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Economic Loan Loss Provision and Expected Loss*

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Abstract

The intention of a loss provision is the anticipation of credit's expected losses by adjusting the book values of the credits. Furthermore, this loan loss provision has to be compared to the expected loss according to Basel II and if necessary, equity has to be adjusted. This however assumes that the loan loss provision and the expected loss are comparable, which is only valid conditionally in current loan loss provisioning methods according to IAS. The provisioning and accounting model developed in this paper overcomes the before mentioned shortcomings and is consistent with an economic rationale of expected losses. We introduce a definition of expected loss referring to the whole maturity of the loan and show that this measure can be reasonably compared with loan loss provisions. Additionally, this model is based on a close-to-market valuation of the loan. Suggestions for changes in current accounting and capital requirement rules are provided.

Keywords loan loss provision · expected loss · IAS · Basel II

J.E.L. Classification G18 · G21 · M41

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1 Introduction

A loan loss provision (LLP) is an adjustment of the book value of a credit which regards future changes in the credit value due to default events. The expected loss (EL) denotes the expected amount of a credit that will be lost within one year in case of a default. According to the Basel II capital requirements, banks have to compare the loan loss provisions with the yearly computed expected losses. Here, it has to be considered that in case of an excess of the EL over the LLP the shortfall has to be subtracted from the liable equity (Tier 1 + Tier 2). In case of an excess of the LLP over the EL, banks are allowed to add the excess up to 0.6 % of the risk-weighted asset value according to the Internal Ratings-Based Approach to their liable equity. Thus, the approach assumes comparability of EL and LLP. However, this comparability is not given in two aspects.

Firstly, current accounting rules, e.g. International Accounting Standards (IAS) and German Accounting Standards, postulate to compute the LLP as the difference between book value and market value (or expected cash flow).[1] The difference between the risk-free value and the risk-adjusted expected value of the cash flows is a reasonable economic interpretation of the LLP. However, the book value cannot be considered as a risk-free value of a loan since different payment dates and interest payments are not taken into consideration. The market value, indeed considers interest payments and varying payment dates. Therefore, an LLP computation based on book and market values cannot be reasonable.

Secondly, according to the Capital Requirements Directive the "expected loss,[...], shall mean the ratio of the amount expected to be lost on an exposure from a potential default of a counterparty or dilution over a one year period to the amount outstanding at default".[2] There are two shortcomings when comparing this value with the LLPs. On the one hand, the expected loss considers a time horizon of one year whereas the LLPs consider the whole maturity of the loan. On the other hand, the expected loss only refers to the outstanding amount at default, which equals the residual book value, and does not consider different payment dates. In an economic rationale it only makes sense to compare total expected losses (TEL) with LLPs, where TEL considers different payment dates and refers to the whole maturity of the loan.

These two shortcomings can lead to a distorted capital allocation, e.g. possible undercapitalization with equity when loans exhibit a maturity of more than one year.

Our paper is organized as follows: After a literature review of the LLP development and possible influences on earnings and capital management in Section 2, our model of an LLP, which is economically reasonable, is derived in Section 3. Here, we also show that this LLP equals the TEL and so a comparability of these two values is assured. Furthermore, this approach better meets the idea of a close-to-market valuation than current accounting

[1] See PricewaterhouseCoopers (2002), pp. 152-154.

[2] See Directive 2006/48/EC, Article 4 (29).

rules. In Section 4 a comparison of our model with current loss provisioning methods according to IAS with respect to the magnitude of the misfit in equity capitalization is done. Section 5 concludes our results.

2 Literature Review

The problem of the quantification of uncertain repayments in the context of credits was already introduced by Cyert and Trueblood (1957) and Cyert, Davidson and Thompson (1962). They basically estimated so called ”loss expectancy rates”, which can be interpreted as a Loss Given Default (LGD), for which they used probabilities of transition between different age categories of retail debt. This approach was adopted by Kim and Santomero (1993) for bank loans. They developed a Bayesian model to estimate loan loss reserves under the assumption of changing information due to new audits. A comprehensive overview of accounting, determinants and uncertainty of loan loss provisions is given in Beattie et al. (1995).

Analyses of loan loss provisions provide different and sometimes contradictory results. For example, Liu, Ryan and Wahlen (1997) showed that the market reacts positive towards loan loss provisions for banks with low regulatory capital whereas negative reactions were observed for banks with high regulatory capital. Furthermore, they observed that increasing loan loss provisions implicate higher cash flow predictions since higher loan loss provisions are associated with activities carried out by bank managers to resolve loan default problems.[3] However, Ahmed, Takeda and Thomas (1999) refute the before mentioned doubtful results and show a significant negative relation between bank stock returns and loan loss provisions.[4] A summary of several studies regarding the effects of capital management and earnings management on loan loss provisions is provided by Wall and Koch (2000).

The analysis of changes in the provisions due to macroeconomic factors is another focus regarding loan loss provisions. Laeven and Majnoni (2003) found empirical evidence that banks worldwide delayed provisioning for bad loans even until downturns have already set in. In their study, they used balance sheet information for the period 1988 to 1999 for 1,419 banks of 45 countries worldwide. As a result, they found a significant negative relation between GDP growth and relative loan loss provision. Pérez, Salas and Saurina (2006) empirically analyzed loan loss provisions in Spain. They used annual data from banks over the period from 1986 to 2002 and examined the relation between loan loss provisions and earnings and capital. The pro-cyclical behavior of loan loss provisions was approved again. Another similar investigation was done by Quagliariello (2006) for Italian intermediaries using accounting ratios of 207 banks over a period from 1985 to 2002. He

[3] See Liu, Ryan and Wahlen (1997), p. 145.

[4] See Ahmed, Takeda and Thomas (1999), pp. 3-4.

also confirms the pro-cyclical but delayed behavior of loan loss provisions. Quagliariello (2008) reviews different empirical analyses about macroeconomic effects on bank stability.

