Discussion Paper No. 05-91

The Impact of a Stock Market Downturn on Corporate Financing Activities in Germany

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Non-Technical Summary

After years of steady growth the volume of bank credit to German enterprises has been continuously falling nearly every quarter from the second quarter of 2001 on to the last quarter of 2004. The coincidence of this credit market development with the burst of the technology bubble on the stock markets has raised some suspicion that inter alia the stock market downturn has had a negative impact on banks' lending behaviour.

The paper analyses this topic from three different perspectives: In the first part of the paper we scrutinize the impact of stock market movements on the banks´ balance sheet. In the second part we analyse whether stock markets influence liquity and default risk of corporate borrowers. In the third part we finally estimate aggregate credit supply and demand functions including a stock market indicator as explanatory variable.

In the first part of our paper, our analysis - concerning the factual impact of the balance sheet channel, future threats to the balance sheet and the banks' operating strain – revealed no major importance of the bank balance sheet channel for the analysis of the relationship between stock market volatility and corporate financing possibilities of non-financial companies.

However, a possible impact of stock market movements on banks´ lending behaviour might be rooted in their impact on the balance sheets of corporate borrowers. While a downturn in stock prices typically does not lead to a major deterioration of the liquidity of a company, there is a high impact on the default risk of a company perceived by market participants. This is certainly the case for listed corporations, which can, however, have follow-on effects on the valuation of non-listed companies as well. Since default risk makes up a major part of credit risk, the degree of default risk inherent to a company therefore crucially determines their creditworthiness. Consequently, the corporate balance sheet channel has to be regarded as a channel of high influence on loans granted by banks.

Overall, the results of the time series analysis yield some evidence that the stock market development has an impact on the credit volume in Germany. The result for the estimated supply and demand functions show some improvement, particularly for the Großbanken (big commercial banks), when a stock market variable is included. This supports the view that the stock market development might be more relevant for the lending behaviour of the Großbanken than for other banks because the Großbanken derive more of their income from stock market related activities. This result is in general confirmed by an additional simultaneous estimation of demand and supply functions in a disequilibrium model.

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Abstract

The paper analyses the potential impact of stock market developments on lending behaviour from different perspectives. First we scrutinize the impact of stock market movements on the banks' and on the borrowers' balance sheets. Subsequently we estimate aggregate credit supply and demand functions including a stock market indicator as explanatory variable. The analysis reveals no major importance of the bank balance sheet channel for the relationship between stock market volatility and corporate financing possibilities of non-financial companies. A possible impact of stock market movements on banks´ lending behaviour might be rooted in their impact on the balance sheets of corporate borrowers. The empirical results of the credit market analysis yield some confirming evidence for an impact of stock market developments. However, the results are not very stable and depend on the specification of the model and on the time period under observation.

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1 Introduction

After years of steady growth the volume of bank credit to German enterprises has been continuously falling nearly every quarter from the second quarter of 2001 on to the last quarter of 2004. The coincidence of this credit market development with the burst of the technology bubble on the stock markets has raised some suspicion that inter alia the stock market downturn has had a negative impact on banks' lending behaviour.

The following paper analyses this topic from three different perspectives: In the first part of the paper we scrutinize the impact of stock market movements on the banks´ balance sheet. In the second part we analyse whether stock markets influence liquity and default risk of corporate borrowers. In the third part we finally estimate aggregate credit supply and demand functions including a stock market indicator as explanatory variable.

2 The banks‘ balance sheet channel

2.1 Theoretical foundation

Banks‘ corporate financing activities can be classified in either equity investments or debt investments, with usually debt investments in the form of common loans granted to companies as by far the dominating investment style. Independently of the type of investment, such financing activities are regarded as risk assets of a bank in the sense of the German Banking Act (Kreditwesengesetz, KWG).[1] Pursuant to the section 10 of the KWG and the Principle 1 (Grundsatz 1) of the BAFin, banks are required to back at least 8% of its weighted risk assets with own funds (capital). Own funds consist of tier 1 capital and tier 2 capital. Tier 1 capital approximately equals shareholders equity plus the special fund for general banking risks (pursuant to Section 340g of the German Commercial Code (Handelsgesetzbuch, HGB)) less goodwill. Tier 2 capital comprises supplementary capital items such as subordinated debt, loan reserves, and other sorts of long-term capital that is not equity.[2] It is also worth noting that at least half of the own funds must come from tier 1 capital.[3]

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[1] For a detailed description of what qualifies to be a risk asset, see Hartmann-Wendels/Pfingsten/Weber (2000), p. 366-370.

[2] See Bieg (1998), pp. 782-783, Bundesbank (2002), pp. 43.

[3] See Hartmann-Wendels/Pfingsten/Weber (2000), p. 371.

Figure 1: The breakdown of own funds of German banks (2000).

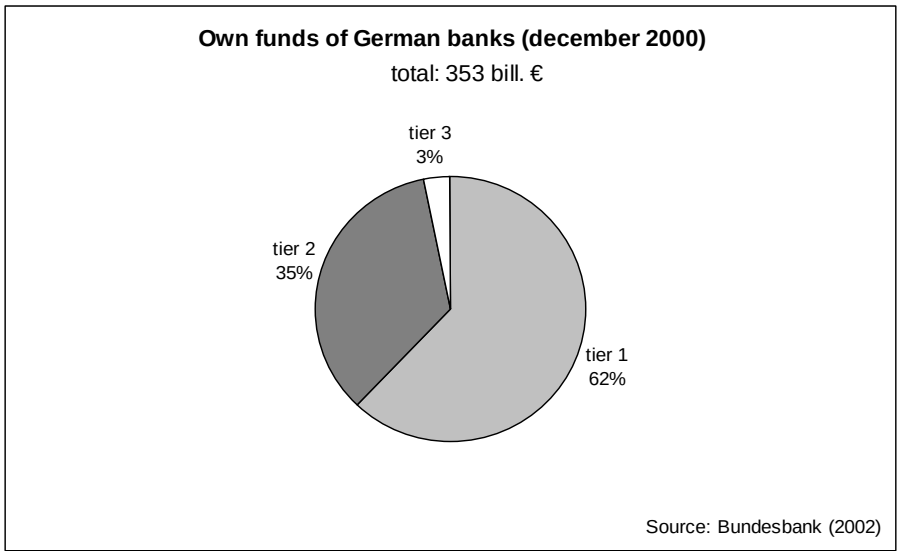

Figure 1 depicts the relationship between tier 1, tier 2 and tier 3 capital for all German banks on an aggregated level. Tier 3 capital mainly consists of certain short-term subordinated debt; it is not part of a bank's capital in the sense of the KWG and therefore does not qualify to back risk assets. The figure shows that it is usually not a problem for banks to fulfil the requirement that 50% of capital have to be tier 1 capital. Nevertheless, it depends on the capital structure of each bank, whether this rule effectively limits the amount of loans grantable.

The consequence for corporate financing, that arise from Principle 1 and the KWG rules, is, that the amount of banks‘ own funds definitely poses an upper limit to the funds available to companies. To put it more clearly, total loans cannot exceed 12.5 times banks‘ own funds since otherwise the 8-percent rule is broken. Obviously, the more own funds a banks possesses the more there is scope for corporate financing activities and vice versa. This restriction is not of major impact if banks‘ debt investment set is rather small. This could be the case if new debt investments are not attractive on a single company level (bad rating results for that company)[4] or if new debt investments do not fit into the existing loan portfolio. However, this restriction highly influences the investment behaviour of banks if they face favourable investment opportunities with lots of „good“ potential debtors.

Stock market volatility might impact the amount of own funds especially via shareholders equity which is a major part of own funds. Shareholders equity is influenced by operating activities either directly by reducing or increasing the equity account or indirectly by flowing through the income statement into the retained earnings ac-

[4] In this context it is important to note, that banks do not automatically respond with higher interest rates to a higher rikiness of the loan. They rather stop lending when rates exceed a certain threshold since high interest rates disproportionately attract bad debtors (see Stiglitz/Weiss 1981).

count. We did not identify any direct impacts on shareholders equity, but there are many items of the income statement that are affected by stock market volatility. In general, income and retained earnings are lower in times of low stock prices and vice versa. However, a deeper examination is necessary to quantify the influence of stock market volatility on shareholders equity, on banks‘ own funds and finally on corporate financing possibilities of SMEs. This is done below from two different perspectives. First, we analyse how stock market volatility has actually been mirrored on the balance sheet until the end of the stock market downturn in 2000. Second, we determine – as of the year 2001 – the threat of future equity decreases due to historic management discretion. The latter analysis is necessary since German GAAP allows for several accounting choices and therefore financial statements do not necessarily reflect accurately the real economic situation.

Both analyses are performed on an aggregated level for all German banks. Due to a lack of data availability we can not conduct our examinations separately for single classes of banks (i.e. commercial banks, savings banks, etc.). However, our general results are largely – albeit not perfectly – valid for commercial banks, since this group of banks owns more than the half of all stocks held by all banks. In contrast, it is not possible to draw any direct conclusions on the individual behaviour of groups of banks other than commercial banks.

2.2 The past and current impact on corporate financing activities

The analysis of the banks‘ balance sheet channel vis-à-vis the stock market volatility proceeds as follows: First, we analyse how the stock market related operating income of banks has impact on shareholders equity (and on banks‘ own funds) in each year. Second, we make a projection of what that means for corporate financing activities of non-financial companies. The data for that examination are drawn from the German *Bankenstatistik* and the German *Ertragslage der deutschen Kreditinstitute* that are both published yearly by the German Bundesbank.[5] The sources provide for all German Banks the aggregated amounts of several items of the consolidated balance sheet and of the most important positions of the consolidated income statement. The aggregation of these items and positions is not biased by different accounting standards, since all banks under examination disclose their financial statements according to the accounting rules of the German Commercial Code (below: German GAAP). Index prices are provided by Thompson Financial Datastream.

A major problem in our analysis is that it is not possible to exactly identify the part of the operational business that is related to the stock market. Two reasons are responsible for that: First, banks‘ disclosure requirements are such that they do not have to isolate the stock market related business but rather exhibit a functional clas-

[5] Both data sources are published as part of the Monatsbericht of the German Bundesbank.

sification. As a consequence, many stock market related expenses are „hidden“ within other positions. This becomes obvious when exemplarily looking at the position „Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets“ (position 15 of the income statement). This position includes depreciation expenses for shares held as fixed assets but also for other securities like debentures. Even write-downs on off-capital markets investments are considered in this position. Similar problems hold for other stock market related expenses. Another example would be the position „Write-downs and value adjustments on loans and certain securities and increase of allowances for possible loan losses“ (position 13 of the income statement). This position comprises mainly the depreciation on certain corporate debt, but also those on shares held in the liquidity reserve of the bank..[6] Revenues are also affected by this isolation problem – however to a lesser extent than expenses. Additional problems arise because some positions of the income statement may be affected by the stock market development even if they are not obviously stock market related. For example, the allocations to the fund for general bank risks grow as the general credit quality of companies decreases. A decrease of the loan quality is in turn often correlated with a downturn on equity capital markets.[7] Second, only quantitative financial statement data are available for this analysis. Qualitative financial data like those that are typically disclosed in the notes of the financial statement are not available on an aggregated level. However, the value-added that the inclusion of certain qualitative financial data would provide, is very low for the analysis of the balance sheet channel. Below the calculation of the stock market related operations along with the assumptions made is described.

Net revenues from stock market related operations especially comprise the „Net commission income“ (positions 5 and 6 of the income statement) and the „Net profit on financial operations“ (position 7 of the income statement). The first one denotes the surplus of all commission income over commission expenses. Net commission income includes income from e.g. payment transactions, procurement, underwriting and advisory services. We assume that most of this income is stock market related and therefore we include it completely into our analysis. However, we are aware that this inclusion tends to overstate the stock market related income. The second position – Net profit on financial operations – consists of the income surplus generated by proprietary trading (especially gains from the sale of securities held for trading). Certainly, income from operations with precious metal, foreign currencies and bonds is part of this position, but actually income from shares makes up the biggest part of it. Thus, the total inclusion of this position only slightly overstates the income from stock market related operations.

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6 See Bieg (1998), p. 353.

7 See Section 2.

Typical expenses related to stock market operations are the write-downs on shares. German GAAP requires a valuation at the „lower of cost or market“ for all assets (section 253, German Commercial Code). That means that securities classified as current assets are disclosed at cost, unless they are written down to the lower end-of-year closing market price (strict „lower of cost or market“-principle, according to section 253 (3) 1 and 2 HGB). Securities classified as fixed assets have to be written down only if it is expected that the market price permanently falls short of cost. If, however, the market price is expected to only temporarily fall below cost, then management has an option to write down (moderated „lower of cost or market“-principle, according to section 253 (2) 3 HGB in conjunction with section 279 (1) 2 HGB). If formerly written-down securities recover value, upward revaluation is permitted only up to cost; a market value higher than cost is ignored on the balance sheet.

For our purposes, especially the „Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets“ (position 15 in the income statement) are of importance. We assume that the most part of this position is stock market related. This is reasonable because not listed investments typically lack a clear benchmark which indicates that depreciation should take place. Certainly, the losses of subsidiaries valued at equity or at the consolidation method also have impact on this position but we assume that the amount is negligible. Furthermore, the write-down of shares held for trading (if there is any write-down) is included in the net profit on financial operations and is therefore already accounted for. The write-down of shares held in the liquidity reserve is hidden in another position in the income statement.[8] However, since these shares only make up a little part of all shares, a suppression of this account does not cause major problems. Thus, the inclusion of position 15 of the income statement is a reasonable proxy for depreciation of stock listed equity securities.

An additional source of potential stock market related income is the „Income from the writing back of investments, holdings in subsidiary companies and securities treated as fixed assets“ (position 16 of the income statement). This kind of income does not only consist of the writing back of previously depreciated assets (no change of ownership) but also of the gain on the sale of assets (change of ownership).[9] Typically, the writing back of previously depreciated assets requires a slump in asset prices followed by a rebound. This has not been the case at international stock markets for the period under examination and the years before examination. In fact, rather the opposite is true: A rise in the market has been followed by a decrease of stock prices (see figure 2). Therefore most of these profits must stem from the sale of assets. Certainly, the profits of subsidiaries valued at equity or at the consolidated

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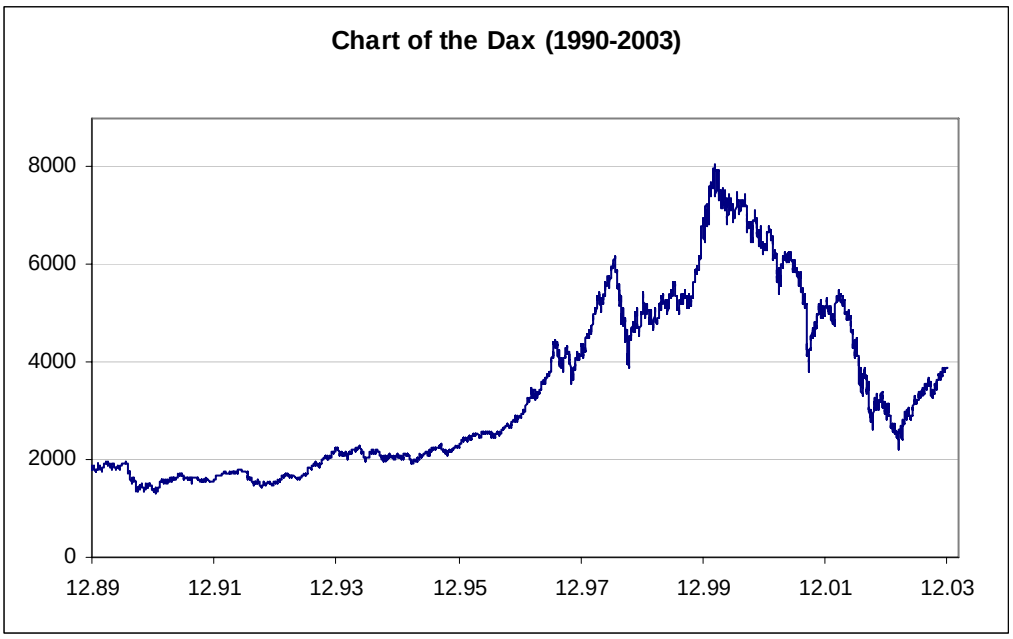
[8] See Bieg (1998), p. 353.

