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Accounting discretion, loan loss provisioning, and discipline of Banks' risk-taking ☆

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ABSTRACT

Examining banks across 27 countries, we estimate two measures of the forward-looking orientation reflected in discretionary loan provisioning practices within a country. We document that forward-looking provisioning designed to smooth earnings dampens discipline over risk-taking, consistent with diminished transparency inhibiting outside monitoring. In contrast, forward-looking provisioning reflecting timely recognition of expected future loan losses is associated with enhanced risk-taking discipline. Thus, proposals to change loan loss accounting embed significant risks of unintended consequences, as gains from reducing pro-cyclicality may be swamped by losses in transparency that dampen market discipline and increase the scope for less prudent risk-taking by banks.

1. Introduction

The objectives of accounting standard setting differ from those of bank regulation. General purpose financial reporting is concerned with providing information to those outside the firm to support a wide range of decision contexts and contractual arrangements.[1] In contrast, prudential bank regulation seeks to limit the frequency and cost of bank failures, and to protect the financial system as a whole by limiting the frequency and cost of systemic crises (e.g., Rochet, 2005). These differing objectives are at the center of a standing debate over loan loss accounting as reflected in recent high profile proposals by the Financial Stability Forum (2009) and U.S. Treasury (2009). Policy makers argue the incurred loss model underlying current loan loss accounting reinforces pro-cyclical effects of bank capital regulation, and should therefore be

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[1] For example, FASB (2010, paragraph OB2) states "The objective of general purpose financial reporting is to provide financial information about the reporting entity that is useful to existing and potential investors, lenders, and other creditors in making decisions about providing resources to the entity."

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changed to allow bank managers more discretion to incorporate forward-looking judgments into loan loss provisions.[2] However, while mitigating pro-cyclicality is an important objective, it is also important to understand other possible consequences of changing loan loss accounting.

In this paper, we explore consequences of increased loan provisioning discretion for accounting information's role in supporting outside discipline of bank risk-taking. Using a large sample of banks from 27 countries, we estimate two distinct constructs of the extent to which discretionary loan provisioning practices within a country reflect a forward-looking orientation. We investigate whether each aspect is associated with stronger or weaker discipline of bank risk-taking. We find that discretionary, forward-looking provisioning can be associated with either enhanced or diminished discipline of bank risk-taking, depending on the specific nature of the forward-looking orientation embedded in provisioning practices. That is, some manifestations of forward-looking provisioning dampen disciplinary pressure on risk-taking, consistent with diminished transparency inhibiting outside monitoring. Our results suggest that any attempt to achieve more forward-looking loan provisioning must take care to avoid significant unintended consequences.

Financial accounting information plays a fundamental corporate governance role, supporting monitoring by boards of directors, outside investors and regulators, and the exercise of investor rights granted by existing laws (e.g., Bushman and Smith, 2001). Related to this idea, the banking literature posits that informational transparency of banks plays a fundamental role in promoting market discipline as a lever of prudential bank regulation. Market discipline is conceptualized as a process by which market participants monitor and discipline excessive risk-taking by banks.[3] A key building block of market discipline is public availability of timely, consistent and reliable information on banks' financial performance and risk exposures (Stephanou, 2010). Financial accounting is clearly a primary source of such information.

Loan loss provisioning is a key accounting choice that directly influences the volatility and cyclicality of bank earnings, as well as information properties of banks' financial reports with respect to reflecting loan portfolios' risk attributes.[4] While the precise form that more forward-looking provisioning should take remains an open question, proposals to date generally incorporate a broader range of information and create an expanded role for managerial discretion in assessing future expected losses.[5] However, accounting discretion is a double-edged sword (e.g., Dechow and Skinner, 2000). While increased discretion may facilitate incorporation of more information about future expected losses into loan provisioning decisions and mitigate pro-cyclicality, it also increases potential for opportunistic or misguided accounting behavior by managers that can degrade bank transparency and lead to negative consequences along other dimensions (e.g., Wall and Koch, 2000).

To investigate implications of discretion in loan loss provisioning for risk-taking, ideally we would directly compare the incurred loss model with specific alternatives. However, this is not possible as such alternatives have not yet been implemented. Instead, we use a large sample of banks from 27 countries to exploit cross-country variation in allowable discretion in loan provisioning behavior. Discretionary provisioning is estimated relative to an extensive set of non-discretionary determinants of loan loss provisions. We estimate two distinct aspects of provisioning practices that can be construed as reflecting a forward-looking orientation.

Our first measure is smoothing, defined as the coefficient from a regression of loan loss provisions on contemporaneous earnings, after controlling for non-discretionary determinants of loan loss provisions.[6] Higher sensitivity of current provisions to current period earnings realizations is interpreted as greater discretionary smoothing. The banking literature posits that smoothing is *implicitly* forward-looking in nature and can mitigate pro-cyclicality. The idea is that smoothing allows a buildup in reserves when earnings are high and current losses are low, and a reserve draw down in future periods when earnings are low and current loan losses are high (e.g., Borio et al., 2001; Laeven and Majnoni, 2003; Bikker and Metzemakers, 2004).[7] However, providing more discretion to smooth provisions permits opportunistic earnings management that obscures fundamentals, instead of enhancing earnings informativeness. We indirectly distinguish these possibilities by investigating the implications of smoothing for the discipline of bank risk-taking.

Our second measure uses a future outcome variable to isolate the extent to which explicit forward-looking information is reflected in current loan provisioning within a country. We use the coefficient from regressing current period loan loss

[2] U.S. GAAP and IFRS utilize an incurred loss model where loan losses are recognized only after loss events have occurred prior to the reporting date that are likely to result in future non-payment of loans. This accounting does not generally allow for consideration of future expected losses based on trends suggestive of additional future losses. Pro-cyclicality refers to the exaggeration of cyclical tendencies in aggregate economic activity that amplifies business cycle fluctuations. When loan loss reserves cannot absorb recessionary credit losses, greater loan loss recognition reduces capital adequacy, potentially causing banks to reduce lending and so exacerbate the downturn.

[3] The regulatory emphasis on market discipline is exemplified by its codification in recent international prudential standards, such as Pillar 3 in the Basel II Framework (Basel Committee on Banking Supervision, 2006).

[4] Prior research documents a positive relation between discretionary loan loss provisions and bank stock return and future earnings. See for example Beaver et al. (1989), Wahlen (1994), Liu and Ryan (1995), Liu et al. (1997), andKanagaretnam et al. (2004).

[5] Discussions of alternative loan loss accounting models include Borio et al. (2001), Fernández de Lis et al. (2001), Laeven and Majnoni (2003), and Benston and Wall (2005)). Barth (2006) carefully explicates a standard setting perspective on incorporating estimates of the future in financial statements. The extent to which any of the proposed alternatives would actually mitigate pro-cyclicality is still largely an open question. See Beatty and Liao (2011) for recent evidence in this regard.

[6] We control for a set of non-discretionary determinants of loan losses, and then extract measures of discretionary smoothing and forward-lookingness that are orthogonal to the non-discretionary fundamentals. This approach allows for the possibility that the incurred loss model could differ across countries in the extent to which discretion is permitted. Beatty and Liao (2011) and Dugan (2009) discuss the role of judgment in the incurred loss model.

[7] The claim that smoothing mitigates pro-cyclicality has not been empirically established.

provisions on next year's change in non-performing loans. Gambera (2000) and Beatty and Liao (2011) show that current economic conditions have predictive power for future nonperforming loans. This second measure captures the extent to which *current* loan provisions explicitly anticipate *future* loan portfolio deterioration.

Discipline over risk-taking is examined using two approaches. The first approach estimates the impact of our two measures of forward-looking provisioning on the relation between changes in asset volatility and changes in bank leverage. This analysis posits that outside discipline of risk-taking will impose pressure on banks to decrease leverage (i.e., increase capital) in response to increases in risk. This implies that more intense outside discipline will be reflected in a higher sensitivity of changes in leverage to changes in risk. Indicative of smoothing dampening disciplinary pressure, the analysis finds that the sensitivity of leverage to changes in asset volatility is lower in high smoothing regimes relative to low smoothing regimes. In contrast, and consistent with stronger market discipline, the extent to which current provisioning explicitly anticipates future loan portfolio deterioration is associated with higher sensitivity of bank leverage to changes in asset volatility.

The second approach investigates relations between provisioning and bank risk-shifting. Merton (1977) characterizes explicit and implicit deposit guarantees as a put option issued by the bank's deposit guarantor. Conceptually, the value of this option represents the fair value of the deposit insurance provided. Risk-shifting occurs when banks increase the value of the option without internalizing the full cost of the increased insurance. Countering banks' incentives to risk-shift, deposit insurers, and uninsured creditors have incentives to monitor and discipline bank risk-taking behavior. The analysis examines the relative strength of these competing forces, providing evidence that banks in high smoothing regimes exhibit more risk-shifting relative to banks in low smoothing countries, while the opposite holds with respect to the explicit forward-looking metric.