Regarding the general idea of creating loan loss provisions, Borio and Lowe (2001) were the first who mentioned that there is a discrepancy between the IAS rules and the Basel II framework concerning concepts of loss. They also notice that fair value accounting amplifies the volatility and cyclicality of bank profits. Benston and Wall (2005) argue that the initial recorded value of a loan in general is underestimated when using historic cost accounting. They advocate a rule that the accounting value of a loan should be the minimum of the historic cost value and the economic value. Additionally, it is argued that "loan loss accounting, therefore, should return to its original function of providing useful information to investors[. . .]".[5] This argument seems to be, at least, doubtful.

Another adequate way of creating provisions is the idea of dynamic provisioning. Issues of this type are presented in Mann and Michael (2002) where the general principle of dynamic provisioning is that provisions are in line with an estimate of long-run expected loss.[6] In other words, the dynamic provision delays the recognition of the credit risk premium by building up an allowance for expected losses. In case of a nondefault, the complete allowance, presenting the risk premium, will be dissolved at maturity. Gebhardt (2008) supports the dynamic provisioning and the fair value approach by comparing the current German GAAP and the IAS and their weaknesses concerning earnings management.

3 Loan Loss Provisions and Expected Loss

3.1 The Model

In this section, we introduce an economic framework for LLPs. In general, LLPs should take expected losses of an asset over its lifetime into consideration. Especially, in the context of loans and receivables expected losses occur if a counterparty fails to meet their contractual payment arrangement. These losses should contain both amortization and interest payments adjusted by possible cash flows from collaterals.

We furthermore connect the introduced LLPs with the expected losses of the Basel II capital requirements. In an economic rationale, the LLPs should equal the expected losses over the whole maturity of the loan. Additionally, a kind of dependency between "write-off probabilities" of different time periods is considered. Here, write-off probabilities vary from the default probability according to Basel II, which will be explained in more detail at the end of this subsection.

Our model is based on a close-to-market valuation approach. This leads to the idea that

[5] See Benston and Wall (2005), p. 99.

[6] See Mann and Michael (2002), p. 130.

an LLP should equal the difference between the present value of a contract without considering uncertainty and the expected present value of the contract including uncertainty.

$$
\begin{aligned}
\text{LLP} \quad &= \quad \sum_{t=1}^{T} \frac{FV_{t-1} \cdot r_t^c + A_t}{(1+r_t^f)^t} - \sum_{t=1}^{T} \frac{\mathrm{E}\left[FV_{t-1} \cdot r_t^c + A_t\right]}{(1+r_t^f)^t} \\
\text{s.t.} \quad & \quad FV_t = FV_{t-1} - A_t \\
& \quad A_T = FV_{T-1},
\end{aligned} \tag{1}
$$

where A_t denotes the amortization in time t, FV_t denotes the residual face value in t after amortization, r_t^c denotes the risk-adjusted interest rate of the contract in time t and r_t^f the risk-free interest rate in time t.[7] The constraints describe the development of the residual face value, where it is assumed that the amortization in the final period equals the residual face value of the prior period.

Here, the risk influence is only regarded in the numerator. In general, this influence should only be taken into consideration either in the cash flows or in the discount rate but not in both.[8]

In Equation (1) the expected value can be described by a state tree, which is illustrated in Figure 1.

For each time period t two different states are possible. The counterparty may either default or not. In case of a default, this is an irrevocable state and therefore this default is different than the definition of default referred to in current accounting standards and Basel II.[9] In these frameworks, default is not a final state.

One general valuation approach for the value of a credit at risk was introduced by Fons (1994)[10] and can be written as

$$
\begin{aligned}
\sum_{t=1}^{T} \frac{\mathrm{E}\left[FV_{t-1} \cdot r_t^c + A_t\right]}{(1+r_t^f)^t} \quad &= \quad \sum_{t=1}^{T} \frac{(1-\mathrm{P}_{wo})^t \cdot (FV_{t-1} \cdot r_t^c + A_t)}{(1+r_t^f)^t} \\
& \quad + \sum_{t=1}^{T} \frac{(1-\mathrm{P}_{wo})^{t-1} \cdot \mathrm{P}_{wo} \cdot (1-\mathrm{LGD}_t) \cdot FV_{t-1} \cdot (1+r_t^c)}{(1+r_t^f)^t}
\end{aligned} \tag{2}
$$

where P_{wo} denotes the write-off probability, i.e. the absorbing state of nature with no recovery possible, and LGD_t denotes the relative loss of the total amount (including

[7] By applying this concept of risk-free discounting of expected values, we imply risk neutrality of the bank, which is reasonable for large credit portfolios. For a detailed analysis of certainty equivalents and risk neutrality see Reichling, Spengler and Vogt (2006).

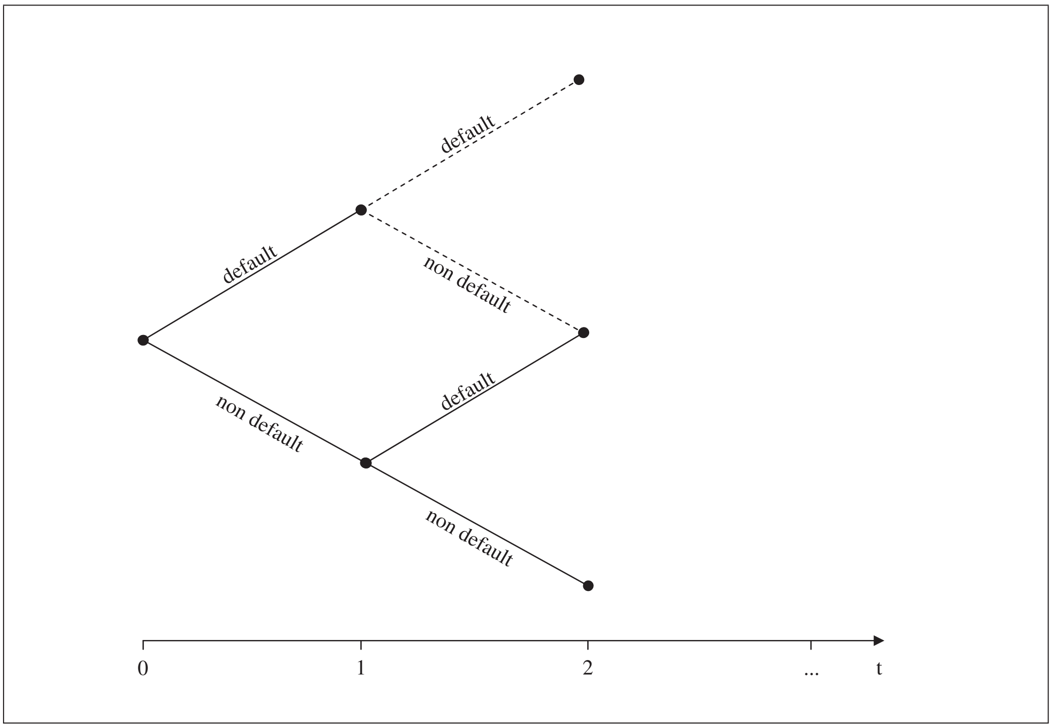
[8] See International Accounting Standards Board (IASB) (2006), p. 49.

