform increases the likelihood of non-systemic crises.

## **7. Conclusions and policy implications**

We have examined the effect of (six dimensions of) financial reform on the likelihood of systemic and non-systemic banking crises. We find that reform that enhances liberalization reduces the likelihood of systemic crises, subject to appropriate supervisory control. Furthermore, financial systems learn from reform, which helps introducing further reforms without adverse outcomes. Moreover, we find that systemic and non-systemic crises are driven by different factors.

Our findings suggest the need to reconsider a widely shared view that has emerged in the wake of the current financial crisis, namely that strict regulation is needed for financial stability. Our results indicate that financial reform conditional on good supervisory control reduces the likelihood of systemic crises, and it therefore important to combine both policies in a meaningful way. In contrast,

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<sup>11</sup> For example, Shehzad *et al.* (2010) show how ownership structures of banking firms affect their risk taking behavior.

nowadays many observers seem to believe that reforms that have liberalized financial systems have played an important role in creating the current financial crises. Consequently, there may be a reversal of some of these liberalization measures in the wake of the crisis. However, as pointed out by Allen and Gale (2007), the extensive financial regulation introduced after the Great Depression not only led to the virtual disappearance of crises, it also seriously affected the efficiency of the financial system. Allen and Gale (2007) argue that the complete elimination of crises is neither optimal nor desirable, because it reduces the ability of financial institutions to perform their basic task of efficient allocation of resources. Excessive regulation reduces the incentives for banks to introduce new services and products. In view of the dynamic requirements of economies, the inability to introduce new products can result in sub-optimal risk hedging and exploitation of consumers. There is a possibility that history may repeat itself. Our results suggest that banking supervision needs to be improved but that the process of financial liberalization should not be reversed.

A potential danger highlighted by our results is the inadequate supervisory control in non-OECD economies. Financial reform in non-OECD countries has narrowed the liberalization gap with high-income OECD countries, but as far as supervision is concerned this gap has widened.

Our results also suggest that financial systems learn from reform, helping to create more stable banking systems. A reversal of liberalization will therefore also indirectly lead to more banking instability.

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## Appendix

<b>Table A1. Systemic and non-systemic banking crises in our sample</b>		
Country:	Systemic crises:	Non-systemic crises:
Albania	1992-96	
Algeria	1990-92	
Argentina	1980-82, 1989-90, 1995, 2001-02	
Australia		1989-92
Austria		
Azerbaijan	1995-96	
Bangladesh	1988-96	
Belarus		1995-02
Belgium		
Bolivia	1986-88, 1994-02	
Brazil	1990, 1994-99	
Britain		1974-76, 1980-89
Bulgaria	1996-97	
Burkina-Faso	1988-94	
Cameroon	1987-93, 1995-98	
Canada		1983-85
Chile	1976, 1981-83	
China	1990-02	
Colombia	1982-87	
Costa Rica	1994-96	
Cote d'Ivoire	1988-91	
Czech Republic	1989-91,	
Denmark		1987-92
Dominican Rep		
Ecuador	1980-84, 1996-01	
Egypt	1980-84	1991-95
El Salvador	1989	
Estonia	1992-95	1998
Ethiopia		1994-95
Finland	1991-94	
France		1994-95
Georgia	1991-96	
Germany		1976-79
Ghana	1982-89	1997-02
Greece		1991-95
Guatemala		1990-02
Hong Kong		1982-86, 1988
Hungary	1991-95	
India		1993-02
Indonesia	1997-02	1994
Ireland		
Israel	1977-83	
Italy		1990-95
Jamaica	1996-00	1994
Japan	1992-02	
Jordan		1989-90
Kazakhstan		
Kenya	1985-89, 1992-95	1996-02
Korea	1997-02	
Kyrgyz Rep	1990-02	
Latvia	1995-96	
Lithuania	1995-96	

