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The Design of the Risk-Sensitivity of Capital Requirements: Does it Matter for Bank Business Choices?

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Abstract

By employing cross-country variations in the adoption of the Basel I and II capital Accords, we examine how different designs of the risk-sensitivity of capital requirements influence bank business choices. We show that the move to the Basel II regime has not amplified the trends found for the Basel I Accord in the form of a reduction in total lending growth (asset substitution), and increases in lending risk (cherry picking) and non-interest income activities (activity substitution). In fact, Basel II has led to a reduction in bank exposure to non-interest income and, at least in the case of banks opting for the high risk-sensitive Internal Rating Based (IRB) option within Basel II, decreased lending risk**.** Nevertheless, the adoption of the IRB approach has had the negative consequence of lowering the growth rate of loans to the corporate sector and amplifying its procyclicality.

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Keywords: Bank Capital, Risk-Based Capital Requirements, Procyclicality.

To Emma

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Contents

Chapter I – Introduction

This study employs cross-country variations in the adoption of the first and second Basel Accords across pre- and post-adoption periods to examine how changes in the design of the risk sensitivity of capital requirements affect bank business choices.

Risk-based capital requirements have been a cornerstone of banking regulation since the late eighties when they were introduced with the purpose of safeguarding bank stability (Acharya et al., 2013; Demirgüç-Kunt et al., 2013; Jackson et al., 1999; Vallascas and Hagendorff, 2013). In terms of the different implications that they might generate for bank behavior, the potential impact on bank business choices has attracted particular attention in the academic literature and between policy makers (see for example, Berger and Udell, 1994; Brinkmann and Horvitz, 1995; Furfine, 2000; Haubrich and Wachtel, 1993; Peek and Rosengren, 1995). The attention on bank business choices is not surprising; the allocation of bank funding in favor of borrowers is recognized as playing a pivotal role in ensuring the flow of investments in the economy and is seen as essential for the survival of numerous non-financial firms with consequent implications in terms of output and employment (Hirakata et al., 2011; Levine and Zervos, 1998). Furthermore, bank business choices are also critical to the effectiveness of monetary policy transmission through their effects on bank asset composition (Adrian and Shin, 2009; Ciccarelli et al., 2010).

The initial debate on how capital requirements might influence and distort bank business choices has been built upon the architecture of the first Basel Accord linking the capital endowments of banks to their portfolio risk. This Accord was mainly characterized by higher capital requirements being applied to loans than to other earning assets, and by a lack of differentiation of these requirements in terms of the default probability of borrowers (Dermine, 2014; Gordy, 2003). The key risk associated with capital requirements

was then related to a possible decline in the supply of credit and to potential increases in lending risk.

Over recent years, however, the design of the risk sensitivity of capital requirements has been characterized by significant revisions – culminating in the adoption of the Basel II Accord. While in response to the recent global financial crisis, and the related concerns over bank capital adequacy, (Demirgüç-Kunt et al., 2013; Miles et al., 2012), capital regulation has been further revised, the Basel II Accord still provides the building blocks of the most recent formulation of the capital requirements known as Basel III.

In general, the revisions of capital requirements post Basel I attempt to achieve a much tighter nexus between the amount of capital banks are required to hold and their portfolio risk, with a significant increase in the differentiation of the risk weights within a given asset class – in particular, loans (BIS, 2006; Borio, 2008; Mariathasan and Merrouche, 2014; Ruthenberg and Landskroner, 2008). Furthermore, the revisions introduce the possibility of banks opting for different approaches in quantifying credit risk – ranging from systems based on internal rating models, that ensure the highest risk-sensitivity of capital requirements, to the standardized approach based on the use of regulatory risk weights (Repullo and Suarez, 2004). Therefore, it remains unclear whether the expected effects of capital regulation on bank business choices that have been conventionally identified on the basis of the original Basel Accord remain valid under the revised risk-sensitivity of capital requirements.

In this respect, while theoretical models have highlighted potential differences between the two capital Accords (Repullo and Suarez, 2004; Ruthenberg and Landskroner, 2008), and several studies conducted pre the adoption of Basel II have speculated on its potential effects (Ayuso et al., 2004; Liebig et al., 2007), the empirical literature post-adoption is

surprisingly lacking. This is particularly unfortunate given that an assessment of how different forms of risk-sensitivity of capital requirements influence business choices appears important to the optimal design of capital regulation and to reduce the unattended consequences for the real economy. Furthermore, an understanding of the effects of different forms of risk-sensitivity has become even more pivotal since numerous countries have initiated the process of adopting Basel III (and the related revisions in the risk-sensitivity of capital requirements) from 2013 (BIS, 2013a).

We base our analysis on a unique dataset of the adoption of Basel I and Basel II covering the period from 1988 to 2012 and including 4,595 banks located in 84 countries that we complement with bank-level information on the adoption of the Internal Rating Based (IRB) and the Standardized Approach (SA) for banks complying with Basel II. We construct our empirical tests around the three effects of capital regulation on bank business choices that have been conventionally identified as potentially associated with the original Basel Accord and more generally with capital requirements; namely, substitution between asset classes, cherry picking within the lending policy and activity substitution from interest based to fee based activities.

In terms of the reallocation of resources between asset classes, under Basel I banks might have incentives to reduce lending in favor of increases in other earning assets that impose lower capital requirements (Berger and Udell, 1994) with a consequent decline in the supply of credit that might lead to a credit crunch (Cathcart et al., 2015; Furfine, 2001). Empirical support for this asset substitution effect is offered by Brinkmann and Horvitz (1995), Furfine (2000), Haubrich and Wachtel (1993), and Peek and Rosengren (1995). However, under Basel II, the new design of the risk-sensitivity of capital requirements, and in particular the increasing possibility to optimize the use of bank capital by acting on the

composition of loan portfolio, might reduce the incentives to reallocate resources between broad categories of assets (Furfine, 2001).

Our initial results confirm that Basel I produced significant portfolio adjustments by inducing banks to invest in interest bearing assets that required lower risk weights than loans. Nevertheless, we also show that the decline in loans has not been directed to corporate borrowers suggesting that under Basel I banks have attempted to maintain high yield credit relationships. When we extend the analysis to the adoption of Basel II, we find that in general the new capital regime has not produced additional incentives for banks to implement portfolio adjustments across asset classes. This is especially the case for banks adopting the Standardized approach (SA) that shares similarities with the original Basel I Accord.

For banks adopting the Internal Rating Based (IRB) approach we find, however, some evidence of a decline in credit growth compared to the Basel I regime but only when we focus on corporate lending; namely, on loans that under the IRB approach are expected to generate the highest capital requirements for a given level of borrower default risk. This conclusion is highlighted also by our analysis of the years from 2007 to 2012 that represent a period of extremely high credit risk in the economy. In line with the previous results, we find a significantly larger likelihood to cut corporate lending in banks adopting the IRB approach. In short, taken together, these results suggest that IRB banks have increased their attention to managing the credit risk exposure related to corporate lending with the consequence of amplifying the procyclicality of capital requirements.

We further elaborate on this finding by looking at a second potential effect of capital regulation; namely, cherry picking within the lending policy (Jackson et al., 1999; Jones, 2000). Essentially, this effect is motivated by risk-weights applied to loans that do not

properly reflect borrowers' default risk, thus creating incentives for banks to increase lending to riskier borrowers (Dangl and Lehar, 2004). Our analysis suggests that the adoption of Basel II has produced a significant shift in banking behavior compared to Basel I. More specifically, under the first regulatory regime, banks significantly engaged in cherry picking by increasing credit-risk taking. This has then generated a consequent rise in the net interest margins via an increase in the default risk-premium. By contrast, under Basel II banks adopting the IRB approach have reduced cherry picking and have moved towards safer borrowers. In short, as postulated by the theoretical models proposed by Furfine (2001), Hakenes and Schnabel (2011) and Ruthenberg and Landskroner (2008), these banks have significantly reduced their credit risk-exposure. This confirms again the growing care in managing credit risk by IRB banks.

We conclude our empirical tests by focusing on the third effect typically linked to capital regulation – the activity substitution effect. This effect considers the possibility that banks shift away from interest-based activities to invest in fee-based activities, thus moving in-balance sheet items to off-balance sheet activities, in order to arbitrage risk-based capital regulation (see also Calomiris and Mason, 2004; Jackson and Perraudin, 2000; Krainer and Laderman, 2014). As suggested by DeYoung and Roland (2001), under the Basel I regime this effect is motivated by a favorable regulatory treatment of non-interest income activities. Nevertheless, the regulatory framework of Basel II was aimed at reducing the preferential regulatory treatments of off-balance sheet activities thus generating disincentives to develop non-interest-based activities (BIS 2009, 2013b; Edmonds, 2012; Francis, 2006). Again, we show that the differences between the two regulatory regimes led to changes in bank business choices. In line with the view of DeYoung and Roland (2001), we show that the Basel I regime has indeed favored a significant development of non-interest income activities and the consequent transformation of interest-based risk into fee-

based risk. However, we also find that Basel II has reduced the contribution of non-interest income to total operating income and this is especially the case for IRB banks. Furthermore, we show that this finding is not driven by the revisions in the regulatory treatment of capital requirements for the trading book that some countries have adopted from 2011.

Overall, we show that how regulators design the risk sensitivity of capital requirements is not neutral for the business choices made by banks and might consequently have important effects for the real economy. In this respect, the regulatory framework supporting Basel II, and broadly confirmed under the Basel III Accord, does not amplify the risk of a contraction in the total credit growth and seems to create incentives for a reduction of bank exposure to non-interest income activities. Furthermore, additional potential benefits emerge especially for IRB banks in the form of a reduction of regulatory arbitrage via cherry picking.

However, the IRB approach also amplifies the procyclical nature of capital requirements linked to corporate lending under negative systemic conditions such as the recent global turmoil (Gordy and Howells, 2006). In this respect, our findings point towards aligning the magnitude of the countercyclical capital buffer proposed by Basel III to the type of credit-risk approach used by banks. In short, a higher buffer should be imposed on banks opting for the IRB approach especially if they show a significant exposure towards the corporate sector.

The remainder of the book is organized as follows. Chapter II reviews the literature. Chapter III describes the sample of banks, how we have constructed the dataset on the evolution of capital regulation at the country level, and the econometric model. Chapter IV is our first empirical chapter and reports the results of the impact of regulatory regimes on

bank portfolio adjustments. Chapter V – that is our second empirical chapter – examines the effects produced in terms of cherry picking. Chapter VI is our third and last empirical chapter that focuses on the effects of the Basel I and Basel II regimes on the development of non-interest-income activities. Chapter VII offers additional analyses. Finally, Chapter VIII presents conclusions and elaborates policy implications.

Chapter II – Literature review

2.1 The Basel Capital Accords

The main goal of the first capital Accord, agreed in 1988 (i.e., Basel I), was to require banks to hold capital according to the credit risk exposures of their portfolios. To do so, the Basel Committee on Bank Supervision (BCBS) decided to link regulatory capital requirements to credit risk by assigning assets to one of the four comprehensive risk-weight categories (that we can alternatively call "buckets"), namely 100%, 50%, 20% and 0% for assets carrying high, moderate, low and zero levels of credit risk, respectively. The Basel I Accord also specifies that a bank has to hold at least a total capital corresponding to 8% of its risk-weighted assets – where total risk-weighted assets correspond to the sum of the assets multiplied by the specific weights assigned to each category – thus to meet the minimum risk-based capital standard. Therefore, within the Basel I regime, government securities are considered totally risk-free (as they belong to the 0% risk-weight category). Mortgage-backed securities issued by government-sponsored firms, instead, require a corresponding 1.6% of capital (as they belong to the 20% risk-weight class). In contrast, exposures in commercial loans – irrespective of the borrowers' creditworthiness – require banks to hold a corresponding 8% of capital (as commercial loans are classified into the 100% risk-weight category).

This very simple version of the risk-based capital regulation, commonly referred to as the *one-size-fits-all approach*, raised a number of issues; among which, the possibility for banks to undertake regulatory capital arbitrage such as "cherry picking" (as underlined by Jones, 2000). In fact, given the flat capital requirements characterizing Basel I, banks shift their assets away from good credit quality assets to lower credit quality assets (within a given risk-weight bucket) as the required capital does not vary. Additionally, investing in lower

quality assets ensures a higher net interest margin. Hence, via cherry picking, the overall credit quality of banks' portfolios decreases (because of the greater holdings of lower credit quality assets), without any corresponding change in the amount of regulatory capital banks are required to hold.

Because of these limits arising from the first capital Accord, in 2004 the Basel Committee issued a new set of rules mostly known as Basel II.[1] This new capital framework accentuates a better alignment of regulatory capital standards with the actual risk of bank portfolio assets. Nevertheless, banks are required to hold an 8% capital ratio, as in the 1988 Basel Accord.

The main feature of the Basel II Capital Accord is, therefore, the arrangement of a direct link between capital requirements and debtors' external or internal ratings. To comply with this framework, banks are given the chance to decide whether utilizing a Standardized Approach (SA) or an Internal Rating Based (IRB) method to compute capital requirements for credit risk. The latter, however, can be implemented only upon local authorities' approval.

The Standardized Approach is very similar to the first Basel regime. Assets are gathered into different categories with different risk-weights. In particular, the SA allows the use of external ratings (if they exist) and details the risk-weights for the various classes of rating. For instance, the less risky commercial loans (those rated AAA to AA–) are given a 20% weight, whereas the riskiest commercial loans (those rated below BB–) are weighted 150%. However, when unavailable, the 100% risk weight applies. This is the case, for example, of the external ratings for corporate loans – that are hardly available in most countries. In

[1] After a few amendments, the final version of the Basel II Accord was issued in 2006.

