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BANKING COMPETITION AND FINANCIAL FRAGILITY: EVIDENCE FROM PANEL-DATA*

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Abstract

We study how banking competition may affect the stability of banking systems. We develop our study by expanding the failure-determinant methodology to include panel-data techniques and by controlling the effects of financial structure and development. We use indicators for 47 countries between 1990 and 1997. The main findings show that banking concentration and foreign ownership are associated to bank-based financial systems and financial underdevelopment. They also show that banking credit and bank-based financial systems enhance banking fragility. Banking concentration is not a significant determinant. Furthermore our findings suggest that financial structure and, maybe, the property regime matter to assess fragility.

Resumen

Estudiamos cómo la competencia bancaria afecta la estabilidad de los sistemas bancarios. Desarrollamos nuestro estudio expandiendo la metodología de los determinantes de las crisis a fin de incluir técnicas de datos en panel y controlando los efectos de la estructura y el desarrollo financieros. Usamos indicadores para 47 países entre 1990 y 1997. Los más importantes hallazgos muestran que la concentración bancaria y los bancos de extranjeros se vinculan a sistemas financieros subdesarrollados y en donde predominan los bancos. Dichos hallazgos muestran también que el crédito bancario y los sistemas financieros en donde predominan los bancos promueven la fragilidad bancaria. La concentración bancaria no es un determinante significativo. Además, nuestros hallazgos sugieren que la estructura financiera y, quizás, el régimen de propiedad importan para evaluar dicha fragilidad.

JEL Classification: G21, D40, L16, G10

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BANKING COMPETITION AND FINANCIAL FRAGILITY: EVIDENCE FROM PANEL-DATA

1. Introduction

The issue of how competition affects the stability of banking systems is not well understood [Carletti (2007)]. Here we study how banking competition may affect the stability of banking systems by using the most extensive and consistent databases publicly available.¹ We develop our study by expanding the failure-determinant methodology to include panel-data techniques and by controlling the effects that financial structure and development may have on the performance of banking systems. We use internationally comparable banking and financial data for 47 countries between 1990 and 1997.

Our study is motivated by academic and practical concerns. Specifically it is motivated by the necessity to understand the nature of this issue and its implications for the design of policies. Currently there is no consensus on the theoretical effects that competition may have on banking fragility. Furthermore, existing empirical studies on the issue usually provide contradictory results. Indeed in the literature exists three different views about the relationship between banking competition and financial fragility.² Thus there is no reliable guide for policy makers regarding how to avoid banking crises in increasingly competitive banking and financial environments.

Here we aim at clarifying how banking competition determinants may relate to financial fragility by suggesting answers to the following questions: What are the main empirical associations between banking competition and financial structure and between banking competition and financial development? How does banking fragility may affect the relationships between banking and finance? What are the specific and joint effects of banking competition determinants on banking fragility? Are these effects differentiated? Which type of implications may be derived from these findings?

¹ We use panel-data extracted from the cross-country database on financial development and structure [Beck, Demirguc-Kunt and Levine (2000)], and from the one on episodes of systemic and borderline banking crises [Caprio and Klingebiel (2002)]. The databases are available at the World Bank's website: <http://econ.worldbank.org> [Titles: "A new database on financial development and structure" and "Episodes of systemic and borderline financial crises"].

² See Allen and Gale (2004a) and Carletti (2007) for surveys.

We develop this study by following three steps. First we build several banking competition indicators based on measures of bank concentration, domestic origin, public ownership, activity and size of banks. Later we estimate several OLS regressions to analyse how the financial situation of banking systems (which may involve or not a crisis), may affect the associations of financial structure and financial development with banking competition. Finally we study the effects of banking determinants on banking fragility with fixed-effects logit models for panel data. We use individual and principal-components indicators for the empirical assessments.

We consider that our study has some specific features that differentiate it with respect to other studies. A first feature is that we use internationally comparable banking indicators to develop the investigation. A second one is that we use logit panel-data models to assess the determinants of banking fragility. Traditional studies use multivariate logit techniques. A third one relates to the characterisation of the “stylised facts” between the banking and financial indicators. The last distinctive feature of our study is that we control the effects of financial structure and development when we assess the determinants of banking fragility.

Our results have implications for theoretical and policy purposes. Specifically OLS regressions suggest that certain general associations exist between the banking and financial indicators. We denominate such empirical associations as the *stylised facts* between banking competition and financial systems. These stylised facts suggest that *banking concentration, foreign ownership and the relative activity and size of banks with respect to those of bank-like institutions are associated to bank-based financial systems and financial underdevelopment*. They also suggest that *domestically and publicly owned banks may prevail in market-based and financially developed financial systems*, at least, during banking crisis episodes.

The models for panel-data *show differentiated effects* of the banking determinants on banking fragility. Particularly the econometric outcomes suggest that *if credit activity relies on banks or if the financial system is bank-based, the likelihood of crises will increase*. Another suggestion is that *the banking determinants, the features of the financial system and the property regime of banks jointly matter* to analyse the

likelihood of crises. Empirically the results support the view that the relationship between banking competition and financial fragility involves more than a trade-off. Moreover they support the idea that financial structure matters to assess fragility.

Our investigation complements other papers that analyse the issue of the determinants of banking fragility. Theoretically our findings support recent studies that suggest that competition determinants may have differentiated effects on banking fragility [See Allen and Gale (2004a) and Boyd and De Nicolo (2005)]. Empirically our study complements the findings of other cross-country studies that have analysed the determinants of banking crises. Specifically our findings complement those that show that weak macroeconomic environments, cyclical movements, deposit-insurance schemes and weak law enforcement conditions may encourage banking fragility.³

The paper is divided in eight sections. Section 2 reviews the literature. Section 3 describes the data. Section 4 discusses methodological issues about the OLS assessments. Section 5 extends such discussion to the failure-determinant methodology. Section 6 characterises the stylised facts associated with the banking and financial indicators. Section 7 shows the effects of banking competition determinants on financial fragility. Section 8 summarises and discusses the main findings. The appendix shows further econometric estimations to support the consistency of the fixed-effects logit panel-data models.

2. Banking competition and financial fragility

Academically it has been recognised that the relationship between banking competition and financial fragility is complex and multifaceted [Allen and Gale (2004a)]. In fact, there is not consensus about the nature of this relationship or about its implications for economic policy. The literature provides several arguments for and against promoting competition. This seems relatively strange because policy-makers frequently deal with competition and stability issues at the same time. Here we review the three main views in the literature and explain the theoretical foundations of our empirical study.

³ See Demirguc-Kunt and Detragiache (2005) for a review of such studies.

The first view assumes that competition enhances fragility. Empirically, under the explanations of this view, fragility arises due to agency problems between banks, depositors and deposit insurance funds or because of non-concentrated banking systems [See Keeley (1990) and Beck, Demirguc-Kunt and Levine (2003)]. Theoretically this view is supported on analyses that focus on the risks associated to competition for deposits, banking deregulation and risk taking behaviour of banks [See Matutes and Vives (1996), Repullo (2004) and Dam and Zendejas-Castillo (2006)]. Traditionally this view has been the predominant one in the literature.

