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Quantitative and qualitative evaluation of creditworthiness

Quantitative and qualitative evaluation of creditworthiness

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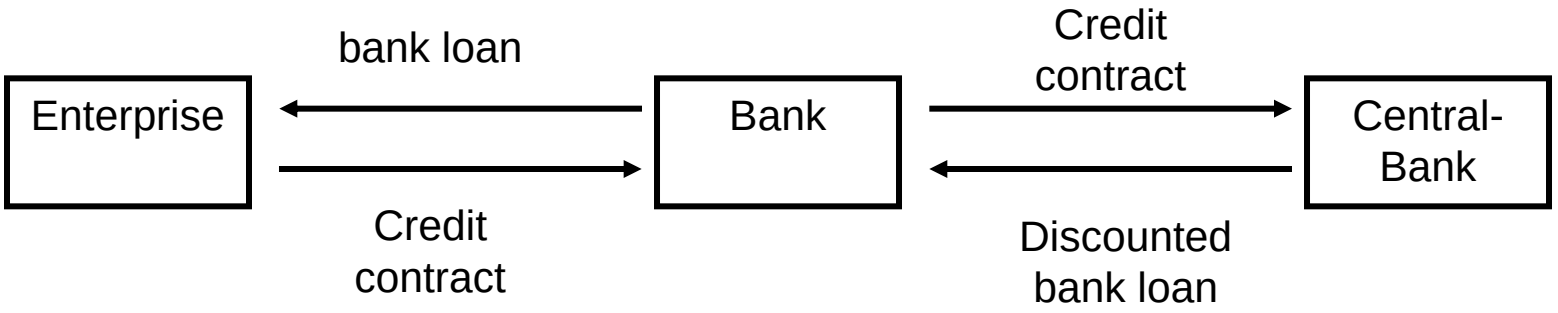
- **Bank loans as security for monetary transaction between commercial banks and Deutsche Bundesbank**



- **Used as security for:**

  - Open market operations
  - Standing facilities

Quantitative and qualitative evaluation of creditworthiness

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- **Credit Information and Evaluation System is subject to ECB supervision**
- **Target: compliance with minimum standard**
- **Measurement category: Default rate number of enterprises with positive rating that turned insolvent in relation to all enterprises with positive rating**
- **Demand of ECB: Short term default rate to be comparable with results AAA-Rating of biggest rating companies**
- **Acceptable default rate: less than 0,14%**

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- **Quality categories: Traffic light approach**

Green zone: default rate < 0,14%
Credit evaluation system meets requirements of ECB

Yellow zone: default rate 0,15% to 0,28%
Credit evaluation system does not meet quality requirements of ECB, gradual adjustment is necessary

Quantitative and qualitative evaluation of creditworthiness

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- **Quality categories: Traffic light approach**

Orange zone: default rate 0,29% to 0,41%
Warning: Does the system's default rate reach this area 3 years out of 5 years significant changes of the system have to be agreed with ECB. If no improvement of success then suspension

Red zone: default rate >0,45%
Warning and urgent demand for improvement, if red zone is reached again then suspension of credit evaluation system

Quantitative and qualitative evaluation of creditworthiness

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Quantitative Information

available and significant for every enterprise (e.g. financial ratios)

not available or not significant for every enterprise (e.g. individual adjustments and corrections to the enterprise's financial statement)

Qualitative Information

after processing of data available and significant for every enterprise (e.g. accounting behaviour)

not available or not significant for every enterprise (e.g age of the enterprise)

Quantitative and qualitative evaluation of creditworthiness

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- **Three sources of information for evaluation of credit and credit policy of a bank:**
  - Balance sheet data: calculation of financial ratios
  - Cash flow data: evaluation of short-term and long-term demand/surplus of financial resources
  - Accounting behaviour: extent of the use of accounting strategies

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Field of ratio analysis	Financial ratios
Ability to generate cash from the company's operations	• Capital recovery ratio • Debt repayment capability • Net income ratio
Ability to earn profits and stay in business	• Profit/ Turnover ratio • Return on Equity • Operating Return • Return on Capital
Balance between short term debt and liquid assets	• Days of accounts receivable • Days of accounts payable • Liquidity ratio • Storage duration
Balance between total debts and assets	• Own funds ratio • Own funds / provision ratio • Own funds / pension provision ratio • Gross equity ratio

Quantitative and qualitative evaluation of creditworthiness

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- **Requirement of a reliable cash-flow calculation:**
  - Identification of a financial excess or –demand as well as the basic features of the enterprises policy regarding investment and financing
  - Description of the enterprise out of its ordinary business, ability to generate cash to fulfil future and present obligations

Quantitative and qualitative evaluation of creditworthiness

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- **Cash-flow calculation according to Deutsche Bundesbank:**
  - Identification of cash flows coming from

    - Turnover: Comparison of current receipts and payables evaluation of the financial result of the business process
    - Investment: Visualisation of the sources of financial demand, comparison through longer period enables analysis of investment behaviour
    - Financing: clarification of the sources of finance (internal or external) and the further use of the financial means

Quantitative and qualitative evaluation of creditworthiness

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Financial flow account	
Turnover	
Operating receipts	(+)
Own products	(+/-)
Staff costs	(-)
Materials costs	(-)
Interest paid	(-)
Interest received	(+)
Receipts from partifications	(+/-)
Other expenses	(-)
Other receipts	(+)
= Profit (+)/loss (-) before taxes	
Taxes on earnings	(-/+)
= Profit (+)/loss (-) after taxes	
Deprication	(+)
Provisions	Inc.(+)Dec.(-)
Own products	Inc.(-)Dec.(+)
Advance payments received	Inc.(+)Dec.(-)
Other items	(+/-)
= Net receipts (+)/net expenses (-)	

Quantitative and qualitative evaluation of creditworthiness

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= Net receipts (+)/net expenses (-)	
Profit/loss surrender	(-/+)
Profit distributions	(-)
Accounts receivable, other short-term cl.	Inc.(-)Dec.(+)
= Disposable operating surplus /deficit	
Investment	
Increase in fixed assets	(-)
Less decreases in fixed assets	(+)
Stocks (occluding own products)	Inc.(-)Dec.(+)
Financial assets a. other long-term claims	Inc.(-)Dec.(+)
=Need for funds (-)/release of funds(+)	
Remaining financial surplus (+)/deficit (-) from turnover and investment	
Financing	
Inpayment/Outpayment of capital	Inc.(+)Dec.(-)
Long-term debts to banks	Inc.(+)Dec.(-)
Other log-term debts	Inc.(+)Dec.(-)
Long-term liabilities	
Short-term debts to banks	Inc.(+)Dec.(-)
Accounts payable	Inc.(+)Dec.(-)
Bills of exchange payable	Inc.(+)Dec.(-)
Other short term debts	Inc.(+)Dec.(-)
Short-term liabilities	
liquid funds	Inc.(+)Dec.(+)

Quantitative and qualitative evaluation of creditworthiness

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- **Limits of a cash-flow calculation:**
- **Due to methodical reasons (use of a advanced format) figures can differ from published items:**
  - Definition of the Cash flow according to needs of Bundesbank evaluation
  - Acknowledgement of investment in tangible assets
  - Acknowledgement of different items of equity capital

Quantitative and qualitative evaluation of creditworthiness

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General observation:

Sound enterprises normally do not see the necessity to show their economic capacity to the public and therefore tend to use conservative accounting features, whereas enterprises with economic problems use progressive accounting measures to pretend financial soundness.

