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Bank provisioning behaviour and procyclicality

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Abstract

The current debate on the possible procyclicality of the new Basel Accord pays little attention to the procyclicality created by unsound loan loss provisioning. This article investigates how bank provisioning behaviour is related to the business cycle, using 8000 bank-year observations from 29 OECD countries over the past decade. Provisioning turns out to be substantially higher when GDP growth is lower, reflecting increased riskiness of the credit portfolio when the business cycle turns downwards, which also increases the risk of a credit crunch. This effect is mitigated somewhat as provisions rise in times when earnings are higher, suggesting income smoothing, and loan growth is higher, indicating increased riskiness.

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1. Introduction

One of the main objectives underlying the new Basel Accord is to substantially increase the risk sensitivity of the minimum capital requirements for banks (BCBS, 2003). This has raised a lively debate in both policy circles and the economic literature about the potential procyclical effect such risk sensitive requirements might have on the economy

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(e.g. Segaviano and Lowe, 2002; Borio et al., 2001; Daníelsson et al., 2001; Turner, 2000). During a cyclical downturn, the quality of banks' assets is likely to deteriorate, which would increase risk exposure and, hence, capital requirements, exactly at a time when new capital becomes more expensive or, for weaker institutions, simply unobtainable (Jackson, 1999). As a consequence, banks might be forced to cut back their lending. Particularly in countries where corporate lending is provided mainly by banks, this would further weaken cyclical conditions into a so-called credit crunch, which would in turn exacerbate the downturn. New proposals by the Basel Committee have substantially reduced the possible procyclical effects of the new accord and thereby reduced the risks of financial instability.¹ Yet the new capital requirements continue to be more risk-sensitive than before, as, by the way, they should in order to promote the financial soundness of banks. Hence, the issue of possible procyclicality continues to exist.

In the current debate on procyclicality, not much attention is being paid to the already existing potential procyclicality created by unsound provisioning. There is general agreement that unexpected losses by banks should be covered by bank capital, whereas expected losses should be covered by loan loss provisions or by future margin income. In reality, however, the distinction may be blurred. Whereas specific provisions are linked to impaired loans, general provisions are often based on a broad assessment of possible future losses on the entire portfolio. According to the Basel definition of capital, part of the general provisions counts as capital. Besides, when loan loss reserves and future margin income are inadequate to cover expected losses due, for instance, to a deterioration of the business cycle, these losses also eat into the capital reserve.

Given this close relation between provisions and capital, one could argue that a sound provisioning policy should be part of any regulations on capital requirements (Cavallo and Majnoni, 2002; Banque de France, 2001). The Second Pillar of the proposed accord – the Supervisory Review – may also provide scope for such a policy (Turner, 2000). In any case, it is useful to investigate the present relationships between provisions on the one hand, and the business cycle and capital on the other.

This article is precisely such an investigation into the provisioning behaviour of banks and their dependency on the business cycle. It seeks to shed light on the question whether such behaviour is procyclical too, as alleged. We distinguish the following two causal channels from the business cycle to provisioning. First, credit risk is most probably linked to the phase of the cycle. The 'classical view' assumes that risk increases in a downturn and vice versa. It is this behaviour which would cause procyclicality, as in a downturn provisioning swallows a larger part of profits just when more resources are needed for capital. An alternative view is that of Borio et al. (2001) and Lowe (2002), who state that credit risks are built up

¹ The Basel Committee has recognized the possible procyclical effects of the Accord and has taken far-reaching steps, elaborated in the recent proposals of the new Accord. First, the new capital requirements are less risk sensitive which reduce the procyclical impact by one third (Segaviano and Lowe, 2002). Second, banks are allowed to treat some types of loans to small- and medium-sized enterprises as retail loans, which have lower capital requirements and are less risk sensitive because the dispersion of small loans over many counterparties in the retail portfolio reduces the risk for the bank. Third, more types of collateral are recognized for capital reduction, what is typically used by banks when the business cycle deteriorates. Fourth, banks need to show with *stress testing* that their capital is adequate to cope with a recession (that is, six months without economic growth) without a reduction of lending. Finally, banks are free to estimate through-the-cycle ratings instead of point-in-time ratings.

61 during a boom, particularly when loan growth is relatively high. Second, provisioning may
62 also depend on earnings, as assumed in the so-called income-smoothing hypothesis. An
63 alternative explanation of smooth income is that prudent banks may behave far-sightedly
64 and provide for lean years during fat years. Sound provisioning when lending grows and
65 flattening of earnings reduce the procyclical behaviour of provisioning.

66 A number of recent studies in the economic literature investigate provisioning behaviour
67 and procyclicality. They tend to focus on certain aspects of provisioning or analyse one
68 individual country only, e.g. [Greenawalt and Sinkey \(1988, 1991\)](#), [Arpa et al. \(2001\)](#), [de](#)
69 [Lis et al. \(2001\)](#) and [Pain \(2003\)](#). We have opted for a wider approach, developing a more
70 comprehensive provisioning model and employing a large set of 8000 bank-year obser-
71 vations from the past decade and from all 29 OECD countries. This approach allowed us
72 to compare bank provisioning behaviour across countries, and may reveal typical world-
73 wide conduct regarding loan loss provisioning as well as idiosyncratic country-specific
74 deviations.