The main implication of this view is that concentration or regulations may enhance banking stability. Such implication explains why the desirability for banking competition has been questioned since long. In addition, it justifies the need for regulation. However this implication is arguable. For example, some studies show that banking concentration is not negatively correlated to competition [Claessens and Laeven (2004)]. Furthermore, others point out that the issue of how competition affects the stability of banking systems and the effectiveness of regulation is not well understood [Carletti (2007)].

The second view argues that banking competition enhances financial stability. Like the previous view, it also has support on several studies. Empirically such view is supported by studies of the history of US banks and by studies that focus on international cross-sectional data [See Rolnick and Weber (1983) and Claessens and Klingebiel (2001), respectively]. Theoretically, this view is supported by analyses that argue that competition may enhance stability by reducing information asymmetries or by increasing liquidity provisions through inter bank markets [See, Caminal and Matutes (2002) and Bossone (2001), among others].

The main policy implication that arises from this view is that financial *laissez-faire* (or free banking), may be desirable. Particularly, Dowd (1996) summarises the three main arguments that support such belief: 1) if free trade is good, there must be a *prima facie* case in favour of free trade in banking; 2) if free banking seems strange at first sight, this is because we take certain things for granted (like government intervention in the financial sector); 3) empirical evidence is consistent with free banking theory. Such

arguments are supported by those who claim that banking failures are the indirect result of regulatory efforts [See Benston and Kaufman (1996)].

The third view suggests that the analysed relationship involves more than a simple trade-off. Particularly, Allen and Gale (2004a) study the efficient levels of competition and stability with several models. They develop their study with general equilibrium models of intermediaries and markets, agency models, models of spatial and Schumpeterian competition and models of contagion. In some of their models, they find a trade-off but in others there is not. This view may explain the contradictory results found by researchers. Differentiated effects may appear as result of the assumptions, circumstances and data used to analyse competition.

The third view also suggests that the effects of competition may depend on specific economic conditions. Specifically Boyd, De Nicolo and Smith (2004), show that a monopolistic banking system faces a higher failure probability than a competitive one, when the inflation rate is below certain threshold; otherwise, the opposite conclusion holds. Furthermore, Boyd and De Nicolo (2005) show that the effects of banking competition depend on opposite risk incentive mechanisms. One is associated to the choice of riskier portfolios when competition increases. The other is associated to the increase of default risks when banking markets become more concentrated.

The three views indicated above do not explicitly consider the financial environment where banking activities are carried out.⁴ However, the opportunities for financial agents to deal with financial risks and to engage on risk sharing activities depend on the particular properties of the financial systems [See Allen and Gale (2000) and (2004b)]. We can relate the study of the relationship between banking competition and financial fragility with the theory on comparative financial systems, because such properties depend on financial competition. Specifically, they depend on the competition among banks and markets, and among banks themselves.

We believe that empirical studies on the relationship between banking competition and financial fragility should include financial system indicators. Methodologically

⁴ The exception is the paper of Boyd, De Nicolo and Smith (2004).

their inclusion will allow us to capture the features and properties of financial systems. Currently few studies relate financial and fragility indicators [See Ruiz-Porrás (2006) and Loayza and Rancière (2006)]. However none of these studies is a banking failure-determinant study.⁵ We believe that such consideration justifies the inclusion of financial structure and development indicators as control variables in assessments regarding the relationship between competition and fragility.

We conclude by indicating that we are far from a consensus regarding the effects of banking competition on financial fragility. The literature is rather limited and inconclusive [Carletti (2007)]. Existing studies show that these effects may not be univocal or straightforward. Thus, further studies are necessary for policy purposes. Particularly, we believe that empirical studies based on the theory of comparative financial systems may be useful to clarify the analysed relationship. In fact, such theory and the necessity to develop further research motivate and differentiate our study. Moreover they suggest some of its methodological guidelines.

3. Banking and financial indicators

Here we describe the financial and banking indicators used in our study. However, before proceeding, we *assume* certain definitions for operative purposes. Specifically we assume that the competitive features of the banking industry can be captured with market structure data of commercial banks and with data of bank-like institutions.⁶ Financial development will mean the level of development of both intermediaries and markets. Financial structure will refer to the degree to which a financial system is based on intermediaries or markets. Banking fragility will mean a situation in which systemic or non-systemic banking crises are present in an economy.

We build the indicators by extracting data from two databases. Specifically we build the main indicators with panel-data extracted from the database of Beck, Demirgüç-Kunt and Levine (2000). Such data allows us to capture the main features of the

⁵ Ruiz-Porrás (2006) studies the “stylised facts” that characterise stable and unstable financial systems. Loayza and Rancière (2006) focus on the determinants of long-run economic growth.

⁶ Bank-like institutions include intermediaries that accept deposits without providing transferable deposit facilities and intermediaries that raise funds on the financial market mainly in the form of negotiable bonds.

financial system and the banking market structure of a country. Furthermore, we use the database of Caprio and Klingebiel (2002) to build the indicators of banking fragility. Such indicators include dummies for systemic and non-systemic crises and a general one for fragility. Methodologically the main advantage of using these databases is that provide us with consistent data across countries and across time.

The features of the banking and financial data are summarised in the following table:

Table 1. Banking and Financial Data

Definition	Variable	Time span	Countries	Observations
<i>Banking fragility variables</i>				
Dummy variable on systemic episodes of banking fragility (banking crisis=1; otherwise 0)	SYSTEM	1975-1999	93	113
Dummy variable on non-systemic episodes of banking fragility (banking crisis=; otherwise 0)	BORDER	1975-1999	44	50
<i>Banking market structure variables</i>				
Concentration (Ratio of the 3 largest banks to total banking assets)	BCON	1990-1997	137	822
Foreign bank share (assets)	FBSA	1990-1997	111	673
Share of publicly owned commercial bank assets in total commercial bank assets	PBSA	1980-1997	41	213
<i>Bank-like institution variables</i>				
Total assets of other bank-like institutions to GDP	BLAY	1980-1997	54	766
Private credit by other bank-like institutions to GDP	BLCY	1980-1997	43	652
<i>Financial structure and development variables</i>				
Overhead costs of the banking system relative to banking system assets	BOHC	1990-1997	129	719
Private credit by deposit money banks to GDP (Bank credit ratio)	DBPCY	1960-1997	160	3901
Private credit by deposit money banks and other financial institutions to GDP (Private credit ratio)	TIPCY	1960-1997	161	3923
Stock market capitalisation to GDP (Market capitalisation ratio)	SMCY	1976-1997	93	1171
Stock market total value traded to GDP (Total value traded ratio)	SMVY	1975-1997	93	1264
Notes:				
<p>- The database on banking crises includes the two qualitative variables included here. A banking crisis is defined as <i>systemic</i> if most or all banking system capital is eroded by loan losses (5% of assets in developing countries). A <i>non systemic</i> banking crisis includes borderline and smaller banking crises [See Caprio and Klingebiel (1996) and (2002)].</p> <p>- 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).</p>				

The sample was built according to data availability. It includes data for Argentina, Australia, Bolivia, Brazil, Barbados, Canada, Chile, Colombia, Costa Rica, Cyprus, Germany, Ecuador, Egypt, El Salvador, Ghana, Greece, Guatemala, Honduras, Ireland, Jamaica, Japan, Jordan, Kenya, Korea, Morocco, Mexico, Malaysia, Namibia, Nigeria, Netherlands, Norway, New Zealand, Paraguay, Peru, Philippines, Spain, South Africa, Sweden, Switzerland, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, United States, Venezuela and Zimbabwe. Thus the sample includes data for 47 countries over the period 1990-97.

