The Effect of Fair vs. Book Value Accounting on Banks*

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Abstract

This paper studies the effect of book versus fair value accounting on a bank's (re)investment behavior, risk of default, investment value, and the need for regulation. Adopting the wide–spread view that fair value accounting increases disclosure and reduces the degree of asymmetric information, we show that fair value accounting increases the liquidity of financial assets. Consequently, it intensifies risk shifting and, therefore, increases the need for regulation and the risk of default. For highly leveraged institutions the increased risk shifting under fair value accounting outweighs an underinvestment effect of book value accounting and ultimately reduces welfare.

Keywords: fair value accounting, book value accounting, disclosure, asymmetric information, banking regulation, liquidity
JEL Classification No.: G21, G28, M41

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1 Introduction

The current change from book value accounting, under which the balance sheet lists financial positions at initial costs, towards fair value accounting, under which financial instruments are listed at the present value of their expected cash flows, marks a fundamental change in accounting rules.[1] The change is meant to improve the informational position of capital markets and regulators. It is argued that this reduction in the degree of asymmetric information leads to more market discipline and thereby facilitates the regulation of banks.[2] In contrast, this paper argues that a reduction of asymmetric information between the capital market and banks may actually intensify the bank's risk shifting behavior and therefore increases the need for regulation.[3] Moreover, risk shifting increases the bank's probability of default and reduces its net present value.

Our argument is based on the reasoning that the well–known risk shifting behavior of debt (e.g. Jensen and Meckling 1976) is more severe under fair value accounting than under book value accounting. The reasoning is as follows: If a move towards fair value accounting improves the informational position of the market, then it reduces the asymmetry of information between the bank and the market. This reduction in asymmetric information increases the liquidity of assets and, thereby, enlarges the bank's investment opportunities. In particular, fair value accounting enables the bank to follow a riskier investment behavior. Such behavior leads to a higher probability of default and a reduction in the bank's overall value.

The fact that fair value accounting leads to a higher liquidity of the bank's assets is due to Akerlof's lemon problem: Under book value accounting the bank possesses private information about the quality of its assets and the market can

[1]For more details see Financial Accounting Standards Board (1997) and Joint Working Group of Standard Setters (2000). Enria et al. (2004) offers a summary of the prevailing arguments in favor and against fair value accounting.

[2]Although fair value accounting applies to all types of firms, it has an especially large impact on banks, because the balance sheets of these financial institutions are dominated by financial instruments. We therefore concentrate our analysis on banks.

[3]See Dewatripont and Tirole (1994, p.31) and Freixas and Rochet (1997, Ch. 9) for why risk shifting behavior is one of the main rationales for regulating banks.

therefore not distinguish between good and bad assets. Hence, it is willing to pay at most an average price, which effectively results into a discount for good assets. The discount deters banks from selling high quality assets and, hence, decreases the liquidity of such assets. Since fair value accounting reduces the asymmetric information between the bank and the market, it increases the liquidity of high quality assets.

We identify fair value accounting with a higher degree of disclosure. It reflects the idea that fair value accounting can only improve the informational position of outsiders if it leads to more disclosure of private information. This view is consistent with that of the Joint Working Group of standard setters (JWG), who define the fair value of a financial instrument as the present value of its expected cash flows under *all available information*.[4] We want to stress that we do not investigate how accounting may achieve such disclosure.[5] Rather, our intention is to show that even if fair value lives up to its ideal of achieving full transparency at zero costs, it increases rather than decreases tensions between regulators and banks. In order to show this rigorously, we sidestep all disclosure problems and take an idealized view of fair value accounting: fair value accounting achieves full transparency. In contrast, book value accounting is, by assumption, an intransparent situation in which the bank retains some private information. Under these ideal circumstances we show that tensions between regulators and banks are higher under fair value accounting. Our argument against fair value accounting therefore does not depend on some form of transaction costs that prevents a disclosure of private information and frustrates fair value accounting.

Since our paper assumes a direct relationship between accounting rules and information structure, it distinguishes itself from other work that points to economic drawbacks of fair value accounting.[6] In particular, O'Hara (1993) focuses

[4]For a formal definition of fair value see for instance Draft Standard & Basis for Conclusions Section 1.8b of the JWG: http://www.standardsetter.de/drsc/docs/drafts/iasb/jwg-paper_conclusions.pdf.

[5]For theoretical work on how fair value accounting may increase transparency, see for instance Barth and Landsman (1995) and Finnerty and Grant (2002).

[6]See Christensen and Demski (2002) for a theory of accounting based on the view that it affects the information structure.

on the choice of maturity and demonstrates how fair value accounting distorts the incentive of firms towards short–term assets. In contrast, Plantin et al. (2004) show how marking–to–market accounting leads to an artificial volatility of market prices.[7] The volatility reduces the informativeness of prices, which leads to economic inefficiencies. On a different note Freixas and Tsomocos (2004) demonstrate that the increased volatility of fair value accounting frustrates the bank's economic role of intertemporal smoothing. For smoothing reasons, book value accounting may therefore be preferred.

The rest of the paper is organized as follows. Section 2 introduces the framework in which we demonstrate our results formally. In Section 3 we abstract from the issue of moral hazard and study the behavior of a non–leveraged "bank". We show that in this case fair value accounting is welfare improving. It raises the bank's value, because it solves an underinvestment problem that occurs under book value accounting. Section 4 builds on the analysis of Section 3 and focuses on the moral hazard problem of a leveraged bank. It shows that the moral hazard problem is more severe under fair value accounting. More specifically, for highly leveraged banks this negative effect of fair value accounting outweighs the positive effect identified in Section 3. To illustrate our formal results Section 5 presents a numerical example. Section 6 argues that the case for fair value accounting is even weaker when there is no deposit insurance. Section 7 concludes. All formal proofs are relegated to the appendix

2 The Framework

Consider a banking supervisor, S, who in period $t = 0$ must decide whether a bank, B, has to use book value accounting (b), or fair value accounting (f), i.e. S chooses $a \in \{b, f\}$. Under book value accounting assets are recorded at their initial value of purchase and are completely uninformative. In contrast, if fair value accounting is chosen, the bank's book lists assets according to their fair value, i.e., the present value of the expected cash flows under all available

[7] As we emphasize in the conclusion and noted already by O'Hara (1993), in markets with asymmetric information there exists an important difference between fair value accounting and marking–to–market accounting.

information. We take the ideal case of fair value accounting that all valuation problems, including possible manipulation of information, are solved. That is, under fair value accounting the bank reveals all its private information so that the asymmetry of information between the bank and other parties is completely resolved.[8] Effectively, the accounting method determines the information structure between the bank and other parties. Under book value accounting the bank is better informed about the prospects of its assets, whereas under fair value accounting this information is shared with all other participants.

