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Bank asset reallocation and sovereign debt

Michele Fratianni* and Francesco Marchionne**

Abstract

This paper examines how banks around the world have resized and reallocated their earning assets in response to the subprime and sovereign debt crises. We also focus on the interaction between sovereign debt and the asset allocation process. We find that banks have readjusted asset shares and the overall regulatory credit risk by substituting government securities for loans. Furthermore, they have been sensitive to those variables of direct interest to the regulator, a result that is consistent with high-debt governments having exerting moral suasion on banks to privilege the purchase of government securities over credit to the private sector.

Key words: crisis, loans, moral suasion, regulator, securities.
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* Indiana University, Kelley School of Business, Bloomington, Indiana 47405, USA; Università Politecnica delle Marche, Ancona (Italy; Money and Finance Research Group (MoFiR); fratiann@indiana.edu

** Nottingham Trent University, Nottingham Business School, NG1 4BU, Nottingham, UK; Money and Finance Research Group (MoFiR); francesco.marchionne@ntu.ac.uk.

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I. INTRODUCTION

This paper examines how banks around the world have resized and reallocated their earning assets in response to the subprime and sovereign debt crises. We focus on three aspects of the reallocation mechanism: the substitution between securities and loans to the private sector, in particular government securities and loans (de-risking for short); the impact of total assets on the asset shares of loans and securities (de-leveraging for short); and the sensitivity of banks' decisions to variables that are of direct interest to the regulator (moral suasion for short).

The initial impact of the subprime financial crisis occurred through the re-pricing of risk across a variety of assets and the shrinking of balance sheets. Then, recapitalization became increasingly costly, and leverage was effected by selling assets in illiquid markets. In the absence of fresh capital and without significant profits to retire debt in the short run, the de-leveraging process necessarily forces distress sales and falling asset values (Adrian and Shin 2008, Figure 2.5). The failure of Lehman Brothers on September 15, 2008 prompted governments to implement vast and costly rescue operations of their banking systems (Fratianni and Marchionne 2013). Banks that received government assistance bought valuable time to restructure. Banks that did not receive assistance had to adjust more quickly.

Bank bailouts shifted risk from banks to governments (Acharya et al. 2014; Hryckiewicz 2014). The sovereign debt crisis of 2010 in the Eurozone and the subsequent rise in spreads of government yields in the Southern countries relative to Germany's gave an impetus to undercapitalized banks to engage in carry-trade strategies. Acharya and Steffen (2013) present evidence of this strategy in which government securities with a preferential treatment in capital regulatory risk weights and in government guarantees are an ideal collateral to obtain cheap central-bank funding. This phenomenon reached its zenith when the South of the Eurozone, facing a sudden stop and later a reversal in capital flows, became disconnected from the money market in the North of the Eurozone.[1] The European Central Bank (ECB) launched in 2011 and 2012 two rounds of exceptional lending to banks at cheap rates to ease the fragmentation in the inter-bank market.[2] The shift from bank loans to securities occurred with a home bias (Levy and Levy 2014, Popov and van Horen 2013) Battistini et al. (2014) suggest three reasons for this bias (which is positively correlated with sovereign yield spreads): moral suasion exerted by governments issuing high-risk debt on banks to purchase more of this debt; the mentioned carry-trade motive; and the superior hedge that domestic government securities provide over foreign euro-denominated securities against the possibility that the country may re-introduce a national currency. Whether with or without home bias, undercapitalized banks raised the share of their assets in securities at the expense of private-sector credit. The implication is a displacement of investments, as in the model by Broner et al. (2013) where the sovereign, in turbulent times, issues high-interest rate debt that is so attractive to crowd out alternative forms of debt.

The nexus between banks and sovereign debt may generate vicious circles. The traditional view is that a credit crunch worsens borrowers' prospect of repaying outstanding loans, making banks riskier and necessitating further de-leveraging and de-risking. Angelini et al. (2014) offer the alternative explanation that the risk of an insolvent government permeates the entire economy and not just the banking system, making the surge in government debt in banks' portfolio a consequence of the crisis. Both interpretations predict a shift towards government securities in banks' portfolio during a sovereign debt crisis.

There are some recent studies on this topic. Sandleris (2014) develops a theoretical model showing that sovereign defaults can lead to a decline in foreign and domestic credit to the domestic private sector, even if domestic agents do not hold sovereign debt; stronger

[1] On sudden stops of capital flows, see Merler and Pisani-Ferry (2012); on the underlying factors of rising spreads in the Eurozone, see Alessandrini et al. (2014).

[2] Long-term refinancing operations had a maturity of 3 years and carried an interest rate of one percent. €489 billion were utilized in December of 2011 and €529 billion in February of 2012. Italian banks absorbed €281 billion and Spanish banks €365 billion.

domestic financial institutions can amplify this effect. Acharya et al. (2014) model and test a two-way feedback between sovereign risk and bank credit risk and obtain that the positive relationship between public debt-to-GDP ratios and sovereign CDS premia is larger in countries with pre-bailout highly stressed banking sectors and higher debt ratios. Using dynamic panel methods, Buch et al. (2010) show that banks' first reaction to a domestic shock is to reduce foreign assets. Bofondi et al. (2013) found that with the onset of the sovereign debt crisis lending by Italian banks grew by approximately 3 percentage points less than lending by foreign banks operating in Italy, thus corroborating the negative impact of a debt shock on bank loans. Popov and van Horen (2013) and De Marco (2014) underscore the impact of a debt shock on banks' capital and funding channels, both of which reduce the supply of bank credit. Adelino and Ferreira (2014) apply difference-in-difference methodology to test the effectiveness of ceiling policies on banks' holdings of sovereign debt set by credit rating agencies, and find that sovereign downgrades lead to a 30 percent reduction in loan amounts for those banks close to the ceiling.

With this background, our paper focuses on de-risking (the substitution of securities for loans), de-leveraging (the impact of total assets' reduction on securities and loans shares) and moral suasion (the sensitivity of banks' decisions to variables that are of direct interest to the regulator). Our empirical approach consists of two simultaneous equations, one explaining gross loans and the other securities. The specification captures demand conditions, supply constraints, and the influence of the country's bank regulator. The main source of our data is Bankscope and our sample period spans from 2005 to 2012, eight years that encompass four pre-crisis years and four crisis years. Our initial dataset consists of 20,236 banks and 197,721 observations, which is then trimmed to eliminate multiple outliers, implausible negative values and extreme outliers; more on this below. In Bankscope, the number of observations on holdings of government securities is about one-half of the observations on holdings of total securities. Given that the simple correlation coefficient between the two series is relatively high (66 percent), we take total securities as a proxy of government securities with the largest dataset and then check the robustness of our results employing government securities with a narrower dataset.

We emphasize three results. The first is the strong loans-to-securities substitution, which is broadly consistent with the recent findings by Becker and Ivashina (2014) who estimate the substitution effects from the viewpoint of financially unconstrained firms that have access to both the loan and corporate bond markets.[3] The second is that securities are more sensitive than loans to changes in total assets, implying that a de-leveraging process reinforces the substitution of securities for loans occurring during a crisis. The third is that banks, in their decisions to readjust the composition of their assets and the overall regulatory credit risk, are sensitive to variables that are of interest to the regulator. The latter faces trade-offs between systemic risk reduction and public debt financing, as well as the desire to dampen business cycle fluctuations. Some of the variables of interest to the regulator are directly observable while others are not. Given that regulator's decisions are taken jointly, we introduce only one general proxy of 'variables of interest to the regulator', which impacts on bank's behavior directly to capture the observable component, and interactively with other explanatory variables to capture the unobservable moral suasion component. Our general proxy is the ratio of the value of sovereign debt to national GDP. We obtain that the asset allocation process favors securities, which is consistent with findings of risk-shifting behavior (as in Acharya and Steffen 2013, Drechsler et al. 2013) and/or moral suasion (as in Battistini et al. 2014).

The structure of the paper is as follows. Section II presents our empirical strategy and testable hypotheses. Section III deals with data and descriptive statistics. We present and

[3] It is also consistent with some of the literature reviewed above, such as Bofondi et al (2013), Popov and Van Horen (2013), and De Marco (2014).

discuss our empirical findings in Section IV and their robustness in Section V. The last section of the paper sums up the salient findings, their policy implications and themes for future research.

II. EMPIRICAL SPECIFICATION

Our empirical specification consists of two simultaneous equations, one explaining gross loans and the other total securities, as a function of demand conditions, supply constraints, and the influence of the country's bank regulator. Banks exploit market demand to seize profitable opportunities, but face supply constraints resulting from the limitations of their financial structure. The sensitivity of bank loans and securities to demand shocks is used as a measure of the bank's ability to seize market opportunities (Gomez Meja et al. 2007). In light of the fact that revenue-oriented strategies are inherently risky, the regulator sets rules to reduce systemic risk (for our purposes we concentrate on credit risk) and to limit the degree of moral hazard. Rules can be formal and observable and/or informal and unobservable to the market. Capital requirements are an example of a formal and observable rule: banks must adhere to keep a minimum ratio of bank capital to risk-weighted assets, where the weight is positive for bank loans and zero for government securities. The impact of bank inspections and moral suasion on banks' decisions are an example of an informal and unobservable intervention. During economic downturns, the regulator faces a trade-off between systemic risk reduction and public debt financing and dampening the adverse business cycle phase. While public debt is formally set to have a zero credit risk, in reality it is not. Aware of the difference between formal rules and markets' perception, the regulator can use moral suasion to induce banks to alter asset allocation in favor of securities, thus raising the degree of moral hazard in banks. We use the ratio of government debt to GDP as a proxy of the observable indicator that is of interest to the regulator. This proxy is particularly relevant because it imbeds the moral suasion incentive. The regulator can also influence banks' decisions concerning de-leveraging and asset allocation by being tougher or easier during bank inspections. If he is tougher, he will force banks to make upward adjustments in non-performing loans; the opposite is true if he is more tolerant. Either way, the regulator will affect bank profitability and the level of bank capital, and consequently banks' decisions on de-leveraging and asset allocation. We measure these unobservable variables of interest to the regulator by the interaction of the ratio of government debt to GDP with the asset demand variable and total assets. If the regulator influences banks' behavior through moral suasion and/or bank inspections, we should observe an allocation bias in favor of securities.