We define eleven *individual* indicators to describe the banking and financial environment of each country. We organise the indicators in three assortments. The assortment of banking indicators contains measures of concentration, origin and ownership of commercial banks. Furthermore it contains measures of the activity and size of banks *relative* to that of bank-like institutions. The assortment of structural indicators contains measures of the activity, size and efficiency of stock markets *relative to* that of banks. The assortment of development indicators contains measures of the activity, size and efficiency of stock markets *and* banks.

The banking assortment is integrated by five indicators. The first three are the Banking-Concentration, the Banking-Domestic and the Banking-Public indicators. The first measures the ratio of three largest banks to total banking assets.⁷ The second and third ones measure the respective share of domestic and public ownership of commercial banks. The last two indicators are the Banking-Activity and Banking-Size ones. Large values of these indicators are associated to high levels of credit activity and to a large size of banks relative to those of bank-like institutions. We include these indicators as complementary measures to competition.

We follow Levine (2002) to build the individual financial system indicators. Such indicators are organised in two assortments: The structural assortment is integrated by the Structure-Activity, Structure-Size and Structure-Efficiency indicators.⁸ In this

⁷ We are aware that this ratio is a very rough measure of banking concentration and an arguable measure of banking competition. However this is the only measure available to capture the structure of the banking industry.

⁸ Levine (2002) uses these three main indicators to assess the structure of financial systems. Structure-Activity equals the logarithm of the total value traded ratio divided by the bank credit ratio. Structure-

assortment market-based financial systems are associated to large values of the indicators while bank-based ones are associated to small values. The financial development assortment is integrated by the Finance-Activity, Finance-Size and Finance-Efficiency indicators.⁹ In this assortment financial development is associated to large values of the indicators, while underdevelopment is associated to small ones.

Furthermore we build two *aggregate* indicators to summarise the information content of each assortment of individual indicators. Again, we follow Levine (2002) to define and construct them. Specifically each aggregate indicator is defined as the first linear combination of the three individual indicators that integrate each financial assortment. Thus the three aggregate indicators summarise the relevant information of the environment. These indicators are the Structure-Aggregate and Finance-Aggregate ones. Here it is important to point out that the eight financial indicators used here are the conventional ones used to assess the merits of different financial systems.

We use first principal-components to capture what may be common to all the indicators that integrate an assortment of correlated variables. Given the lack of empirical definitions for financial development and financial structure, we use the aggregate indicators as indexes of scale for the level of financial development and for the relative prominence of markets in the financial system. We do not use an equivalent measure for banking competition because the interpretation of the aggregate index becomes unclear without further microeconomic assumptions.

The set of banking and financial indicators is summarised in the following table:

Size equals the logarithm of the market capitalization ratio divided by the bank credit ratio. Structure-Efficiency equals the logarithm of the total value traded ratio times overhead costs. These indicators try to assess the activity, size and efficiency of stock markets relative to that of banks. However, we must point out that Levine (2002) indicates that the third indicator has problems to be considered a good measure of financial structure. Here we include it for completeness and consistency purposes.

⁹ Levine (2002) uses these three indicators to assess the degree to which national financial systems provide financial services. Finance-Activity equals the logarithm of the total value traded ratio times the private credit ratio. Finance-Size equals the logarithm of the market capitalization ratio times the private credit ratio. Finance-Efficiency equals the logarithm of the total value traded ratio divided by overhead costs. Levine (2002) indicates that the second indicator has problems to be considered a good measure of financial development. Like in the case of the Structure-Efficiency indicator, we use it for completeness and consistency purposes. .

Table 2. Banking and Financial Indicators

Name	Definition	Measurement
Banking Fragility Indicators		
Crisis	Binary variable for fragility: Banking crisis=1 Non banking crisis=0	Episodes of systemic and/or non systemic banking crises
Banking Competition Indicators		
Banking Concentration	$BNKCON = \ln(BCON)$	Banking system concentration
Banking Domestic	$BNKDOM = \ln(1 - FBSA)$	Share of domestically-owned banks
Banking Public	$BNKPUB = \ln(PBSA)$	Share of publicly-owned banks
Banking Activity	$BNKLACT = \ln\left(\frac{DBPCY}{BLCY}\right)$	Activity of banks relative to that of bank-like institutions
Banking Size	$BNKSIZ = \ln\left(\frac{DBGDP}{BLAY}\right)$	Size of banks relative to that of bank-like institutions
Financial Structure Indicators		
Structure Activity	$STCACT = \ln\left(\frac{SMVY}{DBPCY}\right)$	Activity of stock markets relative to that of banks
Structure Size	$STCSIZ = \ln\left(\frac{SMCY}{DBPCY}\right)$	Size of stock markets relative to that of banks
Structure Efficiency	$STCEFF = \ln(SMVY * BOHC)$	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	$FINACT = \ln(SMVY * TIPCY)$	Activity of stock markets and intermediaries
Finance Size	$FINSIZ = \ln(SMCY * TIPCY)$	Size of stock markets and intermediaries
Finance Efficiency	$FINEFF = \ln\left(\frac{SMVY}{BOHC}\right)$	Financial sector efficiency
Finance Aggregate	First principal component of the set of individual financial development indicators.	Scale index of financial development.
Notes: Large values of the banking activity and size indicators are associated to banking institutions; small ones to bank-like ones. 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 assessment of the stylised facts

OLS regressions allow us to determine certain empirical associations between the banking and financial indicators. Specifically they are used to analyse how the financial situation of banking systems may affect the associations between banking competition and financial structure and between banking competition and financial development. We denominate such associations as the *stylised facts* between banking competition and financial systems. The regressions will allow us to establish such stylised facts by comparing the outcomes of specific sets of OLS regressions.

The stylised facts are assessed with four OLS regression sets. Each set study specific banking and financial relationships. The first set studies the relationships among the banking market structure and bank-like indicators. The second set studies the relationships of the banking indicators with respect to the financial development ones. The third set studies the relationships of the banking indicators with respect to the financial structure ones. Here it is important to recall that our focus is merely on the empirical associations. Thus the regressions do not aim at clarifying any causality.

Each regression set allows us to study specific relationships through the comparison of the outcomes of the subsets that integrate each set. Specifically each set is integrated by subsets of three single-variable regressions that describe the association between a specific pair of indicators for different data samples. In each subset, the first regression estimates an association using all the sampled data. The second and third regressions re-estimate the same association using two data sub-samples that are differentiated according to the fragility indicator.

Comparisons among the regressions allow us to progressively define the stylised facts associated with the banking and financial indicators. Notice that the outcomes of each subset of regressions allow us to analyse how the financial situation of banking systems may affect the associations between specific pairs of indicators. These outcomes may show that certain associations can be consistent in spite of the financial situation that the banking system of a country may be experiencing. The existence of consistent associations in a subset of regressions allows us to define an empirical relationship. Consistent relationships allow us to define an empirical stylised fact.