[9] According to the Institut der Wirtschaftsprüfer (IDW), the definition of a default event with respect to IAS 39 and Basel II are in general congruent. Therefore, we do not distinguish between the two definitions. See IDW (2007), pp. 89.

[10] See Fons (1994).

Figure 1: Assumed tree of the different states of nature

This figure shows the implicitly assumed state tree according to the computation done in Equation (1). Here, it is assumed that the default event is not an absorbing state of nature. Impossible branches are described by a dotted line.



one interest payment) outstanding in case of a default. Here, we deviate from the Basel II framework where the losses on interest payments are already included in the LGD. Thus, this LGD is only multiplied by the total amount outstanding, not including interest payments. Nevertheless, both ways lead to the same result. For reasons of simplification, we assume that P_{wo} is constant but LGD_t may vary over time. The first sum on the right-hand side in Equation (2) can be interpreted as the expected cash flow in case of a nondefault and the second sum as the expected cash flow in case of a default. Furthermore, the write-off probabilities for the different time periods are expressed as a product of the marginal survival probabilities of previous time periods and the period specific write-off probability.

If we insert the result from Equation (2) into Equation (1), a further problem will occur. When generating the LLP according to Equation (1), a symmetric decision tree with no absorbing states of nature as illustrated in Figure 1 is implicitly assumed. This, however, is generally incorrect since the existence of an absorbing state has to be given. For just using write-off probabilities, Figure 1 shows the appropriate state tree resulting from the continuous lines only. Therefore, one has to subtract the impossible states of nature, illustrated as dotted lines. Thus, Equation (1) has to be adjusted by some correction factor F.

The computation of F will be done indirectly by using the following idea. The correction factor equals the cash flows associated with the tree consisting of the dotted lines and the states that are incident with them. To compute the value of F, we firstly subtract the sum of the values associated with a survival over each time period from the present value of the credit. Subsequently, we subtract the sum of the values associated with a write-off depending of the time period. This leads to the following equation for F:

$$\begin{aligned} F_{t-1} &= \sum_{m=t}^{T} \frac{[1-(1-\mathrm{P}_{wo})^{m-t+1}]\cdot(FV_{m-1}\cdot r_m^c + A_m)}{(1+r_m^f)^{m-t+1}} \\ &\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}\cdot(1+r_m^c)}{(1+r_m^f)^{m-t+1}} \end{aligned} \qquad (3)$$

The following property is proofed in Appendix 1.

Lemma 1. *The sign of the correction factor F_{t-1} depends on the risk premium of the loan. In case of a risk premium of zero, F_{t-1} will also be zero.*

For the two special cases $\mathrm{P}_{wo} = 0$ and $\mathrm{P}_{wo} = 1$ the correction factor equals zero. Thus, if P_{wo} becomes zero, there will be no default risk at all. Therefore, a loan loss provision is not needed. If P_{wo} becomes one, the loan loss provision equals the absolute LGD of the credit's present value. For both cases the state tree will comprise of just one branch and therefore a correction factor is not needed.

The portion of F_0 on FV_0 is shown exemplary in Figure 2 for three different maturities of two, five and ten years. We assume a constant yearly amortization, a risk-free interest rate of five percent p.a. and a risk-adjusted contract interest rate according to Fons' model.

Now, if we subtract F_{t-1} from Equation (1) this leads to the loan loss provision with consideration of the correction factor $\mathrm{LLP}_{cor,t-1}$ and accordingly to the total expected loss:

