Regulatory Lags, Liberalization, and Vulnerability to Systemic Banking Crises

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18 October 2011

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OCTUBRE 2011

Abstract

What factors make countries vulnerable to banking crises? Particularly, how do reforms in regulation affect the likelihood of banking crises' onset? Several recent articles describe the "anatomy" of banking crises. However, the economic indicators that precede these crises do not necessarily imply causality. Furthermore, the broader literature on financial crises finds a set of institutional causal factors to be important for financial crises, but these factors likely do not apply to banking crises. In the last 20 years banking crises have affected countries that should be impervious to them, while countries at risk have been surprisingly resilient. I argue that differences in vulnerability to banking crises are a result of the asymmetry between financial market evolution and regulation update. Although regulation tends to follow the developments in the financial market everywhere, lags in regulation have different effects at different levels of financial market liberalization. This paper analyzes the interactions between financial market liberalization and regulation update on a world-wide sample between 1973 and 2006.

Resumen

¿Qué factores aumentan la vulnerabilidad de los países a crisis bancarias? En particular, ¿de qué modo reformas a la regulación afecta a la probabilidad del inicio de crisis bancarias? Varios artículos recientes describen la "anatomía" de las crisis bancarias. Sin embargo, el comportamiento de indicadores económicos que precede a estas crisis no implica necesariamente causalidad. Más aún, la literatura más amplia sobre crisis financieras identifica un conjunto de factores institucionales en el origen de crisis financieras, pero dichos factores no parecen aplicarse al caso de las crisis bancarias. En los últimos veinte años, crisis bancarias han sacudido a países que deberían haber sido capaces de resistirlas, en tanto países en riesgo han sido sorprendentemente resistentes a ellas. En este trabajo se arguye que diferencias en la vulnerabilidad a crisis bancarias es el resultado de la asimetría entre la evolución del mercado financiero y la actualización de la regulación. Aún cuando la regulación tiende a seguir los desarrollos del mercado financiero en casi todos los casos, retrasos en la regulación ("regulatory lags") tienen distintos efectos a diferentes niveles de liberalización del mercado financiero. Este trabajo analiza las interacciones entre liberalización del mercado financiero y actualización de la regulación en una muestra global entre 1973 y 2006.

Introduction

What factors make countries vulnerable to banking crises? Particularly, how do reforms in regulation affect the likelihood of banking crises' onset? A recent literature describes the "anatomy of the crises" by identifying the behavior of economic indicators that precedes banking crises. However, the identification of the behavior of economic indicators observed before a banking crisis does not imply a causal relationship, or the identification of necessary and sufficient conditions. The literature shows that lack of democracy, political or institutional instability, and low development of financial markets are associated with an increased vulnerability to banking crises. However, especially since 1990, divergences between the literature's expectations and reality seem puzzling: banking crises have affected countries that should be less vulnerable to them. Furthermore, some countries that should have suffered banking crises have surprisingly avoided them.

This paper focuses on political choices that affect countries' vulnerability to banking crises. In particular, I explore the effect of lags in regulation update on the likelihood of experiencing banking crises. I argue that differential vulnerability to banking crises is a result of the asymmetry between financial markets' evolution and regulation updating. Although regulation tends to follow the developments in the financial market, as time elapses since a banking regulation reform, there is a higher likelihood of new banking sector developments that can increase financial instability. For example, banks can develop products not foreseen at the time of the regulation, or even find loopholes in the legislation and take advantage of them. Lags in regulation update, however, may not have the same effect in different environments. Empirical evidence presented in this paper suggests that regulatory lags are positively associated with banking crisis onset, but that this relationship is conditional on the level of financial liberalization.

This paper proceeds as follows: I first examine the definition of banking crisis, and the "anatomy" of banking crises. I review the literature on economic and behavioral roots of banking crises and then present a theory of the relationship between regulatory lags and vulnerability to banking crises. In section 3, I present an empirical test for two hypotheses derived from the theory. Section 4 concludes.

Banking crises

Definition

This paper focuses on systemic banking crises,[1] the collective failure of banks of a severe magnitude. Banking crises have been defined as either panics or severe waves of bank failures (Calomiris 2010:4). According to Calomiris and Gorton (1991:112), a *banking panic* occurs "when bank debt holders at all or many banks in the banking system suddenly demand that banks convert their debt claims into cash [...] to such an extent that the banks suspend convertibility of their debt into cash or, in the case of the United States, act collectively to avoid suspension of convertibility by issuing clearing-house loan certificates."[2] *Severe waves of bank failures* are "those resulting in aggregate negative net worth of failed banks in excess of 1 per cent of GDP" (Calomiris 2010:4).

This definition is narrower than many others that include the government´s response as an alternative way to identify a systemic banking crisis (Caprio Jr. and Honohan 2008; Caprio Jr. and Klingebiel 1999; Duttagupta and Cashin 2008; Kaminsky and Reinhart 1999), or one of the crisis's necessary characteristics (Laeven and Valencia 2008, 2010). For example, Kaminsky and Reinhart (1999) use the government's response as an alternative form of identifying banking crises. According to them, banking crises are often defined by two events: "(1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions," or, in the absence of runs, (2) "the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions" (Kaminsky and Reinhart 1999:476). Similarly, Caprio and Honohan define systemic banking crisis as "the widespread insolvency of banks leading to closures, mergers, takeovers, or injections of government resources" (Caprio Jr. and Honohan 2008:2). Duttagupta and Cashin define banking crisis as "an episode involving banking sector problems that resulted in: exhaustion of much of the capital and closure, merger, large-scale nationalization of banks; or extensive bank runs; or large scale liquidity support by the central bank to avoid a run on deposits" (Duttagupta and Cashin 2008:9).

This paper follows Laeven and Valencia's (2008, 2010) definition of banking crisis. They define a systemic banking crisis when two conditions are

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[1] For simplicity, the text refers to "banking crises." Banking crises and systemic banking crises are considered synonymous.
[2] Kindleberger ([1989] 2005) stresses the role of speculation at the root of banking panics. On the difference between banking panics and bank runs, see Calomiris and Gorton (1991:112).

met: not only there have to be (1) "significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and bank liquidations)," but there must also be (2) "significant banking policy intervention measures in response to significant losses in the banking system" (Laeven and Valencia 2010:6). Although including government intervention in the definition of crisis can be problematic for the study of responses to banking crises (Rosas 2006), its inclusion implies a higher threshold for considering a crisis to be systemic.[3]

Anatomy of crises, economic fundamentals, and banking crises

Economic explanations have identified, with more or less precision, the behavior of variables that precedes banking crises, describing what they call the "anatomy of the crises" (Duttagupta and Cashin 2008; Kaminsky and Reinhart 1999). However, the identification of the sequence observed before a banking crisis does not imply a causal relationship, or the identification of necessary and sufficient conditions. For example, Goldstein and Turner (1996) point to different indicators of domestic and foreign macroeconomic volatility, lending booms, increasing bank liabilities with large maturity/currency mismatches; inadequate preparation for financial liberalization; heavy government involvement and loose controls on connected lending; weaknesses in the accounting, disclosure and legal framework; and exchange rate regimes. However, they do not offer a multivariate test of the effect of these indicators on banking crisis onset.

Beyond the description of the anatomy of banking crises, there is evidence regarding the impact of economic fundamentals on the country's vulnerability to banking crises (Calomiris and Gorton 1991; Calomiris and Mason 2003). One of the main factors that precede a banking crisis is recession (Goldstein and Turner 1996:6; Kaminsky and Reinhart 1999; Repullo and Suarez 2008).[4] For example, Kaminsky and Reinhart suggest that crises tend to follow recessions, that are usually a result of "a prolonged boom in economic activity that was fueled by credit, capital inflows, and accompanied by an overvalued currency" (1999:473).

The literature also links inflation with banking crises. Some scholars argue that high inflation precedes banking crises (Angkinand et al. 2010; Boyd and Champ 2003; Demirgüc-Kunt and Detragiache 1999, 2005; Duttagupta and Cashin 2008). High inflation proxies high macroeconomic instability (Duttagupta and Cashin 2008) or indicates an adverse selection problem, because highly inflationary environments could attract borrowers of relatively

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[3] For a justification for including the government's judgment to characterize a banking crisis as systemic, see Ergungor and Thomson (2005:2).

[4] Recessions are argued to precede not only banking crises, but also other kinds of financial crises (Mishkin 1995).

low quality (Boyd and Champ 2003). However, other studies find inflation to have an insignificant impact on crisis onset (Beck et al. 2003; Demirguc-Kunt and Detragiache 2002).[5] This insignificance is attributed to a non-linear relationship (Duttagupta and Cashin 2008). Finally, others argue that inflation rate volatility is important because it makes assessing credit risk hard (Goldstein and Turner 1996:11).

Exchange rate regimes and currency crises are also associated with banking crises. Regarding exchange rate regimes, Goldstein and Turner (1996) argue that the exchange rate regime can affect exposure to speculative attacks. In particular, pegs can increase "the fragility of the banking system to external adverse shocks" (Goldstein and Turner 1996:31). In a similar vein, Gavin and Hausmann suggests that "some degree of exchange-rate flexibility" might prevent shocks to spur banking crises (1996:3). Others suggest that fixed exchange rates reduce the likelihood of banking crises because a constrained monetary policy may be less likely to bailout banks (Domaç and Martinez Peria 2003; Eichengreen and Rose 1998), but this only happens when the peg is credible (Miller 2009). Finally, others find no particular relationship between exchange rate regimes and banking crises (Eichengreen and Arteta 2001:30).

There are contrasting arguments linking currency and banking crises. First, Mishkin argues that currency crises can lead to banking crises in developing countries because banks tend to raise funds with liabilities denominated in foreign currencies. Therefore, devaluations can affect the bank balance and increase the odds of bank failures or panics (Mishkin 1995:24). Second, Kaminsky and Reinhart (1999) posit the opposite causal direction and find that currency crises tend to follow banking crises. However, their paper does not present clear causal mechanisms linking both types of crises, and their sample could be driving this result.[6] Finally, Kaminsky and Reinhart (1999) mention other studies that argue that currency and banking crises have the same roots (Goldfajn and Valdés 1997; McKinnon and Pill 1996).

