Financial structure, financial development and banking fragility: International evidence

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FINANCIAL STRUCTURE, FINANCIAL DEVELOPMENT AND BANKING FRAGILITY: INTERNATIONAL EVIDENCE[*]

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Abstract

We study the effects of financial structure and financial development on banking fragility. We develop our study by using fixed-effects panel-data regressions and by controlling the effects of certain banking indicators. We use individual and principal-components indicators of the activity, size and efficiency of intermediaries and markets. The indicators include data for 211 countries between 1990 and 2003. Our main findings suggest that banking stability is enhanced in market-based financial systems. Financial development reduces it. However this fragility-enhancing effect can be unveiled only when we account for financial structure. Thus, financial structure and development jointly matter to assess banking fragility.

Resumen

Estudiamos los efectos de la estructura financiera y el desarrollo financiero en la fragilidad bancaria. Nuestro estudio se desarrolla con regresiones para datos de panel con efectos fijos y controlando los efectos de ciertos indicadores bancarios. Usamos indicadores individuales y de componentes principales, que evalúan la actividad, tamaño y eficiencia de los intermediarios y mercados financieros. Los indicadores incluyen datos para 211 países entre 1990 y 2003. Nuestros hallazgos sugieren que la estabilidad bancaria se incrementa en sistemas financieros donde predominan los mercados. El desarrollo financiero la reduce. Sin embargo, este efecto desestabilizador es evidente solo cuando se considera la estructura financiera. Así, la estructura financiera y el desarrollo financiero conjuntamente influyen en la fragilidad bancaria.

JEL Classification: G21, N20, E44

Keywords: Banks, fragility, financial structure, financial development

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1. Introduction

One of the main concerns among economists relates to the study of the determinants of banking crises. Particularly, financial structure determinants have been considered important to understand them [Demirguc-Kunt and Detragiache (1998)]. Here we study the effects of financial determinants on banking fragility. We develop our study by using panel-data techniques and by controlling for banking activity, size and concentration. We use indicators of the activity, size and efficiency of intermediaries and markets for 211 countries during the period 1990-2003.

The study is motivated by the necessity to understand the determinants of banking crises. Particularly, our interest on the financial determinants relates to an old concern in economics about the effects that financial systems may have on the performance of the agents within an economy and the economy itself.[1] This concern has encouraged the development of theories and empirical research to assess the relative merits of different financial systems. However we are far from a consensus about which financial systems may contribute to achieve specific goals, like financial stability.

We believe that the understanding the financial determinants is particularly relevant to avoid the economic costs of banking crises. Solely the costs of the recent global financial

[1] Such concern can be traced back to the writings of Bagehot (1873). See Levine (2002) and Allen and Gale (2004) for reviews on the relationships between financial structure and economic performance.

crisis of 2007-2008 have been estimated above 1.4 trillion US dollars [IMF (2008:xiii)]. [2] This crisis, the worst since World War II, has been considered as "a modern form of a traditional banking crisis" [Vives (2008:99)]. Moreover, according to several authors, its origins can be traced on issues related to financial structure and financial development.[3] Thus, the study of these determinants might contribute to avoid further costly crises.

The necessity to develop further investigations on the determinants of banking fragility cannot be minimised. The literature on the impacts of financial structure on banking crises is relatively scarce and in an early stage of development. Until recently, issues regarding data availability, accounting, regulatory and economic methods have inhibited the development of such studies. Indeed, existing studies on the relationship between financial structure and banking fragility are mainly descriptive.[4] Thus there is no reliable guide regarding how to avoid financial crises in national or global contexts.

We aim at clarifying how financial structure and financial development determinants may relate to banking fragility by suggesting answers to the following questions: Does financial structure matter to assess banking performance? What are the effects, if any, of financial structure and development on banking crises? Can we analyse these two determinants independently one of another? Which type of implications may be derived from these findings? Here we analyse these questions by using a variation of the failure-determinant methodology that includes panel-data regressions.

[2] See Barrel and Davies (2008) for a summary of the evolution of the financial crisis of 2007-2008.
[3] See Felton and Reinhart (2008) for a compilation of essays among academic economists and policymakers about the origins, evolution and policy responses to the global financial crisis.
[4] To our knowledge the first study on this relationship is the one of Allen (2001).

We develop this study in three stages. First we build the financial indicators based on measures of activity, size and efficiency of intermediaries and markets. Later we estimate the individual and joint effects of financial development and structure on banking fragility with three sets of fixed-effects logit regressions for panel-data. Finally we use omitted-variable tests to evaluate the pertinence of the joint study of the effects of financial structure and development. We use individual and principal-components indicators for the empirical assessments.

Methodologically, our study has some specific features that differentiate it with respect to others: A first feature is that we use internationally comparable data from the most extensive datasets publicly available for 211 economies during the period 1990-2003.[5] The second one is that we use panel-data techniques that allow us to control the effects of time-constant unobserved heterogeneity among countries. Finally the last distinctive feature of our study is that we analyse the effects of individual and aggregate indicators of financial structure and development on banking fragility.

Our econometric results have implications for theoretical and practical purposes. Specifically the assessments suggest that financial structure and financial development *jointly* matter to assess the stability of banking systems. Banking stability is *enhanced* in economies with market-based financial systems. Financial development *reduces it.*

[5] We use panel-data extracted from the database on financial development and structure [Beck, Demirguc-Kunt and Levine (2006)], and from the datasets on episodes of systemic and borderline banking crises [Caprio and Klingebiel (2003)]. The datasets are available at the World Bank´s website: http://econ.worldbank.org

However the latter fragility-enhancing effect can be unveiled only when we account for financial structure. Furthermore our findings suggest that the size of the banking sector seems to *reduce* banking stability and that lending activities *enhance* it.