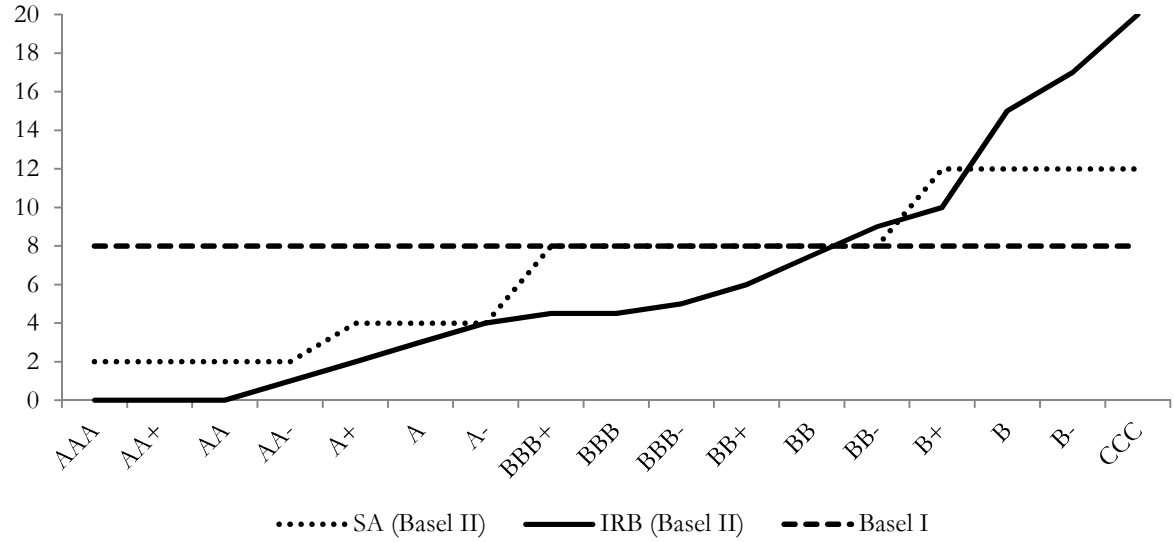
such a situation, since a lack of ratings arises, banks have to utilize the 100% risk-weight – which makes the New Accord very similar to the Basel I regime.

In contrast, the IRB method is mostly characterized by an internal assessment of asset risk. Banks, in fact, are given the possibility to estimate some risk characteristics, like the probability of default, based on internal data. Estimated characteristics, then, are used – following the recommendations of the Basel Committee – as inputs of the risk weight formulas. According to the rules set by the Committee, corporate exposures carry much more risk weights than other retail exposures.

Overall, we have observed that, in Basel II, risk-weights can vary within the same asset category according to borrowers' creditworthiness. Furthermore, within the IRB Approach the capital requirement for safe assets (risky assets) is below (above) the corresponding requirement set by the Standardized Approach. This distinctive feature identifies the IRB method as the more risk-sensitive between the two approaches outlined by the Basel II framework.

In particular, as emphasized by Le Leslé and Avramova (2012), the IRB approach rewards banks with a good risk management. In fact, the risk-sensitivity characterizing this framework (i.e., Basel II–IRB) requires less capital for higher quality assets (compared to the Basel II–SA and Basel I), while increasingly more capital for lower quality activities. Therefore, implementing the more risk-sensitive IRB approach would lead to a considerable reduction of the risk weights. In this regard, Figure 1 – adapted from Le Leslé and Avramova (2012) – shows the differences in the regulatory capital requirements (from Basel I to Basel II) for corporate exposures. Essentially, this figure firstly highlights the risk-insensitivity characterizing Basel I, where the risk weight for corporate exposures is constant and set to 100% – thus to determine an 8% capital requirement.

Figure 1: Percentage of corporate exposures to be held as capital, by rating classes



Source: our adaptation from Le Leslé and Avramova (2012)

Most importantly, Figure 1 also underlines the advantage for IRB implementers to lend to very safe corporate borrowers (particularly to those rated from AA to AAA) because of the corresponding low risk-weights. Additionally, it is worth noting that the risk-weights for IRB banks are lower than the weights applied by SA implementers and, even more, by Basel I adopters. In contrast, IRB banks are discouraged to fund very risky borrowers (for instance, those rated B and even worse) as the related exposures are associated with very high risk-weights that, in turn, imply higher capital requirements. In this case, the necessary capital required to comply with the IRB rules exceeds the one required to comply with the SA regulation and, even more, with the flat-Basel I regime. Hence, given that raising new capital (to comply with capital requirements) is costly, it clearly stands out that the incentive for IRB banks is to implement a good risk management policy.

2.2 Literature Review on Capital Regimes and Asset Substitution

Our study provides several contributions to the existing literature. First, we offer the first attempt to examine how bank portfolio adjustments, via asset substitution, depend on the design of the risk-sensitivity of capital requirements by using information post the adoption of Basel II. Existing studies, to date, have mostly attempted to test for the presence of a credit crunch effect induced by the adoption of Basel I within the US context. With the exception of Berger and Udell (1994), the US based studies suggest that capital regulation has discouraged the growth of lending (Brinkmann and Horvitz, 1995; Furfine, 2000; Haubrich and Wachtel 1993; Peek and Rosengren 1995). More limited is the number of non US-based studies on the impact of Basel I with results that are often in conflict (see Wagster, 1999; and Barajas et al., 2005).

In particular, Berger and Udell (1994), employing a sample of US banks over the years 1979-1992, regress the growth rates of several asset categories (e.g., commercial and industrial loans, real estate loans, treasuries) on a series of variables that proxy for changes in loan demand and on some other regressors that are considered as indicators of financial weakness (the latters including: Tier 1 ratios, total capital as a fraction of risk-weighted assets, leverage ratios, as well as real estate lending and non-performing loans to total loans ratios). Overall, they find that the coefficient values related to some independent variables are inconsistent with the hypothesis that risk-based capital regulation was the origin of the US credit crunch in the early 90s. For instance, they find that the declines in the growth rate of the real estate lending (occurred in the early 90s) were larger for banks with higher capital ratios than for those with lower capital ratios.

Brinkmann and Horvitz (1995), utilizing data on US commercial banks for 1987 and 1991, find that the introduction of Basel I may have incentivized banks to hold a cushion

to meet capital requirements. As a consequence, banks with deficient capital levels decrease loan supply to build the necessary capital cushion. Overall, they find evidence of a significant loan supply contraction upon Basel I implementation.

Furfine (2000) simulates the optimal bank response to changes in capital requirements, shocks to bank capital and changes to bank loan demand, based on a sample consisting of observations on 362 US banks continuously operating from 1989 to 1997. He finds that changes in capital regulation are determinant in explaining the decline in loan growth arisen in the early 90s.

Haubrich and Wachtel (1993) find that the bank portfolio changes affecting the US banks since 1990 were a response to the adoption of Basel I. They, in fact, suggest that the introduction of the risk-based capital requirements led poorly capitalized banks to reconfigure their portfolios, thus moving from high-risk (typically loans) to low-risk and less capital-absorbing (e.g., securities) assets.

Peek and Rosengren (1995), based on a panel data including observations on bank balance sheet and income statement of all large institutions in New England over the period 1989-1992, try to determine whether the implementation of risk-based capital regulation contributed to the well-known credit crunch. They find that the enforcement of those rules led banks to significantly shrink lending – particularly to bank-dependent borrowers.

Wagster (1999) utilizes an international sample of banks from Canada, Germany, Japan, the United Kingdom and the United States over the period 1986-1992. He finds that the effects exerted by the adoption of Basel I vary according to the country where the regulation was implemented. Essentially, while for Germany and Japan, his findings confirm the evidence in Berger and Udell (1994) (i.e., Basel I did not affect lending

growth), for Canada and the UK risk-based capital rules might have been crucial for the drop of credit as a concurrent higher scrutiny of lending standards by regulators was associated to it.

Barajas et al. (2005), based on a unique international data set including 2,893 banks from 152 countries over the period 1987 to 2000, test if the introduction of Basel I was determinant in causing the credit slowdown experienced in Latin American and Caribbean countries. Unlike expected, they find that lending growth increased upon Basel I adoption – meaning that the first Basel Accord was not responsible for the reduction in credit supply.

2.3 Literature Review on Capital Regimes and Lending Risk (Cherry Picking)

Our analysis also extends the empirical evidence on the implications of capital regulation on bank risk-taking via cherry picking. Earlier studies have often assumed a theoretical perspective with a focus on the first capital Accord. In particular, utilizing an option-theoretic model, Flannery (1989) finds that risk-based capital requirements induce higher risk-taking. A similar conclusion is achieved by Gennotte and Pyle (1991), and by Blum (1999).

In particular, Gennotte and Pyle (1991) – working on an option pricing framework – find that increases in capital requirements may be ineffective as they may lead banks to increase asset risk.

Utilizing a dynamic framework consisting of a two-period approach, Blum (1999) shows that a tighter capital regulation may lead to an increase in banks' risk-taking propensity.

This is due to the fact that, since rising new equity to meet higher capital thresholds is too expensive, the bank is induced to increase risk today in order to meet the capital requirements tomorrow.

More recently, theoretical research on Basel II has shown that competition with large banks leads to smaller banks taking higher risks while large banks should focus on safer borrowers (Hakenes and Schnabel, 2011).

Furthermore, differently from our analysis, the existing empirical studies on the risk implications of Basel I (e.g., Konishi and Yasuda, 2004; Rime, 2001) do not focus on risk-taking via the lending policy.

In particular, Konishi and Yasuda (2004) examine the determinants of the banks' risk taking propensity utilizing a sample of Japanese commercial banks between 1990 and 1999. More specifically, they employ five measures of capital market risk, i.e. total risk (that is the standard deviation of the banks' daily stock returns in percentage points), firm-specific risk, systematic risk, market risk, and interest rate risk (these last four measures derive explicitly from a two-index model, as defined by the authors). Overall, Konishi and Yasuda (2004) find that the enforcement of the risk-based capital regulation reduces the risk-taking propensity of banks.

Rime (2001), employing a sample of Swiss banks over the period 1989-1995, analyzes the adjustments in capital and risk by means of a three stage least squares method (3SLS) in order to estimate a simultaneous equation model. He finds that, when banks approach the minimum regulatory capital level, the regulatory pressure leads them to increase capital – without affecting the level of risk.

Similarly, the recent stream of empirical studies on the effects produced by different approaches to measuring credit risk within Basel II have only examined the link between

risk-weighted assets and market measures of bank risk (Vallascas and Hagendorff, 2013) or the impact of the Internal Rating Based System on the value of the risk-weighted assets (Mariathasan and Merrouche, 2014).

Essentially, Vallascas and Hagendorff (2013), utilizing a sample of 246 large banks based in 41 countries over the period 2000-2010, evaluate the relation between bank portfolio risk (measured by asset volatility) and Risk-Weighted Assets (RWA) – the latter representing the minimum amount of capital that banks need to hold against their assets. Their results show a marginal increase in risk sensitivity when banks move to the Basel II regulatory framework.

Utilizing a panel of 115 banks from 21 OECD countries over the period 2004-2010, Mariathasan and Merrouche (2014) study the relation between the ratio of risk-weighted assets-to-total assets and the approval to implement the Internal Rating Based (IRB) Approach of Basel II. They find that risk-weight density decreases upon IRB approval. Additionally, they state that – in line with theories about the manipulation of risk-weights – the decline in the reported riskiness is stronger among those banks with a weaker capital structure.

2.4 Literature Review on Capital Regimes and the Substitution towards Non-Interest Income Activities

Finally, our study is also related to empirical work on the importance of bank and country characteristics for the development of non-interest income activities via activity substitution. In particular, DeYoung and Roland (2001) – employing a sample of 472 US commercial banks between 1988 and 1995 – find that in the US the shift from lending to

non-interest income generating activities arises from a lack of capital regulation (or, say, a lower bank capital strength) that leads banks to arbitrage the risk-based regulation. Using an international sample of 1,334 banks from 101 countries over the period 1995-2007, Demirgüç-Kunt and Huizinga (2010), instead, do not find that the stringency of capital regulation is a significant determinant of the share of non-interest income. Note, however, that the above analysis does not specifically distinguish between the Basel I and Basel II regimes.

Chapter III – Data and Methodology

3.1 The sample of banks

To construct our international sample of banks, we rely on bank-level data provided by BankScope – Bureau van Dijk. This database collects banks' financial statements in a standardized manner, thus favoring reliable cross-country studies (Saunders and Schumacher, 2000). Our dataset contains yearly data on banks' balance sheets and income statements for the period spanning from 1988 to 2012 and focuses on banks whose main activity is lending. Specifically, we maintain in the sample only banks that are classified as commercial, cooperative, savings, and real estate & mortgage banks by BankScope. Furthermore, in order to avoid any duplicate issues related to banks that present both consolidated and unconsolidated statements, and to banks that are consolidated within the balance sheet of another bank, we keep only accounting information from the unconsolidated annual report as in Beck et al. (2013), Fungáčová et al. (2014) and Lepetit et al. (2014). This choice allows us to achieve a more precise assessment of the impact that the adoption of risk-based capital regulation has produced on the composition of bank portfolios since unconsolidated statements do not reflect the activity of the whole banking group. Since this activity can be supranational, it might then reflect the influence of differences in capital regulations across countries. However, we include the consolidated statements when unconsolidated data are not available (Beck et al., 2013; Lepetit et al., 2014).

As suggested by Berger and Udell (1994), a proper estimation of the effects related to the introduction of capital regulation requires data also for the pre-adoption period. Consequently, our sample includes only countries whose bank observations start before the year of adoption. The application of this criterion leads us to maintain in the sample 84

countries. Furthermore, to avoid the risk of an excessive concentration of the sample on a limited number of countries, and especially on the US, for each country we select only banks that, in a given year, are classified among the top 50 largest banking firms and we exclude countries that do not reach a minimum number of observations of at least equal to 90 during the sample period. Finally, similarly to De Haas and Van Lelyveld (2014), we control for the effects of mergers and acquisitions by removing observations where the annual growth in total earning assets exceeds 75%.

The application of the selection criteria described above leads us to a final sample of 47,984 bank-year observations pertaining to 4,595 banks chartered in 84 countries. Table 1 provides the detail of the total observations and the number of banks by country.