The structure of each equation is somewhat reminiscent of the Capital Asset Price Model (CAPM) used in the economics of industrial organization; see Bertrand et al. (2002) and Sraer and Thesmar (2007).[4] There, the firm's sales growth rate depends on the industry's growth rate, firm-specific characteristics and country-specific characteristics. The demand of firm *i* is proxied by industry's sales. Basically, this model is a CAPM applied to quantities instead of prices. This approach has two advantages. The first is a parsimonious use of data, as the demand is determined endogenously exploiting information provided by the dataset. It also reduces the difficulty of integrating alternative datasets with bank accounting data, in particular specific series like bank loans and securities. The second is that the model uses only current variables rather than current and lagged variables. With lagged variables, one faces a higher risk of having missing values and ending up with a selection bias. In sum, our model specification is economical in the use of data and more efficient in handling datasets with many missing values.

[4] Bertrand et al. (2002) use variation in mean industry performance as a source of profit shocks in the single firm to trace the propagation of shocks through a business group. Sraer and Thesmar (2007) estimate a fixed effect model, where single firm sensitivity is identified by the correlation between the changes in log sales and log employment. In both the models, industry shocks provide an ideal candidate to measure firm sensitivity since they affect individual firms but are – to a large extent – beyond their control.

We adapt the industrial organization framework to the banking sector in four ways. First, we replace firm's growth rate of sales with bank's growth rate of loans, L_i, in equation (1) and bank's growth rate of securities, S_i, in equation (2). We expect a positive effect of the home country's market loan growth rate, L_H, on L_i and of the home country's market securities growth rate, S_H, on S_i. Second, we consider the bank supply constraints: the growth rate of total assets, A_i, and the ratio of non-performing loans to total loans, N_i, reflecting cumulative past decisions made by the bank. Third, we add the ratio of government debt to GDP, B_H, as a measure of the country's financial constraint: this is the proxy of the impact that the regulator exercises on the banking system. Fourth, we employ a host of specific control variables, included in vectors X^L in (1) and X^S in (2), which are potentially relevant on banks' decisions concerning bank loans and securities. Finally, u_i and v_i are idiosyncratic error terms. In algebraic terms, the model in linearized form is as follows:

$$L_i = -\alpha_0 S_i + \alpha_1 L_H + \alpha_2 A_i - \alpha_3 B_H - \alpha_4 N_i + \alpha_5 X_i^L + u_i, \qquad (1)$$

$$S_i = -\beta_0 L_i + \beta_1 S_H + \beta_2 A_i + \beta_3 B_H + \beta_4 N_i + \beta_5 X_i^S + v_i. \qquad (2)$$

Coefficients are defined to be positive; so the directional impact of the RHS variable on the LHS is given by the sign preceding the coefficient. All variables are measured at time t, but the time subscript is omitted for brevity. Equations (1) and (2) are interdependent by virtue of the cross-quantity effects: S_i in (1) and L_i in (2). Risk reduction can occur either by a decline of total assets for a given equity value, or through loans-to-securities substitution for a given amount of total asset. We call the first strategy de-leveraging (or size effect): risk reduction, in the strict sense of raising the ratio of equity to risk-weighted assets, is achieved if the response of the 'safer' asset to a decline in total assets is larger than the response of the ‘riskier’ assets. The adjectives ‘safer’ and ‘riskier’ assets are defined by the regulator: government securities are ‘safer’ and loans are ‘riskier’. We call the second strategy de-risking (or substitution effect): risk reduction is achieved by a portfolio re-allocation from ‘riskier’ to ‘safer’ assets, for a given amount of total assets. The two strategies are complementary.

To reduce systemic risk, regulators set observable time-invariant rules (e.g., capital requirements) aimed at preventing bank insolvency. But, as we have noted, regulators also use discretionary power to enforce largely unobservable time-varying rules, which better exploit the changing trade-off over the business cycle between bank credit growth and bank safety. We assume that banks adopt a pecking order when coping with a riskier environment, such as selling assets in preference of raising more costly capital (Hyun and Rhee 2011) and reallocating assets in preference of reducing total assets that would entail capital losses from the sale of illiquid assets. The higher flexibility of the reallocation strategy avoids the realization of losses while gambling for a resurrection of the market value of the unsold assets. On the other hand, a reallocation strategy is more complex and takes more time than a total asset reduction and may not be a viable option when the required risk reduction is intense and fast.

The regulator affects bank strategies through unobserved rules, a sort of latent variables in the model. We assume that the sovereign debt-to-GDP variable, B_H, is of direct concern to the regulator. By interacting B_H with market demand, L_H, and the growth of total assets, A_i, we can infer the influence that regulator’s informal rules exert on loans and securities growth rates; see the following two equations:

$$L_i = -\alpha_0 S_i + \alpha_1 L_H + \gamma_1 L_H B_H + \alpha_2 A_i + \phi_1 A_i B_H - \alpha_3 B_H - \alpha_4 N_i + \alpha_5 X_i^L + u_i, \quad (3)$$

$$S_i = -\beta_0 L_i + \beta_1 S_H + \lambda_1 S_H B_H + \beta_2 A_i + \mu_1 A_i B_H + \beta_3 B_H + \beta_4 N_i + \beta_5 X_i^S + v_i. \quad (4)$$

Using (1) and (2) we can test several hypotheses. The first is that loans and securities are not substitutable, namely $H1_0$: $-\alpha_0 = -\beta_0 = 0$, against the alternative that they are, $H1_a$: $-\alpha_0 < 0$ and $-\beta_0 < 0$. The second is that changes in total assets affect proportionally L_i and S_i, namely $H2_0$: $\alpha_2 = \beta_2 = 1$, against the alternative hypothesis that asset reallocation favors securities, i.e., $H2_a$: $\alpha_2 < \beta_2$. The third deals with the regulator and his potential influence on bank's decisions. Neutrality with respect to government debt implies $H3_0$: $-\alpha_3 = -\beta_3 = 0$, against the alternative of a moral suasion effect on holdings of government securities, $H3_a$: $-\alpha_3 < 0$ and $-\beta_3 > 0$. Finally, using equations (3) and (4), we test whether banks are insensitive to the variables that are of direct interest to the regulator captured by the interaction of the sovereign debt variable with market demand and total assets, $H4_0$: $\gamma_1 = \phi_1 = 0$ and $\lambda_1 = \mu_1 = 0$, against the alternative that banks are sensitive to the preferences of the regulator. Table 1 summarizes our testable hypotheses.

[Insert Table 1 here]

III. DATA AND DESCRIPTIVE STATISTICS

Our data sources are Bankscope and the World Economic Outlook of the International Monetary Fund (IMF) covering the period from 2004 to 2012. From Bankscope we have obtained yearly consolidated accounting data for all financial institutions in 43 countries, 34 of which OECD countries and nine developing countries.[5] Several different financial statements may be available for a given bank in a given reporting period (e.g., subsidiaries,

[5] The 34 OECD countries are: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Korea, Iceland, Ireland, Israel, Italy, Japan, Luxemburg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK and US. The nine developing countries are: Brazil, China, Hong Kong, India, Indonesia, Philippines, Russian Federation, Singapore, and Taiwan.

cross-border banks, etc.). This requires that rules must be defined for selecting and merging these statements to obtain a unique time series for each institution.[6] Our initial dataset consists of 197,721 observations and 20,236 banks. The term "bank" include six types of financial institutions: bank holding and holding companies, commercial banks, cooperative banks, investment banks, real estate and mortgage banks, and savings banks. All of them hold loans and securities and can effect both de-leveraging and de-risking strategies. The market growth rate of loans and securities was computed using all financial entities available in Bankscope, rather than the six categories of banks in our sample; this produces a measure of market changes that is independent (and unbiased) of the holder of loans and securities.

Bankscope data contain many anomalies, not only in a statistical sense, but also in an economic sense. We spent a great deal of effort in cleaning the data from three types of anomalies: multiple outliers, implausible negative values, and extreme outliers. The details of our cleaning procedure are in the Data Appendix. Figure 1 shows the impact of our cleaning procedure on the frequency distributions of three critical variables. Gross loans, total securities, and total assets expressed in growth rates resemble a normal distribution, except for evidence of leptokurtosis due to the presence of outliers. A flatter leptokurtic distribution implies a higher variance. The black line in the boxplots shows the range between the inner fences (i.e., between $Q1 - 1.5 * IQ$ and $Q3 + 1.5 * IQ$); the dark grey line the range between the outer fences (i.e., between $Q1 - 3 * IQ$ and $Q3 + 3 * IQ$); and the light grey the range between the maximum and minimum points. The identification of severe outliers can be obtained by difference.

[6] The primary statement is labelled "Institution" by Bankscope. In general, this is a consolidated statement (C1, C2), and only in the few cases where a bank does not publish annual reports on a consolidated basis we use an unconsolidated version (U1). Bankscope has six codes for consolidation (C2, C1, C* and U2, U1, U*), where C indicates a consolidated and U denotes an unconsolidated statement. The extension "2" indicates that both a consolidated and an unconsolidated statement exist for a bank (codes C2 and U2) at some point of time. Accordingly, the codes C1 and U1 indicate that no companion statement exists. C* and U* indicate that additional statements have been filed. This leads to the following seniority ranking of statements filed (assuming that consolidated statements represent the most senior information available): C2\C1 > C* > U1 > U* > U2.

[Insert Figure 1 here]

To give a measure of the impact of the cleaning and selection process on growth rates and on ratios, consider that the maximum value of gross loans and total securities is 1,808,766 and 60,486,568 percent, respectively, before the treatment and 81.76 and 134.57 percent after the treatment. The latter reduces the number of observations considerably, in a range contained between 25 to 75 percent depending on the variable in question; again, refer to the Data Appendix. We test our hypotheses over the larger sample of banks, including the smaller banks that are usually removed from econometric analyses. Further data trimming, while not justifiable statistically, would run the risk of eliminating data with significant economic content.