5. Failure-determinant methodology and the assessment of fragility determinants

Here we discuss how we assess the effects of banking competition determinants on banking fragility. In spite that our approach is developed along the lines of the failure–determinant literature, we believe important to emphasise that we use logit models for panel data. We emphasise this feature because traditional studies use a multivariate logit approach to analyse the determinants of banking crises.¹⁰ Statistically our panel-data approach allows us to combine the properties of time-series and cross-sectional data for estimation purposes. Furthermore, it allows us to take advantage of all the data available.

Here we use logit models for panel data to assess the determinants of fragility. We assume logistic functions because logit models have statistical advantages with respect to probit ones in terms of estimator consistency and parsimony of assumptions [See Woolridge (2002)]. Furthermore, we focus on estimations with fixed-effects to get rid of time-constant unobserved heterogeneity among the countries analysed. Statistically, fixed-effects estimations are adequate as long as we can reject, for estimations with random-effects, the null hypothesis that the fraction of the total variance due to idiosyncratic errors is zero.¹¹

The traditional financial fragility literature includes indicator sets that capture the main characteristics of the environment [Demirguc-Kunt and Detragiache (1998), (2000)]. Mathematically the matrix of independent K vector-variables $\mathbf{x}_{it} = \mathbf{x}_{it1}, \mathbf{x}_{it2}, \dots, \mathbf{x}_{itK}$ describes the environment through the inclusion of failure-determinant and control variables. In our study, the former variables include the banking indicators while the latter variables include the financial structure and development indicators.¹² Thus, in our case the matrix is defined as:

¹⁰ Classic studies that use the multivariate logit approach are Demirguc-Kunt and Detragiache (1998) and (2000) and Hardy and Pazarbasioglu (1999).

¹¹ Such null hypothesis is expressed as $H_0: \rho=0$. The intuition underlying this hypothesis is that random effects are close to fixed effects when the estimated variance of unobserved effects, σ_c^2 , is relatively

large compared to the one of the idiosyncratic errors, σ_u^2 . Notice that $\rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_c^2}$.

¹² We are particularly aware that some important control variables are omitted due to the absence of data. Relevant omissions include variables to describe different regulatory regimes like deposit insurance, minimum capital requirements and deposit rate ceilings. We completely agree with a referee who pointed out that regulatory regimes may have differentiated impacts on banking fragility.

$$\mathbf{x}_{it} = [B_{it}, S_{it}, F_{it}] \quad (1)$$

Where

- M_{it} Vector of banking indicators
- S_{it} Vector of financial structure indicators
- F_{it} Vector of financial development indicators

Panel-data techniques allow us to use the data available. We consider this feature important not only for estimation purposes, but also because of the potential generality of the estimation results. Such results may be obtained by consistent estimations of the coefficient vector $\boldsymbol{\beta} = [\beta_B, \beta_S, \beta_F]$. Here we denominate the linear functional form of the logit models that relates \mathbf{x}_{it} and $\boldsymbol{\beta}$ as the *banking-competition specification*. Such linear functional form will be used for the empirical estimations of the failure-determinant models. Linearity is a traditional convention in the failure-determinant literature.

The analysis of how competition may affect the stability of banking systems depends on several estimations of the coefficient vector $\boldsymbol{\beta}$. We use these estimations to clarify the nature of the effects of the banking industry determinants. Like other failure-determinant studies, a clear limitation of the analysis refers to the potential existence of *endogeneity*. This limitation is rarely, if ever, mentioned in failure-determinant studies. Endogeneity can arise due to the omission of relevant variables, due to measurement errors or because of simultaneity. We are aware of this potential statistical problem. We deal with it by using further empirical regressions and assuming that causality can be established under certain empirical premises.

Endogeneity is not only an econometric problem. Endogeneity and causality issues can arise under the basis that it is very difficult to disentangle the notion of banking fragility from the state of development and the structure of financial systems and the degree of banking competition. Our study is based on the premise that the design of the financial system, the level of financial development and banking competition are

Currently, the only public database on banking regulatory and supervision practices is the one of Barth, Caprio and Levine (2001). Unfortunately the time span and country coverage of this database do not coincide with the ones of our study.

exogenous to the phenomenon of financial crises. However, we must recognise that this is a very restrictive premise for the assessment and interpretation of the econometric results.¹³

Econometrically we deal with endogeneity issues based on further panel-data regressions and further empirical assumptions. We use random-effects logit regressions to deal with the issues of omitted variable bias and sample size associated to fixed-effects estimations.¹⁴ We use such regressions to analyse statistical consistency. We deal with the causality issue under the basis that each view on the relationship between competition and fragility predicts certain signs for the estimated coefficients. Specifically, the view that assumes that competition enhances fragility predicts that all the estimated coefficients will be negative. The opposite view predicts positive ones. Finally the third view predicts that they will be differentiated or non significant.¹⁵

6. Econometric assessment of stylised facts

Here we report the regression results associated to the assessment of the stylised facts between competition and financial systems. First we report the results used to investigate the relationships among the individual indicators. Specifically we report the results related to the relationships between banking competition and financial development and between banking competition and financial structure. Then we report the results associated to the set of aggregate indicators. Finally we summarise the results of the three regression sets. In all the regressions we have included a constant term to eliminate constant effects.

¹³ Such restrictiveness can be understood in terms of the interpretation of the empirical results: Suppose that for a given set of results we establish that financial underdevelopment and the lack of banking competition *causes* financial fragility (in line with our main premise). However, it may be perfectly reasonable to think about banking fragility in terms of a manifestation of financial underdevelopment and, by extension, of banking inefficiency and the lack of banking competition. Under the later interpretation, we suggest the existence of simultaneity, but not of causality

¹⁴ Wooldridge (2002: p. 252), indicates “This approach [with random effects] is certainly appropriate from an omitted variables or neglected heterogeneity perspective”. Moreover, because the number of countries is relatively large, fixed-effects models would lead us to losses in the number of degrees of freedom.

¹⁵ Methodologically we are assuming that the competitive behaviour of banking systems depends on specific features of the local banking industry (low banking concentration, openness to foreign incumbents, profit maximisation driven by private banks and the existence of providers of substitute financial services). We are aware that these assumptions are particularly strong for empirical purposes. However the available data do not allow us to address this issue more properly.