Target:

Determination of the accounting behaviour (conservative, neutral progressive) by evaluation of the extend of the use of accounting options

Way:

Use of the information inserted in the appendix of the respective annual account

Quantitative and qualitative evaluation of creditworthiness

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Features	**Conservative**	**Neutral**	**Progressive**
1.use of Balance sheet items (e.g.)			
• Reserves • Pension obligations			
2 Evaluation of Balance sheet items (e.g.)			
• Value of stock • Depreciation			
3. others (e.g.)			
• Use of sale lease back • Extend of liquidity			
Total	Σ	Σ	Σ

Quantitative and qualitative evaluation of creditworthiness

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- **Evaluation of weighting factors for every single qualitative accounting feature through statistical processing**

Position		Factor	Conservative (+ 1)	Neutral (+/- 0)	Progressive (- 1)
211	expenditure reserves	0,709		X	
212	other reserves	0,245	X		
...	...	...	...	...	...
225	special depreciation allowances for tax purposes	0,348			X

- **accounting behaviour =**

$$0{,}709*0 + 0{,}245*1 + \ldots + 0{,}348*(-1)$$

Quantitative and qualitative evaluation of creditworthiness

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Field of Analysis	Qualitative characteristics	
	Feature	**Distinction**
Development of enterprise	Development of financial ratios during two or three consecutive years	Strong decrease, moderate decrease, unchanged, moderate increase, strong increase
Structural characteristics	Legal form (Joint Stock company (AG), Limited liability Company (GmbH), Co-operative Company (Genossenschaft), General Partner-ship (OHG))	Good, moderate, bad
	Age of enterprise	Start-up, moderate, well established
Behavioural characteristics	Number of request for annual account	None, few, many
Financial situation	Recognised hidden reserves	Existent, non-existent
	Loans to shareholders / partners	Existent, non-existent

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Adequate processing

- **Mathematical / statistical method, designed for quantitative characteristics (for clearly delimited features)**

- **Knowledge-based Expert-system for qualitative characteristics for fuzzy features and missing values**

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Transparent and comprehensive judgement

Statistical Method: Discriminant Analysis

Definition of appropriate financial ratios, considering facts concerning

- Liquidity
- Asset- / Debt situation
- Profitability
- Cash-flow

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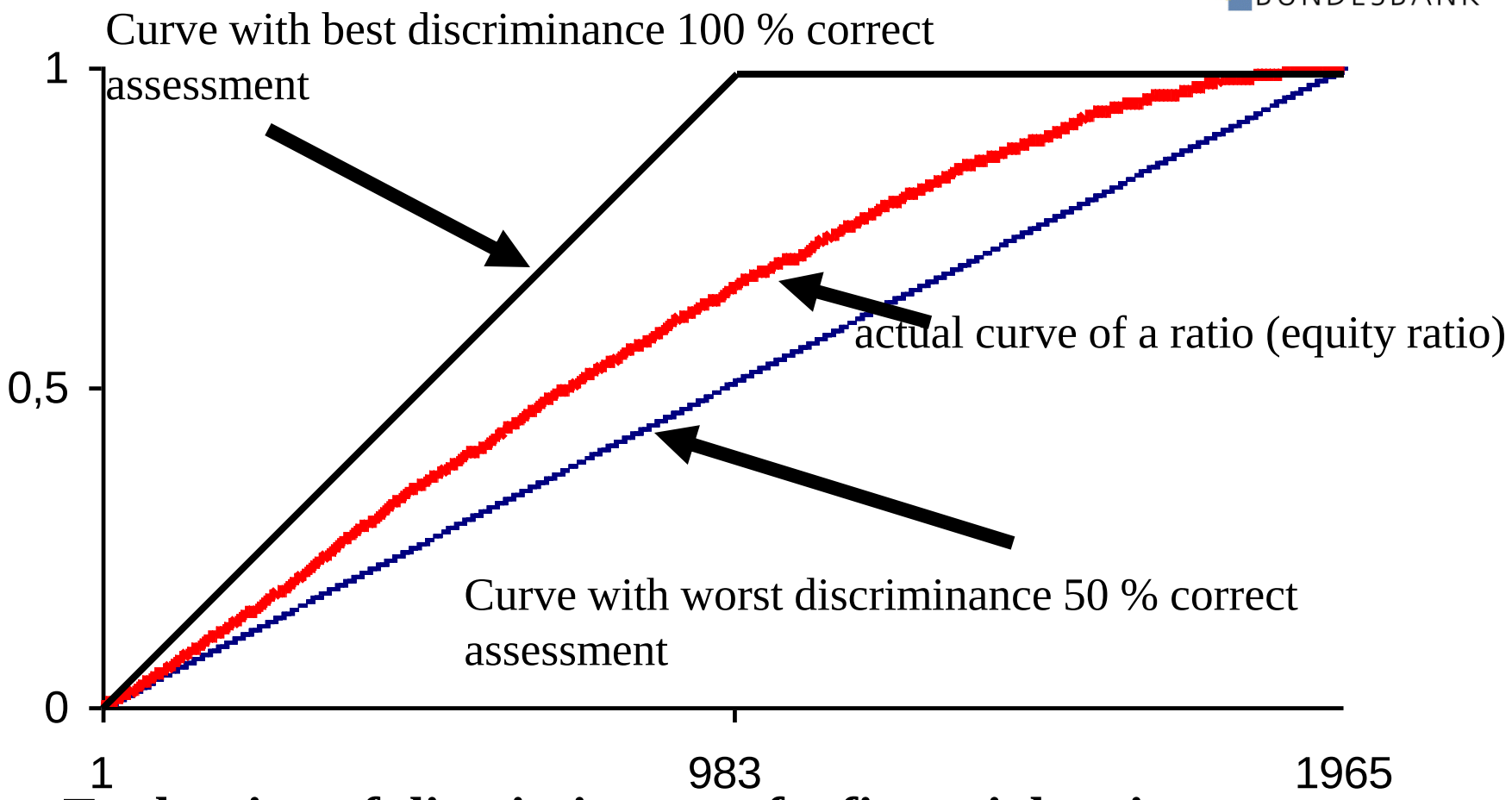
Transparent and comprehensive judgement

- **Criteria for the selection of financial ratios for the purpose of discriminant analysis**
  - scientific acceptance
  - Success in an univariate Analysis: share of correct assessment, α- and β- fault
  - Univariate Analysis:
    - evaluation of a cut-off point / evaluation of a concentration curve
    - sorting of the features (ratios) according to ascending growth, the cut-off point marks the transition from non-solvent to solvent companies

Quantitative and qualitative evaluation of creditworthiness



Evaluation of discriminance of a financial ratio via concentration curve

Quantitative and qualitative evaluation of creditworthiness

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Elimination of extreme values

Consideration of the position of the values

⇒ Reduction of the examination on those values that depict a „normal“ situation of an enterprise