[9] See Bieg (1998), p. 365.

method also have impact on this position but we assume that the amount is negligible. Additionally, it can be assumed that the biggest part of the write-ups is made for shares or at least for stock market listed investments. This is because management tends to primarily sell financial assets rather than strategic assets. However, the general price level at capital markets also impacts the prices of private investments and subsidiary companies. Thus, the amount of write-ups for these off-market items is to a large extent also due to the stock market development. Consequently, this position of the income statement can be regarded as stock market related income.

Figure 2: Development of the Dax index (1990-2003)



Source: Thomson Financial Datastream

However, the nature of this position differs a great deal from that of the two positions mentioned above. The profits from write-ups (i.e. from the sale of shares) are not part of the periodic business of a company, they are rather non-recurring. Therefore this position must be treated as a „extraordinary“ stock market related income source: management has the choice but not the duty to release hidden reserves and to create income via the sale of shares. This extraordinary nature is accounted for in our analysis by calculating two variants of income from stock market operations: ordinary income and income including extraordinary items. In doing this, we can analyse how management has the possibility to influence the impact of stock market related operations.

The amount of own funds is proxied by adding the shareholders equity account and the special fund for general banking risks pursuant to Section 340g, German Commercial Code. This approximation is widely consistent with the simplified calcula-

tion of banks‘ capital used by the Bundesbank.[10] Finally, the contribution of stock market related income to own funds is calculated for each year as a percentage number. This is done in two steps. In a first step, the part of retained earnings that is due to stock market related operations is determined by applying the company’s retention rate on the after tax profits from stock market related operations (hypothetical taxation is performed at the marginal tax rate of the company). In a second step, this amount is put into relation of the banks‘ own funds. This ratio effectively shows, how much of the capital available to back risk assets of the bank is financed by stock market related income. Figure 3 provides a schematic view on the calculation of both the contribution ratio from ordinary operations and the contribution ratio including extraordinary income. Figure 4 depicts the development of the two ratios for the year 1994-2002. A detailed calculation of both ratios can be found in appendix 6.1. It is important to recall, that all these ratios represent the maximum impact on banks‘ own funds, since our calculations tended to overstate the income from stock market related operations.

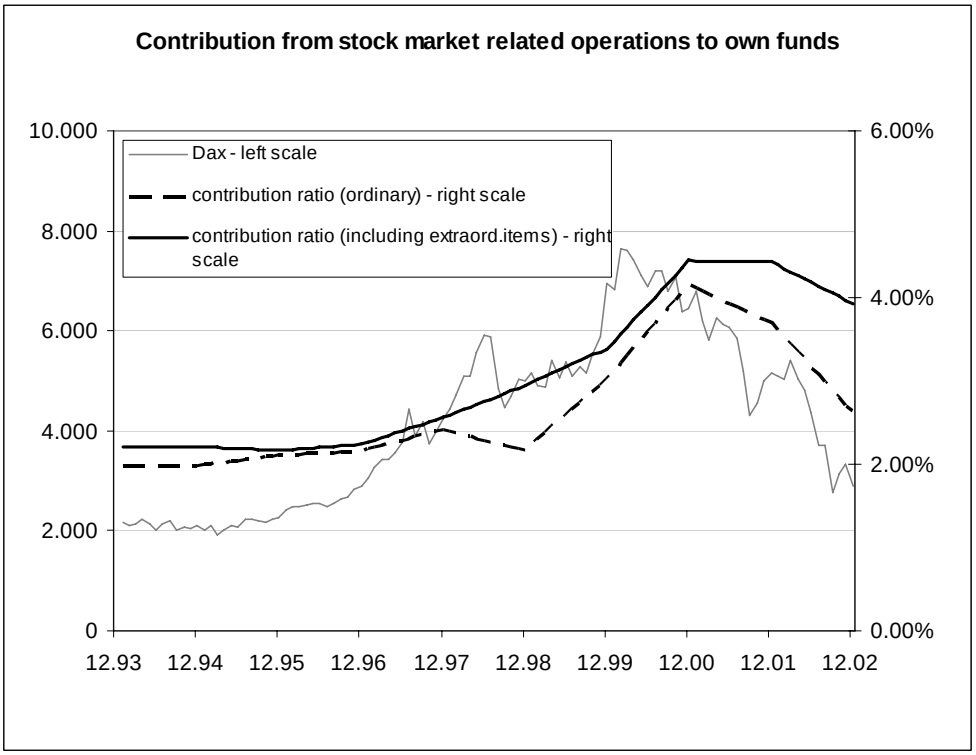
Figure 3: Calculation scheme for contribution ratios

Calculation scheme for contribution ratios		
ordinary contribution ratio		**extraordinary contribution ratio**
Net commission income + Net profit on financial operations + Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets		Net commission income + Net profit on financial operations + Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets + Income from the writing back of investments, holdings in subsidiary companies and securities treated as fixed assets
= Net income from shares (ordinary) * Income tax rate * Plow back ratio		= **Net income from shares (extraordinary - sale of assets included)** * Income tax rate * Plow back ratio
= Part of the retained earnings that is due to stock stock market related operations (ordinary) : Own funds (approximately)	Shareholders' equity + Special fund for general banking risks pursuant to Section 340g, German Commercial Code = own funds (approximately)	= **Part of the retained earnings that is due to stock market related operations (including extraordinary income)** : Own funds (approximately)
= Contribution of stock market related income to own funds (ordinary)		= Contribution of stock market related income to own funds (including extraordinary income)

[10] See e.g. Bundesbank (2003a), p. 11, 13, 15.

Source: ZEW

Figure 4: Contribution ratios from stock market related operations to own funds (1993-2002)



Source: Bundesbank, Thomson Financial Datastream

Figure 4 reveals that the factual contribution ratio (including extraordinary income) steadily increased during the boom years 1994 – 2000. This is largely also true for the ordinary contribution ratio even if it experienced a small backslide in 1998. However, as of the year 2001, the spread between the two ratios widened. While the ordinary ratio declined according to the development of the capital market, the factual contribution ratio approximately kept its level in 2001 and only slightly decreased in 2002. This gives rise to the assumption that management operationally smoothed earnings with non-core business activities during the years 2001 and 2002 and – as a consequence – kept the factual contribution ratio artificially high. It has to be concluded, that obviously management has an option to influence the contribution of stock market related income on net income, shareholders‘ equity and own funds to a certain degree and that management effectively exercises this option if it is deep enough „in-the-money“, i.e. if it promises to noticeably improve the economic situation of the bank.[11] That in turn might lead to the suggestion that the stock

[11] In general, income smoothing is defined as discretionary management behaviour in financial reporting to reduce the time-series variation in income (see Zarowin 2002). In contrast to that common financial view, our approach rather focuses on „operational“ income smoothing. Nevertheless, in any case management‘s motivation of smoothing income is to make the company more attractive to stakeholders and shareholders, hoping that they do not detect this kind of

market development does not have a material influence on corporate financing activities of non-financial companies – at least in terms of banks‘ balance sheet channel. But let us take a closer look on the consequences for the fund raising of companies to quantify the effects of this channel.

With regard to the ordinary contribution ratio, we can see that it decreased between 2000 and 2002 from 4.15 to 2.61. This lowering of the contribution ratio results in relatively lower own funds of banks. More precisely, the difference between the capital in both years amounts

$$1-\frac{(1-0.0415)}{(1-0.0261)}=1.58\%$$

That means, ceteris paribus the amount of equity has been about 1.6 per cent lower in 2002 than it would have been if income from stock market related operations had remained stable between 2000 and 2002. This in turn means that the maximum grantable loan amount is reduced by approximately 1.6 per cent since banks‘ own funds restrict the amount of risk assets of a bank. Considering that the total amount of bank loans was 3,016,941 mio. Euro in 2002[12], banks in Germany could have granted additional loans amounting to

$$\frac{0.0158}{1-0.0158}\cdot 3,016,941 mio.€ = 48,432.91 mio.€ .$$

It is important to note that this calculation only holds if we assume that banks are restricted in their operating efforts by the amount of own funds, i.e. banks would like to hold more than the maximum acceptable amount of risk assets (pursuant to the Principle 1 of the BAFin) in all years.

Actually, banks did not realise the ordinary contribution ratio but the contribution ratio including extraordinary items. As regards this ratio the results are quite different. The difference in own funds between the year 2000 and the year 2002 only yields

$$1-\frac{(1-0.0444)}{(1-0.0393)}=0.53\% .$$

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earnings management (see Healy/Wahlen 2000). The stabilisation of the contribution ratios is just a by-product of this behaviour.

[12] See Bundesbank (2003a), p. 6. This number includes all loans granted to non monetary financial institutions (non MFIs).

Using this number to calculate the relative amount of loans that banks could have granted more in 2002 – assuming profits related to stock market operations being equal to 2000 – we get:

$$\frac{0.0053}{1-0.0053} \cdot 3,016,941 mio.€ = 16,074.98 mio.€ .$$

This is about one third of the amount calculated with the hypothetical ordinary contribution ratio. Again, this calculation is economically significant only if banks would like to take on more than the maximum acceptable amount of risk assets in all years. Table 1 summarizes the effects of the bank balance sheet channel, illustrated by a comparison between the boom year 2000 (with high contribution ratios) and the year 2002 (with very low contribution ratios after the downdraft of markets).

Table 1: Factual impact of the balance sheet channel on SME corporate financing activities (comparison between 2000 and 2002)

	Δ (2000; 2002); *AOTBE*	
Ratio underlying the estimation	Own funds (in %-terms)	Loans grantable
Ordinary contribution ratio	1.58	ca. 48 bill. €
Contribution ratio including extraord. items	0.53	ca. 16 bill. €

To conclude: analysis of the years 1994-2002 reveals that the importance of the banks‘ balance sheet channel is limited when assessing the impact of stock market volatility on SME corporate financing activities. Two reasons are considerably responsible for that. First, the contribution of stock market related income to banks‘ own funds is rather small over the whole period (between 2 and 5 percent). Second, the contribution ratio (including extraordinary income) actually did not change very much after the downturn of stock markets in 2001; i.e. it seems to be quite robust to stock market volatility.

Nevertheless, two questions arise from this analysis: Can banks infinitely continue to smooth earnings via the sale of shares? And: Are there any negative effects of the decrease in stock prices, that are not yet considered on the balance sheet and might probably influence banks‘ amount of own funds during the next years? We address these issues in the following section by shedding more light on the expected future development of the „Income from the writing back of investments, holdings in subsidiary companies and securities treated as fixed assets“ and the „Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets“.

2.3 Future threats to corporate financing possibilities

As has been shown above, banks are likely to have smoothed income with off-core business items like asset sales during the years 2001 and 2002. In having done that, the impact of the stock market downturn on banks‘ equity has noticeably been softened. The big problem with that kind of „operational smoothing“ is that banks need a sufficient amount of assets with a balance sheet value lower than the economic value (this difference is called the hidden reserve of the asset). Even if historical cost accounting – most developed accounting systems like German GAAP, US-GAAP and IAS/IFRS use historical cost accounting – typically supports the creation of hidden reserves, they are not inexhaustively available.

More precisely, banks do not have the possibility to smooth earnings every year to the same extent, since the potential for income smoothing with asset sales is path dependent. This path dependency especially becomes manifest in that banks suffer from a „hidden reserve burnout“ after a sharp drop in stock prices; i.e. the more banks smooth earnings with the sale of low-purchase-price stock today the less they have the possibility to smooth earnings in the future, because they are running danger that they simply run out of low-purchase-price shares.

An additional threat to banks‘ own funds is that the stock account might probably be written down in the future due to incidents that have already happened in the past. This becomes clearer when looking at a concrete example: Imagine a bank that has purchased shares at a high price level during the boom years. Probably these shares have lost value during the last years but are not written down yet. This is a probable scenario because banks (as well as non-financial companies) have certain discretion of when to write down assets, as has been outlined above. However, this discretion is not unlimited. There might be a certain event that triggers the writing down, which would lead to a decrease in shareholders equity via the retained earnings account and therefore would affect own funds.

While relatively generous in the past, the accounting for share depreciation has become a little stricter during the last years. Until the year 2001, banks (and auditors) only had to rely on some kind of „prudent businessman“-rule in deciding when shares have permanently fallen short of cost. There were no concrete indicators that could help in this decision. However, this estimation is a crucial point in asset valuation since the existence of a permanent decline in value would lead to a write-down of shares that are classified as fixed assets (according to section 253 HGB). In 2002, the equity instrument accounting of insurance companies has been adjusted so that it now approximately equals the share accounting of banks (amendment of section 341b HGB[13]). In connection with that, the German Accountants Association (Institut der Deutschen Wirtschaftsprüfer, IDW) disclosed some guidelines on how to deal

[13] See Bundesgesetzblatt I (2002), pp. 1219ff.

with the new accounting rules.[14] The indicators described there, represent an enhancement of the existing Commercial Code rules, but they are still very general in nature and by far not exhaustive. Thus, there is still room for management discretion.[15] Also important to note that – strictly speaking – these indicators only apply to insurance companies. However, it must be assumed that these guidelines will not be without impact on the future accounting for shares of non-insurance companies like banks and industrial companies. As a consequence, it has to be stated, that the probability of future share write-downs for either company – banks, insurance and industrial companies – has increased. This increase becomes even more probable when considering that many banks are expected to change from accounting using German GAAP to accounting using IAS/IFRS during the next years. Such a change would inescapably lead to a revaluation of shares and thus to a write-down to fair market values whenever book value exceeds the then prevailing market value.

The assessment of the magnitude of such probable future write-downs requires a closer look at the banks‘ share account. A major problem in determining the amount of shares that might probably be depreciated in future is that even if the current €-amount of shares is known, there are typically no data about the cost at which the single shares are purchased historically. However, the knowledge of historical share purchase prices is crucial in this examination. We approach this task by simulating different developments of the share account over time. To do this, we have to rely on certain assumptions of which the most important are:

- Banks are only investing into a portfolio that mimics the Dax index. This assumption considers that on an aggregate level the share portfolio is most likely broadly diversified. It does not explicitly consider an international diversification but that does not influence the quality of the analysis. Moreover, the results would not change dramatically if the reference portfolio consists of a global market index because stock movements have been quite similar for the major international indices.
- Securities are purchased and sold only at the last trading day of the year, i.e. december 29, 30 or 31 respectively.
- The average historical share purchase price of all securities bought before 1994 is 1.000 (in terms of the Dax level). This is quite reasonable, because German banks were not very active in securities trading before the stock market boom of the 1990s and thus most shares are purchased a long time ago.
- The whole position 16 of the income statement („Income from the writing back of investments, holdings in subsidiary companies and securities treated as fixed assets“) consists of gains from the sale of shares. The whole position 15 of the

[14] See IDW (2002), pp. 475-477.