Beyond contributing to the policy debate by isolating economic consequences of forward-looking loan loss provisioning, our paper also contributes to the earnings quality literature. Dechow et al. (2010) argue that earnings quality can only be defined with respect to a specific decision setting. In this spirit, we focus on accounting's role in enhancing outside investors' and regulators' ability to monitor and discipline bank risk-taking. While a large literature examines smoothing via loan loss provisions, our paper is the first to investigate the economic consequences of loan loss provisioning regimes, including smoothing, on banks' risk-taking behavior. Overall, the evidence suggests potentially significant unintended consequences associated with increasing discretion over loan loss provisioning to allow for a more forward-looking orientation. The consequences of discretion depend specifically on how discretion is exploited by bank managers. Smoothing loan loss provisions dampens discipline over bank risk-taking, while explicit forward-lookingness that anticipates future deteriorations in the loan portfolio appears to enhance discipline. This latter result complements Beatty and Liao (2011) who provide evidence that forward-looking provisioning mitigates pro-cyclicality in lending.

The rest of the paper is organized as follows. Section 2 puts our paper in context relative to the extant research on bank accounting, transparency, and market discipline as complementary aspects of bank regulation. Section 3 presents the main empirical analysis on the relations between country-level provisioning regimes and the discipline of bank risk-taking. Section 4 concludes.

2. Conceptual framework and related literature

Section 2.1 discusses the relation of our research to existing literature on earnings quality, smoothing and loan loss provisioning. Section 2.2 relates our paper to the literature on market discipline's role in the regulation of banks. Finally, Section 2.3 describes how we control for other aspects of bank regulatory regimes and institutional features of the country in general.

2.1. Earnings quality, smoothing, and loan loss provisioning

A large literature investigates the concept of earnings quality, where banks and other financial institutions are typically excluded due to their unique characteristics. In a recent literature review, Dechow et al. (2010) provide a useful framework for thinking about earnings quality. Dechow et al. (2010) define higher quality earnings as providing more information about the features of a firm's financial performance that are relevant to a specific decision made by a specific decision-maker. An implication is that earnings quality can only be defined in the context of a specific decision setting. In our paper, the specific decision context involves accounting information's role in enhancing outside investors' and regulators' ability to monitor and discipline bank risk-taking. Two distinct characteristics of countries' loan loss provisioning regimes are isolated. Then, the paper investigates the relation between these two "quality" characteristics and both the sensitivity of bank capital to changes in banks' asset risk and the risk-shifting behavior of banks. This specific decision context distinguishes our study from the existing earnings quality literature and the literature on bank loan loss provisioning. In addition, our measure of explicit forward-looking provisioning is new to the literature and we are the first to examine it in the context of bank risk-taking behavior.[8]

Dechow et al. (2010) also note that the study of earnings quality is complicated by the fact that earnings depends on both the firm's financial performance and on the accounting system that measures it. This implies that the value of a particular accounting measure may vary with different types of enterprises. Focusing solely on banks minimizes innate differences in

[8] While unique to the literature, our measure is related to measures used in Beatty and Liao (2011), Bushman and Williams (2011), and Nichols et al. (2009).

the wealth generating process across firms in our sample. During our sample period, banks in different countries were subject to a range of different accounting rules with respect to loan loss provisions. Our research design exploits this variation to extract manifestations of discretion. We control for non-discretionary fundamentals directly associated with loan losses and extract measures of smoothing and forward-lookingness orthogonal to the non-discretionary fundamentals. The set of non-discretionary control variables (see Section 3.2) is consistent with existing empirical loan provisioning models, including cross-country studies by Laeven and Majnoni (2003), Bikker and Metzemakers (2004), Fonseca and Gonzalez (2008), and Gebhardt and Novotny-Farkas (forthcoming). Thus, we abstract away from specific accounting rules and measure accounting discretion in all countries relative to a consistent set of fundamentals.

Dechow et al. (2010) classify research on earnings quality according to whether it provides evidence on the determinants or the consequences of the earnings quality proxy it examines. A significant literature exists examining the use of discretionary loan loss provisioning to smooth earnings that can be characterized as "determinants" studies. Such papers include Greenwald and Sinkey (1988), Beatty et al. (1995), Collins et al. (1995), Ahmed et al. (1999), Laeven and Majnoni (2003), Bikker and Metzemakers (2004), Liu and Ryan (2006), Fonseca and Gonzalez (2008), Pérez et al. (2008), and Gebhardt and Novotny-Farkas (forthcoming), among others.

This is the first paper to explore consequences of discretionary smoothing and forward-looking provisioning for discipline of bank risk-taking.[9] The banking setting allows us to investigate how specific aspects of discretion in loan provisioning impact banks' risk-taking behavior. The idea that bank capital should be sensitive to bank risk-taking is reflected in the risk-weighted capital requirements defined by the Basel II Accord. This idea motivates our analysis of how the sensitivity of bank leverage to changes in asset volatility is impacted by discretion in loan provisioning. The fact that implicit and explicit deposit insurance creates incentives for banks to shift risk onto the government has been recognized in the academic literature since at least Merton (1977), motivating our tests of how risk-shifting is impacted by discretionary loan provisioning. We show that the consequences of discretion depend specifically on how the discretion is exploited by bank managers. Our results complement Beatty and Liao (2011) who provide evidence that forward-looking provisioning mitigates pro-cyclicality in lending.

Finally our paper complements a recent literature examining banks' accounting discretion. Vyas (2011) estimates a novel measure of financial reporting transparency reflecting the timing of banks' actual write-downs of assets in their financial statements relative to the timing of losses reflected in exposure-specific benchmark indices. He finds that accounting write-downs are generally less timely than the devaluations implied by benchmark indices, and the timeliness of write-downs varies across banks. Vyas (2011) finds that investors discover information about the loss exposure of risky assets faster for firms with timelier write-downs. This is consistent with our central theme that a bank's financial accounting can directly impact outsiders' ability to accurately assess risk characteristics of banks' portfolios. Also, Huizinga and Laeven (2009) examine accounting discretion by U.S. banks during the 2007–2008 time frame, documenting that banks used discretion to overstate distressed asset valuations, and banks with large exposures to mortgage-backed securities provisioned less for bad loans.

2.2. Market discipline as a bank regulatory tool

The premise that financial accounting information plays a fundamental role in prudential oversight of banks is consistent with the Basel II Capital Accord, which posits a central role for informational transparency in facilitating market discipline. While Basel Pillar 3 envisions a range of disclosures that may or may not be part of the formal financial accounting rules (e.g., Basel Committee on Banking Supervision, 2006), financial accounting systems form the foundation of the firm-specific information set available to interested parties outside the firm and are a logical starting point for investigating properties of information important for addressing moral hazard problems at banks. It is also plausible that the quality of banks' financial accounting information is correlated with the quality of bank disclosures falling outside the financial accounting rules.

The banking literature distinguishes two different types of market discipline (e.g., Stephanou, 2010). *Direct* market discipline refers to the influence that market participants themselves exert on a bank's risk-taking behavior. For example, transparency may enhance ex-ante discipline as managers anticipate that informed investors would be more likely to discern increased risk-taking and respond quickly to greater risks by demanding higher yields on their investments.[10] By contrast, *indirect* market discipline operates via regulatory intervention triggered by market signals, such as price movements of bank securities (Rochet, 2005; Hovakimian and Kane, 2000; Kane, 2004; Flannery and Thakor, 2006). Our analysis examines associations between loan provisioning practices and risk-taking discipline, but cannot distinguish precise channels through which the market discipline operates.

[9] A long-standing issue concerns whether earnings smoothing increases information content of earnings by revealing innate fundamentals or whether it obscures fundamentals and reduces information. While some argue that income smoothing reveals information (e.g., Arya et al., 2003; Chaney and Lewis, 1995; Tucker and Zarowin, 2006; Trueman and Titman, 1988; Sankar and Subramanyam, 2001; Demski, 1998), others argue that income smoothing distorts information (e.g., Barth et al., 2007; Francis et al., 2004; Lang et al., 2003; Leuz et al., 2003). We shed light on this issue in the specific context of bank-risk-taking.

[10] Better disclosure may not beneficially impact bank risk-taking behavior. For example, Blum (1999) demonstrates that benefits of market discipline via subordinated debt contracts depends on the ability of banks to credibly commit to a given risk level. Cordella and Yayati (2003) show that public disclosure can reduce bank risk-taking, but only if the bank can control the risk of its portfolio. Plantin et al. (forthcoming) and Allen and Carletti (2008) focus on potential negative effects of mark-to-market accounting on bank soundness.

Barth et al. (2004) examine regulations on capital adequacy, deposit insurance systems, bank supervisory power, regulations fostering information disclosure and private sector monitoring of banks, and government ownership of banks, among other factors. They find that policies relying on regulatory features fostering accurate information disclosure, private-sector oversight of banks, and incentives for private agents to exert corporate control work best to promote bank development, performance, and stability. Further, Beck et al. (2006) find that supervisory strategies empowering private monitoring of banks by forcing banks to disclose accurate information lowers the degree to which corruption of bank officials is an obstacle to firms raising external finance.

Demirgüc-Kunt et al. (2008) study whether compliance with the Basel Core Principles for Effective Banking Supervision improves bank soundness. They document that requiring banks to regularly and accurately report financial data to regulators and market participants increases banks' soundness (measured with Moody's financial strength ratings). These findings highlight the importance of transparency in making supervisory processes effective and strengthening market discipline. Tadesse (2006), using a range of survey-based metrics, finds that banking crises are less likely in countries with greater regulated disclosure and transparency.