This study complements and extends the ones of Demirguc-Kunt and Detragiache (1998) and the ones of Ruiz-Porras (2006) and (2008). The first study shows that economies with low growth rates, high rates of inflation and interest rates and BOP problems are likely to experience crises. The second study describes the "stylised facts", between financial systems and banking crises. Concretely, it shows that crises are more likely in bank-based financial systems and that financial development enhances banking stability. Finally the third study analyses the relationship between banking competition and banking crises.

The article is organised in seven sections. Section 2 reviews the literature. Section 3 describes the data. Section 4 discusses methodological issues. Section 5 shows the outcomes of the individual assessments of the effects of financial structure and development. Section 6 focuses on the joint analysis of such effects and its econometric justification. Section 7 summarises and discusses the main findings. The appendixes include further econometric estimations and indicate the countries and data of recognised banking crises used in the study.

2. Financial structure, financial development and banking fragility

Theory suggests that the opportunities to deal with financial risks and to engage on risk sharing activities depend on the particular properties of financial systems [see Allen and Gale (2000) and (2004)]. Financial competition among financial markets and banks, which is reflected on the financial structure of an economy, provides different incentives and opportunities for risk management. The management of risks is the main activity of banks. Thus, it is very likely that banking performance, and the likelihood of crises, may depend on the structure and degree of development of the financial systems.

Why financial structure may be related to the likelihood of banking crises? According to the theory on comparative financial systems, such relationship can be explained in terms of financial competition. Competition between markets and banks erodes the opportunities to engage in inter-temporal risk smoothing activities [See Allen and Gale (2000) and (2004)]. Such erosion is particularly relevant because banking crises have been defined as equilibrium outcomes in a context of inter-temporal risk sharing [See Diamond and Dybvig (1983)].[6]

However, we must emphasise that the relationship between financial systems and banking crises may not be a straightforward one. Theory has not dealt enough with issues regarding how risks may influence intermediaries´ behaviour [see Allen and Santomero (1997) and Scholtens and Van Wensveen (2000)]. We cannot dismiss the possibility of bidirectional effects between financial development and banking crises. Historically, banking crises have had a significant impact on the development of financial systems.

Empirical studies that assess how different financial structures may affect the performance of banks in an international context are scarce. The first study that analyses the relationship between financial structure and banking performance is the one of Demirguc-Kunt and Huizinga (2001). Among their findings, they show that in emerging economies, financial systems tend to be bank-based and relatively underdeveloped. However they do not find any conclusive evidence to support the hypothesis that financial structure has a significant, independent influence on bank margins and profits.

The hypothesis that financial structure matters to explain banking fragility has been explicitly stated by Demirguc-Kunt and Detragiache (1998).[7] Such hypothesis has support on the study of Ruiz-Porras (2006). There he finds that financial development is associated to market-based financial systems and that such association is magnified during episodes of banking crises. Thus, he concludes that financial structure, development and banking crises are interrelated. Such conclusion is reached by analysing data for 47 economies during the period 1990-1997.

Further studies provide indirect evidence to support the idea that financial determinants might explain banking crises. Among these studies, we include the ones of Loayza and Ranciere (2006) and Evrensel (2008). The first study shows that financial liberalisation, as a mean of financial development and change in financial structures, can generate short-

[6] See De Bandt and Hartmann (2002) for a survey on systemic risk in banking.
[7] Demirguc-Kunt and Detragiache (1998:105) indicate that "variables that capture the structure of the banking system and, more generally, the structure of financial markets…, are likely to play an important

run financial instability and long-run growth. The second one suggests that financial and economic development and banking concentration might delay banking crises. In both studies, financial development seems to be a significant determinant.

Methodologically, we should point out that none of the previous empirical studies is a failure-determinant one. This type of studies attempts to explain recognised insolvency situations among intermediaries or troubled banking systems. They seek to identify, ex-post, the factors that may affect the likelihood of banking problems. Currently there are not failure-determinant studies that have focused on how financial structure determinants may affect banking crises.[8] So, the development of such studies may to be particularly necessary to improve our understanding on banking fragility.

We are far from a consensus regarding the effects of financial determinants on banking crises. The theoretical and empirical literature on comparative financial systems is rather limited and inconclusive to deal with this issue. Particularly, we believe that further failure-determinant studies may be useful at clarifying the relationships between financial systems and banking fragility.

3. Banking and financial indicators

Here we describe the financial and banking indicators used in our study. Such indicators are built according to the guidelines proposed by Demirguc-Kunt and Detragiache (1998) and Levine (2002). Thus, we consider as a stable banking system as one that does not

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role in breeding banking crises, but they are neglected here because of lack of data. A study limited to a smaller set of countries that includes more structural variables might yield to more interesting results".

[8] Ruiz-Porras (2008) includes aggregate financial structure and development determinants as control variables to assess the relationship between banking competition and banking fragility for 47 economies

experience a *recognised* episode of borderline or systemic banking crisis. In addition, we follow the convention that financial development depends to the level of development of *both* intermediaries and markets. Finally we consider that financial structure depends on the degree to which a financial system is based on intermediaries *or* markets.

We build the financial structure and development indicators with panel-data extracted from the revised dataset of Beck, Demirguc-Kunt and Levine (2006). We captured the main features of the financial and banking environment. We use the datasets of Caprio and Klingebiel (2003) to build the qualitative indicators of fragility. Datasets allow us to build our sample of financial and banking indicators. The main advantage of using these datasets is that they provide us with consistent data across countries and across time.

We combine the three datasets to develop our failure-determinant study for the period 1990-2003 [See Table 1]. [9] Here it is worthy to indicate that the dataset of Beck, Demirguc-Kunt and Levine (2006) includes panel-data for 211 countries for the period 1960-2004. Specifically, the dataset includes data for 58 low-income, 54 lower-middle, 40 upper-middle, 32 high-income-non-OECD and 26 high-income-OECD countries. The datasets of Caprio and Klingebiel (2003) include data on recognised borderline and systemic episodes of banking crises for several countries during the period 1974-2003. [10]

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during the period 1990-1997. His findings suggest that the orientation toward marked-based financial systems might enhance banking stability.