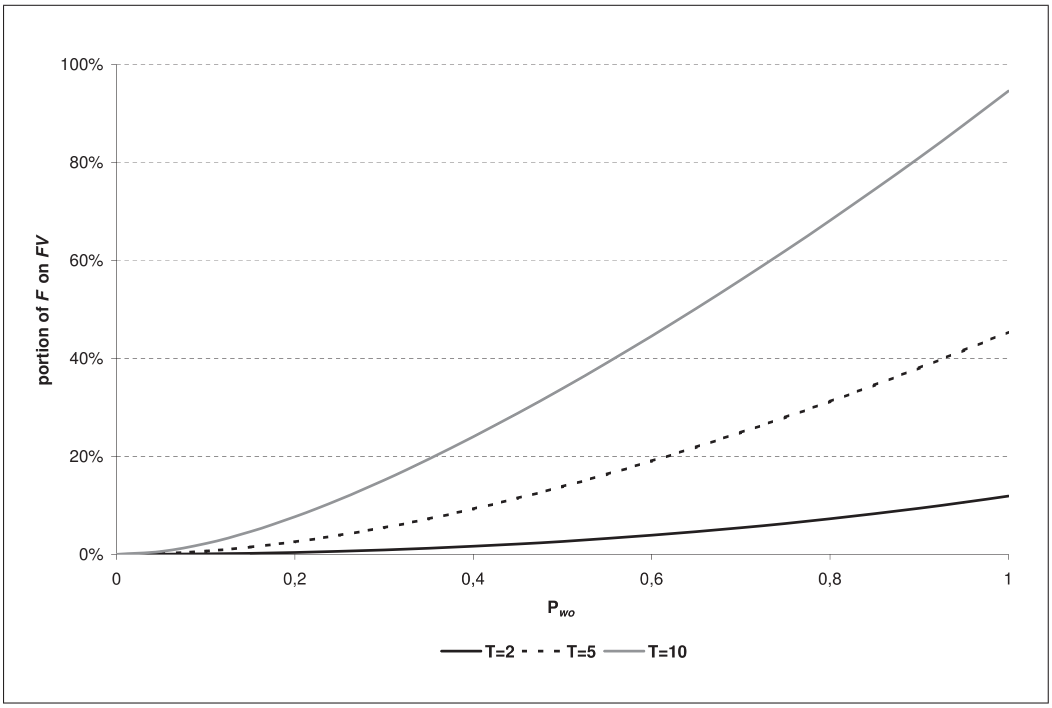
$$\mathrm{LLP}_{cor,t-1} = \mathrm{TEL}_{t-1} = \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot \mathrm{LGD}_m \cdot FV_{m-1}\cdot(1+r_m^c)}{(1+r_m^f)^{m-t+1}} \qquad (4)$$

Equation (4) differs from the EL described in Basel II in three ways. Firstly, we use cumulated write-off probabilities instead of probabilities of default. However, there should be a functional relationship between these two values and for single periods the default probability is an upper bound for the write-off probability. Using the TEL, we assume that in case of a default and a recovery afterwards there are negligible losses for the loan issuer. Secondly, we consider the sum of the expected losses in contrast to single expected losses in Basel II. Otherwise, a comparison between LLPs and expected losses is not possible. Thirdly, the payment structure over different time periods is considered by discounting.

In case of a nondefault in a certain period, the generated $\mathrm{LLP}_{cor,t-1}$ has to be reduced

Figure 2: Development of the correction factor

The figure shows the portion of F_0 on the face value FV_0 with respect to the write-off probability, computed according to the example described above.



in the subsequent period. The income statement-related difference of the two successive $\text{LLP}_{cor,t-1}$ equals the difference between the two successive TELs. Under the assumption of a flat term structure and a constant LGD, the income statement-related difference, $DP_{t-1,t}$, can be described by:

$$DP_{t-1,t} = \sum_{m=t}^{T} \frac{(1-\text{P}_{wo})^{m-t} \cdot \text{P}_{wo} \cdot \text{LGD} \cdot A_m \cdot (1+r^c)}{(1+r^f)^{m-t+1}} \tag{5}$$

When considering the accounting of the above mentioned values, there are some noticeable characteristics. The initial accounting value of the loan equals the present value less $\text{LLP}_{cor,0}$.[11] Here, the initial accounting value can be subdivided into two parts. On the one hand we have the amount paid to the debtor and on the other hand we have the LLP_0 without the correction factor F_0. The booking of $\text{LLP}_{cor,t-1}$ is recognized in profit or loss as well as the change of the present value of the loan and the $DP_{t-1,t}$. Therefore, a net revenue results as the difference between LLP_0 and $\text{LLP}_{cor,0}$, which just equals F_0, at the beginning. In the following periods, the difference of the $\text{LLP}_{cor,t-1}$ has to be booked as revenue and the decrease in the present value of the loan is an expense. In the final

[11] Our model distinguishes between the nominal value and the book value of the credit since the market entry and exit prices are different. Thus, we are in accordance with the opinion of the Joint Working Group of standard setters (JWG). See JWG (2000b), para. 315–317.

period, the corrected present value equals the remaining debt. In case of a nondefault, the sum of the period-specific $DP_{t-1,t}$ equals the $\mathrm{LLP}_{cor,0}$ generated at the beginning. Furthermore, the sum of the net expense of each period equals the net revenue in the first period which amounts the correction factor. Thus, losses and gains offset each other but the model complies with the imparity principle, i.e. possible losses are anticipated before occurrence whereas earnings are only considered when they are realized.

In the derivation done above, we assumed a constant write-off probability over all periods. If we abstract from this, the cumulative survival probability for period t will change to $\prod_{k=1}^{t}(1-\mathrm{P}_{wo,k})$ and the period specific default probability rearranges to $\prod_{k=1}^{t-1}(1-\mathrm{P}_{wo,k})\cdot\mathrm{P}_{wo,t}$.

3.2 Example

The general procedure for calculating the $\mathrm{LLP}_{cor,t-1}$ and the TELs is described by using an example of a bullet repayment loan shown in Table 1. Here, we assume a maturity of four years and a face value of 1,000. The contract interest rate is risk-adjusted according to Fons (1994) and equals 6.275 percent. The cash flow in each period, C_t, is shown in the first row. The second row shows the interest payment of each period. In the third row, the loan loss provision of each period, LLP_t, without the period-specific correction factor F_t is given. For this calculation, a write-off probability of six percent and an LGD of 20 percent is assumed. The term structure is assumed to be flat on a level of five percent. The fourth row shows the correction factor for each period, F_t. Therefore, the true loan loss provision $\mathrm{LLP}_{cor,t}$ is lower than the unadjusted LLP_t and equals the TEL_t for each period, which is illustrated in the fifth row. The second part of the table starts with the present value of the loan. The difference between the period-specific present values is denoted as time effect and illustrated in the seventh row. The eighth row shows the period-specific $DP_{t-1,t}$ for the case of a nondefault in the previous periods. The subsequently illustrated total effect equals the sum of the time effect and the $DP_{t-1,t}$ for each period. The last row shows the balance sheet valuation of the loan and is assumed to be the present value adjusted by $\mathrm{LLP}_{cor,t}$. Below the table, possible accounting records for the different periods are exemplarily shown.[12]

As a first result, our approach is consistent with an expected loss framework since the particular loan loss provision of each period equals the future total expected losses. Furthermore, our model is consistent with the principle of prudence, especially the imparity principle. And finally, we are market-oriented in valuation by applying the present value method with considering default risk. For the generality of our approach, another example for an amortizable loan is shown in Appendix 2.