Finally, Nier and Baumann (2006) investigate bank transparency's role in providing incentives for banks to limit risk. Nier and Baumann (2006) examine the extent to which higher levels of transparency enhance market discipline and provide more incentives for banks to limit risk of default by holding larger capital buffers. Nier and Baumann's primary measure of transparency is a bank level disclosure index constructed by counting the number of individual disclosures available from BankScope.

Our paper complements and extends this literature by demonstrating a connection between market discipline and the availability of more textured information provided in banks' financial reports. All banks in our sample have observable stock prices, and so differences in market discipline across banks must depend on more than just existence of market prices. We conjecture that while prices transmit aggregated information that can trigger outside scrutiny of a bank's activities, supplementing this aggregated information with more textured information amplifies the intensity of disciplinary responses. Stock price changes reflect shifts in a bank's perceived value, while credible, disaggregated accounting information can aid in understanding sources of changes in firm value. This relates to the distinction between monitoring and influence raised by Bliss and Flannery (2002), where outsiders use textured financial information in conjunction with the monitoring mechanism, price changes, to facilitate disciplinary actions.

Finally, Laeven and Levine (2009) focus on conflicts between bank managers and owners over risk, and document that bank risk is generally higher in banks with large owners holding substantial cash flow rights. While we do not have data to control for intricate aspects of bank governance, it is not our objective to focus on the level of risk that a bank takes. Instead, we explore how the sensitivity of bank leverage to changes in risk varies with accounting discretion.

2.3. Controlling for other aspects of bank regulatory regime

To isolate economic consequences of discretion in loan loss provisioning, it is crucial to control for other key aspects of countries' bank regulatory regimes as well as other country-level institutions. Barth et al. (2006) design and implement a survey to collect an extensive array of bank regulations and supervisory practices for many countries. Our main source of bank regulatory variables is Barth et al. (2006), supplemented with variables from other sources. All variables and their sources are described in Appendix A of the paper. We control for these elements as follows:

Regulations on capital adequacy: *CapIndex* is an index constructed by Barth et al. (2006) to measure stringency of capital requirements in each country. This controls for Basle Pillar I.

Supervisory power: *Official* is a measure of the official supervisory power that bank regulators have over bank operations, serving as a control for Basle Pillar II. This measure is from Barth et al. (2006) and is an index constructed from answers to individual questions contained in the survey of bank regulatory practices.

Private-sector monitoring of banks: We include *Private*, developed by Barth et al. (2006), to control for the extent to which bank regulations in a country foster accurate information disclosure, empower private-sector oversight of banks, and create incentives for private agents to exert corporate control over banks.

Properties of the general contracting environment: *Judicial* is an assessment of the efficiency and integrity of the country's legal system.

In robustness analyses we include many additional control variables. These include a measure of the general disclosure requirements of a country's securities regulations, *Disclosure*; *Rights*, a measure of the investor protection rights present in the country; *StateBank*, to control for the extent of state ownership of banks; *Liquidity*, which measures the share turnover of a country's equity market, a common measure of market development; and *MrktCap*, which represents the total market capitalization of a country's stock market as a percentage of GDP, again a common measure of market development.

3. Empirical analysis

3.1. Sample selection criteria

The sample period of our study spans 1995–2006. All bank financial statement data is taken from Bankscope and all market data is from Datastream. Country-level variables derive from five sources: the World Development Indicators

Database; Barth et al. (2006), Demirgüç-Kunt et al. (2005), La Porta et al. (1998). and La Porta et al. (2002). Detailed information concerning variable construction and data sources is included in Appendix A.

First, to estimate country-level measures of forward-looking provisioning, we use all banks in a country, both private and public. To be included, a bank must have all necessary bank-level financial data and country-level data spanning a period of at least three years. We also require banks to have more than $5 billion in total assets. We trim the data at the 1 and 99 percentiles. These requirements result in a sample of 55,236 bank year observations over 27 different countries. Table 1, panel A, provides descriptive statistics on the sample. Table 2, column 2, shows the sample sizes (in parentheses) by country used to estimate the loan provisioning measures.

Next, to examine the relation between provisioning practices and risk discipline, we further require banks to have available equity market data to estimate changes in the implied market value of banks' assets, the volatility of bank's assets, and the value of the deposit insurance put option. We trim the data at the 1 and 99 percentiles. These requirements yield a sample of 3091 bank-year observations across 27 countries. Table 2, column 2, shows the sample sizes by country used in our main analyses of risk-taking behavior as reported in Tables 3–6.

3.2. Estimating country-level aspects of discretionary, forward-looking loss provisioning

We begin by estimating two distinct aspects of loan provisioning practices within a given country. To separate discretionary from non-discretionary provisions, we estimate the following:

$$LLP_{itj} = \gamma_0 + \gamma_1 Ebllp_{itj} + \gamma_2 \Delta NPL_{it+1,j} + \gamma_3 \Delta NPL_{itj} + \gamma_4 \Delta NPL_{it-1,j} + \gamma_5 \Delta NPL_{it-2,j} + \gamma_6 CAP_{it-1,j} + \gamma_7 Size_{it-1,j} + \gamma_8 \%\Delta GDP_{tj} + \varepsilon_{itj} \quad (1)$$

LLP_{itj} is the loan loss provision scaled by lagged total loans for bank i, in country j, for year t. $Ebllp_{itj}$ is earnings before loan loss provisions and taxes for period t scaled by lagged total loans. $\Delta NPL_{it+1,j}$ is the change in non-performing loans

Table 1
Pooled estimation of the determinants of loan loss provisions.
OLS regression of loan loss provisions (*LLP*) on earnings before provisions and tax (*Ebllp*), change in non-performing loans (ΔNPL), capital (*CAP*), the natural logarithm of the bank's assets (*Size*) and percentage change in GDP per capita ($\%\Delta GDP$). Bank specific variables are trimmed at the 1 and 99 percentiles. Standard errors (reported) are clustered at the country and year level. Country, bank type, and year fixed effects are included. Data range 1995–2006.

Panel A. Descriptive statistics

Variable	Mean	Median	StdDev
LLP_t	0.0045	0.0025	0.0103
$Ebllp_t$	0.0299	0.0268	0.0599
ΔNPL_t	0.0007	0.0000	0.0129
CAP_{t-1}	0.1527	0.1400	0.0471
$Size_{t-1}$	5.5067	5.0265	1.9966
$\%\Delta GDP_t$	1.8444	1.6976	1.1567

Panel B. OLS regression—Smoothing via LLP_t

Variable	**Dependent Variable**: *LLP*
$Ebllp_t$	0.0586***
	(0.0156)
ΔNPL_{t+1}	0.0393**
	(0.0190)
ΔNPL_t	0.1310***
	(0.0181)
ΔNPL_{t-1}	0.0933***
	(0.0238)
ΔNPL_{t-2}	0.0703***
	(0.0209)
CAP_{t-1}	−0.0024**
	(0.0110)
$Size_{t-1}(x100)$	0.0010***
	(0.0002)
$\%\Delta GDP_t$	0.0001
	(0.0001)
R^2	0.3320
Observations	55,236

***, **, * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Table 2
Country-level statistics.

N is the number of bank-year observations within a country that are used in the risk-taking analyses (Tables 3–6) for which financial and market data is available in Bankscope and Datastream. N^* is the number bank-year observations within the country that are used to estimate both *Smoothing* and *Forward-NPL* that have available financial statement data in Bankscope. *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. Both *Smoothing* and *Forward-NPL* are estimated on all banks (public and private) that have financial data available in Bankscope. *CapIndex, Private, Official, Judicial*, and *GDP* are country-level control variables (see Appendix A). Data range 1995–2006.