In addition to weak fundamentals, economic volatility is also associated with vulnerability to crises. Goldstein and Turner suggest that volatility can alter the ratio of the values of bank assets and their liabilities (1996:9). The literature points out two main sources of volatility: large fluctuations in foreign trade (Caprio Jr. and Klingebiel 1996; Kaminsky and Reinhart 1999), and in real interest rates (Goldstein and Turner 1996:10).

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[5] In Demirguc-Kunt and Detragiache (2002), once real interest rate is added to the 1999 paper's model (and on a larger sample), inflation loses statistical significance. The authors attribute this to the high correlation between inflation and real interest rate. However, that problem disappears when using inflation's natural log.
[6] Their sample includes 20 countries between 1970 and 1995, and covers 26 banking crises and 76 currency crises (Kaminsky and Reinhart 1999:476).

Whose behavior?

Something is missing when attributing banking crises to the behavior of economic variables. Linking banking crisis onset to drops in the economic activity or to currency crises leaves economic actors and the governments almost as mere spectators of economic dynamics. A few explanations focus on the depositors' behavior. According to these works, depositors have a distinct impact on banking crises, even independently from changes in the real economy. This argument reaches the extreme of presenting banking crises as self-fulfilling prophesies (Bryant 1980; Diamond and Dybvig 1983). In this line, bank runs are explained as a coordination problem (Carlsson and van Damme 1993), or problems of information (Chang 2007; Chari and Jagannathan 1988).

On the opposite side, many authors stress government's decisions. In particular, many identify liberalization as the root of banking crises (Caprio Jr. and Klingebiel 1996; Ergungor and Thomson 2005:3; Kaminsky and Reinhart 1999). Liberalization (and/or access to financial markets) facilitates access to financing, and potentially leads to financial bubbles (Kaminsky and Reinhart 1999:474). However, other authors argue liberalization could have the opposite effect,[7] leading to more financial stability and economic growth. Angkinand et al. (2010) find an inverted U-shaped relationship between liberalization and the likelihood of crisis, conditional on the strength of capital regulation and supervision. At some levels, liberalization is associated with better governance, risk management, and credit allocation in a liberalized system. Their evidence indicates that "the level of liberalization beyond which further liberalization reduces the likelihood of banking crisis is relatively low in emerging market countries" (Angkinand et al. 2010:286).

What is still not clear is what political decisions affect an economy's vulnerability to crises. In particular, what (and how) do political decisions affect the incentive structure for banking market actors? This paper does not intend to explain the behavior of depositors, but to explore the effect of political decisions and their timing on a country's vulnerability to banking crises.

Regulatory lags and vulnerability to banking crises

In early works, there was a concern regarding the impact of non-economic factors on the likelihood of crisis onset. For example, Calomiris and Gorton

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[7] Angkinand et al. wonder whether the connection between liberalization and banking crises' onset "simply captures a truism because some degree of liberalization is probably required for losses in the banking system to be manifested as a banking crisis. A highly repressed banking system may perform very poorly and still survive based on different forms of more or less overt state support" (Angkinand et al. 2010:264).

conclude that "banking panics are not inherent in banking contracts — institutional structure matters" (1991:110).

I argue that differential vulnerability to banking crises is a result of the asymmetry between financial market evolution and regulation update. My explanation is framed in Kane's *regulatory dialectic* (Kane 1977), a concept that focuses on the cyclical interactions between political institutions and market actors in regulated markets. As Kane explains, "it treats political processes of *regulation* and economic processes of *regulatee avoidance* as opposing forces that [...] adapt continually to each other. This alternating adaptation evolves as a series of lagged responses, with regulators and regulatees seeking to maximize their own objectives, conditional on how they perceive the opposing party to behave" (Kane 1981:355).

Bearing those dynamics in mind, I define regulatory lag as the time elapsed since the last regulation reform (in this case, the last *prudential* reform). In most cases, regulation follows developments in the regulated area.[8] However, there is a wide variance in the pace at which countries update their banking regulation (i.e., in the regulatory lags). I posit that longer regulatory lags give the banking sector more opportunities to find ways to avoid constraints and to exploit the regulation in order to engage in more profitable operations. This is consistent with Ergungor and Thomson's view, suggesting that financial systems' vulnerability to crises results from "the underlying incentives faced by banks, bank regulators, and other financial market participants" (2005:3). Not only regulation, but also regulatory lags directly affect the incentives for banks.

Adapting to (and sometimes, finding loopholes in) the regulation takes time. Therefore, the development of risky activities should not happen right after a new regulation is passed. Furthermore, it is likely that new legislation is better tailored to the financial market's needs than older one. It is the development of risky activities not foreseen by the legislation what increases the country's vulnerability to banking crises. This suggests the following hypothesis:

Hypothesis 1:   The longer the time elapsed since the last banking regulation reform, the more vulnerable the country is to banking crises.

This hypothesis contradicts some literature that suggests that elapsed time should actually be helpful to prevent banks' risky behavior. Longer lags would provide regulators with the opportunity to learn the rules and to how effectively implement them. For example, Noy argues that "since supervisors are ... unfamiliar with the new 'rules', their effectiveness decreases (Dewatripont and Tirole 1993; Martinez Peria and Schmukler 2001; Nier and

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[8] The exception includes the cases where regulation is a product of diffusion, learning or some form of coercion (for example, conditions imposed in an agreement signed by the country).

Baumann 2006). This effect [should] be stronger the weaker is the underlying supervisory regime" (Noy 2004:342).

Although regulation tends to follow the developments in the financial market, and I argue lags are positively associated with banking crisis vulnerability, regulatory lags may have different effects depending on the financial market characteristics. In particular, I argue that regulatory lags should have different effects at different levels of financial market liberalization. The level of liberalization should matter because liberalization affects both available profit opportunities (and therefore, the incentives for banks to engage in risky behavior), and the structure of the financial market. These two circumstances also suggest that regulatory lags should have a *stronger* impact in less liberalized markets for the following reasons.[9]

Regarding profit opportunities, when the banking sector is highly regulated, new opportunities for profit are usually limited. This creates incentives to find ways to avoid the regulation's constraints – especially when regulations impose low ceilings for profit. Regulatory lags should have a stronger impact in this environment characterized by regulation avoidance, and should make the country more vulnerable to crises. On the contrary, when the banking sector is highly deregulated, regulatory lags should have a minimal impact on banking crisis vulnerability.

Regarding the structure of the market, a more liberalized financial market allows the participation of more banks in the system. Although liberalization-spurred competition among banks could encourage banks to take more risks, cross-national bank-level evidence shows higher levels of market discipline in more liberalized markets (e.g., Flannery 1998; Martinez Peria and Schmukler 2001; Nier and Baumann 2006). Therefore, at higher levels of liberalization, when competition among banks is strong, market discipline curbs banks' incentives to adopt risks (Martinez Peria and Schmukler 2001) and reduces the impact of regulatory lags less on vulnerability to banking crises.[10] These reasons suggest the following hypothesis:

Hypothesis 2: The impact of the time elapsed since the last banking regulation reform on the country's vulnerability to banking crises is larger at lower levels of liberalization of the financial system.

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[9] This effect's direction is not necessarily intuitive. In theory, it is possible that regulatory lags should not matter or matter less at lower levels of liberalization because there are fewer opportunities to abuse lags, or because supervision becomes easier. I thank Covadonga Meseguer for these suggestions.

[10] An additional way in which the number of actors may affect the country's vulnerability to banking crises is that less liberalized markets are characterized by relatively fewer banks participating in the system and monopolies. With fewer actors in the banking system, any panic or run affecting one or few banks can cause a systemic crisis.

Empirical evidence

Research design

The dependent variable is *Crisis onset*. It is coded 1 the first year of a banking crisis, and zero otherwise. Data come from Laeven and Valencia (2010). This dataset includes both systemic and borderline banking crises, updating Caprio et al.'s (2005) dataset.[11] The beginning of a crisis is defined by two events: (1) "significant signs of financial distress in the banking system," and (2) "significant banking policy intervention measures in response to significant losses in the banking system" (Laeven and Valencia 2010:6).[12] The dataset codes 374 country-year observations as experiencing a banking crisis.[13] I coded as *Crisis onset* the first year of the crisis.[14] There are 142 episodes coded as crisis onsets in this dataset, with the following distribution according to income groups: 30 in low income countries, 38 in lower middle income countries, 37 in upper middle income countries, and 77 in high income countries. Figure 1 shows the number of banking crisis onset per year; figure 2 compares the number of banking crisis onset on the background of total ongoing banking crises, and figure 3 breaks down the crisis onsets by country income group.

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[11] This dataset improves the previous version (Laeven and Valencia 2008) because it also reports the end date of crisis episodes.

[12] A policy intervention is considered significant if the government uses at least three of the following six measures: 1) extensive liquidity support (5 percent of deposits and liabilities to nonresidents); 2) bank restructuring costs (at least 3 percent of GDP); 3) significant bank nationalizations; 4) significant guarantees put in place; 5) significant asset purchases (at least 5 percent of GDP), and 6) deposit freezes and bank holidays (Laeven and Valencia 2010:7).