Table 1: Sample Distribution by Country

	Banks		Observations	
	Number	**Percentage**	**Number**	**Percentage**
ALGERIA	18	0.39	167	0.35
ARGENTINA	104	2.26	1,065	2.22
AUSTRALIA	74	1.61	598	1.25
AUSTRIA	95	2.07	1,373	2.86
BAHAMAS	41	0.89	217	0.45
BAHRAIN	15	0.33	172	0.36
BELGIUM	86	1.87	966	2.01
BOLIVIA	18	0.39	216	0.45
BOTSWANA	12	0.26	121	0.25
BRAZIL	117	2.55	1,058	2.20
BULGARIA	32	0.70	325	0.68
CANADA	97	2.11	909	1.89
CHILE	39	0.85	519	1.08
CHINA	99	2.15	967	2.02
COLOMBIA	55	1.20	483	1.01
COSTA RICA	63	1.37	508	1.06
CROATIA	57	1.24	569	1.19
CYPRUS	27	0.59	245	0.51
CZECH REPUBLIC	39	0.85	385	0.80
DENMARK	86	1.87	1,179	2.46
DOMINICAN REPUBLIC	73	1.59	536	1.12
ECUADOR	39	0.85	392	0.82
EGYPT	33	0.72	556	1.16
ETHIOPIA	10	0.22	113	0.24
FINLAND	24	0.52	181	0.38
FRANCE	171	3.72	1,725	3.59
GERMANY	137	2.98	1,990	4.15
GHANA	25	0.54	224	0.47
GREECE	31	0.67	368	0.77
GUATEMALA	39	0.85	461	0.96
HONG KONG	48	1.04	651	1.36
HUNGARY	48	1.04	430	0.90
ICELAND	23	0.50	138	0.29
INDIA	74	1.61	1,204	2.51
INDONESIA	116	2.52	1,041	2.17
IRELAND	44	0.96	352	0.73
ISRAEL	19	0.41	250	0.52
ITALY	138	3.00	1,534	3.20
JAPAN	83	1.81	1,437	2.99
JORDAN	12	0.26	203	0.42
KENYA	52	1.13	532	1.11
KUWAIT	8	0.17	106	0.22
LEBANON	63	1.37	831	1.73
LUXEMBOURG	109	2.37	1,321	2.75
MALTA	12	0.26	114	0.24
MAURITIUS	18	0.39	172	0.36
MEXICO	61	1.33	503	1.05
MOROCCO	18	0.39	195	0.41
NAMIBIA	8	0.17	95	0.20
NETHERLANDS	79	1.72	711	1.48
NEW ZEALAND	26	0.57	224	0.47
NIGERIA	76	1.65	477	0.99
NORWAY	79	1.72	878	1.83
OMAN	13	0.28	157	0.33
PAKISTAN	30	0.65	396	0.83
PANAMA	114	2.48	841	1.75
PARAGUAY	29	0.63	251	0.52
PERU	31	0.67	284	0.59
PHILIPPINES	59	1.28	580	1.21
POLAND	71	1.55	656	1.37
PORTUGAL	47	1.02	499	1.04
QATAR	6	0.13	91	0.19
REPUBLIC OF KOREA	37	0.81	381	0.79
RUSSIAN FEDERATION	155	3.37	1,181	2.46
SAUDI ARABIA	11	0.24	206	0.43
SINGAPORE	26	0.57	263	0.55
SLOVAKIA	26	0.57	254	0.53
SLOVENIA	34	0.74	320	0.67
SOUTH AFRICA	33	0.72	306	0.64
SPAIN	124	2.70	1,362	2.84
SRI LANKA	18	0.39	196	0.41
SWEDEN	68	1.48	640	1.33
SWITZERLAND	136	2.96	1,577	3.29
THAILAND	29	0.63	409	0.85
TUNISIA	17	0.37	277	0.58
TURKEY	56	1.22	452	0.94
UNITED ARAB EMIRATES	20	0.44	313	0.65
UNITED KINGDOM	139	3.03	1,498	3.12
UNITED STATES OF AMERICA	112	2.44	1,201	2.50
URUGUAY	48	1.04	331	0.69
VENEZUELA	63	1.37	442	0.92
VIETNAM	49	1.07	378	0.79
YEMEN	7	0.15	103	0.21
ZAMBIA	17	0.37	152	0.32
Total	**4,595**	**100.00**	**47,984**	**100.00**

3.2 The capital regulation database

We compile our database on the adoption of Basel I and Basel II at the country level by gathering information from various sources that we describe in detail in Appendix A. We employ the collected information to generate two dummy variables that are a key part of our empirical analysis. The first dummy (**Basel I**) is equal to one from the adoption of the Basel I capital Accord in a given country and zero otherwise; while a second dummy (**Basel II**) is equal to one when a country has switched to the Basel II capital Accord and zero otherwise.

Panel A of Table 2 displays the sample distribution according to the capital adequacy regime. Approximately 11% of our sample, equivalent to a total number of 5,241 observations, corresponds to a period without risk based capital requirements – a reasonable control group with respect to the adoption of any risk-based regime. Approximately 70% of our sample falls within the first Basel Accord, while approximately 19% is made up of observations falling under the Basel II regime – this allows us to draw conclusions on the impact of this second capital adequacy regime on bank behavior.

Table 2: Sample Distribution by Capital Requirements

Panel A: Sample Distribution by Capital Requirements

		Number		Percentage	
No Capital Requirements		5,241	5,241	10.92	10.92
Capital Requirements	Basel I	42,743	33,776	89.08	70.39
	Basel II		8,967		18.69
Total		47,984	47,984	100.00	100.00

Panel B: Sample Distribution by Basel II

		Number		Percentage	
Basel II (*missing obs.*)		4,301	4,301	47.97	47.97
Basel II (*detailed obs.*)	Basel II – SA	4,666	3,294	52.03	36.73
	Basel II – IRB		1,372		15.30
Total		8,967	8,967	100.00	100.00

Under Basel II banks can opt for different approaches to measure the capital requirements of the loan portfolio; the Internal Rating Based (IRB) approach links the regulatory risk weights directly to the borrower's probability of default, while the Standardized Approach (SA) maintains more similarities with the Basel I regime. To test how the different risk-sensitivity between the two approaches impacts on bank behavior, we inspect the annual reports of the sampled banks to identify whether a bank has chosen the IRB or the standardized option. We find the required data for a sub-sample of 1,022 banks chartered in 49 countries – covering 52% of the bank-year observations falling into the Basel II era.

As highlighted in Panel B of Table 2, our sample includes 3,294 bank-year observations of banks using SA and 1,372 bank-year observations of banks adopting IRB. To the best of our knowledge, this is the most extensive dataset available with such detailed data on Basel II. We employ the additional information on the approach employed by Basel II banks to create a **Basel II–SA** dummy that takes the value of one during the years in which banks employ SA and a **Basel II–IRB** dummy equal to one during the years in which banks opt for the IRB approach.

Figure 2: Basel I Adoption – Timeline

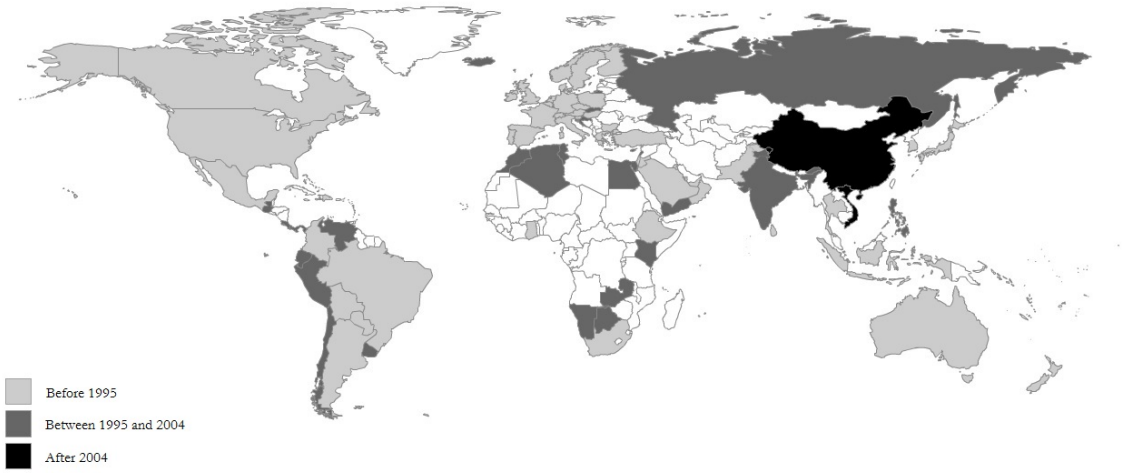
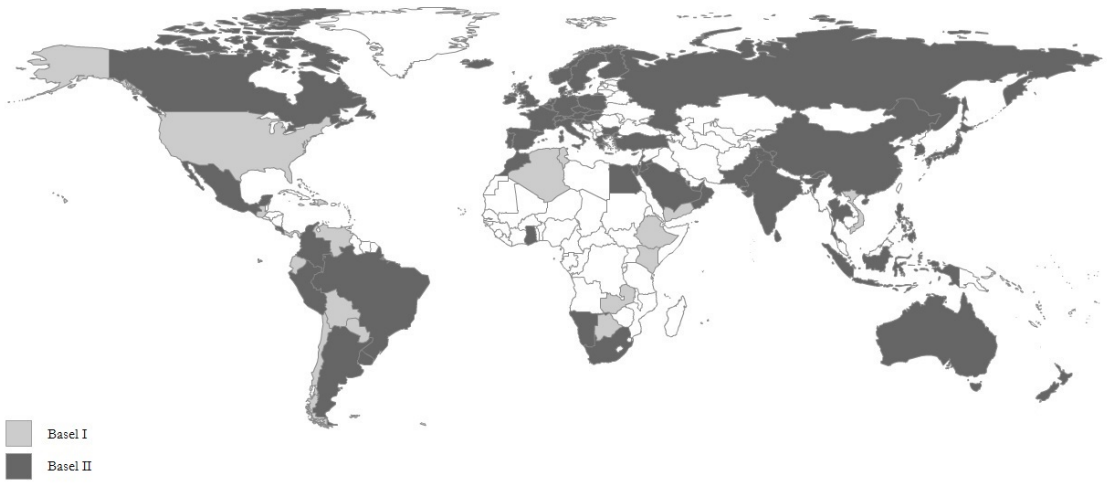


Figure 2 shows a geographical map of the distribution of our sample by year of adoption of Basel I. Early Basel-adopter countries (before 1995) are highlighted with light shading and include most of the Western nations that complied with the risk-based capital regulation early on, namely since 1992, and a reasonable number of South-American territories. Countries that adopted Basel I between 1995 and 2004 are highlighted in darker shading. This group includes large countries such as India and Russia that have adopted risk-based capital requirements respectively in 1995 and 1996, and some other countries which contribute to our analysis with a relevant number of bank-year observations, such as Lebanon and Panama that adopted Basel I in 1995 and 1998, respectively. Finally, late adopters are highlighted in black and include countries moving to a risk-based capital regime only from 2005 onwards – such as Vietnam and China (Basel I was put into force in China in 2006).[2]

Figure 3: State of Basel Accords Adoption – as of December 2012



[2] It is worth noting that while the New Capital Rules (NCR) issued by the China Banking Regulatory Commission (CBRC), and broadly consistent with the Basel I Accord, took effect on April 1st 2004, the final deadline for compliance was set at the end of 2006 (Brehm and Macht, 2004). This has motivated our choice to use 2006 as the year of effective adoption of Basel I by Chinese banks. Nevertheless our results remain unchanged if we employ 2004 as the year of adoption of Basel I in China.

Finally, Figure 3 provides an overview of the capital adequacy regimes adopted in the countries belonging to our sample as of December 2012. Countries with dark shading represent those adopting Basel II, whereas in light shading we highlight countries that are still adopting Basel I. In this regard, it can be seen that the US, and other smaller countries, have delayed upgrading to the Basel II Accord. In particular, though US regulators have started the process of introducing Basel II regulation since 2007 and require the very largest banks to report both Basel I and Basel II calculations of capital requirements in parallel, as of December 2012 none of the US banks had received formal approval to shift to the Basel II regime. As a consequence, the reported information in the annual reports still refers to the Basel I Accord and its rules.

Panel A of Table 3 summarizes key descriptive statistics for the four regulatory dummy variables included in our analysis.