Madagascar	1988	
Malaysia	1997-01	1985-88
Mexico	1981-91, 1994-00	
Morocco	1980-84	
Mozambique	1987-95	
Nepal	1988	
Netherlands		
New Zealand		1987-90
Nicaragua	1986-02	
Nigeria	1991-95	1997
Norway	1990-93	
Pakistan		
Paraguay	1995-00	2001-02
Peru	1983-90	
Philippines	1983-87, 1998-02	
Poland	1992-95	
Portugal		
Romania	1990-96	
Russia	1995, 1998-99	
Senegal	1988-91	
Singapore		1982
South Africa		
Spain	1977-85	
Sri Lanka	1989-93	
Sweden	1991-94	
Switzerland		
Taiwan	1997-98	1983-84, 1995
Tanzania		
Thailand	1983-87, 1997-02	
Tunisia		1991-95
Turkey	1982-85, 2000-02	1994
Uganda	1994-96	
Ukraine	1997-98	
United States		1988-91
Uruguay	1981-84, 2002	
Uzbekistan		
Venezuela	1994-95	1976-89
Vietnam	1997-02	
Zimbabwe	1995-96	

Source: Honohan and Laeven (2005)

**Table A2. Spearman's rank correlation coefficients of different dimension of financial reform**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>Δ Liberalization (1)</b>	1.00							
<b>Δ Credit Controls (2)</b>	0.39	1.00						
<b>Δ Interest Rate Control (3)</b>	0.44	0.12	1.00					
<b>Δ Banking Entry (4)</b>	0.38	0.02	0.03	1.00				
<b>Δ Privatization (5)</b>	0.36	0.00	0.07	0.08	1.00			
<b>Δ Supervisory Control (6)</b>	0.36	0.03	-0.03	0.10	-0.01	1.00		
<b>Δ Capital Controls (7)</b>	0.47	0.05	0.13	0.08	0.05	0.00	1.00	
<b>Δ Securities Markets (8)</b>	0.35	0.09	0.06	0.01	0.02	-0.03	0.10	1.00

**Table A3. Variable description and sources**

<b>Dependent Variables</b>		
<b>Variable:</b>		<b>Source:</b>
Systemic crises		Honahan and Laeven (2005)
Non-systemic crises		Honahan and Laeven (2005)
<b>Explanatory Variables</b>		
<b>Variable:</b>	<b>Expected sign:</b>	<b>Source:</b>
Liberalization (overall)	+/-	Abiad <i>et al.</i> (2008)
Credit controls	+/-	Abiad <i>et al.</i> (2008)
Interest rate control	+/-	Abiad <i>et al.</i> (2008)
Banking entry	+/-	Abiad <i>et al.</i> (2008)
Privatization	+/-	Abiad <i>et al.</i> (2008)
Supervisory control	-	Abiad <i>et al.</i> (2008)
Capital controls	+/-	Abiad <i>et al.</i> (2008)
Securities markets	+/-	Abiad <i>et al.</i> (2008)
Real GDP growth	-	World Development Indicators
GDP/Capita	-	World Development Indicators
Real interest rate	+	World Development Indicators
Inflation	+	World Development Indicators
Depreciation	+	World Development Indicators
Economic Freedom index	+/-	Gwartney and Lawson (2008)
Openness	+/-	World Development Indicators
Bank concentration	-	Beck <i>et al.</i> (2000)
Corruption	+	ICRG
Money and quasi-money/GDP	+/-	World Development Indicators
Credit to private sector/GDP	+/-	World Development Indicators