Panel A. Descriptive statistics

Country	*N* (*N**)	Smoothing	Forward-NPL	Official	CapIndex	Private	Judicial
Argentina	10 (87)	0.0656**	−0.0804**	9.5	7	2.0	6.00
Australia	45 (194)	0.1911**	−0.0107	11.0	7	4.0	10.00
Austria	14 (18)	0.1583**	0.3564**	13.5	9	1.9	9.50
Canada	54 (182)	0.1112**	0.0378*	10.5	4	3.0	9.25
Chile	13 (113)	−0.0002	−0.0756	11.0	6	1.9	7.25
Germany	53 (53)	0.0043*	−0.0314	9.0	6	3.0	9.00
Hong Kong	22 (88)	0.0853*	−0.3634**	11.0	7	4.0	10.00
India	105 (173)	0.1621**	−0.3283**	10.0	8	0.3	8.00
Ireland	7 (38)	0.1108*	0.3746**	13.0	4	3.0	8.75
Israel	35 (81)	0.0222**	−0.0027	8.0	7	3.5	10.00
Japan	269 (2790)	0.1232**	0.0141**	12.0	6	3.0	10.00
Mexico	6 (138)	0.0399**	0.1215**	11.5	8	3.0	6.00
Netherlands	9 (15)	0.3535**	0.1696*	8.0	6	2.0	10.00
Norway	56 (300)	0.0893**	0.0730**	9.0	7	3.0	10.00
Pakistan	61 (34)	−0.1034**	0.0598**	13.0	7	2.4	5.00
Peru	17 (130)	0.4479**	−0.0669**	12.0	6	1.4	6.75
Philippines	60 (73)	0.2555**	0.0084*	11.0	5	2.9	4.75
Portugal	21 (144)	0.0213	0.0043*	14.0	7	2.8	5.50
Singapore	21 (31)	−0.0391	−0.0006	12.5	8	4.0	10.00
South Africa	18 (52)	−0.0382**	0.1300**	9.0	7	3.5	6.00
Spain	65 (435)	0.0044	0.0321*	8.5	10	2.0	6.25
Switzerland	39 (169)	−0.0042	−0.0026	14.0	6	2.8	10.00
Thailand	48 (55)	0.0461*	0.0820**	9.0	5	3.0	3.25
Turkey	36 (172)	0.1607**	0.0415*	14.0	6	2.9	4.00
U.K.	43 (205)	0.0977**	0.0109*	11.5	6	3.0	10.00
U.S.A.	1954 (49,414)	0.0493**	−0.0064**	13.0	6	2.0	10.00
Zimbabwe	10 (52)	0.0476**	−0.0926	14.0	5	3.0	7.50
Total	3091 (55,236)						
Mean		0.0912	0.0168	11.2	6.5	2.7	7.88
Median		0.0656	0.0084	11.0	6	3.0	8.75
StdDev		0.1196	0.1527	2.0	1.4	0.8	2.21

Panel B. Correlation matrix (Pearson-lower/Spearman-upper)

	Smoothing	*Forward-NPL*	*Official*	*CapIndex*	*Private*	*Judicial*
Smoothing		0.028	−0.026	−0.255	−0.213	0.119
Forward-NPL	0.021		−0.032	−0.029	0.071	−0.166
Official	−0.063	0.109		−0.144	−0.132	−0.077
CapIndex	−0.215	−0.085	−0.154		−0.063	0.076
Private	−0.329*	0.104	0.028	−0.182		0.292
Judicial	0.078	−0.038	−0.044	0.027	0.180	

**, * indicate significance at the 0.05 and 0.10 level, respectively.

over the period $t+1$ scaled by lagged total assets. *Controls* for non-discretionary fundamentals directly associated with loan losses include changes in non-performing loans (scaled by lagged total loans), ΔNPL, for the current and the previous two years to capture observed changes in portfolio performance and ultimate collectability. We also include equity capital to total assets ($CAP_{it-1,j}$) at the beginning of the period, the natural logarithm of total assets ($Size_{it-1,j}$), and the percentage change in GDP per capita ($\%\Delta GDP_{tj}$) to control for macroeconomic trends in the overall economy.[11]

[11] In untabulated results, we tried a number of additional control variables including the volatility of equity, the volatility of assets extracted from an option pricing framework, contemporaneous loan growth, and beginning of the period loan loss reserve. All results are robust to these alternative specifications for estimating country-level provisioning regimes.

Table 3
Loan loss provisioning and sensitivity of changes in leverage to changes in risk.

OLS regression results of changes in debt-to-assets ($\Delta D/V$) on changes in asset risk ($\Delta\sigma_v$) interacted with country-level institutional features. $\Delta D/V$ is the face value of debt divided by the market value of assets and $\Delta\sigma_v$ is the change in the volatility of assets (see Appendix B for details). *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *CapIndex, Private, Official, Judical* and *GDP* are country-level control variables (see Appendix A). *ROE* is bank level return on equity and *Size* is the natural logarithm of the bank's assets. Bank specific variables are trimmed at the 1 and 99 percentiles. For brevity main effects are included in regressions but not reported. Standard errors (reported) are clustered at the country and year level. Both bank type and year fixed effects are included. Data range 1995–2006.

Panel A. Descriptive statistics

Variable	Mean	Median	StdDev
$\Delta\sigma_v$	−0.0043	−0.0015	0.1255
ΔIPP	−0.0004	−0.0001	0.0243
SIZE	8.0370	7.7936	1.7740
ROE	0.1212	0.1284	0.1753

Panel B. OLS regressions—capital sensitivity

	Dependent variable: $\Delta D/V$			
Variables	**I**	**II**	**III**	**IV**
$\Delta\sigma_v$**Smoothing*		3.9407***		3.2271***
		(0.972)		(0.835)
$\Delta\sigma_v$**Forward-NPL*			−3.9432***	−2.7497***
			(1.088)	(0.601)
$\Delta\sigma_v$**Official*		−0.2878***	−0.2001***	−0.2692***
		(0.055)	(0.050)	(0.054)
$\Delta\sigma_v$**CapIndex*		0.0392	−0.2671**	−0.1200
		(0.126)	(0.117)	(0.108)
$\Delta\sigma_v$**Judicial*		−0.1527***	−0.2527***	−0.2082***
		(0.033)	(0.036)	(0.032)
$\Delta\sigma_v$**Private*		0.1269	−0.2820	0.1171
		(0.168)	(0.179)	(0.116)
$\Delta\sigma_v$**Size*		−0.1391**	−0.0989*	−0.1122*
		(0.063)	(0.054)	(0.059)
$\Delta\sigma_v$**ROE*		−0.0643	0.0178	−0.0392
		(0.180)	(0.213)	(0.180)
$\Delta\sigma_v$**GDP*		−0.1015***	−0.0606**	−0.0736**
		(0.034)	(0.029)	(0.029)
$\Delta\sigma_v$	−1.1700***	3.3937***	6.0960***	4.3263***
	(0.023)	(1.156)	(1.284)	(0.996)
Observations	3091	3091	3091	3091
R^2	0.4141	0.5883	0.5701	0.6057

***, **, * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Our measures of forward-looking discretion in loan provisions are captured by the two coefficients γ_1 and γ_2 in Eq. (1). First, *Smoothing* is captured by γ_1, the coefficient on earnings before taxes and loan loss provisions ($Ebllp_{itj}$). After controlling for fundamental determinants of loan losses, γ_1 picks up the extent to which banks record loss provisions based solely on the level of earnings without reference to information about the loan portfolio. That is, they record large provisions because earnings are high and low provisions because earnings are low.[12] The second measure of forward-looking discretion is γ_2, the coefficient on the subsequent period change in non-performing loans, $\Delta NPL_{it+1,j}$. We refer to the coefficient γ_2 as *Forward-NPL*. This measure captures the extent to which current provisions explicitly anticipate *future* deteriorations in the performance of the loan portfolio.

To provide an overview of the specification, we first estimate Eq. (1) using a pooled, time series regression using all banks in all countries in all years.[13] Table 1 reports descriptive statistics of the sample in panel A, while panel B reports the

[12] See Greenwald and Sinkey (1988), Beatty et al. (1995), Collins et al. (1995), Ahmed et al. (1999), Laeven and Majnoni (2003), Bikker and Metzemakers (2004), Liu and Ryan (2006), Fonseca and Gonzalez (2008), Pérez et al. (2008), and Gebhardt and Novotny-Farkas (forthcoming) as examples that also use a similar measure of income smoothing in the banking industry.

[13] That is, we utilize all banks with data available to estimate Eq. (1) regardless of whether the bank is publically traded or has the required data for our later analysis.

Table 4
Loan loss provisioning and risk-shifting.

OLS regression results of changes in IPP (ΔIPP) on changes in asset risk ($\Delta\sigma_v$) interacted with country-level institutional features. Following Merton (1977) ΔIPP is the fair value of the deposit insurance premium per dollar of deposits and $\Delta\sigma_v$ is the change in the volatility of assets (see Appendix B for details). *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *CapIndex, Private, Official, Judical*, and *GDP* are country-level control variables (see Appendix A). *ROE* is bank level return on equity and *Size* is the natural logarithm of the bank's assets. Bank specific variables are trimmed at the 1 and 99 percentiles. For brevity main effects are included in the regression but not reported but are available upon requests. Standard errors (reported) are clustered at the country and year level. Both bank type and year fixed effects are included. Data range 1995–2006.