Panel A of Table 2 presents descriptive statistics after having applied the cleaning procedure.[7] Five points are worth making. The first is that we lose more than two thirds of the observations due to missing values; for example, out of potential 160,963 observations for gross loans and total securities only 54,331 and 52,720 are usable, respectively. The second is that the number of observations for government securities is about one-half of total securities'. The third is that the wide dispersion of these variables and the right-skewness of the frequency distributions (e.g. 2.44 for gross loans, 2.43 for total securities, 2.56 for government securities, and 2.46 for total assets) indicate a further potential problem with outliers. The fourth is that all variables are leptokurtic, in particular gross loans (8.89), total securities (8.69), government securities (9.40), and total assets (8.94). The evidence of leptokurtosis and skewness suggest the use of growth rates to handle normally distributed variables. Finally, dummy variables show that 59 percent of observations come from commercial banks and 43 percent from banks adopting a regulatory accounting standard.

[7] Panel B refers to countries, not banks; there are 344 observations covering 43 countries in an eight-year period; growth rates and computed ratios are not reported for brevity.

These statistics corroborate the prevailing view that the introduction of a new regulatory system during a financial crisis is relatively slow moving.

[Insert Table 2 here]

Panel B of Table 2 presents descriptive statistics for the only country-level variable used in our study, the debt-to-GDP ratio.[8] Also, this ratio shows wide dispersion, right-skewness and leptokurtosis. These statistical phenomena reflect, not only the mix of highly indebted developed countries with lowly indebted developing countries, but also the jump in the debt-to-GDP ratio that has occurred as a result of the financial and sovereign debt crisis.

Figure 2 shows the movement of three critical frequency distributions. For improved visual clarity, we plot the distribution in the pre-crisis year of 2005, in the peak crisis year of 2008, and in the last available year of 2012. The world leverage ratio rises until 2008 and declines during the crisis.[9] But in Europe, one can identify an asymmetry between Northern EU (NEU) countries, where the leverage ratio is continuously decreasing, and Southern EU (SEU) countries, where it is increasing:[10] the expected post-crisis de-leveraging process did not occur in Southern Europe. The asymmetry between NEU and SEU banks is even sharper if we consider the relative movements of gross loans and securities. In SEU, the distribution of gross loans to total assets shifts sharply to the left after the crisis, whereas in NEU it goes in the opposite direction. As to the ratio of securities to total assets, there is a rightward shift in its distribution after 2008, especially in SEU. In sum, after the crisis we observe a general substitution from loans to securities, substitution that is accompanied by a de-leveraging process at the world level and in NEU countries, but not in SEU countries. The latter were boosting their holdings of government debt at the expense of a significant reduction of credit

[8] The source of the data is the World Economic Outlook Database of the IMF.
[9] Leverage is defined as total assets over equity, which is the inverse of equity to total assets shown in Figure 2.
[10] NEU = Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Slovakia, and Slovenia; SEU = Greece, Italy, Portugal, Spain.

to the private sector. This behavior, not only facilitated the absorption of government debt, but also reduced the overall regulatory credit risk.

[Insert Figure 2 here]

IV. MAIN EMPIRICAL FINDINGS

Table 3 presents estimates of two different models: the “benchmark” Model 1 (equations (1)-(2)) and the “interactive” Model 2 (equations (3)-(4)), where the debt-to-GDP ratio interacts with the market demand variable and total assets.[11] In Model 2, we also add the square of the debt-to-GDP ratio to capture potential non-linearity. For each of the two models, we apply two different econometric methods: a panel estimator with bank fixed effects (FE) to capture idiosyncratic institutional features and an instrumental variables (IV) technique to control for endogeneity. There are eight columns, equally divided between the two models. We have data on 5,824 banks for loans and 5,834 for securities and the number of observations ranges from 20,546 to 24,028 depending on the estimation method. We ran both random and fixed effects models but report only the latter based on the Hausman test; however, results are similar for the two models. FEs capture differences not only among banks, but also among countries. The consistently higher R^2 for *Loans* than for *Securities* reflects the intensity of the home bias.

As to the estimated coefficients of the FE models (columns 1 and 2), the elasticity of loans and securities to market demand (Y_H) is positive and is consistent with a CAPM-type model. The relatively low estimated value of beta is due to the incomplete universe of banks (six types) we have drawn from Bankscope. Significantly negative coefficients for the cross-variable (X_i) indicate a strong substitution effect between loans and securities; hence, $H1_0$ is

[11] We do not add time dummies in the empirical specification because macro effects are captured by country-specific market demand. Time dummies would raise statistically the R^2 of the regressions but not in a meaningful way.

rejected. Securities are much more sensitive than loans to the cross-variable. The elasticities relative to total assets (A_i) reject $H2_0$ that banks allocate A_i proportionally between L_i and S_i: securities are more responsive to changes in A_i than loans. The debt-to-GDP (B_H) coefficient is negative on loans and positive on securities, rejecting $H3_0$ that banks are neutral with respect to government debt in favor of the alternative of moral suasion exerted by the regulator and/or risk shifting behavior. The coefficients of the ratio of non-performing loans to total assets (N_i) mimic those of B_H and reinforce the general pattern that risk reduction is achieved by substituting securities for loans (de-risking). A credit squeeze on the private sector is the natural consequence of a financial crisis.

Model 2 adds to the basic specification of Model 1 the interaction of B_H with Y_H and A_i, as well as the B_H non-linearity. The interaction terms capture banks' response to variables of direct interest to the regulator. The evidence is that they do and thus $H4_0$ is rejected (columns 3 and 4). The statistically significant coefficient of B_H^2 suggests the presence of threshold effects already emphasized in the literature (Minea and Parent, 2012; Checherita-Westphal and Rother, 2012; Law and Singh, 2014). Even though its economic impact is relatively small, the novel aspect here is that the curvature for loans is different than that of securities (concave).

As to the IV estimation (columns 5 and 6), the instruments we have used include the exogenous variables of the reduced-form equations (equations (5)-(6) shown in the Appendix) plus the growth rate of deposits, the ratio of liquid assets to total assets, the return on assets and the four bank-characteristic dummies; as such, the specification is in line with what we have done with FE. The difference between IV and FE, in addition to the endogeneity treatment, consists of ten dummies generated from three bank-characteristic categorical variables and 43 country dummies in place of bank fixed effects. In this way, we have a finer control of endogeneity because we use the same dummy variables in both IV stages, whereas bank FE can be only applied only to the second one due to the high number of banks. There is a strong similarity in the findings. In particular, there is confirmation of the much stronger substitution effect of securities for loans than loans for securities. This substitution pattern is reinforced by the larger response of S_i to A_i relative to the response of L_i to A_i. Finally, the biggest impact on asset reallocation originates from the debt-to-GDP ratio: it is positive on securities and negative on loans and through the interactive terms it is stronger on securities than on loans. Over the entire period, B_H has reduced loans by 13.4 percentage points and raised securities by 21.2 percentage points, for a net reallocation towards securities of about 35 percentage points.

[Insert Table 3 here]

In Table 4, we replace total securities with government securities. The number of observations, as mentioned above, drops by approximately one-half in relation to Table 3. Coefficient signs and their statistical significance, with a few exceptions, remain the same as those of Table 3.[12] The relative order of magnitudes of the coefficients and the explanatory power of the regressions mimic those of Table 3. The net reallocation effect towards securities, over the whole sample period, is about 51 percentage points. The four null hypotheses are rejected in Table 4, as they are in Table 3. In fact, there is a such a strong similarity between the two tables to suggest that government securities and total securities can proxy for each other, thus justifying our decision to rely on total securities to exploit a larger sample.

In Table 5, we replace banks of all types with large banks, where large is defined being above the country-level median value of banks' average total assets. Again, we note a strong similarity between the two tables: coefficient signs, their statistical significance,

[12] One difference between the two tables refers to the interaction between Y_H and B_H in the FE regression of Model 2, which is positive and statistically significant in Table 4 but not in Table 3. Another difference is that the coefficient of N_i is negative and statistically significant for securities under IV in Table 4.

relative order of magnitudes, and explanatory power of the regressions are extremely close.[13] The inference is that large banks are not that different from other banks. In sum, the conclusions reached with the large sample that includes all banks and total securities hold for smaller samples that either use government securities and all banks or large banks and total securities.

[Insert Tables 4 and 5 here]

V. ROBUSTNESS

To check the robustness of our results, we run several econometric exercises. The first is to apply a quantile regression on median values (LAV = least absolute values) to mitigate the noted outlier problem, as well as a quantile regression applied to reduced-form equations to address simultaneously the outlier and endogeneity problems;[14] see Table 6. For this, we could not use the far too numerous bank dummies, and replaced them with an assortment of dummies that tried to capture bank characteristics, such as whether they were listed, their type of accounting standards, their type of specialization, as well as country dummies (see IV estimates). All of these dummies are jointly and highly significant statistically. LAV regressions confirm the signs and economic impact of the FE regression coefficients (columns 1-2 and 5-6), with two exceptions: the substitution effects are stronger and the positive impact of the non-performing loans ratio on securities is statistically insignificant under FE. For the reduced-form equations of L_i and S_i (columns 3-4 and 7-8), the regressors in the first stage are the right-hand variables side of (5) and (6) plus four dummies that capture the bank characteristics noted in the previous tables. All the signs of the estimated coefficients are consistent with those of the reduced-form equations, except for the cross

[13] One difference between the two tables is that N_i is positive and statistically significant for securities in the IV of Table 5 but not in Table 3.