75 During our analysis we came across two studies ([Cavallo and Majnoni \(2002\)](#) and [Laeven](#)
76 [and Majnoni \(2003\)](#), further abbreviated to C&M and L&M), which in some respects are
77 similar to this article. This article aims at elaborating on these studies by:

- 78 • Criticizing some aspects of the C&M model.
- 79 • Including additional variables in the applied regression model of provisioning, such as
80 GDP growth (to investigate cyclical behaviour; left out in C&M), equity ratio (to test the
81 capital management hypotheses; left out in C&M and L&M) and country dummies (left
82 out in L&M).
- 83 • Using all available data instead of a selected subset, analysing a somewhat more recent
84 period and improving on the estimation procedures.
- 85 • Analysing also the levels of loan loss reserves besides the annual additions to the loan loss
86 provisions (levels are more important for the financial soundness of the bank and differ
87 from the annual additions, which are supposed to be primarily determined by discrete –
88 cycle-dependent – decisions).

89 In any case our analysis forms a robustness test on the two mentioned studies, as it de-
90 viates from them by using different (i) explanatory variables (and different definitions
91 of common explanatory variables), (ii) estimation techniques to avoid autocorrelation,
92 (iii) data, and (iv) countries and regions. With respect to the sign of the loan growth ef-
93 fect, our estimation results appear to deviate significantly from those of C&M and L&M.
94 We find a positive effect in line with the view of [Borio et al. \(2001\)](#) and [Lowe \(2002\)](#),
95 whereas C&M and L&M discovered a negative coefficient. We execute a set of sensi-
96 tivity analyses to reveal which differences are responsible for this essential change in
97 outcome.

98 The outline of this article is as follows. Section 2 reviews the theory and practice of bank
99 provisioning behaviour and its relation to procyclicality. Section 3 specifies our hypotheses
100 and presents a regression model for provisioning. Section 4 reports the empirical results
101 of this loan loss provisions model, while the next section provides outcomes of a loan loss
102 reserves model. The final section summarises and draws conclusions.

2. Provisioning in theory and practice

An important aspect of provisioning is its timing with respect to the business cycle and the related issue of procyclicality. The common view is that an economic upswing and rising incomes indicate improving conditions for firms and reduce the likelihood of loan defaults, whereas a recession will have the opposite effect. Banks are expected to reflect this feature in their decisions by lowering provisions during an economic boom and increasing them during a downturn. This cyclical bank behaviour is reported by e.g. C&M, L&M and Bikker and Hu (2002).² According to this common view, the banks' provisioning behaviour may be procyclical, meaning that it may reinforce the current development of the business cycle. However, an alternative, countercyclical view states that credit risk is build up in a boom and materialises in a downturn (Borio et al., 2001; Lowe, 2002). The favourable conditions of an economic expansion could lead to an excessive increase in credit lending and a less critical assessment of creditworthiness.³ The countercyclical view associates this with higher risks and the build-up of financial imbalances that increase the likelihood of economic contraction. According to this view, provisions should be positively correlated with the lending cycle, for banks should recognise the underlying risk and build up loan loss reserves in good times to be drawn on in bad times.

This countercyclical behaviour assumes (far) forward-looking risk assessment by banks. However, in practice, business cycle developments are hard to foresee, given their erratic duration and amplitude. In addition, accounting rules and tax constraints also contribute to increases in general provisions during downturns, as they tend to allow only provisions based on past events, not on expectations (Borio and Lowe, 2001). Nevertheless, Spain introduced a new provisioning regulation in mid 2000, called statistical provisioning, based on risk assessment with a longer time horizon (de Lis et al., 2001).⁴ The French supervisor is firmly advocating a comparable approach, called dynamic provisioning (Banque de France, 2001). Other countries, such as the Netherlands, also allow certain forward looking elements in provisioning.⁵

Provisioning leaves room for subjective judgements as to what extent losses are inherent in the loan portfolio on the balance sheet date. This holds in particular for general provisions meant to cover possible or expected losses, which neither have become manifest nor are related to individually identified loans.⁶ Therefore, bank management may have some discretion in setting the appropriate provisioning levels, so that loan loss reserves can be influenced by several other considerations. The literature cites three main reasons for the use of provisioning, other than purely providing a realistic valuation of outstanding loans.

² Bikker and Hu (2002) used aggregated country level data instead of bank data.

³ Keeton (1999) pointed out that there is empirical support for this statement, insofar as the increase in loan growth is driven by an expansion of loan supply. As loan growth is often demand driven – which is not harmful – the link between loan growth and loan losses is no 'law of nature'.

⁴ A similar provisioning approach is compulsive for Portuguese banks.

⁵ More transparency on provisioning, as recently introduced in the Netherlands, may also enhance market discipline in terms of proper provisioning and may thus counter procyclicality. See also the Pillar III proposals under Basel II (BCBS, 2003).

⁶ As opposed to specific provisions which reflect known and identified loan impairment.