Table 3: Variable Definitions and Summary Statistics

		N	Mean	Median	St.dev	1 Pc	99 Pc
Panel A: Regulatory dummies							
Basel I	A dummy variable equal to 1 during the years of adoption of Basel I. It takes values of zero before the adoption of Basel I and, for the related years, if the country switches to Basel II.	47,984	0.704	1.000	0.457	0.000	1.000
Basel II	A dummy variable equal to 1, for the countries involved, during the years of adoption of Basel II. It takes values of zero before the adoption and if the country did not switch to Basel II.	47,984	0.187	0.000	0.390	0.000	1.000
Basel II – SA	A dummy variable equal to 1, for the banks involved, during the years of adoption of Basel II – Standardised Approach. It takes values of zero before the adoption and if the country did not switch to Basel II.	43,720	0.075	0.000	0.264	0.000	1.000
Basel II – IRB	A dummy variable equal to 1, for the banks involved, during the years of adoption of Basel II – Internal Rating-Based Approach. It takes values of zero before the adoption and if the country did not switch to Basel II.	43,720	0.031	0.000	0.174	0.000	1.000
Panel B: Dependent variables							
Δ Gross Loans/Gross Earn. $Assets_{t-1}$	Growth rate of gross loans over lagged gross earning assets (real LCU)	47,967	0.045	0.033	0.158	-0.357	0.470
Δ Corporate Lending/Gross Earn. $Assets_{t-1}$	Growth rate of corporate lending over lagged gross earning assets (real LCU)	17,220	0.024	0.010	0.187	-0.353	0.396
Δ Other Earning Assets/Gross Earn. $Assets_{t-1}$	Growth rate of other earning assets over lagged gross earning assets (real LCU)	47,867	0.021	0.013	0.158	-0.430	0.484
LLP Ratio	Loan loss provisions over gross loans	41,335	0.015	0.006	0.198	-0.026	0.157
LLR Ratio	Loan loss reserves over gross loans	26,630	0.044	0.023	0.078	0.000	0.353
Net Interest Margin (NIM)	Interest income minus interest expense over interest-bearing assets	45,196	0.029	0.027	1.461	-0.010	0.205
Non-Interest Income Share	Non-interest-operating income over total operating income	45,490	0.331	0.296	0.214	0.007	0.941
Panel C: Control variables present in every model							
Equity Ratio	Equity over total assets	47,984	0.061	0.078	3.356	0.006	0.538
Size	Log transformation of bank total assets (real US $)	47,984	14.730	14.662	2.231	9.709	20.039
Deposit Ratio	Customer deposits over total assets	47,984	0.587	0.627	2.338	0.003	0.935
Real GDP Growth Rate	Annual real growth rate of the domestic GDP	47,984	0.033	0.033	0.035	-0.069	0.117
Ln (GDP per capita)	Log transformation of domestic GDP per capita	47,984	9.420	9.918	1.401	6.120	11.508
Bank Claims	Domestic bank claims on private sector as % of GDP	47,984	0.776	0.723	0.511	0.092	2.113
Public Debt	Domestic Public Debt as % of GDP	44,328	0.581	0.540	0.344	0.063	1.852
Financial Freedom	Index derived after scoring for the degree of government regulation of financial services, the degree of state intervention in banks and other financial firms, the level of financial market development, the government influence in the credit allocation process, and the degree of openness to foreign competition. The overall score ranges from 0 to 1 with higher values denoting higher financial freedom. (Source: Heritage Foundation).	47,984	0.611	0.600	0.181	0.300	0.900
Private Ownership	Index that accounts for the percentage of bank deposits held in privately owned banks. Countries with larger shares of deposits held by private institutions are given higher ratings. Therefore, the higher the value of the index, the higher the private ownership and, on the other hand, the lower the state-ownership of banks. (Source: Fraser Institute)	47,412	0.726	0.800	0.283	0.000	1.000
Banking Crises	A dummy variable equal to 1, for the countries involved, when a crisis occurs, according to the definition by Laeven and Valencia (2012).	47,984	0.151	0.000	0.358	0.000	1.000
Panel D: Additional control variables for the balance-sheet adjustments and the lending risk analysis							
ROA	Profit before taxes over total assets	46,957	0.010	0.009	0.126	-0.075	0.086
Panel E: Additional control variables for the Net Interest Margin and Non-Interest Income Share analysis							
Liquidity Ratio	Liquid assets over total assets	45,948	0.240	0.188	0.199	0.003	0.863
Concentration	Dual Herfindahl-Hirschman Index (HHI-dual) of assets concentration	47,984	0.785	0.817	0.175	0.252	0.995
Inflation	Annual percentage change in Consumer Price Index (CPI)	47,984	0.088	0.031	0.724	-0.012	0.701

3.3 Dependent variables

In this section we describe the dependent variables that we employ to analyze the three potential effects of capital regulation on bank business choices. Key descriptive statistics for these dependent variables are reported in Panel B of Table 3.

3.3.1 Asset substitution variables

Risk-based regulation may lead banks to undertake balance-sheet adjustments between asset categories – in order to easily meet capital requirements – thus generating a credit crunch towards specific borrowers. The literature generally links these adjustments to the substitution of high capital absorbing assets, such as loans, by other earning assets that the regulators assume to be less risky (Furfine, 2001; Haubrich and Wachtel, 1993; Jackson et al., 1999). Therefore, to analyze the influence of capital regulation in terms of portfolio adjustments we employ as dependent variables the growth rate of different asset classes. These are computed in constant (or real) values, thus corrected for inflation through the national GDP deflator, and in local currencies in order to avoid our results being driven by fluctuations in exchange rates and not by actual bank business choices. More precisely, following Dinç (2005), we compute the growth in gross lending scaled by the gross value of earning assets from the previous year, i.e., (*Gross Loans*(*t*) – *Gross Loans*(*t*-1))/*Gross Earning Assets*(*t*-1) to describe the evaluation of bank lending activity. We focus on gross loans instead of net loans because changes in the latter can be influenced by a worsening in credit risk (De Haas and Van Lelyveld, 2014) rather than by changes in bank lending volumes.

We then specifically assess the impact of capital regulation on the growth rate of corporate loans, computed via the increase of corporate loans in year *t* normalized by gross

earning assets from the previous year, i.e., (*Corporate Loans*(*t*) – *Corporate Loans*(*t*-1))/*Gross Earning Assets*(*t*-1). Although available only for a sub-sample of banks, this variable is important to understand the differential effects of Basel II compared to Basel I. Specifically, whereas in Basel I for the different loan categories there is only a single risk weight, with Basel II the capital requirements vary with a borrower's default probability with loans to corporate borrowers representing the most risk-sensitive loan category – especially for credit institutions adopting the IRB approach[3]. It follows that, during Basel II, banks might effectively optimize the use of their capital base by acting on the portfolio of corporate loans rather than on other loans categories.

Finally, the propensity of banks to adjust their portfolios should be reflected in an increase in the volume of non-other earning assets that are characterized by lower capital requirements. We aim to capture this potential effect of capital regulation via the growth of other earning assets; namely, the increase of other interest-bearing assets in year *t* normalized by gross earning assets from the previous year, i.e., (*Other Earning Assets*(*t*) – *Other Earning Assets*(*t*-1))/*Gross Earning Assets*(*t*-1).

3.3.2 Cherry picking – lending risk variables

The design of risk-based capital requirements might also influence credit-risk taking by banks. Under Basel I, as suggested by Jackson et al. (1999) and Jones (2000), the lack of differentiation of capital charges within loan categories raises the possibility of cherry-picking. This is a form of regulatory capital arbitrage where banks reduce loans to good

[3] For example (based on BIS, 2004), for the same PD (probability of default), corporate exposures require higher risk-weights than mortgages. The difference in terms of risk-weights between the two asset classes widens with decreased PDs. In fact, if we take PDs of 2.5%, 1.3%, 0.5%, we observe capital charges respectively amounting to 122.16%, 100.95%, 69.61% for the corporate exposure, and to 100.64%, 67%, 35.08% for the exposure in mortgages, highlighting a differential in risk-weights of about 21.52, 33.95 and 34.53 percentage points. This suggests that a significant capital saving can also emerge when banks reduce corporate lending to safe borrowers.

credit quality borrowers to expand lending to lower credit quality borrowers within a given risk-weight category (Dangl and Lehar, 2004). The presence of cherry-picking implies that the overall credit quality of the bank's loan portfolio would decrease under Basel I due to greater relative holdings of lower credit quality assets. Nevertheless, an increase in the risk sensitivity within loan categories – as under Basel II – should encourage lending to safer borrowers (especially by IRB banks) and this might reduce the propensity for cherry-picking by banks (Furfine, 2001; Hakenes and Schnabel, 2011).

In the following tests we employ three variables that reflect the risk of bank lending. The first two are direct measures of credit risk and include the ratio between loan loss provisions and gross loans (*Loan Loss Provisions/Gross Loans*) and the ratio between loan loss reserves and gross loans (*Loan Loss Reserves/Gross Loans*). The third variable is the spread between interest income and interest expense scaled by total earning assets, i.e., *(Interest Income – Interest Expense)/Total Earning Assets*. Essentially, *ceteris paribus*, if banks increase credit risk after capital regulation this should be reflected by a higher margin being applied to banks' intermediation function. This is because one of the key components of the net interest margin is the default risk premium related to credit risk where borrowers with higher default risk should be charged with higher lending rates (Angbazo, 1997; Degryse et al., 2012; Strahan, 1999; Valta, 2012).

3.3.3 Non-interest income share and activity substitution

A third potential effect of the design of risk-based capital requirements refers to the substitution of activities towards non-interest income activities. Under the Basel I regime banks benefit from a favorable regulatory treatment of these activities. As suggested by DeYoung and Roland (2001) this should induce banks to transform interest-based risk into

fee-based risk – thus moving on-balance sheet items to off-balance sheet activities – in order to arbitrage risk-based capital regulation. This is not necessarily true, however, under the Basel II Accord that imposes higher requirements for off-balance sheet activities (BIS 2009, 2013b; Edmonds, 2012; Francis, 2006) and gives banks the opportunity to optimize the use of capital by modifying their lending policy. In our empirical tests, we employ the ratio between non-interest-operating income and total operating income (*Non-Interest-Operating Income/Total Operating Income*) to examine the effect of capital regulation on substituting to non-interest income activities.

3.4 Econometric approach and control variables

We employ a similar econometric analysis to the one adopted by Barajas et al. (2005), Guidara et al. (2013), and Wagster (1999). Essentially, we define the introduction of risk-based capital requirements as regulatory shocks and study how banks modify their business choices upon the shock occurrence.

To this end, we estimate panel models via the within estimator that allows us to control for unobserved bank heterogeneity caused by factors that remain constant across the sample period at the bank level. This estimator, by computing a separate intercept for each bank, strips out cross-sectional variation before estimating the slope coefficients. This approach is, therefore, well suited to capturing variations in business choices at the level of individual banks over time. Standard errors have been corrected for heteroskedasticity and are clustered at the bank-level to remove any estimation bias resulting from within-group correlation in the sample. More formally, the general specification of our model is the following:

$$y_{it} = \alpha_i + \delta\, CAR_{k,t} + \beta X_{it-1} + \gamma Z_{k,t} + \varepsilon_{it} \quad (1)$$

where:

- y_{it} is one of the dependent variables (a business choice), described in the previous section, for bank *i* at time *t*;
- α_i is the bank-specific intercept;
- $CAR_{k,t}$ is one of our dummies on risk-based regulation that allow us to evaluate the impact of capital regulation on business choices;
- X_{it-1} is a vector of lagged bank-control variables (these variables are lagged by one year to reduce simultaneity and endogeneity bias);
- $Z_{k,t}$ is a vector of country controls;
- ε_{it} is an idiosyncratic error $\varepsilon_{it} \sim \text{IID}(0, \sigma^2_{\varepsilon})$.

Additionally, utilizing the same specification (1), we also estimate a logit model where the dependent variable y_{it} is a dummy equal to one if banks have experienced a negative growth of corporate credit during the period 2007-2012 and zero otherwise. Essentially, we employ this methodology only in a test for the recent crisis period.

Panel C of Table 3 describes bank and country controls that enter in all specifications. The set of bank controls includes size, the equity to asset ratio, and deposits over total assets. Bank size is measured by the log transformation of bank total assets in constant thousands of US dollars at year 2012. Larger banks show a higher investment opportunity set with a consequent increase in the likelihood to invest in other earning assets and a decline in the growth rate of loans. Furthermore, while we do not have a defined expectation on the impact of size on our two direct measures of credit risk, larger banks are generally expected to show a lower net interest margin, as they operate with lower

operating costs for a unit of production, and higher non-interest income share (Demirgüç-Kunt et al., 2004; Demirgüç-Kunt and Huizinga, 2010).

The equity ratio is a measure of bank soundness and should increase the probability of banks in providing lending (Berger and Udell, 2004). Furthermore, better capitalized banks can tolerate more aggressive credit risk-taking, achieve higher net-interest margin because of lower funding costs (Demirgüç-Kunt et al., 2004), and have less incentives to expand non-interest based activities. An additional control is the ratio between deposits and total assets with higher values leading to relatively more stable lending (De Haas and Van Lelyveld, 2014), as well as to higher net interest margins (given the lower cost of funding) and a lower non-interest income share.

The set of country controls described in Panel C consists of the real GDP growth rate, the natural logarithm of GDP, the ratio between public debt and domestic GDP, the ratio between domestic bank claims on the private sector and domestic GDP, an index of financial freedom from the Heritage Foundation, an index measuring the percentage of bank deposits held in privately owned banks from the Fraser Institute and a dummy that identifies systemic banking crises. Given the procyclicality of bank credit (see, for instance, Berger and Udell, 2004; Bertay et al., 2015), we expect a positive effect of the real GDP growth rate on lending growth and a negative impact on the growth rate of other earning assets. Furthermore, borrowers' capacity to pay back loans decreases during recessions and increases during booms (Bernanke and Gertler, 1989) implying a lower credit risk when the GDP growth rate is larger with a consequent decline in the net interest margin (Poghosyan, 2012). A high real GDP growth rate should also lead to a greater non-interest income share (Demirgüç-Kunt and Huizinga, 2010).

The natural logarithm of GDP per capita, computed as in Dinç (2005), is a measure of economic development. We conjecture that the more a country is developed, the more banks are inclined to expand their businesses and the lower the credit risk, the net interest margins and the non-interest income share given the higher opportunities for lending. Furthermore in countries with a larger ratio between public debt and domestic GDP, banks are likely to have greater incentives to invest in government securities with a consequent increase in the growth rate of other earning assets and a decline in the net interest margin. While the effect of this variable on non-interest income share is ambiguous a priori, higher values could signal more country risk with a consequent increase in a borrower's default probability.

The ratio between domestic bank claims on the private sector as a percentage of GDP accounts for the degree of development of the credit industry and should increase both lending and other earning assets growth and decrease net interest margins as banks may face higher competition which can lead to narrower margins. While in more bank-oriented countries, banks are expected to be more exposed to credit risk, they might benefit from cross-selling capabilities so as to increase non-interest income. The index of financial freedom and the index measuring the importance of private sector banks should enter with negative (positive) signs in the models for the growth of lending (other earning assets) and the growth of corporate lending (in particular), as banks chartered in countries that are more financially free might be less inclined to provide credit. Finally, we control for bank crises by constructing a dummy based on the dataset compiled by Laeven and Valencia (2012).

Panel D of Table 3 focuses on the ratio between profit before taxes over total assets (ROA) that is used as an additional determinant of portfolio adjustment and lending risk.

More profitable banks should have greater opportunities to increase capital by retaining earnings; therefore, they should be characterized by a greater propensity to grow. Furthermore, banks with greater profitability might propend for more cautious lending policies in the following period thus reducing their risk-taking.