The first regression set analyses the associations between financial development and banking competition indicators. We summarise the econometric results in the following table:

**Table 3. Banking Competition and Financial Development
(Regression Analysis)**

<i>Regressor Indicator</i>	<i>All Observations (1)</i>		<i>Stable Banking Systems (2)</i>		<i>Fragile Banking Systems (3)</i>	
	β (t)	R ²	β (t)	R ²	β (t)	R ²
<i>Regressed Indicator: Banking-Concentration</i>						
Finance Activity	-0.03** (-4.85)	0.10	-0.04*** (-3.98)	0.07	-0.04*** (-3.25)	0.07
Finance Size	-0.04*** (-3.54)	0.04	-0.03** (-2.47)	0.03	-0.06*** (-2.73)	0.07
Finance Efficiency	-0.03*** (-3.57)	0.04	-0.03*** (-2.76)	0.03	-0.04*** (-2.74)	0.07
<i>Regressed Indicator: Banking-Domestic</i>						
Finance Activity	0.02*** (4.85)	0.08	0.04*** (4.85)	0.22	0.00 (1.60)	0.02
Finance Size	0.03*** (5.10)	0.09	0.05*** (5.60)	0.17	0.01* (1.85)	0.03
Finance Efficiency	0.02*** (4.31)	0.07	0.03*** (5.70)	0.17	0.01 (1.54)	0.02
<i>Regressed Indicator: Banking-Public</i>						
Finance Activity	0.05 (0.69)	0.01	-0.17 (-0.95)	0.05	0.38*** (4.70)	0.51
Finance Size	-0.01 (-0.08)	0.00	-0.20 (-0.95)	0.04	0.81*** (3.63)	0.42
Finance Efficiency	0.10 (1.09)	0.03	-0.33 (-1.48)	0.10	0.46*** (6.48)	0.70
<i>Regressed Indicator: Banking-Activity</i>						
Finance Activity	-0.06* (-1.83)	0.01	-0.03 (-0.64)	0.00	-0.09** (-2.10)	0.07
Finance Size	-0.18*** (-3.17)	0.05	-0.13* (-1.68)	0.02	-0.22*** (-3.12)	0.15
Finance Efficiency	-0.13*** (-3.17)	0.06	-0.12* (-1.95)	0.03	-0.15*** (-2.74)	0.13
<i>Regressed Indicator: Banking-Size</i>						
Finance Activity	-0.00 (-0.20)	0.00	0.01 (0.24)	0.00	-0.02 (-0.46)	0.00
Finance Size	0.01 (0.32)	0.00	0.04 (0.55)	0.00	-0.00 (-0.02)	0.00
Finance Efficiency	-0.06 (-1.49)	0.01	-0.08 (-1.34)	0.01	-0.05 (-0.94)	0.01
Notes: The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β , the t-statistic of this estimate (in parentheses) and the R ² value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.						

Table 3 shows *differentiated relationships* among the banking competition and financial development indicators according to fragility. Particularly it suggests that *the degree of financial development is low in countries with concentrated banking systems*. All the estimated regressions between the concentration and development indicators are negative and significant. Moreover the comparisons among data samples suggest that such relationship is magnified during episodes of banking crises. The coefficients β and R^2 are relatively higher and more statistically significant for the sample involving episodes of banking fragility.

An interesting finding is that *financial development indicators are positively correlated to the share of domestic-owned banks*. The regressions are statistically significant in most cases. Moreover, such relationship is magnified during stability periods. We are aware that this finding may be counter-intuitive on the basis that foreign banks may induce competition and incentives for innovation. However this finding is consistent with the idea that domestic bankers may have better knowledge of the local market. Also, this finding is consistent in terms of the positive correlation between financial and banking development: In developed banking systems domestic banks may be more stable and less likely to be purchased by foreign banks.

According the regressions, public banking might enhance financial development. Comparisons among the associations suggest that the relationships between financial development and public banking depend on the stability of banking systems. The evidence shows that *financial development indicators are positively correlated to the share of public-owned banks only when the banking systems are experiencing crises*. Otherwise, the estimations are neither consistent nor significant. This finding may reflect public efforts to deal with banking crises and to stabilise banking systems.

Other findings suggest that *the degree of financial development is low in countries with relatively active banking systems*. Almost all the estimated regressions between the banking activity and financial development indicators are negative and significant. Moreover, like in the case of the concentration indicator, the comparisons among data samples suggest that such relationship is magnified during episodes of banking crises. The coefficients β and R^2 are relatively higher and more statistically significant for the sample involving episodes of banking fragility.

The second regression set analyses the relationships between financial structure and banking competition. We summarise the results of the regression set of individual indicators in the following table:

**Table 4. Banking Competition and Financial Structure
(Regression Analysis)**

<i>Regressor Indicator</i>	<i>All Observations (1)</i>		<i>Stable Banking Systems (2)</i>		<i>Fragile Banking Systems (3)</i>	
	β (t)	R ²	β (t)	R ²	β (t)	R ²
<i>Regressed Indicator: Banking-Concentration</i>						
Structure	-0.05***	0.05	-0.08***	0.10	-0.03	0.02
Activity	(-3.95)		(-4.67)		(-1.56)	
Structure	-0.00	0.00	-0.04	0.00	0.05	0.01
Size	(-0.02)		(-1.26)		(1.17)	
Structure	-0.04***	0.05	-0.06***	0.09	-0.03*	0.03
Efficiency	(-3.98)		(-4.43)		(-1.69)	
<i>Regressed Indicator: Banking-Domestic</i>						
Structure	0.03***	0.06	0.07***	0.21	0.01	0.01
Activity	(4.11)		(6.46)		(1.22)	
Structure	0.04***	0.03	0.07***	0.05	0.01	0.00
Size	(2.70)		(3.00)		(0.84)	
Structure	0.02***	0.06	0.04***	0.16	0.01	0.02
Efficiency	(3.91)		(5.44)		(1.44)	
<i>Regressed Indicator: Banking-Public</i>						
Structure	0.16	0.05	-0.75*	0.15	0.44***	0.65
Activity	(1.54)		(-1.75)		(6.35)	
Structure	0.33	0.03	-2.84***	0.42	0.97***	0.66
Size	(1.26)		(-3.68)		(6.01)	
Structure	0.08	0.01	-0.28	0.07	0.35***	0.46
Efficiency	(0.88)		(-1.24)		(3.93)	
<i>Regressed Indicator: Banking-Activity</i>						
Structure	-0.06	0.00	-0.03	0.00	-0.07	0.01
Activity	(-1.08)		(-0.42)		(-0.87)	
Structure	-0.35***	0.03	-0.40**	0.04	-0.19	0.01
Size	(-2.65)		(-2.28)		(-0.98)	
Structure	-0.07	0.00	-0.01	0.00	-0.12	0.04
Efficiency	(-1.15)		(-0.12)		(-1.54)	
<i>Regressed Indicator: Banking-Size</i>						
Structure	-0.04	0.00	-0.09	0.01	0.02	0.00
Activity	(-0.84)		(-1.20)		(0.34)	
Structure	-0.10	0.00	-0.56***	0.07	0.37**	0.07
Size	(-0.84)		(-3.17)		(2.30)	
Structure	0.01	0.00	0.01	0.00	0.01	0.00
Efficiency	(0.34)		(0.18)		(0.23)	
Notes:						
The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β , the t-statistic of this estimate (in parentheses) and the R ² value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.						

Table 4 also shows *differentiated relationships* among the banking competition and financial structure indicators according to banking fragility. Particularly it suggests that *concentrated banking systems prevail in bank-based financial systems*. Financial structure indicators are negatively correlated to the ratio of the three largest banks to total banking assets. In spite that this main finding per se is not surprising, the comparisons among samples suggest that such relationship is magnified during banking stability periods. β and R^2 , are relatively high and statistically significant for the sample involving episodes of banking stability.

An unexpected finding is that financial structure indicators are positively correlated to the share of domestic-owned banks. The estimated regressions are positive and statistically significant in most cases. Moreover, the comparisons among samples suggest that such association is magnified during banking stability periods. Such findings may suggest that *a high degree of foreign penetration prevails in bank-based financial systems*. However our findings also show that the property regime of banks does not matter when the banking systems are unstable.