[13] The distribution of the of crisis by income groups is the following: 88 in low income countries, 105 in lower middle income countries, 104 in upper middle income countries, and 77 in high income countries.
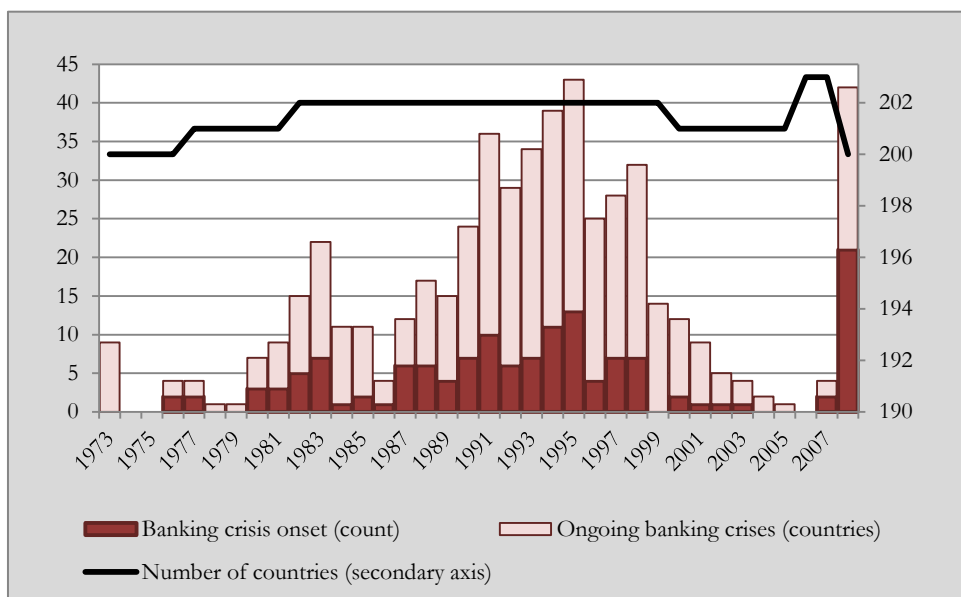
[14] In cases in which there is more than one consecutive crisis, I included the year of the beginning of the second crises as another crisis onset (for example, Brazil 1994 and Congo 1994).
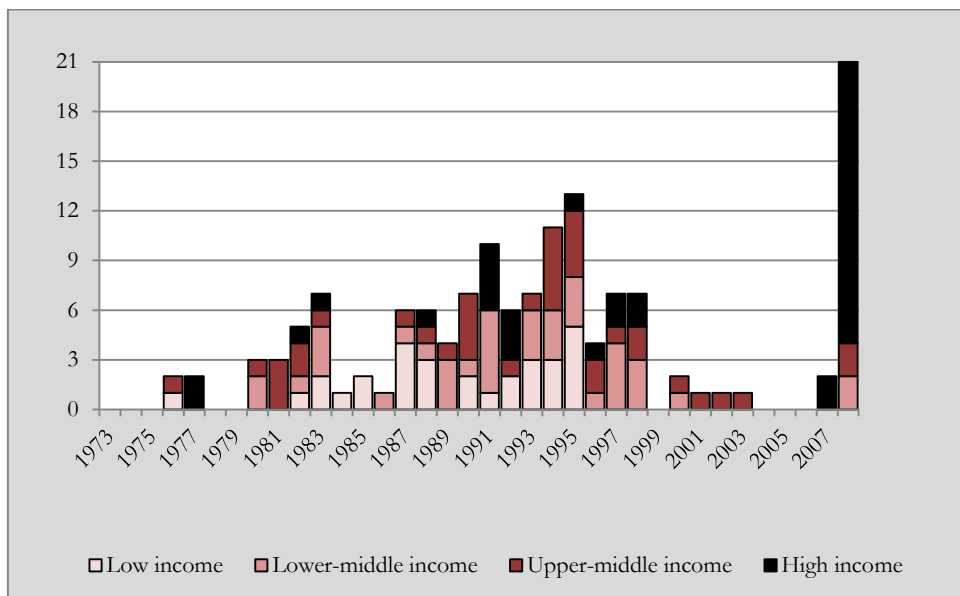
FIGURE 1: BANKING CRISIS ONSET PER YEAR AND NUMBER OF COUNTRIES INCLUDED IN THE SAMPLE
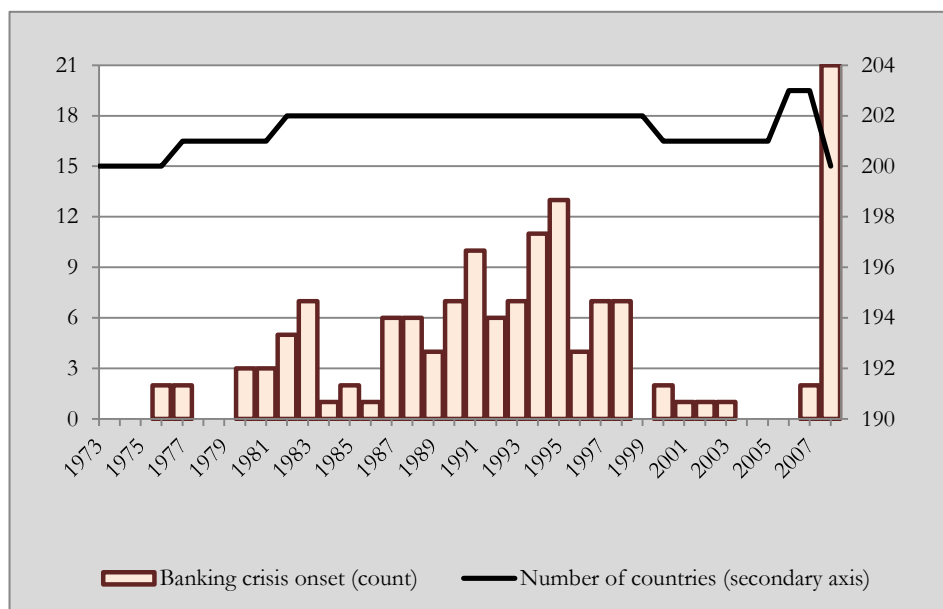
FIGURE 2: BANKING CRISIS ONSET PER YEAR AND NUMBER OF COUNTRIES EXPERIENCING BANKING CRISES

FIGURE 3: BANKING CRISIS ONSET PER YEAR BY COUNTRY INCOME GROUP

The main independent variables are coded from Abied, Detragiache and Tressel's (ADT) dataset on financial reforms (Abiad et al. 2010). This dataset includes information on the dates, type and intensity of financial reforms. They code seven dimensions of financial sector policy (credit controls, interest rate controls, entry barriers, state ownership in the banking sector, financial account restrictions, prudential regulations and supervision of the banking sector, and security market policy). Each dimension is given a score from zero to three (full liberalization), and all the scores are combined in a 0-21 index of financial liberalization.

I separate ADT's liberalization index in *Prudential supervision*, and *Liberalization*. I measure *Prudential supervision* using the ADT's "banking sector supervision" variable. This is a categorical variable that codes both de facto and de jure indicators of strength of banking supervision.[15] It is coded 0 (non regulated and unsupervised), 1 (less regulated and supervised), 2 (largely regulated and supervised), or 3 (highly regulated and supervised). *Liberalization* is the ADT's liberalization index excluding banking sector's supervision. It ranges from 0 to 18 (minimum to maximum degrees of liberalization).

Years since reform is a count variable of the number of years elapsed since the change in the ADT's score for banking sector supervision, as long as there was a change during the period included in the sample. Counting from any change in the banking sector supervision's score has two drawbacks.

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[15] For the detailed description of this variable's coding rules, see Appendix I.

First, given that I only consider changes in the score for this variable, it is possible that I do not capture all the prudential regulation's reforms. However, changes in the banking sector supervision's score capture significant changes in banking legislation. Second, using any change in this score may treat equally changes of different magnitude. However, out of 148 changes in the ADT's score for banking sector supervision, only 11 have implied a two-point increase in the score.

I control for several factors that may affect the likelihood of banking crisis occurrence that are common in the literature. The regulatory environment can also be affected by restriction of capital movements. International capital flows can affect the volatility of domestic interest rates and of deposits. I include *Capital Openness,* Chinn and Ito's index measuring the extensity of capital controls based on the information from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (Chinn and Ito 2008).

The literature suggests different controls for monetary and exchange policy. Ergungor and Thomson (2005:3) find that banking crises "tend to follow periods of expansionary monetary and fiscal policy." Although there is no consensus regarding the linkages between inflation and banking crisis onset, I control for inflation. *Inflation (log)* is the natural log of the rate of price change in the economy as a whole. The World Bank (2010) is the source of these data.

I use two controls for the exchange regime. *Exchange rate regime* is Reinhard and Rogoff's coarse classification. Alternatively, *Peg* controls for the de facto exchange rate regime, following Reinhard and Rogoff's coarse classification (Reinhart and Rogoff 2004). *Peg* is a dichotomous variable that equals 1 when there is no separate legal tender, when there is a pre-announced peg or currency board arrangement, when there is a pre-announced horizontal band that is narrower than or equal to +/-2%, or when there is a de facto peg (Reinhart and Rogoff 2004). The source of this data is Reinhart and Rogoff's updated chronology.

The market's depth can also affect the country's vulnerability to banking crises (Angkinand et al. 2010; Demirgüc-Kunt and Detragiache 2005). Therefore, I include the ratio *M2/reserves* (World Bank 2010). Given that some literature argues that crises are caused by excessive credit creation that leads to financial bubbles (Goldstein and Turner 1996:12), I include controls for *Domestic Credit/GDP* and for *Real interest* (Ergungor and Thomson 2005:5).

To control for volatility and fluctuations that may cause financial instability, I include two variables. *Trade volatility*, measured as change in trade as a percentage of the GDP, and *Domestic credit growth*, measured as percent change in domestic credit. Both variables are built using World Bank data (2010) and are usually included in models of banking crises (e.g.,

Angkinand et al. 2010; Demirgüc-Kunt and Detragiache 2005; Duttagupta and Cashin 2008; Gavin and Hausmann 1996).

I also include a series of economic and political controls: In the baseline model, *GDPPC* measures the GDP per capita (Angkinand et al. 2010), *GDP growth* (as suggested by Angkinand et al. 2010; Demirgüc-Kunt and Detragiache 2005) controls for economic activity and eventually, recession, and *Polity2*, the 21-point combined index of regime, ranging from 10 for a highly democratic country to -10 for a highly autocratic state (Marshall and Jaggers 2007).

Other specifications control for important factors that could affect the likelihood of a country experiencing a systemic banking crisis. I include *Trend* – the number of years elapsed since 1973 -, and *Diffusion (crises),* a count of the number of banking crises in the world in a given year to account both for possible time-dependent world-wide vulnerability and for contagion effects in interconnected financial markets (e.g., Allen et al. 2009). I also control for *Diffusion (supervision)*, representing the average level of banking supervision in the sample in a given year. This variable accounts for the international origin of important supervision regulation and the possibility that stricter banking is a product of changes in international norms and worldwide domestic adaptation.

To control for the country's underlying vulnerability to banking crises, I include three controls: *Currency crisis,* a dichotomous variable coded 1 if the country experienced a currency crisis in a given year (data from Angkinand et al. 2010), controls for arguments linking banking and currency crises. Finally, *Crises count* is the number of previous banking crises in the country during the sample span.

The final set of controls expands the political variables included in models predicting banking crises. Scholars have started exploring the role of partisanship on banking crises' onset (e.g., Broz 2011). It is possible that right-leaning governments are less likely to bailout banks in distress and, therefore, banks adopt less risky behavior. I run additional models to test whether the government's party ID has an independent effect of the country's vulnerability to banking crises, and whether party ID alters the relationships under study here. *Right* reflects the partisanship of the executive. It is coded 1 when the EXECRLC item in the Database of Political Institutions equals 1, and zero otherwise (Beck *et al*. 2001; Beck *et al*. 2008; Keefer 2007).