Finally, Panel E reports variables employed as additional determinants of bank interest-margins and non-interest income share. Specifically, we control for the percentage of liquid assets, that are characterized by lower interest yields than loans, and should reduce the interest margin and, conversely, increase the non-interest income share. Inflation is expected to have a positive impact on the interest margins (Demirgüç-Kunt et al., 2004; Huybens and Smith, 1999), as well as on the non-interest income shares (Demirgüç-Kunt and Huizinga, 2010). Finally, we control for banking market concentration (at the country level) measured by the dual Herfindahl-Hirschman Index (HHI-dual) of total assets as in Tabak et al. (2013).[4] In highly concentrated markets banks charge greater rates on loans and tend to pay lower rates on deposits (Berger and Hannan, 1989; Hannan, 1991) with a consequent increase in net-interest margin (Demirgüç-Kunt et al., 2004). Finally, it is worth noting that following Demirgüç-Kunt et al. (2004), the non-interest income share is also employed as a determinant of the net interest margin since higher values of this variable are expected to reduce interest margins via a decline in loan pricing (Demirgüç-Kunt et al., 2004).

[4] As emphasized by Tabak et al. (2013), the dual HHI has a number of advantages. For instance, since it is normalized and non-dimensional, it allows comparison among different concentration measures. Furthermore, it enables comparison between countries and years as the dual is not influenced by the number of individuals in the series. See Tabak et al. (2013) – left column of page 3858 – for an extended description of the HHI-dual.

Chapter IV – Capital Regimes and Asset Substitution

4.1 Basel I and Basel II and the growth rates of asset classes

This first empirical chapter presents our results on the asset substitution effect. In particular, Table 4 reports our benchmark specifications that focus on the impact of Basel I on the growth rate of different types of assets. More precisely, in column 1 we report a baseline specification on the impact of Basel I on the growth rate of gross loans that includes as key controls for bank characteristics the equity ratio, bank size, the deposit ratio and the return on assets (all of them lagged by one year), three country control variables (the real growth rate of GDP, the natural logarithm of GDP per capita and a variable that controls for total country bank claims) and a dummy variable to account for the impact of banking crises. We then include in column 2 some additional country characteristics (financial freedom, private ownership and public debt).

Table 4: The Impact of Basel I and Basel II on Bank Portfolio Variables (Asset Substitution)

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on bank portfolio variables. The dependent variables are described in Section 3.3. **Basel I** is a dummy that equals one if a bank complies with the Basel I capital standards in a given year; **Basel II** is a dummy that equals one if a bank complies with the Basel II capital standards in a given year. Equity Ratio is the ratio between equity and total assets; Size is the log transformation of bank total assets (in real US $); Deposit Ratio is the ratio between customer deposits and total assets; ROA is the ratio between profit before taxes and total assets; all bank characteristics are lagged by one year. Real GDP Growth Rate is the annual real growth rate of the domestic GDP; Ln (GDP per capita) is the log transformation of domestic GDP per capita; Bank Claims is domestic bank claims on private sector as % of GDP; Banking Crises is a dummy that equals one if a country is hit by a banking crisis in a given year; Financial Freedom is an index measured at the country level by the Heritage Foundation with higher values denoting higher financial freedom; Private Ownership is an index measured at the country level by the Fraser Institute with higher values denoting higher private ownership of banks; Public Debt is domestic Public Debt as % of GDP. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Δ Gross Loans / Gross Earning Assets$_{t-1}$		**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**		**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**		**Δ Gross Loans / Gross Earning Assets$_{t-1}$**	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Basel I	**-0.015*** **	**-0.021*** **	-0.001	0.005	**0.028*** **	**0.025*** **			
	(0.00)	**(0.00)**	(0.01)	(0.01)	**(0.00)**	**(0.00)**			
Basel II							0.002	-0.001	-0.003
							(0.00)	(0.00)	(0.00)
Equity Ratio$_{t-1}$	0.126***	0.138***	0.172***	0.200***	0.107***	0.104***	0.091***	0.143***	0.089***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)
Size$_{t-1}$	-0.029***	-0.030***	-0.015***	-0.011**	-0.033***	-0.036***	-0.031***	-0.014***	-0.029***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Deposit Ratio$_{t-1}$	0.019**	0.020**	0.043***	0.039***	0.048***	0.045***	0.020**	0.032**	0.038***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ROA$_{t-1}$	0.692***	0.740***	0.315***	0.392***	-0.274***	-0.180***	0.750***	0.442***	-0.089
	(0.06)	(0.07)	(0.08)	(0.09)	(0.07)	(0.07)	(0.06)	(0.08)	(0.07)
Real GDP Growth Rate	0.644***	0.633***	0.493***	0.439***	-0.360***	-0.285***	0.600***	0.424***	-0.298***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)
Ln (GDP per capita)	0.053***	0.068***	0.012	0.012	0.011	0.038***	0.069***	0.024**	0.043***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank Claims	0.054***	0.062***	0.049***	0.045***	0.025***	0.028***	0.032***	0.025***	0.007
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Banking Crises	-0.039***	-0.031***	-0.021***	-0.010	-0.018***	-0.007	-0.021***	-0.014**	-0.010***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Financial Freedom		-0.011		-0.030		0.028**	0.008	-0.029*	0.029***
		(0.01)		(0.02)		(0.01)	(0.01)	(0.01)	(0.01)
Private Ownership		-0.008		-0.035***		0.034***	-0.014*	-0.030**	0.039***
		(0.01)		(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Public Debt		0.035***		-0.009		0.047***	0.028***	0.000	0.025***
		(0.01)		(0.02)		(0.01)	(0.01)	(0.01)	(0.01)
Constant	-0.089	-0.224***	0.071	0.062	0.379***	0.135*	-0.234***	-0.021	-0.016
	(0.06)	(0.07)	(0.09)	(0.12)	(0.06)	(0.07)	(0.06)	(0.11)	(0.06)
Observations	38,022	34,236	13,610	12,915	37,937	34,156	39,564	14,911	39,474
R-squared	0.08	0.08	0.06	0.06	0.03	0.03	0.08	0.06	0.02
Number of banks	4,365	4,171	2,239	2,179	4,358	4,163	4,229	2,348	4,222
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The results of both specifications indicate a significant decline in the growth rate of loans in bank balance sheets after the adoption of Basel I, with our Basel-dummy entering all models with a negative coefficient (significant at the 1% level). The estimated coefficients imply that the introduction of a risk-based capital regime reduced lending growth by a magnitude that varies between 1.5% and 2.1%. In addition, in the following two columns (3 and 4) we find that the lending contraction has not been especially directed to the corporate sector: when we use as a dependent variable the growth rate of corporate lending the Basel I variable is not significant at customary levels. In additional tests that we do not report in the interest of brevity, we find that this latter result is not driven by the substantial decline in the number of observations in our sample – motivated by the large number of banks without data on the growth rate of corporate loans. In fact, if we exclude the banks that do not provide information on corporate lending and then re-estimate the model with the growth of total loans as a dependent variable, we still observe (for this sub-sample) a decline in the growth of the broad credit following the adoption of Basel I.

Taken together with the findings discussed above, the results reported in columns 5 and 6 provide support for the presence of a portfolio adjustment effect induced by Basel I. In essence, the results show that the decline in the growth of total loans is associated with a significant increase in the growth of other earning assets: the Basel I dummy signals that the introduction of capital requirements induced banks to raise their investments in other earning assets in a range between 2.5%-2.8%. Overall, the analysis of the effects of Basel I on bank portfolio adjustments offer results that are consistent with part of the literature that ascribes the bank balance sheet adjustments to the introduction of capital requirements regulation (see, in this regard, Brinkmann and Horvitz, 1995; Furfine, 2000; Haubrich and Wachtel, 1993; and Jackson et al., 1999, for a comprehensive review of the empirical literature).

In the final three columns of Table 4 we analyze whether the introduction of Basel II has produced any differential effects on asset substitution as compared to Basel I. As suggested by Furfine (2001), a capital regime with higher risk sensitivity within asset-classes can reduce bank incentives to cut lending given the possibility of optimizing capital requirements via within asset-classes adjustments. To conduct these additional tests we restrict our sample to only bank-year observations that fall within the periods after the adoption of Basel I. In other words, we exclude years without capital requirements with the purpose of directly assessing the effects of Basel II when we use Basel I regulation as a benchmark. We find that the Basel II dummy does not enter in any specification with a significant coefficient, suggesting that none of our dependent variables have been significantly influenced when countries have moved from Basel I to the adoption of the Basel II Accord.

In summary, the results reported in this section suggest that the Basel I framework produced significant effects in terms of balance sheet re-adjustments (asset substitution) with a reduction in the growth rate of gross loans between 1.5% and 2.1%, thus generating a credit crunch effect, and a contemporaneous increase in earning assets that impose lower capital requirements between 2.5% and 2.8%. The decline in lending was not, however, directed toward the corporate sector. Furthermore, Basel II has not generated any differential effect in terms of balance sheet re-adjustments compared to Basel I and we do not find evidence of amplification in the risk of a decline in the credit growth in the presence of more risk-sensitive capital requirements.

4.2 Comparing Basel I with the Internal Rating Based and Standardized Approach

One of the peculiarities of the Basel II Accord is the possibility for banks to adopt two different approaches to quantifying credit risk for regulatory purposes. It might, therefore, be the case that any different effect compared to the original Basel Accord in terms of asset substitution is limited to only one of these two approaches. In this regard, given that within the IRB Approach corporate lending appears to be the most risk sensitive category of loans, IRB banks might have reduced their lending activity to the corporate sector as compared to Basel I. This view is in line with Hakenes and Schnabel (2011), Kroszner (2007), and Ruthenberg and Landskroner (2008) who, more generally, suggest that the IRB approach raises the preference of banks for loans with lower capital requirements. In addition, given the possibility to optimize the use of capital by acting on the lending portfolio, IRB banks might have also lower incentives than other banks to expand the portfolio of other earning assets.

In the following empirical tests, to disentangle the effects of the credit risk approaches proposed by Basel II on asset substitution, we re-estimate the models discussed in the previous sections by replacing the Basel II dummy with our Basel II–SA and Basel II–IRB dummies.

Table 5: The Impact of the Internal Rating-Based Approach (IRB) and Standardized Approach (SA) on Bank Portfolio Variables (Asset Substitution)

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on bank portfolio variables. The dependent variables are described in Section 3.3. **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year; **Trading Book Review** is a dummy that equals one if a country complies with the revisions to the market risk framework after 2010. Equity Ratio is the ratio between equity and total assets; Size is the log transformation of bank total assets (in real US $); Deposit Ratio is the ratio between customer deposits and total assets; ROA is the ratio between profit before taxes and total assets; all bank characteristics are lagged by one year. Real GDP Growth Rate is the annual real growth rate of the domestic GDP; Ln (GDP per capita) is the log transformation of domestic GDP per capita; Bank Claims is domestic bank claims on private sector as % of GDP; Banking Crises is a dummy that equals one if a country is hit by a banking crisis in a given year; Financial Freedom is an index measured at the country level by the Heritage Foundation with higher values denoting higher financial freedom; Private Ownership is an index measured at the country level by the Fraser Institute with higher values denoting higher private ownership of banks; Public Debt is domestic Public Debt as % of GDP. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Δ Gross Loans / Gross Earning Assets$_{t-1}$	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**
	(1)	(2)	(3)	(4)
Basel II – IRB	0.007	**-0.015***	**-0.023*****	**-0.020*****
	(0.01)	**(0.01)**	**(0.01)**	**(0.01)**
Basel II – SA	0.000	**-0.010**	**-0.005**	**-0.004**
	(0.00)	**(0.01)**	**(0.00)**	**(0.00)**
Trading Book Review				**-0.011***
				(0.01)
Equity Ratio$_{t-1}$	0.103***	0.170***	0.110***	0.109***
	(0.03)	(0.05)	(0.04)	(0.04)
Size$_{t-1}$	-0.031***	-0.014***	-0.034***	-0.034***
	(0.00)	(0.00)	(0.00)	(0.00)
Deposit Ratio$_{t-1}$	0.020**	0.035**	0.043***	0.043***
	(0.01)	(0.01)	(0.01)	(0.01)
ROA$_{t-1}$	0.742***	0.416***	-0.134*	-0.136*
	(0.06)	(0.08)	(0.07)	(0.07)
Real GDP Growth Rate	0.641***	0.460***	-0.331***	-0.331***
	(0.04)	(0.06)	(0.05)	(0.05)
Ln (GDP per capita)	0.073***	0.027**	0.050***	0.049***
	(0.01)	(0.01)	(0.01)	(0.01)
Bank Claims	0.044***	0.033***	0.016***	0.017***
	(0.00)	(0.01)	(0.01)	(0.01)
Banking Crises	-0.026***	-0.014**	-0.010***	-0.010***
	(0.00)	(0.01)	(0.00)	(0.00)
Financial Freedom	0.009	-0.019	0.025**	0.026**
	(0.01)	(0.02)	(0.01)	(0.01)
Private Ownership	-0.013*	-0.032**	0.040***	0.040***
	(0.01)	(0.01)	(0.01)	(0.01)
Public Debt	0.039***	0.007	0.038***	0.038***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-0.317***	-0.064	-0.059	-0.047
	(0.07)	(0.12)	(0.08)	(0.08)
Observations	35,343	13,219	35,264	35,264
R-squared	0.08	0.06	0.03	0.03
Number of banks	4,117	2,174	4,110	4,110
Time dummies	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes

In Table 5 we report the result of these additional tests based on our balance sheet dependent variables. They show that IRB banks have reduced the growth rate of other earning assets and simultaneously opted for a decline in lending to the corporate sector (–1.5% with a p-value of 6.5%). This confirms the view that under the IRB approach banks become particularly concerned about the exposure to loans with higher risk sensitivity. Furthermore, while there is no evidence of any change in bank behavior following the adoption of the Standardized Approach to measuring credit risk, we find that under the IRB method the optimization of the use of a bank's capital base can be achieved via adjustments within the loan portfolios that reduce the need to invest in other earning assets.