[14] The presence of outliers could bias standard econometric approaches, particularly when there are, as in our case, many missing and misreported values.

demand variable of Model 2. In Model 1, a one percent increase in the market demand for loans raises L_i by 0.115 percent and lowers S_i by 0.077 percent, whereas a one percent increase in the market demand for securities raises S_i by 0.269 percent and lowers L_i by 0.032 percent; hence, an equal one percent increase in both the market demand for loans and securities shifts banks' portfolio toward securities by 0.11 percent. In Model 2, both cross market demand variables exert a positive impact on assets, but an equal one percent increase in the demand for loans and securities shifts S_i relative to L_i by about 0.04 percent. Total assets have a strong and highly statistically significant effect on loans and securities, the inference being that the direct effect in the own equation dominates the indirect effect in the cross equation. On the other hand, an increase in total assets produces a slightly stronger response in L_i than in S_i, in contrast to the FE estimates.

[Insert Table 6 here]

The second exercise tests Model 1 over the crisis period (2009-2012), the sub-sample of EU countries over the entire period, and the sub-sample of large EU banks also over the entire period; see, respectively, columns 1-4, 5-8, and 9-12 of Table 7. In the crisis period, the debt-to-GDP ratio has a smaller negative impact on loans than in the entire period in both FE and IV models. The material changes in the securities equation occur in the substitution effect and in response to market demand. The former goes from -0.548*** to -0.279*; the latter from .224* to .547***. The implication is that during the crisis period securities have been more responsive to changes in market demand and less responsive to changes in loans. These patterns are what we would have expected and are in sympathy with one of the main results of our study: a deep financial crisis penalizes credit to the private sector.

In comparing the world with EU countries and using the IV estimates, one striking difference is the much larger impact of the debt-to-GDP ratio on securities in the EU (0.50***) than in the world (0.13***), a result suggesting that moral suasion may have been more prevalent in Europe than elsewhere. For large EU banks, the coefficient rises even further (0.85***), suggesting that a regulator may exert even more pressure on the big players. The other difference refers to the larger impact of market demand for securities in EU banks (0.54***) than in the world (0.22***). Both findings are consistent with what transpired from the section on descriptive statistics, where EU banks, but especially SEU banks, accentuated their portfolio re-adjustment towards securities at the expense of credit to the private sector.[15]

The third and final exercise broadens the number of exogenous variables included in the first stage of the IV regressions; see Table 8. The added controls are of two types, macro and micro. The macro control consists of the country's economic growth (real GDP). The micro controls are the ratio of bank's total business to total assets, the number of banks under the same business group and banks' net interest margin. The four controls are first entered one at a time and then as a group.[16] There is a considerable degree of stability in the sign, size, statistical and economic significance of the estimated coefficients and in the explanatory power of the regressions across the table's columns, a reflection that the specification of the IV estimation is robust to potential omitted variables proxied by the four added macro and micro controls.

[Insert Tables 7 and 8 here]

VI CONCLUSIONS

This paper has examined how banks around the world have re-sized and re-allocated their earning assets in response to the subprime and sovereign debt crises. We have focused especially on the interaction between sovereign debt-to-GDP ratio and the bank asset allocation process. After the crisis, we observe a general substitution from loans to securities,

[15] See the relative movements of gross loans and securities in Figure 2.
[16] We experimented with combinations of two and three controls with similar results. We don't report results for brevity.

which is accompanied by a de-leveraging process at the world level and in NEU countries, but not in SEU countries. The latter were boosting their holdings of government debt at the expense of a significant reduction of credit to the private sector. Our econometric findings corroborate that banks have readjusted the composition of their assets and reduced the overall regulatory credit risk by substituting securities for loans. Banks, furthermore, have also been sensitive to those variables that are of direct interest to the regulator, a finding that is consistent with high-debt governments exerting moral suasion on banks to privilege the purchase of government securities over credit to the private sector. The quality of our findings is strengthened by our large dataset. While previous studies have focused on specific institutions, typically large banks, ours encompasses the universe of the available categories of banks; and to our knowledge, this is the first paper to do so. Surprisingly, we find that large banks behave no differently than other banks, suggesting similar strategies in response to the crisis. It also suggests that the regulator has not discriminated among sizes of banks.

As to specific hypotheses, we found strong substitution effects between loans and securities, with the substitution of securities for loans being approximately five times as strong as the substitution of loans for securities. This asymmetric pattern is reinforced by a larger elasticity of securities with respect to total assets than the corresponding loan elasticity. In essence, de-risking and de-leveraging have reinforced one another. The debt-to-GDP coefficient has a negative impact on loans and positive one on securities, rejecting the hypothesis that banks are neutral with respect to the ratio of government debt to GDP in favor of the alternative of a sort of “mutual protection pact” between regulator and regulated banks. The evolution of the debt-to-GDP ratio has the biggest impact on asset re-allocation. EU banks have accentuated their portfolio readjustment towards securities at the expense of credit to the private sector. Finally, during the crisis period 2009-2012, banks have further raised their securities shares in response to changes in market demand, while lowering their securities sensitivity to the growth of loans. These patterns are what we would have expected and are in sympathy with one of the main results of our study: a deep financial crisis penalizes credit to the private sector

Our evidence that banks have effected de-risking by substituting securities for loans reflects the Basel rule that government securities, a significant component of total securities, have been accorded the special status of having a zero weight in the computation of risk-weighted assets. The noted substitution lowers regulatory risk, but not necessarily true economic risk. The obvious policy recommendation would be to align regulatory risk to economic risk, so as to achieve portfolio allocations based on return-risk profiles without the murky considerations of moral hazard and possible mutual protection pacts. On the other hand, strict public-choice considerations suggest that such a change is not likely to occur.

As to plans for future research, we have two extensions in mind. The first is to focus on Eurozone banks and especially on the asymmetry between Northern and Southern regions with a longer and updated period. We expect that financially stressed Southern banks might have adopted more de-risking than de-leveraging to achieve relevant risk reductions, whereas the opposite might have occurred in Northern banks. The second is to examine in further detail how regulators impact on the asset allocation of bank portfolios through the use of risk-weighted assets instead of market measures.

References

Acharya, V.V., Drechsler, I., Schnabl, P. (2014). A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk, *Journal of Finance* (forthcoming), DOI**:** 10.1111/jofi.12206

Acharya, V.V., Steffen, S. (2013). The “greatest” carry trade ever? Understanding Eurozone bank risks, *NBER*, WP 19039.

Adelino, M., Ferreira, M.A. (2014). Bank Ratings and Lending Supply: Evidence from Sovereign Downgrades, available at SSRN: http://ssrn.com/abstract=2376721

Adrian, T., Shin, H.S. (2008). Liquidity and leverage, *Federal Reserve Bank of New York*, available online at http://www.newyorkfed.org/research/staff_reports/sr328.html.

Alessandrini, P., Fratianni, M., Hughes Hallett, A., Presbitero, A. (2014). External imbalances and fiscal fragility in the Euro area, *Open Economies Review*, 25: 3-34.

Angelini, P., Grande, G., Panetta, F. (2014). The negative feedback loop between banks and sovereigns, *Banca d'Italia*, WP 213, January 2014

Battistini, N., Pagano, M., Simonelli, S. (2014). Systemic risk, sovereign yields and bank exposure in the euro crisis, *Economic Policy*, April: 203-251.

Becker, B., Ivashina,V. (2014). Cyclicality of credit supply: Firm level evidence, *Journal of Monetary Economics*, 62:76-93.

Bertrand M., Mehta P., Mullainathan S. (2002). Ferreting out tunnelling: an application to Indian business groups, *Quarterly Journal of Economics*, 117(1):121-148

Billor, N., Hadi, A.S., Velleman, P.F. (2000). BACON: Blocked adaptive computationally efficient outlier nominators, *Computational Statistics & Data Analysis*, 34: 279-29.

Bofondi, M., Carpinelli, L., Sette, E, (2013). Credit supply during a sovereign debt crisis, WP 909, Banca d'Italia, April.

Broner, F., Erce, A., Martin, A., Ventura, J. (2013). Sovereign debt markets in turbulent times: Creditor discrimination and crowding-out effects, NBER Working Paper No. 19676.

Buch, C.M., Carstensen, K., Schertler, A. (2010). Macroeconomic Shocks and Banks' Foreign Assets, *Journal of Money, Credit and Banking*, 42(1):171-188

Checherita-Westphal, C., Rother, P (2012). The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area, *European Economic Review*, 56(7):1392–1405.

De Marco, F., (2014). Bank lending and sovereign debt crisis, Boston College, WP November.

Drechsler, I., Drechsel, Th., Marques-Ibanez, D., Schnabl, Ph. (2013). Who borrows from the lender of last resort?, Working Paper, August.

Fratianni, M., Marchionne, F. (2013). The fading stock market response to announcements of bank bailouts, *Journal of Financial Stability*, 9: 69-89.

Gomez Mejia, L., Haynes, K.T., Nunez, M., Jacobson, K., Moyano, J. (2007). Socio-emotional wealth and business risk in family-controlled firms: evidence from Spanish olive market. *Administrative Science Quarterly*. Q. 52, 106–137.

Hryckiewicz, A. (2014). What do we know about the impact of government interventions in the banking sector. An assessment of various bailout programs on bank behavior, *Journal of International Financial Markets, Institutions and Money*, 32:150–166

Hyun, J.S., Rhee, B.K. (2011). Bank capital regulation and credit supply, *Journal of Banking & Finance*, 35:323–330.

International Monetary Fund (online),World Economic Outlook Database; available at http://www.imf.org/external/pubs/ft/weo/2014/01/weodata/index.aspx

Law, S.H., Singh, N. (2014). Does too much finance harm economic growth? *Journal of Banking & Finance*, 41 (2014) 36–44

Levy, H., Levy, M. (2014). The home bias is here to stay, *Journal of Banking & Finance*, 47:29-40

Merler, S., Pisani-Ferry, J. (2012). Sudden stops in the euro area, *Review of Economics and Institutions*, 3(3):Article 5.

Minea, A., Parent, A. (2012). Is high public debt always harmful to economic growth? Reinhart and Rogoff and some complex nonlinearities, *Association Francaise de Cliometrie*, WP 8.

Popov, A., van Horen, N. (2013). The impact of sovereign debt exposure on bank lending. Evidence from the European debt crisis, *De Nederlandsche Bank*, WP No. 382.