OLS regression—risk shifting

	Dependent Variable: ΔIPP			
Variables	**I**	**II**	**III**	**IV**
$\Delta\sigma_v$*Smoothing*		0.3431***		0.2712***
		(0.067)		(0.044)
$\Delta\sigma_v$* Forward-NPL*			−0.3760***	−0.2776***
			(0.109)	(0.082)
$\Delta\sigma_v$*Official*		−0.0179	−0.0102	−0.0160
		(0.011)	(0.011)	(0.011)
$\Delta\sigma_v$*CapIndex*		−0.0147	−0.0432**	−0.0308
		(0.024)	(0.020)	(0.022)
$\Delta\sigma_v$*Judicial*		−0.0092	−0.0186***	−0.0148**
		(0.007)	(0.007)	(0.007)
$\Delta\sigma_v$*Private*		−0.0170	−0.0517***	−0.0178
		(0.023)	(0.019)	(0.018)
$\Delta\sigma_v$*Size*		−0.0237***	−0.0199***	−0.0210***
		(0.007)	(0.007)	(0.007)
$\Delta\sigma_v$*ROE*		0.0227	0.0304	0.0252
		(0.032)	(0.031)	(0.030)
$\Delta\sigma_v$*GDP*		−0.0044	−0.0005	−0.0016
		(0.006)	(0.006)	(0.006)
$\Delta\sigma_v$	0.1041***	0.6711*	0.9147***	0.7645**
	(0.030)	(0.353)	(0.317)	(0.348)
Observations	3091	3091	3091	3091
R^2	0.4141	0.5554	0.5470	0.5727

***, **, * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

coefficients from the pooled estimation of (1). Consistent with prior research (e.g., Laeven and Majnoni, 2003, Bikker and Metzemakers, 2004, and Fonseca and Gonzalez, 2008), we find a positive and significant coefficient of 0.0586 (p-value <0.01) on $Ebllp_t$, indicating that on average banks around the world smooth earnings via the loan loss provision. Panel B reports a coefficient on $\Delta NPL_{it+1,j}$ of 0.0393 (p-value <0.05). This positive coefficient is indicative of banks on average anticipating *future* deteriorations in the performance of the loan portfolio in their current loss provisions, consistent with U.S. findings in Beatty and Liao (2011) and Nichols et al. (2009).

To investigate consequences of discretion for risk discipline, we require measures of discretionary, forward-looking provisioning at the country level. We next estimate (1) by country and use the country-specific coefficients on $Ebllp_t$, and $\Delta NPL_{t+1}$to represent *Smoothing* and *Forward-NPL*, respectively.[14] Table 2 reports details of these country specific estimates, indicating if estimates are statistically different from zero. We see in Table 2, panel A, that there is considerable cross-country variation in our two measures of discretionary provisioning, implying significant differences in loan loss provisioning practices across countries. For the *Smoothing* (*Forward-NPL*) measure 22 (20) of 27 country-level estimates are significantly different than zero at the 0.10 level. We set coefficients not statistically different from zero equal to zero.[15]

Table 2, panel B, reports Spearman and Pearson correlations between our two measures of discretionary provisioning and measures of countries' bank regulatory regimes and other country-level institutions. We see that *Smoothing* and

[14] When estimating (1) at the country level, we include *Ebllp* and ΔNPL simultaneously to pick up the orthogonal contribution of each variable. While we acknowledge that this may throw away common sources of variation in the two measures, we cannot objectively allocate the variance to either variable.

[15] As discussed in Section 3.6.2, we verify that results are robust to alternative measures of *Smoothing* and *Forward-NPL*, including, using the coefficients regardless of their statistical significance, using the incremental R^2 from $Ebllp_t$ and ΔNPL_{t+1} in Eq. (1) instead of the coefficients, and including additional control variables in (1).

Table 5
Loan loss provisioning and risk-shifting: controlling for poor performance.

Panel A. Controlling for capital levels
OLS regression results of changes in IPP (ΔIPP) on changes in asset risk ($\Delta\sigma_v$) interacted with country-level institutional features. Following Merton (1977) ΔIPP is the fair value of the deposit insurance premium per dollar of deposits and $\Delta\sigma_v$ is the change in the volatility of assets (see Appendix B for details). *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *CapIndex, Private, Official, Judical*, and *GDP* are country-level control variables (see Appendix A). *ROE* is bank level return on equity and *Size* is the natural logarithm of the bank's assets. Bank specific variables are trimmed at the 1 and 99 percentiles. For brevity main effects are included in the regression but not reported but are available upon requests. Standard errors (reported) are clustered at the country and year level. Both bank type and year fixed effects are included. Data range 1995–2006.

	Dependent variable: ΔIPP					
Variables	**Cap < 7%**	**7% ≤ Cap ≤ 10%**	**Cap < 10%**	**Cap < 7%**	**7% ≤ Cap ≤ 10%**	**Cap > 10%**
$\Delta\sigma_v$*Smoothing				0.3896**	0.3399***	−0.6079
				(0.196)	(0.066)	(0.356)
$\Delta\sigma_v$*Forward-NPL				−0.5162***	−0.1519**	−0.1705
				(0.229)	(0.080)	(0.176)
$\Delta\sigma_v$*Official				0.0170*	−0.0087	−0.0218
				(0.008)	(0.011)	(0.017)
$\Delta\sigma_v$*CapIndex				0.0100	0.0004	−0.0889*
				(0.006)	(0.013)	(0.045)
$\Delta\sigma_v$*Judicial				−0.0204***	−0.0179**	−0.0173
				(0.006)	(0.007)	(0.013)
$\Delta\sigma_v$*Private				0.0318	−0.0158	−0.0061
				(0.029)	(0.019)	(0.033)
$\Delta\sigma_v$*Size				−0.0027	−0.0127*	−0.0108
				(0.004)	(0.007)	(0.020)
$\Delta\sigma_v$*ROE				−0.0086	0.0897	0.1086
				(0.011)	(0.058)	(0.075)
$\Delta\sigma_v$*GDP				−0.0003	0.0075	−0.0083
				(0.006)	(0.005)	(0.006)
$\Delta\sigma_v$	0.0341*	0.1730***	0.0786*	−0.1181	0.3939*	1.1319***
	(0.020)	(0.052)	(0.042)	(0.193)	(0.215)	(0.415)
Observations	864	1315	912	864	1315	912
R^2	0.4639	0.7143	0.2495	0.6538	0.9424	0.3958

***, **, * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Panel B. Controlling for ROE
OLS regression results of changes in IPP (ΔIPP) on changes in asset risk ($\Delta\sigma_v$) interacted with country-level institutional features. Following Merton (1977) ΔIPP is the fair value of the deposit insurance premium per dollar of deposits and $\Delta\sigma_v$ is the change in the volatility of assets (see Appendix B for details). *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. Standard errors (reported) are clustered at the country and year level. Both bank type and year fixed effects are included. Data range 1995–2006.

	Dependent variable: ΔIPP			
Variables	**Low ROE**	**High ROE**	**Low ROE**	**High ROE**
$\Delta\sigma_v$*Smoothing			0.2475**	0.0430
			(0.113)	(0.116)
$\Delta\sigma_v$*Forward-NPL			−0.3412***	−0.2480*
			(0.106)	(0.133)
$\Delta\sigma_v$*Official			−0.0196	−0.0110*
			(0.014)	(0.006)
$\Delta\sigma_v$*CapIndex			−0.0257	−0.0124
			(0.025)	(0.018)
$\Delta\sigma_v$*Judicial			−0.0271**	−0.0006
			(0.012)	(0.004)
$\Delta\sigma_v$*Private			−0.0228	−0.0280*
			(0.023)	(0.015)
$\Delta\sigma_v$*Size			−0.0185**	−0.0140
			(0.007)	(0.010)

Table 5 (*continued*)

Panel B. Controlling for ROE

OLS regression results of changes in IPP (ΔIPP) on changes in asset risk ($\Delta\sigma_v$) interacted with country-level institutional features. Following Merton (1977) ΔIPP is the fair value of the deposit insurance premium per dollar of deposits and $\Delta\sigma_v$ is the change in the volatility of assets (see Appendix B for details). *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. Standard errors (reported) are clustered at the country and year level. Both bank type and year fixed effects are included. Data range 1995–2006.

	Dependent variable: ΔIPP			
Variables	**Low ROE**	**High ROE**	**Low ROE**	**High ROE**
$\Delta\sigma_v$*ROE			0.0594	0.2201**
			(0.039)	(0.105)
$\Delta\sigma_v$*GDP			0.0007	−0.0133
			(0.007)	(0.010)
$\Delta\sigma_v$	0.1164***	0.0511	0.8751*	0.4147
	(0.046)	(0.027)	(0.473)	(0.262)
Observations	618	619	618	619
R^2	0.5448	0.1533	0.7629	0.2612

***, **, * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Forward-NPL are uncorrelated. *Smoothing* and *Forward-NPL* are uncorrelated with bank supervisory power (*Official*), regulations on capital adequacy (CapIndex) and judicial efficiency of the legal system (*Judicial*), while *Smoothing* is negatively correlated with *Private*. Recall *Private* captures the extent to which bank regulations in a country foster accurate information disclosure, empower private-sector oversight of banks, and create incentives for private agents to exert corporate control over banks. Barth et al. (2004) show that *Private* is associated with better bank development, performance, and stability.

3.3. Loan loss provisioning and risk-taking—sensitivity of leverage to changes in risk

In this section, we take the first of two approaches to investigating the impact of discretionary provisioning on bank risk-taking behavior. We examine the effect that each of our two distinct aspects of forward-looking loan provisioning has on the sensitivity of changes in bank leverage to changes in risk. The idea that capital should increase with risk has long been a basic tenet of prudential bank regulation as reflected, for example, in the risk-weighted capital requirements in the Basel II Accord. To operationalize this construct, we follow Duan et al. (1992) and posit a linear equilibrium relation between changes in leverage (or equivalently, changes in capital) and changes in risk. We estimate the following using OLS:

$$\Delta D/V = \alpha_0 + \alpha_1 \Delta\sigma_v + \alpha_2 \Delta\sigma_v * LLP\ \ REGIME + \alpha_3 LLP\ \ REGIME, \tag{2}$$

where D is the face value of debt, V is the market value of bank assets, $\Delta\sigma_v$ is the change in the volatility of bank assets, and *LLP REGIME* is either *Smoothing* or *Forward-NPL*. The specification uses first differences where Δ is the change operator. To estimate V and σ_v we focus on publicly traded banks and exploit the concept that a firm's equity can be represented as a call option on the firm's assets, where the strike price is the face value of debt. Using the face value of reported liabilities (D), the observed market value of equity, and the estimated standard deviation of stock returns, we obtain values for V and σ_v (see Appendix B for details).