[9] The countries and episodes of banking crises considered in our study are contained in Appendix B.

[10] A limitation of the datasets of Caprio and Klingebiel (2003) refers to the characterisation and coverage of banking crises. In many countries, banking problems are underestimated and also the size of their costs. Moreover, the time span of banking crises is not easy to determine. Even at a mere qualitative level, the characterisation of crises may be difficult to establish for certain countries because they are not officially recognised. Thus, we cannot dismiss the possibility that certain "periods of banking stability", in our database, may occur in reality due to missing or non reported data on banking crisis episodes.

Table 1. Financial and Banking Data

Definition	Variable	Period	Countries (Crises)	Observations (Crises)
Banking fragility variables				
Dummy variable on borderline episodes of banking fragility (Banking crisis=1, otherwise=0)	BORDER	1974-2003	211 (44)	6330 (278)
Dummy variable on systemic episodes of banking fragility (Banking crisis=1, otherwise=0)	SYSTEMIC	1974-2003	211 (92)	6330 (697)
Financial structure and development variables				
Private credit by deposit money banks and other financial institutions to GDP (Private credit ratio)	PCRDBOFGDP	1960-2004	161	4597
Stock market capitalisation to GDP (Market capitalisation ratio)	STMKTCAP	1976-2004	111	1541
Stock market total value traded to GDP (Total value traded ratio)	STVALTRADED	1975-2004	111	1588
Banking system variables				
Concentration (Ratio of the 3 largest banks to total banking assets	CONCENTRATION	1990-2004	160	1790
Deposit money bank assets to GDP (Bank size ratio)	DBAGDP	1960-2004	161	4606
Overhead costs of the banking system relative to banking system assets	OVERHEAD	1990-2004	158	1738
Private credit by deposit money banks to GDP (Bank credit ratio)	PCRDBGDP	1960-2004	161	4582

Notes:
- The database on banking crises includes the two qualitative variables included here. A banking crisis is defined as *systemic* if most or all banking system capital is eroded by loan losses (5% of assets in developing countries). A *non systemic* banking crisis includes borderline and smaller banking crises.
- Annual observations associated to episodes of recognised banking crises are given in parenthesis.
- The complete financial development and structure database includes statistics on the size, activity and efficiency of various intermediaries (commercial banks, insurance companies, pension funds and non-deposit money banks) and markets (primary equity and primary and secondary bond markets).

Methodologically, we define nine individual indicators to describe the financial and banking environments prevailing in every country every year according to data availability. We organise these indicators into three assortments. The *structural assortment* contains measures of the activity, size and efficiency of stock markets *relative to* that of banks. The *development assortment* contains measures of the activity, size and efficiency of stock markets *and* banks. Finally the *banking assortment* contains measures of activity, size and concentration of banking systems.

We follow Levine (2002) to build the financial assortments that capture the specific features of the financial system in a country. The structural assortment is integrated by the Structure-Activity, Structure-Size and Structure-Efficiency indicators. Here market-based financial systems are associated to large values of the indicators and bank-based ones to small values. The development assortment is integrated by the Finance-Activity, Finance-Size and Finance-Efficiency indicators. Financial development is associated to large values of the indicators and underdevelopment to small ones.[11]

We summarise the information content of these assortments by using two aggregate indicators of financial structure and development. We follow the approach of Levine (2002) to define them. Such indicators are built with principal-component methods. Specifically they are the Structure-Aggregate and the Finance-Aggregate ones. We use the aggregate indicators as indexes of scale for the level of development and of the

[11] The financial indicators may have limitations to describe the main features of financial systems. Particularly, Levine (2002) indicates that the Finance-Size and the Structure-Efficiency indicators have some problems to be considered good measures of financial development and financial structure. Here we include these indicators for completeness and consistency with other studies.

relative prominence of markets in the financial system. These two indicators complement the previous ones included in the structure and development assortments.

Finally we describe the main features of the banking sector with the third assortment. The banking assortment is integrated by the Banking-Activity, Banking-Size and Banking-Concentration indicators. Large values of the first two indicators are associated to high levels of credit activity and to a large size of banking assets [See Demirguc-Kunt and Huizinga (2001)]. High values of the last indicator are associated to concentrated banking systems. We use these three indicators as control variables in the panel-data models. They are included here under the basis of data availability.[12]

[12] We are aware that important control variables are missing. We do not include them due to the lack of data. These omissions include economic indicators and variables to describe different regulatory regimes.

Table 2. Banking and Financial Indicators

Name	Definition	Measurement
Banking Fragility Indicators		
Crises	Binary variable for fragility: Banking crisis=1 Non banking crisis=0	Recognised episodes of systemic and/or borderline banking crises
Financial Structure Indicators		
Structure Activity	$STCACT = \ln\left(\frac{\text{STVALTRADED}}{\text{PCRDBGDP}}\right)$	Activity of stock markets relative to that of banks
Structure Size	$STCSIZ = \ln\left(\frac{\text{STMKTCAP}}{\text{PCRDBGDP}}\right)$	Size of stock markets relative to that of banks
Structure Efficiency	$STCEFF = \ln(\text{STVALTRADED} * \text{OVERHEAD})$	Efficiency of stock markets relative to that of banks
Structure Aggregate	First principal component of the set of individual financial structure indicators.	Scale index of financial structure.
Financial Development Indicators		
Finance Activity	$FINACT = \ln(\text{STVALTRADED} * \text{PCRDBOFGDP})$	Activity of stock markets and intermediaries
Finance Size	$FINSIZ = \ln(\text{STMKTCAP} * \text{PCRDBOFGDP})$	Size of stock markets and intermediaries
Finance Efficiency	$FINEFF = \ln\left(\frac{\text{STVALTRADED}}{\text{OVERHEAD}}\right)$	Financial sector efficiency
Finance Aggregate	First principal component of the set of individual financial development indicators.	Scale index of financial development.
Banking System Indicators		
Banking Activity	$BNKACT = \ln(\text{PCRDBGDP})$	Credit activity of the banking system
Banking Size	$BNKSIZ = \ln(\text{DBAGDP})$	Overall size of the banking sector
Banking Concentration	$BNKCON = \ln(\text{CONCENTRATION})$	Banking system concentration
Notes: The characterisation of the financial and banking systems depends on the indicators´ relative value (with respect to the sample medians). Large values of the financial structure indicators are associated to market-based financial systems; small ones to bank-based ones. Large values of the financial development indicators relate to high levels of financial development.		