[12] There may be some deviations due to rounding.

Table 1: Example of LLP computation

The table shows a bullet repayment loan at par with a maturity of four years and a face value of 1,000. Furthermore, we assume a risk-free interest rate of five percent p.a., a risk-adjusted contract interest rate of 6.275 percent p.a., a write-off probability of six percent, and an LGD of 20 percent.

t	0	1	2	3	4
C_t	−1,000	62.75	62.75	62.75	1,062.75
Amortization	–	0.00	0.00	0.00	1,000.00
Interest payments	–	62.75	62.75	62.75	62.75
LLP_t without F_t	45.22	34.73	23.71	12.15	0.00
F_t	3.75	1.98	0.69	0.00	–
$\text{LLP}_{cor,t}$ / TEL_t	41.47	32.75	23.02	12.15	0.00
Present value	1,045.22	1,034.73	1,023.71	1,012.15	1,000.00
Time effect	–	−10.49	−11.02	−11.57	−12.15
$DP_{t-1,t}$	–	8.71	9.73	10.87	12.15
Total effect	3.75	−1.78	−1.29	−0.70	0.00
Balance sheet valuation	1,003.75	1,001.98	1,000.69	1,000.00	0.00

Accounting records:

$t = 0:$	Loans and Receivables	1,045.22	to	Cash	1,000.00
	Loan Loss Provision	41.47		Loans and Receivables	41.47
				Revenues	45.22
$t = 1:$	Cash	62.75	to	Interest Revenues	62.75
	Loans and Receivables	8.71	to	Revenues from $DP_{t-1,t}$	8.71
	Expenses	10.49		Loans and Receivables	10.49
⋮					
$t = 4:$	Cash	62.75	to	Interest Revenue	62.75
	Loans and Receivables	12.15	to	Revenues from $DP_{t-1,t}$	12.15
	Expenses	12.15		Loans and Receivables	12.15
	Cash	1,000.00	to	Loans and Receivables	1,000.00

4 Comparison of our Model to IAS and Basel II

This section introduces different ways of generating loan loss provisions according to IAS. Capital market-oriented companies are obliged to compile their consolidated accounts according to IAS since the beginning of 2005.[13] At the same time, capital requirements according to Basel II are also obliged for banks.[14] For a further analysis of the interfaces between Basel II and IAS, one may refer to PricewaterhouseCoopers (2006), Cluse, Engels and Lellmann (2005), Grünberger (2007) and Leitner (2005).

[13] See EC 1606/2002, Art. 4.

[14] The Basel II capital requirements were codified by the Directive 2006/49/EC which are obligatory since the beginning of 2007.

The first possibility for an LLP according to IAS is the specific provision. It is created after the occurrence of an impairment trigger event only for single financial assets. Impairment trigger events are according to IAS 39.59 such events like significant financial difficulties of the issuer or obligor, or a breach of contract, such as a default or delinquency in interest or principal payments. The amount of the specific provision equals the "[...] difference between the asset's carrying amount and the present value of estimated future cash flows (excluding future credit losses that have not been incurred) discounted at the financial asset's original effective interest rate [...]".[15] In case of a constant effective interest rate, the present values equal the continued book values for all periods.

This difference does not consider any interest losses and discounting as well. Although the usage of the fair value is often proclaimed by different institutions, e.g., the Joint Working Group of standard setters, a descriptive approach for obtaining a fair value is not given.[16] For example, possible future credit losses have to be excluded in the fair value computation.[17] However, market participants anticipate possible future losses and therefore the so-called fair value according to IAS is not market-oriented. In case of a nonconstant effective interest rate over the maturity, the values discounted with the initial effective interest rate are hardly economically interpretable.

According to Basel II, the LLPs have to be compared to the amount of the expected losses. However, the time horizon of the expected losses is just one year in the Basel II framework. Furthermore, expected losses, which also include losses that are not incurred, are considered and possible interest losses are incorporated in the LGD computation. Additionally, in case of a credit event the probability of default equals one for the computation of the expected loss. Thus, according to Basel II it is assumed that in this case the probability of recovery is zero and the credit will be written off. Therefore, it is obvious that the specific provisions are incomparable to the expected losses according to Basel II.

Another possibility for creating an LLP according to IAS is the general provision which is generated only for portfolios of credits that were not subject to a specific provision and the portfolio consists of credits with similar features as for example branch or collateralization. Here, we can differentiate in whether a credit event already took place or not.

In case of an already occurred credit event, the default probability is equal to one and, therefore, the loan loss provision, LLP_g^d is computed by the following equation

$$\mathrm{LLP}_g^d = \sum_{i=1}^{m} \mathrm{EAD}_i \cdot \overline{\mathrm{LGD}}, \tag{6}$$

where EAD_i denotes the exposure at default of credit i and $\overline{\mathrm{LGD}}$ denotes the average

[15] See IAS 39.63.

[16] See JWG (2000a), para. 28.

[17] See IAS 39.63.

Loss Given Default of the portfolio. However, it is implicitly assumed that a credit cannot recover once a default occurs. Therefore, the default probability is assumed to equal the write-off probability and so a default event is treated as a write-off event, which is not in line with the definitions of a default stated in IAS. In comparison to the Basel II framework, the LLP_g^d is equal to the expected loss when assuming an EAD-weighted average LGD.