Rousseeuw, P.J., van Driessen, K. (1999). A fast algorithm for the minimum covariance determinant estimator, *Technometrics*, 41:212-223.

Rousseeuw, P.J., van Zomeren, B. (1990). Unmasking multivariate outliers and leverage points (with discussion), *Journal of the American Statistical Association*, 85:633-639.

Sandleris, G. (2014). Sovereign Defaults, Credit to the Private Sector, and Domestic Credit Market Institutions, *Journal of Money, Credit and Banking*, 46(2–3):321-345.

Sraer D., Thesmar D. (2007). Performance and Behaviour of Family Firms: Evidence from the French Stock Market, *Journal of the European Economic Association*, 5(4):709–751.

Table 1: Summary of hypotheses testing

HYP	Name	H_0	H_a
1	Substitution effect	$-\alpha_0 = -\beta_0 = 0$	$-\alpha_0 < 0\ , -\beta_0 < 0$
2	Size effect	$\alpha_2 = \beta_2 = 1$	$\alpha_2 < \beta_2$
3	Neutrality of the government	$-\alpha_3 = -\beta_3 = 0$	$-\alpha_3 < 0\ , -\beta_3 > 0$
4	Demand sensitivity to regulator	$\gamma_1 = \phi_1 = 0$ $\lambda_1 = \mu_1 = 0$	$\gamma_1, \phi_1 \neq 0$ $\lambda_1, \mu_1 \neq 0$

NOTES: HYP = hypothesis number, H_0 = null hypothesis, H_a = alternative hypothesis. Coefficients refer to equations (1)-(4).

Table 2: Descriptive statistics on cleaned Bankscope data

Variables	Mean	St.Dev	Min	Median	Max	Nr.Obs.	Skewness	Kurtosis
PANEL A: Bank-level variables								
Gross Loans (th USD)	889,380	1,351,278	0.27	324,127	7,280,833	54,331	2.44	8.89
Total Securities (th USD)	311,159	507,139	0.03	91,692	2,631,347	52,720	2.43	8.69
Government Securities (th USD)	137,959	235,014	1	37,886	1,253,555	26,846	2.56	9.40
Total Assets (th USD)	1,691,330	2,631,584	38.65	565,254	13,900,000	55,350	2.46	8.94
Total Equity (th USD)	137,490	208,641	7.7	49,005	1,093,173	55,491	2.43	8.78
Total Deposits (th USD)	963,834	1,435,918	0.03	346,714	7,397,910	52,778	2.30	8.07
Impaired Loans (th USD)	40,026	65,885	0.07	9,947	339,115	32,757	2.35	8.30
Liquid Assets (th USD)	223,604	358,711	1	63,600	1,893,717	55,121	2.42	8.70
Coverage Ratio (%)	97.50	50.70	0.01	87.60	311.56	52,693	1.34	5.59
Return on Assets (%)	0.62	0.82	-2.63	0.43	3.98	58,690	0.65	6.09
Listed (dummy)	0.07	0.25	0	0	1	160,963	3.41	12.62
Accounting								
IFRS (dummy)	0.08	0.27	0	0	1	160,963	3.05	10.30
Regulatory (dummy)	0.43	0.50	0	0	1	160,963	0.28	1.08
GAAP (dummy)	0.27	0.44	0	0	1	160,963	1.02	2.05
Specialization								
Holding (dummy)	0.14	0.34	0	0	1	160,963	2.12	5.48
Commercial (dummy)	0.59	0.49	0	1	1	160,963	-0.36	1.13
Cooperative (dummy)	0.12	0.33	0	0	1	160,963	2.28	6.20
Investment (dummy)	0.02	0.15	0	0	1	160,963	6.50	43.26
Real Estate (dummy)	0.01	0.12	0	0	1	160,963	8.08	66.36
Saving (dummy)	0.11	0.32	0	0	1	160,963	2.41	6.85
PANEL B: Country-level variables								
Debt-to-GDP ratio (%)	56.61	37.65	3.68	47.50	238.02	344	1.67	7.58

NOTES: Period: 2005-2012. We use 2004 to compute growth rate (see other tables). Panel A reports descriptive statistics at the bank level: 160,963 observations and 20,236 banks. Panel B reports descriptive statistics at country level: 344 observations and 43 countries.

Table 3: Model 1 and 2 using total securities. Panel (Bank FE) and instrumental variables (IV) estimates.

	Model 1				Model 2			
	FE		***IV***		***FE***		***IV***	
Variables	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X_i	-0.052***	-0.456***	-0.097***	-0.548***	-0.055***	-0.482***	-0.103***	-0.517***
Y_H	0.185***	0.293***	0.121***	0.224***	0.230***	0.297***	0.087***	-0.024
YB_H					-0.0009*	0.0006	0.0004	0.004***
A_i	0.668***	1.001***	0.803***	1.203***	0.580***	0.783***	0.716***	0.983***
AB_i					0.0016***	0.0037***	0.0012***	0.0026***
B_H	-0.134***	0.064***	-0.118***	0.127***	-0.221***	0.084**	-0.205***	0.238***
B_H^2					0.0003***	-0.000	0.0004***	-0.0004***
N_i	-0.687***	0.669***	-0.270***	0.140#	-0.600***	0.626***	-0.226***	0.097
Constant	16.30***	-6.16***	2.94***	-14.39***	19.81***	-7.95***	5.38***	-11.17***
Dummies	Bank	Bank	L/A/S/C	L/A/S/C	Bank	Bank	L/A/S/C	L/A/S/C
Obs.	24,028	23,658	20,546	20,546	24,028	23,658	20,546	20,546
R^2	0.534	0.152	0.607	0.190	0.540	0.161	0.611	0.199
Nr. Banks	5,824	5,834			5,824	5,834		
F^{ALL}	1,068	128.8	545,146	40,201	809.6	139.2	346,540	97,473
$Pr(F^{ALL})>F$	0	0	0	0	0	0	0	0
F^{CTRL}			1,629	1,141			1,525	826.3
$Pr(F^{CTRL})>F$			0	0			0	0
Hausman	1,292	32			756.6	256.4		
$Pr(H)>chi^2$	0	0			0	0		

NOTES: Model 1 consists of equations (1) and (2) in the text. Three hypotheses are tested: substitution effect, size effect, and government neutrality (see Table 1). Model 2 consists of equations (3) and (4) in the text. Four hypotheses are tested: substitution effect, size effect, government neutrality, and demand sensitivity to regulator (see Table 1). All of them are rejected. FE = (bank) Fixed Effects model with robust standard errors; IV = Instrumental Variables with robust standard errors. Y_i is the dependent variable (i.e. loans or securities). X_i is the cross variable, that is securities for the loan equation and loans for the securities equation. Y_H and X_H is the sum of Y_i and X_i at the country level. L = listed (dummy); A = accounting standards (dummies); S = specialization (dummies); C = country (dummies). F^{ALL} = overall F-test for the regression. F^{CTRL} = F-test for the significance of control dummy variables. H = Hausman test: it compares fixed vs random effects model using the same specification. *** p<0.01, ** p<0.05, * p<0.10, # p<0.15.

Table 4: Model 1 and 2 using government securities. Panel (Bank FE) and instrumental variables (IV) estimates.

	Model 1				Model 2			
	FE		***IV***		***FE***		***IV***	
Variables	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X_i	-0.035***	-0.729***	-0.147***	-1.459***	-0.034***	-0.730***	-0.148***	-1.637***
Y_H	0.238***	0.372***	0.177***	0.341***	0.1003**	0.165**	0.120***	0.139**
YB_H					0.0015***	0.002***	0.0005	0.0021***
A_i	0.707***	1.323***	0.870***	1.940***	0.632***	1.092***	0.774***	1.752***
AB_i					0.0006#	0.0021***	0.0009**	0.0031***
B_H	-0.105***	0.113***	-0.059***	0.108***	-0.379***	0.4362**	-0.148***	0.563***
B_H^2					0.0008***	-0.0008*	0.0003**	-0.0012***
N_i	-0.645***	1.074***	-0.252***	-0.1578	-0.487***	0.710**	-0.240***	-0.323**
Constant	17.52***	-13.86***	0.878	-14.93#	36.53***	-36.74**	3.934	-8.891
Dummies	Bank	Bank	L/A/S/C	L/A/S/C	Bank	Bank	L/A/S/C	L/A/S/C
Obs.	10,777	10,894	10,110	10,110	10,777	10,894	10,110	10,110
R^2	0.581	0.108	0.563	0.106	0.588	0.113	0.563	0.104
Nr. Banks	3,224	3,243			3,224	3,243		
F^{ALL}	507.1	82.50	34,985	1,498	935.4	81.27	36324	1669
$Pr(F^{ALL})>F$	0	0	0	0	0	0	0	0
F^{CTRL}			454.7	375.4			368.6	212.4
$Pr(F^{CTRL})>F$			0	0			0	0
Hausman	60.16	55.59			57.87	91.53		
$Pr(H)>chi^2$	0	0			0	0		

NOTES: Model 1 consists of equations (1) and (2) in the text. Three hypotheses are tested: substitution effect, size effect, and government neutrality (see Table 1). Model 2 consists of equations (3) and (4) in the text. Four hypotheses are tested: substitution effect, size effect, government neutrality, and demand sensitivity to regulator (see Table 1). All of them are rejected. FE = (bank) Fixed Effects model with robust standard errors; IV = Instrumental Variables with robust standard errors. Y_i is the dependent variable (i.e. loans or securities). X_i is the cross variable, that is securities for the loan equation and loans for the securities equation. Y_H and X_H is the sum of Y_i and X_i at the country level. *L* = listed (dummy); *A* = accounting standards (dummies); *S* = specialization (dummies); *C* = country (dummies). F^{ALL} = overall F-test for the regression. F^{CTRL} = F-test for the significance of control dummy variables. H = Hausman test: it compares fixed vs random effects model using the same specification. *** p<0.01, ** p<0.05, * p<0.10, # p<0.15.

Table 5: Model 1 and 2 for large banks. Panel (Bank FE) and instrumental variables (IV) estimates.