137 First, the discretionary use of provisioning is frequently associated with the practice
138 of earnings management. Allegedly, banks may reserve more in good years, for instance,
139 because as a precaution – provisions are increased in fat years for use in lean ones – or, as
140 is suggested in the literature, for credibility (not to say window dressing), i.e. presenting
141 a fairly constant profit over the years.⁷ Reporting a less variable income flow could be
142 seen as signalling good performance from the viewpoint of stock price stability, external
143 rating performance and lowering of funding costs, and management rewards (Greenawalt
144 and Sinkey, 1988; Fudenberg and Tirole, 1995). Such countercyclical provisioning policies
145 would reduce procyclical provisioning behaviour by banks.

146 Second, as far as general provisions also count as regulatory capital,⁸ they may be used
147 to manage the capital ratio (e.g. Kim and Kross, 1998; Ahmed et al., 1999; Cortavarria et
148 al., 2000). The capital management hypothesis assumes that banks with low Tier 1 capital
149 ratios are inclined to make more general loan loss provisions in order to keep their capital
150 ratios adequate. Reasons for managing the capital ratio through provisions are the high cost
151 in terms of both money and time of raising new capital on the market (particularly when
152 market conditions are unfavourable), the trade-off between dividend payments and retained
153 earnings due to shareholder pressure and the tax regime (see below).

154 Third, if general provisions are tax deductible as is the case in most countries, this in itself
155 is an incentive to provisioning. And if general provisions also count as regulatory capital,
156 this incentive is even stronger, as a shift from pure (Tier 1) capital to general provisions
157 lowers the tax burden (Cortavarria et al., 2000).⁹

158 3. A model for loan loss provisioning

159 As explained above, both loan loss reserves and the capital stock are buffers to preserve
160 banks' continued solvency by shielding it against, respectively, expected and unexpected
161 loan losses. They are formed, however, according to different principles. The optimum
162 capital stock is determined mainly by strategic and long-term arguments reflecting, among
163 other things, the trade-off between risk and return on assets on the one hand and regula-
164 tory requirements on the other. Provisions are linked more directly to the quality of the

⁷ Kim and Santomero (1993) argue that a positive correlation between earnings and provisions may well be the result of optimal statistical forecasting with respect to loan losses and hence need not be due to misleading provisioning behaviour as supposed in the income smoothing theory. Hence, we cannot distinguish window dressing from prudent provisioning.

⁸ The Basel Accord allows banks to include general loan loss reserves in Tier 2 capital, the lower quality part of regulatory capital, up to 1.25% of risk weighted assets. An accompanying constraint is that Tier 2 capital may not exceed the level of Tier 1 capital, the higher quality part of regulatory capital.

⁹ There are, however, large differences in tax regulations across countries. Beattie et al. (1995) and Dziobek (1996) have documented these differences for a large number of OECD countries. In general, there are five main areas where national tax rules may differ: (i) the relationship between the tax and accounting treatment of loan loss provisions; (ii) the limit on the amount of provisions that is tax deductible; (iii) differences in the deductibility of general and specific provisions and write-offs; (iv) the choice of method used to determine allowable provisions; and (v) the existence of spreading provisions. All in all, these differences mean that banks in different countries face different incentives towards optimising their provisioning, resulting in different practices around the world. This also means that banks may differ in their response to other variables that determine the level of provisions.

loan portfolio and hence are more susceptible to short-term fluctuations arising from the macroeconomic environment and developments in the solvency of individual counterparties. This holds in particular for specific provisions, which are directly linked to impaired loans. Provisioning may also be affected by country-specific circumstances with respect to accounting, regulatory and tax rules or to bank behaviour such as income smoothing or forward-looking risk assessment. Given such discretionary features, a model explaining the level of provisions should prominently contain variables that relate to the underlying decision-making process of provisioning.

This article investigates both the loan loss provisions (the annual addition) and the loan loss reserves (the level) because the two are different in character. Loan loss provisions reflect managerial decisions at a point in time, which may be more likely to be ad hoc discretionary decisions. Loan loss reserves reflect the year-on-year accumulated net provisioning that, on average, ought to reflect mainly actual expected loan losses. Analysts, regulators, management and auditors tend to see the loan loss reserves as important information regarding the credit portfolio's quality.

C&M developed a simple theoretical model for banks' profits that incorporates the business cycle and shows the impact of various provisioning regimes on earnings, income taxes and the capital ratio:

$$\begin{aligned} \pi &= L[(r_B + E(d) + k) - r_D] - OC - BL - [\gamma E(d)L - BL] \quad \text{either} \\ &L[(r_B + k) - r_D] - OC + (1 - \gamma)E(d)L \quad \text{if LLR} > 0 \text{ or} \quad (1) \\ &L[(r_B + k) - r_D] - OC + [E(d)L - BL] \quad \text{if LLR} = 0 \end{aligned}$$

where π are bank profits, L loans, r_B the risk-free interest rate, $E(d)$ the expected default ratio on loans as an average through the business cycle, k the risk premium, r_D the funding rate, OC operating costs, BL bank losses on loans and LLR loan loss reserves. Loans and bank losses on loans are stochastic variables with a cyclical pattern, respectively, positively and negatively correlated with the business cycle. The business cycle feeds into bank profits through bank losses (BL), the demand for loans (L) and, probably, the levels of the interest rates. The expected default ratio $E(d)$ should not depend on the business cycle, as it is a (so-called) through-the-cycle rate.