⇒ Values that can be found mostly

Threshold value

Quantitative and qualitative evaluation of creditworthiness

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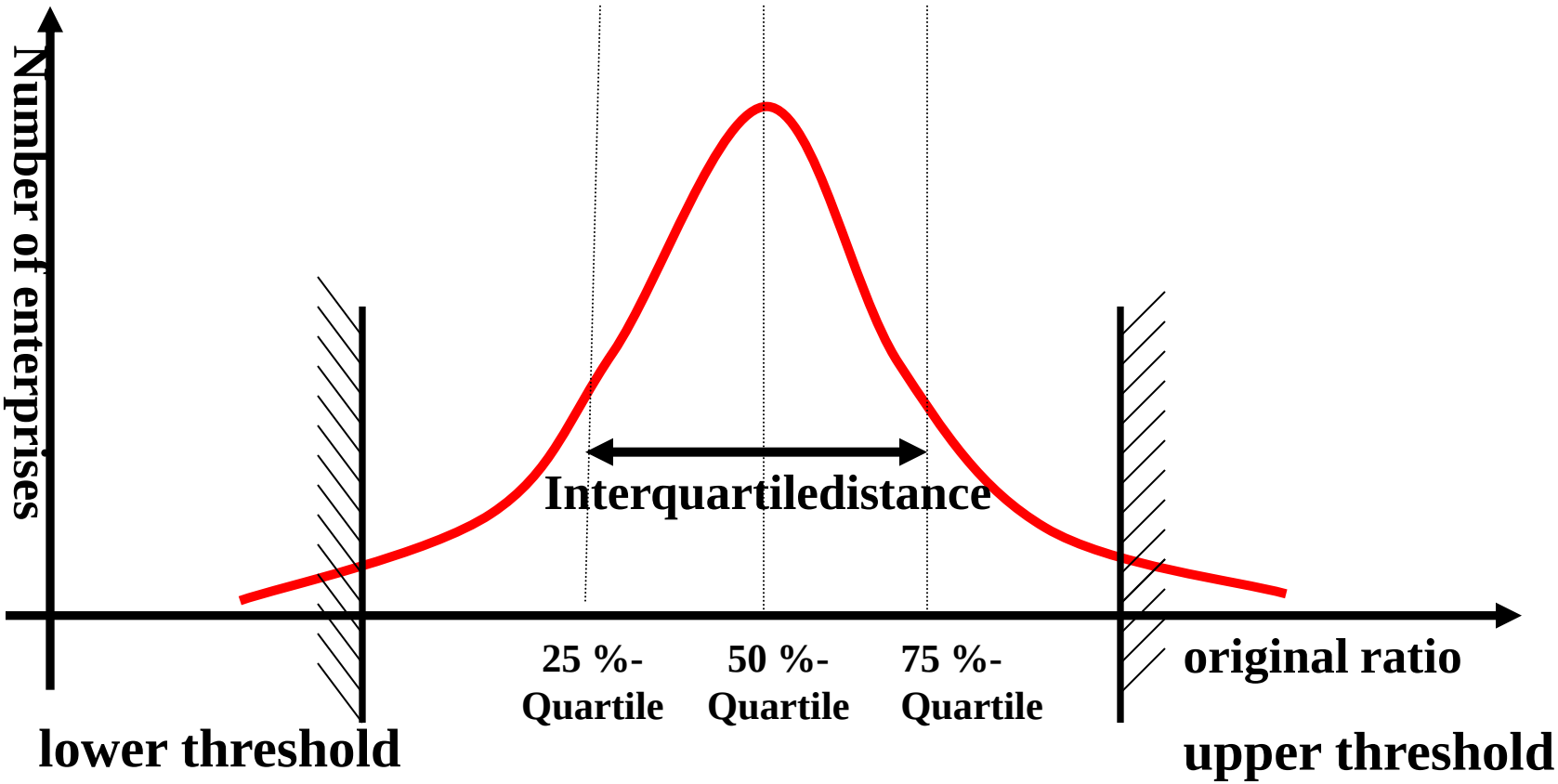

upper threshold: 75%-Quartile + 1,5 Interquartiledistance

lower threshold: 25%-Quartile - 1,5 Interquartiledistance

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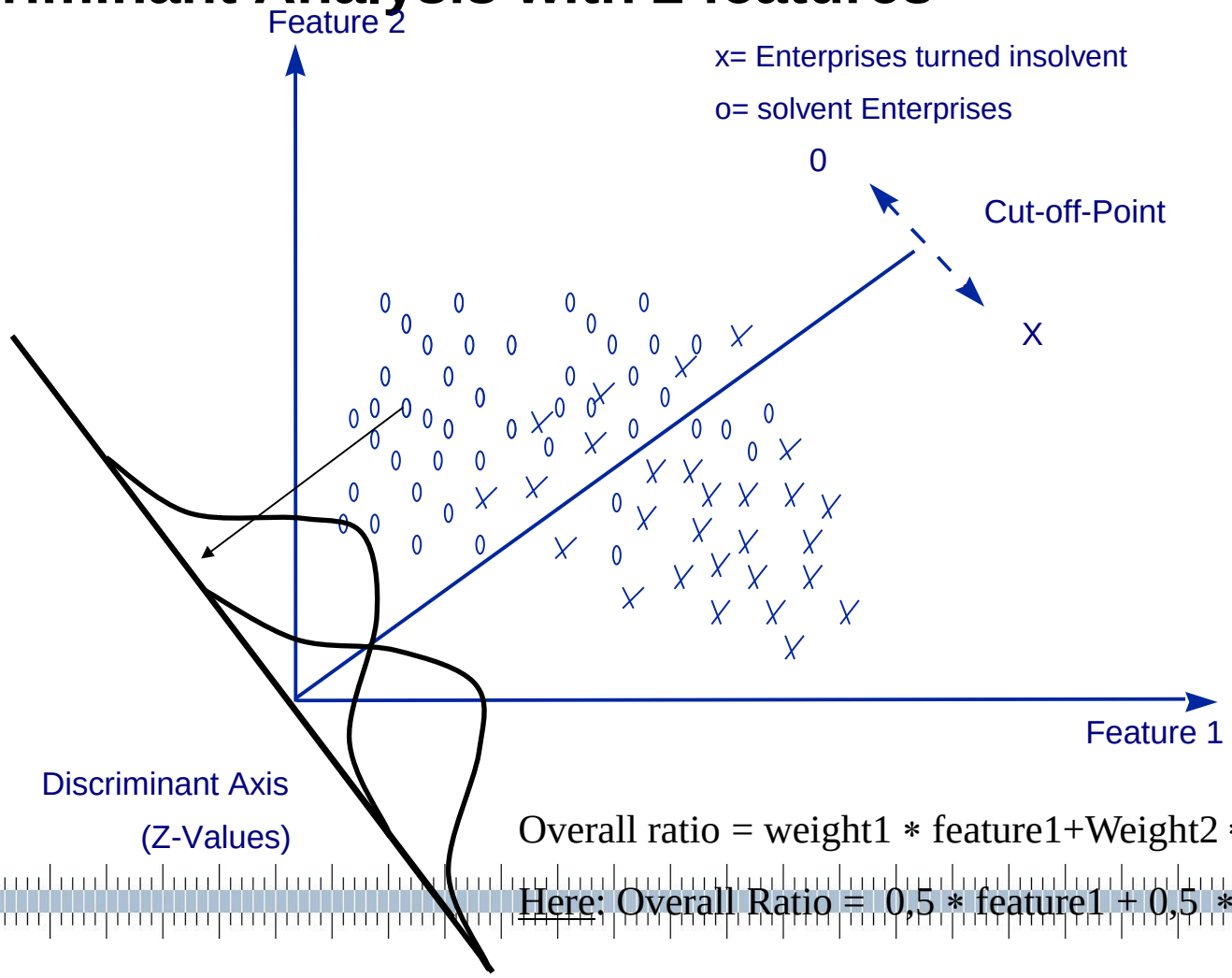
Discriminant Analysis with 2 features