[15] See Boersen-Zeitung (2002)

income statement („Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets“) is related to shares or stock listed investments. See the outlines in section 2.2 regarding the reliability of this assumption.

One might think that these are quite a lot of very strict adhoc-assumptions, but they are necessary since the data available do not provide all the information we need for the examination. Additionally, the focus of this second part of the analysis of the bank balance sheet channel is on qualitative rather than on quantitative characteristics. Thus, minor differences between our calculations and economic reality are tolerable as long as the tendencies are identical.

Scenario analysis is used to account for different strategies of banks about which kind of shares to be sold. Some banks might prefer to sell shares first that have been originally purchased at a relatively high price (and that offer only a small gain per share upon sale since the spread between selling and purchase price is narrow). Contrary to that, other banks rather prefer to sell low-purchase-price shares. For our analysis we established three different scenarios, each with a different trading strategy. The first strategy is following the lowest in – first out (LoFo) principle; the second one uses the highest in – first out (HiFo) principle. The third one assumes that banks sell shares each year at an equal €-amount from each layer[16] (with a change to LoFo in 2002, since otherwise the reported gains on the sale of shares cannot be realised). Some minor deviations from these strategies are necessary to reach consistency with the financial statement data. Whenever they occur, it is indicated in the footnotes of the calculation scheme of the respective strategy in the appendix 6.2.

Our analysis starts with the share account in the year 1994 (where all securities are assumed to be valued at cost=1.000). From this year on, the effects of the different trading strategies of banks on the development of the share account are examined. More precisely, for every single year the examination proceeds as follows: In a first step we calculate the gain on the sale of shares for a single unit of shares (i.e. the gain on the sale of shares in terms of Dax Index points). This gain equals the difference between the value of the index at the end of the year (the selling price of the shares) and the historical purchase price of the shares to be sold. The average historical purchase price of the shares sold differs dependent on which trading strategy the banks follow. For the „equally selling“ strategy it is calculated as the unweighted average price of all layers that exist at the time of sale (including the purchases of the current year). E.g., in the year 1994 it is the mean of 1.000 (all shares purchased before 1994) and 2.107 (purchase price in 1994) which yields approximately 1.553. For the LoFo-scenario it is 1.000 throughout the whole period under examination, since exclusively those shares are sold that are purchased before 1994 and this layer still comprises shares at the end of 2002. For the HiFo-scenario the proceeding is a

[16] A layer consists of all shares purchased at an identical price.

little bit different. More precisely, in general the average historical purchase price equals the price of the highest-purchase-price layer. If, however, the sales of shares exceed the €-amount of shares in the respective layer, also shares from the next to highest-price layer and probably of the second next to highest-price layer have to be sold. Thus, depending on the amount of shares available in the respective layers the historical purchase price either equals the purchase price of the highest-price layer or is some kind of average price of two – sometimes three – layers.

In a second step we calculate the €-amount of sales of shares necessary to realise the reported gain on sales. Finally, we determine the amount of shares that have to be purchased to yield the reported end of year share account value. These purchased shares represent a new layer with the layer-price equalling the end of year level of the Dax. The calculation procedure is shown in details in figure 6.

This procedure is repeated for every year under examination with the respective numbers. The final result is the structure of the share account at the end of the year 2002. The development over the years and the final result is provided in the figures 7-9. A detailed calculation scheme for each of the three strategies can be found in appendix 6.2.

Figure 5: Calculation scheme for yearly share purchases

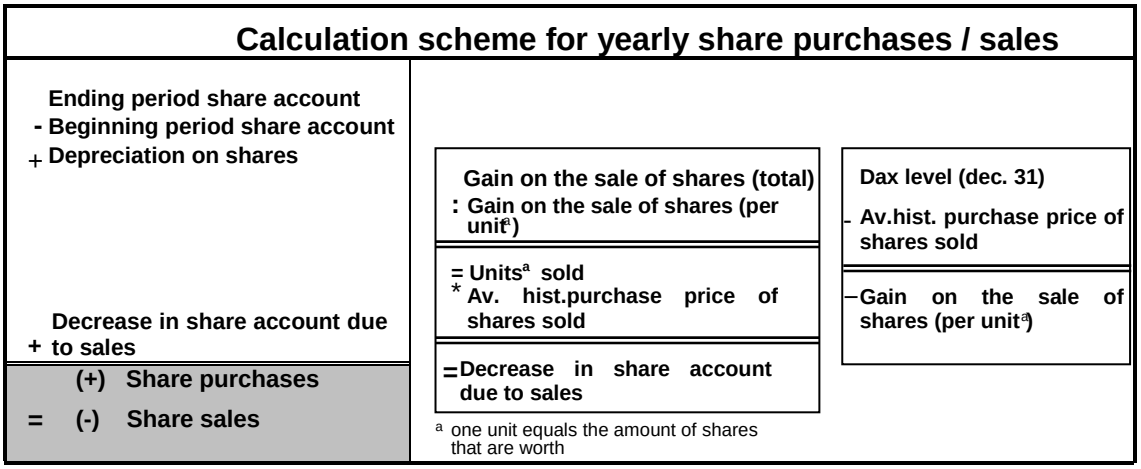


Figure 6: Banks‘ share account (1993-2002) following the „Lowest in, First out“ strategy

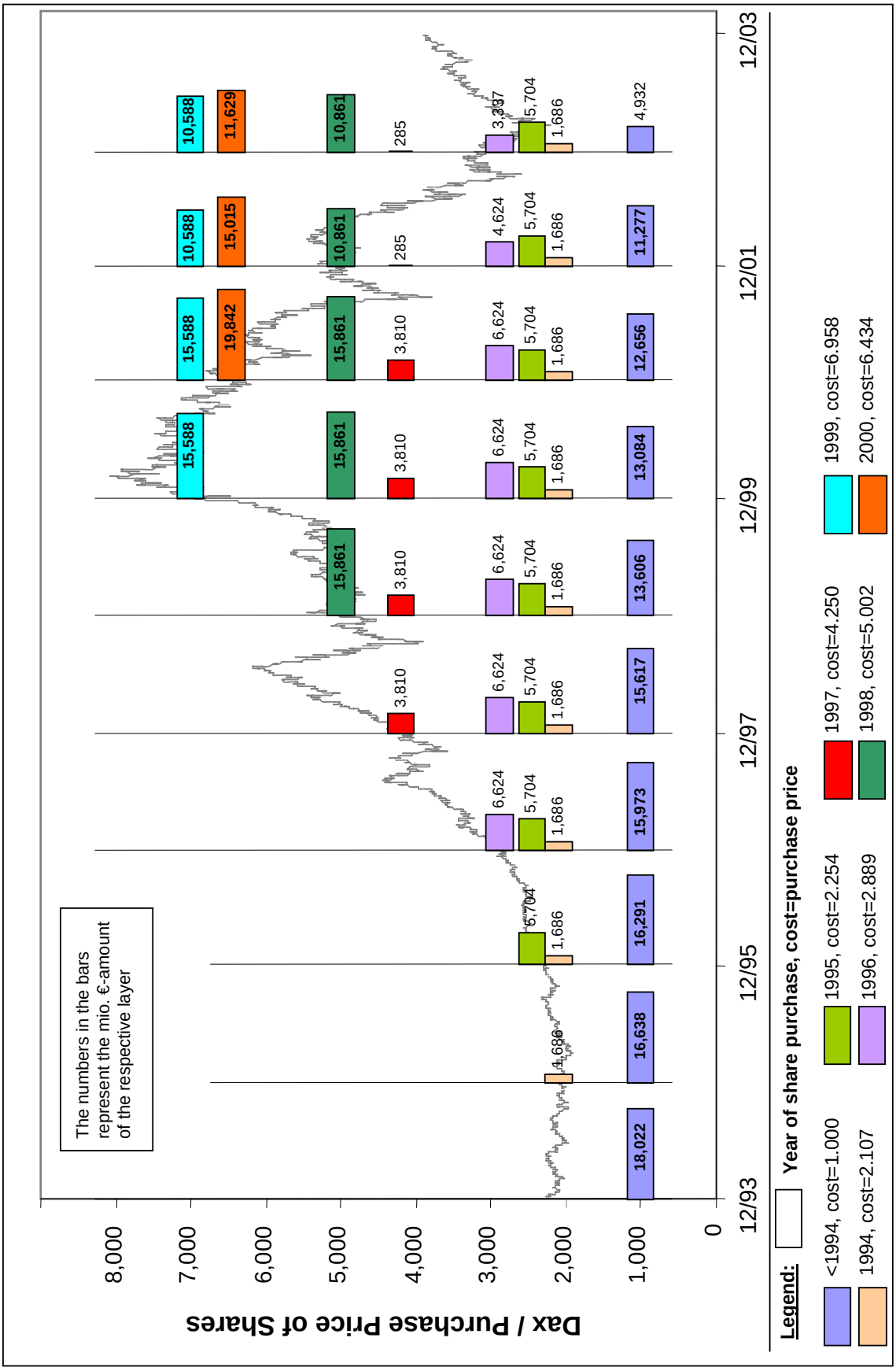


Figure 7: Banks‘ share account (1993-2002) following the „Highest in, First out“ strategy

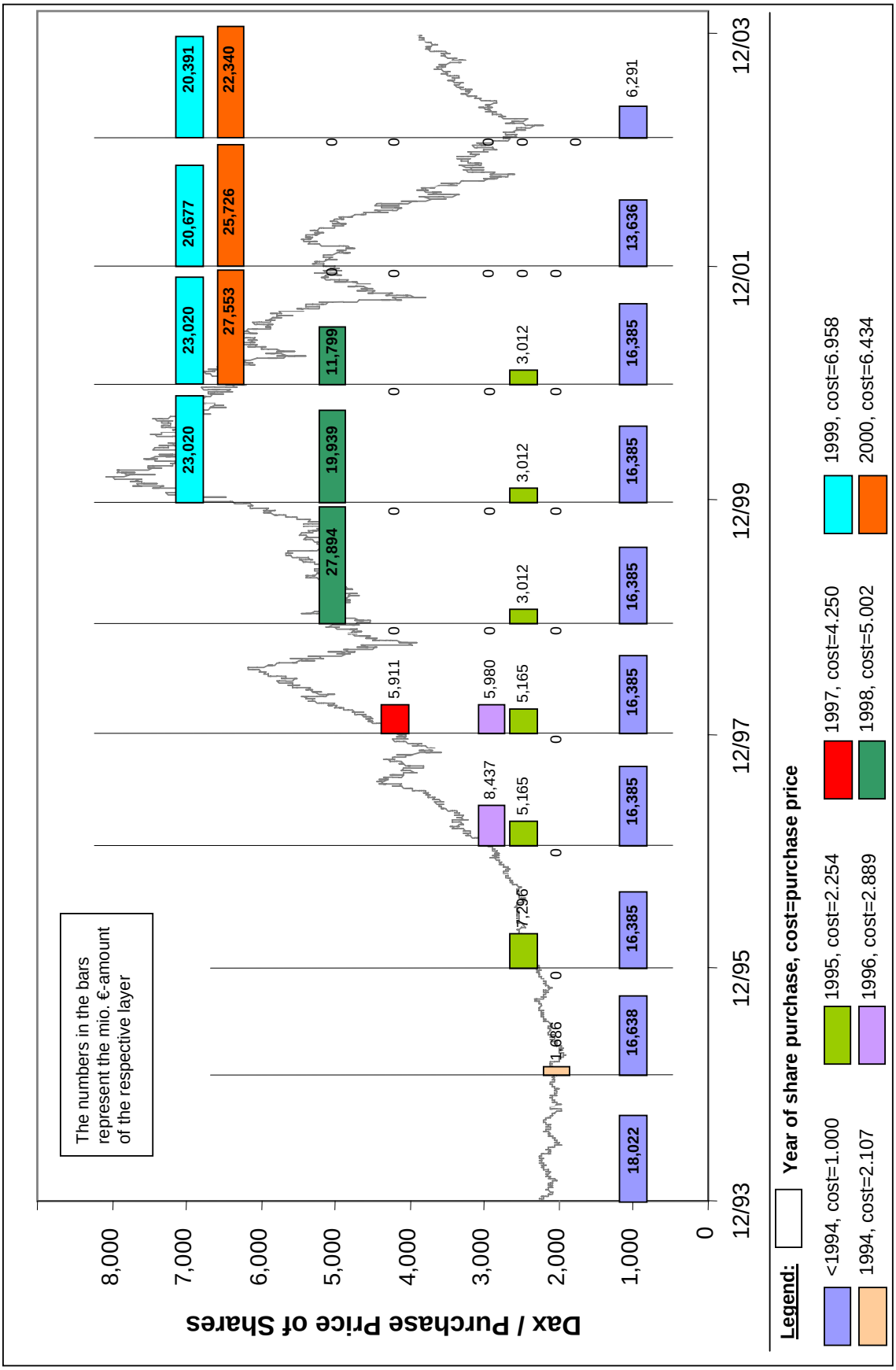
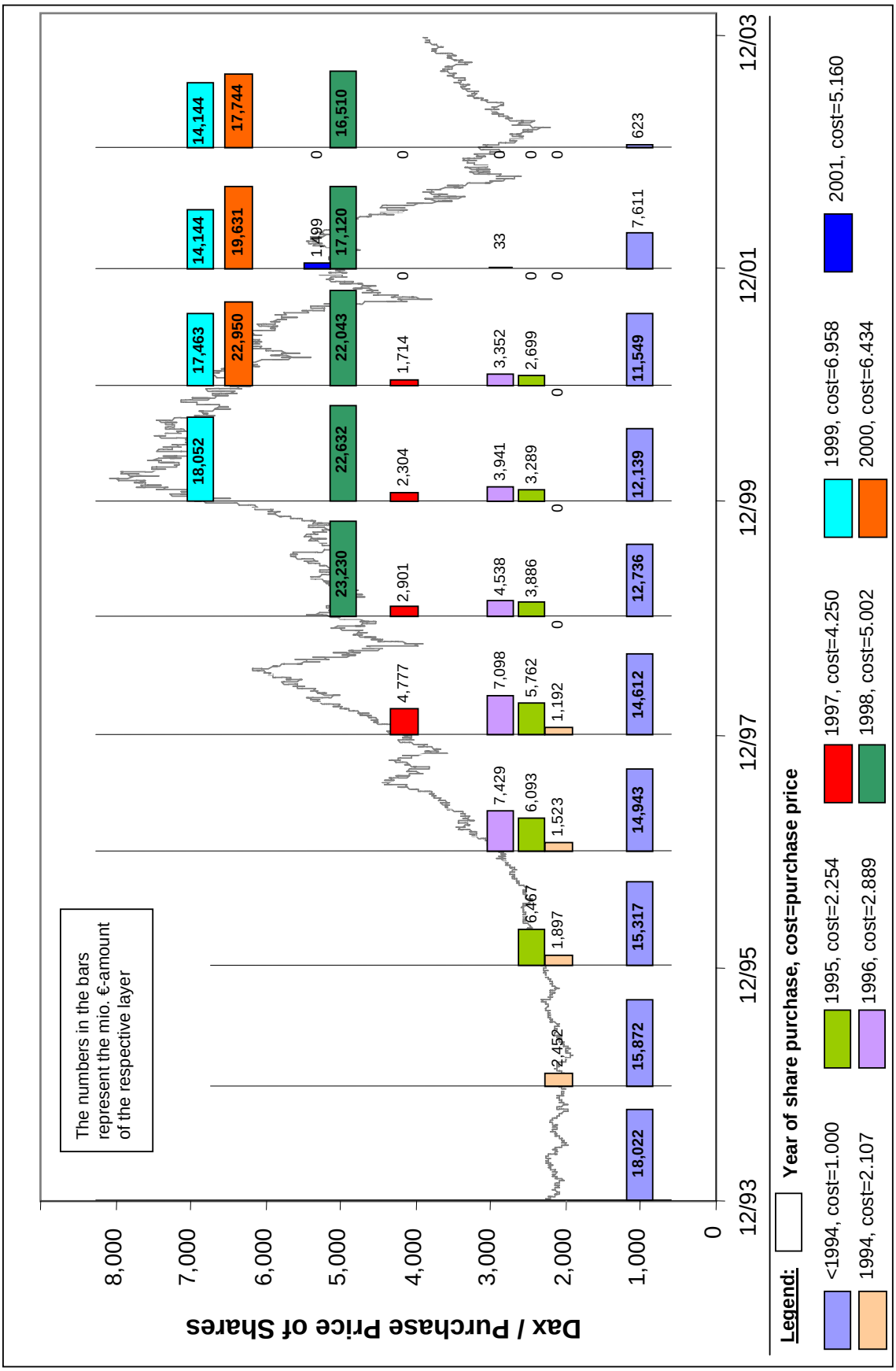


Figure 8: Banks‘ share account (1993-2002) following the equally selling strategy



All three figures reveal that banks have great amounts of shares in their portfolio with historical purchase prices well above current market prices. Certainly, there are differences between the three trading strategies regarding the concrete amounts of high-purchase-price shares but the big picture is basically identical in each scenario. Similar is true for the low-purchase-price shares. While the „equally selling"-strategy exhibits an ending 2002 share account with almost no shares left that are purchased below current market price, the LoFo-strategy leaves at least some minor amounts of shares in the „cheap" layers. Following the HiFo-trading strategy leads to a share account with several securities historically valued at 1.000 (i.e. shares that are purchased before 1994), but no shares left that are purchased between 1.000 and 6.000 points (in terms of the Dax level). However, it can be stated that for all three strategies the amount of low price shares available is reduced significantly compared to the situation at the beginning of the examination in 1994.