In case of nonexistence of a credit event, the general provision, denoted by LLP_g^{nd} is created. The provision is computed by the following equation

$$\mathrm{LLP}_g^{nd} = \sum_{i=1}^{m} \mathrm{EAD}_i \cdot \overline{\mathrm{PD}} \cdot \overline{\mathrm{LGD}} \cdot \overline{\mathrm{LIP}}, \tag{7}$$

where $\overline{\mathrm{PD}}$ denotes the average default probability of the portfolio and $\overline{\mathrm{LIP}}$ denotes the average Loss Identification Period.[18] The LIP is a fractional value of the number of months between the appearance of the default event and its recognition by the bank over twelve. Thus, it can be interpreted as a time adjustment of the default probability. However, a $\overline{\mathrm{LIP}}$ between zero and one reduces the LLP_g^{nd} and possible expected losses, which maybe already incurred, are not considered when creating the loss provision. During the time span of occurrence and recognition, capital is misallocated due to an underestimated amount of the loss provision. Thus, by using this adjustment the imparity principle is partially reversed.

Due to the definition of the default probability, the general provision just refers to one year. This is not in line with a reasonable economic interpretation of a loan loss provision since the principle of prudence and the imparity principle are only partially allowed for. However, if $\overline{\mathrm{LIP}}$ equals one and the average probability of default and the average Loss Given Default are EAD-weighted then the amount of LLP_g^{nd} equals the expected loss according to the Basel II capital requirements.

Summarizing this part, it can be seen that all types of provisions in the framework of IAS do not comply with a reasonable definition of an expected loss, i.e. considering the cumulative expected loss over the whole maturity. In contrast to this, our model has the advantage of considering the total expected loss of a loan. However, a discrepancy between Basel II and our approach is given since we use discounted total expected losses and Basel II just uses yearly expected losses. This difference is only relevant for the comparison of the LLP and the expected loss according to IAS and not for the general capital requirements. But in general it seems at least doubtful to treat the expected loss as period specific and not as a period-independent total expected loss.

When using the different types of loss provisions, provision-specific impacts result for the income statement. Generally, our approach and the specific provision according to IAS

[18] Compare PricewaterhouseCoopers (2006), p. 36, Figure 1.

pursue a rather strong imparity principle since the total expected loss is considered in the LLP. However, for the specific provision, this only holds in case of a credit event whereas the consideration in our approach is independent whether a credit event occurred or not.

The general provision without the occurrence of a credit event only rectifies yearly expected losses of the actual exposure. After the initial creation of an LLP, only the difference of consecutive yearly expected losses is income statement-related. The upward revaluation of the credit amounting to the expected losses of the final period leads to a revenue at maturity.

In case of an incurred credit event, the provision development for the general case is similar to one without credit event. However, the scale is different since at the beginning of the provision generation a write-off is taken as certain. The provision amount is computed by Equation (6).

The development for all cases referring to our example in Section 3.2 is shown in Figure 3. Here, we show the relative influence according to the face value of the loan of the different provision alternatives on the profit-and-loss accounting (P&L) for each period in case that there is a creation of provisions but no write-off at all. The relative impacts of our model, the specific provision and the general provision without credit event refer to the left axis and the relative impact of the general provision with credit event refers to the right axis since the probability of default equals one and therefore the scale of the impact is higher.

From Figure 3 it can be seen that there are three different types of development. In our model, there is an initial revenue which is compensated by similarly but decreasing expenses over the following periods. However, the relative influence on the P&L is the lowest compared to all other methods. Regarding the specific provision, there is an initial expense which is compensated by revenues that are similarly distributed over the following periods. The two general provisions reveal a different development with an initial expense, a relative small release amount in the following periods and a high remaining release at maturity.

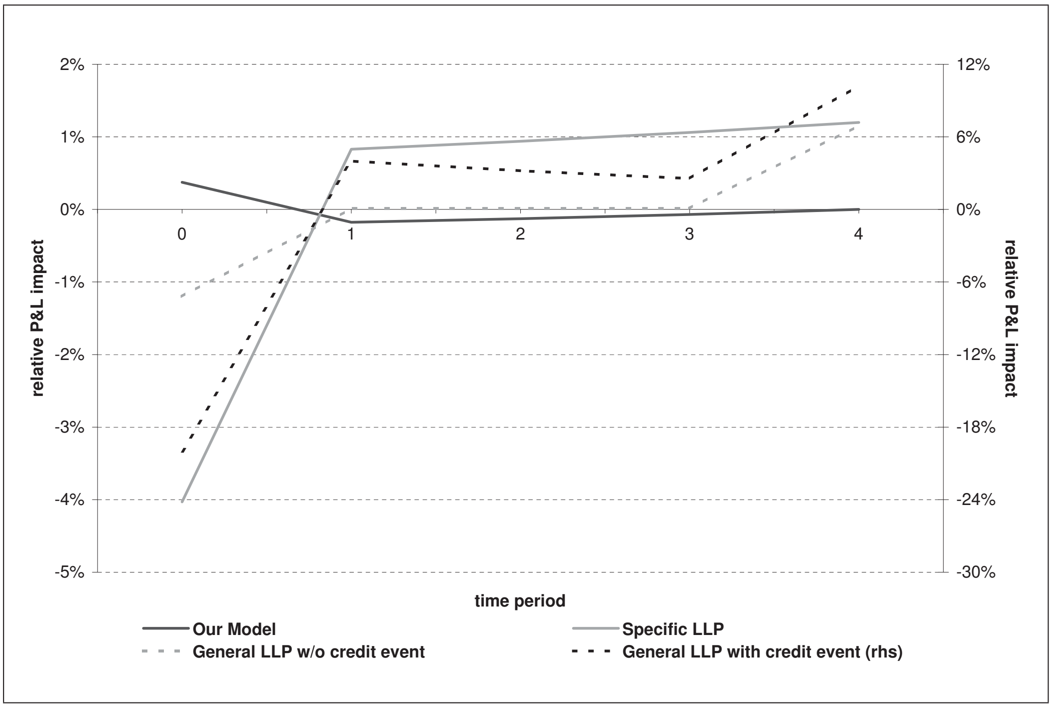
In comparison to the general provisions, our model allows for the cumulative expected loss over the whole maturity whereas the general provisions only consider the yearly expected losses. However, the impact on the P&L is more uniformly distributed and therefore the development is smoother. Additionally, it has to be considered that our model uses write-off probabilities instead of default probabilities. Therefore, the impact on the profit-and-loss accounting of the IAS-based provisions is higher since the default probability is greater or equal to the write-off probability. Thus, the relative influences exemplarily shown in Figure 3 may be even higher than illustrated.[19]

An implication of the comparison between the expected losses and our approach is the

[19] The relative P&L impact according to the initial face value of the loan of the different LLP methods for an amortizable loan are shown in Appendix 3. There, our model also leads to the smoothest P&L development.