Overall ratio = weight1 ∗ feature1+Weight2 ∗ feature2

Here: Overall Ratio = 0,5 ∗ feature1 + 0,5 ∗ feature2

Quantitative and qualitative evaluation of creditworthiness

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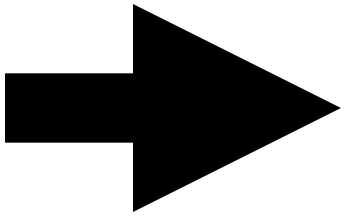
- **Evaluation of discriminant function :**
  - $OR = a_1 * KZ_1 + a_2 * KZ_2 + a_3 * KZ_3 + a4 * KZ4 + a_{qual} * KZ_{qual} + a_0$
  - $a_{i,}$ i = 1, 2, 3...n Weights in Discriminant function



Target function:

Separation between Solvent / non-solvent max!

Quantitative and qualitative evaluation of creditworthiness

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- **Criteria for the acceptance of a discriminant function:**

  - ⇒ Share of correct assessment, α- and β- fault
  - ⇒ scientific acceptance of the function
  - ⇒ weight / attribution of the respective ratios to the overall ratio
  - ⇒ level of the constant

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Example: calculation of an overall ratio

Ratio	Value	Weight*	weighted result
Own funds ratio	13,7	0,1546	2,1
operating return	21,4	0,1021	2,2
days of accounts receivable	37	-0,1283	-4,7
debt recovery capability	-6	0,0979	-0,6
accounting behaviour	-1,075	1	-1,1
constant	6,6611		6,7
overal ratio			4,6

*** Weights are examples, not reflecting existing values**

Quantitative and qualitative evaluation of creditworthiness

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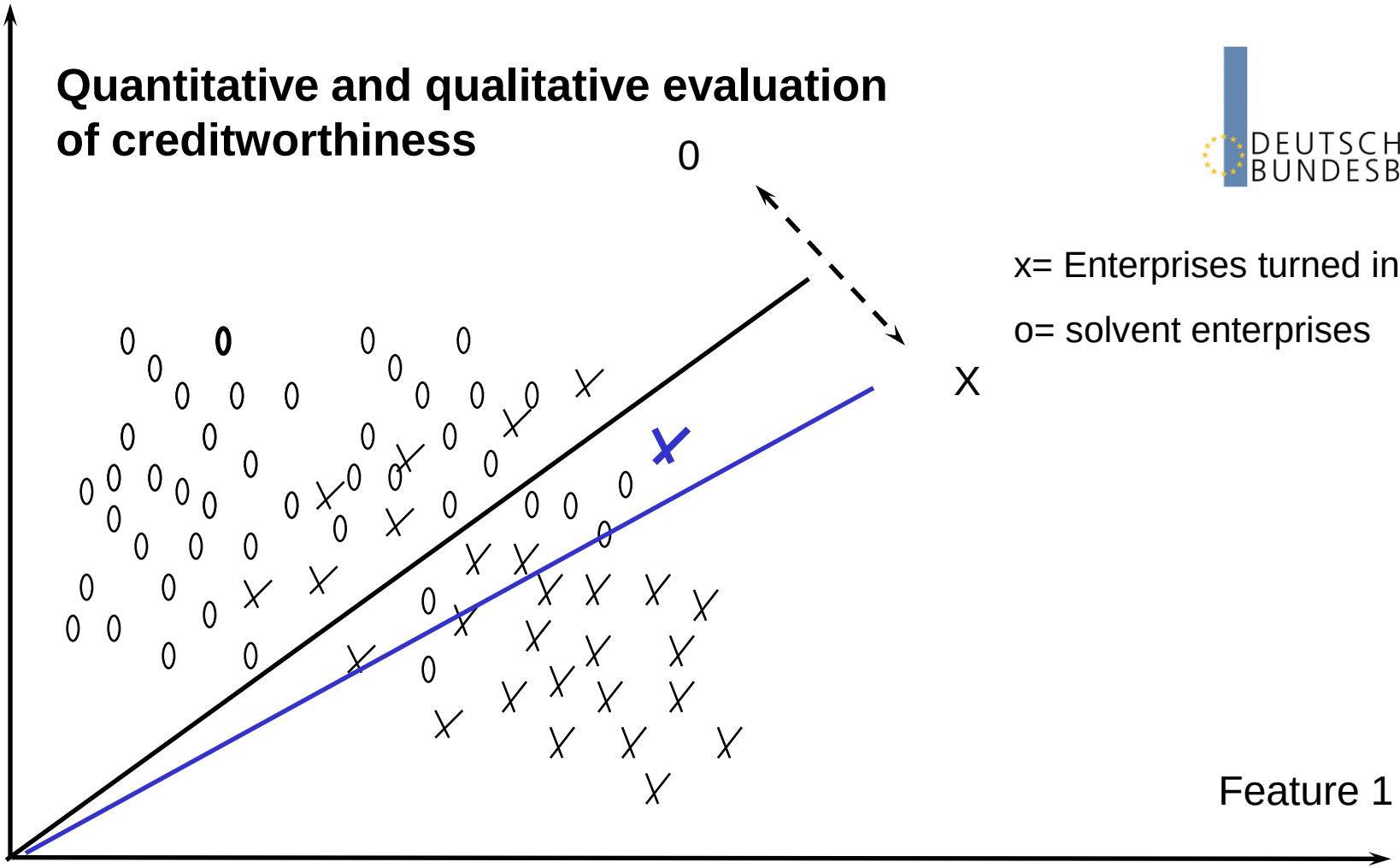
after the determination of the discriminant function the following shall be regarded as fixed:

- ⇒ combination of ratios
- ⇒ weight of a ratio

An alteration of the combination of the chosen ratios and or the weights would falsify the results

Quantitative and qualitative evaluation of creditworthiness



x= Enterprises turned insolvent

o= solvent enterprises

Consequence:among the one enterprise that is now reclassified, many others are reclassified as well

⇨the share of correctly classified enterprises would decline

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Use of different discriminant functions for different branches to...