It is also possible that longer regulatory lags are absorbing both the effect of available time for market actors to escape tight regulations, and of a slower decision-making process. For example, a system with more veto players could have problems not only to adapt prudential regulation to market development, but also to adopt decisions that would make the economic environment more stable and resilient to banking crises. I therefore include

measures of institutional and political veto players (*POLCONIII* and *POLCONV*, from Henisz 2010).

Finally, I control for political instability. It is possible that banking crises are a part of a more general process of unrest that translates in a weakened trust in banking institutions. Lack of regulatory updates could be related to the perception of deeper causes (or causes outside the banking sector) for banking crises onset. *Political instability* is a count of the number of disturbances such as riots, strikes, anti-government demonstrations or assassinations in a country in a given year (Banks 2011).

Modeling choice

There are three methodological approaches in the literature on banking crises.[16] The first strategy implies building a chronology of events and the behavior of the variables of interest, and then comparing the behavior of variables before and after the crisis. The goal is to infer "possible causal patterns" (Kaminsky and Reinhart 1999:474) The second tactic is a computation of the probability of the occurrence of a banking crisis, using some form of maximum likelihood technique (Demirgüc-Kunt and Detragiache 1999, 2005; Noy 2004). Finally, Duttagupta and Cashin (2008) used Binary Classification Tree to identify the most significant variables (and their threshold) associated with increased vulnerability to banking crisis.

I run multivariate logistic regressions for panel data because I am more interested in individualizing the direct and indirect impact of regulatory lags on crisis onset´s likelihood, than in evaluating the pre- and post-crisis behavior of economic variables. I include fixed effects to account for different variables' means in different countries. The inclusion of fixed effects is also a way to control for institutional and bureaucratic characteristics that may explain both different vulnerability to banking crises, and the very regulatory lags. The sample includes 75 developed and developing countries (see Appendix 2). I only include the year of the crisis onset and exclude the following years reported as still experiencing crisis, a standard practice in the literature on banking crises (e.g., Angkinand et al. 2010; Demirgüc-Kunt and Detragiache 2005; Domaç and Martinez Peria 2003).[17] For descriptive statistics, see Table 1.

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[16] The first two approaches are identified by Demirgüc-Kunt and Detragiache as the "signals approach" and the "multivariate probability approach" (Demirgüc-Kunt and Detragiache 2005). See also Duttagupta and Cashin (2008:3).

[17] The crisis itself can affect the behavior of some of the explanatory variables in observations following the crisis onset, particularly during the crisis. Therefore, these observations are usually excluded from the sample in models predicting crisis onset (Demirgüc-Kunt and Detragiache 2005:7).

TABLE 1: DESCRIPTIVE STATISTICS

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
CRISIS ONSET	2638	.0307051	.1725502	0	1
BANKING CRISIS	2638	.0921152	.2892434	0	1
PRUDENTIAL SUPERVISION$_{T-1}$	2638	.772555	.9578791	0	3
LIBERALIZATION$_{T-1}$	2638	9.465504	5.588206	0	18
CAPITAL OPENNESS$_{T-1}$	2465	.0903061	1.537148	-1.831187	2.500014
YEARS SINCE REFORM	2548	7.511381	6.186941	0	30
INFLATION (LOG)$_{T-1}$	2447	2.268277	1.41905	-3.495929	9.644866
M2/RESERVES$_{T-1}$	2121	7425.196	172949.4	0	4738331
DOMESTIC CREDIT/GDP$_{T-1}$	2437	2381.316	18604.55	-1.601714	209059.8
REAL INTEREST$_{T-1}$	2297	4816.556	204291.7	-6547.28	9693343
EXCHANGE RATE REGIME$_{T-1}$	2507	2.49302	1.301149	1	6
PEG$_{T-1}$	2638	.2361638	.4248045	0	1
TRADE VOLATILITY$_{T-1}$	2519	1.124834	8.574622	-99.07393	129.6192
DOMESTIC CREDIT GROWTH$_{T-1}$	2417	-1.620282	720.0223	-11698.8	15494.58
GDPPC$_{T-1}$	2564	6.88658	8.874677	.102286	40.61784
GDP GROWTH$_{T-1}$	2557	3.356897	4.838184	-44.9	26.4
POLITY2$_{T-1}$	2616	3.416667	6.970405	-10	10
RIGHT$_{T-1}$	2484	.3059581	.4609048	0	1
POLCON$_{T-1}$	2011	.3090303	.2167978	0	.73
POLITICAL INSTABILITY$_{T-1}$	2605	2.560461	4.662814	0	49
TREND	2638	17.95679	9.512323	1	33
DIFFUSION (CRISES)$_{T-1}$	2638	11.21835	9.637106	0	30
DIFFUSION (SUPERVISION)	2548	.7938832	.6805514	.084507	1.977778
CURRENCY CRISIS	2636	.0436267	.2043019	0	1
CURRENCY CRISIS$_{T-1}$	2634	.0447988	.2069012	0	1
CRISES COUNT	2638	.4787718	.6353006	0	4

Findings

Models 1 to 5 show different specifications to make clear the effect of the regulation variables and of the inclusion of the main explanatory variables (See Table 2). Model 1 includes all the variables suggested by the economic literature. *Inflation, Domestic credit/GDP,* and *Domestic credit/GDP growth* are positive and statistically significant predictors of the likelihood of crisis onset. Model 2 includes regulation variables that capture the degree of liberalization in the financial market and of banking sector's supervision, and the country's capital controls: higher levels of *Prudential regulation* are associated with a lower likelihood of crisis onset, whereas *Liberalization* is positively associated, as suggested by the literature. *Capital openness* does not achieve conventional levels of statistical significance. The inclusion of these variables increases two of the economic indicators' standard errors, making both *Inflation* and *Domestic credit/GDP growth* statistically insignificant.

TABLE 2: PROBABILITY OF BANKING CRISIS ONSET. ALL COUNTRIES – YEARS OF CRISIS OMITTED

	MODEL 1 COEFFICIENT (STD. ERR.)	MODEL 2 COEFFICIENT (STD. ERR.)	MODEL 3 COEFFICIENT (STD. ERR.)	MODEL 4 COEFFICIENT (STD. ERR.)	MODEL 5 COEFFICIENT (STD. ERR.)
REGULATION					
PRUDENTIAL SUPERVISION$_{T-1}$		**-1.143 (.358)***	**-.974 (.387)**	**-1.192 (.395)***	**-1.094 (.331)***
LIBERALIZATION$_{T-1}$		**.137 (.054)**	**.130 (.056)**	**.260 (.079)***	**.228 (.063)***
CAPITAL OPENNESS $_{T-1}$		-.312 (.221)	-.307 (.224)	-.298 (.223)	**-.283 (.174)***
YEARS SINCE REFORM			.019 (.026)	**.135 (.056)**	**.131 (.046)***
YEARS SINCE REFORM* LIBERALIZATION$_{T-1}$				**-.012 (.005)**	**-.011 (.004)**
MONETARY AND EXCHANGE					
INFLATION (LOG) $_{T-1}$	**.304 (.110)***	-.002 (.156)	-.005 (.156)	-.032 (.158)	
M2/RESERVES $_{T-1}$	-.003 (.003)	-.003 (.005)	-.003 (.005)	-.003 (.006)	
DOMESTIC CREDIT/GDP $_{T-1}$	**.016 (.006)***	**.017 (.007)**	.016 (.007)	**.016 (.007)**	
REAL INTEREST $_{T-1}$	-.0001 (.0003)	-.0002 (.0003)	-.0002 (.0003)	-.0002 (.0003)	
PEG $_{T-1}$	.379 (.384)	.437 (.457)	.470 (.461)	.682 (.480)	
VOLATILITY					
TRADE VOLATILITY $_{T-1}$	-.015 (.011)	.007 (.020)	.007 (.020)	.007 (.020)	
DOMESTIC CREDIT GROWTH $_{T-1}$	**.021 (.010)**	.026 (.016)	.025 (.016)	.023 (.017)	
EC. AND POLITICAL CONTROLS					
GDPPC $_{T-1}$	.110 (.077)	.167 (.136)	.168 (.138)	.201 (.144)	
GDP GROWTH $_{T-1}$	-.035 (.023)	-.053 (.036)	-.051 (.036)	-.047 (.036)	
POLITY2 $_{T-1}$	-.004 (.029)	-.070 (.044)	-.075 (.046)	**-.086 (.046)***	
NUMBER OF OBS	1735	1039	1001	1001	1462
NUMBER OF GROUPS	71	45	45	45	55
LR CHI2	(10) = 43.76	(13) = 36.50	(14) = 34.78	(15) = 40.59	(5) = 29.40
PROB > CHI2	0.0000	0.0005	0.0016	0.0004	0.0000
PSEUDO-R^2	.081	.110	.106	.124	.067
AIC	515.1511	321.7313	320.6603	316.854	421.1248
BIC	569.7388	386.0295	389.3828	390.4854	447.5626

Notes: Panel logit coefficients with fixed effects. Standard errors in italics. Statistical significance is indicated as follows: *$p<0.10$, **$p<0.05$, ***$p<0.01$.

The number of years elapsed since the last prudential reform does not have a direct effect on crisis onset (Model 3) unless the indirect effect of liberalization is accounted for. Model 4 shows that once the conditional effect of the rest of the regulatory context is taken into account (with the

inclusion of the interaction term), the coefficient associated with *Years since reform* is positive and statistically significant. This effect is stronger at lower levels of liberalization, as indicated by the interaction term's direction. The statistical significance and direction of these two variables is consistent with the relationships posited by hypotheses 1 and 2. Model 5 illustrates the effect of the regulatory variables omitting all the other controls, suggesting that these results are not an artifact of the combination of included controls. Their effect is not substantially different from the one produced by models that include all the controls suggested by the economic literature. Comparing measures of goodness of fit (on the same sample, to avoid the distorting effect of different samples)[18] suggests that the models including all the variables have a better statistical fit and explanatory power than the ones without the variables of interest for this paper. Model 4 is used as baseline for robustness tests (see Table 3).