The idea behind (2) is that disciplinary pressure on risk-taking should result in $\alpha_1 < 0$, where banks decrease leverage (increase capital) in response to an increase in risk. We posit that stronger discipline is associated with a greater sensitivity of leverage to risk (i.e., more negative values of α_1). To investigate whether loan-provisioning practices impede or promote disciplinary pressure, we include interactions of *Smoothing* and *Forward-NPL* with $\Delta\sigma_v$. A result that $\alpha_2 > 0$ ($\alpha_2 < 0$) implies that a particular provisioning practice is associated with weaker (stronger) discipline of bank risk-taking. In estimating (2) we cluster standard errors by country and year.[16] We also include other country and bank level controls as both main effects and interactions.

Table 3, panel A, reports the descriptive statistics for our variables of interest in the risk-taking analyses. Table 3, panel B, presents the results from estimating Eq. (2) (for brevity we do not report main effects). In panel B, column I, we document that $\alpha_1 < 0$ across the whole sample, consistent with Duan et al. (1992) and the basic intuition that risk discipline pressures banks to decrease leverage in response to an increase in risk. In panel B, column II, we find that the coefficient on the

[16] Results are robust to other clustering dimensions, e.g., firm and year, country, firm and year.

Table 6
Loan loss provisioning and risk-shifting: additional controls.

OLS regression results of changes in IPP (ΔIPP) on changes in asset risk ($\Delta\sigma_v$) interacted with country-level institutional features. Following Merton (1977) ΔIPP is the fair value of the deposit insurance premium per dollar of deposits and $\Delta\sigma_v$ the change in the volatility of assets (see Appendix B for details). *Smoothing* is defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *Forward-NPL* is defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise. *CapIndex, Private, Official, Judical,* and *GDP* are country-level control variables (see Appendix A). *ROE* is bank level return on equity and *Size* is the natural logarithm of the bank's assets. Bank specific variables are trimmed at the 1 and 99 percentiles. For brevity main effects are included in the regression but not reported but are available upon requests. Standard errors (reported) are clustered at the country and year level. Both bank type and year fixed effects are included. Data range 1995–2006.

Variables	***Dependent variable:*** ΔIPP					
$\Delta\sigma_v$*Smoothing*	0.3304***	0.2535***	0.2189***	0.2525***	0.2630***	0.3621***
	(0.120)	(0.053)	(0.050)	(0.054)	(0.050)	(0.121)
$\Delta\sigma_v$*Forward-NPL*	−0.2128***	−0.2803***	−0.3636***	−0.2956***	−0.2814***	−0.2305***
	(0.053)	(0.038)	(0.042)	(0.042)	(0.036)	(0.051)
$\Delta\sigma_v$*Disclosure*	0.0259					0.0724
	(0.051)					(0.053)
$\Delta\sigma_v$*StateBank*		0.0412				0.0351**
		(0.030)				(0.016)
$\Delta\sigma_v$*Rights*			−0.0588			−0.0833***
			(0.040)			(0.032)
$\Delta\sigma_v$*Liquidity*				−0.0144		0.0056
				(0.045)		(0.029)
$\Delta\sigma_v$*MrktCap*					−0.0165	0.0101
					(0.026)	(0.012)
$\Delta\sigma_v$*Official*	−0.0168	−0.0144	−0.0122	−0.0149	−0.0153	−0.0125
	(0.012)	(0.011)	(0.012)	(0.013)	(0.011)	(0.012)
$\Delta\sigma_v$*CapIndex*	−0.0262	−0.0303	−0.0391	−0.0311	−0.0291	−0.0300
	(0.019)	(0.022)	(0.024)	(0.022)	(0.022)	(0.019)
$\Delta\sigma_v$*Judicial*	−0.0142**	−0.0109	−0.0108	−0.0140	−0.0137*	−0.0049
	(0.006)	(0.009)	(0.008)	(0.008)	(0.008)	(0.007)
$\Delta\sigma_v$*Private*	−0.0137	−0.0114	−0.0145	−0.0188	−0.0147	0.0031
	(0.017)	(0.019)	(0.017)	(0.018)	(0.019)	(0.016)
$\Delta\sigma_v$*Size*	−0.0207***	−0.0226***	−0.0224***	−0.0212***	−0.0216***	−0.0231***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
$\Delta\sigma_v$*ROE*	0.0273	0.0279	0.0278	0.0246	0.0262	0.0374
	(0.032)	(0.030)	(0.030)	(0.030)	(0.030)	(0.034)
$\Delta\sigma_v$*GDP*	−0.0021	−0.0011	−0.0008	−0.0015	−0.0013	−0.0017
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$\Delta\sigma_v$	0.7135**	0.6854*	0.7634**	0.7561**	0.7412**	0.5698***
	(0.278)	(0.351)	(0.350)	(0.355)	(0.353)	(0.208)
Observations	3084	3084	3084	3084	3084	3084
R^2	0.5749	0.5781	0.5801	0.5737	0.5737	0.5931

***, **, * indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Smoothing interaction term is positive and significant (3.9407, p-value <0.01), consistent with discretion via *Smoothing* dampening (making less negative) the sensitivity of leverage to changes in risk. In contrast, column III shows that the coefficient on *Forward-NPL* is −3.9432 (p-value <0.01), consistent with explicit forward-looking loan provisioning enhancing the disciplining of risk-taking by increasing (making more negative) the sensitivity of leverage to changes in risk. In column IV we include interactions for both provisioning aspects simultaneously, where the *Smoothing* interaction is positive and significant (3.2271, p-value <0.01), and the *Forward-NPL* interaction is a significant negative of −2.7497 (p-value <0.01).[17]

These results demonstrate that the impact of discretionary loan provisioning on risk discipline depends on precisely how discretion is manifested in loss provisioning behavior. However, these results speak only to the relative strength of risk restraining discipline across provisioning regimes, but cannot address how the *level* of discipline relates to the strength of banks' incentives to take risks. To prevent risk-shifting by banks, the level of risk restraining discipline must offset banks' inherent incentives to increase risks without adequately compensating via increased capital levels. In the

[17] In columns II–IV we do not attempt to interpret the main effect on $\Delta\sigma_v$ because it is a lower order term with multiple higher order terms. However in unreported results, we drop all of the interaction terms except the *Smoothing* (*Forward-NPL*) and find the results are robust on the interaction term and the main effect for $\Delta\sigma_v$ become negative and significant.

next section, we address this issue by embedding the model of risk discipline posited in Eq. (2) into a model of risk-shifting that directly captures the competing inter-play of incentives to increase risk and risk discipline.

3.4. Loan loss provisioning and risk-taking behavior—risk-shifting

Deposit insurance provides an explicit or implicit guarantee that in the event of default by the bank, depositors will receive some proportion of the face value of the deposits. Risk-shifting occurs whenever a contractual counterparty is exposed to loss from leverage or volatility without receiving adequate compensation for the risk entailed. A bank can shift risk onto its deposit insurer by increasing the risk of its assets without simultaneously increasing its capital adequately to cushion the risk increase. Risk-shifting is subsidized whenever the value of the explicit and implicit deposit guarantees exceeds the implicit and explicit premiums the insurer imposes on a bank. To avoid subsidizing bank risk-taking, a deposit insurer must monitor increases in volatility and leverage and police them appropriately (Laeven, 2002).

Merton (1977) characterizes deposit insurance as a put option written by the deposit insurer on a bank's assets, and derives a pricing model for this option as a function of the volatility of assets and leverage. Conceptually, the value of this option represents the fair value of the deposit insurance provided. Risk-shifting occurs when banks increase the value of the option without internalizing the full cost of the increased insurance.[18] We utilize this put option framework to estimate risk-shifting behavior by banks.