The bank operates for two consecutive periods $t = 1, 2$. In period $t = 1$ the bank may invest in project 1, which requires a fixed amount of size $I_1 = 1$.[9] The project matures after period $t = 2$. Initially, it is known that the project is successful with probability p_1, in which case it yields a cash flow of h_1. A failure of the project occurs with probability $1 - p_1$ and leads to a cash flow of $l = 0$. To make the initial investment non–trivial, we assume that the probability of success is high enough to recoup the initial investment of $I_1 = 1$, i.e., $h_1 > 1/p_1$.

At the beginning of period $t = 2$ the bank has a possibility to invest in a second project, which also matures at the end of period $t = 2$. For convenience we assume that this project is scalable and the bank may invest any amount $I_2 > 0$. The project is successful with probability j in which case it yields a cashflow of h_2 per invested amount, where $h_2 > h_1$. If the project fails, which occurs with probability $1 - j$, it yields zero. In period $t = 0$ it is only known that the probability of success j is uniformly distributed on $[0, 1]$. Importantly, we assume that the bank cannot raise new capital to invest in project 2. That is, if the bank wants to invest in project 2, it has to sell (part of its) first project in a competitive market.[10]

[8]As discussed in the introduction, we do not explain how this difference between book and fair value comes about. Rather we simply follow the prevailing view that fair value increases transparency. This effectively implies that fair value accounting tends to resolve asymmetric information. We comment on this prevailing view in the final section.

[9]We view the bank's investment as an initially unmarketable bank loan to which only the bank has access due to its superior screening possibilities.

[10]It is exactly this assumption which creates a role for the liquidity of the bank's initial assets. An alternative interpretation is that the bank securitizes the loan. Under this interpretation

The bank finances its initial investment $I_1 = 1$ through private capital e and deposits d, i.e., $e + d = 1$. We assume that depositors are protected by deposit insurance. This assumption is not crucial.[11] It simplifies the exposition and is relaxed in Section 6. Normalizing the market's interest rates to zero, deposit insurance implies that depositors will demand a return that matches their initial deposit d.

After investing the bank learns some private information $i \in \{g, b\}$ about project 1. With probability q the information is good which means that the probability of success of project 1 rises from p_1 to p_g. If, on the other hand, the bank receives bad information, which occurs with probability $1-q$, the probability of success of project 1 reduces to p_b, where $p_g > p_1 > p_b$.[12] Hence, as of this stage there exist two types of banks: Good banks that received good information and hold a project which succeeds with probability p_g and bad banks which hold a project that succeeds with the lower probability p_b.

At the end of period $t = 1$ the bank publishes its accounts according to the accounting rule set in period $t = 0$. That is, if the bank is required to use fair value accounting, a good bank's capital is listed as $e_g^f = p_g h_1 - d$, whereas a bad bank's statement displays $e_b^f = \max\{0, p_b h_1 - d\}$. Clearly, $e_g^f > e_b^f$ and market participants can deduce the bank's type from its accounts. If the bank uses book value accounting, its accounts show $e^b = 1 - d$ and are independent of the bank's type so that this remains private information.

At the beginning of period $t = 2$ the bank learns the probability of success, j, of the second project and must decide whether it wants to finance it. As mentioned, the investment is only possible if the bank decides to sell (part of) its first project. Since the second project is fully scalable, it can invest the entire

the accounting method affects the informational position of the institution that securitizes the loan and therefore the revenue from securitization.

[11]John et al. (1991) explain that the risk shifting effect does not depend on whether the bank pays the fair price of the deposit insurance, but on the fact that its price is not contingent on the bank's behavior. Hence, the question of a fair price of the deposit insurance is not directly related to our concerns and we abstract from it (see also Chan et. al. (1992) and Freixas and Rochet (1997, p. 266–272)).

[12]Statistical consistency requires $p_1 = qp_g + (1-q)p_b$.

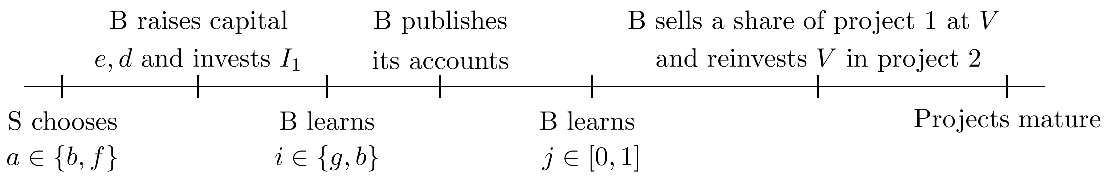

Figure 1: Time line

proceeds V into the second project. In this case, $I_2 = V$. Clearly, the bank will only use this reinvestment opportunity, if it expects to gain from it. That is, only if V and j are large enough.

At the end of period 2 both projects mature and the bank receives the proceeds r from its investments. It reimburses from these proceeds the depositors for their share d. If $r < d$ the deposit insurance reimburses the depositors for a share $d - r$. Figure 1 summarizes the different stages in a time line.

3 All Equity

In order to develop some intuition about the model we first investigate the bank's investment behavior when it is fully funded by equity. That is, we analyze the bank's behavior for $d = 0$. In this case there does not exist a moral hazard problem concerning the bank's investment's behavior. This section shows that fair value accounting has a positive effect, because it resolves an underinvestment effect that occurs under book value accounting.

We may solve the model backwards. In period $t = 2$ the bank observes the probability of success j and has to decide whether to sell its stake in the first project and to reinvest it in the second project. This is profitable if the expected profit of the new project is larger than the expected profit of the old project. That is, given the bank's information $i \in \{b, g\}$ and its ability to sell its first project at a price V a swap of projects is profitable if

$$jVh_2 \geq p_i h_1.$$

Clearly, the proceeds V of the sell–off play a crucial role in the bank's reinvestment decision.

Given that the regulator required the bank to use fair value accounting, there does not exist any asymmetry of information between the bank and capital markets. More specifically, the bank's information $i \in \{b, g\}$ about whether the first project is a good or a bad project is shared with the market. Hence, a bank of type $i \in \{b, g\}$ is able to sell its first project at the fair price $V_i = p_i h_1$. It follows that the bank will swap projects if and only if the probability of success j exceeds the critical level of

$$j_i^f \equiv \frac{1}{h_2}.$$

We note that the critical level is independent of the bank's type: $j_b^f = j_g^f$.