	Model 1				Model 2			
	FE		*IV*		*FE*		*IV*	
Variables	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X_i	-0.055***	-0.489***	-0.0593	-0.424***	-0.056***	-0.501***	-0.0619	-0.383**
Y_H	0.178***	0.340***	0.134***	0.282***	0.248***	0.3703***	0.104***	0.1268#
YB_H					-0.0014***	-0.0002	0.0003	0.0028**
A_i	0.709***	1.082***	0.756***	1.088***	0.638***	0.960***	0.675***	0.918***
AB_i					0.0014***	0.0022***	0.0012***	0.0021***
B_H	-0.113***	0.076***	-0.113***	0.152***	-0.172***	0.0653	-0.186	0.242***
B_H^2					0.0002***	0.0001	0.0003***	-0.0003**
N_i	-0.789***	0.926***	-0.516***	0.519***	-0.721***	0.94***	-0.452***	0.494***
Constant	13.94***	-7.50***	5.191***	-11.89***	16.18***	-7.66**	7.327	-9.949***
Dummies	Bank	Bank	L/A/S/C	L/A/S/C	Bank	Bank	L/A/S/C	L/A/S/C
Obs.	11,899	11,684	9,817	9,817	11,899	11,684	9,817	9,817
R^2	0.551	0.176	0.607	0.188	0.555	0.179	0.611	0.191
Nr. Banks	2,923	2,927			2,923	2,927		
F^{ALL}	741.2	131.2	467,754	3,644	736.0	103.4	535,576	4154
$Pr(F^{ALL})>F$	0	0	0	0	0	0	0	0
F^{CTRL}			683.6	262.6			606.4	247.6
$Pr(F^{CTRL})>F$			0	0			0	0
Hausman	76.62	112.4			302.8[a]	135.7		
$Pr(H)>chi^2$	0	0			0	0		

NOTES: Model 1 consists of equations (1) and (2) in the text. Three hypotheses are tested: substitution effect, size effect, and government neutrality (see Table 1). Model 2 consists of equations (3) and (4) in the text. Four hypotheses are tested: substitution effect, size effect, government neutrality, and demand sensitivity to regulator (see Table 1). All of them are rejected. FE = (bank) Fixed Effects model with robust standard errors; IV = Instrumental Variables with robust standard errors. Y_i is the dependent variable (i.e. loans or securities). X_i is the cross variable, that is securities for the loan equation and loans for the securities equation. Y_H and X_H is the sum of Y_i and X_i at the country level. L = listed (dummy); A = accounting standards (dummies); S = specialization (dummies); C = country (dummies). F^{ALL} = overall F-test for the regression. F^{CTRL} = F-test for the significance of control dummy variables. H = Hausman test: it compares fixed vs random effects model using the same specification. a) both (co)variance matrices are based on disturbance variance estimate from efficient estimator because the standard Hausman test is not available. *** p<0.01, ** p<0.05, * p<0.10, # p<0.15.

Table 6: Robustness: outliers and endogeneity with outliers. Quantile regressions (median LAV)

	Model 1				Model 2			
	LAV(HS)		***LAV - Reduced Form***		***LAV(HS)***		***LAV - Reduced Form***	
Variables	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X_i	-0.081***	-0.744***			-0.080***	-0.735***		
X_H			-0.032***	-0.077***			0.080***	0.0979*
XB_H							-0.002***	-0.004***
Y_H	0.091***	0.184***	0.115***	0.269***	0.122***	0.133***	0.125***	0.304***
YB_H					-0.0004*	0.0010*	-0.0003	-0.0002
A_i	0.915***	1.484***	0.787***	0.668***	0.874***	1.325***	0.713***	0.381***
AB_i					0.0005***	0.0019***	0.0009***	0.0043***
B_H	-0.087***	0.068***	-0.106***	0.120***	-0.162***	0.151***	-0.215***	0.265***
$B_H{}^2$					0.0003***	-0.0003***	0.0004***	-0.0006***
N_i	-0.251***	0.0752	-0.307***	0.155***	-0.201***	0.0211	-0.229***	0.144*
Constant	2.30***	-15.99***	3.83***	-21.20***	3.25***	-15.41***	4.70***	-20.28***
Dummies	L/A/S/C	L/A/S/C	L/A/S/C	L/A/S/C	L/A/S/C	L/A/S/C	L/A/S/C	L/A/S/C
Obs.	24,028	23,658	25,948	24,284	24,028	23,658	25,948	24,284
R^2	0.454	0.141	0.397	0.089	0.456	0.143	0.401	0.097
F^{ALL}	872.2	68.52	623.2	37.25	942.1	86.01	705.0	50.84
$Pr(F^{ALL})>F$	0	0	0	0	0	0	0	0
F^{CTRL}	28	12.99	27.11	13.58	26.76	11.63	27.18	12.43
$Pr(F^{CTRL})>F$	0	0	0	0	0	0	0	0

NOTES: Model 1 consists of equations (1) and (2) in the text. Three hypotheses are tested: substitution effect, size effect, and government neutrality (see Table 1). Model 2 consists of equations (3) and (4) in the text. Four hypotheses are tested: substitution effect, size effect, government neutrality, and demand sensitivity to regulator (see Table 1). All the hypothesis are rejected. LAV = Least-Absolute-Value model (quantile regressions on median) using the Hall-Sheather bandwidth (same results using the Chamberlain bandwidth). Y_i is the dependent variable (i.e. loans or securities). X_i is the cross variable, that is securities for the loan equation and loans for the securities equation. Y_H and X_H is the sum of Y_i and X_i at the country level. L = listed (dummy); A = accounting standards (dummies); S = specialization (dummies); C = country (dummies). F^{ALL} = overall F-test for the regression. F^{CTRL} = F-test for the significance of control dummy variables. *** p<0.01, ** p<0.05, * p<0.10, # p<0.15.

Table 7: Robustness: Panel (Bank FE or RE) and Instrumental Variables (IV) estimates for subsample 2009-2012, EU Countries, and large EU banks. Model 1.

	Subperiod 2009-2012				EU Countries				Large EU Banks			
	FE		***IV***		***FE***		***IV***		***RE***	***FE***	***IV***	
VARIABLES	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities	Loans	Securities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
X_i	-0.047***	-0.455***	-0.121***	-0.279*	-0.049***	-0.514***	-0.156***	-0.963***	-0.084***	-1.098***	-0.154***	-0.903***
Y_H	0.218***	0.534***	0.103***	0.547***	0.251***	0.626***	0.248***	0.543***	0.328***	0.763***	0.285***	0.552***
A_i	0.577***	1.065***	0.762***	1.076***	0.592***	1.084***	0.842***	1.646***	0.792***	1.681***	0.943***	1.825***
B_H	-0.085***	-0.0016	-0.050***	0.141***	-0.345***	0.469***	-0.160***	0.503***	-0.089***	0.341**	-0.128**	0.853***
N_i	-0.252**	0.948***	-0.225***	0.1229	-0.2118	0.838***	-0.111*	0.1764	-0.373***	0.772#	-0.111#	0.3387
Constant	10.50***	0.4589	5.70***	-10.79***	39.763***	-46.36***	7.65	-28.06**	14.52***	-36.84**	-17.12**	-123.74***
Dummies	Bank	Bank	L/A/S/C	L/A/S/C	Bank	Bank	L/A/S/C	L/A/S/C	Bank	Bank	L/A/S/C	L/A/S/C
Obs.	13,117	12,736	10,943	10,943	5,576	5,558	5,227	5,227	1,712	1,710	1,629	1,629
R^2	0.373	0.150	0.5347	0.1874	0.566	0.230	0.612	0.294	0.705	0.300	0.810	0.353
Nr. Banks	4,957	4,907			1,907	1,906			335	335		
F^{ALL}	254.4	91.14	5,665	1,107	201.0	85.61	13,230	60,293	2,098	79.80	294,706	799.2
$Pr(F^{ALL})>F$	0	0	0	0	0	0	0	0	0	0	0	0
F^{CTRL}			853.2	209.3			151.1	219.7			331.3	78.99
$Pr(F^{CTRL})>F$			0	0			0	0			0	0
Hausman	18.43	144.3			186.4	13.54[a]			6.340	25.50		
$Pr(H)>chi^2$	0.0025	0			0	0.0188			0.274	0.0001		
BPLM									0.390			
$Pr(BPLM)>chi^2$									0.265			

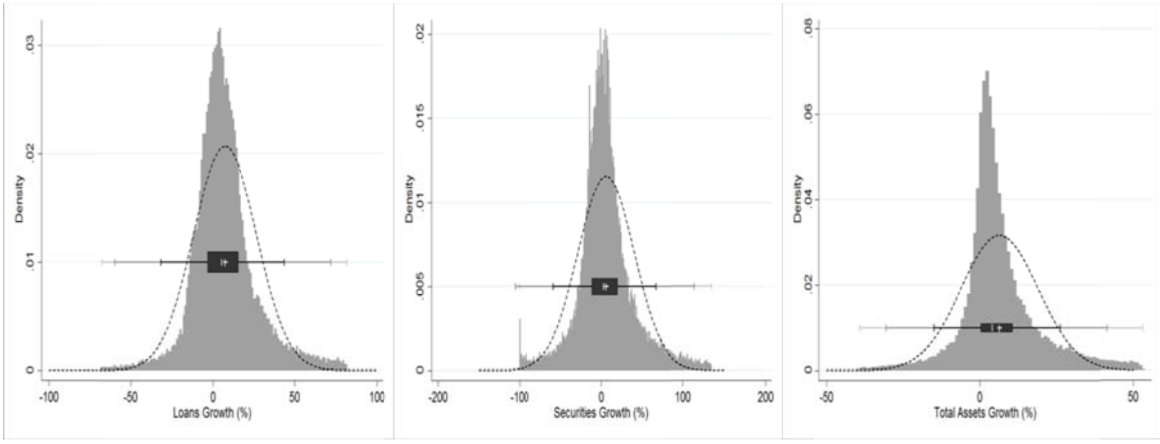
NOTES: Model 1 consists of equations (1) and (2) in the text. Three hypotheses are tested: substitution effect, size effect, and government neutrality (see Table 1 in the text). All the hypothesis are rejected. FE = (bank) Fixed Effects model with robust standard errors; IV = Instrumental Variables with robust standard errors. Y_i is the dependent variable (i.e. loans or securities). X_i is the cross variable, that is securities for the loan equation and loans for the securities equation. Y_H and X_H is the sum of Y_i and X_i at the country level. *L* = listed (dummy); *A* = accounting standards (dummies); *S* = specialization (dummies); *C* = country (dummies). F^{ALL} = overall F-test for the regression. F^{CTRL} = F-test for the significance of control dummy variables. H = Hausman test: it compares fixed vs random effects model using the same specification. a) both (co)variance matrices are based on disturbance variance estimate from efficient estimator because the standard Hausman test is not available. BPLM = Breush-Pagan Lagrange Multiplier test. *** p<0.01, ** p<0.05, * p<0.10, # p<0.15.