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[18] These models are not reported.

TABLE 3: PROBABILITY OF BANKING CRISIS ONSET. ALL COUNTRIES – YEARS OF CRISIS OMITTED

	MODEL 6	MODEL 7	MODEL 8	MODEL 9	MODEL 10	MODEL 11	MODEL 12	MODEL 13	MODEL 14	MODEL 15
	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)
REGULATION										
PRUDENTIAL SUPERVISION$_{T-1}$	**-1.203** **(.437)***	**-.964** **(.418)**	**-.840** **(.454)***	**-1.177** **(.402)***	.164 (.500)	.579 (.560)	.488 (.563)	.449 (.568)	-.643 (.584)	.484 (.563)
LIBERALIZATION$_{T-1}$	**.255** **(.116)**	**.189** **(.090)**	**.333** **(.099)**	**.260** **(.079)***	**.764** **(.131)***	**.885** **(.147)***	**.872** **(.147)***	**.863** **(.149)***	**.828** **(.169)***	**.879** **(.147)***
CAPITAL OPENNESS$_{T-1}$	-.296 (.226)	-.299 (.225)	-.320 (.231)	-.256 (.225)	**-.778** **(.306)**	**-.947** **(.321)***	**-.874** **(.322)***	**-.883** **(.323)***	-.347 (.369)	**-.886** **(.323)***
YEARS SINCE REFORM	**.133** **(.064)**	**.115** **(.057)**	**.139** **(.057)**	**.120** **(.056)**	**.323** **(.084)***	**.393** **(.096)***	**.381** **(.096)***	**.359** **(.097)***	**.374** **(.107)***	**.385** **(.097)***
YEARS S. REFORM *LIBERALIZATION$_{T-1}$	**-.012** **(.006)**	**-.011** **(.005)**	**-.013** **(.005)**	**-.011** **(.005)**	**-.024** **(.007)***	**-.027** **(.008)***	**-.026** **(.008)***	**-.024** **(.008)***	**-.030** **(.010)***	**-.026** **(.008)***
MONETARY AND EXCHANGE										
INFLATION (LOG)$_{T-1}$	-.032 (.158)	-.064 (.159)	-.044 (.160)	-.004 (.162)	-.293 (.201)	-.165 (.213)	-.117 (.218)	-.133 (.219)	-.129 (.227)	-.124 (.219)
M2/RESERVES$_{T-1}$	-.003 (.006)	-.003 (.006)	-.003 (.005)	-.005 (.007)	-.001 (.003)	-.0007 (.003)	-.001 (.003)	-.0007 (.003)	-.001 (.003)	-.0009 (.003)
DOMESTIC CREDIT/GDP$_{T-1}$	**.016** **(.007)**	**.015** **(.008)**	**.017** **(.007)**	**.016** **(.008)**	**.029** **(.009)***	**.033** **(.012)***	**.033** **(.012)***	**.033** **(.012)***	**.026** **(.014)***	**.033** **(.012)***
REAL INTEREST$_{T-1}$	-.0002 (.0003)	-.0002 (.0003)	-.0002 (.0003)	-.0001 (.0003)	**-.0007** **(.0004)**	**-.0007** **(.0004)***	-.0006 (.0004)	-.0006 (.0004)	-.0006 (.0004)	-.0006 (.0004)
PEG$_{T-1}$	.688 (.492)	.746 (.482)	.574 (.498)	.638 (.483)	.707 (.625)	.710 (.661)	.559 (.663)	.365 (.698)	-.802 (.907)	.559 (.662)
VOLATILITY										
TRADE VOLATILITY$_{T-1}$	.007 (.020)	.007 (.020)	.009 (.020)	.013 (.022)	.015 (.022)	.008 (.023)	.011 (.024)	.012 (.024)	.035 (.025)	.010 (.024)
DOMESTIC CREDIT GROWTH$_{T-1}$	.023 (.017)	.023 (.017)	.021 (.017)	.025 (.017)	.024 (.021)	.028 (.023)	.029 (.024)	.029 (.024)	.026 (.026)	.029 (.024)
EC. AND POLITICAL CONTROLS										
GDPPC$_{T-1}$	.199 (.147)	.187 (.146)	.243 (.154)	.183 (.144)	.295 (.228)	.374 (.250)	.359 (.250)	.335 (.249)	.412 (.256)	.375 (.248)
GDP GROWTH$_{T-1}$	-.047 (.037)	-.047 (.036)	-.054 (.036)	-.045 (.037)	-.060 (.044)	-.057 (.045)	-.056 (.046)	-.054 (.046)	-.031 (.048)	-.052 (.047)

	MODEL 6 COEFF. (STD. ERR.)	MODEL 7 COEFF. (STD. ERR.)	MODEL 8 COEFF. (STD. ERR.)	MODEL 9 COEFF. (STD. ERR.)	MODEL 10 COEFF. (STD. ERR.)	MODEL 11 COEFF. (STD. ERR.)	MODEL 12 COEFF. (STD. ERR.)	MODEL 13 COEFF. (STD. ERR.)	MODEL 14 COEFF. (STD. ERR.)	MODEL 15 COEFF. (STD. ERR.)
POLITY2 $_{T-1}$	-.087 (.047)*	-.087 (.047)*	-.073 (.047)	-.080 (.045)*	.048 (.056)	.084 (.060)	.079 (.061)	.068 (.063)	.061 (.084)	.083 (.061)
RIGHT $_{T-1}$								-.047 (.570)		
POLCON $_{T-1}$									-.427 (2.146)	
POLITICAL INSTABILITY $_{T-1}$										.036 (.052)
OTHER CONTROLS										
TREND	.003 (.055)									
DIFFUSION (CRISES $_{T-1}$)		.032 (.020)								
DIFFUSION (SUPERVISION)			-.950 (.652)							
CURRENCY CRISIS				1.557 (.441)***			.954 (.519)***	.847 (.534)	-7.623 (1.506)***	-9.728 (1.591)***
CRISES COUNT					-6.307 (1.042)***	-9.937 (1.585)***	-9.658 (1.587)***	-9.474 (1.586)***	1.236 (.298)***	1.533 (.302)***
CRISES COUNT^2						1.552 (.300)***	1.522 (.300)***	1.479 (.299)***	1.248 (.547)**	.954 (.516)*
NUMBER OF OBS	1001	1001	1001	1001	1001	1001	1001	950	738	1000
NUMBER OF GROUPS	45	45	45	45	45	45	45	45	35	45
LR CHI2	(16) = 40.59	(16) = 43.20	(16) = 42.79	(16) = 51.50	(16)=123.09	(17)=140.69	(18)=143.89	(19)=136.42	(19)=101.43	(16)=144.24
PSEUDO-R^2	.124	.132	.131	.152	.376	.430	.439	.429	.402	.441
PROB > CHI2	0.0006	0.0003	0.0003	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
AIC	318.8509	316.2398	316.6564	307.9448	236.3573	220.7531	219.5582	219.5862	189.0837	221.1075
BIC	397.391	394.7799	395.1965	386.4849	314.8974	304.2019	307.9158	311.859	276.5587	314.3549

Notes: Panel logit coefficients with fixed effects. Standard errors in italics. Statistical significance is indicated as follows: *$p<0.10$, **$p<0.05$, ***$p<0.01$.

Models 6 to 11 show different specifications to explore the robustness of the relationships of interest and to enhance the model specification. Model 11 is used for estimating substantive impacts because of its better fit. Across models, the coefficient associated with *Years since reform* is positive and statistically significant, providing support to hypothesis 1. Holding other things constant, the likelihood of banking crisis onset increases as time elapses since a significant banking reform. However, the substantive impact of time is conditional on the degree of financial liberalization. As stated in hypothesis 2, I expect regulatory lags to have a larger impact on the likelihood of crisis onset at lower levels of liberalization. The negative and statistically significant coefficient associated with the interaction term provides support to hypothesis 2. In order to interpret the effect of regulatory lags on the likelihood of crisis onset, figure 4 plots the odds ratio increase of an additional year, conditional on the level of liberalization.

FIGURE 4: ODDS OF EXPERIENCING A BANKING CRISIS FOR EACH ADDITIONAL YEAR ELAPSED SINCE THE BANKING SECTOR REGULATION REFORM, AT DIFFERENT LEVELS OF FINANCIAL SYSTEM LIBERALIZATION
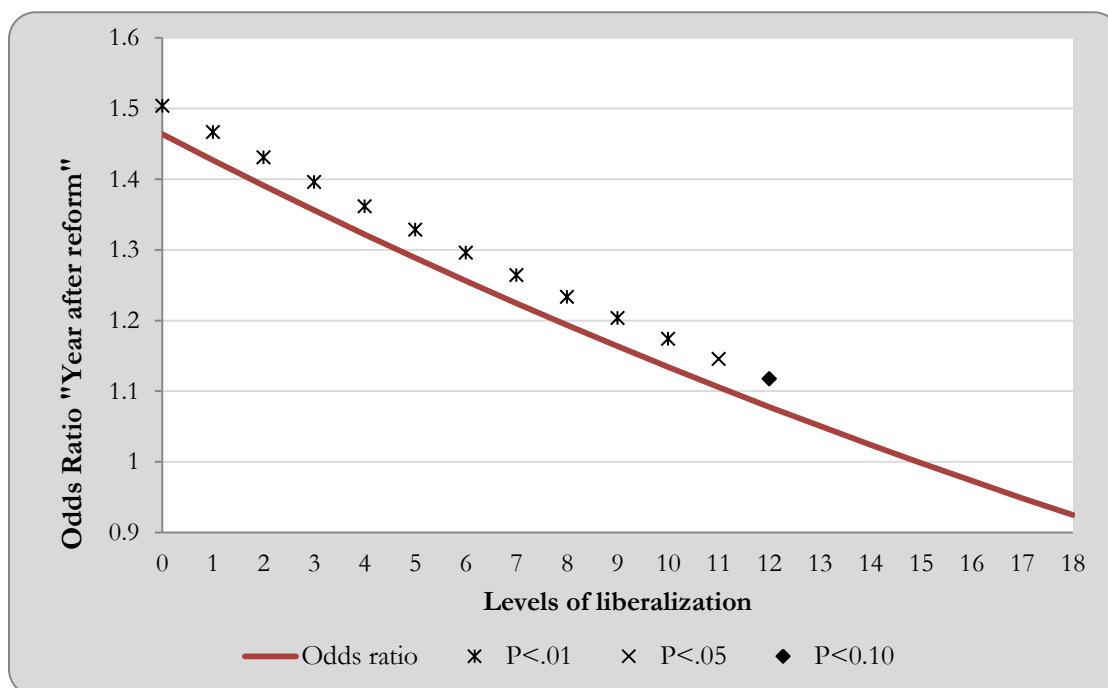
The joint effect of *Years since reform* and the interaction term is statistically significant at conventional levels when *Liberalization* is ≤ 11.75.[19]   At the lowest possible level of *Liberalization*, each additional year increases the odds of crisis onset in .46.   At a low level of *Liberalization* (mean minus a standard deviation, around 4 in the 18-point scale), each additional year increases the odds of crisis onset in .32.   Finally, at when *Liberalization* equals 9, each additional year elapsed since the last prudential reform increases the odds of a banking crisis by .16.