Net loan loss provisions equal the difference between gross provisions ($\gamma E(d)L$) and write-offs (BL), where γ is a proportional factor which, according to C&M, ranges from 0 to 1. However, in general, γ is expected to fluctuate around 1. During an economic upswing, when loan losses are smaller than the provisions based on through-the-cycle rate default rates, there is build-up of loan loss reserves and γ indeed ranges from 0 to 1. During a downturn, when loan losses increase and net provisions become negative, the reserves are gradually drawn down. This provisioning regime requires initially positive loan loss reserves. To some extent this model shares features with the dynamic or statistical provisioning strategy. According to C&M, expected losses are fully provisioned when $\gamma = 1$ and there is no need for an a priori positive reserve for loan losses. This would be true when the expected default ratio on loans was a so-called point-in-time (hence up-to-date) estimate. However, C&M actually state that expected default ratios are averages through the cycle, which indeed is more plausible, as the risk margin of the interest rate on long-term loans is fixed over the entire duration. Where actual losses turn out higher than expected, γ would be larger than 1.

206 This model assume the full provisioning strategy – as long as loan loss reserves remain
 207 positive – which insulated profits from unexpected loan losses, so that the only source of
 208 variability in banks' earnings is the cyclical pattern of demand for loans over the business
 209 cycle. Further, it ignores the many other determinants of bank profitability, as discussed in
 210 Section 2.¹⁰

We employ a more elaborated multi-country model, including the core elements of the gross loan loss provisions term $\gamma E(d)L$ discussed above, which includes proxies for the business cycle, various bank specific balance sheet characteristics and dummy variables for country-specific conditions. This model for loan loss provisions (LLP) reads as:

$$\begin{aligned} \frac{LLP_{i,j,t}}{(0.5(TA_{i,j,t} + TA_{i,j,t-1}))} = & \alpha_1 + \alpha_2 \Delta \ln GDP_{j,t} + \alpha_3 UNEMPL_{j,t} + \alpha_4 EARN_{i,j,t} \\ & + \alpha_5 \Delta \ln LOANS_{i,j,t} + \alpha_6 \left(\frac{LOANS}{TA} \right)_{i,j,t} \\ & + \alpha_7 \left(\frac{CAP}{TA} \right)_{i,j,t} + \sum_{j=1 \dots 28} \alpha_{7+j} d_j + \varepsilon_{i,t} \end{aligned} \quad (2)$$

211 The flow variable LLP is scaled by the stock variable 'total assets', for which we have
 212 taken the average of the current and preceding year. The subindices refer to bank i from
 213 country j in year t. The dependent variables can be subdivided into (i) the macroeconomic
 214 variables of the banks' own country, GDP growth and the unemployment rate (UNEMPL),
 215 (ii) various bank specific variables, earnings (EARN), loan growth ($\Delta \ln LOANS$), loans as
 216 share of total assets and the equity or capital ratio, and (iii) country dummies (d_j). These
 217 variables are explained in greater detail in Annex 1 of [Bikker and Metzemakers \(2004\)](#).
 218

219 3.1. The data

220 We use pooled cross-section and time series data of individual banks' balance sheet items
 221 from 29 OECD countries (listed in [Table 1](#)) and country-specific macroeconomic indicators
 222 for these countries, over an 11-year period from 1991 to 2001. This episode covers a full
 223 business cycle for all the countries included. In general, the cycle develops from a trough
 224 in or after 1991, an economic boom in the nineties to a slowdown beginning in 2001. Some
 225 countries, such as Korea, Mexico and Turkey, experienced a severe financial crisis during
 226 this period. The macroeconomic data are from the OECD and the IMF (see [Bikker, 2004](#),
 227 page 246), whereas the balance sheet data were taken from the Bankscope database (Fitch-
 228 IBCA). Bank-specific data allow for the investigation of individual banks' provisioning
 229 characteristics. Moreover, the high number of available observations on banks' provisions
 230 provides a rich source of information. We employed data from commercial banks only, in
 231 order to obtain a more homogeneous group of banks. Besides, commercial banks tend to
 232 provide more balance sheet information, especially about the loan loss provisions central
 233 to our analysis. Nevertheless, data on loan loss reserves and total problem loans are less

¹⁰ See also [Demirgüç-Kunt and Huizinga \(1999, 2001\)](#), and [Bikker and Hu \(2002\)](#) for other determinants of bank profitability in practice.

Table 1
OECD and EU models for loan loss provisions

Variables ^a	OECD		EU	
	Coefficient	<i>t</i> -value ^b	Coefficient	<i>t</i> -value ^b
Intercept	−0.0016	−1.1	0.0032	1.3
LLP/TA, lagged	0.4131	5.2***	0.4259	5.2***
GDP growth	−0.0005	−3.8***	−0.0007	−2.9***
Unemployment rate	0.0000	0.3	0.0002	1.0
Earnings before T&P ^c	0.2784	5.1***	0.3512	3.6***
Loan growth	0.0003	2.4***	0.0003	0.5
Loans/TA	0.0038	2.5***	0.0023	1.1
Capital/TA	−0.0329	−3.6***	−0.0355	−2.5***
No. of observations	7947		3965	
<i>F</i> -test	139.4***		127.6***	
<i>F</i> -test dummies	5.7***		4.8***	
Adjusted <i>R</i> -square	0.37		0.40	
Durbin–Watson test	1.74		1.67	
Breusch–Godfrey LM <i>F</i> -test	0.3		7.8***	

^a Country dummies are not shown.