The decrease in the growth rate of other earning assets – experienced by IRB banks – is further corroborated when we also control for the change in the regulatory treatment of market risk associated with the trading book, agreed in 2009 and adopted by several countries from 2011 within the Basel II regulation. This change includes in particular the introduction of stressed VaR (Value at Risk) and the alignment of the treatment of securitization exposures across the banking book and the trading book (BIS, 2012)[5], thus implying an increase in the overall capital requirements for market risk (BIS, 2013a; BIS, 2012). To control for the possible impact of these changes on our results, we add in column 4 a dummy (*Trading book review*) equal to one for countries complying with the described change. While *Trading book review* enters the model with a negative and significant coefficient (at the 10% level), suggesting that the increased capital charges for the trading book bring banks to reduce their exposure in other earning assets, our key results remain largely unaffected. In essence, we still observe a decrease in the growth rate of other

[5] The revision to the market risk framework was also addressed to improve the risk factor coverage of internal models, enhance prudent valuation guidance and introduce the IRC (Incremental Risk Charge) (BIS, 2012).

earning assets for IRB banks. In unreported tests, we achieve a similar conclusion when we exclude from our sample those bank-year observations belonging to the revised period of the Basel II regulation on market risk.

In summary, we find that IRB banks seem to have optimized the use of their capital base by modifying the composition of total lending to reduce the exposure in high-risk weight loan categories, while banks opting for the Standardized Approach do not behave, on average, differently from Basel I banks. In addition, IRB banks have significantly reduced the growth rate of other earning assets.

4.3 Capital regulation and bank lending during the global turmoil 2007-2012

The previous tests suggest that the impact of Basel II on the growth rate of bank lending has been limited and mostly motivated by the increase in the risk-sensitivity of the new regulatory framework for some loan categories such as corporate loans. Nevertheless, the growing attention of IRB banks to monitor the exposure to loans with high risk weights (such as corporate loans) might generate a much more significant impact in terms of lending volumes in periods where credit risk – and in particular the credit-risk of corporate borrowers – is exacerbated by negative systemic and macroeconomic conditions. Essentially, under such conditions, the increase in the risk-sensitivity of the capital regime might have the potential to generate a larger decline in credit growth than has been suggested by the previous analysis (see, for example, Heid 2007).

We assess the validity of this conjecture by re-estimating our baseline model where the growth rate of corporate lending is the dependent variable for the period ranging from

2007 to 2012 that is widely recognized as a period of global economic turmoil. During that period numerous countries have suffered from a systemic banking crisis (as defined by Laeven and Valencia, 2012) and the average country default probability experienced a significant increase, moving from 0.5% in the first part of the sample (1988-2006) to 0.7% in the second part (2007-2012)[6]. In short, we focus on the differences in the behavior of banks subject to different regulatory regimes in a period of systemic distress.

The results, reported in the first three columns of Table 6, show that while the Basel II–SA dummy does not enter with a significant coefficient in any model, the IRB dummy shows a negative coefficient that is significant at customary levels. In particular, from the results reported in columns 2 and 3, we observe that the IRB adopters have shown a growth of corporate loans that is 5.4% lower than banks still adopting the Basel I approach. We further elaborate on the impact of capital regulatory regimes on the growth of corporate loans in the last three columns of Table 6. In these columns we report the results of a logit specification where the dependent variable is a dummy equal to one if banks have reduced corporate loans during the period 2007-2012 and zero otherwise. Essentially, we model the probability of a contraction in corporate loans during a period of global systemic distress.

[6] As estimated by the Credit Research Initiative (CRI) at the Risk Management Institute (RMI) of the National University of Singapore (NUS) available at http://www.rmicri.org/cms/about/cri/

Table 6: Growth of Corporate Lending during the Crisis Period 2007-2012

In this Table, columns 1-3 show regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on the growth of credit to corporate borrowers (see Section 3.3 for a complete description of the dependent variable). Columns 4-6 show regression results for the logit model where the dependent variable is a dummy equal to one if banks have experienced a negative growth of corporate credit during the period 2007-2012 and zero otherwise. **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year. Equity Ratio is the ratio between equity and total assets; Size is the log transformation of bank total assets (in real US $); Deposit Ratio is the ratio between customer deposits and total assets; ROA is the ratio between profit before taxes and total assets; all bank characteristics are lagged by one year. Real GDP Growth Rate is the annual real growth rate of the domestic GDP; Ln (GDP per capita) is the log transformation of domestic GDP per capita; Bank Claims is domestic bank claims on private sector as % of GDP; Financial Freedom is an index measured at the country level by the Heritage Foundation with higher values denoting higher financial freedom; Private Ownership is an index measured at the country level by the Fraser Institute with higher values denoting higher private ownership of banks; Public Debt is domestic Public Debt as % of GDP. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. Logit models in columns 4-6 also control for country dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Δ Corporate Loans/Gross Earning Assets$_{t-1}$			**The dep. var. is a Dummy equal to 1 if the growth of corporate lending is negative**		
	(1)	(2)	(3)	(4)	(5)	(6)
Basel I – IRB	**-0.038****	**-0.054****	**-0.054***	**0.477*****	**1.096*****	**0.969*****
	(0.02)	**(0.03)**	**(0.03)**	**(0.16)**	**(0.36)**	**(0.37)**
Basel I – SA		**-0.018**	**-0.022**		**0.631***	**0.521**
		(0.02)	**(0.02)**		**(0.33)**	**(0.35)**
Equity Ratio$_{t-1}$	-0.014	-0.010	0.008	-1.066	-1.097	-1.135
	(0.11)	(0.11)	(0.11)	(0.77)	(0.77)	(0.79)
Size$_{t-1}$	-0.074***	-0.073***	-0.068***	-0.071**	-0.075**	-0.070**
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Deposit Ratio$_{t-1}$	0.046	0.046	0.048	-1.369***	-1.366***	-1.344***
	(0.04)	(0.04)	(0.04)	(0.29)	(0.29)	(0.29)
ROA$_{t-1}$	0.364*	0.357*	0.315	-7.329***	-7.076**	-5.942**
	(0.19)	(0.19)	(0.19)	(2.84)	(2.83)	(2.82)
Real GDP Growth Rate	0.315***	0.318***	0.310***	-6.701***	-6.850***	-5.870**
	(0.11)	(0.12)	(0.12)	(2.32)	(2.31)	(2.35)
Ln (GDP per capita)	0.123***	0.122***	0.111***	-2.061***	-2.062***	-1.414**
	(0.03)	(0.03)	(0.03)	(0.53)	(0.53)	(0.63)
Bank Claims	0.100***	0.098***	0.098***	-1.539**	-1.521**	-1.913**
	(0.03)	(0.03)	(0.03)	(0.74)	(0.74)	(0.77)
Financial Freedom			-0.168***			7.931***
			(0.06)			(1.68)
Private Ownership			0.155***			-3.841***
			(0.04)			(0.77)
Public Debt			0.018			0.916
			(0.03)			(0.86)
Constant	-0.174	-0.166	-0.164	17.111***	17.159***	10.064**
	(0.29)	(0.29)	(0.34)	(3.84)	(3.84)	(4.79)
Observations	3,130	3,130	3,107	3,130	3,130	3,107
R-squared	0.07	0.07	0.08			
Number of banks	973	973	962			
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes			
Country dummies				Yes	Yes	Yes

The models, estimated with clustered standard errors at the bank level and with the addition of country dummies as controls, suggest that the probability that banks cut corporate lending is significantly larger under the IRB approach: the coefficient of the IRB dummy is significant at customary levels in all model specifications. The results reported in Table 6 are also economically relevant: if we consider the coefficients reported in the last

column of Table 6, the probability that a bank not adopting the IRB Approach reduces corporate loans during the period 2007-2012 is approximately equal to 33% while it increases up to 55% for an IRB bank.

Furthermore, to ensure that the results discussed above are not due to a more general business model effect (in line with the argument proposed by Fahlenbrach et al., 2012) rather than to the adoption of the IRB approach we perform a placebo test utilizing a different turmoil period. Namely, we analyze the behavior of banks employing the Basel II –IRB and –SA approaches during the period from 1997 to 2001 – which is characterized by a series of crises directly affecting some Asian countries, by the Long Term Capital Management default, and by September 11. We conjecture that if our main results are capturing a business model effect, we should still find a significant negative association between our IRB dummy and our dependent variables measuring the growth of corporate credit during this alternative crisis period. In contrast, the results of these additional tests, that we report in Appendix B, confirm that the reduction experienced in corporate lending growth during the period 2007-2012 by IRB banks is motivated by the procyclicality of Basel II capital charges. In essence, the IRB dummy does not enter with a significant coefficient in any fixed effect specification.

All in all, the results discussed in this section highlight that IRB banks are characterized by a focus on managing loans with high risk-weights. The increased attention to keep under control the capital absorbed by these loans has favored a decline in corporate lending when the default probability of borrowers are amplified by negative systemic conditions – as was the case of the most recent years of our sample period. This finding offers support to the more general theoretical predictions about the procyclical nature of capital charges under Basel II (see, e.g., Repullo and Suarez, 2008; 2013).

Chapter V – Capital Regimes and Lending Risk (Cherry Picking)

5.1 Basel I and Basel II and the risk of bank lending

In this second empirical chapter we focus on the cherry picking effect that capital regulation might generate on bank lending policy. As in the previous chapter, our initial focus is on the impact of Basel I on credit-risk taking and the consequent effect on the net-interest margins of banks, we then extend the analysis to the Basel II regime.

The results, reported from columns 1 to 5 in Table 7, support our conjecture that the introduction of Basel I, where all loans in a given category receive the same risk-weight, induced banks to opt for riskier borrowers. More precisely, the first two columns of Table 7 show that, despite changes in the model specifications in terms of control variables, after the adoption of Basel I the ratio between loan loss provisions and gross loans increased by 0.3%. In the next two columns we confirm the increase in bank credit-risk taking after Basel I when we employ the ratio between loan loss reserves and gross loans to measure credit risk: this ratio increased on average by more than 1.5% with the adoption of Basel I. Furthermore, column 5 of Table 7 suggests that the increase in the riskiness of bank lending generated higher bank net-interest margins under Basel I. In particular, the estimated coefficient of the Basel I dummy – significant at the 5% level – suggests that the introduction of a risk-based capital regime led to an increase in the bank net interest margin of 0.2%; this is not a minor increase given that the average net interest margin in the selected countries is equal to 2.9%.

Table 7: The Impact of Basel I and Basel II on Lending Risk (Cherry Picking)

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on lending risk. The dependent variables are described in Section 3.3. **Basel I** is a dummy that equals one if a bank complies with the Basel I capital standards in a given year; **Basel II** is a dummy that equals one if a bank complies with the Basel II capital standards in a given year. Equity Ratio is the ratio between equity and total assets; Size is the log transformation of bank total assets (in real US $); Deposit Ratio is the ratio between customer deposits and total assets; ROA is the ratio between profit before taxes and total assets; Liquidity Ratio is the ratio between liquid assets and total assets; Non-Interest Income Share is the ratio between non-interest-operating income and total operating income; all bank characteristics are lagged by one year. Concentration is the Dual Herfindahl-Hirschman Index (HHI-dual) of assets concentration; Inflation is the annual percentage change in Consumer Price Index (CPI); Real GDP Growth Rate is the annual real growth rate of the domestic GDP; Ln (GDP per capita) is the log transformation of domestic GDP per capita; Bank Claims is domestic bank claims on private sector as % of GDP; Banking Crises is a dummy that equals one if a country is hit by a banking crisis in a given year; Financial Freedom is an index measured at the country level by the Heritage Foundation with higher values denoting higher financial freedom; Private Ownership is an index measured at the country level by the Fraser Institute with higher values denoting higher private ownership of banks; Public Debt is domestic Public Debt as % of GDP. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	LLP ratio	**LLP ratio**	**LLR ratio**	**LLR ratio**	**NIM**	**LLP ratio**	**LLP ratio**	**LLR ratio**	**LLR ratio**	**NIM**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Basel I	**0.002****	**0.003*****	**0.017*****	**0.018*****	**0.002****					
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**					
Basel II						0.000	0.000	0.001	0.002	0.001
						(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Equity Ratio$_{t-1}$	0.006	0.003	0.017	0.025	0.048***	0.012*	0.008	0.045**	0.048**	0.047***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Size$_{t-1}$	0.005***	0.005***	-0.003	-0.001	-0.002**	0.005***	0.005***	-0.000	0.000	-0.002***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Deposit Ratio$_{t-1}$	0.003	0.004**	0.003	0.004	0.010***	0.001	0.001	-0.002	-0.002	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ROA$_{t-1}$	-0.074***	-0.080***	-0.484***	-0.439***		-0.107***	-0.117***	-0.535***	-0.489***	
	(0.02)	(0.02)	(0.05)	(0.05)		(0.02)	(0.02)	(0.05)	(0.05)	
Liquidity Ratio$_{t-1}$					0.001					0.000
					(0.00)					(0.00)
Non-Interest Income Share$_{t-1}$					-0.026***					-0.025***
					(0.00)					(0.00)
Concentration					0.020***					0.013***
					(0.00)					(0.00)
Inflation					0.007***					0.006**
					(0.00)					(0.00)
Real GDP Growth Rate	-0.149***	-0.114***	-0.188***	-0.129***	-0.065***	-0.158***	-0.116***	-0.199***	-0.158***	-0.076***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Ln (GDP per capita)	-0.015***	-0.009***	-0.013**	0.003	-0.003*	-0.014***	-0.007***	-0.014***	0.001	-0.004***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank Claims	-0.002**	-0.000	-0.012***	0.001	-0.007***	-0.001*	0.001	-0.005**	0.005*	-0.008***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Banking Crises	0.013***	0.011***	0.017***	0.013***	0.003***	0.008***	0.006***	0.014***	0.012***	0.002***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Financial Freedom		0.002		0.007	0.004		0.002		-0.004	0.003
		(0.00)		(0.01)	(0.00)		(0.00)		(0.01)	(0.00)
Private Ownership		-0.009***		-0.025***	-0.001		-0.006***		-0.019***	-0.001
		(0.00)		(0.01)	(0.00)		(0.00)		(0.00)	(0.00)
Public Debt		0.008***		0.030***	-0.009***		0.007***		0.025***	-0.009***
		(0.00)		(0.01)	(0.00)		(0.00)		(0.00)	(0.00)
Constant	0.095***	0.015	0.223***	-0.008	0.075***	0.086***	0.028**	0.193***	0.034	0.105***
	(0.02)	(0.02)	(0.04)	(0.04)	(0.02)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)
Observations	33,586	30,350	20,603	18,067	31,365	37,779	35,512	22,794	21,078	36,832
R-squared	0.11	0.10	0.11	0.13	0.11	0.12	0.10	0.13	0.14	4,056
Number of banks	4,105	3,911	3,057	2,685	3,999	4,163	3,987	2,967	2,684	0.12
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

In the final columns (6-10) of Table 7 we test for any differential effect generated by Basel II on lending risk; namely, we evaluate whether in countries complying with Basel I rules, the adoption of Basel II has modified lending risk with a consequent effect on bank interest margins. Therefore, we re-estimate the models reported in the previous columns 1-5 on credit risk and bank interest margins by assuming as a benchmark Basel I capital regulation. The results indicate that the adoption of Basel II has not affected the risk of bank lending. This conclusion holds for both measures of credit risk employed in our empirical tests. Furthermore, the results reported in the last column on net interest margin also show that banks have not modified the profitability of their intermediation function after the adoption of Basel II.