The regressions show *differentiated associations* between the public banking indicator with respect to financial development. Such differentiation depends on the financial situation of the banking system. Specifically our findings suggest that *private banks prevail in bank-based financial systems during banking fragility periods*. But they also suggest that *public banks prevail in bank-based systems during stable ones*. In both cases the regression coefficients are mostly significant. However, according to β and R^2 , it is likely that the former association might prevail as a relationship.

Not surprisingly, our findings show that *the relative prominence of banks with respect to bank-like institutions characterises bank-based financial systems*. In most regressions, the financial structure indicators are negatively correlated to the banking activity and banking size ones. Moreover, such relationships are magnified during banking crises. Interestingly the regressions show that the size of banks increases in bank-based financial systems during fragility periods. But they also suggest that the size of banks increases in market-based financial systems during stability periods.

The third regression set analyses the relationships between the banking and financial aggregate indexes. We summarise the results of the regression set of indicators in the following table:

**Table 5. Banking and Financial Aggregate Indicators
(Regression Analysis)**

<i>Regressor Indicator</i>	<i>All Observations</i>		<i>Stable Banking Systems</i>		<i>Fragile Banking Systems</i>	
	<i>(1)</i>		<i>(2)</i>		<i>(3)</i>	
	β	R ²	β	R ²	β	R ²
	(t)		(t)		(t)	
<i>Regressed Indicator: Banking-Concentration</i>						
Finance	-0.05***	0.05	-0.05***	0.04	-0.07***	0.09
Aggregate	(-3.85)		(-2.85)		(-2.93)	
Structure	-.04***	0.02	-.07***	0.06	-.02	0.00
Aggregate	(-2.61)		(-3.51)		(-0.81)	
<i>Regressed Indicator: Banking-Domestic</i>						
Finance	0.03***	0.09	0.05***	0.20	0.02*	0.04
Aggregate	(4.96)		(5.98)		(1.91)	
Structure	0.02***	0.06	0.05***	0.17	0.01	0.02
Aggregate	(3.87)		(5.40)		(1.38)	
<i>Regressed Indicator: Banking-Public</i>						
Finance	0.12	0.01	-0.33	0.06	0.80***	0.66
Aggregate	(0.72)		(-1.08)		(5.24)	
Structure	0.15	0.04	-0.77*	0.18	0.45***	0.62
Aggregate	(1.24)		(-1.94)		(4.80)	
<i>Regressed Indicator: Banking-Activity</i>						
Finance	-0.23***	0.07	-0.21**	0.04	-0.25***	0.17
Aggregate	(-3.54)		(-2.14)		(-3.19)	
Structure	-0.21**	0.03	-0.22	0.02	-0.20*	0.07
Aggregate	(-2.50)		(-1.60)		(-1.93)	
<i>Regressed Indicator: Banking-Size</i>						
Finance	-0.06	0.00	-0.08	0.00	-0.06	0.00
Aggregate	(-0.94)		(-0.81)		(-0.71)	
Structure	-0.04	0.00	-0.28**	0.03	0.07	0.00
Aggregate	(-0.61)		(-1.99)		(0.71)	
Notes:						
The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β , the t-statistic of this estimate (in parentheses) and the R ² value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.						

Table 5 shows that the aggregate financial indicators are negatively correlated to the banking indicators of concentration, activity and size and positively with the domestic one. These findings suggest that *banking concentration, the relative prominence of banks and foreign ownership are associated to bank-based financial systems and financial underdevelopment*. As before, the consistency and robustness of these associations depends on banking fragility. Furthermore the regressions suggest that *public banking is associated to market-based financial systems and financial development during banking crises*.

We summarise by indicating that the financial situation prevailing in the banking systems (the stability or fragility one), emphasises specific associations between financial development and the banking competition determinants. Concretely banking crises emphasise the *negative* correlations between financial development with banking concentration and the relative prominence of banking over bank-like institutions. They also emphasise the *positive* correlations between financial development and public banking. Stability periods emphasise the *positive* correlation between financial development and domestically owned banks.

The financial situation also emphasises specific associations between financial structure and banking competition. Our findings show that banking crises emphasise the associations between bank-based financial systems with the relative activity of banking institutions, and the ones between market-based financial systems with public banking. Furthermore they also show that banking stability periods emphasise the associations between bank-based financial systems with banking concentration, public banking and the relative size of banking institutions, and the ones between market-based financial systems with domestically owned banks.

We conclude by pointing out that the evidence suggests differentiated associations among the banking and financial indicators. Specifically the stylised facts suggest that *banking concentration, foreign ownership and the relative activity and size of banks with respect to those of bank-like institutions are associated to bank-based financial systems and financial underdevelopment*. They also suggest that *domestically and publicly owned banks may prevail in market-based and financially developed financial systems*, at least, during banking crisis episodes.

7. Econometric assessment of the effects of the banking determinants

Here we report the outcomes of the two sets of failure-determinant models that estimate the banking-competition specification defined by equation (1). These outcomes complement the previous OLS regressions. Furthermore the outcomes will allow us to compare the evidence with the alternative theoretical predictions regarding the effects of banking competition on banking fragility. But also they will allow us to analyse the specific and joint effects of banking competition determinants on fragility. In all the estimations we have included the aggregate financial indicators as control variables.

The first set of failure determinants models focuses on the specific effects of the banking determinants on banking fragility. We summarise the results of this set of failure-determinant models in the following table:

Table 6. Banking Competition and Financial Fragility (Fixed Effects Logit Models for Panel Data)					
/Model	Concentration	Domestic	Public	Activity	Size
Regression Indicators					
Structure	-1.37** (-2.05)	-2.26*** (-2.56)	-2.02 (-0.67)	-3.32*** (-2.75)	-2.11** (-2.08)
Aggregate Finance	0.36 (0.44)	1.72 (1.55)	2.50 (0.76)	0.80 (0.73)	0.28 (0.27)
Banking Concentration	-1.65 (-1.24)	-	-	-	-
Banking Domestic	-	19.15* (1.84)	-	-	-
Banking Public	-	-	13.09 (1.25)	-	-
Banking Activity	-	-	-	3.05*** (2.81)	-
Banking Size	-	-	-	-	2.24** (2.08)
Observations	139	112	18	75	74
LR-CHI2	10.55**	12.80***	2.62	21.87***	11.12**
Prob > chi2	0.0144	0.0051	0.4539	0.0001	0.0111
Log Likelihood	-51.70	-40.61	-7.36	-21.24	-25.30

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 6 shows *differentiated effects* of the specific banking competition determinants on financial fragility. Particularly the analysis shows that concentration enhances the stability of banking systems and that banking credit activity enhances their fragility. However, none of the determinants are statistically significant. Furthermore the evidence suggests that financial underdevelopment and the orientation toward market-based financial systems might enhance banking stability. In fact all the coefficient estimations of the significant financial structure indicators are negative. Thus the estimations support the idea that *financial structure matters to assess banking performance*.

Further results offer weak evidence that the higher the share of public and domestically owned banks or the higher size of the banking sector with respect to that of like-bank institutions, the higher probability that banking crises will occur. Thus, the regressions might suggest that *the performance of the banking system may depend on the property regime of banks*. This conclusion has support on other banking studies.¹⁶ However the evidence is not conclusive because only the domestic ownership coefficient is significant. Moreover, it could be argued that the public banking coefficient may appear as a consequence of government efforts to deal with banking crises.