^b Based on Newey and West's heteroskedasticity and autocorrelation consistent covariances. One, two and three asterisks indicate a level of confidence of 90%, 95% and 99%, respectively. Critical values are: 1.282, 1.645 and 2.326.

^c T&P is short for tax and provisions.

234 abundantly available (due to varying local regulations), restricting the final data sample used
 235 for the subsequent analysis. We used virtually all available data, apart from obvious errors,
 236 and did not select the data such as has been done by C&M and L&M. Among other things,
 237 they disregarded various kinds of outliers (loan growth rates above 50%, provisioning and
 238 earnings to total assets ratios above 10%). Thereby, L&M deleted 10% of all observations
 239 (estimated using our data set) and not 2%, as they claimed in their article.¹¹

240 4. Empirical results of the loan loss provisions model

241 Table 1 presents the 'world-wide' estimation results of the loan loss provisions model
 242 of Eq. (2).¹² Initial estimates reveal that the disturbances of this regression model exhibit
 243 serial correlation, as indicated by the Durbin–Watson (DW) test and Breusch–Godfrey's
 244 Lagrange Multiplier (LM) test.¹³ This feature has been dealt with through inclusion in

¹¹ Another threshold is that L&M require at least three successive annual observations for each bank. This could affect the calculations.

¹² The correlation matrices in Annex 2 of Bikker and Metzmakers (2004) show that multicollinearity is not a problem in this regression nor in later ones. We tested the model for influences caused by any possible correlation by regressing the lagged dependent and macroeconomic variables first, and then one by one regressing the other variables on the residuals of the preceding regression. Value and significance of all coefficients remained unchanged.

¹³ In this table and in later ones, we present the *F*-test statistic of the LM test. The alternative, the number of observations times the *R*-squared, which has a χ^2 distribution, yields virtually identical test results.

245 the model of the lagged dependent variable as an explanatory variable. Such a Koyck lag
246 model assumes that the actual provision values adjust gradually over time to its assumed
247 model values due, for instance, to the lagged availability of information or the gradual
248 build-up of necessary provisions (Theil, 1971). An argument for gradual adjustment may
249 be that banks observe the state of the cycle with a lag, while information with respect
250 to the bank's balance sheet items and income accounts are also obtained with a certain
251 lag. Another argument is that provisions for (probable) losses may be spread out over a
252 longer term.¹⁴ Going by the DW and the Breusch-Godfrey LM test statistics, the Koyck
253 lag solves the autocorrelation problem.¹⁵ Nevertheless, to remain on the safe side, we use
254 the approach of Newey and West (1987) to correct the t -values of the coefficients for any
255 possible remaining heteroskedasticity and autocorrelation. This prevents us from making
256 wrong inferences from these t -values, such as regarding the level of significance (Greene,
257 2000). Incidentally, the estimates from the model with a Koyck lag (λ) hardly deviate from
258 the initial equation without gradual adjustment (after correction of the lag effect by dividing
259 the coefficients by $(1 - \lambda)$).¹⁶

260 All macroeconomic and bank-specific variables, except the unemployment rate, have
261 significant effects on loan loss provisions, see the left-hand column in Table 1.¹⁷ In line
262 with expectations, the GDP growth coefficient is significantly negative, indicating that
263 provisions indeed rise when the business cycle falls. The elasticity between provisions as
264 share of total assets and GDP growth is -0.23 in the short run and -0.39 in the long
265 run.¹⁸ This strong cyclical effect implies that banks' provisioning behaviour is significantly
266 procyclical and probably lacks a (far) forward looking risk assessment over the business
267 cycle. Similar cyclical effects were found by C&M, L&M and Bikker and Hu (2002).
268 Unemployment, which also reflects structural unbalances, apparently does not increase
269 loan loss risk significantly.

270 This procyclical behaviour as reflected by the coefficient of GDP is mitigated somewhat
271 by the impact of banks' earnings on provisions, as banks do provision considerably more
272 when earnings are high and vice versa. The elasticity between provisions and earnings is
273 0.76 in the short run and 1.29 in the long run. This positive relationship is found in virtually
274 all studies cited in this article. Regardless of the commendable or condemnable motives

¹⁴ Besides, just like autocorrelation, this model structure often indicates that at least one explanatory variable with lasting effects has been omitted. This comes as no surprise, as our model can use only general (balance-sheet) information; after all, more detailed information about the loan portfolio and its riskiness being unavailable. For instance, in many countries, information regarding concentration on regions, sectors or obligors is not made public.

¹⁵ The DW test statistic is not applicable to models with a lagged dependent variable, but the high number of observations made the formula of the appropriate Durbin's h -test statistic – here and elsewhere in this paper – intractable. DW test values below 1.60 may well be within the critical limit. This limit is derived from an estimated critical lower limit, D1, which is downward-distorted as the number of explanatory variables (k) increases. The usual DW tables run to $k = 6$ as a maximum with a DW index of 1.57. As this model and subsequent models in this and following tables all contain considerably more than six variables and considerably more observations, we may deduce that the critical D1 limit is well below 1.57.