Under book value accounting the sale of the old project differs. In this case, the bank's balance sheets are uninformative about the quality of the first project and the capital market cannot deduce its actual value. In contrast to an accounting at fair value, the market cannot make its price V contingent on the bank's information i. Instead, it can only offer a uniform, average price that is consistent with its belief about the offered quality. Hence, as in Akerlof (1970)'s lemon's problem good projects will be sold at a discount. If this discount is too large, adverse selection occurs in that only projects with the low valuation $p_b h_1$ are offered to the market:

Proposition 1 *If $p_b h_2 < p_g$, there exists a market equilibrium in which only a bank holding a bad project sells its project at a market price $V = p_b h_1$.*

Indeed, given that the market offers to buy projects at a price $V = p_b h_1$, the discount for a good project is $(p_g - p_b)h_1$. That is, if $p_b h_2 < p_g$ then even a bank which is sure that the second project succeeds ($j = 1$) is unwilling to sell the first project to invest in the second one.[13] In fact, the critical probability, j_g^b, that

[13]Proposition 1 only shows the existence of the equilibrium and not uniqueness. It may, however, be shown that an equilibrium in which banks that hold a good investment sell their project does not exist if, quite intuitively, h_2 is small enough or, more precisely, if $p_g/p_b > (2\sqrt{h_2} + h_2 - 1)/(2\sqrt{h_2} - h_2 + 1)$.

would make a good bank indifferent about the reinvestment opportunity exceeds one:

$$j_g^b p_b h_1 h_2 = p_g h_1 \;\Rightarrow\; j_g^b \equiv \frac{p_b h_2}{p_g} > 1.$$

In the remainder of this paper we assume $p_b h_2 < p_g$ and focus on the equilibrium of Proposition 1.[14]

Consequently, under book value accounting only a bad bank would want to reinvest. In fact, it will do so exactly when $j p_b h_1 h_2$ exceeds $p_b h_1$. That is, whenever the probability of success j exceeds the critical level of

$$j_b^b \equiv \frac{1}{h_2}.$$

The cut–off values j_i^a describe the reinvestment behavior of the different banks $i \in \{g, b\}$ under the two accounting rules $a \in \{b, f\}$. Since, under book value accounting, a good bank does not reinvest even for $j > p_g$ we arrive at our first result:

Proposition 2 *Book value accounting leads to an underinvestment by the bank and a welfare loss as compared to fair value accounting.*

Apart from the influence on investment behavior financial regulators will be especially interested in the bank's default probabilities under the two alternative accounting schemes. We say that the bank defaults when its projects fail. The probability of default therefore coincides with the probability that the returns are zero. Thus, we may identify the effect of accounting rules on the default probability by considering the different cash flow distributions.

Figure 2 displays the overall cashflow distribution under fair value accounting. The probability of default under fair value accounting, k^f, computes as

$$\begin{aligned} k^f &= q\left[j_g^f(1-p_g)+(1-j_g^f)\int_{j_g^f}^1 \frac{1-j}{1-j_g^f}dj\right]+(1-q)\left[j_b^f(1-p_b)+(1-j_b^f)\int_{j_b^f}^1 \frac{1-j}{1-j_b^f}dj\right] \\ &= q\left[j_g^f(1-p_g)+\frac{1}{2}(1-j_g^f)^2\right]+(1-q)\left[j_b^f(1-p_b)+\frac{1}{2}(1-j_b^f)^2\right]. \end{aligned}$$

[14] Qualitative results remain unchanged, but become less tractable, for $p_b h_2 > p_g$. In this case a good bank may sell its first project, but will still receive a discount. This discount causes a difference between j_g^b and j_g^f on which all our results ultimately depend.

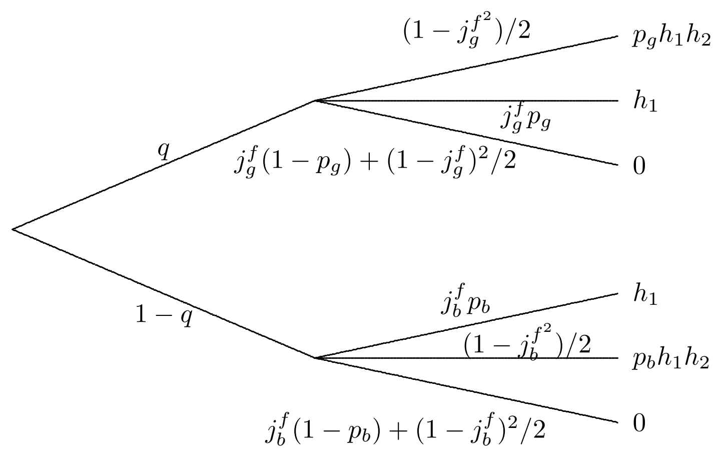

Figure 2: Cashflow distribution under fair value accounting

Similarly, Figure 3 represents the probability distribution of cashflows under book value accounting. The corresponding probability of default, k^b, may be calculated as

$$
\begin{aligned}
k^b &= q(1-p_g)+(1-q)\left[j_b^b(1-p_b)+(1-j_b^b)\int_{j_b^b}^{1}\frac{1-j}{1-j_b^b}dj\right] \\
&= q(1-p_g)+(1-q)\left[j_b^b(1-p_b)+\frac{1}{2}(1-j_b^b)^2\right].
\end{aligned}
$$

Proposition 3 *The probability of default under book value accounting is larger than under fair value accounting if and only if* $1-p_g > p_g - j_g^f$.

Proposition 3 shows that the accounting method has an ambiguous effect on the bank's default probability. Hence, fair value accounting does not automatically lead to a lower probability of default. The intuition behind this result is best understood by considering Figure 4, which depicts the probability distribution of default of a good bank. For the range $[0, j_g^f]$ there is no difference, because regardless of the accounting method, the bank does not swap investment projects and the probability of default is simply $1-p_g$. But at j_g^f a good bank using fair value accounting would sell its first investment to invest in the second one. Since $j_g^f < p_g$ the probability of default rises from $1-p_g$ to $1-j_g^f$ as compared to a good

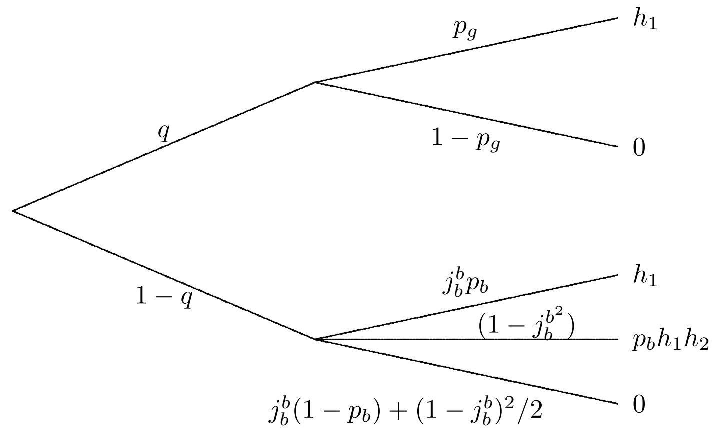

Figure 3: Cashflow distribution under book value accounting

bank that, due to book value accounting, never reinvests. On the other hand, for values of j exceeding p_g the reinvestment decision under fair value accounting actually lowers the probability of default. Triangle A displays the increased probability of default, while triangle B represents the decreased probability of default. As the investment behavior of bad banks is independent of the accounting method ($j_b^b = j_b^f$), the difference of the two areas reflects the difference in the two probabilities. Due to the uniform distribution of j, the difference translates to $1 - p_g > p_g - j_g^f$ as stated in Proposition 3.