Figure 3: Relative P&L impact of different LLPs

The figure shows the development of the relative P&L impact based on the example given in Section 3.2. Here, the development according to the alternative provisioning methods affecting the P&L is shown. The illustration of the general LLP with credit event refers to the right axis (rhs) since the relative amount is much higher than for the others.



equality of cumulated expected losses and the LLP. Hence, according to this, there is no need for a change in equity. In contrast, the specific provision and the general provision with a LIP bigger than one may lead to capital reduction. This is distortionary because capital may be invested in a different manner than used for risk provisioning. This effect is pro-cyclical since in case of an economic downturn the specific provisions increase more than the yearly expected losses. Therefore, the possible capital reduction also increases.

For the general provisions with credit event and without credit event and a LIP equal to one, there is no distortion in capital. However, for the general provision with credit event it is assumed that the complete portfolio is written off. This assumption is at least doubtful. For the general provision without credit event and LIP equal to one, the capital allocation is only done for one year and not for the whole maturity. The question arises whether these approaches comply with an economic rationale of risk management.

5 Conclusion

The aim of the paper was to develop a loss provision model that complies with an economic rationale of expected losses. In this context, we intentionally deviated from the definition of an expected loss according to Basel II since it seems reasonable that the expected loss should cover the possible losses over the whole maturity of a loan. Therefore, the loan loss provision should also cover the maturity of the credit, which is not in line with the current IAS accounting rules. Although the specific provision refers to the maturity, there are some shortcomings regarding a close-to-market valuation.

In our model, write-off probabilities are used instead of default probabilities but a functional relationship between these two measures should exist and therefore the model can easily be adopted. Additionally, we modeled the provisioning problem via an unsymmetric state tree problem. For the transformation of the symmetric state tree into the unsymmetric state tree, a correction factor was introduced and it was shown that the sign of this factor depends on the risk premium. Even when using default probabilities, an absorbing state, i.e. a state in which the loan definitely defaults without the possibility of recovering, should always exist in every period. Thus, a correction factor is generally needed for loan loss provisions that are calculated as a difference between two values. However, this fact was neither allowed for in the literature nor in the accounting rules. This negligence leads, depending on the risk premium, to a capital distortion.[20]

Our approach incorporates the cumulative expected losses at the beginning of the credit. In case of a nondefault in subsequent periods, the loan loss provision is partly reversed in each period. In the first period, the expense for the generation of the initial provision is compensated by accounting the risk-free present value as the book value of the loan. Hence, the model offers a higher transparency and a close-to-market valuation since the loan loss provision in each period exactly equals the sum of expected losses. Furthermore, by using this prospective approach, the pro-cyclical effect of the loan loss provision in an economic downturn is reduced due to the initial consideration of expected losses and not only in case of a credit event. Thus, our model differs from the idea of dynamic loan loss provisioning where the loss allowance constantly increases. From an economic point of view, this idea of the dynamic loan loss provision is counterintuitive since expected losses should ceteris paribus decrease with decreasing maturity.

The general question that arises refers to the necessary changes in accounting and capital requirement rules. Firstly, regarding the accounting rules, a change from discounting by the initial effective interest rate to a risk-free rate is appropriate because risk consideration should only be done either in the cash flows or in the discount rate. Regarding the creation of general provisions, the total maturity of a credit should be the correct time horizon. In

[20] Since we use write-off probabilities, possible losses from defaulted but recovered loans can be incorporated by a general provision. In general, these losses are at least smaller than the losses occurred by a write-off.

common, a loan loss provision should be created foresighted and not after occurrence of a credit event to account for the prudence and imparity principle. Secondly, regarding the capital requirement rules, a time horizon of one year seems to be too short-dated for an adequate credit risk coverage. Therefore, for a comparison of the expected losses and the loan loss provision one should at least match the time horizons for not comparing apples and oranges.

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Appendix 1

Proof.

$$
\begin{aligned}
F_{t-1} &= \sum_{m=t}^{T} \frac{[1-(1-\mathrm{P}_{wo})^{m-t+1}]\cdot(FV_{m-1}\cdot r_m^c + A_m)}{(1+r_m^f)^{m-t+1}} \\
&\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}\cdot(1+r_m^c)}{(1+r_m^f)^{m-t+1}} \\
&= \sum_{m=t}^{T} \frac{[1-(1-\mathrm{P}_{wo})^{m-t+1}]\cdot FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} + \sum_{m=t}^{T} \frac{[1-(1-\mathrm{P}_{wo})^{m-t+1}]\cdot A_m}{(1+r_m^f)^{m-t+1}} \\
&\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} \\
&= \sum_{m=t}^{T} \frac{FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot(1-\mathrm{P}_{wo})\cdot FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} \\
&\quad +\sum_{m=t}^{T} \frac{A_m}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot(1-\mathrm{P}_{wo})\cdot A_m}{(1+r_m^f)^{m-t+1}} \\
&\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} \\
&= \sum_{m=t}^{T} \frac{FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} + \sum_{m=t}^{T} \frac{A_m}{(1+r_m^f)^{m-t+1}} \\
&\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot(1-\mathrm{P}_{wo})\cdot A_m}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}}{(1+r_m^f)^{m-t+1}}
\end{aligned}
$$