**Table A4. Correlation matrix**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
<b>Systemic crises (1)</b>	1																				
<b>Non-systemic crises (2)</b>	-0.13	1																			
<b>Liberalization (overall) (3)</b>	-0.15	0.06	1																		
<b>Credit controls (4)</b>	-0.07	0.09	0.79	1																	
<b>Interest rate control (5)</b>	-0.08	0.07	0.82	0.63	1																
<b>Banking entry (6)</b>	-0.04	-0.01	0.75	0.54	0.57	1															
<b>Privatization (7)</b>	-0.18	-0.01	0.7	0.45	0.47	0.42	1														
<b>Supervisory control (8)</b>	-0.13	0.03	0.78	0.58	0.52	0.55	0.45	1													
<b>Capital controls (9)</b>	-0.15	0.08	0.83	0.56	0.65	0.5	0.51	0.59	1												
<b>Securities markets (10)</b>	-0.17	0.1	0.83	0.6	0.59	0.55	0.49	0.63	0.71	1											
<b>Real GDP growth (11)</b>	-0.12	-0.02	0.01	0.07	-0.01	-0.05	0.02	0	0	0	1										
<b>GDP/capita (12)</b>	-0.2	0.01	0.57	0.41	0.36	0.28	0.39	0.5	0.53	0.65	-0.08	1									
<b>Real interest rate (13)</b>	0.07	-0.02	0.06	0.06	0.11	0.06	0.03	0.03	0.05	0.01	-0.06	-0.04	1								
<b>Inflation (14)</b>	0.14	0	-0.36	-0.36	-0.21	-0.19	-0.27	-0.33	-0.32	-0.33	-0.23	-0.3	-0.07	1							
<b>Depreciation (15)</b>	0.02	0.01	-0.02	-0.01	0	-0.01	-0.02	-0.03	-0.02	-0.03	-0.02	-0.02	0	0.02	1						
<b>Economic Freedom index (16)</b>	-0.21	0.07	0.69	0.58	0.44	0.35	0.49	0.55	0.67	0.68	0.05	0.68	0.13	-0.55	-0.01	1					
<b>Openness (17)</b>	-0.05	-0.07	0.32	0.22	0.19	0.3	0.31	0.25	0.25	0.24	0.08	0.13	-0.02	-0.07	0.02	0.3	1				
<b>Bank concentration (18)</b>	-0.05	-0.12	-0.14	-0.06	-0.18	-0.05	-0.1	-0.08	-0.12	-0.13	0.06	0	-0.11	0.08	0.01	-0.03	0.11	1			
<b>Corruption (19)</b>	-0.22	0.03	0.44	0.32	0.31	0.23	0.31	0.36	0.39	0.46	-0.05	0.67	0.01	-0.21	0	0.53	0.14	0.21	1		
<b>Money &amp; Quasi-money/GDP (20)</b>	-0.03	-0.02	-0.05	-0.09	-0.09	-0.09	0.05	-0.03	-0.02	-0.02	-0.04	-0.01	0	-0.01	0	-0.03	-0.02	-0.08	0.03	1	
<b>Credit to private sector/GDP (21)</b>	-0.08	-0.05	0.52	0.38	0.32	0.27	0.44	0.42	0.49	0.56	-0.03	0.74	-0.03	-0.35	0	0.68	0.25	-0.09	0.51	0.01	1

**Table A5. Effect of financial reform on systemic crises - Instrumental Probit results**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Real GDP growth (t-1)</b>	Coefficient	-5.148***	-4.988**	-3.172	-5.115*	-5.290***	-4.814**	-3.832
	S.E.	1.982	2.361	6.578	2.699	1.969	2.076	3.247
<b>Log (Initial GDP/capita)</b>	Coefficient	-0.301***	-0.212	-0.238	-0.214	-0.324***	-0.286***	-0.262**
	S.E.	0.101	0.178	0.332	0.207	0.096	0.1	0.126
<b>Real interest rate</b>	Coefficient	0.006	0.008	0.005	0.004	0.005	0.005	0.004
	S.E.	0.006	0.006	0.005	0.006	0.007	0.006	0.006
<b>Inflation</b>	Coefficient	-0.115	-0.219	0.502	-0.645	-0.341	-0.304	-0.348
	S.E.	0.906	0.867	0.889	0.959	0.859	0.913	0.941
<b>Depreciation</b>	Coefficient	0.509	0.619	0.435	0.661	0.714	0.685	0.71
	S.E.	0.461	0.524	0.739	0.528	0.47	0.475	0.483
<b>Initial level of liberalization</b>	Coefficient	-0.033	-0.051*	-0.002	-0.055	-0.027	-0.031	-0.032
	S.E.	0.034	0.029	0.042	0.038	0.031	0.028	0.027
<b>Supervisory control</b>	Coefficient	-0.035	-0.063	-0.213	-0.021	0.016	-0.017	-0.079
	S.E.	0.098	0.091	0.167	0.09	0.144	0.097	0.114
<b>Financial reform (overall)</b>	Coefficient	-0.092						
	S.E.	0.16						
<b>Credit controls reform</b>	Coefficient		-0.775					
	S.E.		0.786					
<b>Interest rate control reform</b>	Coefficient			-0.985				
	S.E.			0.757				
<b>Banking entry reform</b>	Coefficient				-0.743			
	S.E.				1.142			
<b>Privatization reform</b>	Coefficient					-0.428		
	S.E.					0.768		
<b>Capital controls reform</b>	Coefficient						-0.271	
	S.E.						0.402	
<b>Securities markets reform</b>	Coefficient							-0.634
	S.E.							0.901
<b>Constant</b>	Coefficient	1.868***	1.558**	1.894	1.572**	1.893***	1.620**	1.655***