- **cover the particularities of the different sectors of the economy**
- **improve the results by forming more homogeneous classes**

Formation of Branches

- ➔ **manufacturing sector**
- ➔ **wholesale / retail trade**
- ➔ **others**

Quantitative and qualitative evaluation of creditworthiness

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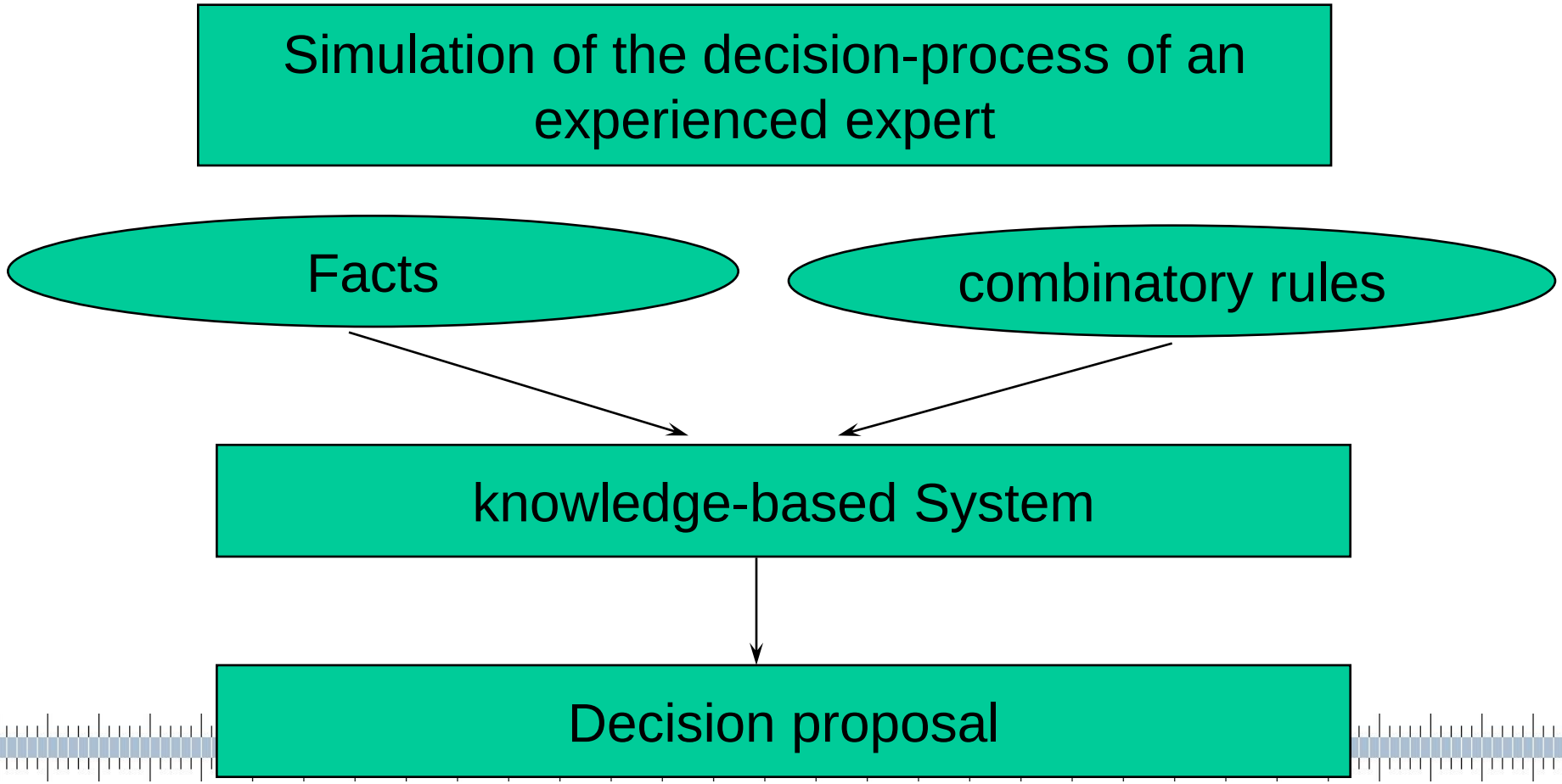

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Knowledge basis

Data / Facts:

- pre-selection by score / result of discriminant function
- additional, not yet evaluated data, mainly based on development processes (e.g. development of turnover expressed as a percentage)

Combinatory rules:

- syntactical structure: If proposition 1 is fulfilled and proposition 2 is fulfilled and ....and proposition N is fulfilled, then increase or decrease the score

The knowledge based expert system uses the implications of the fuzzy logic theory

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Comprehensiveness of the process through ...

Easy to understand “if - then rules”,

Transparency during the processing

- absolute weight of rule: Measurement for the importance of the rule
- individual degree of fulfilment: Measurement in how far a certain rule is applicable for a particular enterprise

Correct application of the rules (semantically contradiction-free functions)

Expert-System

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- Basic consideration:

  Processing of economic experience into a common framework
- Rules with 3 propositions as a maximum
- Proposition with 3 manifestations as a maximum

- <u>Example:</u>

  If enterprise young and high degree of liability, then reduce overall ratio
  If investment ratio high and income suplus decreased then raise overall ratio

Fuzzy-values

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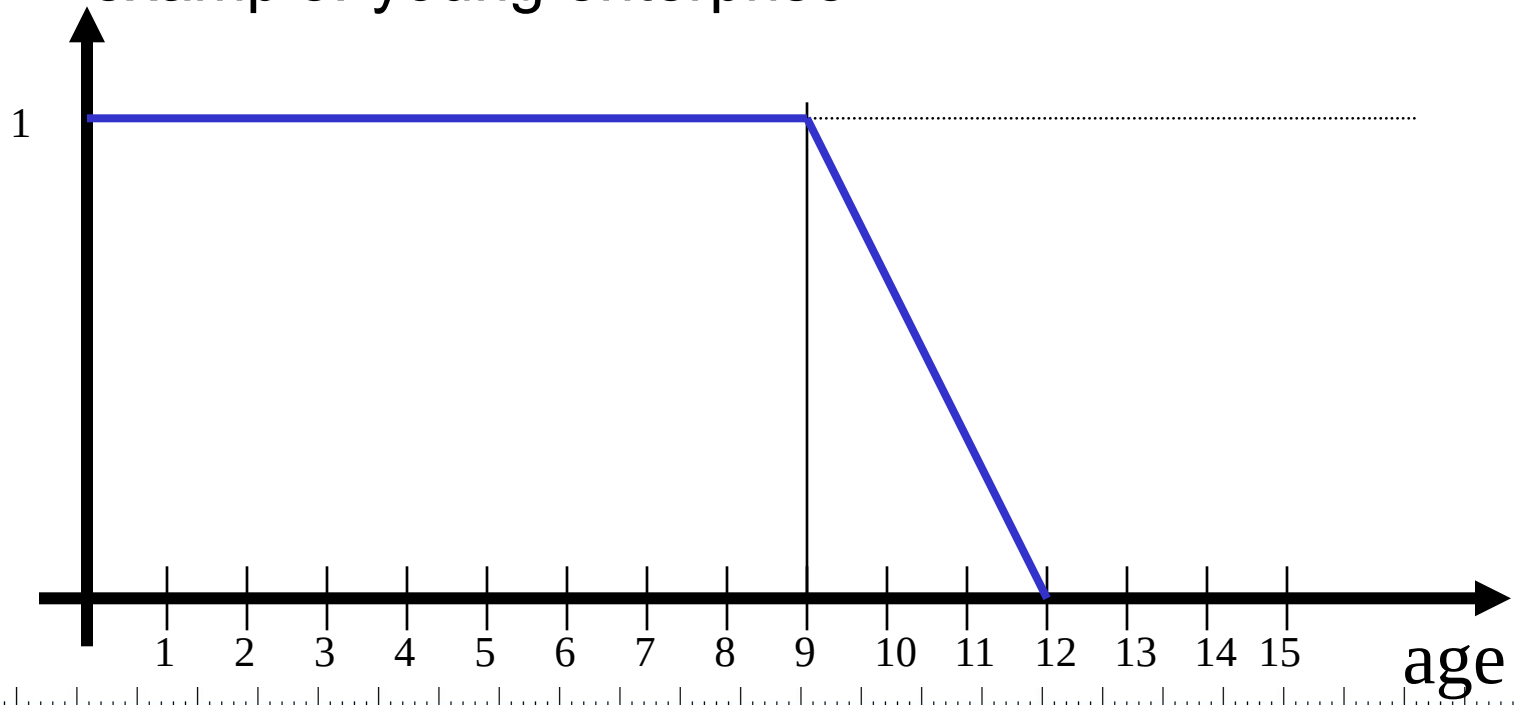
- Fuzzy description of a fact (i.e. young enterprise)
- values of acceptance between 0 and 1
- example:“young enterprise“