4. Methodological issues on the econometric assessment

In this section we discuss some methodological issues regarding our assessment on the effects of financial determinants on banking fragility. Particularly, we define the scope and limits of our research. From an empirical perspective, its main distinctive feature is that the failure-determinant framework relies on fixed-effects logit models for panel-data. We combine the properties of time-series and cross-sectional data for estimation purposes. The assessment is based on estimations of three functional form specifications.

We assess the effects of financial structure and development by estimating the probabilities of occurrence of banking crises according to the conventions of the failure-determinant literature. Specifically, given cross-country annual data for n economies, we have that, for each period *t,* the *i*-country is either experiencing a banking crisis, or it is not. The probability that a crisis may to occur is hypothesised to be a function of a matrix of K vector-variables $\mathbf{x}_{it} = \mathbf{x}_{it1}, \mathbf{x}_{it2}, ..., \mathbf{x}_{itK}$. Such matrix describes the financial environment through the inclusion of failure-determinant and control variables.

We study the specific and joint effects of financial determinants with three subunits of the independent-variable matrix $\mathbf{x}_{it}$. We differentiate each specification by using a superscript. The first design $\mathbf{x}_{it}^{S}$ focuses on the effects of the financial structure indicators. The second one $\mathbf{x}_{it}^{F}$ focuses on the effects of the financial development. The last $\mathbf{x}_{it}^{SF}$ focuses on the joint effects of both indicators. Thus the set of designs of the matrix $\mathbf{x}_{it}$ is:

$$\mathbf{x}_{it}^{F} = [0, F_{it}, B_{it}] \qquad (1)$$

$$\mathbf{x}_{it}^{S} = [S_{it}, 0, B_{it}] \quad (2)$$

$$\mathbf{x}_{it}^{SF} = [S_{it}, F_{it}, B_{it}] \quad (3)$$

Where

S_{it} Vector of financial structure indicators

F_{it} Vector of financial development indicators

B_{it} Vector of banking indicators

Our analysis is based on estimations of linear functional forms that relate the coefficient vector $\boldsymbol{\beta}$ with the matrix $\mathbf{x}_{it}$. Linearity is a convention in the failure-determinant literature. Here denominate the specification that relates $\mathbf{x}_{it}^{S}$ and $\boldsymbol{\beta}^{S} = [\beta_S, 0, \beta_B]$ as the *financial-structure specification (FS specification)*. We denominate the one that relates $\mathbf{x}_{it}^{F}$ and $\boldsymbol{\beta}^{F} = [0, \beta_F, \beta_B]$as the *financial-development specification (FD specification)*. Finally we denominate the joint specification that relates $\mathbf{x}_{it}^{SF}$ and $\boldsymbol{\beta}^{SF} = [\beta_S, \beta_F, \beta_B]$as the *financial-structure-and-development specification (FSD specification)*.

The analysis of how financial structure and development may affect the stability of banking systems depends on several estimations of the coefficient vector $\boldsymbol{\beta}$. We use these estimations to clarify the effects of the financial system determinants. The assessment of each specification depends on four estimations; three estimations for the individual indicators and one to the aggregate indicators. We do not combine indicators of the same type due to the potential multicollinearity that may exist among them.

Econometrically, it can be argued that endogeneity may arise in our assessment framework. Endogeneity can arise due to the omission of relevant variables or or because of simultaneity. Here we deal with endogeneity issues with likelihood-ratio (LR) tests for omitted variable bias. Such tests assume that $\mathbf{x}_{it}^{SF}$ includes irrelevant variables and that the $\mathbf{x}_{it}^{S}$, and $\mathbf{x}_{it}^{F}$ may be correctly specified. Thus the hypothesis that financial structure and development effects must to be analysed *jointly* predicts that the null hypothesis of correct specification of $\mathbf{x}_{it}^{S}$, or $\mathbf{x}_{it}^{F}$ will be *rejected*.

Furthermore, endogeneity and causality problems may be related. Here we use lags of the independent variables to avoid potential simultaneity and endogeneity problems arising from potential two-way relationships. In addition, we deal with causality issues postulating certain hypotheses about the signs for the estimated coefficients. Specifically, the hypothesis that market-based financial systems *enhance* banking stability, predicts that the estimated signs of β_S will be *negative*. The hypothesis that financial development also *enhances* stability, predicts that the signs of β_F will be *negative* too.[13]

5. Econometric assessment of the effects of the individual determinants[14]

Here we report the outcomes of the sets of models used to assess the specific effects of the financial determinants on banking crises. The outcomes associated to the eight estimations of the specifications defined by equations (1) and (2). We compare the

[13] Notice that our study assumes that the design of the financial and banking systems and the level of financial development are exogenous of banking crises. this is a very restrictive assumption.
[14] The econometric software used for the assessments is Stata 9.0.

evidence with the theoretical predictions. All the estimations included the banking indicators as control variables and the lagged financial indicators as independent ones.