4 Deposits and Equity

In this section we consider a more typical bank that is financed by deposits rather than equity alone. This leads to problems of moral hazard in the bank's investment behavior, because the bank will take decisions that maximize the payoff of the owners, i.e., equity holders, and neglect the effect on depositors.[15] Jensen and Meckling (1976) argue that moral hazard leads to a riskier investment behavior and, thereby, leads to an important rationale for a regulation of banks. This section shows that the negative risk shifting effect may outweigh the posi-

[15] We abstract from additional problems of moral hazard between the bank's owners and its management.

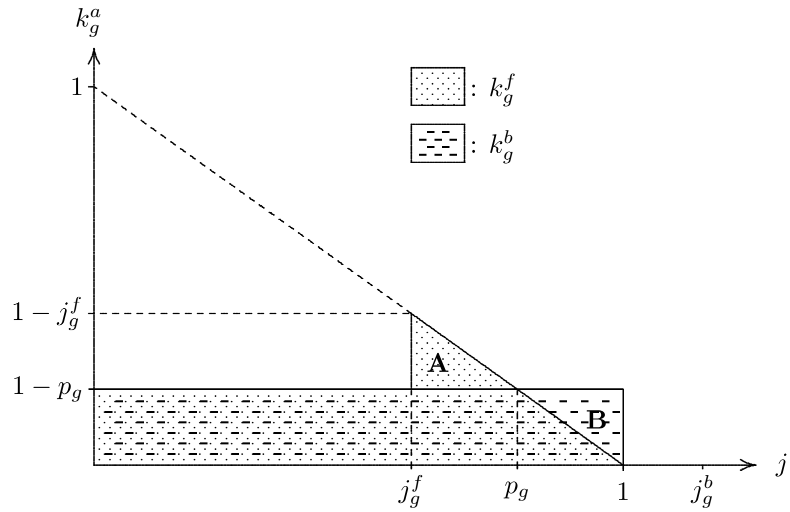

Figure 4: Default probability distribution of a good bank

tive effect identified in the previous section that fair value accounting solves an underinvestment problem.

A funding by deposits changes the bank's payoff function as compared to the previous section. More precisely, given the bank's deposits d and a final cash flow of r, the bank receives an amount $\max\{0, r - d\}$.

Again we proceed by computing the critical success probabilities to determine the bank's investment behavior. Under fair value accounting the capital market can deduce the bank's information $i \in \{g, b\}$ from its accounts and the bank is able to sell its assets at the fair price $V_i = p_i h_1$. To a good bank, a successful reinvestment therefore yields $p_g h_1 h_2 - d > 0$. We conclude that the expected payoff from switching the investment is $j(p_g h_1 h_2 - d)$, whereas the expected payoff from holding onto the initial investment is $p_g(h_1 - d) > 0$. Reflecting the moral hazard effect of debt, the critical success probability at which a bank wants to reinvest is now a function of the deposits d. In particular, a bank using fair value accounting and holding a good investment reinvests only if the probability of success, j, exceeds the threshold value

$$j_g^f(d) = \frac{p_g(h_1 - d)}{p_g h_1 h_2 - d}. \tag{1}$$

Note that for any debt level $d \in (0, 1)$ the threshold value $j_g^f(d)$ is smaller than 1.[16]

In contrast, a bank holding a bad project can sell its first investment only at the lower price $p_b h_1$. The expected payoff from switching the investment is $j(p_b h_1 h_2 - d)$, whereas the expected payoff from holding onto the initial investment is $p_b(h_1 - d)$. The truncated threshold value $j_b^f(d)$ above which a bad bank wants to reinvest satisfies

$$j_b^f(d) = \begin{cases} \frac{p_b(h_1-d)}{p_b h_1 h_2 - d} & \text{, if } d < \tilde{d} \equiv \frac{p_b h_1(h_2-1)}{1-p_b} \\ 1 & \text{, otherwise.} \end{cases} \tag{2}$$

The truncation at $\tilde{d}$ reflects the fact that for larger debt levels a bad bank will not even want to reinvest when the probability of success, j, is one.

We next turn to the behavior under book value accounting. First, we argue that Proposition 1 remains valid; due to the adverse selection problem, the market will value assets at the lower price $p_b h_1$. Indeed, if the resale value of the asset is $V = p_b h_1$, the expected payoff from switching the investment is $j(p_b h_1 h_2 - d)$. To a good bank the expected payoff from holding onto the initial investment is $p_g(h_1 - d)$. But since $p_g > p_b h_2$ it follows that $p_b h_1 h_d - d < p_g h_1 - d < p_g(h_1 - d)$ so that, even for a success probability of $j = 1$, a good bank will not want to swap investments. A rational market, which anticipates that a good bank will never offer its investment for sale, will correctly price any asset at $V = p_b h_1$. Thus we conclude that, under book value accounting, the price $V = p_b h_1$ is still an equilibrium price. Proposition 1 remains valid also with debt finance: good banks never reinvest. The truncated threshold value $j_g^b(d)$ is

$$j_g^b(d) = 1.$$

[16]This follows because, due to $d(1 - p_g) < 1 - p_g < 1 - 1/h_2 = (h_2 - 1)/h_2 < h_2 - 1 < h_1 p_g(h_2 - 1)$, the numerator in (1) is smaller than the denominator.

Under book value accounting the resale value V equals $p_b h_1$, which, to a bad bank, is equivalent to its resale value under fair value accounting. As a result, the threshold value $j_b^b(d)$ and $j_b^f(d)$ coincide.