Quantitative and qualitative evaluation of creditworthiness

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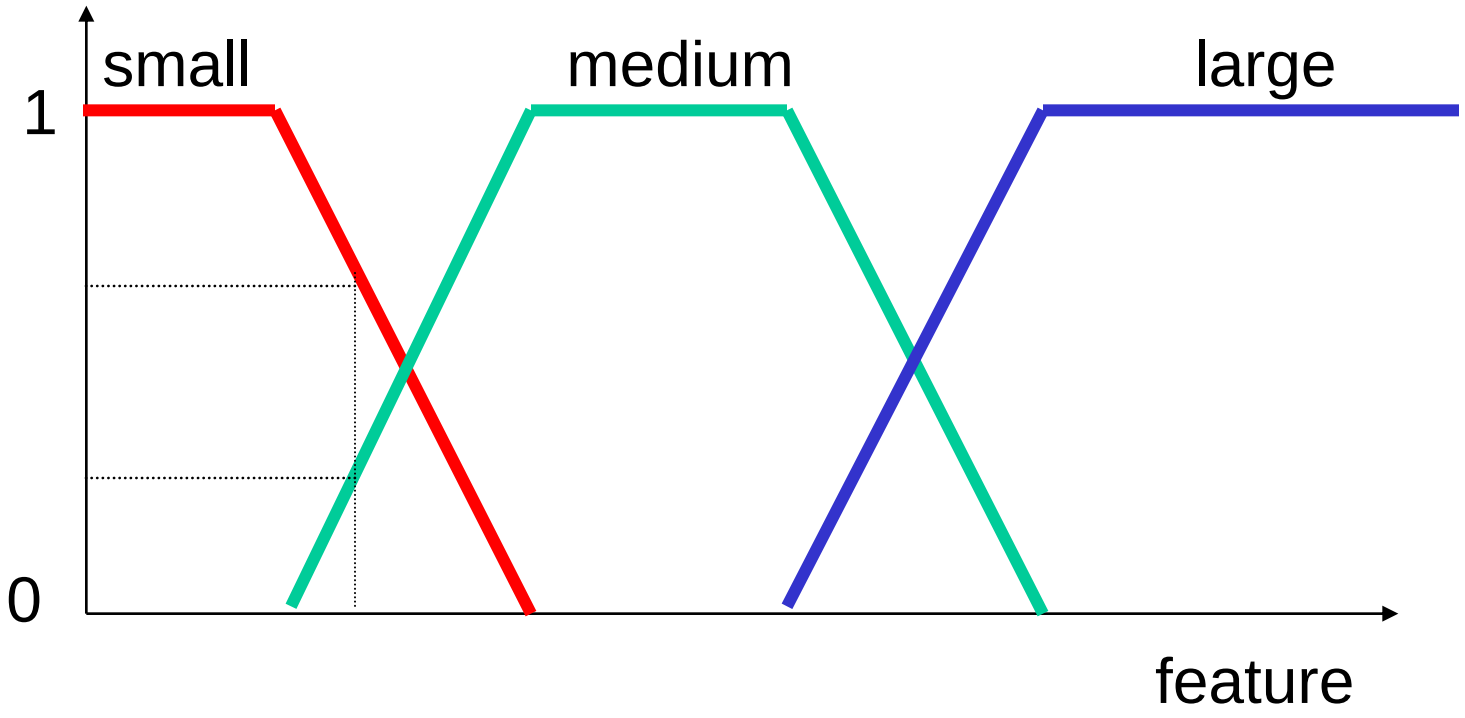
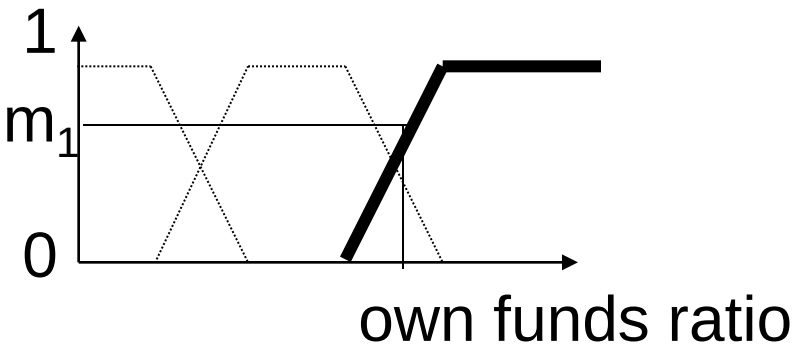
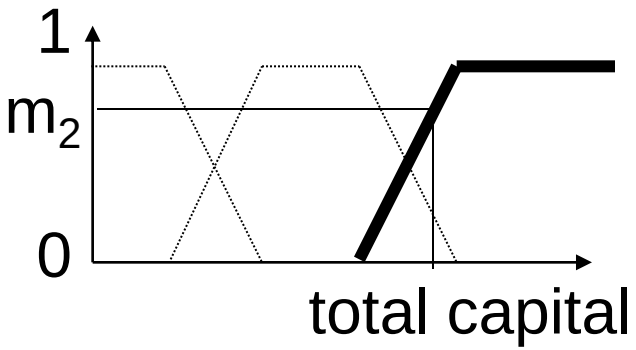
Manifestation



Rules

If own funds ratio is large and total capital strongly increased





then enhance overall ratio.

grade of fulfillment $E = \gamma \cdot m_1 \cdot m_2$

Calculation of γ through non-linear optimising

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Results

- **Possibility to discriminate with a success rate of more than 99% (i.e. default rate about 0,2%)**
- **Number of enterprises assessed: maximum 80.000; although no limit defined by system**
- **Number of staff involved:**
  - 4 staff members for scientific research
  - 250 members for datatyping and surveillance