The first set of failure-determinants models focuses on the effects of the financial structure determinants on fragility. We summarise their results in Table 3.

Table 3. Financial Structure and Banking Crises
(FS specification)

Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Structure Aggregate (lagged)	-1.03*** (-4.64)	-	-	-
Structure Activity (lagged)	-	-0.64*** (-4.35)	-	-
Structure Size (lagged)	-	-	-0.83*** (-3.31)	-
Structure Efficiency (lagged)	-	-	-	-0.85*** (-4.97)
Banking Activity	-4.29*** (-3.84)	-5.07*** (-4.64)	-5.43*** (-4.89)	-3.79*** (-3.43)
Banking Size	4.99*** (3.72)	5.74*** (4.57)	6.20*** (4.84)	4.98*** (3.82)
Banking Concentration	0.99 (1.05)	0.40 (0.58)	0.80 (1.07)	1.03 (1.18)
Observations	339	431	411	371
LR-CHI2(4)	67.00***	63.44***	55.49***	68.81***
Prob > chi2	0.000	0.000	0.000	0.000
Log Likelihood	-119.92	-158.77	-155.68	-129.43

Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

Table 3 shows that the likelihood of banking crises is associated to a relative *decrease* in the level of activity of stock markets with respect to that of banks. All the financial structure determinants are negative and statistically significant (1 percent significance level). The consistency of the estimated associations holds independently of the specific

failure-determinant model estimated. Thus the evidence suggests that market-based financial systems *enhance* banking stability. Thus, it seems that financial structure matters to assess the stability of banking systems.

The second set of failure-determinants models focuses on the effects of the financial development determinants on fragility. We summarise their results in Table 4.

Table 4. Financial Development and Banking Crises
(FD specification)

Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Finance Aggregate (lagged)	-1.01*** (-3.31)	-	-	-
Finance Activity (lagged)	-	-0.49*** (-3.34)	-	-
Finance Size (lagged)	-	-	-0.36 (-1.57)	-
Finance Efficiency (lagged)	-	-	-	-0.63*** (-4.05)
Banking Activity	-3.60*** (-3.07)	-4.33*** (-3.90)	-5.01*** (-4.20)	-3.74*** (-3.36)
Banking Size	5.23*** (3.93)	5.91*** (4.77)	6.47*** (5.01)	5.00*** (3.83)
Banking Concentration	1.41 (1.48)	0.60 (0.84)	1.25 (1.62)	1.47* (1.71)
Observations	339	431	411	371
LR-CHI2(4)	52.81***	54.15***	45.79***	57.30***
Prob > chi2	0.000	0.000	0.000	0.000
Log Likelihood	-127.01	-163.41	-160.53	-135.18

Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

Table 4 reports the outcomes associated to the financial-development specification. It shows that the likelihood of banking crises is associated to a relative *decrease* in the level of development of intermediaries and financial markets. All the financial development

determinants are negative and most of them are statistically significant (1 percent significance level). Again, the consistency of the estimated associations holds independently of the specific failure-determinant model estimated. Thus the estimations suggest that financial development might enhance banking stability.

What effects may have banking system features on banking fragility? The estimations in the previous tables suggest that the indicators have *differentiated effects* on the likelihood of banking crises. Specifically the size of the banking sector seems to *increase* it and banking credit activity seems to *reduce* it. In all cases, the estimations are consistent and significant. The evidence also suggests that banking concentration might increase banking fragility. However, in none of the estimated models such variable is significant. Here we should point out that some of these findings are counterintuitive.

We support our results with statistical tests. Specifically, we support the adequacy of the estimated failure-determinant models with likelihood-ratio tests [See Tables 3 and 4]. In all cases, such test rejects the null hypothesis that all the parameters of the models are zero. Furthermore, according to comparisons of the log-likelihood indicators, the aggregate models may be the ones that best describe the individual effects of financial structure and development. This finding may not be surprising. However, we should emphasise that, by the moment, we cannot reject the possibility of omitted variable bias.

6. Econometric assessment of the joint effects of financial structure and development determinants

Here we report the outcomes of the sets of models used to assess the joint effects of the financial determinants on banking crises. We report the outcomes associated to the four estimations of the specification defined by equation (3). Furthermore we report the outcomes of the tests of omitted variable bias. Such outcomes will allow us to analyse the pertinence of the study of both, financial structure and development, jointly. Again, in all the regressions we have included the banking indicators as control variables and the lagged financial indicators as independent ones.

The third set of failure-determinants models focuses on the joint effects of the financial determinants on fragility. We summarise their results in Table 5.

Table 5. Financial Structure, Financial Development and Banking Crises (FSD specification)

Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Structure Aggregate (lagged)	-3.31*** (-4.55)	-	-	-
Structure Activity (lagged)	-	-2.16*** (-3.97)	-	-
Structure Size (lagged)	-	-	-2.26*** (-3.89)	-
Structure Efficiency (lagged)	-	-	-	-1.05*** (-3.27)
Finance Aggregate (lagged)	3.64*** (3.40)	-	-	-
Finance Activity (lagged)	-	1.65*** (2.94)	-	-
Finance Size (lagged)	-	-	1.60*** (2.84)	-
Finance Efficiency (lagged)	-	-	-	0.23 (0.76)
Banking Activity	-7.58*** (-4.95)	-7.71*** (-5.27)	-7.81*** (-5.37)	-3.90*** (-3.52)
Banking Size	4.64*** (3.39)	5.54*** (4.24)	5.84*** (4.33)	5.02*** (3.88)
Banking Concentration	1.38 (1.33)	0.73 (0.97)	1.20 (1.47)	1.06 (1.21)
Observations	339	431	411	371
LR-CHI2(5)	81.12***	73.38***	64.71***	69.39***
Prob > chi2	0.000	0.000	0.000	0.000
Log Likelihood	-112.86	-153.80	-151.07	-129.13

Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

Table 5 shows that the likelihood of banking crises is *inversely* associated to the levels of the financial structure indicators and *directly* associated to the ones of financial development. All the determinants are statistically significant (1 percent significance level). The consistency of the estimated associations holds independently of the failure-determinant model estimated. Financial structure and development, both, matter to

explain banking stability. Thus the evidence suggests that in market-based and underdeveloped financial systems the likelihood of banking crises is reduced.