Again, one may calculate the probabilities of default under fair value accounting. In particular, the probability of default under fair value accounting is

$$k^f(d)=q\left[j_g^f(d)(1-p_g)+\frac{1}{2}(1-j_g^f(d))^2\right]+(1-q)\left[j_b^f(d)(1-p_b)+\frac{1}{2}(1-j_b^f(d))^2\right] \tag{3}$$

whilst the default probability, $k^b(d)$, under book value accounting equals

$$k^b(d)=q(1-p_g)+(1-q)\left[j_b^b(d)(1-p_b)+\frac{1}{2}(1-j_b^b(d))^2\right]. \tag{4}$$

A comparison of the default probabilities yields the following insight.

Proposition 4 *The probability of default increases with the size of deposits d. The increase is greater under fair value accounting than under book value accounting.*

The first part of the proposition is the well–known risk shifting effect due to debt financing (e.g. Jensen and Meckling (1976) and Barnea et al. (1985)) and needs little discussion. More interestingly, the second part of the proposition reveals that the size of the increase depends on the accounting method. In order to understand why fair value accounting leads to a sharper increase in the probability of default it is helpful to consider the effect of depositors on bad and good banks separately.

First, consider a bank holding a bad project at the end of period $t=1$. Independent of the accounting method $a \in \{f, b\}$, deposits increase the threshold $j_b^a(d)$ at which the bad bank is willing to swap investments. This increase represents the risk shifting effect. Since, as illustrated in Figure 5, it holds $j_b^a > p_b$, it follows that the probability of default increases by an area A.[17] We emphasize that the magnitude of the increase does not depend on the accounting rule $a \in \{b, f\}$. I.e., the risk shifting effect of deposits on bad banks is identical under fair value and book value accounting.

[17] The inequality $j_b^a > p_b$ follows, due to $1 > p_g > p_b h_2$, from $j_b^a \equiv 1/h_2 = p_b/(h_2 p_b) > p_b/p_g > p_b$.

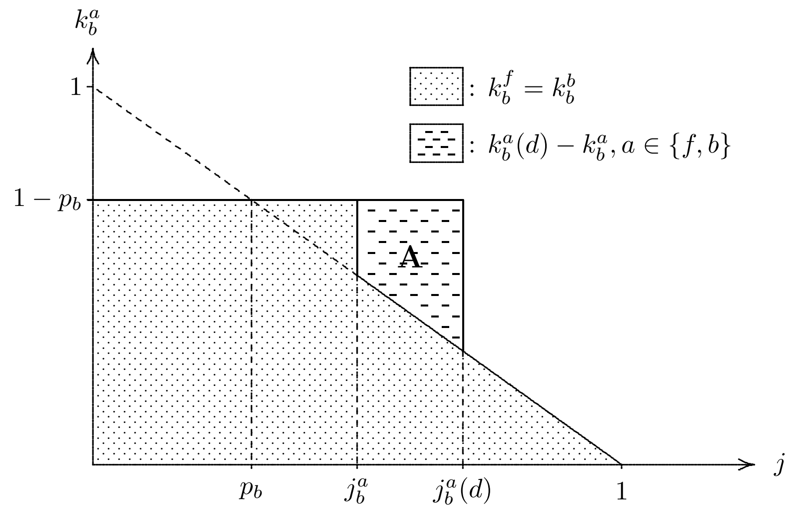

Figure 5: Default probability of bad banks

For good banks, however, the occurrence of risk shifting does depend on the accounting method. A good bank using book value accounting will, due to the lemon's problem, never sell its investment to reinvest. Hence, its (non)reinvestment behavior is independent of the size of the deposits d and, for good banks, deposits do not lead to risk shifting.

In contrast, risk shifting does arise under fair value accounting. As illustrated in Figure 6, deposits induce good banks to reinvest at a smaller probability of success, $j_g^f(d) < j_g^f$. But since, from a default perspective, a good bank without any deposits switches already too soon ($j_g^f < p_g$), the even lower threshold $j_g^f(d)$ implies that under fair value accounting deposits increase the probability of default.[18] That is, fair value accounting leads to an increase for both types of banks, whereas book value accounting only increases the probability of default of bad banks. This explains why the default probability rises faster under fair value accounting.

According to Proposition 3 fair value accounting leads to a lower probability of default if $1 - p_g > p_g - j_g^f$. Yet, since the threshold j_g^f decreases with the

[18]Due to $p_g h_2 > p_g h_1 > 1$ it holds $j_g^f \equiv 1/h_2 = p_g/(h_2 p_g) < p_g$.

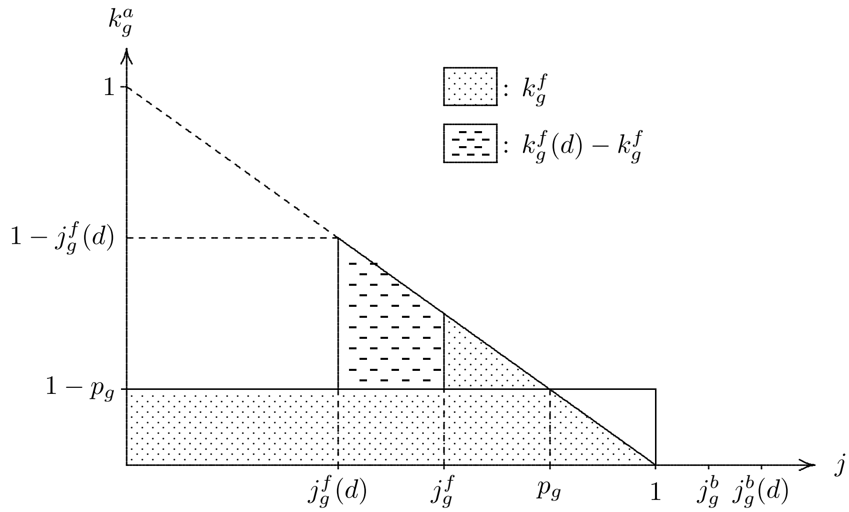

Figure 6: Default probability of good banks

size of deposits d, one may find a cut–off value $\bar{d} > 0$ at which the inequality becomes violated. Fair value accounting leads to a larger probability of default than book value accounting for any debt level that exceeds $\bar{d}$. Figure 6 illustrates this graphically. The probability of default under fair value accounting is smaller than under book value accounting if and only if the distance between p_g and $j_g^f(d)$ is smaller than the difference $1-p_g$. The following proposition derives the cut–off value explicitly.

Proposition 5 *Fair value accounting leads to a larger probability of default than book value accounting whenever the deposits d exceed the threshold $\bar{d}$, where*

$$\bar{d} \equiv \frac{p_g h_1(1 + h_2 - 2p_g h_2)}{1 - p_g}.$$

Proposition 5 implies that for high leveraged banks fair value accounting leads to a higher probability of default than book value accounting. The result is a direct consequence of the second part of Proposition 4: The moral hazard effect induces banks to make riskier investments, i.e., accept higher probabilities of default. Since the moral hazard effect is stronger for fair value accounting, the probability of default increases faster than under book value accounting.