Two consequences arise out of this examination: First, if banks are forced (for whatever reason) to write-down shares in future, this would lead to increasing expenses in the income statement, consequently to a lower net income and finally to lower contribution ratios. Thus, corporate financing possibilities of non-financial companies might be reduced by this depreciation threat. Second, the lack of cheap shares decreases management's ability to operationally smooth earnings in future, because there are no longer any hidden reserves left to be released. With no gains from the sale of shares both net income and contribution ratios will be lower. That means, corporate financing possibilities are again reduced because of fewer possibilities for extraordinary income.

To quantify the consequences for corporate financing activities of SMEs we put these share account figures into relation to banks' own funds and the amount of loans granted to non MFIs (similar to the proceeding in section 2.1). We first determine the impact on the income statement for each of the three scenarios assuming that banks had to write-down all overvalued shares in the end of 2002.[17] In a next step, the implications of these write-downs on banks' own funds are determined. Finally, it is shown what that means for the amount of loans held by banks, assuming that they are operating at the regulatory limit. We also shed some light on the possibilities to offset the write downs with capital gains from the sale of shares. Our calculations are all based on the end-of-2002 Dax level which has been approximately 2.900 points.

Tabel 2 exhibits the consequences of share revaluations on the amount of loans grantable, broken down by negative effects due to write-downs and positive effects due to write-ups. The net amount in the last line indicates the reduction in loans grantable resulting from the total fair valuation of all shares.

[17] While this did not happen actually, it demonstrates what might happen in future. The reference year 2002 was chosen because of illustration purposes and data availability reasons.

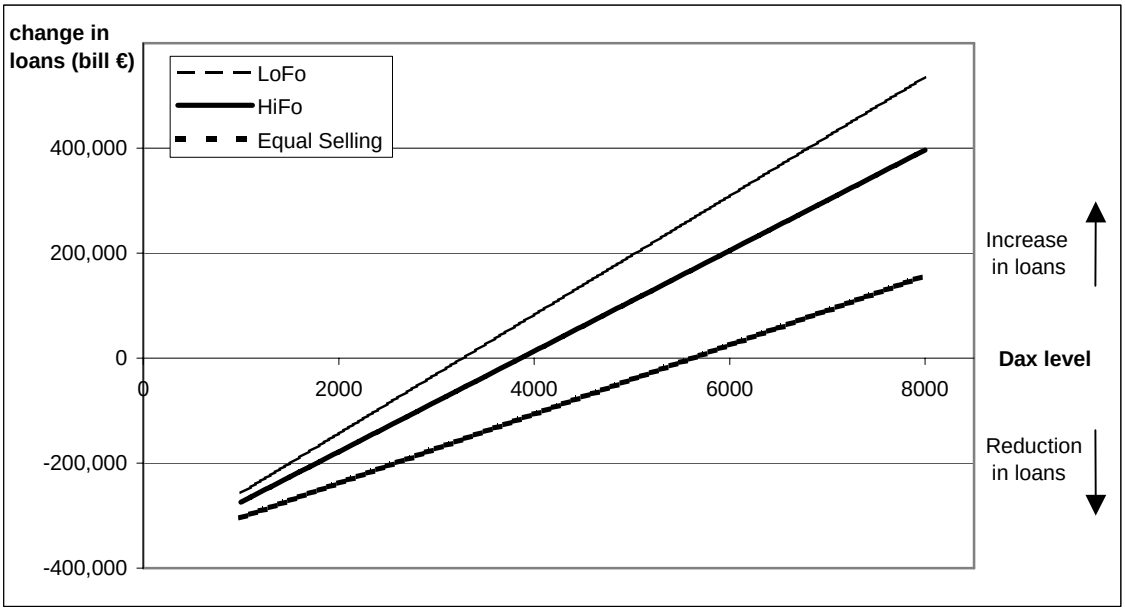
Table 2: Future opportunities and threats to banks‘ balance sheets and SME corporate financing possibilities

	Trading strategies		
in mio. €	**LoFo**	**HiFo**	**Equally selling**
Write-downs of the share account	17,216.97	24,162.59	24,934.01
Reduction in „banks own funds“	4.31 %	6.05 %	6.24 %
Reduction in loans grantable (assuming maximum operating strain with regard to Principle 1)	129,977.26	182,412.28	188,236.01
Gains from the sale of shares (maximum amount)	11,654.86	11,952.75	1,184.31
Increase in „banks‘ own funds“	2.92 %	2.99 %	0.30 %
Increase in loans grantable (assuming maximum operating strain with regard to Principle 1)	87,986.82	90,235.69	8,940.80
+			
Net reduction in loans grantable (assuming maximum operating strain with regard to Principle 1)	41,990.45	92,176.59	179,295.21

To assess these numbers economically sound, one should recall that the calculation relies on several limiting assumptions. Additionally, the figures indicated in the table clearly overstate the impact of stock market volatility on corporate financing activities of non-financial companies for at least three reasons. First, not all shares have to be written down at one single moment. In many cases it is still up to management discretion how to proceed with shares that have a book value exceeding the market value. Second, not every bank has to write down these overvalued shares. Certainly, those banks that wish to change to IAS/IFRS are obligated to revalue assets but there will remain many institutes that still rely on the German accounting system. Thirdly, stock markets have experienced a rebound in 2003 which clearly mitigates the impact of potential share write downs. To illustrate the latter point, figure XX highlights the change in banks‘ own funds due to write-downs and write ups of shares to the fair market value for different Dax levels. It can be seen that banks would realise a relative increase in own funds and thus in loans grantable already at a Dax level of 4.000 (Dax at the end of 2003: 3,965.16) assuming the LoFo- or HiFo-scenario. Assuming the equally selling strategy, however, the break even would be reached not under a Dax level of 5,600. Nonetheless, it can be concluded

that future depreciation only causes a threat to corporate financing activities of non-financial companies if international stock markets experience a devastating stock market crash and all banks have to change to a fair value accounting and simultaneously banks are operating at the regulatory limit. The first two assumptions are very unlikely to happen but their occurrence is not totally impossible. However, to get a complete picture, we have to shed some more light on the degree of banks‘ operating strain, which is done in the next section.

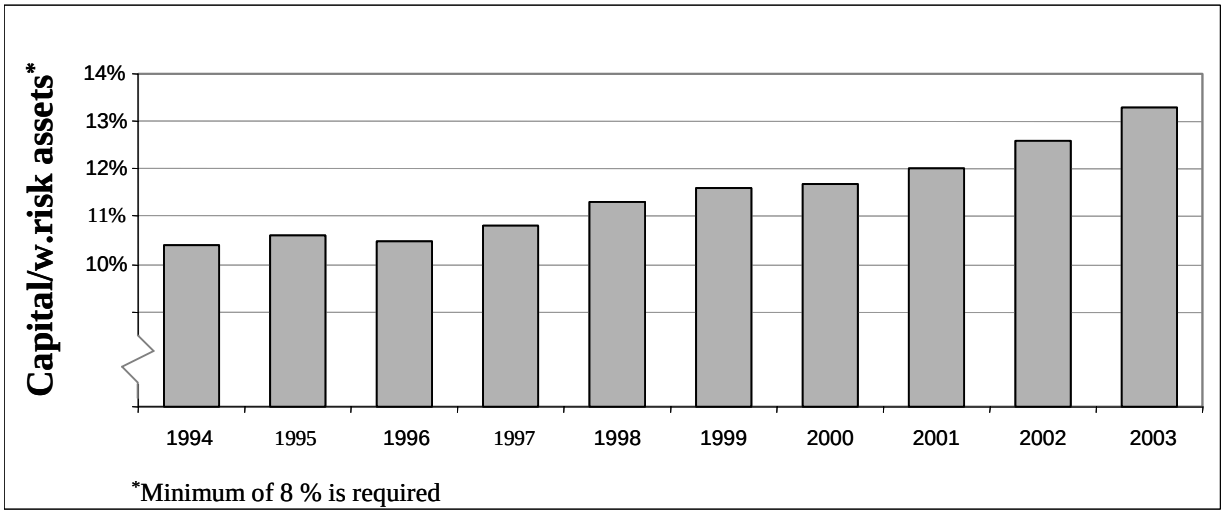
Figure 9: The impact of „Fair Value Accounting“ on corporate financing possibilities of non-financial companies



2.4 Banks‘ operating strain with regard to Principle 1

As mentioned above, the assumption that banks are effectively restricted by the Principle 1 is crucial for the validity of our analysis. Actually, however, banks are far from operating at this regulatory limit. Figure XX reveal that the capital / weighted risk assets-ratio of German banks noticeably exceeds the required 8 percent in every year under examination. Additionally, the ratio dramatically increased during the last years. However, assuming the importance of the balance sheet channel in assessing the impact of stock market volatility for corporate financing activities of non-financial companies, we should have expected a rather decreasing capital / risk assets ratio since 2001.

Figure 10: Capital / weighted risk assets-ratios (1994-2003)



Source: Annual Reports of the Deutsche Bundesbank (1994-2003)

The meaning of these ratios becomes clearer when putting it into relation of the examinations already conducted. Taking e.g. the ratio in 2002, which is approximately 12.6, we can see that even a reduction of about 36.5 per cent would not force the banks to cut investments due to regulatory reasons. This number is by far bigger than the maximum possible reduction in own funds that could arise from a stock market downturn.

The explanatory power of these figures is mitigated a little bit, since it has to be assumed that the increase in ratios is also due to banks preparation for the imminent new capital requirements of Basel II. However, it is not likely that banks will be operating at the regulatory limit once the new requirements become effective since even in the long term these ratios clearly exceeded the 8 per cent minimum requirement hurdle. This observation is consistent with the „buffer theory", which says that banks typically hold capital buffers in order to adequately react on unexpected investment opportunities or to cushion the effect of external shocks.[18] That in turn would indicate that banks are consciously well prepared to any negative impact arising from unfavourable stock market movements.

To summarise: Taken together, these three examinations – the analysis of the factual impact of the balance sheet channel, the analysis of future threats to the balance sheet and the examination of banks' operating strain – indicate that the bank balance sheet channel is without any major importance for the analysis of the relationship between stock market volatility and corporate financing possibilities of non-financial

[18] See Berger et al. (1995)

companies. This result is consistent with the view provided by the German *Sachverständigenrat* in 2003.[19]

3 The corporate balance sheet channel

3.1 Theoretical foundations

The availability of debt financing of non-financial companies heavily depends on the degree of creditworthiness which in turn is a function of the development and level of several financial fundamentals and some qualitative characteristics. In contrast to the analysis of a planed increase in equity capital – which rather focuses on the future operating performance and on the ability to generate cash flows available to shareholders – the analysis of the creditworthiness of a company strictly focuses on the ability to repay the funds borrowed.

The volatility of stock prices affects this repaying capability in especially two ways. First, it influences the liquidity of a company. If a firm plans to sell assets to pay down debt obligations, a downturn of equity prices would lower the market price of these assets and therefore limit the cash flow potential of security sales. Contrary to that, the operating cash flow is positively affected by a stock market downturn. Usually, lower stock prices lead to higher write-downs on shares held at the asset side of the balance sheet.[20] This in turn leads to lower tax expenses due to the write-down tax savings and consequently to a higher cash flow from operations. Second, it influences the default risk of the company. A decrease in value of shares held at the asset side of the balance sheet reduces their use as collateral. This is especially true for borrowings which are secured with a pledge of shares. However, it is important to consider that also unpledged shares serve as a general security for the outstanding debt. For corporations a stock market downturn might lead to an additional increase of the default risk because the market value of shareholders equity at the liability side of the balance sheet – which can be seen as a mirror of the market value of all assets owned by shareholders – also loses value. The consequences for the default probability of a company become clearer when looking at the ratio of the market value of equity to the book value of total liabilities. A company with a high ratio (e.g. equity 200 € and debt 100 €) could experience a large drop in asset value before suffering from bankruptcy; a company with a low ratio (e.g. equity 100 € and

[19] See Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2003), p. 115-116.

[20] See Section XX for a detailed description of when and how companies have to write down impaired shares under German GAAP.

debt 200 €) will be insolvent if the total asset value decreases only slightly. Thus, the market value of equity serves as a cushion for loses on asset values.[21]

Our analysis focuses on both the ability to use share sales to repay debt and on the changing default risk due to changes in the market value of shareholders equity. Both investigations emphasise the impact of stock market movements on the non-operating business of a company. We do not investigate the consequences of stock market volatility on the regular business of a company for two reasons. First, operating cash flow is affected by the tax benefit only due to higher write-downs in the case of a stock market downturn. That favourably influences the liquidity of a company and therefore does not pose a threat for these companies. Second, the impact of tax savings from write-downs on shares is usually low for non-financial companies, especially since these write-downs are not systematic but rather happen sporadically. Thus the write-down tax savings can not serve as an automatic stabiliser of corporate liquidity, neither. [22] That means that in general stock market movements have no major impact on the operating business of a non-financial company.

For our analysis we use balance sheet data for German corporations as well as market values of some balance sheet items. The data stem from the German *Finanzierungsrechnung* published by the German Bundesbank[23] and the *Ertragslage und Finanzierungsverhältnisse der deutschen Unternehmen*[24]. Due to limited data availability our analysis has to focus on German corporations. We will come back to what that means for the financing possibilities of companies that are not corporations at the end of this section.

3.2 The impact of stock market volatility on corporate liquidity

In this section we concentrate on the liquidity of a company that is necessary to pay down debt. A company has principally three ways to repay debt. The first – and most important – way is to use the cash flow from operations. Since for non-financial companies the core business is not directly depending on capital markets development (such as for brokerage firms, insurance companies and banks), this repayment variant is largely unaffected by sudden increases or decreases in stock prices. As noted above, the influences of the tax savings which come from write-downs on

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[21] See Altman (2000), p. 8-9.