Regarding regulation, and consistent with the literature, both financial liberalization and banking deregulation are associated with higher likelihood of banking crisis' onset.   However, only the impact of *Liberalization* is robust to all model specifications.   *Capital openness* is negatively associated with crisis onset, but its coefficient is statistically significant only when previous banking crises are included in the model.   On the contrary, *Prudential supervision* loses statistical significance when controls for previous banking crises are included.[20]

Very few of the economic controls achieve acceptable levels of statistical significance in these models: *Domestic credit/GDP* is a robust predictor of crisis onset, suggesting that larger levels of credit increase the country's vulnerability to financial bubbles.   *Real interest* is consistently negative, but it only achieves .05 and .1 levels of statistical significance in models 9 and 19, respectively.

Regarding additional controls, Model 6 shows that a control for an eventual trend in the data does not affect the results.   The *Trend* variable is statistically insignificant.   However, this also suggests that the effect of regulatory lags is not absorbing the impact of the mere passage of time.   Similar results are obtained when controlling for diffusion of banking supervision standards (*Diffusion (supervision)*), and for the diffusion of banking crises (*Diffusion (crises)*).[21]   It is possible, however, that a more sophisticated measure of diffusion would better capture the effect of contemporary bank crises in other countries.

The simultaneous presence of a currency crisis is also associated with a higher likelihood of banking crisis onset (see Model 9).   More research should shed light regarding the nature of this association: it is possible that currency crises have similar roots as bank crisis, and the variable *Currency crisis* is merely absorbing the effect of omitted variables.   It is noteworthy that the lagged variable (*Currency crisis* ₜ₋₁) does not have a significant impact on crisis

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[19] The sample mean for this variable is 9.47, and its standard deviation is 5.59. In the subsample used in these models, the mean for this variable is 8.14, and its standard deviation is 5.27. Liberalization is ≤ 11.75 for 684 observations.

[20] This is consistent with Mitchener's argument regarding possible contradictory effects that capital and reserve requirements may have on banks' propensity to risky behavior (Mitchener 2005:157).

[21] Diffusion (crises) achieves statistical significance if included in Model 12 (that is, when controlling also for currency crises and the count of past crises). Its inclusion does not affect the main variables included in that model, but negatively affects the goodness of fit of that model. This specification is not reported.

onset. Its inclusion does not alter the results reported in Model 9, but decreases the model's overall fit.

Model 10 includes the number of previous banking crisis episodes (within the sample period). The inclusion of this variable substantially increases the explanatory power of the models (according to both the pseudo-R^2 and the Bayesian criteria). Surprisingly, the coefficient associated to this variable is negative, suggesting that a country that has experienced more systematic banking crises in the past is less vulnerable to banking crises. Intuitively, however, more crises in the past could suggest a more vulnerable banking system. Model 11 includes a squared count of previous crises, showing that this relationship is not linear. More research should explore this counterintuitive result. It is possible that the number of previous crises is absorbing other regulatory reforms that are not contemplated in the variables included in these models, or that previous crises make economic agents' behaviors more cautious, reducing the system's vulnerability.

Politics beyond regulation

At lower levels of liberalization, market actors have strong incentives to find ways to escape regulation and adopt risky behavior. It is more likely that they find these opportunities the more time old prudential regulation stays in place. The theory does not suggest that regulatory lags should be conditioned by factors other than level of liberalization, such as typical political factors. However, does partisanship affect the effect of regulatory lags? Furthermore, is it possible that regulatory lags are mere epiphenomena of deeper political causes for banking crisis vulnerability?

Model 13 shows that the government's partisanship does not have an independent effect of the country's vulnerability to banking crises. Neither *Right* nor *Center-right* (variables coding the party ID of the government, contemporary or lagged) has a significant impact on banking crisis onset. Their inclusion does not affect the direction or statistical significance of the results reported in Model 12.

As mentioned above, longer regulatory lags could absorb both the effect of available time for market actors to escape tight regulations, and of a slower decision-making process in the country. Neither of the measures of veto players (*POLCONIII* and *POLCONV*, either contemporaneus or lagged) achieves statistical significance (see Model 14). Finally, *Political instability* does not have a significant effect on banking crisis onset (see Model 15). The inclusion of these variables does not affect the relationships of interest.

I also test whether partisanship or the two veto player measures have an indirect impact on the likelihood of crisis onset, by interacting each of these three variables (and their alternative measurements) with regulatory lags. Again, neither of these three variables or their interaction terms achieves statistical significance. Furthermore, the results reported in Model 12 are not altered by these different specifications. For space considerations, Table 3 only shows the inclusion of one of the permutations of the political controls (the lagged values), and omits the models including interaction terms.

Income groups and regulatory lags

I conducted further robustness checks by changing the sample (see Table 4). First, the inclusion of fixed effects prevents knowing the effect of regulatory lags in countries with different levels of development. I run the baseline model (Model 12) on a sample excluding most developed countries or advanced economies (see Model 16),[22] and excluding both the most developed and the poorest countries (Model 17).[23] Although some of the controls behave differently (notably, *Currency crisis* and *Crisis count*) or achieve acceptable levels of statistical significance (e.g., *GDPPC*), the main results are not altered. Finally, I also re-run these models on samples including all the years.[24] Again, the main results hold across samples.

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[22] These models exclude countries from income group 4, identified in Appendix 2.

[23] These models exclude countries from income groups 1 and 4, identified in Appendix 2. I do not run models on samples exclusively of the most developed countries (income group 4) or the least developed countries (income group 1) because of sample size restrictions.

[24] Recall the original samples excluded years of crisis after the onset.

TABLE 4: PROBABILITY OF BANKING CRISIS ONSET. DIFFERENT SAMPLES

	ALL COUNTRIES		ALL DEVELOPING COUNTRIES		UPPER-MIDDLE AND LOWER-MIDDLE DEVELOPING COUNTRIES	
	MODEL 12	MODEL 12A(†)	MODEL 16	MODEL 16A(†)	MODEL 17	MODEL 17A(†)
	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)	COEFF. (STD. ERR.)
REGULATION						
PRUDENTIAL SUPERVISION$_{T-1}$	.488 (.563)	.411 (.537)	1.146 (.719)	1.257 (.701)*	1.102 (.767)	1.176 (.750)
LIBERALIZATION$_{T-1}$	.872 (.147)***	.887 (.146)***	.649 (.160)***	.651 (.159)***	.776 (.190)***	.785 (.189)***
CAPITAL OPENNESS$_{T-1}$	-.874 (.322)***	-.922 (.319)***	-.681 (.347)**	-.764 (.347)**	-.978 (.384)***	-1.081 (.387)***
YEARS SINCE REFORM	.381 (.096)***	.393 (.094)***	.374 (.101)***	.396 (.100)***	.455 (.133)***	.467 (.132)***
YEARS S.REFORM* LIBERALIZATION$_{T-1}$	-.026 (.008)***	-.027 (.008)***	-.018 (.009)**	-.020 (.009)**	-.025 (.011)**	-.027 (.010)***
MONETARY AND EXCHANGE						
INFLATION(LOG)$_{T-1}$	-.117 (.218)	-.157 (.219)	-.121 (.224)	-.155 (.222)	-.220 (.251)	-.258 (.249)
M2/RESERVES$_{T-1}$	-.001 (.003)	-.001 (.003)	-.001 (.003)	-.001 (.003)	.045 (.021)**	.046 (.021)**
DOMESTIC CREDIT/GDP$_{T-1}$	.033 (.012)***	.027 (.013)**	.031 (.013)**	.024 (.013)*	.029 (.016)*	.019 (.014)
REAL INTEREST$_{T-1}$	-.0006 (.0004)	-.0004 (.0005)	-.0007 (.0004)	-.0005 (.0005)	-.0007 (.0004)*	-.0006 (.0004)
PEG$_{T-1}$	.559 (.663)	.749 (.632)	.205 (.669)	.530 (.631)	.860 (.735)	1.176 (.698)*
VOLATILITY						
TRADE VOLATILITY$_{T-1}$	.011 (.024)	.011 (.023)	.019 (.025)	.020 (.024)	.026 (.029)1	.031 (.028)
DOMESTIC CREDIT GROWTH$_{T-1}$	.029 (.024)	.002 (.016)	.026 (.025)	.005 (.017)	.038 (.026)	.014 (.018)
EC. AND POLITICAL						
GDPPC$_{T-1}$	.359 (.250)	.442 (.250)*	2.273 (.870)***	2.032 (.802)**	2.620 (.953)***	2.520 (.870)***
GDP GROWTH$_{T-1}$	-.056 (.046)	-.056 (.044)	-.053 (.049)	-.055 (.046)	-.055 (.058)	-.063 (.055)
POLITY2$_{T-1}$	.079 (.061)	.122 (.055)**	.038 (.060)	.091 (.055)*	.076 (.069)	.131 (.062)**
OTHER CONTROLS						
CURRENCY CRISIS	.954 (.519)***	-9.787 (1.544)***	-9.057 (1.594)***	-9.201 (1.517)***	-10.314 (2.013)***	-10.589 (1.966)***
CRISES COUNT	-9.658 (1.587)***	1.514 (.291)***	1.349 (.305)***	1.433 (.291)***	1.575 (.371)***	1.667 (.361)***
CRISES COUNT^2	1.522 (.300)***	.834 (.507)*	.985 (.522)*	.772 (.514)	.944 (.599)	.686 (.594)
NUMBER OF OBS	1001	1101	869	961	677	760
NUMBER OF GROUPS	45	45	39	39	31	31
LR CHI2	(18)=143.89	(18)=151.98	(18)=123.54	(18)=130.47	(18)=110.24	(18) = 117.09
PSEUDO-R^2	.439	.445	.424	.428	.467	.472
PROB > CHI2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AIC	219.5582	225.7745	203.7883	210.097	161.7019	166.9829
BIC	307.9158	315.846	289.6005	297.7205	243.02	250.3827

Notes: Panel logit coefficients with fixed effects. Standard errors in italics. Statistical significance is indicated as follows: $p<0.10$, **$p<0.05$, ***$p<0.01$. (†) These models include all years.