Overall, the results of this section show that the introduction of risk-based capital regulation (i.e., Basel I) with a lack of risk-sensitivity within different categories of bank loans but with relevant differences in the risk weights across asset classes favored lending to riskier borrowers – as proven by the rise in our credit risk measures. This more aggressive credit-risk taking allowed banks to increase by approximately 7% the average net interest margins after the adoption of Basel I. Under the more risk-sensitive Basel II framework banks have not apparently modified their credit risk levels and consequently they have not shown any change in their net interest margin. We further elaborate on this point in the next section where we evaluate whether the risk of bank lending is influenced by the credit risk approach utilized under Basel II to compute the capital requirements.

5.2 Does the impact on lending risk by Basel II depend on the credit risk approach?

Given the attempt of IRB banks to manage the capital absorbed by the loan portfolio, as shown by the results reported in Tables 5 and 6, and the consequent theoretical predictions that these banks should opt for safer borrowers (Hakenes and Schnabel, 2011; Ruthenberg and Landskroner 2008), it is unlikely that the results reported in the previous section can be generalized to IRB banks.

In effect, the results reported in Table 8 suggest that, despite the non-significant impact of Basel II previously documented in Table 7, there is a decline in credit risk-taking for banks adopting the IRB approach. More precisely, in IRB banks the ratio between loan loss provisions and gross loans and the ratio loan loss reserves-to-gross loans have shown a decline of approximately 0.3% and 0.6% respectively. To put it differently, the adoption of the highly risk-sensitive capital regime has moved IRB banks towards safer borrowers. By contrast, under the Standardized Approach banks have not modified the quality of the loan portfolio compared to Basel I.

Table 8: The Impact of the Internal Rating-Based Approach (IRB) and Standardized Approach (SA) on Lending Risk (Cherry Picking)

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on lending risk. The dependent variables are described in Section 3.3. **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year. Equity Ratio is the ratio between equity and total assets; Size is the log transformation of bank total assets (in real US $); Deposit Ratio is the ratio between customer deposits and total assets; ROA is the ratio between profit before taxes and total assets; Liquidity Ratio is the ratio between liquid assets and total assets; Non-Interest Income Share is the ratio between non-interest-operating income and total operating income; all bank characteristics are lagged by one year. Concentration is the Dual Herfindahl-Hirschman Index (HHI-dual) of assets concentration; Inflation is the annual percentage change in Consumer Price Index (CPI); Real GDP Growth Rate is the annual real growth rate of the domestic GDP; Ln (GDP per capita) is the log transformation of domestic GDP per capita; Bank Claims is domestic bank claims on private sector as % of GDP; Banking Crises is a dummy that equals one if a country is hit by a banking crisis in a given year; Financial Freedom is an index measured at the country level by the Heritage Foundation with higher values denoting higher financial freedom; Private Ownership is an index measured at the country level by the Fraser Institute with higher values denoting higher private ownership of banks; Public Debt is domestic Public Debt as % of GDP. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	LLP ratio	**LLP ratio**	**LLR ratio**	**LLR ratio**	**NIM**
	(1)	(2)	(3)	(4)	(5)
Basel II – IRB	**-0.003*** **	**-0.002** **	**-0.005** **	**-0.006** **	0.001
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	(0.00)
Basel II – SA	-0.000	0.000	-0.000	0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Equity Ratio$_{t-1}$	0.010	0.006	0.042*	0.047**	0.048***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Size$_{t-1}$	0.005***	0.004***	-0.000	0.001	-0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Deposit Ratio$_{t-1}$	0.002	0.003	0.001	0.000	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ROA$_{t-1}$	-0.092***	-0.102***	-0.546***	-0.499***	
	(0.02)	(0.02)	(0.05)	(0.05)	
Liquidity Ratio$_{t-1}$					0.000
					(0.00)
Non-Interest Income Share$_{t-1}$					-0.025***
					(0.00)
Concentration					0.016***
					(0.00)
Inflation					0.005**
					(0.00)
Real GDP Growth Rate	-0.169***	-0.126***	-0.206***	-0.160***	-0.080***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Ln (GDP per capita)	-0.016***	-0.009***	-0.018***	-0.002	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank Claims	-0.002**	0.000	-0.005**	0.005*	-0.008***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Banking Crises	0.009***	0.007***	0.014***	0.011***	0.002***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Financial Freedom		0.002		-0.001	0.003
		(0.00)		(0.01)	(0.00)
Private Ownership		-0.006***		-0.018***	-0.001
		(0.00)		(0.00)	(0.00)
Public Debt		0.007***		0.026***	-0.010***
		(0.00)		(0.00)	(0.00)
Constant	0.098***	0.040***	0.220***	0.048	0.102***
	(0.01)	(0.01)	(0.04)	(0.03)	(0.02)
Observations	34,081	31,834	20,549	18,833	32,729
R-squared	0.12	0.10	0.14	0.15	3,941
Number of banks	4,045	3,868	2,893	2,609	0.11
Time dummies	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes

In addition, interestingly under both approaches the (average) value of the net interest margin remains at the level observed under the Basel I capital regulation, suggesting that – in line with theories about the rigidity of prices that lead to downward-sticky lending rates (see Hannan and Berger, 1991; Neumark and Sharpe, 1992) – although risk has decreased for IRB banks (that would imply charging a lower credit risk premium in the net-interest margin), banks do not seem to have adjusted their margins accordingly.

In short, we find that the higher risk-sensitivity associated with the IRB approach has favored the refocusing of the bank lending function towards less risky borrowers, as suggested by Hakenes and Schnabel (2011) and Kroszner (2007), and a consequence reduction of forms of cherry picking. Overall, our analysis so far points to IRB banks attempting to optimize the use of their capital base by significantly modifying their lending policy compared to the Basel I regime.

Chapter VI – Capital Regimes and the Substitution towards Non-Interest Income Activities

In this third and last empirical chapter we test for the presence of an activity substitution effect between interest-based and non-interest-based activities due to capital regulation. It is a widely held view that banks might optimize the use of their capital base by expanding their business toward non-interest income activities when the regulatory regime assigns to these activities a favorable treatment in terms of capital requirements. We assess the validity of this conjecture in Table 9. We start by focusing on the impact of Basel I in columns 1 and 2 and we then extend the analysis to the Basel II regime.

Overall, the findings are consistent with the view that the adoption of Basel I stimulated banks to increase the non-interest income share given the favorable capital requirements for these activities (DeYoung and Roland, 2001). More precisely, Basel I produced an increase in the non-interest income share between 1.7 and 2.1% according to the model specification. Notably, in unreported tests, we achieve similar results if we also control for other financial reforms implemented at the country level by adding to the model the index proposed by Abiad et al. (2008)[7].

[7] The Financial Reform Index offered by Abiad et al. (2008) is a conglomerate index that acknowledges the multidimensional nature of financial reforms and regulation, by considering seven different ambits (namely, credit controls and reserve requirements, interest rate controls, entry barriers, state ownership in the banking sector, securities market policy, banking regulation and supervision, as well as restrictions on capital accounts).

Table 9: The Impact of Capital Requirements on Non-Interest Income Share (Activity Substitution)

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on Non-Interest-Operating Income. The dependent variable utilized in columns 1-5 is described in Section 3.3; in columns 6-8 we utilize the first-difference of the variable employed in previous columns. **Basel I** is a dummy that equals one if a bank complies with the Basel I capital standards in a given year; **Basel II** is a dummy that equals one if a bank complies with the Basel II capital standards in a given year; **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year; **Trading Book Review** is a dummy that equals one if a country complies with the revisions to the market risk framework after 2010. Equity Ratio is the ratio between equity and total assets; Size is the log transformation of bank total assets (in real US $); Deposit Ratio is the ratio between customer deposits and total assets; Liquidity Ratio is the ratio between liquid assets and total assets; all bank characteristics are lagged by one year. Concentration is the Dual Herfindahl-Hirschman Index (HHI-dual) of assets concentration; Inflation is the annual percentage change in Consumer Price Index (CPI); Real GDP Growth Rate is the annual real growth rate of the domestic GDP; Ln (GDP per capita) is the log transformation of domestic GDP per capita; Bank Claims is domestic bank claims on private sector as % of GDP; Banking Crises is a dummy that equals one if a country is hit by a banking crisis in a given year; Financial Freedom is an index measured at the country level by the Heritage Foundation with higher values denoting higher financial freedom; Private Ownership is an index measured at the country level by the Fraser Institute with higher values denoting higher private ownership of banks; Public Debt is domestic Public Debt as % of GDP. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Non-Interest Income Share	Non-Interest Income Share	Non-Interest Income Share	Non-Interest Income Share	Non-Interest Income Share	Δ Non-Interest Income Share	Δ Non-Interest Income Share	Δ Non-Interest Income Share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Basel I	**0.017*** **	**0.021*** **						
	(0.01)	**(0.01)**						
Basel II			**-0.028*** **			**-0.050*** **		
			(0.00)			**(0.01)**		
Basel II – IRB				**-0.062*** **	**-0.060*** **		**-0.044*** **	**-0.044*** **
				(0.01)	**(0.01)**		**(0.01)**	**(0.01)**
Basel II – SA				**-0.045*** **	**-0.044*** **		**-0.036*** **	**-0.036*** **
				(0.01)	**(0.01)**		**(0.01)**	**(0.01)**
Trading Book Review					**-0.008**			**0.006**
					(0.01)			**(0.01)**
Equity Ratio$_{t-1}$	-0.176***	-0.194***	-0.191***	-0.202***	-0.202***	-0.075	-0.061	-0.060
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)	(0.09)	(0.09)
Size$_{t-1}$	-0.012***	-0.014***	-0.015***	-0.014***	-0.014***	-0.012	-0.025***	-0.024***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Deposit Ratio$_{t-1}$	-0.076***	-0.084***	-0.087***	-0.084***	-0.084***	0.046**	0.043*	0.043*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
Liquidity Ratio$_{t-1}$	0.039***	0.040***	0.051***	0.050***	0.050***	-0.026	-0.027	-0.027
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Concentration	-0.004	-0.026	0.073**	0.025	0.024	0.030	-0.022	-0.024
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.06)	(0.06)
Inflation	0.005*	0.027***	0.037***	0.038***	0.038***	0.076	0.051	0.046
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.07)	(0.09)	(0.09)
Real GDP Growth Rate	-0.056	-0.001	0.150***	0.116**	0.116**	0.080	0.203**	0.203**
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.07)	(0.08)	(0.08)
Ln (GDP per capita)	-0.058***	-0.040***	0.008	-0.009	-0.010	-0.031*	-0.001	0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Bank Claims	0.044***	0.038***	0.007	0.015**	0.016**	0.013	-0.021	-0.022
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
Banking Crises	0.035***	0.033***	0.032***	0.029***	0.030***	0.014**	0.028***	0.028***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Financial Freedom		0.046***	0.037**	0.057***	0.057***	-0.059*	0.091**	0.088**
		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)	(0.04)
Private Ownership		-0.051***	-0.043***	-0.041***	-0.041***	0.035	0.009	0.009
		(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
Public Debt		-0.006	0.005	0.013	0.014	0.013	0.038*	0.033
		(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Constant	1.000***	1.005***	0.415***	0.592***	0.704***	0.477***	0.356	0.272
	(0.09)	(0.12)	(0.11)	(0.12)	(0.13)	(0.17)	(0.22)	(0.22)
Observations	35,134	32,288	37,697	33,535	33,535	12,835	8,753	8,753
R-squared	0.04	0.05	0.04	0.04	0.04	0.02	0.02	0.02
Number of banks	4,222	4,050	4,113	4,002	4,002	2,665	2,158	2,158
						2007-2012	**2007-2012**	**2007-2012**
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The adoption of the Basel II regime – which has introduced a more stringent regulatory framework for non-interest based activities such as securitization (Francis, 2006) – has led to a completely different picture. The results reported in columns 3 and 4 show a negative and highly significant coefficient for the Basel II dummy, as well as for the Basel II –IRB and –SA dummies, hence signaling a relevant decline in the propensity of banks to invest in non-interest income activities as compared to the first capital regime. Furthermore, an unreported test suggests that the coefficients of the two Basel II dummies in column 4 are statistically different at the 5% level, thus implying a stronger (negative) impact of Basel II for IRB banks – than for SA adopters – on the income share coming from non-interest oriented business. Moreover, in column 5 we observe the results found in column 4 are consistent even after controlling for the review of the Basel II rules pertaining to the trading book – as we did in the previous section 4.2 for the growth rate of other earning assets. In fact, although our trading book review variable is non-significant, Basel II –IRB and –SA dummies still enter negative and highly significant. This conclusion remains valid also when we exclude from the sample those bank-year observations falling into the revised period of Basel II in terms of regulation of market risk.