Table 8: Robustness: IV with different exogenous variables in stage one.

	VARIABLES	X_i	A_i	B_H	YB_H	AB_i	B_H^2	R^2	WALD-Test	Exog.Vars
					Model 1					
(1)	Loans	-0.095***	0.801***	-0.119***				0.607	545,529	E/-/-/-
(2)	Securities	-0.540***	1.197***	0.128***				0.192	40,143	E/-/-/-
(3)	Loans	-0.087***	0.794***	-0.120***				0.608	548,380	-/B/-/-
(4)	Securities	-0.510***	1.175***	0.133***				0.191	40,054	-/B/-/-
(5)	Loans	-0.088***	0.794***	-0.120***				0.608	548,240	-/-/G/-
(6)	Securities	-0.517***	1.180***	0.132***				0.192	40,078	-/-/G/-
(7)	Loans	-0.085***	0.793***	-0.121***				0.608	548,848	-/-/-/M
(8)	Securities	-0.515***	1.179***	0.132***				0.192	40,074	-/-/-/M
(9)	Loans	-0.092***	0.798***	-0.119***				0.607	546,817	E/B/G/M
(10)	Securities	-0.529***	1.190***	0.130***				0.192	40,114	E/B/G/M
					Model 2					
(11)	Loans	-0.101***	0.715***	-0.204***	0.0004	0.0012***	0.0004***	0.610	347,355	E/-/-/-
(12)	Securities	-0.509***	0.975***	0.243***	0.0040***	0.0026***	-0.0004***	0.199	98,451	E/-/-/-
(13)	Loans	-0.095***	0.711***	-0.207***	0.0005	0.0012***	0.0004***	0.611	349,410	-/B/-/-
(14)	Securities	-0.486***	0.961***	0.249***	0.0041***	0.0026***	-0.0004***	0.198	98,666	-/B/-/-
(15)	Loans	-0.096***	0.712***	-0.206***	0.0005	0.0012***	0.0004***	0.611	349,120	-/-/G/-
(16)	Securities	-0.494***	0.966***	0.247***	0.0041***	0.0026***	-0.0004***	0.198	98,611	-/-/G/-
(17)	Loans	-0.093***	0.710***	-0.207***	0.0005	0.0012***	0.0004***	0.611	350,087	-/-/-/M
(18)	Securities	-0.492***	0.965***	0.248***	0.0041***	0.0026***	-0.0004***	0.198	98,609	-/-/-/M
(19)	Loans	-0.097***	0.713***	-0.206***	0.0004	0.0012***	0.0004***	0.611	348,788	E/B/G/M
(20)	Securities	-0.498***	0.969***	0.246***	0.0040***	0.0026***	-0.0004***	0.198	98,514	E/B/G/M

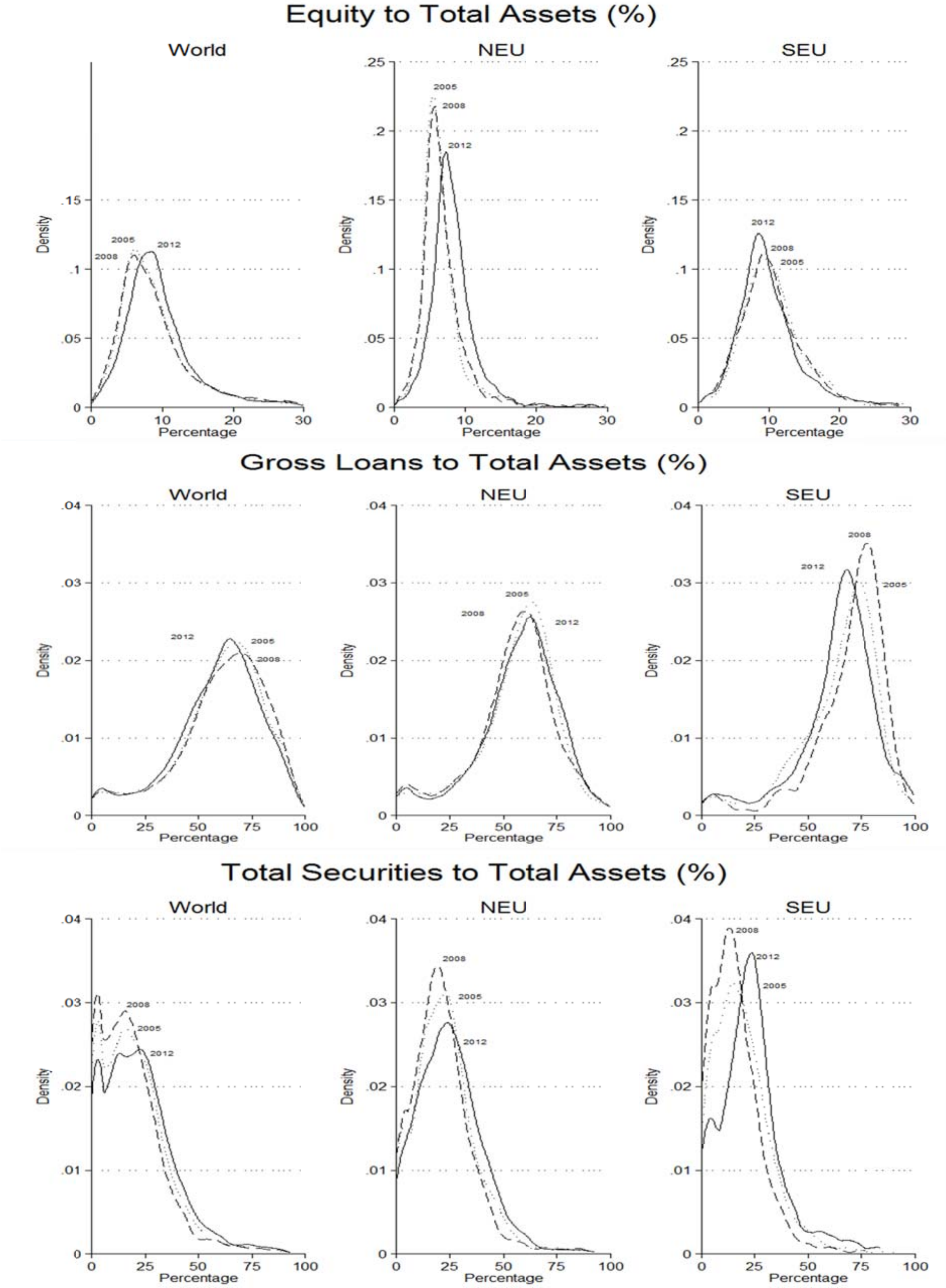
NOTES: IV regressions with robust standard errors. All regressions include Ya, Ai, Ni, Constant, *L* = listed (dummy); *A* = accounting standards (dummies); *S* = specialization (dummies); *C* = country (dummies). The number of observations ranges from 20518 to 20520. Exog.Vars = additional exogenous variables at the Step 1. E = economic growth (%); B = total business to total assets (%); G = banks in the business group (unit); M = net interest margin (%). Robust standard errors. *** p<0.01, ** p<0.05, * p<0.10, # p<0.15

Figure 1: Boxplot and frequency distribution after the cleaning procedures: growth rate of gross loans (%), total securities (%), and total assets (%).



NOTES: Our elaborations on Bankscope data.

Figure 2: De-leveraging and de-risking: World, Northern and Southern EU countries.



NOTES: Our elaboration on Bankscope data. WORLD = all sample countries, NEU = Northern European Union countries, SEU = Southern European Union countries.

DATA APPENDIX

Table A.1: Variable definition and sources.