Appendix

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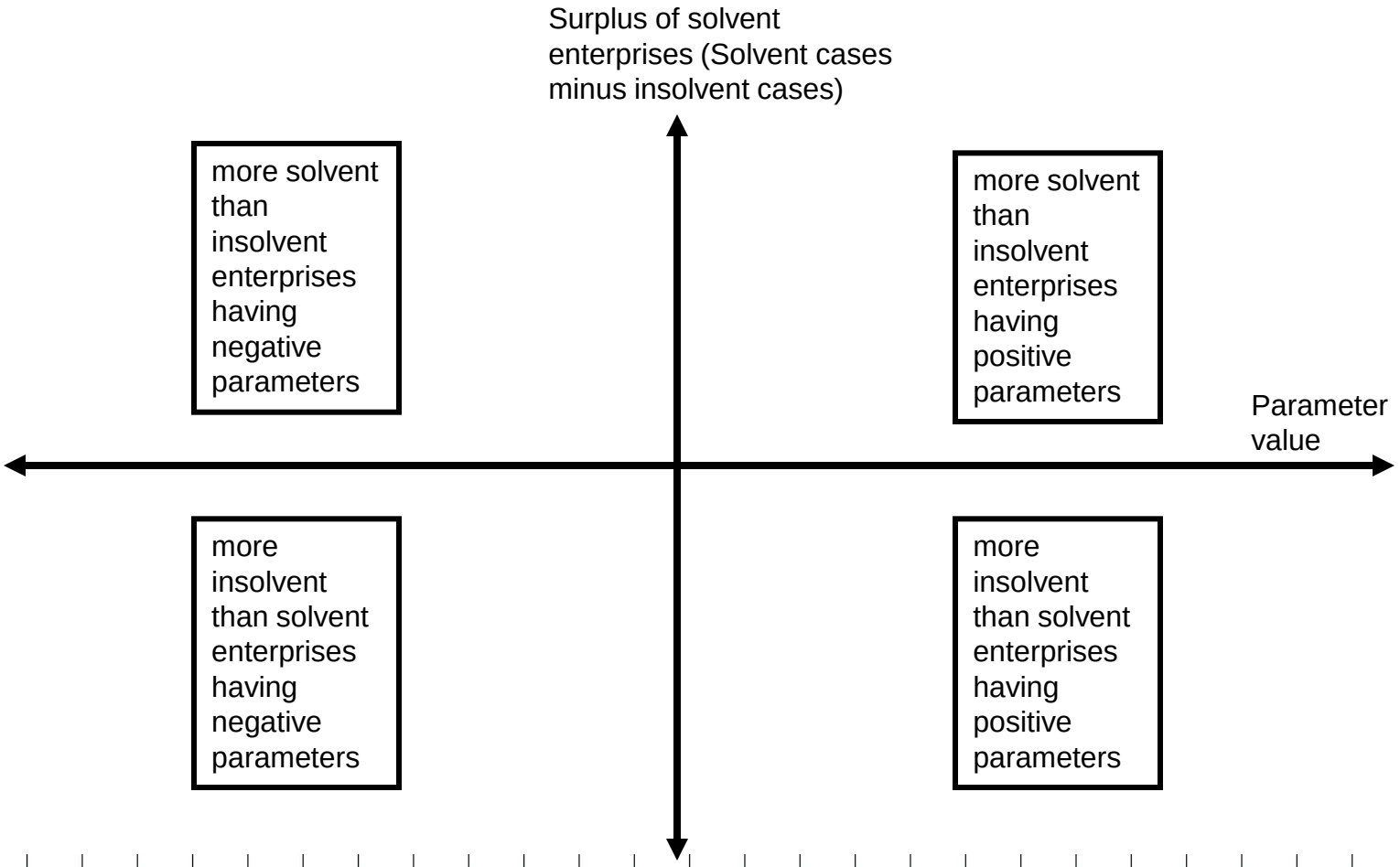
Financial Ratios
as used by Deutsche Bundesbank

Additional Information

Construction of Ratio overview



Cash-flow ratio

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$$\frac{\text{Profit + deprication +/- Provisions}}{\text{Turnover}}$$

=

$$\frac{\text{actual inflow of liquidity}}{\text{Turnover}}$$

evaluation of the acutal inflow of financial means

High figures indicate solvency, low figures indicate insolvency

Cash-flow ratio
(Frequency Distribution)

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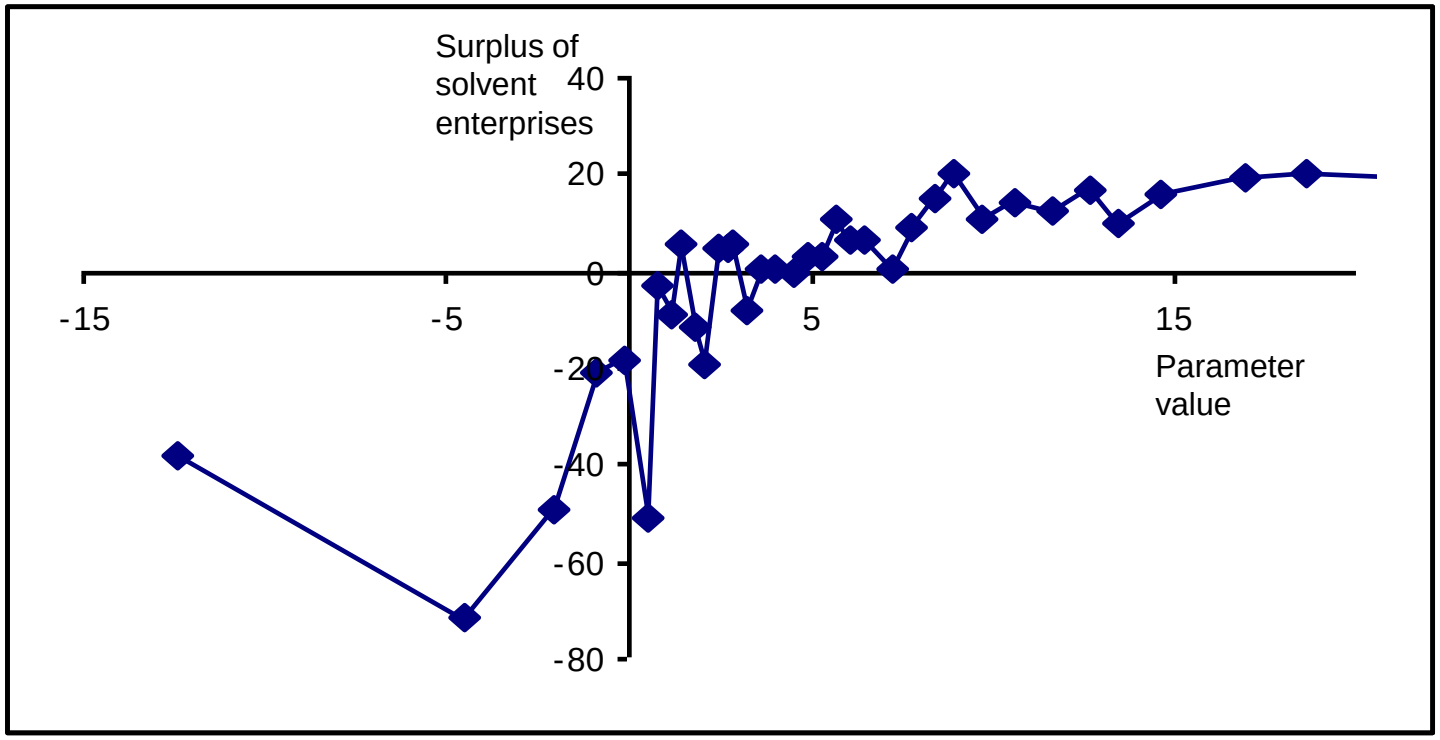

Gross-Equity ratio

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actually existing equity plus liablilities to shareholders
balance sheet total