[22] This does not preclude that in some cases single companies can greatly benefit from the tax savings on write-downs on investments. A recent example is the Vodafone/Mannesmann case where Vodafone plans a 50 bill Euro write-down for tax reasons (Teilwertabschreibung) of assets acquired in the Mannesmann-merger. This proceeding – mandated by the German tax law if the market value of assets has fallen short of the carrying cost – would noticeably lower the tax expenses and consequently increase Vodafone's cash flow.

[23] See Bundesbank (2003b).

[24] Published each year in April as part of the Monatsbericht of the German Bundesbank

shares are only of minor importance. The second way to raise funds for paying off a loan is refinancing. Especially short term debt is sometimes refinanced and thus rolled over from one period to the other. Refinancing essentially does not reduce the debt amount of a company but rather postpones the repayment. Certainly, the ability of a company to refinance debt crucially depends on the conditions at capital markets (interest rate level, absorbing power of the market, etc.). However, it usually does not depend on the level and development of the stock market – assuming that the stock market is largely unaffected from the debt and money market. The third way is to sell assets to generate immediate cash for repayment. This approach is of minor importance for companies, and borrowers usually only go for it if the two other sources of finance are exhausted. However, if asset sale is a necessary proceeding then companies typically prefer the sale of shares held at the asset side of the balance sheet. The advantage of share sales compared to the sale of operating assets is that share sales typically do not reduce the future cash flow from operations and therefore do not restrict the future repayment potential of a company. Obviously, the success of share sales highly depends on the level and development of stock markets: the amount of funds raisable is a direct function of the market prices of equities.

To investigate how stock market volatility influences the liquidity of a company we analyse the ability of a company to repay short term debt obligations via the sale of shares. This is done by examining the development of the share-liquidity ratio over the years 1992-2002, where the share-liquidity ratio is defined as:

$$share\ liquidity\ ratio = \frac{market\,value\ of\ shares}{market\,value\ of\ short\ term\ debt}.$$

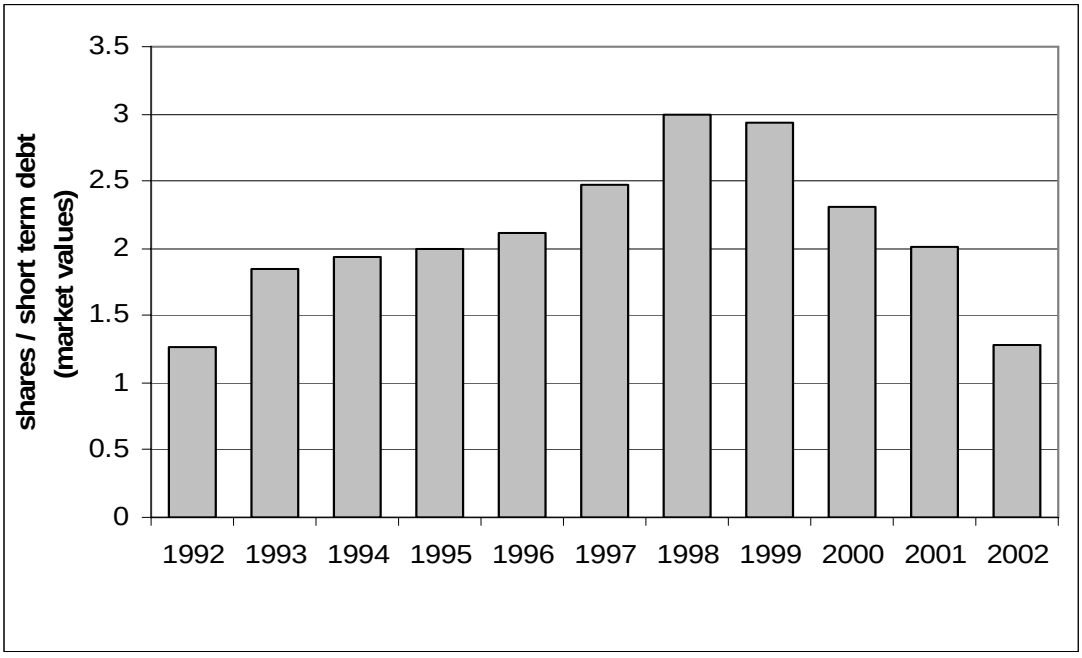
This ratio is measured at market values rather than at book values because we are only interested in realisable values for assets as well as for liabilities. Effectively, the share-liquidity ratio is an adjusted current ratio (current assets to current liabilities) respectively cash ratio (cash + marketable securities to current liabilities). These two ratios are measures of the liquidity of a company generated by short term assets. Both ratios only differ in the assumption of which part of the current assets is used to fulfil the short term liabilities repayment.[25] The ratio in our investigation also measures the liquidity of a company generated by asset sales based on the assumption that only shares are used to pay down debt. This ratio is a quite reasonable liquidity indicator for companies that do not have any excess cash or cash equivalents. Moreover, it emphasises the dependence of a company on stock market volatility when managing their liabilities. We are focusing on short term (interest bearing) li-

[25] Regarding an in depth presentation of ratio analysis to assess a company's financial situation, see Peemöller (2003), pp. 331-386. Current assets are assets that are expected to leave the company within the next period while current or short term liabilities are liabilities that become due within the next period.

abilities in the denominator rather than on all current assets because the goal of our analysis is to determine the impact on debt financing possibilities. However, we are aware that a bad accounts payable management can also trigger financial distress and thus, usually accounts payable have to be covered by short term assets as well. For our analysis it is sufficient to assume that the company's operating credit-debit management is in equilibrium which means that accounts payables equal accounts receivables.

Figure 12 shows the development of the share-liquidity ratio for the years 1992-2002. As expected, the ratio increases with the rise of stock prices and decreases with the downdraft. An important result is that the value of the share-liquidity ratio does not fall below "one" in either year. "One" is the critical value for this ratio since a ratio higher than "one" indicates that the company has enough financial flexibility to always fulfil its debt repayment duties. More precisely, in the event of a financial hardship due to low operating cash flows and bad access to capital markets, the company can still use share sales to pay off its entire debt obligations for this period. Contrary to that, a share-liquidity ratio value below "one" indicates that a company can no longer meet its full obligations if the firm's operating business goes through a sudden decline and if external sources of capital are unavailable.[26]

Figure 11: Share-liquidity ratio for German non-financial corporations (1992-2002)



Source: Deutsche Bundesbank, ZEW

[26] This interpretation is similar to the interpretation of other liquidity ratios like the current ratio, quick ratio or cash ratio, see Peemöller (2003), p. 362-367.

The figure indicates that German corporations in general did not face major liquidity problems due to the high stock market volatility during the last decade. Even in the year 2002, where financial markets experienced a tremendous slump in asset prices, German companies in general had enough potential liquidity at the asset side of the balance sheet.

These results, however, require some further explanations. First, our analysis only comprises German corporations; partnerships and sole proprietorships have not been part of our investigation. It can reasonably be assumed that companies that are not in the status of a corporation hold fewer shares at the asset side of the balance sheet. This might be due to the lower capital market orientation of these companies in general. However, we think that these potential differences in the amount of shares held are not significant and therefore our results largely hold for smaller companies, too, although we can not support our hypothesis because of a lack of data.

Second, while in general the liquidity of German corporations is not affected, this does not preclude that single companies suffered from the stock market downturn. Probably, some of these companies ran out of liquidity, did not have enough shares or other assets for selling and experienced bankruptcy. Thus, following our analysis we can only state that a liquidity crisis due to stock market movements is supposably not a general problem in Germany.

Third, from an economic point of view the results have to be handled with care. Since asset sales are typically applied only if both cash flow from operations and capital market or bank debt refinancing can not serve as a mean to repay the debt obligations, this variant is only important if the company has problems in its core operating and financing activities. Consequently, a strong ability to generate cash via asset sales rather represents a default risk cushion than a liquidity provider in the recurring business of a company. Therefore, such a repayment strategy should rather be regarded from the viewpoint of a company crisis. This, in turn, directly leads to the following section, where we shed more light on the default risk of a company and how it is related to stock market movements.

3.3 The impact of stock market volatility on the default risk of a company

Default risk of a company is defined as the risk that the borrower can not pay down debt anymore, not because of a short term liquidity crisis but because of insufficient resources in general. Therefore, default refers to as the principal failure of the operating and core business of a company. Lenders are overly concerned about the default risk of a borrower. Consequently, to assess the creditworthiness of a company, one of the main tasks of banks is to predict the probability of financial distress of the

borrower. Thus, the corporate financing possibilities heavily depend on and are negatively correlated to the default risk of a company.

Stock market volatility affects the default risk of a company especially because the market value of assets is traded at stock markets. The market value of assets in turn is one of the main determinants of the solvency of a company: the higher the market value of assets (all other things being equal) the lower the default risk of a company and vice versa.[27] The aim of this investigation is to determine how much influence changes in the level of stock prices have on the probability of default of a company.

Our investigation is based on a model for assessing the distress of industrial corporations: the so called Z-Score Model.[28] This model uses multi discriminant analysis to generate an overall score for each company at a specific point in time. While discriminant analysis is not a popular statistical technique in general, it is often applied in predicting bankruptcy.[29] The Z-Score Model comprises five discriminant coefficients (different financial ratios) which have proven to predict distress quite accurately. Although the basics of the model have been developed more than 35 years ago, it is still used by many practitioners today.

The Z-Score Model takes the following form:

$$Z = 1.2 \cdot X_1 + 1.4 \cdot X_2 + 3.3 \cdot X_3 + 0.6 \cdot X_4 + 0.999 \cdot X_5$$

where

X_1 = Working Capital/Total Assets

X_2 = Retained Earnings/Total Assets

X_3 = Earnings before Interest and Taxes/Total Assets

X_4 = Market Value of Equity/Book Value of Total Debt

X_5 = Sales/Total Assets

[27] See the example in the theoretical foundations of this section for an illustration of how market values of assets and default risk are correlated.

[28] See Altman (1968), Altman (2000)

[29] See e.g. Fulmer et al. (1984).

A company is classified as failed if the Z-Score falls below 1.8, a firm with a score exceeding 2.99 is regarded as free from default risk. Between these two numbers the firm is in the zone of indifference.[30]

Table 3: Zones of discrimination of the Z-Score Model

Z-Score Classifications	
Z > 2.99	"Safe"- Zone
1.80 < Z < 2.99	"Grey"- Zone
Z < 1.80	"Distress"- Zone

Source: Altman (2003)

The coefficients X_1, X_2, X_3 *and* X_5 are directly related to the operating business of a company. Coefficient X_4, however, is only indirectly related to the operating business via the stock market estimation of the market value of assets. Moreover, if stock price levels change (for reasons of simplicity we assume independence between stock market movements and the development of the operating business of the company here), the value of the coefficients which are directly to operating business related changes only slightly. E.g., in case of a write-down of shares held at the asset side of the balance sheet both the nominator and the denominator are reduced for the ratios X_1, X_2 and X_3. Coefficient X_5 changes favourably because of a reduction of the denominator which leads to an increase of the ratio; however, this change is negligible in most cases.

Contrary to that, Coefficient X_4 exhibits a high elasticity to stock price movements because a change in stock price levels directly reduces the nominator by the same percentage amount while typically leaving the denominator unchanged. The direction of the change in the coefficient is such that a decrease in stock prices reduces the overall score of the model and vice versa. Therefore, low stock prices generally lead to a higher probability of default according to the Z-Score Model.

[30] See Altman (2003), p. 6.

Figure 12: Equity-debt ratio of German non-fnancial corporations (1994-2002)

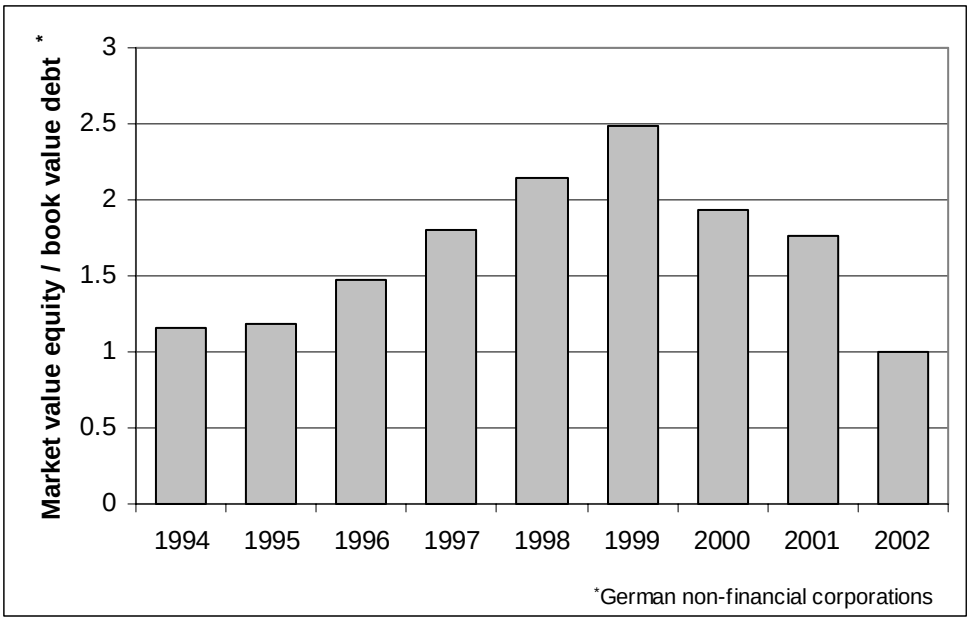


Figure 13: Z-Score Model contribution of the equity-debt ratio of German non-financial corporations (1994-2002)

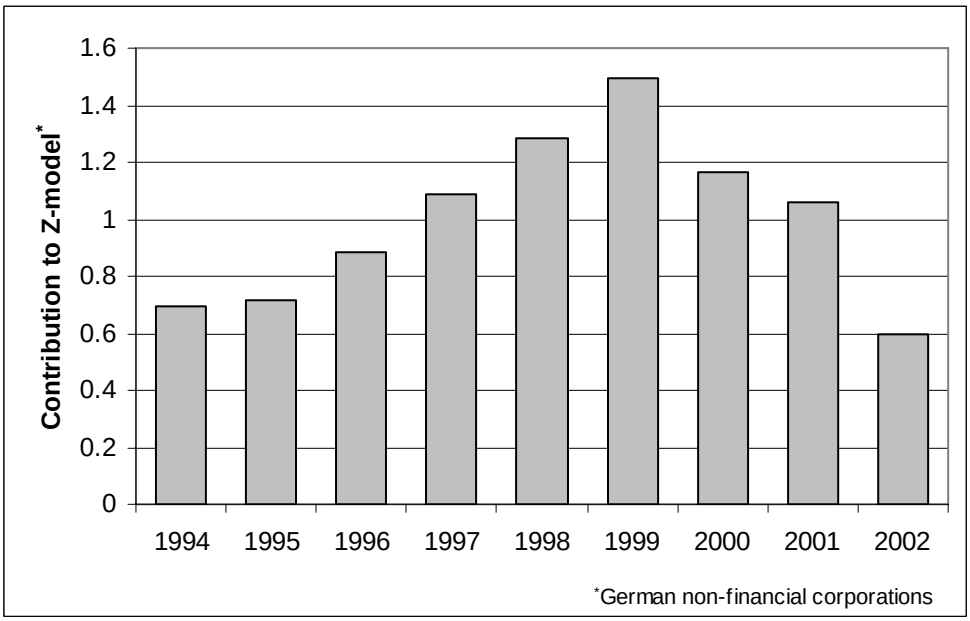


Figure 13 reveals the development of the "market-value-equity-to-book-value-debt ratio" for all German Corporations in the years 1994 to 2002 and figure 14 exhibits the contribution of this ratio to the overall score of the Z-Score Model. Comparing the two years 1999 and 2002, it can be seen that the score contribution was lowered by about 0.9 during that three year time period. With regard to the zones of discrimination of that model, it becomes obvious that the decrease in stock prices might have a dramatic impact on the default probability of companies. Certainly, in general the observed stock market development did not transfer a default risk free company to a company with a high probability of distress (i.e. the stock market development

did not transfer a company from the safe-zone to the distress-zone). However, the impact of stock price movements has been high enough to take many of the former "good" companies to the grey zone, where no definite estimates about their financial solvency can be made. Moreover, if companies have already been in that zone of indifference in 1999, they are probably estimated as default companies in 2002, with the dramatic impact on their corporate financing possibilities. Figure XX highlights the possible changes in default risk estimates for the years 1999 and 2002 according to the Z-Score Model, where each arrow represents the change for one company. The different arrows are just examples of where a company's Z-Score shifts to in 2002 (arrowhead) if its score in 1999 is indicated by the foot of the arrow. Once again, it can be illustrated that even if no company is transferred directly from the safe-zone to the distress-zone, there might be many companies whose rating is downgraded from the safe-zone to the grey-zone or from the grey-zone to the distress-zone.