We should point out that these findings seem to *contradict* the ones of the previous section regarding the individual effects of financial development. Furthermore, they are counter-intuitive. It seems plausible to believe that this may occur due to a bias associated to the econometric specification of the models. We evaluate this possibility by using tests for omitted variables [See Table 6]. Such tests reject the null hypothesis of irrelevant variables in the unrestricted models. Thus according to our tests, we should analyse *jointly* the effects of financial structure and financial development.

Table 6. Analysis of Specification Bias
(Omitted Variable Tests)

Model	Aggregate	Activity	Size	Efficiency
Log Likelihood				
FS specification	119.92	158.77	155.68	129.43
FD specification	127.01	163.41	160.53	135.18
FSD specification	112.86	153.8	151.07	129.13
Omitted-Variables Likelihood Ratio (Unrestricted: FSD specification)				
LR-CHI2(1) (FS specification)	14.12***	9.94***	9.22***	0.60***
LR-CHI2(1) (FD specification)	28.30***	19.22***	18.92***	12.10***

Notes: We consider the financial-structure-and-development specification models as unrestricted and the financial-development and the financial-structure specification models as the restricted ones. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

The necessity to jointly analyse the determinants of banking crises make us to re-examine the conclusions obtained in the previous section. Such conclusions may be consistent with

the latter evidence if the financial development indicators are highly correlated with the financial structure ones; in other words, if there is multicollinearity between them. Fixed-effects (within) regressions confirm this intuition [See Appendix A]. Thus, the hidden fragility-enhancing effects of financial development can be unveiled only when we account for the degree to which a financial system is based on intermediaries or markets.

Here we need to recall that multicollinearity is a sample phenomenon. A traditional procedure used to deal with it is to drop a variable in order to fit a regression. However we *do not* follow this practice to explain the likelihood of banking crises because of the results of the tests of omitted-variable bias. Indeed, t it is worthy to recall that the consequences of the specification bias introduced by omitting a financial indicator may be worse than the ones introduced by multicollinearity.[15] Notice that omitted-variable bias induces the estimation of biased and inconsistent $\boldsymbol{\beta}$ estimators among other consequences.

We summarise by indicating that the evidence suggests that the financial structure and development matter to assess the stability of banking systems. Particularly the assessments suggest that *banking stability is enhanced* in economies with market-based financial systems. Financial development reduces it. However this fragility-enhancing effect can be unveiled only when we account for financial structure. Thus, financial structure and development *jointly* matter. Furthermore the size of the banking sector seems to *reduce* banking stability and its lending activity seems to *enhance* it.

7. Summary and discussion

The issue of how financial systems affect the likelihood of banking crises is not well understood. Such understanding may be essential to avoid banking crises and their associated costs. Here we have shown the results of an investigation developed to study such issue with data for 211 countries during the period 1990-2003. Our investigation uses on fixed-effects logit models for panel-data and likelihood tests to analyse such issue. We have aimed at clarifying the individual and joint effects of financial structure and development by controlling for the effects of certain banking system features.

Our main research finding suggests that the financial structure and financial development *jointly* matter to assess the stability of banking systems. Particularly the assessments imply that *banking stability is enhanced in economies with market-based financial systems*. *Financial development reduces it.* However this fragility-enhancing effect can be unveiled only when we account for financial structure. Furthermore, our findings show that the size of the banking sector seems to *reduce* banking stability and its lending activity seems to *enhance* it.

Our study leads us to some interesting implications: The first one is that the hypothesis that financial structure does not have independent effects on banking performances deserves to be re-examined again.[16] According to our findings, financial structure seems

[15] Statistically, the worst consequence of multicollinearity relates to the sensitivity of the β estimators and their standard errors to small changes in data. Thus the coefficients may not be estimated with great precision and accuracy.

[16] Demirguc-Kunt and Huizinga, (2001), conclude that financial structure per se appears to have no effects on bank margins, neither on bank profitability after controlling for both, bank and market development. The idea about the irrelevance of financial structure has support on studies that have focused on the determinants

to affect the likelihood of banking crises. However, we must recognise that the scope of the financial indicators used in our study is a very narrow one. Legal and regulatory regimes, financial and monetary institutions also shape intermediation activities. We have not considered them into our investigation due to the lack of available data.

We believe that further studies on the relationship between financial structure and banking fragility should focus on these institutional features of the financial systems. Lender-of-last-resort activities, deposit insurance schemes and solvency regulations may change the behaviour of banks and the likelihood of banking crises. Currently, most of the discussions about how to avoid and manage crises deal with the institutional features that regulatory regimes should adopt. These discussions are particularly relevant in the context of institutions that can operate not only in a domestic, but also on a global scale.

The second implication of our study relates to the fragility enhancing effects of financial development. These effects are particularly well-known in developing economies. Financial development, termed as liberalisation, frequently leads to financial crises in such economies [See Diaz-Alejandro (1985)]. This consideration and our previous results, make us believe that regulation must play an in-advance role there. Concretely, we think that regulations and supervised market-based oriented reforms should precede financial liberalisation in order to enhance banking stability.[17]

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of economic growth and investment. [See Levine (2002) and Ndikumana (2005), respectively]. Among these studies, the panel-data study of Loayza and Ranciere (2006), views financial fragility and economic growth, as the short and long-term consequences of financial development.