¹⁶ A model without a Koyck lag estimates the long-run only, ignoring short-term dynamics. Similar long-run effects do not imply that short-term dynamics are absent.

¹⁷ By significant (or very significant) we mean, in this paper, at the 95% (or 99%) level of confidence.

¹⁸ The short-run elasticity is calculated as $-0.0005 \times 3.236/0.007 = 0.23$ (see Tables 1 and 4). The long-run elasticity is the short-run elasticity divided by $(1 - \lambda)$, with $\lambda = 0.41$.

275 underlying income smoothing (as discussed above), this behaviour contributes to financial
276 soundness of banks and reduces procyclicality.

277 Loan growth as a proxy of increased credit risk appears to be significantly positive as a
278 determinant of provisioning, reflecting the views of [Borio et al. \(2001\)](#) and [Lowe \(2002\)](#)
279 that risks are built up during economic booms. This countercyclical outcome is in line with
280 the earnings effect, but is dominated by the overall procyclical provisioning behaviour as
281 indicated by the GDP effect. Our estimation result deviates strongly from that of C&M and
282 L&M, who found negative loan growth effects.¹⁹ We have executed a series of sensitivity
283 analyses to find out which differences are essential for the swing in the loan growth effect.
284 Differences in specification choices and in restrictions on data each explain a part of the
285 change. When we re-estimate the model with our data but with specification choices of
286 L&M (see Section 1), the loan growth effect becomes insignificant.²⁰ When we further
287 apply the – rather rigorous and arbitrary – data restrictions of L&M (see Section 3), the
288 loan growth effect becomes significantly negative.²¹ Re-estimation of C&M in two steps
289 yields similar results. Although we consider our specification as more plausible and our
290 data choices as less controversial, the results at least make clear that the loan growth effect
291 appears to be sensitive to such choices.

292 Banks that have higher credit risk exposure, in the sense that they hold greater amounts
293 in (risky) loans on the balance sheet, tend to provision more, as also found by [Greenawalt
294 and Sinkey \(1988\)](#) and C&M. The elasticity between provisions and loans is 0.30 in the
295 short run and 0.51 in the long run, hence lower than 1. This result suggests that banks with
296 relatively more loans do not increase provisioning proportionally.

297 Finally, the capital to asset ratio is negatively correlated with provisions, which supports
298 the capital management hypotheses predicting higher provisioning when the capital ratio
299 is relatively low. The elasticity between provisioning and capital is -0.42 in the short run
300 and -0.72 in the long run. The same result was found by [Ahmed et al. \(1999\)](#) for the US.
301 An alternative phenomenon contributing to these results might be that some banks are more
302 risky in the sense that they (i) hold a greater share of risky loans (and hence incur more
303 losses and provision more) and (ii) have a lower capital ratio. This also engenders a negative
304 relationship between provisioning and capital.

305 Many country dummies – not shown in [Table 1](#) – are significant. The F -test indicates
306 that they are also jointly significant, as also found by C&M. More than half of the country
307 dummy coefficients show a significant positive deviation from the US. This reflects
308 that banks in these countries provision more, taking the other explanatory variables into
309 account.

310 Three variables reflect the cyclical pattern: GDP growth, earnings on provisions and
311 loan growth, the first one pointing to procyclicality and the latter indicating behaviour
312 that mitigates procyclicality. The multiple regression coefficients provide little insight
313 into the net effect of the cyclical on provisioning. A more commodious method is to

¹⁹ Both in our study and in their analyses, this effect varies also across countries, showing a certain lack of robustness.

²⁰ Alternatively, when we re-estimate the model with our specification using the data restrictions of L&M, we immediately observe a significant negative loan growth effect, as found by L&M.

²¹ Particularly, L&M's loan growth cap affect the estimation results.

314 use a simple bilateral comparison between provisioning and GDP growth, assuming
315 that GDP growth in the best indicator of the business cycle. On average, in periods of
316 GDP growth below 3%, provisions are as much as 60% higher than in periods with
317 GDP growth above 3%.²² This confirms the substantial procyclical effect of provisioning
318 behaviour.

319 We applied the provisioning model to the EU and individual countries as well, in or-
320 der to test its robustness and to reveal possible empirical differences across countries.²³
321 The results for the EU as a whole, the US, Japan and France are rather similar to the to-
322 tal sample outcome, see, respectively, [Tables 1 and 2](#). The GDP effects are significantly
323 negative, in line with expectations, a result also found by [Arpa et al. \(2001\)](#) for Austrian
324 banks. For the EU as well as France, the unemployment rate is significant too, in accor-
325 dance with expectations carrying a positive sign. These outcomes support the view that
326 provisioning behaviour is typically procyclical. Income smoothing or prudential dynamic
327 provisioning, as indicated by the positive coefficient of earnings, is common in the EU,
328 the US and France, but lacking in Japan. The sign and significance of the loan growth
329 effect varies across the countries. The loan-share ratio behaves as expected in the US
330 (and Italy), but not elsewhere.²⁴ In Japan the loan growth coefficient is negative, which
331 further emphasises the procyclical provisioning behaviour observed above. For the US,
332 we also tried the share of total problem loans as a proxy for credit risk; this variable is
333 hardly ever available for banks in other countries. Surprisingly, and contrary to our hy-
334 pothesis, this variable proved not to be significant. Apparently, a clear link between the
335 recorded impaired loans and provisioning is lacking. [Kim and Kross \(1998\)](#) also found
336 an insignificant effect of the lagged nonperforming loans-assets ratio on LLP for low-
337 capital banks, but a significantly positive impact for high-capital banks. The capital ratio
338 coefficient is negative in these regions and countries, supporting the capital management
339 view.