	S.E.	0.724	0.735	1.366	0.767	0.71	0.656	0.633
<b>No. of Observations</b>		1164	1164	1164	1164	1164	1164	1164
<b>Wald Chi-squared</b>		35.887***	72.969***	183.900***	63.209***	40.660***	40.014***	46.675***
<b>Probability (Wald Test of Exogeneity)</b>		0.99	0.49	0.663	0.609	0.842	0.728	0.546
<b>Probability (Amemiya-Lee-Newey Statistic)</b>		0.891	0.723	0.779	0.335	0.938	0.989	0.609
*** indicates significance at 1 percent level of significance, ** indicates significance at 5 percent level and * indicates significance at 10 percent level of significance.								

**Table A6. Effect of financial reform on systemic crises - Developing economies**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Real GDP growth (t-1)</b>	<i>Coefficient</i>	-1.175***	-1.265***	-1.393***	-1.306***	-1.414***	-1.287***	-1.329***	-1.377***
	<i>S.E.</i>	0.313	0.358	0.36	0.356	0.359	0.359	0.356	0.361
<b>Log (Initial GDP/capita)</b>	<i>Coefficient</i>	-0.046	-0.065*	-0.066*	-0.074**	-0.066*	-0.067*	-0.064*	-0.064*
	<i>S.E.</i>	0.036	0.037	0.036	0.037	0.036	0.037	0.037	0.036
<b>Real interest rate</b>	<i>Coefficient</i>	0.003***	0.003***	0.003**	0.003***	0.003***	0.003***	0.003***	0.003***
	<i>S.E.</i>	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
<b>Inflation</b>	<i>Coefficient</i>	0.057	0.081	0.107	0.131	0.106	0.059	0.071	0.109
	<i>S.E.</i>	0.165	0.172	0.17	0.17	0.17	0.172	0.17	0.17
<b>Depreciation</b>	<i>Coefficient</i>	0.218*	0.188	0.198*	0.197	0.210*	0.205*	0.196*	0.204*
	<i>S.E.</i>	0.117	0.121	0.12	0.121	0.12	0.12	0.119	0.12
<b>Initial level of liberalization</b>	<i>Coefficient</i>	-0.025*	-0.028*	-0.028*	-0.026*	-0.026*	-0.026*	-0.028*	-0.026*
	<i>S.E.</i>	0.014	0.015	0.015	0.015	0.014	0.015	0.015	0.014
<b>Supervisory control (SC)</b>	<i>Coefficient</i>	-0.012	0.046	0.019	0.017	-0.013	0.009	0.018	0.002
	<i>S.E.</i>	0.025	0.031	0.027	0.027	0.028	0.027	0.026	0.028
<b>Reform (LR) (overall)</b>	<i>Coefficient</i>		-0.003						
	<i>S.E.</i>		0.007						
<b>SC*LR</b>	<i>Coefficient</i>		-0.026***						
	<i>S.E.</i>		0.01						
<b>Credit controls reform (CR)</b>	<i>Coefficient</i>			0.031					
	<i>S.E.</i>			0.023					
<b>SC*CR</b>	<i>Coefficient</i>			-0.055**					
	<i>S.E.</i>			0.028					
<b>Interest rate control reform (IR)</b>	<i>Coefficient</i>				-0.014				
	<i>S.E.</i>				0.018				
<b>SC*IR</b>	<i>Coefficient</i>				-0.082***				
	<i>S.E.</i>				0.03				
<b>Banking entry reform (BR)</b>	<i>Coefficient</i>					-0.019			
	<i>S.E.</i>					0.025			
<b>SC*BR</b>	<i>Coefficient</i>					0.035			