Figure 14: Impact of stock price volatility on the Z-Score Model

Source: Altman (2003), ZEW

The conclusion regarding the impact of stock market volatility on the corporate financing possibilities of non-financial companies via the corporate balance sheet channel is as follows: While a down turn in stock prices typically does not lead to a major deterioration of the liquidity of a company, there is a high impact on the default risk of a company perceived by market participants. However, the investigation only revealed that stock market volatility is of very high importance in the case of stock listed corporations. The probability that not listed companies become distressed, presumably does not depend that much on stock market movements since data of the market value of equity of those companies are not readily available and therefore credit analysts have to rely on other – less capital market related – indica-

tors to assess creditworthiness. Contrary to that, many analysts determine market values of not-listed companies using some form of comparable company valuation with listed companies as comparable companies.[31] Therefore, it can be concluded that even for not listed companies the movements of share prices are not negligible at all when assessing the default risk of a company.

To put it in context of the corporate financing possibilities of non-financial companies: Default risk makes up a major part of credit risk and the degree of default risk inherent to a company therefore crucially determines the creditworthiness. Consequently, the corporate balance sheet channel has to be regarded as a channel of high influence for our investigation. Even if the concrete reduction in loans granted by banks due to the downturn of stock markets between 1999 and 2002 can not be determined here, it has to be assumed that it is a material reduction.

4 Credit supply, credit demand and stock markets in an econometric perspective

The preceding analysis has shown that when looking at banks' balance sheets there is little evidence that the stock market boom and the following decline in the late 1990s impacted the credit market. However some influence is evident on the (perceived) default risk of borrowers. In the following section we complement this approach with a time series analysis of the credit market to scrutinise whether the development of the stock market has any econometrically significant influence on credit demand or supply.

Fig. 15 and Fig. 16 give a first impression of the possible links between the credit volume of different groups of banks and the development of the stock market. Fig. 1 shows the annual changes of the credit volume to enterprises and self employed persons (excluding mortgages) [32] , taken from all banks, Großbanken (4 large private banks)[33], Savings Banks, and Cooperative Banking Associations and is compared to the annual changes of the German Composite DAX (CDAX)[34]. Obviously tight comovement of the credit aggregates and the stock market does not take place in the short run. Fig. 2 shows the same series in levels (calculated from cumulative changes of the credit volume): From this perspective a long run relationship between

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[31] See Peemöller et al. (2002), p. 198.

[32] We thank Rolf-Dieter Werner from the Deutsche Bundesbank for providing data on changes of the credit volume in this particular definition.

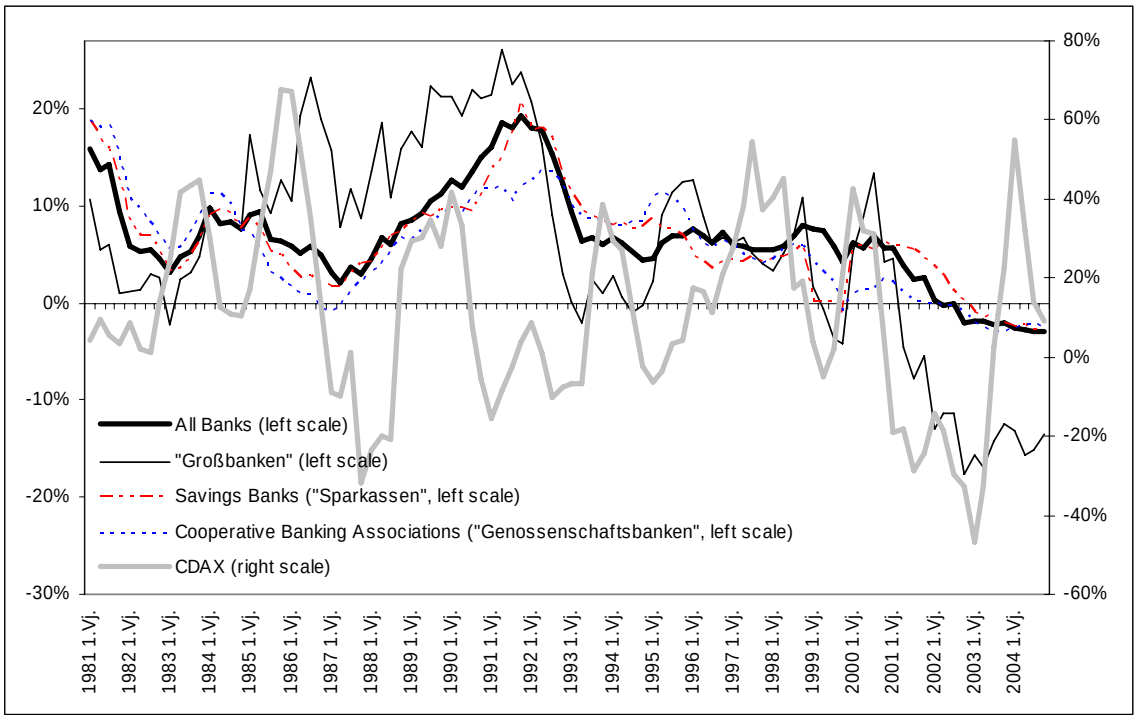
[33] This aggregate comprises the Deutsche Bank AG, the Commerzbank AG, the Dresdner Bank AG since Jan. 1999 the HypoVereinsbank AG and since Dec. 2004 the Postbank AG. We continue to use the German expression to designate this particular aggregate.)

[34] The CDAX is the most comprehensive German stock index, it includes all German shares in the Prime and General Standards.

the credit volume and the stock market seems likely.

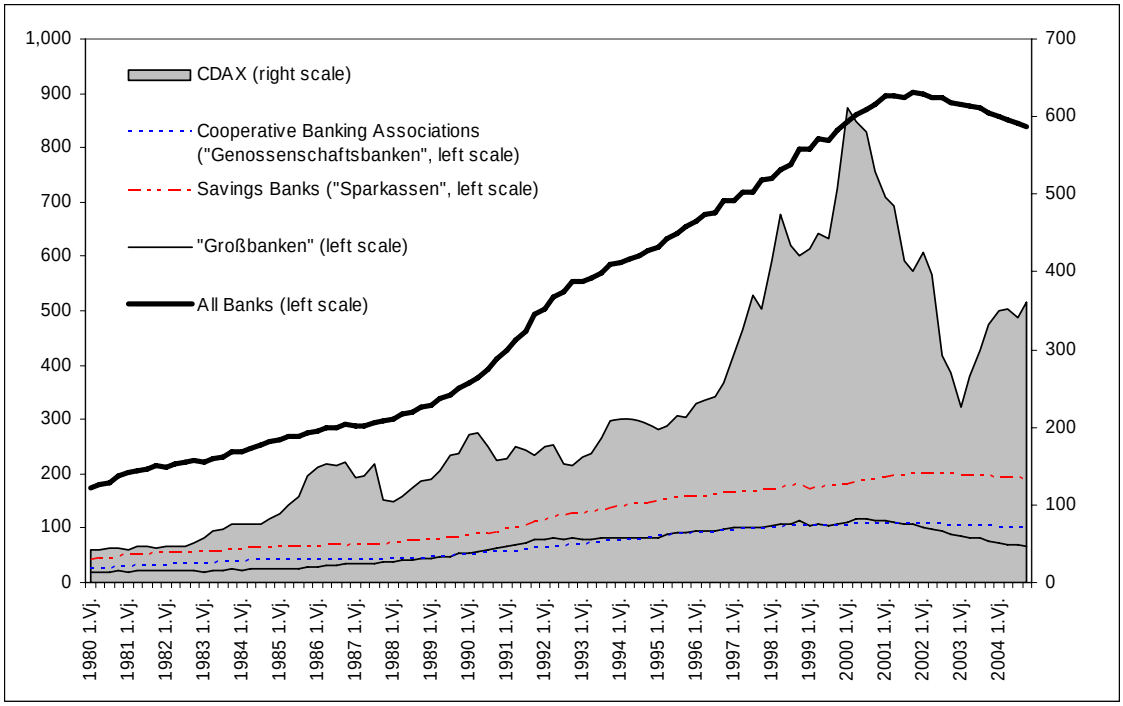
Since the series in levels are obviously non-stationary, we have to use a cointegration analysis to search for long run relationships between the stock market indicator and the credit volume.

Figure 15: Credit volume and stock market – annual changes



Source: Deutsche Bundesbank, EcoWin, credit volume seasonally adjusted for statistical breaks and season effects.

Figure 16: Credit volume and the stock market – levels



Source: Deutsche Bundesbank, EcoWin, credit volume: cumulative changes from 1980 to 2004, adjusted for statistical breaks and season effects.

4.1 Empirical evidence in the literature

Recent econometric analyses of the German credit market have been carried out by the Deutsche Bundesbank (2002, 2005), the German Council of Economic Experts (Sachverständigenrat, 2002), Detken/Lang (2003) and Schmidt/Nehls (2004). The Deutsche Bundesbank (2002) has estimated error correction models with GDP and interest rates as explanatory variables for differently defined credit volumes. The results show no cointegration for any credit aggregate except for consumer credit during the period ranging from the first quarter of 1980:1 to the second quarter of 2002:2. However, further segmentation into two periods, one being before and one after the German reunification yields significant and plausible results for both time periods. For the second period, a time trend is included in the model. The Bundesbank concludes that the long run relationship between credit volume, GDP and interest rates is stable. Although, since 2000, the actual credit volume is below the explainable growth rates, there is no significant evidence of major supply restrictions on the credit market. However, the difference between actual and explicable credit volume leaves some room for speculation in other influences on the credit volume, among them being lending restraints between banks.

The German Council of Economic Experts (Sachverständigenrat) analyses the credit demand in an error correction-framework which includes credit volume (to enterprises and self employed persons), GDP, long term and short term interest rate dur-

ing the time period ranging from the first quarter of 1970 to the second quarter of 2002. These results also do not indicate a structural break in the relation between theses aggregates. Out of sample forecasts based on this model show that forecasts exceed the actual credit volume, however the difference is not statistically significant. In their annual report 2004, the Sachverständigenrat has confirmed that the results still hold even if the time period is extended to the first quarter of 2004.

Detken and Lang estimate the relationship between (proxied) new loan commitments, GDP and long term interest rates for time interval from the first quarter 1993 to the second quarter 2003. They conclude that since 2003 new loan commitments deviate substantially from the long term relationship with the other macroeconomic variables.

Only Schmidt and Nehls focus explicitly on the impact of the stock market development on the credit supply in a disequilibrium model, mainly analysing the period starting from first quarter of 1993 and continuing to the second quarter of 2003. They specify a loan supply function with bank capital as a proxy for bank lending capacity, the German stock market indicator CDAX (Composite DAX) as an indicator for unrealised gains/losses of (bank owned) stocks and an interest rate spread as a proxy for credit risk. The simultaneously estimated demand function contains GDP as a variable for economic activity, an interest rate as proxy for capital costs and the volume of outstanding corporate bonds as an indicator for the usage of alternative financial resources. They find that from the last quarter of 2002 the credit market has most likely been restrained by the supply side and the stock market's losses seem to be an important determinant of this restrictive behaviour. This seems to be the case particularly for "Großbanken" (large private banks), which hold relatively more shares and earn relatively more from share-related business activities than smaller banks.

The Deutsche Bundesbank (2005) analyses the linkages between bank capital, GDP and the volume of credit in a vector autoregressive model from the beginning of 1991 to the end of 2004. The results show that an initial decline of 1 per cent of the GDP does reduce bank lending activity significantly in the first three quarters following the decline. However, the reaction of bank capital is insignificantly negative: therefore it is unlikely that supply restrictions are the origin of the decrease in lending following a slowdown of economic activity. However, the impact of stock market events and their impact on bank capital have not been taken into consideration.

4.2 Methods and Data

The following analysis is based on two approaches. In the first approach we estimate single equations for both credit demand and credit supply. Both kinds of equations are alternatively specified with and without a stock market variable. While the inclusion of the stock market variable in the supply function is straight from the argu-

ments stated in chapters 2 and 3 above, its inclusion in the demand function deserves an explanation: In our view the stock market indicator might serve as an indicator of general business prospects and therefore could be related not only to credit supply, but to credit demand as well.

To assess the impact of stock markets developments on the development of the credit volume, we analyse whether cointegration among variables can be established by inclusion of the stock market variable or whether an existing cointegrating relationship can be improved. We test for cointegration first by using a unit root test of the residuals, and by applying the McKinnon (1996) critical values. In the second step, we estimate an error correction model including these residuals and check the adjustment coefficient for cointegration by applying the Ericsson/MacKinnon (2002) critical values.

The demand function is specified as

$$(1)\quad D_t = \alpha + \beta_1 GDP_t + \beta_2 i + \beta_3 CDAX_t + \varepsilon_{1t}$$

with

- D_t = Realised Credit Demand (=credit volume)[35]
- GDP = Gross Domestic Product
- i_t = capital costs[36]
- $CDAX^t$ = Composite DAX
- ε_{1t} = residuals

The supply function is defined as

$$(2)\quad S_t = \alpha + \beta_1 LCAP_t + \beta_2 SPREAD_t + \beta_3 CDAX_t + \varepsilon_{2t}$$

with

- S_t = Realised Credit Supply (credit volume)[37]
- $LCAP_t$ = Lending Capacity of Banks (sum of bank capital and deposits[38])

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[35] Credit volume to enterprises and self employed persons (excluding mortgages).

[36] Current yield on domestic bonds.

[37] Credit volume to enterprises and self employed persons (excluding mortgages).

[38] Bank capital, sight deposits, time deposits and savings deposits.

- $Spread_t$ = interest rate spread between loans[39] and deposits[40]
- $CDAX_t$ = Composite DAX
- ε_{2t} = residuals

The error correction models are specified as

$$(3)\ \Delta D_t = \alpha + \sum_{i=1}^{t} \beta_i \Delta D_{t-i} + \sum_{i=0}^{t} \gamma_i \Delta X_{t-i} + \delta \varepsilon_{1t} + \varepsilon_{3t}$$

$$(4)\ \Delta S_t = \tilde{\alpha} + \sum_{i=1}^{t} \tilde{\beta}_i \Delta S_{t-i} + \sum_{i=0}^{t} \tilde{\gamma}_i \Delta X_{t-i} + \tilde{\delta} \varepsilon_{2t} + \varepsilon_{4t}$$

where X_t represents the vector of (weakly) exogenous variables and $\varepsilon_{1t,}$ ε_{2t} are the residuals from equations 1 and 2, respectively.