What effects may have the joint of banking competition determinants on financial fragility? We explore this question with a set of panel-data regressions that include multiple banking determinants. We follow the Sargan-and-Hendry approach to build it.¹⁷ Econometrically such approach allows us to dismiss the possibility of specification and model selection problems. Hence we show the outcomes of a general regression model that includes all the fragility determinants and the outcomes of simplified models of it. Then we use log likelihood and z-statistics tests in order to simplify the model and to choose among several alternative regression specifications.

The second set includes fixed-effects panel-data regressions that focus on the joint effects of banking determinants on fragility according to the guidelines indicated

¹⁶ See Demirguc-Kunt and Detragiache (2005).

¹⁷ About this approach it has been indicated that “[Sargan and Hendry] argue in favor of starting with a very general model and simplifying it progressively based on the data available” [Maddala (1992:3)].

above. We summarise the results of this set of failure-determinant models in the following table:

Table 7. Banking Competition and Financial Fragility (Fixed Effects Logit Models for Panel Data)						
/Model	General Model	Simplified Model 1	Simplified Model 2	Simplified Model 3	Simplified Model 4	Simplified Model 5
Regression Indicators						
Structure	4.59	-4.68**	-3.30**	-3.55***	-3.67***	-2.78***
Aggregate	()	(-2.38)	(-2.39)	(-2.60)	(-2.91)	(-2.95)
Finance	18.76	3.21	-	-	-	-
Aggregate	()	(1.06)	-	-	-	-
Banking	-32.49	5.77	2.33	-	-	-
Concentration	(0.00)	(1.10)	(0.70)	-	-	-
Banking	-235.89	16.84	-8.51	-3.81	-9.28	-
Domestic	()	(0.47)	(-0.36)	(-0.17)	(-0.69)	-
Banking	-40.19	-	-	-	-	-
Public	()	-	-	-	-	-
Banking	12.01	4.17	3.45	3.23	3.26**	2.90***
Activity	()	(0.80)	(0.82)	(0.77)	(2.28)	(2.78)
Banking	12.02	2.18	0.97	0.29	-	-
Size	()	(0.38)	(0.20)	(0.06)	-	-
Observations	6	55	55	55	64	75
LR-CHI2	5.42**	19.92***	18.67***	18.17***	23.32***	21.32
Prob > chi2	0.0200	0.0029	0.0022	0.0011	0.0000	0.0000
Log Likelihood	0.00	-12.91	-13.54	-13.79	-15.04	-21.52

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 7 confirms that banking competition determinants have differentiated effects on financial fragility. The regressions confirm that the relative credit activity of banks significantly enhances the fragility of banking systems. They also confirm that financial development enhances it. In most models the estimated determinants are consistent. Furthermore the evidence confirms that *the orientation toward market-based financial systems might enhance stability*. In fact all the coefficient estimations, of the significant financial structure indicators, are negative. Thus the estimations also confirm that financial structure matters to assess banking performance.

The second regression set offers additional information on the relationship between banking competition and financial fragility. According to statistical tests, the best parsimonious specification that describes such relationship corresponds to the fourth simplified model. Such specification includes indicators of financial structure, domestic ownership and relative activity of banks as explanatory variables.¹⁸ Interestingly, other results in the regression set seem to contradict our previous findings regarding the effects of banking concentration and domestic ownership. However none of the estimated coefficients are significant.

What effect does banking competition may have on financial fragility? According to the both regression sets, *it is likely that banking determinants have differentiated effects*. Specifically, if credit activity relies on banking institutions or the orientation of the financial system is bank-based, the outcomes suggest that banking fragility will be enhanced. Furthermore, both regression sets offer weak evidence that financial development and, particularly, the property regime matters. Indeed the Banking-Domestic indicator seems necessary to avoid misspecification problems. However none of the indicators are statistically significant.

We support our results with statistical tests and further regressions. Specifically, the overall significance of the variables used in the models is supported with likelihood ratio tests. According to the Wald criterion, all the models in both regression sets are

¹⁸ We arrive to such conclusion by using the log likelihood indicators in the fourth and fifth simplified models. According to an omitted variables-ratio test, the inclusion of the Banking Domestic indicator is relevant for specification testing purposes. With a level of significance of 0.01 $\chi_1^2 = 6.63$, the null hypothesis of no incorrect omission is rejected [LR=-2(-21.52+15.04)=12.96].

significant [See Tables 6 and 7]. We assess the consistency and adequacy of the models with further random-effects logit regressions [See the Appendix]. By such regressions we conclude that the results obtained with the models are consistent and that fixed-effects are necessary for estimation purposes. Moreover, they also confirm that the Banking-Domestic indicator is necessary for specification purposes.

We summarise by indicating that the evidence shows *differentiated effects* of the banking determinants on fragility. Specifically the outcomes suggest that *if credit activity relies on banks or if the financial system is bank-based, the likelihood of crises will increase*. Another suggestion is that *the banking determinants, the features of the financial system and the property regime of banks jointly matter* to analyse the likelihood of crises. Empirically the results support the view that the relationship between banking competition and financial fragility involves more than a trade-off. Moreover they support the idea that financial structure matters to assess fragility.

8. Conclusions and discussion

The issue of how banking competition affects the stability of banking systems is not well understood. Here we have shown the results of an investigation regarding the clarification of such issue by using a panel-data for 47 countries during the period 1990-97. Such investigation has relied on an extension of the failure-determinant methodology that uses a double-technique approach based on OLS regressions and fixed-effects logit models for panel-data. We have aimed at clarifying the stylised facts associated with the banking and financial indicators and at assessing the specific and joint effects of banking competition determinants on financial fragility.

The evidence suggests differentiated associations among the banking and financial indicators. Specifically the stylised facts suggest that *banking concentration, foreign ownership and the relative activity and size of banks with respect to those of bank-like institutions are associated to bank-based financial systems and financial underdevelopment*. They also suggest that *domestically and publicly owned banks may prevail in market-based and financially developed financial systems*, at least, during banking crisis episodes. Apparently the financial situation of banking systems matters to assess the associations among the indicators.

The models for panel-data show *differentiated effects* of the banking determinants on fragility. Specifically the outcomes suggest that *if credit activity relies on banks or if the financial system is bank-based, the likelihood of crises will increase*. Another suggestion is that *the banking determinants, the features of the financial system and the property regime of banks jointly matter* to analyse the likelihood of crises. Empirically the results support the view that the relationship between banking competition and financial fragility involves more than a trade-off. Moreover they support the idea that financial structure matters to assess fragility.

The study leads to some interesting implications and suggestions for further research and policy-making: The first one relates to the property regime of banks. Our findings suggest that *it is likely that the property regime matters* to explain financial fragility in spite of the lack of statistical significance of the ownership indicators. Assuming that public, private, domestic and foreign banks have different goals and experience, it is very likely that their behaviour may be different under the same economic and

financial conditions. Such considerations make us believe that further studies on the performance of banks and their fragility should focus on the property regime.