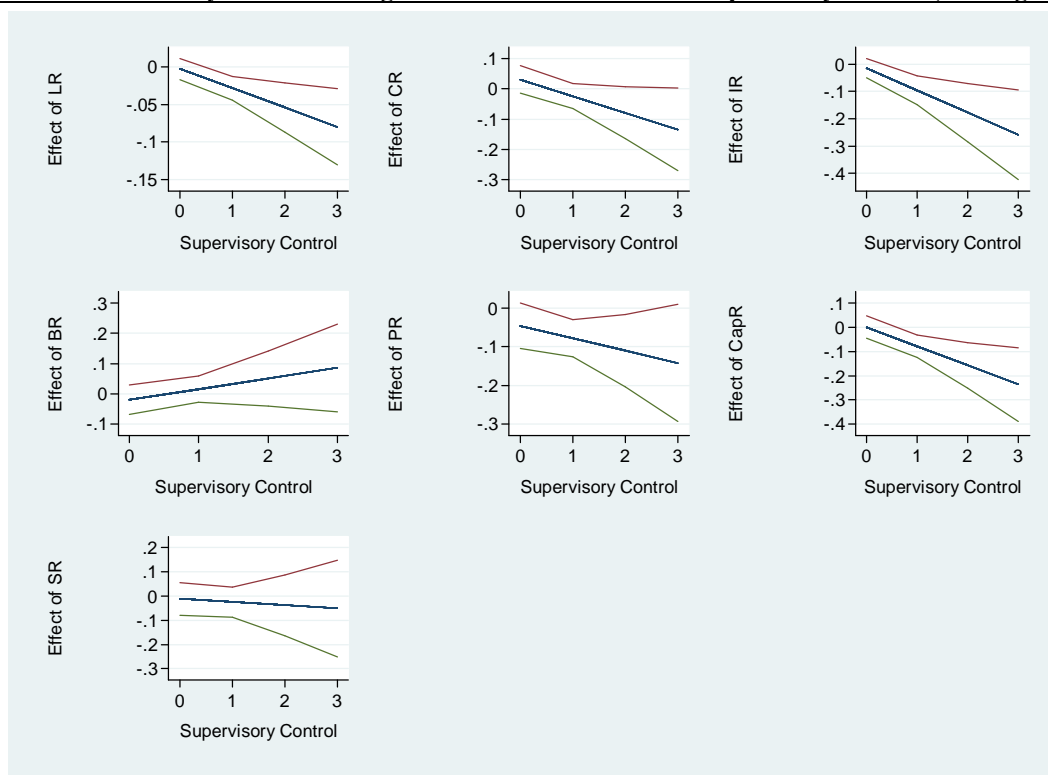


	<i>S.E.</i>					0.029			
<b>Privatization reform (PR)</b>	<i>Coefficient</i>						-0.046		
	<i>S.E.</i>						0.03		
<b>SC*PR</b>	<i>Coefficient</i>						-0.032		
	<i>S.E.</i>						0.031		
<b>Capital controls reform (CapR)</b>	<i>Coefficient</i>							0.001	
	<i>S.E.</i>							0.023	
<b>SC*CapR</b>	<i>Coefficient</i>							-0.079***	
	<i>S.E.</i>							0.03	
<b>Securities markets reform (SR)</b>	<i>Coefficient</i>								-0.012
	<i>S.E.</i>								0.034
<b>SC*SR</b>	<i>Coefficient</i>								-0.013
	<i>S.E.</i>								0.04
<b>No. of Observations</b>		1000	944	944	944	944	944	944	944
<b>No. of Countries</b>		61	61	61	61	61	61	61	61
<b>Wald Chi-squared</b>		37.252***	51.463***	43.737***	52.390***	41.651***	49.291***	49.829***	41.292***
<b>L Ratio Test</b>		132.369***	134.574***	133.979***	132.115***	133.158***	140.819***	136.700***	126.530***
<b>Brier Score</b>		0.181	0.177	0.179	0.177	0.179	0.179	0.177	0.179

Reported co-efficient and corresponding Standard Errors (S.E.) are Average Marginal Effects and have been calculated as suggested by Bartus (2005)

\*\*\* indicates significance at 1 percent level of significance, \*\* indicates significance at 5 percent level and \* indicates significance at 10 percent level of significance.

**Figure A1. Effect of financial reform on systemic banking crises at different levels of supervisory control (non-high income OECD countries)**



The figure shows the marginal effect of different kinds of financial reform on the likelihood of systemic banking crises at different levels of supervisory controls for non high-income OECD countries. It corresponds to our results in Table A6. The middle line shows the marginal effect of a particular dimension of reform while the upper and lower lines indicate the upper and lower 95 percent confidence intervals. LR refers to overall reform, CR refers to credit control reform, IR refers to interest rate control reform, BR refers to banking entry reform, PR refers to privatization reform, CapR refers to capital control reform, and SR refers to securities market reform.

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