Let *IPP* represent the value of the deposit insurance put option per dollar of deposits, σ_v the volatility of the value of the bank's assets, and D/V the leverage of the bank (as defined earlier). Following Ronn and Verma (1986) and Duan et al. (1992), we consider a linear approximation for the value of the put option:

$$IPP = \delta_0 + \delta_1 \Delta\sigma_v + \delta_2 D/V + \varepsilon. \tag{3}$$

In (3), δ_1 and δ_2 represent the partial derivatives of *IPP* with respect to volatility and leverage, respectively.[19] Deposit insurers and uninsured creditors seek to impose discipline on banks' risk-taking, implying that banks are generally constrained in their choice of risk, leverage pairs. To incorporate this disciplinary force into (3), we revisit Eq. (2) from Section 3.3 that specifies leverage as a linear function of asset volatility:

$$D/V = \alpha_0 + \alpha_1 \sigma_v, \tag{4}$$

where again, $\alpha_1 < 0$ in (4) represents the natural equilibrium relation between risk and leverage. We embed this disciplinary force into (3) by substituting the right-hand side of (4) into (3) for D/V and simplifying to yield

$$IPP = \beta_0 + \beta_1 \sigma_v + \varepsilon. \tag{5}$$

In (5), $\beta_1 \equiv \delta_1 + \delta_2 * \alpha_1 \equiv (\partial IPP/\partial \sigma_v) + (\partial IPP/\partial D/V) * \alpha_1$. Conceptually β_1 captures the net effect of the tension between banks' incentives to increase risk and outside disciplining forces. The first term comprising β_1, $\delta_1 = \partial IPP/\partial \sigma_v$, captures a bank's direct incentive to increase risk, while the second term, $\delta_2 * \alpha_1 = (\partial IPP/\partial D/V) * \alpha_1$, is generally negative as $\alpha_1 < 0$ and $(\partial IPP/\partial D/V) > 0$, and captures the *offsetting* impact of the disciplinary response to a bank's risk increasing incentives. The overall interpretation is that $\beta_1 > 0$ is consistent with observed risk-shifting behavior as the disciplining effect does not completely neutralize incentives to increase risk. The economic intuition behind this interpretation of β_1 as observed risk-shifting behavior is that if banks find risk-shifting behavior beneficial, then in equilibrium they will manage overall risk levels to increase the actuarially fair value of the insurance. In contrast, if increases in the risk profile are borne by the equity holders of the bank, then such risk-shifting is not advantageous.

Following Duan et al. (1992), Hovakimian and Kane (2000), and Hovakimian et al. (2003), we estimate variants of (5) in changes to examine the relation between loan loss provisioning and risk-shifting. We estimate the following:

$$\Delta IPP = \beta_0 + \beta_1 \Delta\sigma_v + \beta_2 \Delta\sigma_v * LLP\ \ REGIME + \beta_3 LLP\ \ REGIME + \varepsilon, \tag{6}$$

where ΔIPP is the change in the fair deposit insurance premium (see Appendix B for calculation) and other variables are defined above. The coefficient β_2 captures the impact of discretionary loan loss provisioning on risk-shifting, where $\beta_2 > 0$ is consistent with higher discretion increasing risk-shifting.

Table 4, column I, reports the results from the estimation of risk-shifting across the entire sample. The reported positive β_1 coefficient (0.1041, p-value < 0.01) is consistent with Hovakimian et al. (2003) that on average banks' risk-shifting incentives dominate the disciplinary pressure imposed on them by regulators and investors. Columns II and III of Table 4 document the extent to which *Smoothing* and *Forward-NPL*, respectively, exacerbate or reduce observed risk-shifting. Column II shows that the coefficient on the *Smoothing* interaction term is positive and significant (0.3431, p-value < 0.01), consistent with discretion via *Smoothing* increasing observed risk-shifting. In contrast, column III shows that the coefficient on the *Forward-NPL* interaction term is negative (-0.3760, p-value < 0.01), consistent with reduced risk-shifting in these regimes. In column IV we include interactions for both provisioning aspects simultaneously. The *Smoothing* interaction is

[18] Chan et al. (1992) describe the difficulties involved in implementing a risk-sensitive deposit insurance pricing scheme that is incentive compatible. It is generally held that the pricing of deposit insurance results in bank risk-taking being subsidized. See, for example, Laeven (2002), Demirgüç-Kunt et al. (2005), and Pennacchi (2006).

[19] Merton (1977) derives the comparative static results that $(\partial IPP/\partial \sigma_v) > 0$ and $(\partial IPP/\partial D/V) > 0$.

positive and significant (0.2712, p-value <0.01), and the *Forward-NPL* interaction (-0.2776, p-value <0.01) is negative and significant.

These results extend and complement the earlier results by showing how distinct aspects of loan provisioning regimes balance the competing inter-play of incentives to increase risk against risk discipline imposed by outsiders. In countries allowing high levels of smoothing, the incentives of banks to increase risk dominate the offsetting disciplinary pressures, resulting in more risk-shifting. In contrast, in regimes where discretionary provisioning anticipates future loan deterioration, the incentives of banks to increase risk are more than offset by disciplinary pressures, resulting in less risk-shifting.

3.5. Loan provisioning, poor performance, and risk-shifting behavior

To further explore the role of discretion and incentives to risk-shift, we draw on prior research showing the incentives to risk-shift are higher for poorly performing firms (e.g., Eisdorfer, 2008; Loktionov, 2009). We examine this issue in Table 5, panels A and B, using two different specifications for poor performance.

In panel A we measure performance with a bank's level of balance sheet capital (*CAP*). The idea is that gains to banks' shareholders from risk-shifting should be higher as banks move closer to violating regulatory capital requirements. Regulatory capital requirements for Tier 1 and/or Tier 2 capital for our sample range from 6% to 10% depending on the country. Because we do not have access to precise measures of regulatory capital for our cross-country sample, we use balance sheet capital rather than regulatory capital. Given that our proxy for regulatory capital is noisy and regulators have the ability to exercise forbearance, it is not obvious where the right capital cutoffs are in our panel of banks. We partition banks into three groups based on the whether a bank's level of balance sheet capital is less than 7%, between 7% and 10%, and greater than 10%. While incentives to risk-shift in the lowest capital range ($<7\%$) are likely to be significant, it is possible that these banks have already attracted regulatory scrutiny that could limit risk-shifting opportunities. In the 7–10% range, gains to banks' shareholders from risk-shifting are likely to be lower than for bottom group but still non-trivial, as these banks have not likely deteriorated to the point of attracting significant regulatory scrutiny. Given these considerations, we expect that the impact of loan provisioning practices on risk-shifting behavior will be significantly more pronounced for banks with book capital less than 10% relative to those that are greater than 10%.

Columns 1–3 of Table 5, panel A, report estimation of risk-shifting within each capital partition. Risk-shifting is most significant in the 7–10% capital range, although there is modest evidence of risk-shifting in both the below 7% and above 10% partitions. We next run risk-shifting regressions that include interactions of *Smoothing* and *Forward-NPL* with risk and control variables. For capital greater than 10%, the coefficients on both interactions are not statistically different from zero, indicating that loan provisioning does not impact risk-shifting in this range. For the lower capital ranges, the *Smoothing* interaction is positive and significant in both the 7–10% and the less than 7% capital ranges, indicating that smoothing exacerbates risk-shifting in both ranges. Similarly, *Forward-NPL* reduces risk-shifting in both the low capital partitions.

In Table 5, panel B, we measure performance using banks' return on equity (*ROE*). We sort banks into *ROE* quintiles and designate the top quintile as good performers and the bottom as poor performers. The first two columns of panel B show that for poor performers, the coefficient on the change in risk is 0.1164 (p-value <0.01), indicative of poor performers having strong incentives to risk-shift. In contrast, for the high *ROE* group, the coefficient on the change in risk is not significantly different from zero. Turning to provisioning practices, for the high *ROE* group the coefficient on the *Smoothing* interaction term is insignificantly different from zero and *Forward-NPL* is only marginally different at the 0.10 level. In contrast, for the low *ROE* group *Smoothing* increases observed risk-shifting (0.2475, p-value <0.05), while *Forward-NPL* significantly reduces observed risk-shifting (-0.3412, p-value <0.01).

3.6. Robustness

3.6.1. Correlated omitted Variables

To address correlated omitted variable concerns, we rerun our risk-shifting specification in Table 4 and include a wider range of control variables that may affect risk-shifting (all variables are defined in Appendix A). We include a measure of the general securities market disclosure in a country from La Porta et al. (2006) (*Disclosure*), and a proxy for whether there is a high prevalence of state owned banks in the country (*StateBank*). To control for cross-country differences in shareholder rights, we follow La Porta et al. (1998) and include a proxy for shareholder rights (*Rights*). Because the risk-shifting analyses relies on market prices, we control for development of equity markets by including the country's market liquidity (*Liquidity*) (La Porta et al., 2006), and the country's total stock market capitalization (*MrktCap*). The results reported in Table 6 show that our results on provisioning practices are robust to inclusion of these variables.

3.6.2. Alternative measures of Smoothing and Forward-NPL

To examine the robustness of our results to our proxies for discretionary provisioning, *Smoothing* and *Forward-NPL*, we try four alternative proxies: (a) Instead of setting point estimates of *Smoothing* and *Forward-NPL* equal to zero for those

point estimates not statistically different from zero, we use the reported point estimate. (b) As an alternative to using the magnitude of the coefficient estimates, we use the incremental adjusted R^2 from *Ebllp* (ΔNPL_{t+1}) in estimating Eq. (1). To incorporate the directional relationship we sign the incremental R^2 using the sign of the coefficient; (c) we dichotomize both *Smoothing* and *Forward-NPL* at the median; and (d) we re-estimate Eq. (1) while including current loan growth and the level of the beginning loan loss reserve. Untabulated results show that all inferences are robust to all four alternative specifications.