[17] This statement is controversial. Usually development economists propose bank-based reforms to encourage financial and economic development [See Fry (1995)]. Among other arguments, they point out that banks are "better at mobilising savings, identifying good investments and exerting sound corporate control" [Levine (2002: 398)].

However, this recommendation may not be implementable everywhere. Particularly, in developed economies, it may be unfeasible. Usually financial innovation arises there to avoid financial regulations [Cecchetti (2008)]. Nevertheless, this situation does not imply that there are not opportunities to enhance stability. Indeed the global financial crises that we are currently experiencing (2007-2008), may contribute to enhance financial stability. As we have mentioned, we cannot dismiss the possibility of bidirectional effects between financial development and banking crises.

We believe that further studies on the joint impact of financial structure and development may be necessary to clarify and evaluate the statements indicated above. It is our belief that such studies will reveal us further insights that may contribute to improve our understanding of the contracting process and of the functioning of intermediaries and markets. Particularly we think that regulatory issues may be the most fruitful ones. Hopefully, results based on these investigations may have some relevance for enhancing the stability and performance of banking systems.

APPENDIX A

Here we include the outcomes of the fixed-effects panel-data models that assess the relationships among the financial indicators. The regressions include constant terms to eliminate constant effects.

Table A.1 Financial Structure and Financial Development
Fixed-Effects (within) Regressions

Regressor/Regressed Variables	Structure Aggregate	Structure Activity	Structure Size	Structure Efficiency
Regression Indicators				
Finance Aggregate	1.12***	-	-	-
	(52.22)			
Finance Activity	-	0.80***	-	-
		(79.44)		
Finance Size	-	-	0.63***	-
			(48.37)	
Finance Efficiency	-	-	-	0.86***
				(61.62)
Constant	0.00	1.10***	1.00***	-6.71***
	(0.38)	(23.89)	(27.84)	(-450.11)
Observations	990	1408	1376	1120
F	2726.87***	6310.95***	2339.85***	3796.83***
R^2 within	0.75	0.82	0.64	0.78
R^2 between	0.62	0.65	0.29	0.80
R^2 overall	0.61	0.70	0.35	0.77
Corr(u_i,Xb)	-0.58	-0.55	-0.61	-0.39
σ_u	1.19	1.29	1.09	0.98
σe	0.39	0.55	0.47	0.47
ρ	0.90	0.84	0.84	0.81
F (Ho: u_i=0)	52.98***	40.63***	37-13***	36.88***

Notes: The t statistics are given in parenthesis. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

Table A.1, shows that the financial structure indicators are positively and highly correlated to the financial development ones. All the associations are positive and statistically significant (1 percent significance level). The economic interpretation of these results is that *developed financial systems are associated to market-based ones*.

APENDIX B

Table B.1 Recognised Banking Crises per Country (1980-2003)

Number	Country	Years	Number	Country	Years
1	Aruba	-	22	Bahrain	-
2	Andorra	-	23	Bahamas, The	-
3	Afghanistan	-	24	Bosnia and Herzegovina	1992-2003
4	Angola	1991-2003	25	Belarus	1995-2003
5	Anguilla	-	26	Belize	-
6	Albania	1992	27	Bermuda	-
7	Netherlands Antilles	-	28	Bolivia	1986-1988, 1994-2003
8	United Arab Emirates	-	29	Brazil	1990, 1994-1999
9	Argentina	1980-1982, 1989-1990, 1995-1997, 2001-2003	30	Barbados	-
10	Armenia	1994-1996	31	Brunei	1983-1987
11	American Samoa	-	32	Bhutan	-
12	Antigua and Barbuda	-	33	Botswana	1994-1995
13	Australia	1989-1992	34	Central African Republic	1976-1992
14	Austria	-	35	Canada	1983-1985,
15	Azerbaijan	1995	36	Switzerland	-
16	Burundi	1994-2003	37	Channel Islands	-
17	Belgium	-	38	Chile	1976, 1981-1986,
18	Benin	1988-1990	39	China	1990-1999
19	Burkina Faso	1988-1994	40	Cote d'Ivoire	1998, 1989-1991
20	Bangladesh	1986-1996	41	Cameroon	1987-1993, 1995-1998
21	Bulgaria	1995-1997	42	Congo, Rep.	1992-2003

Notes: 1) Financial structure and development data are extracted from the database of Beck, Demirguc-Kunt and Levine, (2006). 2) Data on banking crises are extracted from the datasets of Caprio and Klingebiel, (2003).

Table B.1 Recognised Banking Crises per Country (1980-2003)
(Continued)

Number	Country	Years	Number	Country	Years
43	Colombia	1982-1987	65	France	1994, 1995
44	Comoros	-	66	Faeroe Islands	-
45	Cape Verde	1993-2003	67	Micronesia, Fed. Sts.	-
46	Costa Rica	1987-2003	68	Gabon	1995-2003
47	Cuba	-	69	United Kingdom	1974-1976, 1980-1999,
48	Cayman Islands	-	70	Georgia	1991
49	Cyprus	-	71	Ghana	1982-1989, 1997-2003
50	Czech Republic	1989-2003	72	Guinea	1985, 1993-1994
51	Germany	1976, 1978-1980	73	Gambia, The	1985-1992
52	Djibouti	1991-1993	74	Guinea-Bissau	1995-2003
53	Dominica	-	75	Equatorial Guinea	1983-1985
54	Denmark	1987, 1988, 1989, 1990, 1991, 1992	76	Greece	1991-1995
55	Dominican Republic	-	77	Grenada	-
56	Algeria	1990-1992	78	Greenland	-
57	Ecuador	1980-1984, 1996-2003	79	Guatemala	-
58	Egypt, Arab Rep.	1980-1985, 1991-1995M	80	Guam	-
59	Eritrea	1993	81	Guyana	-
60	Spain	1977-1985	82	Hong Kong, China	1982-1986, 1998
61	Estonia	1992-1995, 1998	83	Honduras	-
62	Ethiopia	1994, 1995,	84	Croatia	1996
63	Finland	1991, 1992, 1994, 1995	85	Haiti	-
64	Fiji	-	86	Hungary	1991-1995

Notes: 1) Financial structure and development data are extracted from the database of Beck, Demirguc-Kunt and Levine, (2006). 2) Data on banking crises are extracted from the datasets of Caprio and Klingebiel, (2003).