In the second approach, we estimate a disequilibrium model similar to Nehls/Schmidt (2004), extending the observation period to the end of 2004 – in contrast to the paper of Nehls and Schmidt who ended in the second quarter of 2003. The supply and demand functions are specified as above. We estimate the coefficients in the disequilibrium model under the assumption that the credit volume is the minimum of credit demand and credit supply:

$$(4)\ C_t = \min(S_{t,} D_t)$$

Like Nehls and Schmidt we follow Maddala (1983, p. 298) and assume that ε_{1t} and ε_{2t} are independently and normally distributed. We can then write the joint probability density function of S_t and D_t as the product of the density functions of single equations $g_1(D)$ and $g_2(S)$:

$$(5)\ g(D,S) = g_1(D) g_2(S)$$

with the two conditional probabilities

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[39] Average interest rates on current account credit from 100.000 EUR to 500.000 EUR, extrapolated from he second half of 2003 with the changes of the effective interest rate on new overdraft credit to non-financial corporations offered by German Banks.

[40] Average interest rate on savings deposits with a legal period of notice of 12 months, extrapolated from the second half of 2003 with the changes of the effective interest rate on new deposits of non-financial corporations in Germany with an agreed duration of 12 months offered by German Banks.

$$(6)\ h(C|C = D) = \int_{c}^{\infty} g(C, D)dD$$

$$(7)\ h(C|C = S) = \int_{c}^{\infty} g(C, S)dS$$

The likelihood function for independent ε_{1t} and ε_{2t} is

$$L = \prod_{t} \{g_1(C_t)[1 - G_2(C_t)] + g_2(C_t)[1 - G_1(C_t)]\}$$

where G1 and G2 are the distribution functions of credit demand and supply, and g1 and g2 are the density functions. We maximise the likelihood function by the using the Marquardt-Procedure implemented in EViews.

All estimates have been separately carried out for all banks and for the Großbanken in order to analyse whether there is a higher impact of the stock market variable on the Großbanken, whose business is more stock market related than of the average bank.

Credit volume, GDP and LCAP are seasonally adjusted and deflated with the GDP-deflator. All series, except for interest rates and spreads, are in logs. Interest rates and CDAX are in nominal terms. Philips-Perron-Tests (see Appendix 6.3) indicate that in all time intervals all variables are I(1), aside from the interest rate spread, which is I(0) in two observation periods. The ADF-Tests yield diverging results, since they indicate, in several observation periods, non-stationarity for some credit volumes, even in the first difference of the time series.

4.3 Results

4.3.1 Demand functions

The results (see appendix 6.4) do not show a substantial improvement following the inclusion of the stock market index in the demand equation if estimated over the whole period 1980:1 – 2004:4. Despite the disturbances caused by the German re-unification, the test statistic of the EG test without CDAX is almost significant. The inclusion of the CDAX, however, reduces the significance level. The error correction model (results not published here), on the contrary, improves slightly when the stock market index is included. However, in both specifications the coefficient of the error correction term is not significant and does not indicate cointegration. The specification, including only the Großbanken, yields results even worse.

When the observation period is shortened to 1993:1 – 2004:1 in order to avoid a structural break caused by the German reunification, the results of the EG tests and

the ECM deteriorate. While with the inclusion of the CDAX, the significance of the ADF-statistics in the one-step EG test increases, the significance level remains below the level of the longer time period. The ECM models indicate that there is no cointegration in either specification as well and show no improvement with the inclusion of the CDAX. However, estimates only including the Großbanken now show some improvement, particularly in the specification including the CDAX. But no significant cointegration on a normally applied level is observable.

Particularly good results from the demand functions for all banks can be achieved only when the observation period is limited to 2003:2 (the specification is also applied by Schmidt/Nehls). With this limitation, the ADF-test for the residuals of the demand function is only slightly below the 10 per cent significance level in the specification without the CDAX and is significant on the 1 per cent level in the specification including the CDAX. The ECM models show the same tendency, although the significance levels of the adjustment coefficients for the residual series do not exceed the critical 10 per cent value. Limited to the Großbanken, the results of all specifications are much weaker.

4.3.2 Supply functions

The estimates of the supply function over the whole time period yield in general low values for the ADF-statistic of the residuals (see appendix 6.4). The test statistic substantially increases when the stock market variable is included, but the value is far from being significant. A particularly strong increase is observable if only the Großbanken are included in the sample. Yet here, the coefficient remains insignificant as well.

The ECM models (results not published here) show better results for all banks, but the adjustment coefficients for the residual series are also insignificant. The ECM-results for the Großbanken show lower significance levels for the adjustment coefficient and an improvement following the inclusion of the stock market index is observable as well.

When limiting the observation period to 1993-2004 the results, contrary to the demand functions, do not deteriorate. Instead, the Engle-Granger-one-step estimates improve substantially. Including the stock market index the test statistic in the one step-EG-Test does not improve, while in the ECM model the significance of the adjustment coefficient of the residual series is substantially improved and weakly points to cointegration among the variables. The results for the Großbanken weakly indicate cointegration in the ECM specification with the CDAX as well, but not in the specification without the CDAX.

As with the demand functions, the supply functions yield much better results for the period 1993:1 -2003:2. The one step residual test points to cointegration in both

specifications with and without the stock market indicator. In the ECM model the adjustment coefficient without the stock market indicator is significant as well, while the specification with the stock market indicator fails to be significant on a normally applied level. The results of the Großbanken in both specifications are insignificant, however by including the CDAX the relative standard error of the adjustment coefficient for the residuals series in the ECM model decreases and the ADF statistic in the one step model improves.

4.3.3 Disequilibrium model

The estimation of the disequilibrium model shows different results, depending on the observation period (see Appendix 0). While the size of the coefficients differs, the signs and relative standard errors for the time periods 1980: 1 – 2003:2 and 1992:4 – 2003:2 are similar to the results of Schmidt and Nehls 2004, whose model is only slightly different.[41]

In both periods, the coefficient for the activity variable (GDP) is positive and has a low relative standard deviation (z-statistic), whereas the capital cost variable is negative, but has a relatively low z-value for the longer time interval.[42] The variables for the supply function generally show the correct signs as well: The lending capacity and the stock market variable have a positive impact. The spread is negative, but only during the period 1992:4-2003:2.[43] The Z-values for the lending capacity and the stock market indicator are particularly high during the period 1992:4-2003:2, indicating that these supply side variables have a strong influence.

Unfortunately the picture changes when the period is extended to 2004:4. The standard errors increase, the z-value for the stock market indicator now points to the insignificance of this variable during the period 1992:4 – 2004:4. During the longer observation period 1980:1 – 2004:4 the standard error of the stock market indicator is smaller but still higher than in the period 1980:1 – 2003:2. Obviously the model cannot explain the continuing decrease of the credit volume that somehow stands in opposition to the stock market recovery during 2003 and 2004.

When limiting the estimates to the Großbanken, the results show, in line with our

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[41] Schmidt and Nehls used industrial bonds as a further explanatory variable in the demand function and used a deflated CDAX-variable. What is clear is, whether Schmidt and Nehls include the CDAX with a lag of one period or the simultaneous value. While equation 5 of their paper describes the inclusion of the lagged CDAX, the results in table 1 and 2 show results for contemporaneous values.

[42] The results of Schmidt/Nehls are not clear here, the value for the capital cost coefficient 1980:1 – 2003: 1 is mistyped (-0-009).

[43] We did not use the interval 1993:1 to 2003:2 like Schmidt and Nehls because our model could not be solved for this period.

expectations, for all time periods positive coefficients for the stock market variable, that are substantially higher than for all banks. This finding corresponds to the empirical fact that Großbanken earn a larger part of their profits from stock-related activities and hold comparatively more shares in their own books. However, the coefficients for the lending capacity variable are incorrectly signed in all estimates. This is also true for the GDP-coefficient during the period 1992-2004:2.

4.3.4 Concluding remarks concerning the econometric results

Overall, the results of the time series analysis yield some evidence that the stock market development has an impact on the credit volume in Germany. Estimates of the supply and demand functions for different observation periods show, in general, that the cointegration results tend to become weaker when the observation period is extended to the end of 2004. This is particularly true for the demand functions for the credit volume of all banks. Better results can be found for the credit volume of the Großbanken. The best results for all banks can be achieved when the observation period begins after the German reunification and ends in the first half of 2003, i.e. before the recent recovery of the stock markets.

The result for the supply and demand functions in the single equation models show some improvement, particularly for the Großbanken when a stock market variable is included. This supports the view that the stock market development might be more relevant for the lending behaviour of the Großbanken than for other banks because the Großbanken derive more of their income from stock market related activities. The results of the disequilibrium model show the expected signs of the coefficients only in the periods ending in 2003:2. By extending the period to 2004:4 the standard error of the stock market variable increases, particularly for the credit volume of all banks. Again in line with our expectations are higher stock market coefficients for Großbanken, although the estimates yield implausible signs for the lending capacity and GDP variables.

5 Overall conclusion

In the first part of our paper, our analysis - concerning the factual impact of the balance sheet channel, future threats to the balance sheet and the banks‘ operating strain – revealed no major importance of the bank balance sheet channel for the analysis of the relationship between stock market volatility and corporate financing possibilities of non-financial companies.

However, a possible impact of stock market movements on banks´ lending behaviour might be rooted in their impact on the balance sheets of corporate borrowers. While a downturn in stock prices typically does not lead to a major deterioration of the liquidity of a company, there is a high impact on the default risk of a company

perceived by market participants. This is certainly the case for listed corporations, which can, however, have follow-on effects on the valuation of non-listed companies as well. Since default risk makes up a major part of credit risk, the degree of default risk inherent to a company therefore crucially determines their creditworthiness. Consequently, the corporate balance sheet channel has to be regarded as a channel of high influence on loans granted by banks.

The results of the time series analyses yield some confirming evidence for an impact of stock market developments on the credit volume in Germany. However, the results are not very stable and depend on the specification of the model and on the time period under observation. Most observations point to a higher relevance of stock market developments for the lending behaviour of the Großbanken.

6 Appendix

6.1 Calculation of contribution ratios

Contribution from stock market related operations to own funds											
		all Banks (in bil. €)	1994	1995	1996	1997	1998	1999	2000	2001	2002
	(1)	net commission income	13951	13849	14942	17433	18923	22461	28095	25368	24315
	(2)	Net profit on financial operations	250	2247	2112	2713	3619	3587	6449	5370	2951
	(3)	Write-downs and value adjustments on investments, holdings in subsidiary companies and securities treated as fixed assets	802	266	292	305	279	551	1747	1827	3386
	(4)	Income from the writing back of investments, holdings in subsidiary companies and securities treated as fixed assets	1532	435	600	1158	8048	3110	2329	5736	12008
	(5)	net income before taxes	16788	19717	20058	20575	33687	21385	19324	14489	10647
	(6)	net income after taxes	8841	9946	9655	10432	17761	12397	12577	10733	6752
	(7)	retained earnings (not accumulated)	5271	5980	6277	6651	9298	8172	8602	6951	4659
1-(6)/(5)	(8)	income tax rate	47.3%	49.6%	51.9%	49.3%	47.3%	42.0%	34.9%	25.9%	36.6%
(7)/(6)	(9)	plow back ratio	59.6%	60.1%	65.0%	63.8%	52.3%	65.9%	68.4%	64.8%	69.0%
	(10)	equity account (all items)	135150	145445	153994	167559	179464	204066	221926	236130	251313
	(11)	the special fund for general banking risks pursuant to Section 340g, Commercial Code	222	333	1262	1952	2257	2322	2997	3612	4119
(10)+(11)	(12)	tier 1 capital (approximately)	135372	145778	155256	169511	181721	206388	224923	239742	255432
	(13)	tier 1 capital / own funds (year 2000)	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%
(12) / (13)	**(14)**	**own funds (approximately)**	**211791**	**228072**	**242900**	**265203**	**284305**	**322897**	**351895**	**375080**	**399628**
(1)+(2)-(3)	(15)	net income from shares (ordinary)	13399	15830	16762	19841	22264	25497	32797	28911	23880
(1)+(2)-(3)+(4)	(16)	net income from shares (extraordinary - sale of assets included)	14931	16265	17362	20999	30311	28607	35126	34647	35888
[(15)*(1-(8))*(9)] / (14)	**(17)**	**contribution of net income from shares to own funds (ord.)**	**1.99%**	**2.10%**	**2.16%**	**2.42%**	**2.16%**	**3.02%**	**4.15%**	**3.70%**	**2.61%**
[(16)*(1-(8))*(9)] / (14)	**(18)**	**contribution of net income from shares to own funds (extraord.)**	**2.21%**	**2.16%**	**2.24%**	**2.56%**	**2.94%**	**3.39%**	**4.44%**	**4.43%**	**3.93%**

6.2 Determination of the structure of bank's share account in 2002

		LoFo-method of share sales									
	all banks (in bill. €)	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
(1)	ending period share account		18,324.12	23,681.42	29,987.16	33,441.43	47,291.26	62,357.00	81,770.00	60,039.00	49,022.00
(2)	beginning period share account		18,022.46	18,324.12	23,681.42	29,987.16	33,441.43	47,291.26	62,357.00	81,770.00	60,039.00
(3)	depreciation on shares		802.21	266.38	291.95	304.73	278.65	551.00	1,747.00	1,827.00	3,386.00
	gain on the sale of shares		1,531.82	435.11	600.25	1,157.56	8,047.70	3,110.00	2,329.00	5,736.00	12,008.00
	av.hist. purchase price of shares sold	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
	selling/purchase price (31/12)		2,106.58	2,253.88	2,888.69	4,249.69	5002.39	6958.14	6433.61	5160.1	2892.63
(4)	decrease in share account due to sales		1,384.29	347.01	317.82	356.21	2,010.72	521.97	428.63	1,378.81	6,344.61
(1)-(2)+(3)+(4)	(+)purchases / (-)sales (31/12)		2,488.16	5,970.69	6,915.50	4,115.21	16,139.20	16,138.72	21,588.63	-18,525.19	-1,286.39
	share account (historical prices)										
	1,000.00	18,022.46	16,638.17	16,291.16	15,973.35	15,617.14	13,606.42	13,084.44	12,655.81	11,277.00	4,932.39
	2,106.58		1,685.95	1,685.95	1,685.95	1,685.95	1,685.95	1,685.95	1,685.95	1,685.95	1,685.95
	2,253.88			5,704.31	5,704.31	5,704.31	5,704.31	5,704.31	5,704.31	5,704.31	5,704.31
	2,888.69				6,623.55	6,623.55	6,623.55	6,623.55	6,623.55	4,623.55	3,337.16
	4,249.69					3,810.48	3,810.48	3,810.48	3,810.48	285.29	285.29
	5,002.39						15,860.55	15,860.55	15,860.55	10,860.55	10,860.55
	6,958.14							15,587.72	15,587.72	10,587.72	10,587.72
	6,433.61								19,841.63	15,014.63	11,628.63
	5,160.10										
	2,892.63										

Note: A small portfolio of additional shares (with average historical price equaling the respective end of year Dax level - and therefore not affecting the gain on the sale of shares) has been sold in 2001 and 2002 to arrive at the reported end of year share account