3.6.3. Differences in market efficiency

Another issue revolves around the fact that we use stock prices to extract estimates of the market value of assets, *V*, and risk, $\Delta\sigma_v$. As noted by Griffin et al. (2007), there can be differences across countries in market efficiency. To the extent market efficiency differs across countries, our estimates of *V* and $\Delta\sigma_v$ could embed measurement error that varies with market efficiency, and this measurement error could be correlated with our estimates of *Smoothing* and *Forward-NPL*. Following Griffin et al. (2007), we split countries into developed and undeveloped markets. In untabulated results we find that our results are not driven by cross-country differences in market efficiency.

3.6.4. Sample composition and simultaneity

Consistent with prior research, a large proportion of our sample consists of banks from Japan and the US. For the U.S. and Japan we randomly select 100 firm-year observations from each country, and using these observations along with complete observations from all other countries in the analyses, we find that all results are robust. To verify that our results are not attributable to any one country, we re-run all analyses sequentially excluding a different county each time. In untabulated results we find that that the results presented in Tables 3–6 are qualitatively robust in all specifications.[20] As a last robustness test, we investigate potential simultaneity bias. Following prior research (Hovakimian and Kane, 2000; Hovakimian et al., 2003) we test for this bias using a Hausman Test and, consistent with prior literature, find no evidence of simultaneity.

4. Summary and conclusions

This paper explores consequences of discretionary loan loss provisioning for the role of accounting information in supporting discipline of bank risk-taking. Using a large sample of banks from 27 countries, we isolate two distinct aspects of discretionary loan provisioning practices within each country that reflect forward-looking orientation. We estimate one measure that is *implicitly* forward-looking, smoothing, and one measure that captures the extent to which current period provisions *explicitly* anticipate future changes in non-performing loans. We document that discretionary provisioning in the form of earnings smoothing dampens disciplinary pressure on risk-taking, consistent with smoothing reducing bank transparency and inhibiting monitoring by outsiders. In contrast, provisioning that captures the extent to which provisions explicitly anticipate future changes in non-performing loans is associated with enhanced discipline of bank risk-taking.

A main message of our paper is that discretion over bank loan loss provisioning can have beneficial or negative real consequences for the discipline of bank risk-taking, depending specifically on how managers exploit available discretion to shape loan loss provisions. While discretionary smoothing via loan loss provisions (implicit forward-lookingness) dampens discipline over bank risk-taking, explicit forward-lookingness that captures the extent to which current provisions anticipate future deteriorations in the loan portfolio enhances discipline. Although we cannot speak directly to a comparison of the incurred loss model with specific alternative models proposed by bank policy makers, our results strongly suggest that great care must be exercised with respect to allowing more discretion into loan provisioning. Proposals to increase discretion in loan loss accounting embed significant risks of unintended consequences, as gains from reducing pro-cyclicality may be swamped by losses in transparency that dampen market discipline and increase the scope for less prudent risk-taking by banks.

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[20] It is interesting to note that our results are robust to excluding Spain, which at some points during our sample period employed a dynamic provisioning regime (e.g., Fernández de Lis et al., 2001).

Appendix A

See Table A1.

Table A1

Variable	Description	Reference/source
Smoothing	Defined as the country-level coefficient on *Ebllp* from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise	
Forward-NPL	Defined as the country-level coefficient on ΔNPL_{t+1} from model (1) for those countries with a coefficient statistically different from zero and 0 otherwise	
LLP	The reported loan loss provision on the income statement the end of the period scaled by lagged total loans outstanding	Bankscope
Ebllp	Earnings before taxes and loan loss provisions scaled by lagged total loans	Bankscope
ΔNPL	The change in non-performing loans over the reporting period scaled by total loans outstanding	Bankscope
CAP	Book value of equity reported at the end of the period scaled by end of period total assets	Bankscope
Size	Natural logarithm of total assets	Bankscope
$\%\Delta GDP$	Percentage change in GDP per capita	World Development Indicators
Official	An index computed from answers to the following questions: (a) Does the supervisory agency have the rights to meet with external auditors to discuss their reports without the approval of the bank? (b) Are auditors required by law to communicate directly to the supervisory agency and presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (c) Are off-balance sheet items disclosed to the supervisors? Can supervisors: (d) take legal action against external auditors for negligence? (e) force a bank to change its internal organizational structure? (f) order a bank's directors or management to constitute provisions to cover actual or potential losses? (g) suspend the directors' decision to distribute bonuses? (h) suspend the director's decision to distribute management fees? (i) Who can legally declare – such that this declaration supersedes some of the rights of shareholders – that a bank is insolvent? (j) According to the Banking Law, who has authority to intervene – that is, suspend some or all ownership rights – a problem bank? Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency: (k) supersede shareholder rights? (l) remove or replace management? and (m) remove and replace directors?	Barth et al. (2006, 2007)
CapIndex	A composite measure that captures both the amount of capital and verifiable sources that a bank is required to possess. The index is created from a answers to the following questions as of 2003: (1) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (2) Can the initial disbursement of subsequent injections of capital be done with assets other than cash or government securities? (3) Can initial disbursement of capital be done with borrowed funds? (4) is the minimum capital-asset ratio risk-weighted in line with the Basel guidelines? (5) Does the minimum ratio vary as a function of market risk? (6) Are market value of loan losses not realized in accounting books deducted? (7) Are unrealized losses in securities portfolios deducted? (8) Are unrealized foreign exchange losses deducted?	Barth et al. (2006, 2007)
Private	A composite index comprises answers to the following questions: (1) is there an explicit deposit insurance protection scheme? (2) Does accrued, though unpaid interest/principal enter the income statement while the loan is still non-performing? (3) Are financial institutions required to produce consolidated accounts covering all bank and any non-financial subsidiaries? (4) Must banks disclose their risk management procedures to the public? (5) Are all of the top ten banks in the country rated by international credit rating agencies?	Barth et al. (2006, 2007)
Judicial	Assessment of the "efficiency and integrity of the legal environment as it affect business, particularly foreign firms" produced by the country-risk rating agency Business International Corporation. Average between 1980 and 1993. Scale between 0 and 10, with lower scores implying lower efficiency levels	La Porta et al. (1998)
$\Delta\sigma_v$	The change in the underlying risk of the assets, see Appendix B for computation details	Ronn and Verma (1986)
$\Delta D/V$	The change in the face value of debt as of the end of the fiscal period divided by the market value of the assets (see Appendix B for computation details)	Ronn and Verma (1986)
ROE	Return on equity defined as earnings before taxes scaled by owner's equity.	Bankscope
Disclosure	A measure of disclosure created from components of the general securities law disclosure requirements	La Porta et al. (2006) (LLS)
StateBank	Share of the assets of the top 10 banks in a given country owned by the government of that country	La Porta et al. (2002)
Rights	A summary measure of shareholder rights in a country, measured as the number of important shareholder rights that exist in the country's legal code	La Porta et al. (1998)
Liquidity	The average total value of stocks traded as a percentage of GDP for the period 1996–2000	WDI/LLS
MrktCap	The countries total market capitalization divided by GDP	WDI
EfficientMrkt	And indicator variable equal to 1 if the market is developed and 0 otherwise	Griffin et al. (2007)

Appendix B. Estimating *V*, σ, and *IPP*

We follow Ronn and Verma (1986) to estimate the market value of assets, V, the instantaneous standard deviation of the rate of return on the value of the bank's assets, σ, and the fair value of the deposit insurance put-option per dollar of deposit, *IPP*.

We first obtain values for V and σ by solving two equations simultaneously. The solutions from these two equations are then used to calculate *IPP*. Following prior research, we make the following assumptions: (1) deposits equal the total liabilities of the bank; (2) asset values follow a geometric Brownian motion; and (3) the time to maturity is the time to the next audit this way the guarantor can treat the deposits as if they were term and interest bearing.

The first equation states σ as a function of market value of equity (E), asset value (V), and the instantaneous standard deviation of return on equity over the prior twelve-month period (σ_E):

$$\sigma_v = \frac{\sigma_E E}{VN(x)}, \tag{a}$$

where

$$x \equiv \frac{\ln(V/\rho D)+\sigma_v^2 T/2}{\sigma_v\sqrt{T}}.$$

$N(*)$ is the cumulative density of a standard normal random variable. ρ is the forbearance parameter to capture regulators desire to stay the exercise of the option in hopes of a recovery in the bank. Following prior research we set this parameter equal to 0.97, which allows the asset value to deteriorate to 97% of debt value before the option is called. T is the unit of time until the next audit, which is set equal to 1.

The second equation is the option formulation of equity value, E. Following Merton (1977) and Ronn and Verma (1986) we model the market value of the bank's equity as

$$E = VN(x)-\rho DN(x-\sigma_v\sqrt{T}), \tag{b}$$

where all variables are defined previously.

We simultaneously solving (a) and (b) for V and σ, and use these values to solve for fair value of the deposit insurance put-option, *IPP*, as derived by Merton (1977):

$$IPP = N(y+\sigma_v\sqrt{T})-(1-\delta)^n\left(\frac{V}{D}\right)N(y), \tag{c}$$

where

$$y \equiv \frac{\ln[D/V(1-\delta)^n]-\sigma_v^2 T/2}{\sigma_v\sqrt{T}}.$$

The parameter δ is the dividend per dollar of asset value, paid n time per period. The resulting *IPP* is the deposit insurance put-option (or actuarial fair insurance premium) per dollar of deposits.

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