Table B.1 Recognised Banking Crises per Country
(1980-2003)
(Continued)

Number	Country	Years	Number	Country	Years
87	Indonesia	1994, 1997-2003	109	Liberia	1991-1995
88	Isle of Man	-	110	Libya	-
89	India	1993-2003	111	St. Lucia	-
90	Ireland	-	112	Liechtenstein	-
91	Iran, Islamic Rep.	-	113	Sri Lanka	1989-1993
92	Iraq	-	114	Lesotho	1988-2003
93	Iceland	1985, 1986, 1993,	115	Lithuania	1995-1996
94	Israel	1977-1983	116	Luxembourg	-
95	Italy	1990-1995	117	Latvia	1995-2003
96	Jamaica	1994-2000	118	Macao, China	-
97	Jordan	1989, 1990	119	Morocco	1980-1985
98	Japan	1991-2003	120	Monaco	-
99	Kazakhstan	-	121	Moldova	-
100	Kenya	1985-1989, 1992-2003	122	Madagascar	-
101	Kyrgyz Republic	1990-1999	123	Maldives	-
102	Cambodia	-	124	Mexico	1981-1991, 1994-1997
103	Kiribati	-	125	Marshall Islands	-
104	St. Kitts and Nevis	-	126	Macedonia, FYR	1993-1994
105	Korea, Rep.	1997-2003	127	Mali	1987-1989
106	Kuwait	1980-1989	128	Malta	-
107	Lao PDR	1990-1995	129	Myanmar	1996-2003
108	Lebanon	-	130	Mongolia	-

Notes: 1) Financial structure and development data are extracted from the database of Beck, Demirguc-Kunt and Levine, (2006). 2) Data on banking crises are extracted from the datasets of Caprio and Klingebiel, (2003).

Table B.1 Recognised Banking Crises per Country (1980-2003)
(Continued)

Number	Country	Years	Number	Country	Years
131	Northern Mariana Islands	-	153	Palau	-
132	Mozambique	1987-1995	154	Papua New Guinea	1989-2003
133	Mauritania	1984-1993	155	Poland	1990-1999
134	Montserrat	-	156	Puerto Rico	-
135	Mauritius	1996	157	Korea, Dem. Rep.	-
136	Malawi	-	158	Portugal	-
137	Malaysia	1985-1988, 1997-2003	159	Paraguay	1995-1999, 2001
138	Mayotte	-	160	French Polynesia	-
139	Namibia	-	161	Qatar	-
140	New Caledonia	-	162	Romania	1990-2003
141	Niger	1983-2003	163	Russian Federation	1995-2003
142	Nigeria	1990-1999	164	Rwanda	1991-2003
143	Nicaragua	1986-1996	165	Saudi Arabia	-
144	Netherlands	-	166	Sudan	-
145	Norway	1987-1993	167	Senegal	1988-1991
146	Nepal	1988	168	Singapore	1982
147	New Zealand	1987-1990	169	Solomon Islands	-
148	Oman	-	170	Sierra Leone	1990-2003
149	Pakistan	-	171	El Salvador	1989
150	Panama	1988-1989	172	San Marino	-
151	Peru	1983-1990	173	Somalia	-
152	Philippines	1981-1987, 1998-2003	174	Sao Tome and Principe	1980-1999

Notes: 1) Financial structure and development data are extracted from the database of Beck, Demirguc-Kunt and Levine, (2006). 2) Data on banking crises are extracted from the datasets of Caprio and Klingebiel, (2003).

Table B.1 Recognised Banking Crises per Country (1980-2003)
(Continued)

Number	Country	Years	Number	Country	Years
175	Suriname	-	194	Uganda	1994-2003
176	Slovak Republic	1991-2003	195	Ukraine	1997-1998
177	Slovenia	1992-1994	196	Uruguay	1981-1984, 2002-2003
178	Sweden	1991-1994	197	United States	1984-1991
179	Swaziland	1995	198	Uzbekistan	-
180	Seychelles	-	199	St. Vincent and the Grenadines	-
181	Syrian Arab Republic	-	200	Venezuela	1975-1989, 1994-1995
182	Chad	1980-1989, 1992	201	Virgin Islands	-
183	Togo	1993-1995	202	Vietnam	1997-2003
184	Thailand	1983-1987, 1997-2003	203	Vanuatu	-
185	Tajikistan	1996	204	West Bank and Gaza	-
186	Turkmenistan	-	205	Samoa	-
187	Timor-Leste	-	206	Yemen, Rep.	1996-2003
188	Tonga	-	207	Serbia and Montenegro	-
189	Trinidad and Tobago	1982-1993	208	South Africa	1977, 1989-2003
190	Tunisia	1991-1995	209	Congo, Dem. Rep.	1980-1989, 1991-1992, 1994-2003
191	Turkey	1982-1985, 1994, 2000-2003	210	Zambia	1995
192	Taiwan, China	1983-1984, 1995, 1998	211	Zimbabwe	1995-2003
193	Tanzania	1986-1999			

Notes: 1) Financial structure and development data are extracted from the database of Beck, Demirguc-Kunt and Levine, (2006). 2) Data on banking crises are extracted from the datasets of Caprio and Klingebiel, (2003).

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