Model's explanatory power

The pseudo-R^2 may not provide a satisfactory indication of logit models' fit. The partial correlation between the predicted probability of a crisis onset and the observed crisis onset is .61. Table 5 shows the number of observations where crisis onsets were (not) observed, and the model 12's predicted probability of observing a crisis onset. For simplicity, I divided the predicted probabilities in larger and smaller than .5 (there are no cases where predicted probability equals .5).

TABLE 5: OBSERVED AND PREDICTED CRISES ONSET. NUMBER OF CASES AND MEAN PREDICTED PROBABILITY (ACCORDING TO MODEL 11)

		PREDICTED CRISIS ONSET	
		P<.5	P>.5
OBSERVED CRISIS ONSET	ONSET=0	N=942 (.027)	N=2 (.585)
	ONSET=1	N=45 (.202)	N=12 (.773)

Note: N: number of observations. Mean predicted probability between parentheses.

According to Table 5, the model accurately predicts 942 cases where there was no crisis onset, estimating an average probability for those cases lower than .03. The model estimates a probability of crisis larger than .5 for two observations where there was no crisis onset: Nicaragua 1989 and Bulgaria 1995. Regarding observed crisis onset, the model seems to perform poorly: 12 of the observed crisis onsets have a predicted probability >.5 (on average, the predicted probability for those observations is .77), but 45 of the observed crises have a predicted probability <.5. This suggests a very high percentage of Type II errors (false negatives). However, a closer look to those cases suggests that the table is obscuring the accuracy of the prediction.

TABLE 6: OBSERVED CRISES ONSET WITH PREDICTED PROBABILITY >.5 (ACCORDING TO MODEL 12)

| COUNTRY	CRISIS YEAR	PREDICTED PROBABILITY	AVERAGE PREDICTED PROBABILITY
ALGERIA	1990	.156	.038
	1989	.117	
ARGENTINA	1995	.190	.071
	2001	.056	
BANGLADESH	1987	.435	.037
BRAZIL	1994	.00001	.043
BULGARIA	1996	.282	.1
	1987	.352	
CAMEROON	1995	.003	.04
CHINA	1998	.079	.077
	1982	.334	
COLOMBIA	1998	.056	.034
	1987	.295	
COSTA RICA	1994	.0009	.037
D. REPUBLIC	2003	.384	.125
	1982	.319	
ECUADOR	1998	.177	.056
EGYPT	1980	.064	.031
GHANA	1982	.057	.032
INDONESIA	1997	.301	.038
JAMAICA	1996	.075	.043
	1985	.282	
KENYA	1992	.0006	.033
MADAGASCAR	1988	.313	.034
MALAYSIA	1997	.177	.038
	1981	.274	
MEXICO	1994	.061	.048
MOROCCO	1980	.036	.045
NEPAL	1988	.399	.036
NICARAGUA	1990	.405	.25
NIGERIA	1991	.064	.038
NORWAY	1991	.296	.04
PARAGUAY	1995	.396	.059
PERU	1983	.080	.031
PHILIPPINES	1997	.145	.04
	1983	.097	
THAILAND	1997	.316	.038
TUNISIA	1991	.268	.031
	1982	.380	
TURKEY	2000	.040	.034
UGANDA	1994	.030	.05
U.S.A.	1988	.190	.031
URUGUAY	2002	.480	.059
VENEZUELA	1994	.420	.036
ZIMBABWE	1995	.197	.06

Note: Highlighted cells are Type II errors

Table 6 shows the 45 observations where crisis onset were observed, but with a predicted probability smaller than .5. Table 6's last column also show the average crisis onset's probability for the country in the sample. In most cases, the predicted probability – although low in absolute terms, doubles (or more) the average predicted probability of a banking crisis in a given country. This table identifies nine cases where the model predicts a crisis onset probability that is lower than the average probability (cells highlighted in Table 6). Figure 5 plots both the observed and the estimated probability of crisis onset for selected countries.
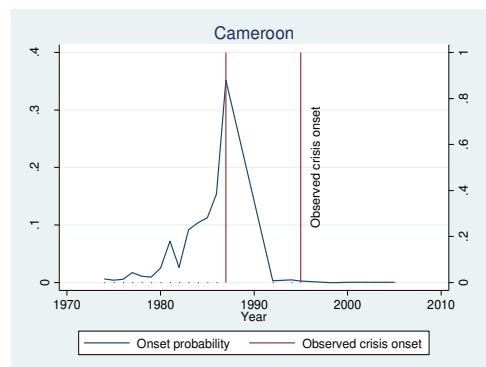
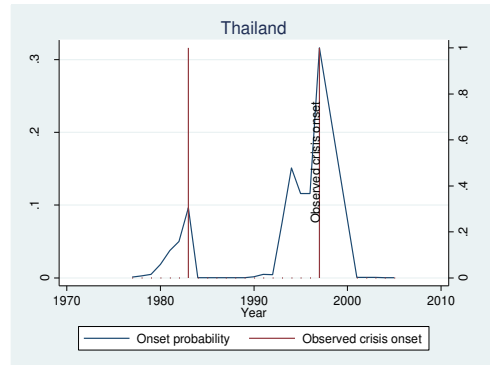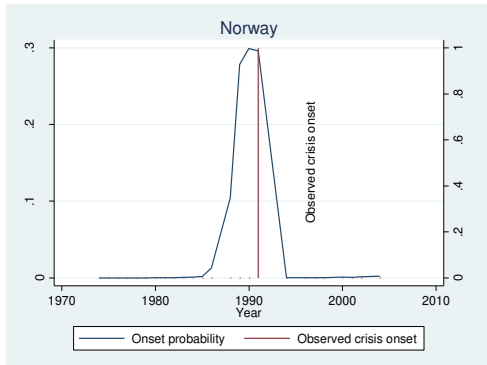**FIGURE 5: CRISES PREDICTED AND OBSERVED. ILLUSTRATIVE CASES WHERE PREDICTED PROBABILITY <.5**
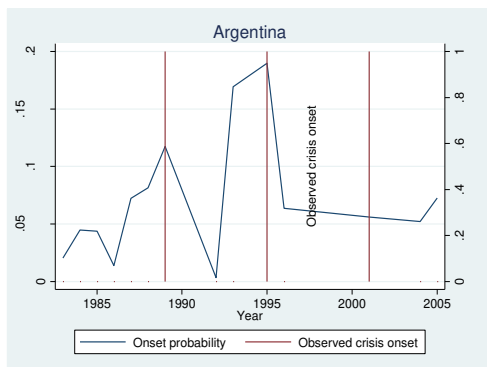
Argentina 2001 (Type II error)
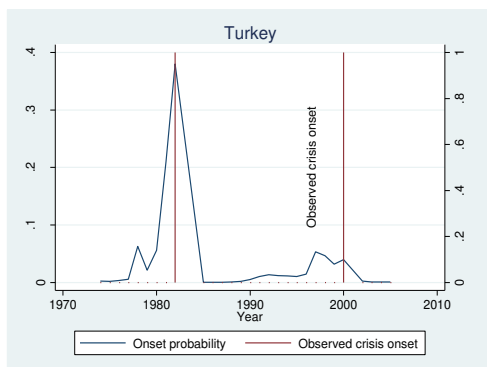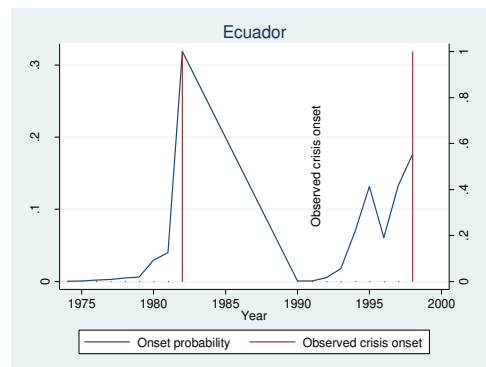
Turkey 2000 (Type II error)

Cameroon 1995 (Type II error)

Conclusions

This article explored the effect of states' lags in regulation update on their likelihood of experiencing banking crises. In spite of the clear importance of banking crises to the global economy, this subject remains underanalyzed, and the extant literature falls short with its explanations of crises. I argue that delays in revising banks' prudential regulation give opportunities for banks to adopt risky behavior. This increases the country's vulnerability to systemic banking crises. This effect, however, is conditional on the level of liberalization of the financial market. At lower levels of liberalization, banks have strong incentives to escape regulation's constraints and to take advantage of regulatory lags. At high levels of liberalizations, those incentives are curbed by market discipline. The evidence presented here provides support to this argument. This result is robust to different model specifications and sample sizes.

The results highlight that the incentives that institutions create can and do vary with the passage of time. This provides an important contribution to the literature, given that a substantial amount of research has assumed static effects of institutions – and particularly, of regulation - on countries' vulnerability to crises. These results are also of interest beyond the research question motivating this paper and open other venues of study. Although the baseline model presented here is parsimonious in comparison with the econometric models present in the literature, its predictive power is relatively high. Its parsimony allows for further testing of other hypotheses regarding banking crises onset, providing a good baseline for analysis. The empirical analysis also suggests reevaluating the importance of some economic variables assumed to be related to banking crises, but that failed to achieve statistically significant relationships with crisis onset in these models.

These findings open questions for future research. In particular, do regulatory lags have similar effects on other industries, or is this effect specific to the banking sector? Second, and given that prudential supervision does not seem to be a robust predictor of banking crisis onset: what kinds of prudential rules are more effective at diminishing countries' vulnerability to banking crises? How does the nature of the supervisory agency affect the country's vulnerability to banking crises? What characteristics of the financial market make regulatory lags more problematic?