340 The results in the other four countries, Italy, Luxembourg, Spain and the UK, are less in
341 line with those for the whole sample. The cyclical effects as indicated by GDP growth are
342 not significant. Income smoothing or prudential provisioning is found in Luxembourg only.
343 The credit risk indicator 'loans as a share of total assets' is significantly positive in Italy
344 and the UK, whereas the capital ratio is significantly negative in Italy and Luxembourg.
345 All in all, these outcomes suggest substantial differences in provisioning behaviour across
346 countries, as could be expected given the diverging legal, regulatory or institutional frame-
347 works, including tax and accounting regimes, market or financial structures and business
348 cultures.

²² The original procyclical effect as measured by the GDP growth, so without the buffers originating from earnings on provisions and loan growth, is substantially greater.

²³ We have chosen only countries with many banks for which the required data are available. For this reason we did not test the model for Germany, as [Bankscope](#) did not provide many observations of loan loss provisions for that country. Autocorrelation was not solved always by inclusion of a Koyck lag. For some models, inclusion of an AR(1) term worked out well. In the remaining models, the Newey and West's procedure is supposed to correct for any residual autocorrelation.

²⁴ Note, however, that the loan share is significant for the *level* of loan loss reserves, as observed in the next section.

349 5. The level of loan loss reserves

350 The model of C&M specifies the gross loan loss provisions as $\gamma E(d)L$, see below Eq. (1).
 351 Although this is a proper description of ex ante provisioning, reflecting the need to reserve
 352 for expected losses in order to cover incurred losses, it lacks a direct link between the optimal
 353 level of total provisioning and the real quality of the loan portfolio. Deviations of actual
 354 losses from expectations over former years are not adjusted. Moreover, when the business
 355 cycle deteriorates and the creditworthiness of the obligor gets worse, more provisions are
 356 needed, whereas the need for provisions declines when economic conditions improve. This
 357 cyclical adjustment is recognised in our Eq. (2) as all cyclical effects are measured, but it
 358 is ignored in the model of C&M. Finally, gross provisions may also be affected by discrete
 359 managerial decisions, such as those related to income smoothing. For this reason it is also
 360 interesting to investigate the level of loan loss reserves (LLR) – which is the accumulation
 361 of annual net provisions – instead of its annual gross provisions (LLP) only, as in Section
 362 4:

$$363 \quad \text{LLR}_t = \sum_{i=0,1,2,\dots} \text{LLP}_{t-i} - \text{BL}_{t-i} = \text{LLR}_{t-1} + \text{LLP}_t - \text{BL}_t \quad (3)$$

364 Therefore, we apply Eq. (2) with provisioning LLP replaced by the level of the reserves
 365 LLR,²⁵ as we expect that the same explanatory variables determine the loan loss reserve
 366 level.

367 The first column of Table 3 presents the results of the ‘world-wide’ model for LLR.
 368 Because data on banks’ reserves levels are unavailable for many countries, the world-wide
 369 data set looks like a survey sample, including only a limited subset of 12 countries. Although
 370 the level of reserves may differ substantially from gross provisions, we find that the level is
 371 affected by the explanatory variables in a similar way: almost all coefficients are significant
 372 and have the same sign. The effects of the business cycle (GDP), income smoothing or
 373 dynamic provisioning (earnings) and credit risk (loan growth and loan share) all are similar
 374 to those in the provisioning model, be it that the t values are somewhat lower. In terms of
 375 elasticities, the effects on the LLR of GDP growth (–0.77 in the short run and –4.95 in the
 376 long-run) and of loans (0.36 in the short run and 2.29 in the long-run) are larger compared to
 377 provisioning, whereas the effect of earnings (0.12 in the short run and 0.80 in the long run)
 378 is smaller. Only a clear relationship between reserves and capital appears to be lacking. This
 379 is remarkable, as the capital management hypothesis predicts a possible interdependence
 380 between these two cushions for larger losses. Apparently, provisions react on the equity
 381 level, but there is no feedback with the level of reserves.

382 The speed of adjustment of the reserves level towards its model value ($0.222 = 1 - 0.788$)
 383 is substantially lower than in the model for the annual provisioning ($0.587 = 1 - 0.413$),
 384 seems to make sense. The coefficients of the country dummies – not shown in Table 1 – are
 385 rather similar to those of the provisioning model discussed in Section 4.

386 We test the ‘world-wide’ model’s consistency by also applying the model to the US and
 387 Europe separately. Note that Europe is represented by six countries only.²⁶ The differences

²⁵ Note, however, that LLR, as a stock variable, is scaled by current total assets (and not by an average).