Variable	Description	Source or Formula
Gross Loans	Total amount of issued credits given to banks during the accounting period (th. USD)	Bankscope
Total Securities	Total amount of securities in bank asset portfolio (th. USD)	Bankscope
Government Securities	Amount of government securities in bank asset portfolio (th. USD)	Bankscope
Total Assets	Total value of all bank current and long-term assets (th. USD)	Bankscope
Total Deposits	The sum of interest and non-interest bearing deposit accounts at a bank (th. USD)	Bankscope
Total Equity	The total amount of common and preferred stock equity of the bank (th. USD)	Bankscope
Liquid Assets	Cash and central bank reserves of the bank (th. USD)	Bankscope
Impaired Loans	The amount for which it is not likely the bank will collect the full value of the loans because the borrowers' creditworthiness is fallen (th. USD)	Bankscope
L_i	Growth rate in percentage of *Gross Loans* at the (individual) bank level (%)	$L_{\mathrm{i}} = \frac{\text{Gross Loans}_{\mathrm{i,t}}}{\text{Gross Loans}_{\mathrm{i,t-1}}} - 1$
L_H	Growth rate in percentage of *Gross Loans* at the (market) country level (%)	$L_{\mathrm{H}} = \frac{\sum_{i \in H} \text{Gross Loans}_{\mathrm{i,t}}}{\sum_{i \in H} \text{Gross Loans}_{\mathrm{i,t-1}}} - 1$
S_i	Growth rate in percentage of *Total Securities* at the (individual) bank level (%)	$S_{\mathrm{i}} = \frac{\text{Total Securities}_{\mathrm{i,t}}}{\text{Total Securities}_{\mathrm{i,t-1}}} - 1$
S_H	Growth rate in percentage of *Total Securities* at the (market) country level (%)	$S_{\mathrm{H}} = \frac{\sum_{i \in H} \text{Total Securities}_{\mathrm{i,t}}}{\sum_{i \in H} \text{Total Securities}_{\mathrm{i,t-1}}} - 1$
A_i	Growth rate in percentage of *Total Assets* at the (individual) bank level (%)	$A_{\mathrm{i}} = \frac{\text{Total Assets}_{\mathrm{i,t}}}{\text{Total Assets}_{\mathrm{i,t-1}}} - 1$
N_i	Ratio of *Non-Performing Loans* to *Total Assets* (%)	$N_{\mathrm{i}} = \frac{\text{Impaired Loans}_{\mathrm{i,t}}}{\text{Total Assets}_{\mathrm{i,t}}}$
B_H	Debt-to-GDP ratio (%)	World Economic Outlook
E_i	Ratio of *Total Equity* to *Total Assets* (%)	$E_{\mathrm{i}} = \frac{\text{Total Equity}_{\mathrm{i,t}}}{\text{Total Assets}_{\mathrm{i,t}}}$
C_i	Loans-to-deposit coverage ratio (%)	$N_{\mathrm{i}} = \frac{\text{Impaired Loans}_{\mathrm{i,t}}}{\text{Total Assets}_{\mathrm{i,t}}}$
D_i	Growth rate of *Total Deposits* (%)	$D_{\mathrm{i}} = \frac{\text{Total Deposits}_{\mathrm{i,t}}}{\text{Total Deposits}_{\mathrm{i,t-1}}} - 1$
Q_i	Ratio of *Liquid Assets* to *Total Assets* (%)	$Q_{\mathrm{i}} = \frac{\text{Liquid Assets}_{\mathrm{i,t}}}{\text{Total Assets}_{\mathrm{i,t}}}$
R_i	Return on Average (Total) Assets (%)	Bankscope
E	Real economic growth rate (%)	World Economic Outlook
B	Ratio of total business to total assets (%)	Bankscope
G	Number of banks in the business group (unit)	Bankscope
M	Net interest margin at the bank level (%)	Bankscope

Data treatment

Our data treatments consists of the following three steps: multiple outliers, implausible negative, and extreme outliers.

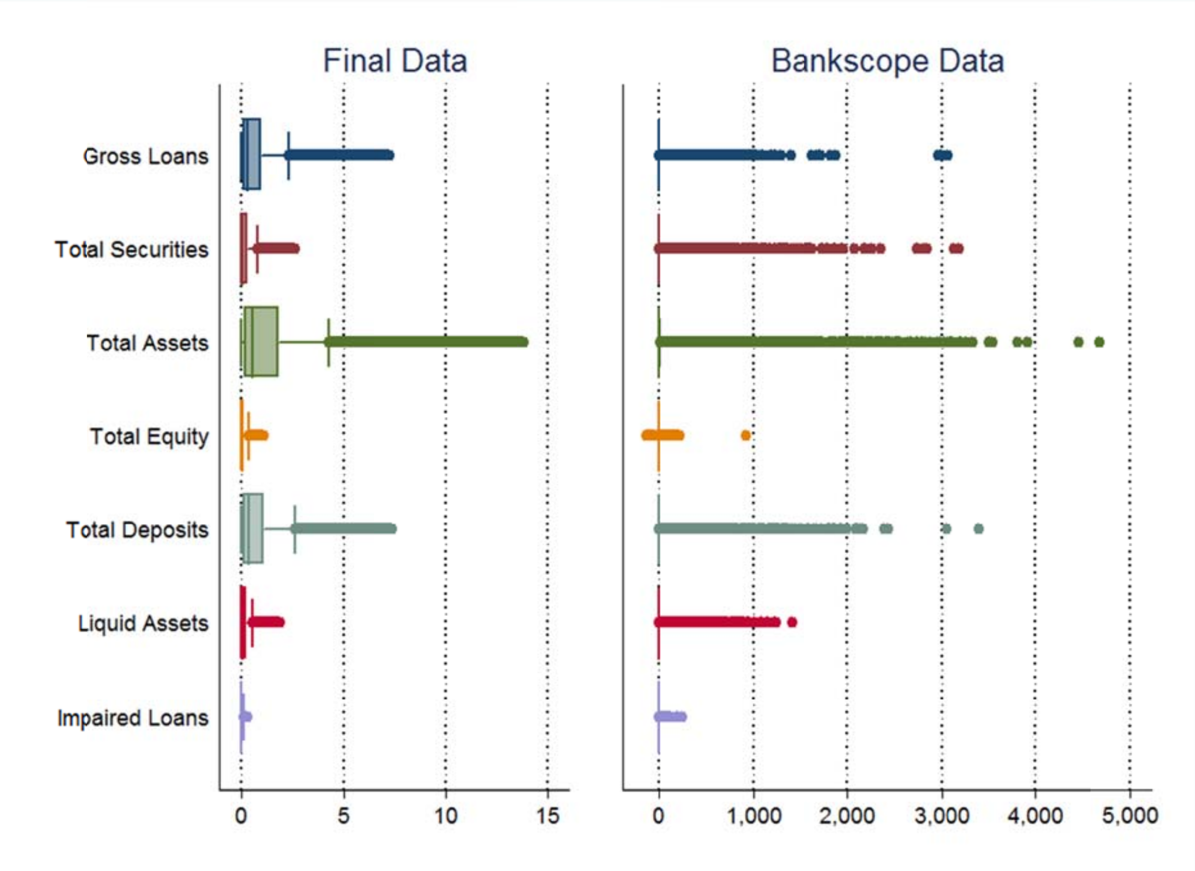
Multiple outliers. We use Billor's et al. (2000) BACON (blocked adaptive computationally efficient outlier nominators) algorithm, which works with iterative estimates and starts with an initial basic subset of "clean" observations and strikes a balance "...between affine equivariance and robustness." Unlike other approaches, this method identifies outliers hidden in the standard 95% confidence interval. Furthermore, it is relatively insensitive to the starting point and detects multiple outliers with a modest computational cost. The identified outliers are treated as systematic errors and the record in which they appear is removed from the dataset because of the contamination risk of the outlier metric.

Implausible negative values (e.g., negative equity value and equity-to-total-assets ratios larger than 100 percent). We replace these anomalies with missing values under the assumption that those observations are idiosyncratic and do not cross correlate with other data entries for the same bank at a given time period. If they were correlated and thus systematic, we would have eliminated the entire record of bank *i* at time *t*. Given that the NEG procedure removes only negative values, the treated distribution accentuates its right skewness, which, in turn, makes it necessary a further detection method to identify right-side outliers.

Extreme outliers. These are defined as $x < Q1 - 3 * IQ$ and $x > Q1 + 3 * IQ$, where *x* is the treated variables, *Q1* = 1st quartile of the frequency distribution, *Q3* = 3rd quartile, and *IQ* = inter-quartile difference. Given that most of our variables have a right-skewed frequency distribution and our treatment of negative values, the inter-quartile difference range procedure (IQR) detects outliers on the right side of the distribution. Again, we consider anomalous values as idiosyncratic errors and in the data are replaced with missing values.

The three steps were first applied to the original variables in level and then to the computed rates of growth and ratios. The only exception is the negative-value correction for growth rates: in this case, the frequency distributions are normal and the inter-quartile differences impact symmetrically on both sides of the distribution. BACON detects 1,165 anomalous records. NEG and IRQ procedures identify a much higher number of outliers for all variables, in particular for our two variables of interest, gross loans (10,344) and total securities (11,841). The selection criterion reduces the sample by 15-20 percent; see the box plots of Figure A.1 for a visual comparison between Bankscope data and final data.

Figure A.1: Boxplot on final data and original data downloaded from Bankscope



NOTES: The order of magnitude of the x-axis scale on the left (Final Data) is 3 digits smaller than that on the right (Bankscope Data). There is a trade-off between data cleaning and the number of observations. The boxplots on Final Data suggest that the outlier problems could be not completely removed. Stricter cleaning criteria would have reduced excessively the number of observations.

APPENDIX ON REDUCED FORM EQUATION OF SYSTEM (1)-(2)

The two reduced-form equations of system (1)-(2) are:

$$L_i = \frac{\alpha_1}{\Delta} L_H - \frac{\alpha_0\beta_1}{\Delta} S_H + \frac{\alpha_2-\alpha_0\beta_2}{\Delta} A_i - \frac{\alpha_3+\alpha_0\beta_3}{\Delta} B_H - \frac{\alpha_4+\alpha_0\beta_4}{\Delta} N_i + \gamma X_i + \varepsilon_i \quad (5)$$

$$S_i = -\frac{\beta_0\alpha_1}{\Delta} L_H + \frac{\beta_1}{\Delta} S_H + \frac{\beta_2-\beta_0\alpha_2}{\Delta} A_i + \frac{\beta_3+\beta_0\alpha_3}{\Delta} B_H + \frac{\beta_4+\beta_0\alpha_4}{\Delta} N_i + \lambda X_i + \delta_i \quad (6),$$

where $\Delta = 1 - \alpha_0\beta_0 > 0$, $\gamma X_i = \frac{\alpha_5}{\Delta} X_i^L - \frac{\alpha_0\beta_5}{\Delta} X_i^S$, $\varepsilon_i = \frac{u_i-\alpha_0 v_i}{\Delta}$, $\lambda X_i = -\frac{\beta_0\alpha_5}{\Delta} X_i^L + \frac{\beta_5}{\Delta} X_i^S$ and $\delta_i = \frac{v_i-\beta_0 u_i}{\Delta}$. The coefficients of L_H and S_H have opposite signs in (5) and (6), the coefficients of B_H and N_i are negative in (5) and positive in (6), and the coefficients of A_i are ambiguous.