Proposition 2 showed that fair value accounting solves an underinvestment problem and, therefore, increases overall social welfare. Yet, risk shifting leads to an investment behavior that reduces welfare. Hence, the fact that risk shifting is stronger under fair value accounting indicates that for high levels of deposits fair value accounting may lead to lower social welfare despite its solution to the underinvestment problem. To investigate whether the moral hazard effect may indeed outweigh the underinvestment effect, we calculate the expected ex ante value of the investment under the different accounting rules. Under fair value accounting this value computes as

$$\begin{aligned} PV^f(d) &= q\left[j_g^f(d)p_g h_1 + \frac{1}{2}\left(1 - j_g^f(d)^2\right)p_g h_1 h_2\right] \\ &\quad +(1-q)\left[j_b^f(d)p_b h_1 + \frac{1}{2}\left(1 - j_b^f(d)^2\right)p_b h_1 h_2\right]. \end{aligned}$$

Book value accounting yields a value

$$PV^b(d) = qp_g h_1 + (1-q)\left[j_b^b(d)p_b h_1 + \frac{1}{2}\left(1 - j_b^b(d)^2\right)p_b h_1 h_2\right].$$

A comparison of the two values reveals the following result.

Proposition 6 *The present value of the investment decreases with debt d. The decrease is larger under fair value accounting than under book value accounting. The investment's value under fair value accounting is greater than under book value accounting if and only if*

$$d < \hat{d} \equiv \frac{p_g h_1 h_2(h_2 - 1)}{h_2(1 + p_g) - 2}.$$

The proposition shows that the presence of debt may indeed reverse the beneficial effect of fair value accounting that was obtained in Proposition 2. Proposition 6 calculates the exact cut–off value $\hat{d}$ at which the negative risk shifting and the positive investment effect are balanced. From a welfare point of view, book value accounting is preferred to fair value accounting if deposits exceed $\hat{d}$.

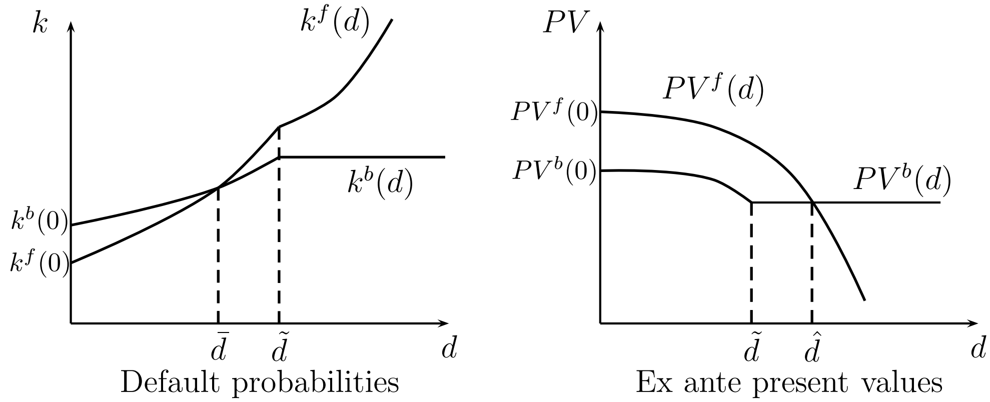

Figure 7: A numerical example.

5 A numerical example

This section illustrates our results in a numerical example. In this example the rate of return on the first project is 8%, whereas the rate of return of the second project is 9%. Good projects fail only with a probability of 5%, whereas bad projects fail with a probability of 15%. The likelihood of a good project is 80%. These parameter values satisfy the restrictions of the model and enable us to illustrate all the salient features of our model. Figure 7 illustrates the results graphically, while Table 1 reports the actual values of the most important variables for some critical debt levels d.

The example confirms our results that, without debt financing, fair value accounting induces an investment behavior that yields a higher ex ante present value: $PV^f(0) > PV^b(0)$. This reflects the positive effect of fair value accounting that it solves an underinvestment problem. In addition, the probability of default is, in our example, smaller under fair value accounting when there is no debt financing: $k^f(0) > k^b(0)$.

Figure 7 illustrates how the default probability rises, as the debt level increases; both curves $k^f(d)$ and $k^b(d)$ are increasing. The important insight, however, is that the curve under fair value accounting, $k^f(d)$, is steeper than the curve

	Example: $q=0.8, p_g=.95, h_1=1.08, h_2=1.09, p_b=.85$,				
	d=0	$d=\bar{d}\approx 0.39$	$d=\tilde{d}\approx 0.55$	$d=\hat{d}\approx 0.8$	$d=0.95$
j_g^f	0.91743	0.9	0.8858	0.83486	0.73363
j_b^f	0.91743	0.96048	1	1	1
j_g^b	1	1	1	1	1
j_b^b	0.91743	0.96048	1	1	1
k^f	0.06763	0.06897	0.07065	0.07430	0.08773
k^b	0.06821	0.06897	0.07	0.07	0.07
PV^f	1.00813	1.00781	1.007	1.0044	0.9994
PV^b	1.00508	1.0049	1.0044	1.0044	1.0044

Table 1: The numerical example with deposit insurance.

under book value accounting, $k^b(d)$. Hence, even though the default probability without debt financing is smaller under fair value accounting, we find a critical value $\bar{d}$ above which the curve $k^f(d)$ exceeds the curve $k^b(d)$; the default probability is smaller for book value accounting. From Table 1 one may learn that this is uniquely due to a different behavior of good banks under the different accounting rules. Under fair value accounting good banks already switch investments when the success probability of the second project exceeds $j_g^f(\bar{d}) = 90\%$. From an efficiency point of view, however, the optimal switching point is $j_g^f(0) \approx 91.7\%$. Due to the risk shifting effect of debt financing, good banks switch too early, thereby raising the default probability. The table shows how this risk shifting effect intensifies as debt rises, exacerbating the downward distortion of the critical threshold j_g^f further. This does not occur under book value accounting, where, due to the lemon's effect, good banks never switch investments, $j_g^b(d) = 1$. Risk shifting does occur for bad banks, but its magnitude is independent of the accounting rule, $j_b^f(d) = j_b^b(d)$.