²⁶ The dummy variables appeared to be not jointly significant. Therefore, they are dropped in the final regression and shown mainly, between brackets, to indicate which countries represent Europe. Actually, the dummies hardly

Table 3

Models for loan loss reserves

Variable ^a	Whole sample		Europe		US	
	Coefficient	<i>t</i> -value ^b	Coefficient	<i>t</i> -value ^b	Coefficient	<i>t</i> -value ^b
Intercept	-0.0058	-1.7**	-0.0089	-1.7**	-0.0021	-1.3*
LLR/TA, lagged	0.7880	17.7***	0.7754	16.4***	0.7965	17.5***
GDP growth	-0.0003	-2.0**	-0.0007	-1.9***	-0.0001	-0.8
Unemployment rate	0.0003	1.3*	0.0007	2.4***	0.0000	0.0
Earnings before T&P ^c	0.0760	1.8**	-0.0931	-1.0	0.0549	2.1**
Loan growth	0.0001	1.8**	-0.0002	-1.0	0.0001	3.9***
Loans/TA	0.0082	2.4***	0.0157	2.0**	0.0056	4.1***
Capital/TA	0.0056	0.4	0.0257	1.2	-0.0016	-0.3
No. of observations	4167		874		2742	
Adjusted <i>R</i> -square	0.75		0.78		0.73	
<i>F</i> -test statistic	697.5***		450.0***		1043.8***	
<i>F</i> -test on dummies	6.9***		(1.1)			
Durbin–Watson test	2.03		2.29		1.82	
Breusch–Godfrey LM	12.6***		0.1		1.2	

^a Country dummies are not shown.

^b Based on Newey and West (1987). One, two and three asterisks indicate a level of confidence of 90%, 95% and 99%, respectively.

^c T&P is short for tax and provisions.

388 that emerge between the European and American stock of reserves are much clearer than in
 389 the case of gross provisions. In Europe, both GDP growth (business cycle) and unemploy-
 390 ment (both business cycle and structural unbalances) have significant coefficients, whereas
 391 the business cycle does not affect reserves in the US. Income smoothing or dynamic provi-
 392 sioning on the level of reserves is found for the US but not for Europe. (However, for Europe
 393 it was found for the annual additions). The two credit risk proxies are highly significant
 394 in the US. For Europe, the loan share is significant too, but loan growth has no impact.
 395 A capital effect is lacking in all three data sets. These results confirm that reserve level
 396 behaviour is different across regions and most probably, across countries.²⁷

397 6. Concluding remarks

398 Provisioning appears to depend significantly on the business cycle, as evidenced by
 399 the direct negative relation between GDP growth and provisioning. This strong cyclical
 400 effect implies that banks' provisioning behaviour might be procyclical: as their buffers
 401 need to grow (fast) during downturns, less profits are available to supplement the (rising
 402 required) capital, possibly forcing banks to reduce lending.²⁸ The procyclical effect is

affect the other estimates.

²⁷ As the number of observations of LLR was low for the other countries, we did not estimate more country-specific models.

²⁸ Because part of general loan loss provisions counts as BIS capital.

mitigated somewhat by the impact of the banks' earnings on provisions. This 'earnings' effect might be due either to dubious income smoothing or to recommendable farsighted dynamic provisioning. Finally, procyclicality is also mitigated somewhat by the positive effect of loan growth on provisioning, supporting Borio et al. (2001) and Lowe (2002), who state that credit risks are built up during a boom. This outcome challenges the result of Cavallo and Majnoni (2002) and Laeven and Majnoni (2003), who found a significant negative effect of loan growth. Choices regarding the model specification and, particularly, the data are responsible for this shift in outcome. All in all, banks tend to build up (highly) insufficient buffers in fat years as reserves for lean years, in terms of their ability to smooth out the impact of the business cycle. Banks may not wish to build up such abundant reserves, but it is also probable that a clear (far) forward-looking risk assessment over the business cycle would be beyond their (or anyone's) powers. Hence, the provisioning behaviour of banks is potentially procyclical.

Our data also support the capital management hypothesis: banks provision more when their capital ratio is low. Effects in individual countries may deviate from this general picture: substantial differences exist in provisioning behaviour across countries and regions, as might be expected given diverging legal, regulatory or institutional frameworks, including tax and accounting regimes.

Loan loss reserves are determined by the same variables as are provisions, but the effects are less strong. This is in line with expectations, as annual additions are more susceptible to outside influences than large stocks. However, no clear evidence is found either of increased provisioning during successive years of economic boom, resulting in substantially higher loan loss reserves levels, or of persisting erosion of reserves after consecutive years of recession. Apparently, the cyclical effects, which could contribute to procyclicality, are weaker than is suggested by the provisioning results, as they do not cumulate systematically over time. Remarkably, as a clear link between the recorded impaired loans and provisioning appears to be lacking, banks' loan loss risks are not consistently assessed as being higher during cyclical troughs than during cyclical highs.

All in all, the results underline that greater scrutiny of forward-looking provisioning and capital management will be needed, in particular with respect to cyclical fluctuations. Under Basel II, because procyclical risks may increase, this need will be even stronger, calling for a strict and adequate Supervisory Review. On the other hand, the tools currently developed by banks in order to fulfil the requirements for the new IRB framework of Basel II, such as the estimates of 'Probability of Default' and 'Loss Given Default', make excellent instruments with which to systematically predict future losses on loans. Finally, more transparency on provisioning might also help market discipline in order to enhance proper provisioning and to counter procyclicality.

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