Finally, more research should examine the role of other political variables on banking crisis vulnerability. For example, although partisanship was not a significant predictor of banking crisis onset in the tests of this paper, and is not part of the theory's argument, it is possible that the government's party ID has conflicting effects in different countries, depending on the government's credibility, past experience with bailouts, or even its duration in office.

Appendices

Appendix 1: Coding of the variable "Banking Sector Supervision"

This appendix is an excerpt of Abiad, Detragiache, and Tressel' "A New Database of Financial Reforms" (Abiad et al. 2010:299-301). Exclusions and minor changes have been made for brevity reasons.

Banking Sector Supervision

1) Has a country adopted a capital adequacy ratio based on the Basle standard? (0/1)

> 0: the Basle risk-weighted capital adequacy ratio is not implemented. Also, prior to 1993, when the Basle regulations were not in place internationally

> 1: the Basle CAR is in force. (Note: If the large majority of banks meet the prudential requirement of an 8 percent risk-weighted capital adequacy ratio, but this is not a mandatory ratio as in Basle, the measure is still classified as 1).

2) Is the banking supervisory agency independent from executives' influence? (0/1/2)

> 0: when the banking supervisory agency does not have an adequate legal framework to promptly intervene in banks' activities; and/or when there is the lack of legal framework for the independence of the supervisory agency such as the appointment and removal of the head of the banking supervisory agency; or the ultimate jurisdiction of the banking supervision is under the MOF; or when a frequent turnover of the head of the supervisory agency is experienced.

> 1: when the objective supervisory agency is clearly defined and an adequate legal framework to resolve banking problems is provided (the revocation and the suspension of authorization of banks, liquidation of banks, and the removal of banks' executives etc.) but potential problems remain concerning the independence of the banking supervisory agency (for example, when the MOF may intervene into the banking supervision in such as case that the board of the banking supervisory agency board is chaired by the MOF, although the fixed term of the board is ensured by law); or although clear legal objectives and legal independence are observed, the adequate legal framework for resolving problems is not well articulated.

2: when a legal framework for the objectives and the resolution of troubled banks is set up and if the banking supervisory agency is legally independent from the executive branch and actually not interfered with by the executive branch.

3) Does a banking supervisory agency conduct effective supervisions through on-site and off-site examinations? (0/1/2)

0: when a country has no legal framework and practices of on-site and off-site examinations is not provided or when no on-site and off-site examinations are conducted.

1: when the legal framework of on-site and off-site examinations is set up and the banking supervision agency have conducted examinations but in an ineffective or insufficient manner.

2: when the banking supervisory agency conducts effective and sophisticated examinations.

4) Does a country's banking supervisory agency cover all financial institutions without exception? (0/1)

0: if some kinds of financial institutions are not exclusively supervised by the banking supervisory or are excluded from banking supervisory agency oversights.

1: when all banks are under supervision by supervisory agencies without exception.

Enhancement of banking supervision over the banking sector is coded by summing up these four dimensions, which are assigned a degree of reform as follows.

Highly Regulated = [6], **Largely Regulated =** [4-5], **Less Regulated =** [2-3], **Not Regulated** = [0-1]

Appendix 2: Observations included in different samples.

TABLE A1. OBSERVATIONS INCLUDED IN THE CRISIS ONSET MODELS, EXCLUDING CRISES YEAR (MODEL 12)

	COUNTRY	YEARS	CRISIS ONSET	INCOME GROUP
1	UNITED STATES OF AMERICA	1974-2005	1988	4
2	DOMINICAN REPUBLIC	1997-2005	2003	3
3	JAMAICA	1974-1998	1996	3
4	MEXICO	1979-2005	1981, 1994	3
5	NICARAGUA	1989-1995	1990	2
6	COSTA RICA	1974-2005	1987, 1994	3
7	COLOMBIA	1974-2005	1982, 1998	3
8	VENEZUELA	1974-2005	1994	3
9	ECUADOR	1974-1982, 1986, 1990-1998	1982, 1998	2
10	PERU	1974-2005	1983	3
11	BRAZIL	1974-1987, 1990-2005	1990, 1994	3
12	PARAGUAY	1989 – 2005	2005	2
13	ARGENTINA	1981–1993, 1995–1996, 2001, 2003-2005	1988, 1995, 2001	3
14	URUGUAY	1982 – 2005	2002	3
16	POLAND	1992-2005	1992	4
17	HUNGARY	1991-2005	1991	4
18	BULGARIA	1995-2005	1996	3
19	RUSSIAN FEDERATION	1997-2005	1998	3
20	UKRAINE	1997-2005	1998	2
21	SWEDEN	1974-2005	1991	4
22	NORWAY	1974-1986, 1988-1994, 1996-1998, 2000-2002, 2004	1991	4
23	CAMEROON	1974-1987, 1889, 1991-1992, 1994-2005	1987, 1995	2
24	BURKINA FASO	1989-1991, 1993, 1995-2000, 2002-2005	1990	1
25	GHANA	1974-2005	1982	1
26	NIGERIA	1974-1986, 1988-1998, 2000-2005	1991	2
27	UGANDA	1984-1999, 2001-2002, 2004-2005	1994	1
28	KENYA	1974-2005	1985, 1992	1
29	MADAGASCAR	1974-1994, 1996-1997, 1999-2005	1988	1
30	MOROCCO	1974-1989, 1995-2000, 2002-2005	1980	2
31	ALGERIA	1975-1998, 2000-2005	1990	3

	COUNTRY	YEARS	CRISIS ONSET	INCOME GROUP
32	TUNISIA	1974-2005	1991	2
33	TURKEY	1974-2005	1982, 2000	3
34	EGYPT	1974-2005	1980	2
35	JORDAN	1978, 1980-1984, 1987, 1989-1999, 2002-2005	1989	2
36	CHINA	1991-1998, 2001-2005	1998	2
37	KOREA, REPUBLIC OF	1974-2005	1997	4
38	INDIA	1974-1975, 1977-2005	1993	2
39	BANGLADESH	1979-2005	1987	1
40	SRI LANKA	1974-2005	1989	2
41	NEPAL	1977, 1979-2005	1988	1
42	THAILAND	1977-2005	1983, 1997	2
43	MALAYSIA	1974-1975. 1977-1985, 1988-2005	1997	3
44	PHILIPPINES	1974-2005	1983, 1997	2
45	INDONESIA	1975-1986, 1988-2005	1997	2

TABLE A2. OBSERVATIONS INCLUDED IN THE CRISIS ONSET MODELS, INCLUDING CRISES YEAR

	COUNTRY	YEARS	CRISIS ONSET	INCOME GROUP
1	UNITED STATES OF AMERICA	1974-2005	1988	4
2	CANADA	1974-2005		4
3	DOMINICAN REPUBLIC	1997-2003, 2005	2003	3
4	JAMAICA	1974-1996	1996	3
5	MEXICO	1979-2005	1981, 1994	3
6	GUATEMALA	1974-2005		2
7	EL SALVADOR	1998-2005		2
8	NICARAGUA	1989-1995	1990	2
9	COSTA RICA	1974-2005	1987, 1994	3
10	COLOMBIA	1974-2005	1982, 1998	3
11	VENEZUELA	1974-2005	1994	3
12	ECUADOR	1974-1998	1982, 1998	2
13	PERU	1974-2005	1983	3
14	BRAZIL	1974-2005	1990, 1994	3
15	BOLIVIA	1974-2005		2
16	PARAGUAY	1995		2
17	CHILE	1994-2005		3
18	ARGENTINA	1983-2005	1988, 1995, 2001	3
19	URUGUAY	1986-2002	2002	3
20	SWITZERLAND	1997-2005		4
21	POLAND	1992-2005	1992	4
22	HUNGARY	1991-2005	1991	4
23	CZECH REPUBLIC	2001-2005		4
24	ALBANIA	1996-2005		3
25	BULGARIA	1995-2005	1996	3
26	ROMANIA	1996-2005		3
27	RUSSIAN FEDERATION	1997-2005	1998	3
28	ESTONIA	1997-2005		4
29	LATVIA	1997-2005		4
30	LITHUANIA	1997-2005		3
31	UKRAINE	1997-2005	1998	2
32	BELARUS	1997-2005		3
33	GEORGIA	1998-2005		2
34	AZERBAIJAN	1997-2005		3
35	SWEDEN	1974-2005		4
36	NORWAY	1974-2004	1991	4
37	DENMARK	1974-2005		4
38	SENEGAL	1974-2005		2
39	COTE D'IVOIRE	1974-2005		2
40	BURKINA FASO	1989-2005	1990	1
41	GHANA	1974-2005	1982	1
42	CAMEROON	1974-2005	1987, 1995	2
43	NIGERIA	1974-2005	1991	2
44	UGANDA	1985-2005	1994	1

	COUNTRY	YEARS	CRISIS ONSET	INCOME GROUP
45	KENYA	1974-2005	1985, 1992	1
46	TANZANIA	1993-2005		1
47	ETHIOPIA	1983-2005		1
48	MOZAMBIQUE	1995-2005		1
49	ZIMBAWE	1985-2003	1995	1
50	SOUTH AFRICA	1974-2005		3
51	MADAGASCAR	1974-2005	1988	1
52	MOROCCO	1974-2005	1980	2
53	ALGERIA	1975-2005	1990	3
54	TUNISIA	1974-2005	1991	2
55	TURKEY	1974-2005	1982, 2000	3
56	EGYPT	1974-2005	1980	2
57	JORDAN	1978-2005	1989	2
58	ISRAEL	1983-2003		4
59	KYRGYSTAN	2000-2005		1
60	KAZAKHSTAN	1997-2005		3
61	CHINA	1991-2005	1998	2
62	KOREA, REPUBLIC OF	1974-2005	1997	4
63	JAPAN	1974-1995		4
64	INDIA	1974-2005	1993	2
65	PAKISTAN	1974-2005		2
66	BANGLADESH	1979-2005	1987	1
67	SRI LANKA	1974-2005	1989	2
68	NEPAL	1977-2005	1988	1
69	THAILAND	1977-2005	1983, 1997	2
70	MALAYSIA	1974-2005	1997	3
71	SINGAPORE	2005		3
72	PHILIPPINES	1974-2005	1983, 1997	2
73	INDONESIA	1975-2005	1997	2
74	AUSTRALIA	1974-2005		4
75	NEW ZEALAND	1974-2005		4

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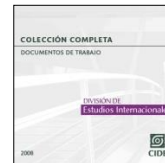
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