We use the constraint $A_m = FV_{m-1} - FV_m$

$$
\begin{aligned}
&= \sum_{m=t}^{T} \frac{FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot FV_{m-1}\cdot r_m^c}{(1+r_m^f)^{m-t+1}} + \sum_{m=t}^{T} \frac{FV_{m-1}-FV_m}{(1+r_m^f)^{m-t+1}} \\
&\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot(FV_{m-1}-FV_m)}{(1+r_m^f)^{m-t+1}} + \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot(FV_{m-1}-FV_m)}{(1+r_m^f)^{m-t+1}} \\
&\quad -\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_{m-1}}{(1+r_m^f)^{m-t+1}} \\
&= \sum_{m=t}^{T} \frac{FV_{m-1}\cdot(1+r_m^c)}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot FV_{m-1}\cdot(1+r_m^c)}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{FV_m}{(1+r_m^f)^{m-t+1}} \\
&\quad +\sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot FV_m}{(1+r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1-\mathrm{P}_{wo})^{m-t}\cdot \mathrm{P}_{wo}\cdot FV_m}{(1+r_m^f)^{m-t+1}}
\end{aligned}
$$

Now, we denote x_t as the risk premium of the loan in period t. Therefore, it holds: $r_t^c = r_t^f + x_t$.

$$
\begin{aligned}
= \quad & \sum_{m=t}^{T} \frac{FV_{m-1} \cdot (1 + r_m^f + x_m)}{(1 + r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot FV_{m-1} \cdot (1 + r_m^f + x_m)}{(1 + r_m^f)^{m-t+1}} \\
& - \sum_{m=t}^{T} \frac{FV_m}{(1 + r_m^f)^{m-t+1}} + \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot FV_m}{(1 + r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot \mathrm{P}_{wo} \cdot FV_m}{(1 + r_m^f)^{m-t+1}} \\
= \quad & \left(\sum_{m=t}^{T} \frac{FV_{m-1}}{(1 + r_m^f)^{m-t}} - \sum_{m=t}^{T} \frac{FV_m}{(1 + r_m^f)^{m-t+1}} \right) - \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot \mathrm{P}_{wo} \cdot FV_m}{(1 + r_m^f)^{m-t+1}} \\
& + \left(\sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot FV_m}{(1 + r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot FV_{m-1}}{(1 + r_m^f)^{m-t}} \right) \\
& + \sum_{m=t}^{T} \frac{FV_{m-1} \cdot x_m}{(1 + r_m^f)^{m-t+1}} - \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot FV_{m-1} \cdot x_m}{(1 + r_m^f)^{m-t+1}} \\
\stackrel{FV_T=0}{=} \quad & FV_0 - \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot \mathrm{P}_{wo} \cdot FV_m}{(1 + r_m^f)^{m-t+1}} - FV_0 + \sum_{m=t}^{T} \frac{(1 - \mathrm{P}_{wo})^{m-t} \cdot \mathrm{P}_{wo} \cdot FV_m}{(1 + r_m^f)^{m-t+1}} \\
& + \sum_{m=t}^{T} \frac{(1 - (1 - \mathrm{P}_{wo})^{m-t}) \cdot FV_{m-1} \cdot x_m}{(1 + r_m^f)^{m-t+1}} \\
= \quad & \sum_{m=t}^{T} \frac{(1 - (1 - \mathrm{P}_{wo})^{m-t}) \cdot FV_{m-1} \cdot x_m}{(1 + r_m^f)^{m-t+1}}
\end{aligned}
$$

Here, it can be seen that the sign of the correction factor depends on the sign of the x_t and on the x_t-weighted sum of the present values. In case of a constant x_t for all periods, the sign of the correction factor solely depends on the sign of x. $\square$

Appendix 2

Table 2: Example of LLP computation for an amortizable loan

The table shows an amortizable loan at par with a maturity of four years and a face value of 1,000. Furthermore, we assume a risk-free interest rate of five percent p.a., a risk-adjusted contract interest rate of 6.275 percent p.a., a write-off probability of six percent, and an LGD of 20 percent.

t	0	1	2	3	4
C_t	−1,000	312.75	297.06	281.38	265.69
Amortization	–	250.00	250.00	250.00	250.00
Interest payments	–	62.75	47.06	31.38	15.69
LLP$_t$ without F_t	28.95	17.65	8.96	3.04	0.00
F_t	1.60	0.67	0.17	0.00	–
LLP$_{cor,t}$ / TEL$_t$	27.35	16.98	8.79	3.04	0.00
Present value	1,028.95	767.65	508.96	253.04	250.00
Time effect	–	−11.30	−8.69	−5.92	−3.04
$DP_{t-1,t}$	–	10.37	8.19	5.75	3.04
Total effect	1.60	−0.93	−0.50	−0.17	0.00
Balance sheet valuation	1,001.60	750.67	500.17	250.00	0.00

Accounting records:

$t = 0:$	Loans and Receivables	1,028.95	to	Cash	1,000.00
	Loan Loss Provision	27.35		Loans and Receivables	27.35
				Revenues	28.95
$t = 1:$	Cash	312.75	to	Interest Revenues	62.75
				Loans and Receivables	250.00
	Loans and Receivables	10.37	to	Revenues from $DP_{t-1,t}$	10.37
	Expenses	11.30		Loans and Receivables	11.30
$\vdots$					
$t = 4:$	Cash	265.69	to	Interest Revenue	15.69
				Loans and Receivables	250.00
	Loans and Receivables	3.04	to	Revenues from $DP_{t-1,t}$	3.04
	Expenses	3.04		Loans and Receivables	3.04

Appendix 3

Figure 4: Relative P&L impact of different LLPs

The figure shows the development of the relative P&L impact based on the example given in the Appendix 2. Here, the development according to the alternative provisioning methods affecting the P&L is shown. The illustration of the general LLP with credit event refers to the right axis (rhs) since the relative amount is much higher than for the others.