Academically we believe that one of the most surprising conclusions of our study refers to banking concentration. Our panel-data models suggest that concentration is *not* a significant determinant of fragility. We are aware that this finding contradicts other studies and even our own intuition.¹⁹ Many studies use this indicator as *the measure* of competition. Moreover, policy-makers usually consider concentration as an important issue whenever they discuss competitive and stability issues. Apparently the inclusion of fixed-effects in our models reduces the significance of the concentration indicator. Thus our results might suggest that the effects supposedly caused by banking concentration, really depend on time-constant country features.

We believe that our study suggests some ideas relevant for the policy-making process. The first one is that there are not general policy-making strategies to deal with financial stability issues. Our results suggest that such strategies should be “tailored” according to the specific features of the banking and financial sectors of the economy. Furthermore, an important consideration pointed out by the ones that support the view that banking competition involves more than a simple trade-off, is that perfect financial stability can be socially undesirable [See Allen and Gale (2004a)]. Thus regulations should not always need to avoid the occurrence of banking crises.

A final implication of our analysis is that *financial structure matters to assess banking performance*. The interactions among intermediaries and financial markets seem to explain the likelihood banking crises.²⁰ Indeed, we believe that further research may be developed along the guidelines of the literature of comparative financial systems [See Allen and Gale (2000) and (2004b)]. Published studies describe some empirical relationships between financial structure and crises [See Allen (2001) and Ruiz Porras (2006)]. However they do not study how financial and banking competition may affect the stability of banks. Our current efforts are oriented along this direction.

¹⁹ Beck, Demirguc-Kunt and Levine (2003), among others, have considered banking concentration as an important determinant of banking stability.

²⁰ We are aware that this argument is controversial. Demirguc-Kunt and Huizinga (2001), arrive exactly to the opposite conclusion through the analysis of the determinants of banking profitability.

APPENDIX

Here we show the estimation outcomes of the random-effects logit regressions for panel-data used to assess the consistency for the models in the main text. Furthermore, we use them to analyse the adequacy of fixed-effects for modelling purposes. We develop such assessments by reporting the outcomes of two sets of failure-determinant regressions. Like in the main text, the first set includes regressions to study the effects of the specific banking determinants of banking crises. The second set includes regressions to study the joint effects of multiple banking determinants according to the Sargan-Hendry approach.

The first set of failure-determinant regressions focuses on the specific effects of banking determinants on banking fragility. We summarise the results of this set of failure-determinant regressions in the following table:

**Table A1. Specific Failure-Determinant Regressions
(Random Effects Logit Regressions for Panel Data)**

/Model	Concentration	Domestic	Public	Activity	Size
Regression Indicators					
Structure	-0.49*	-0.25	-0.42	-1.95***	-1.08**
Aggregate	(-1.90)	(-0.87)	(-0.83)	(-3.13)	(-2.07)
Finance	-0.32	-0.51*	-0.37	0.18	0.05
Aggregate	(-1.33)	(-1.76)	(-0.69)	(0.52)	(0.15)
Banking	-2.37***	-	-	-	-
Concentration	(-3.10)	-	-	-	-
Banking	-	2.44	-	-	-
Domestic	-	(1.45)	-	-	-
Banking	-	-	0.27	-	-
Public	-	-	(0.71)	-	-
Banking	-	-	-	1.64***	-
Activity	-	-	-	(2.97)	-
Banking	-	-	-	-	0.79
Size	-	-	-	-	(1.46)
Constant	-2.65***	-0.90*	-0.54	-4.75***	-2.83***
	(-4.13)	(-1.86)	(-0.76)	(-3.18)	(-2.75)
Observations	261	220	35	153	158
LR-CHI2	13.23***	13.37***	9.22**	24.49***	14.59***
Prob > chi2	0.0042	0.0039	0.0264	0.0000	0.0022
Log Likelihood	-125.05	-105.12	-17.13	-64.86	-74.11
σ_u	3.58	3.19	0.08	7.49	5.43
ρ	0.79	0.75	0.00	0.94	0.89
CHI2 (Ho: $\rho=0$)	59.19***	52.74***	0.00	48.64***	45.67***
Prob > chi2	0.000	0.000	0.497	0.000	0.000

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 A1 shows *consistent results* with the ones of the main text (Table 6). Specifically, the random-effects logit regressions confirm that banking credit activity, publicly and domestically-owned banks might enhance the fragility of banking systems. Moreover, they also confirm that the orientation toward marked-based financial systems enhances their stability. Furthermore most of the random-effects regressions reject the null hypothesis that the fraction of the total variance due to idiosyncratic errors is zero. Such rejection shows that the estimations with fixed-effects, like the ones in the main text, are *necessary* for modelling purposes.

The second set includes random-effects logit panel-data regressions that focus on the joint effects of banking determinants. We summarise the results of this second regression set in the following table:

Table A2. Joint Failure-Determinant Regressions (Random Effects Logit Regressions for Panel Data)					
/Model	General Model	Simplified Model 1	Simplified Model 2	Simplified Model 3	Simplified Model 4
Regression Indicators					
Structure	-151.99	-1.67**	-1.47**	-1.45**	-1.49**
Aggregate	(.)	(-2.20)	(-2.31)	(-2.08)	(-2.55)
Finance	255.09	0.39	-	-	-
Aggregate	(0.00)	(0.59)	-	-	-
Banking	-154.32	2.32**	2.18*	0.11	-
Concentration	(-0.00)	(1.99)	(1.91)	(0.11)	-
Banking	332.76	0.48	3.11	-	-
Domestic	(.)	(0.09)	(0.91)	-	-
Banking	-344.33	-	-	-	-
Public	(.)	-	-	-	-
Banking	-89.71	10.14***	10.42***	8.21**	8.27**
Activity	(0.00)	(2.85)	(3.06)	(2.29)	(2.31)
Banking	57.86	-8.47***	-8.98***	-7.61**	-7.66**
Size	(.)	(-2.58)	(-3.01)	(-2.25)	(-2.27)
Constant	53.01	-4.18**	-3.66**	-4.72**	-4.83**
	(.)	(-2.33)	(-2.53)	(-2.12)	(-2.46)
Observations	8	117	117	139	139
LR-CHI2	10.59***	27.47***	27.06***	30.63***	30.61***
Prob > chi2	0.0011	0.0001	0.0001	0.0000	0.0000
Log Likelihood	0.00	-45.74	-45.95	-55.59	-55.60
σ_u	0.00	5.01	4.55	2.69	2.73
ρ	0.00	0.88	0.86	0.68	0.69
CHI2 (Ho: $\rho=0$)	0.00	9.17***	12.62***	13.54***	16.79***
Prob > chi2	1.00	0.001	0.000	0.000	0.000

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 A2 also shows *consistent results* with the ones of the main text (Table 7). The random-effects logit regressions confirm that banking concentration and financial development might enhance banking fragility. They also confirm that the credit activity of bank-like institutions and market-based financial systems may enhance banking stability. All the random-effects simplified regressions show that the estimations with fixed-effects are *necessary* for modelling purposes. Moreover, according to an omitted variables-ratio test again, in this regression set, the Banking-Domestic indicator allows us to avoid misspecification problems.²¹

²¹ We arrive to such conclusion by using the log likelihood indicators of the second and third simplified regressions. Again with a level of significance of 0.01 $\chi_1^2 = 6.63$, the null hypothesis of no incorrect omission is rejected [LR=-2(-55.59+45.95)=19.28].

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