We provide additional support for our conclusions in columns 6-8 where we restrict our sample to the period 2007-2012. Our purpose is to rule out the possibility that the Basel II dummies are simply capturing a more general decline in non-interest income share in the latest part of the sample period. To this end, for the period 2007-2012, we regress the first difference in the non-interest income share with our Basel II dummies, our *Trading book review* variable and our set of control variables. Our conjecture is that, if Basel II banks are less inclined to undertake non-interest income activities, we should observe a negative relationship between the change in the non-interest income shares and our regulatory dummies when the analysis is limited to the latest part of the sample period. Our findings

are supportive of this conjecture as they show that between 2007-2012 the change in non-interest income share was significantly lower for Basel II banks. As a further robustness test we repeat the analysis above under a placebo setting by focusing on the period 1997-2001 (see Appendix B). We do not find any different behavior by banks complying with Basel II in the most recent part of our sample period during this alternative period of turmoil.

To summarize, our results show that banks increased their non-interest income shares during Basel I, while Basel II has produced an opposite effect; namely a reduction of non-interest income activities compared to the previous regulatory regime. Such a result is likely to be motivated by the introduction with Basel II of tougher capital charges for numerous non-interest based activities and, at least for IRB banks, by the possibility to minimize capital requirements by acting on the lending policy as shown in the previous chapter IV and chapter V.

Chapter VII – Additional Analysis

In this chapter we discuss a number of robustness tests.

7.1 Random assignment test

One possible concern with our results is that they are driven by unobservable country characteristics and are then capturing spurious correlations. We conduct a falsification test to rule out this possibility by randomly shuffling the adoption dates of Basel I and Basel II across the sample. If our main results are driven by unobserved country characteristics, we should still find a significant association between our regulatory dummies and our various dependent variables. On the other hand, if the modifications in bank behavior we have found so far are linked to changes in bank capital regulation, then the reshuffling should remove any possible relation between the two. The results reported in Table 10 confirm the latter hypothesis, that is, our results are not capturing potential spurious correlations.

Table 10: The Impact of Capital Regimes on Bank Portfolio Variables, Lending Risk and Non-Interest Income Share

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on bank portfolio variables (Panel A), quality of lending (Panel B) and Non-Interest Income Share (Panel C). The dependent variables are described in Section 3.3. **Basel I** is a dummy that equals one if a bank complies with the Basel I capital standards in a given year; **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year. Control variables utilized as in the main analysis. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: *The impact of capital regimes on bank portfolio variables*

	Δ Gross Loans / Gross Earning Assets$_{t-1}$	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**	**Δ Gross Loans / Gross Earning Assets$_{t-1}$**	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**
	(1)	(2)	(3)	(4)	(5)	(6)
Basel I	0.003	-0.002	-0.003			
	(0.00)	(0.01)	(0.00)			
Basel II – IRB				-0.001	-0.006	0.005
				(0.01)	(0.01)	(0.01)
Basel II – SA				-0.003	-0.006	-0.000
				(0.00)	(0.01)	(0.00)
Observations	38,980	14,555	38,889	37,019	14,188	36,947
R-squared	0.08	0.06	0.02	0.07	0.06	0.02
Number of banks	4,249	2,308	4,242	4,140	2,318	4,133
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: *The impact of capital regimes on lending risk*

	LLP ratio	**LLR ratio**	**NIM**	**LLP ratio**	**LLR ratio**	**NIM**
	(1)	(2)	(3)	(4)	(5)	(6)
Basel I	0.000	-0.002	0.000			
	(0.00)	(0.00)	(0.00)			
Basel II – IRB				0.001	0.005	0.001
				(0.00)	(0.00)	(0.00)
Basel II – SA				0.001	0.002	0.000
				(0.00)	(0.00)	(0.00)
Observations	34,574	20,932	35,863	32,985	20,163	34,250
R-squared	0.09	0.12	0.12	0.10	0.13	0.12
Number of banks	3,999	2,757	4,078	3,896	2,660	3,972
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: *The impact of capital regimes on Non-Interest Income Share*

	Non-Interest Income Share	**Non-Interest Income Share**
	(1)	(2)
Basel I	-0.000	
	(0.00)	
Basel II – IRB		0.001
		(0.01)
Basel II – SA		-0.011
		(0.01)
Observations	36,854	35,113
R-squared	0.04	0.03
Number of banks	4,130	4,029
Bank controls	Yes	Yes
Country controls	Yes	Yes
Time dummies	Yes	Yes
Bank fixed effects	Yes	Yes

7.2 Control period

As widely emphasized by Berger and Udell (1994), analyses should be carried on datasets that include a reasonable control period before the adoption of the regulatory regime, in order to achieve an appropriate estimation of its effects on the dependent variables being studied. Accordingly, we decide to re-run our estimations imposing a control period of at least three years before the adoption of Basel I. This leads us to remove 11 countries which do not comply with our criterion (namely, 11 countries with less than three years observations pre-Basel I adoption). Results on the described sub-sample are reported in Table 11. They confirm our main findings, with the only exception regarding the impact of Basel I on the net interest margin.

Table 11: The Impact of Basel I on Bank Portfolio Variables, Lending Risk and Non-Interest Income Share

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of Basel I on bank portfolio variables (Panel A), quality of lending (Panel B) and Non-Interest Income Share (Panel C). The dependent variables are described in Section 3.3. **Basel I** is a dummy that equals one if a bank complies with the Basel I capital standards in a given year. Control variables utilized as in the main analysis. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: *The impact of Basel I on bank portfolio variables*

	Δ Gross Loans / Gross Earning Assets$_{t-1}$		**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**		**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**	
	(1)	(2)	(3)	(4)	(5)	(6)
Basel I	-0.015***	-0.020***	-0.002	0.005	0.029***	0.025***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
Observations	34,383	30,888	12,069	11,390	34,321	30,831
R-squared	0.08	0.07	0.06	0.06	0.03	0.03
Number of banks	3,954	3,770	2,004	1,944	3,949	3,764
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: *The impact of Basel I on lending risk*

	LLP ratio	**LLP ratio**	**LLR ratio**	**LLR ratio**	**NIM**
	(1)	(2)	(3)	(4)	(5)
Basel I	0.003***	0.003***	0.017***	0.018***	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	30,255	27,271	18,399	16,044	28,126
R-squared	0.12	0.10	0.11	0.13	0.11
Number of banks	3,727	3,543	2,780	2,437	3,600
Bank controls	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes

Panel C: *The impact of Basel I on Non-Interest Income Share*

	Non-Interest Income Share	**Non-Interest Income Share**
	(1)	(2)
Basel I	0.017***	0.021***
	(0.01)	(0.01)
Observations	31,514	28,967
R-squared	0.05	0.06
Number of banks	3,812	3,650
Bank controls	Yes	Yes
Country controls	Yes	Yes
Time dummies	Yes	Yes
Bank fixed effects	Yes	Yes

7.3 Anticipation effect

Since banks usually know in advance the formal date of adoption of a new capital regulatory regime, they might anticipate changes in their behavior before the enforcement of these new rules. To control for this possibility we repeat our analysis by including the year before the formal adoption of the new rules as part of the new regulatory regime. For instance, if Basel I has been introduced in 1995, we include also 1994 as part of the Basel I regime. Overall, this modification tends to broadly confirm our key conclusions – see the following Table 12.

Table 12: The Impact of Capital Regimes on Bank Portfolio Variables, Lending Risk and Non-Interest Income Share

This Table shows regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on bank portfolio variables (Panel A), quality of lending (Panel B) and Non-Interest Income Share (Panel C). The dependent variables are described in Section 3.3. **Basel I** is a dummy that equals one if a bank complies with the Basel I capital standards in a given year; **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year. Control variables utilized as in the main analysis. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: *The impact of capital regimes on bank portfolio variables*

	Δ Gross Loans / Gross Earning Assets$_{t-1}$	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**	**Δ Gross Loans / Gross Earning Assets$_{t-1}$**	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Other Earn Ass. / Gross Earn Assets$_{t-1}$**
	(1)	(2)	(3)	(4)	(5)	(6)
Basel I	-0.017***	0.002	0.009*			
	(0.01)	(0.01)	(0.00)			
Basel II – IRB				0.010**	-0.007	-0.017***
				(0.00)	(0.01)	(0.01)
Basel II – SA				0.003	-0.000	-0.007*
				(0.00)	(0.01)	(0.00)
Observations	32,274	12,120	32,200	36,582	13,659	36,502
R-squared	0.08	0.05	0.03	0.08	0.06	0.03
Number of banks	4,091	2,094	4,083	4,157	2,230	4,150
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: *The impact of capital regimes on lending risk*

	LLP ratio	**LLR ratio**	**NIM**	**LLP ratio**	**LLR ratio**	**NIM**
	(1)	(2)	(3)	(4)	(5)	(6)
Basel I	0.004***	0.020***	0.001*			
	(0.00)	(0.00)	(0.00)			
Basel II – IRB				-0.002**	-0.006**	0.002***
				(0.00)	(0.00)	(0.00)
Basel II – SA				0.001	0.001	0.002**
				(0.00)	(0.00)	(0.00)
Observations	28,556	17,063	29,495	32,811	19,509	33,745
R-squared	0.11	0.13	0.11	0.10	0.14	0.12
Number of banks	3,825	2,641	3,916	3,908	2,685	3,981
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: *The impact of capital regimes on Non-Interest Income Share*

	Non-Interest Income Share	**Non-Interest Income Share**
	(1)	(2)
Basel I	0.015*	
	(0.01)	
Basel II – IRB		-0.040***
		(0.01)
Basel II – SA		-0.024***
		(0.01)
Observations	30,388	34,616
R-squared	0.05	0.04
Number of banks	3,967	4,041
Bank controls	Yes	Yes
Country controls	Yes	Yes
Time dummies	Yes	Yes
Bank fixed effects	Yes	Yes

Chapter VIII – Conclusions

By increasing the risk-sensitivity of capital requirements within asset classes, Basel II has not generally intensified the bank business choices noted for Basel I. In essence under Basel I, we find evidence of significant substitution between asset classes (that has penalized loan growth), of cherry picking within the lending policy (that has favored riskier loans) and of substitution to non-interest income activities. In contrast, Basel II has not affected the overall credit growth, has reduced bank exposure to non-interest income and, at least in the case of banks opting for the IRB approach, has favored less risky loans.

However, IRB banks show also some evidence of a decline in the growth of the credit to the corporate sector compared to the Basel I regime; namely, in the growth of those loans that under the IRB approach generate the highest capital requirements for a given level of borrower default risk. The growing attention of IRB banks in optimizing the use of their capital base via the lending policy is also highlighted by our analysis for the period 2007-2012, which represents a period of extremely high credit risk. During this period, we observe a significantly larger likelihood to cut corporate lending by IRB banks than by other banks.

Overall, our study shows that the regulatory framework supporting Basel II, and broadly confirmed under the recent Basel III Accord, does not amplify the risk of a generalized contraction in total lending while it reduces forms of regulatory arbitrage via cherry picking in IRB banks and moves towards non-interest income activities.

Nevertheless, whereas the emphasis on monitoring credit risk by IRB banks is likely to be beneficial in normal times, it also seems to amplify the procyclical nature of capital requirements associated with corporate loans. In this respect, it appears critical to align the

design of the countercyclical capital buffer under the Basel III regime to the type of credit-risk approach used by banks. In short, a key implication of our analysis is that the countercyclical capital buffer has to be higher for banks opting for the IRB approach especially when they show a significant exposure towards the corporate sector.

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Appendix

Appendix A – Regulatory Database

We collected data on the adoption of Basel I from Barajas et al. (2005) and Vallascas and Hagendorff (2013). We complemented these two data sources with data from the domestic regulatory authorities, policy reports and academic papers and from the notes to Annual Reports for the largest banking firms in our sample. As far as the adoption of Basel II is concerned, our main source of data has been the Financial Stability Institute (FSI) Survey on "Basel II, 2.5 and III implementation" released in June 2013 by the Bank of International Settlements. This survey, launched in 2012, is annually updated with data on the status of the adoption of Basel II, 2.5 and III, collected through a specific questionnaire that the FSI sends to jurisdictions that do not belong either to the Basel Committee on Banking Supervision (BCBS) and to the European Union. When unavailable from this survey, data have been manually gathered from Central Banks' or local Monetary Authorities' websites and from bank annual reports.

When data were available, we also hand-collected bank-level data regarding the specific Basel II approach adopted, from banks' annual reports or specific risk reports (e.g., the Basel II–pillar III disclosure reports explicitly issued by major banks). Note, as well, that we had to pay particular attention to tracking banks' evolutionary path within the adoption of Basel II, that is by controlling if banks originally adopting the Standard Approach (SA) then moved – after being authorized – to the more sophisticated Internal Rating Based (IRB) approach.

Appendix B – Placebo Test

Table B1: Placebo Test on the Effects of Basel II –IRB and –SA banks during the 1997-2001 Crisis Period

In this Table, columns 1-4 show regression results for the fixed-effects model presented in Section 3.4, concerning the impact of capital requirements on the growth of credit to corporate borrowers and on the first difference of Non-Interesting Income Share (see Section 3.3 for a complete description of the dependent variables). **Basel II–IRB** is a dummy that equals one if a bank complies with the Basel II–IRB capital standards in a given year; **Basel II–SA** is a dummy that equals one if a bank complies with the Basel II–SA capital standards in a given year. Control variables utilized as in the main analysis. Heteroskedasticity-robust standard errors, clustered at the bank level, are reported in parentheses. All specifications control for time dummies. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Δ Corporate Loans / Gross Earn Assets$_{t-1}$	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Corporate Loans / Gross Earn Assets$_{t-1}$**	**Δ Non-Interest Income Share**
	(1)	(2)	(3)	(4)
Basel II – IRB	0.006	0.024	0.026	-0.038
	(0.01)	(0.02)	(0.02)	(0.03)
Basel II – SA		0.033	0.031	0.023
		(0.02)	(0.02)	(0.02)
Observations	3,089	3,089	2,968	7,361
R-squared	0.07	0.07	0.07	0.01
Number of banks	1,123	1,123	1,083	2,548
Bank controls	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes

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