HiFo-method of share sales											
	all banks (in bill. €)	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
(1)	ending period share account		18,324.12	23,681.42	29,987.16	33,441.43	47,291.26	62,357.00	81,770.00	60,039.00	49,022.00
(2)	beginning period share account		18,022.46	18,324.12	23,681.42	29,987.16	33,441.43	47,291.26	62,357.00	81,770.00	60,039.00
(3)	depreciation on shares		802.21	266.38	291.95	304.73	278.65	551.00	1,747.00	1,827.00	3,386.00
	gain on the sale of shares		1,531.82	435.11	600.25	1,157.56	8,047.70	3,110.00	2,329.00	5,736.00	12,008.00
	av.hist. purchase price of shares sold	1,000.00	1,000.00	1,840.80	2,253.88	2,888.69	3,180.07	5,002.39	5,002.39	3,747.52	1,000.00
	selling/purchase price (31/12)	1,000.00	2,106.58	2,253.88	2,888.69	4,249.69	5002.39	6958.14	6433.61	5160.1	2892.63
(4)	decrease in share account due to sales		1,384.29	1,938.94	2,131.19	2,456.89	14,043.83	7,954.71	8,140.30	15,217.42	6,344.61
(1)-(2)+(3)+(4)	(+)purchases / (-)sales (31/12)		2,488.16	7,562.62	8,728.88	6,215.90	28,172.31	23,571.46	29,300.30	-4,686.58	-1,286.39

share account (historical prices)										
1,000.00	18,022.46	16,638.17	16,385.18	16,385.18	16,385.18	16,385.18	16,385.18	16,385.18	13,635.53	6,290.92
2,106.58		1,685.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,253.88			7,296.24	5,165.04	5,165.04	3,012.42	3,012.42	3,012.42	0.00	0.00
2,888.69				8,436.93	5,980.04	0.00	0.00	0.00	0.00	0.00
4,249.69					5,911.17	0.00	0.00	0.00	0.00	0.00
5,002.39						27,893.66	19,938.94	11,798.64	0.00	0.00
6,958.14							23,020.46	23,020.46	20,677.17	20,390.78
6,433.61								27,553.30	25,726.30	22,340.30
5,160.10										
2,892.63										

Note: A small portfolio of shares (with average historical purchase price equaling the respective end of year Dax level - and therefore not affecting the gain on the sale of shares has been sold in 2001 and 2002 to arrive at the reported end of year share account

		Equal share sales from each layer									
	all banks (in bill. €)	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
(1)	ending period share account		18,324.12	23,681.42	29,987.16	33,441.43	47,291.26	62,357.00	81,770.00	60,039.00	49,022.00
(2)	beginning period share account		18,022.46	18,324.12	23,681.42	29,987.16	33,441.43	47,291.26	62,357.00	81,770.00	60,039.00
(3)	depreciation on shares		802.21	266.38	291.95	304.73	278.65	551.00	1,747.00	1,827.00	3,386.00
	gain on the sale of shares		1,531.82	435.11	600.25	1,157.56	8,047.70	3,110.00	2,329.00	5,736.00	12,008.00
	av.hist. purchase price of shares sold	1,000.00	1,553.29	1,786.82	2,062.29	2,499.77	2,916.87	3,725.47	4,112.34	4,243.31	1,000.00
	selling/purchase price (31/12)		2,106.58	2,253.88	2,888.69	4,249.69	5002.39	6958.14	6433.61	5160.1	2892.63
(4)	decrease in share account due to sales		4,300.40	1,664.58	1,497.94	1,653.58	11,255.77	3,584.09	4,126.04	26,548.84	6,344.61
(1)-(2)+(3)+(4)	(+)purchases / (-)sales (31/12)		5,404.27	7,288.26	8,095.62	5,412.58	25,384.25	19,200.83	25,286.04	6,644.84	-1,286.39

share account (historical prices)										
1,000.00	18,022.46	15,872.26	15,317.40	14,942.92	14,612.20	12,736.24	12,138.89	11,549.46	7,611.32	623.32
2,106.58		2,451.86	1,897.00	1,522.52	1,191.80	0.00	0.00	0.00	0.00	0.00
2,253.88			6,467.02	6,092.53	5,761.82	3,885.86	3,288.51	2,699.07	0.00	0.00
2,888.69				7,429.19	7,098.48	4,538.35	3,941.00	3,351.57	32.97	0.00
4,249.69					4,777.14	2,901.18	2,303.83	1,714.39	0.00	0.00
5,002.39						23,229.63	22,632.29	22,042.85	17,120.04	16,510.00
6,958.14							18,052.48	17,463.05	14,144.44	14,144.44
6,433.61								22,949.61	19,631.00	17,744.23
5,160.10									1,499.23	0.00
2,892.63										

6.3 Unit Roots Tests

1980:1 -2004:4

ADF

	LC all	LC GB	Kredall	KredGB	CDAX	Spread	UREND
Levels							
No. of Values	100	100	95	95	100	100	100
No. of Lags	1	0	8	8	1	1	1
Test	0.048	0.894	-0.962	-1.612	-1.626	-2.485	-1.303
Prob.	0.960	0.995	0.764	0.473	0.466	0.122	0.626
1. Differences							
No. of Values	100	100	95	95	100	97	100
No. of Lags	0	0	7	7	0	5	0
Test	-6.036	-8.305	-3.258	-1.659	-7.645	-4.090	-7.266
Prob.	**0.000**	**0.000**	**0.020**	0.449	**0.000**	**0.002**	**0.000**

Philips-Perron

	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
Levels							
No. of Values	100	100	100	100	100	100	100
Bandwith	0	3	7	7	3	7	2
Test	0.556	0.732	-1.564	-1.482	-1.617	-2.188	-1.029
Prob.	0.988	0.992	0.497	0.539	0.470	0.212	0.740
1. Differences							
Uroots	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
No. of Values	100	100	100	100	100	100	100
Bandwith	11	4	6	5	2	3	2
Test	-5.774	-8.265	-5.983	-6.972	-7.620	-4.587	-7.203
Prob	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

1993:1 -2004:4

ADF Levels

Uroots	LC all	LC GB	Kredall	KredGB	CDAX	Spread	UREND
No. of Values	48	48	48	48	48	48	48
No. of Lags	1	0	2	8	1	1	4
Test	-1.276	-0.295	-1.519	-1.617	-2.005	-2.512	-1.448
Prob	0.633	0.918	0.516	0.467	0.284	0.119	0.551

ADF 1. Diff.

Uroots	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
No. of Values	48	48	48	48	48	48	48
No. of Lags	0	0	1	7	0	0	3
Test	-4.309	-5.915	-1.558	-1.357	-4.906	-3.745	-4.660
Prob	**0.001**	**0.000**	0.496	0.595	**0.000**	**0.006**	**0.000**

PP Levels

Uroots	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
No. of Values	48	48	48	48	48	48	48
Bandwith	3	1	5	4	3	4	1

Test	-1.304	-0.346	-1.851	0.437	-1.935	-2.675	-1.721
Prob	0.620	0.910	0.352	0.983	0.314	**0.086**	0.415
PP 1. Diff.							
Uroots	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
No. of Values	48	48	48	48	48	48	48
Bandwith	2	3	2	4	0	3	3
Test	-4.323	-5.890	-2.869	-4.372	-4.906	-3.666	-4.765
Prob	**0.001**	**0.000**	**0.056**	**0.001**	**0.000**	**0.008**	**0.000**
1980:1 -2003:2							
ADF Levels							
	LC all	LC GB	Kredall	KredGB	CDAX	Spread	UREND
No. of Values	94	94	89	89	94	94	94
No. of Lags	1	0	8	8	1	1	1
Test	0.507	0.828	-0.475	-1.526	-1.725	-2.395	-1.349
Prob	0.986	0.994	0.890	0.516	0.415	0.146	0.604
ADF 1. Diff.							
	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
No. of Values	94	94	89	89	94	94	94
No. of Lags	0	0	7	7	0	0	0
Test	-5.951	-8.228	-3.734	-1.548	-7.429	-4.454	-6.976
Prob	**0.000**	**0.000**	**0.005**	0.505	**0.000**	**0.000**	**0.000**
PP Levels							
	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
No. of Values	94	94	94	94	94	94	94
Bandwith	2	0	6	6	4	6	3
Test	0.916	0.828	-1.068	-1.396	-1.737	-2.112	-1.084
Prob	0.995	0.994	0.726	0.581	0.409	0.241	0.719
PP 1. Diff.							
No. of Values	LC all	LC GB	Kredall	KredGB	CDAX	spread	UREND
Bandwith	94	94	94	94	94	94	94
Test	3	1	5	6	3	2	0
Prob	-5.928	-8.224	-6.330	-7.404	-7.449	-4.372	-6.976
Prob	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.000**
1993:1 -2003:2							
ADF Levels							
	LC all	LC GB	Kredall	KredGB	CDAX	Spread	UREND
No. of Values	42	42	42	42	42	42	42
No. of Lags	1	0	2	8	1	1	1
Test	-0.793	-0.342	-1.334	-1.729	-1.854	-2.404	-1.653
Prob	0.811	0.910	0.605	0.410	0.350	0.147	0.447
ADF 1. Diff.							
No. of Values	42	42	42	42	42	42	42

No. of Lags	0	0	1	1	0	0	3
Test	-4.215	-5.646	-1.711	-2.175	-4.581	-3.253	-4.224
Prob	**0.002**	**0.000**	0.419	0.218	**0.001**	**0.024**	**0.002**
PP Levels							
No. of Values	42	42	42	42	42	42	42
Bandwith	2	1	4	4	3	4	1
Test	-0.736	-0.392	-1.467	-0.869	-1.783	-2.772	-1.622
Prob	0.826	0.901	0.540	0.788	0.384	**0.071**	0.463
PP 1. Diff.							
No. of Values	42	42	42	42	42	42	42
Bandwith	1	2	3	4	1	2	2
Test	-4.193	-5.648	-3.534	-4.355	-4.574	-3.091	-4.353
Prob	**0.002**	**0.000**	**0.012**	**0.001**	**0.001**	**0.035**	**0.001**

6.4 Single Equation Results

Engle-Granger Residual Tests

1980:1 - 2004:4						
without CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	100	100	98	98	0.1	-3.514
No. of Lags	0	0	2	2	0.05	-3.872
Test	-3.10	0.59	-0.91	-0.17	0.01	-4.441
with CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	100	100	100	100	0.1	-3.895
No. of Lags	0	1	1	1	0.05	-4.210
Test	-2.75	-1.77	-1.32	-2.56	0.01	-4.827
1980:1 - 2003:2						
without CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	94	94	92	92	0.1	-3.518
No. of Lags	0	0	2	2	0.05	-3.833
Test	**-3.559**	-0.507	-1.365	-0.798	0.01	-4.451
with CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	94	94	94	94	0.1	-3.900
No. of Lags	0	0	1	1	0.05	-4.217
Test	-2.988	-1.818	-1.667	-3.541	0.01	-4.839
1993:1 - 2004:4						
without CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	48	48	48	48	0.1	-3.583
No. of Lags	3	8	3	3	0.05	-3.923
Test	-0.638	-2.719	-2.843	-1.439	0.01	-4.608
with CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	48	48	48	48	0.1	-3.987
No. of Lags	3	3	3	6	0.05	-4.335
Test	-2.100	-2.852	-2.614	-1.949	0.01	-5.036
1993:1 - 2003:2						
without CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	42	42	42	42	0.1	-3.602
No. of Lags	0	2	3	3	0.05	-3.950
Test	-3.580	-1.041	**-4.247**	-1.828	0.01	-4.656
with CDAX	All Demand	GB Demand	All Supply	GB Supply	Prob.	Critical Value
No. of Values	42	42	42	42	0.1	-4.012
No. of Lags	0	0	4	0	0.05	-4.370
Test	**-4.690**	-3.322	**-4.948**	-2.358	0.01	-5.096

6.5 Results of the Disequilibrium Model

All Banks
1980:1 - 2004:4
Observations: 100

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	4.112	0.059	69.272	0.000
Interest Rate	0.005	0.004	1.191	0.234
GDP	1.895	0.041	46.208	0.000
Const. S.	-6.400	1.374	-4.656	0.000
Lending				
Cap.	0.794	0.110	7.196	0.000
CDAX	0.142	0.040	3.586	0.000
Spread	0.016	0.004	4.052	0.000
Log likelihood	220.692			

„Großbanken“
1980:1 - 2004:4
Observations: 100

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	0.464	0.102	4.552	0.000
Interest Rate	-0.005	0.005	-0.955	0.339
GDP	4.164	0.124	33.471	0.000
Const. S.	6.855	1.043	6.574	0.000
Lending				
Cap.	-0.297	0.082	-3.636	0.000
CDAX	0.221	0.135	1.633	0.102
Spread	-0.047	0.037	-1.283	0.199
Log likelihood	135.050			

1980Q1 2003Q2
Observations: 94

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	4.141	0.036	113.754	0.000
Interest Rate	-0.002	0.003	-0.480	0.631
GDP	1.916	0.025	75.401	0.000
Const. S.	-4.449	1.079	-4.123	0.000
Lending				
Cap.	0.638	0.086	7.383	0.000
CDAX	0.190	0.032	5.916	0.000
Spread	0.019	0.004	4.767	0.000
Log likelihood	226.453			

1980Q1 2003Q3
Observations: 95

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	1.435	0.174	8.253	0.000
Interest Rate	0.045	0.016	2.746	0.006
GDP	2.379	0.121	19.732	0.000
Const. S.	1.975	0.761	2.595	0.010
Lending				
Cap.	-0.199	0.086	-2.328	0.020
CDAX	0.697	0.058	11.945	0.000
Spread	0.087	0.013	6.470	0.000
Log likelihood	96.522			

1992-4 - 2003:2
Observations: 43

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	3.499	0.172	20.336	0.000
Interest Rate	-0.022	0.007	-3.357	0.001
GDP	2.620	0.148	17.651	0.000
Const. S.	-1.892	0.017	-112.008	0.000
Lending				
Cap.	0.528	0.001	384.102	0.000
CDAX	0.062	0.002	30.638	0.000
Spread	-0.011	0.002	-7.035	0.000
Log likelihood	131.300			

1994:1 - 2003:2
Observations: 38

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	2.583	0.281	9.177	0.000
Interest Rate	0.012	0.013	0.898	0.369
GDP	1.435	0.272	5.279	0.000
Const. S.	6.016	0.467	12.891	0.000
Lending				
Cap.	-0.263	0.026	-10.032	0.000
CDAX	0.334	0.036	9.261	0.000
Spread	-0.074	0.015	-4.833	0.000
Log likelihood	91.054			

1992:4 2004:4
Observations: 49

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	3.963	0.719	5.514	0.000
Interest Rate	-0.002	0.022	-0.090	0.928
GDP	2.100	0.750	2.800	0.005
Const. S.	-1.194	0.373	-3.199	0.001
Lending				
Cap.	0.498	0.034	14.488	0.000
CDAX	0.035	0.033	1.085	0.278
Spread	-0.027	0.007	-3.767	0.000
Log likelihood	124.921			

1992:2 2004:4
Observations: 51

	Coeff.	St.Err.	z-Stat.	Prob.
Const. D.	15.504	4.891	3.170	0.002
Interest Rate	0.357	0.048	7.373	0.000
GDP	-11.879	4.459	-2.664	0.008
Const. S.	3.634	0.390	9.307	0.000
Lending				
Cap.	-0.098	0.034	-2.873	0.004
CDAX	0.283	0.047	6.038	0.000
Spread	0.006	0.012	0.488	0.626
Log likelihood	93.244			

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