A further critical debt level is $d = \tilde{d}$, where the risk shifting effect on bad banks becomes so strong, that it keeps also these banks from switching investments: $j_b^f(\tilde{d}) = j_b^b(\tilde{d}) = 1$. Hence, under book value accounting, neither the good banks nor the bad banks will switch investments. As a consequence, the expected present value of the overall investment coincides with the expected present value of the first project and equals 1.0044. This is illustrated in Figure 7, where the curves $k^b(d)$ and $PV^b(d)$ remain flat from $\tilde{d}$ onwards. In contrast, the curve $PV^f(d)$ decreases further, because under fair value accounting the risk shifting effect distorts the behavior of good banks further and further. We find that as of $d = \hat{d}$ the ex ante expected present value of investment behavior is lower under fair value accounting. Note that at $d = 0.95$ the present value has dropped below 1. Hence, given the initial investment outlay $I = 1$, the net present value of the bank's investment behavior is actually negative.

6 No deposit insurance

We analyzed risk taking behavior under the assumption that depositors were protected by deposit insurance. We made this assumption for three reasons. First, our results do not depend on the presence of deposit insurance; deposit insurance actually mitigates the underlying problem. Second, the assumption is more realistic, because in practise most depositors are indeed protected by deposit insurance. Third, without deposit insurance the analysis is less tractable. This section underpins our first claim that deposit insurance actually mitigates the problem. In line with John et al. (1991), a removal of deposit insurance does not alleviate the risk shifting problem, because depositors are unable to condition their return on the bank's investment behavior. When depositors demand a fixed rate of return that, in equilibrium, represents a fair premium, then, from the bank's perspective, this fair premium is simply equivalent to a larger share of deposits. As a consequence, uninsured deposits exacerbate risk shifting and fair value accounting becomes even less attractive. This section confirms this argument.

Without deposit insurance, depositors demand a positive interest rate in order to be compensated for the possibility of default. In particular, a depositor, who expects a probability of default of k^e, will demand an interest of at least $k^e/(1 - k^e)$. Hence, if the bank wants to take on deposits $d > 0$, it must promise a payout of $d/(1 - k^e)$ to depositors. Effectively, the depositors' compensation for risk taking raises the cost of deposits by a factor $1/(1 - k^e)$. Consequently, we may repeat the analysis without deposit insurance by substituting $d/(1 - k^e)$ for d.

Thus, from expressions (1) and (2) we obtain the adjusted cut–off values

$$\begin{aligned} j_g^f(k^e,d) &= \frac{p_g(h_1(1-k^e)-d)}{p_g h_1 h_2(1-k^e)-d}; \quad j_g^b(k^e,d)=1; \\ j_b^f(k^e,d) &= j_b^b(k^e,d) = \begin{cases} \frac{p_b(h_1(1-k^e)-d)}{p_b h_1 h_2(1-k^e)-d} & \text{if } d < \frac{p_b h_1(h_2-1)(1-k^e)}{1-p_b} \\ 1 & \text{otherwise.} \end{cases} \end{aligned}$$

In a rational expectation equilibrium, the depositor's expectations k^e are confirmed. This means that, under fair value accounting, the equilibrium probability of default $k_f^*(d)$ follows from (3) and is implicitly defined by

$$\begin{aligned} k_f^*(d) &= q\left[j_g^f(k_f^*(d),d)(1-p_g)+\frac{1}{2}(1-j_g^f(k_f^*(d),d))^2\right] \\ &\quad +(1-q)\left[j_b^f(k_f^*(d),d)(1-p_b)+\frac{1}{2}(1-j_b^f(k_f^*(d),d))^2\right]. \end{aligned}$$

Likewise, the equilibrium probability of default under book value accounting, $k_b^*(d)$, follows from (4) and satisfies

$$k_b^*(d) = q(1-p_g)+(1-q)\left[j_b^b(k_b^*(d),d)(1-p_b)+\frac{1}{2}(1-j_b^b(k_b^*(d),d))^2\right].$$

These equilibrium conditions yield polynomials of the fifth order and cannot be solved analytically.[19] However, due to the increased risk shifting effect it follows that the equilibrium default probabilities must be at least as large as with deposit insurance. To see this, note that both the probability of default and the present value of investment behavior depend on the depositors' demanded return k^e only indirectly in that it affects the thresholds j_g^f, j_b^f, and j_b^b. The distortions of these thresholds increase with the effective debt level $d/(1-k^e)$. Hence, if depositors expect a positive probability of default, $k^e > 0$, and demand a fair compensation, then the thresholds become more distorted than when the depositors do not ask for risk adjusted compensation.

For our numerical example in Section 5 Table 2 reports the relevant variables without deposit insurance. A comparison to Table 1 confirms that fair value

[19] In addition, we cannot guarantee the existence of an equilibrium. E.g., Table 2 shows that for $d = 0.95$ there exists no (pure strategy) equilibrium in our numerical example.

	Example: $q=0.8, p_g=.95, h_1=1.08, h_2=1.09, p_b=.85,$				
	d=0	$d=\bar{d}\approx 0.39$	$d=\tilde{d}\approx 0.55$	$d=\hat{d}\approx 0.8$	$d=.95$
j_g^f	0.91743	0.89793	0.88069	0.80367	—
j_b^f	0.91743	0.966	1	1	—
j_g^b	1	1	1	1	—
j_b^b	0.91743	0.966	1	1	—
k_f^*	0.06763	0.06918	0.07092	0.07757	—
k_b^*	0.06821	0.0691	0.07	0.07	—
PV_f^*	1.00813	1.00773	1.00685	1.00166	—
PV_b^*	1.00508	1.00485	1.0044	1.0044	—

Table 2: The numerical example without deposit insurance.

accounting fares worse without deposit insurance. This becomes especially clear when comparing the defaults probabilities for the debt level $\bar{d}$. With deposit insurance, the debt level $\bar{d}$ yields equal probabilities, $k^f = k^b$, whilst without deposit insurance fair value accounting yields a larger probability of default in equilibrium, $k_f^* > k_b^*$. In addition at a debt level $\hat{d}$ the present values are equal with deposit insurance, $PV^f = PV^b$, whereas the present value under fair value accounting is smaller without deposit insurance, $PV_f^* < PV_b^*$. This confirms that deposit insurance skews results in favor of fair value accounting; without deposit insurance the case against fair value accounting becomes even stronger.

7 Conclusion and Discussion

This paper shows that the risk shifting effect of debt is more severe under fair value accounting than under book value accounting. The driving forces that lead to this conclusion are twofold: 1) the fact that fair value accounting leads to a better informed market than book value accounting and 2) that in a better informed market a bank's assets are more liquid. From these two facts alone it follows that fair value accounting raises the bank's investment opportunities and leads to riskier investments. This observation has two important consequences for leveraged banks. First, default probabilities will be higher and, second, the bank's overall value will be lower under fair value accounting. Moreover, since the moral hazard effect constitutes an important rationale for a regulation of banks, the need of regulation is larger under fair value accounting.

We did not analyze the question how this additional regulation should look like. An interesting solution in the context of our model is to let the accounting rule depend on the debt level d. In particular, the regulator could specify that the bank should use fair value accounting when $d \leq \bar{d}$ and book value accounting otherwise. An obvious disadvantage of this sophisticated accounting rule is that it requires a well–informed regulator who has enough information to calculate the cut off value $\bar{d}$ in a satisfactory way.

To concentrate on the liquidity effect, we assumed that the bank had to sell (or securize) its assets if it wanted to benefit from a later investment opportunity. In particular, it could not raise capital in other ways such as issuing new equity or additional debt. However, if such refinancing is easier under symmetric information, then our insights also obtain with different modes of refinancing. Myers and Majluf (1984), for example, show that a firm will be better at raising new capital if there is less asymmetric information concerning its assets. Hence, also in this case fair value accounting exacerbates problems of moral hazard and increases tensions between regulator and bank increase.

Finally, we want to address our assumption that fair value accounting reduces asymmetries of information. The assumption captures the prevalent view that fair value accounting increases transparency. Given this view we identified the effects on the investment behavior of banks. However, a crucial question is, of course, how this change of the information structure comes about. We want to stress that simply marking assets to market does not by itself reduce asymmetric information. Already O'Hara (p.60, 1993) raised this issue by pointing to the lemon's problem. Indeed, under asymmetric information an uninformed market prices the asset at $p_b h_1$. Hence, under marking–to–market accounting the bank's books would, irrespective of the asset's actual quality, list the asset at $p_b h_1$. Both good and bad assets are listed at the same price and outsiders cannot learn the asset's true quality from looking in the books. We conclude that marking–to–market by itself does not reveal any information. Increased transparency of fair value accounting may only come about through an honest reporting of private information by the bank. In this respect Freixas and Tsomocos (p.2, 2004) argue that "the prevailing view is that sufficiently high penalties would give the management the right incentives to report the true market values." Clearly, this somewhat naive view may represent further objections to fair value accounting.

8 Appendix

Proof of Proposition 1: To check existence, we first show that at a price $V = p_b h_1$ a bank with a good project does not want to sell its first project and reinvest. The payoff from holding on to the first project is $p_g h_1$. Selling the first project at the price $V = p_b h_1$ and reinvesting it in project 2 yields at most $p_b h_1 h_2$. Due to assumption 1 this is strictly less so that a bank holding a good project does not want to sell it at a price $V = p_b h_1$. Moreover, a bad bank reinvests for j close enough to one, as, due to $h_2 > 1$, it holds $p_b h_1 h_2 > p_b h_1$. Hence, at a price $V = p_b h_1$ only banks with bad projects who observe a high j will offer their project to the market. Finally, in equilibrium the market expectations are correct, i.e. it is aware that only bad project are offered. With these rational expectations the market is willing to pay at most $V = p_b h_1$. Q.E.D.

Proof of Proposition 2: Given its reinvestment behavior the present value at date $t = 0$ of a bank that uses fair value accounting is

$$PV^f = q\left[\int_0^{j_g^f} p_g h_1 dj + \int_{j_g^f}^1 j p_g h_1 h_2 dj\right] + (1-q)\left[\int_0^{j_b^f} p_b h_1 dj + \int_{j_b^f}^1 j p_b h_1 h_2 dj\right]. \quad (5)$$

Under book value accounting the bank's present value is

$$PV^b = q\int_0^1 p_g h_1 dj + (1-q)\left[\int_0^{j_b^b} p_b h_1 dj + \int_{j_b^b}^1 j p_b h_1 h_2 dj\right].$$

Using that $j_g^f = j_b^f = j_b^b = 1/h_2$ it follows

$$\Delta PV = PV^f - PV^b = q p_g h_1 \int_{j_g^f}^1 [j h_2 - 1] dj > 0.$$

Q.E.D.

Proof of Proposition 3: Due to $j_b^f = j_b^b$ it follows that $k^b > k^f$ if and only if $(1-p_g) > j_g^f(1-p_g) + \frac{1}{2}(1-j_g^f)^2$. Due to $p_g h_1 > 1$ and $h_2 > h_1$ it follows $p_g > 1/h_2$ and, hence, $1 = j_g^f h_2 > j_g^f/p_g$. This implies $j_g^f < p_g$. Therefore, it holds for $j \in [j_g^f, p_g)$ that $1-j > 1-p_g$. Hence, switching investments for $j \in [j_g^f, p_g)$ increases the probability of default. As the switch occurs only under fair value accounting, the probability of default for $j \in [j_g^f, p_g)$ is larger under fair value accounting than under book value accounting. For $j \in [p_g, 1]$ the opposite holds, as it implies $1-j \leq 1-p_g$. Due to the uniform distribution of j it then follows that $k^b > k^f$ if and only if $1-p_g > p_g - j_g^f$. Q.E.D.

Proof of Proposition 4: Differentiating (3) with respect to d yields

$$\frac{\mathrm{d}k^f(d)}{\mathrm{d}d} = h_1^2\left(\frac{p_b^2(h_2p_b-1)^2(1-q)}{(h_1h_2p_b-d)^3} + \frac{p_g^2(h_2p_g-1)^2q}{(h_1h_2p_g-d)^3}\right) > 0,$$

where the inequality holds due to $h_1h_2p_g > h_1h_2p_b > d$. Differentiating (4) with respect to d yields

$$\frac{\mathrm{d}k^f(d)}{\mathrm{d}d} = \frac{h_1^2p_b^2(h_2p_b-1)^2(1-q)}{(h_1h_2p_b-d)^3} > 0,$$

where the inequality holds due to $h_1h_2p_b > d$. Finally, it holds

$$\frac{\mathrm{d}}{\mathrm{d}d}\left(k^f(d) - k^b(d)\right) = \frac{h_1^2p_g^2(h_2p_g-1)^2q}{(h_1h_2p_b-d)^3},$$

which is positive due to $h_1h_2p_g > h_1h_2p_b > d$. Q.E.D.

Proof of Proposition 5: Solving $k^f(\bar{d}) = k^b(\bar{d})$ as defined by (3) and (4) with respect to $\bar{d}$ yields

$$\bar{d} = \frac{p_gh_1(1+h_2-2p_gh_2)}{1-p_g}.$$

Proposition 5 shows that $k^f(d)$ increases faster than $k^b(d)$ such that for $d > \bar{d}$ it follows $k^f(d) > k^b(d)$ and $k^f(d) < k^b(d)$ for $d < \bar{d}$. Q.E.D.

Proof of Proposition 6: Follows directly from solving $PV^f(d) < PV^b(d)$. Q.E.D.

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