=

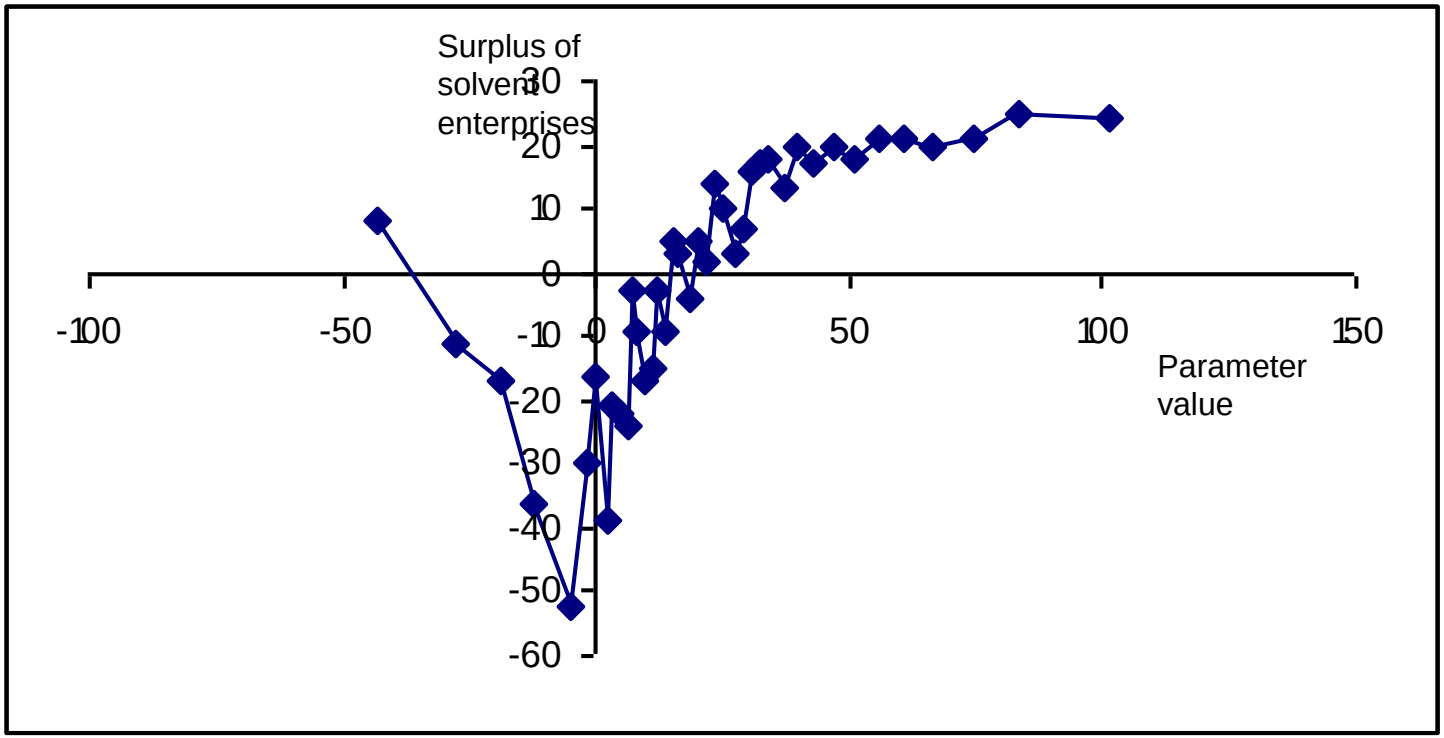
Actually exixsting and enlarged equity in relation to total capital of the enterprise

=

broad liablity concept

High figures indicate solvency, low figures indicate insolvency

Gross Equity ratio
(Frequency Distribution)



Days of accounts receivable

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$$\frac{\text{accounts receivable from sales and services}}{\text{turnover}} \times 360 = \text{average payment term} = \text{dependency from market}$$

high figures indicate isovlvency, low figures indicate solvency

Days of accounts receivable

(Frequency Distribution)

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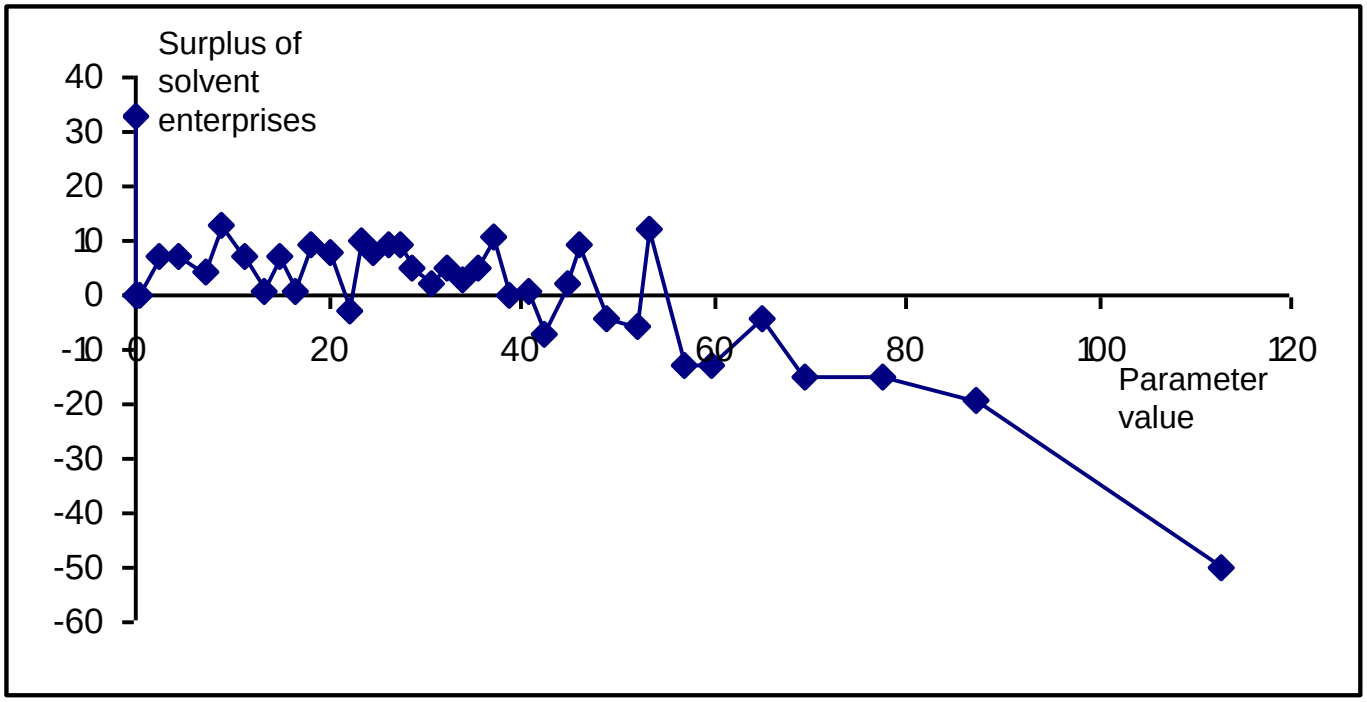

Storage duration

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$$\frac{\text{Inventories}}{\text{total operating performance}} \times 360$$

=

average duration of storage, average time in which inventories are used

=

ability of the enterprise to react on market changes

High figures indicate insolvency, low figures indicate solvency

Storage duration
(Frequency Distribution)

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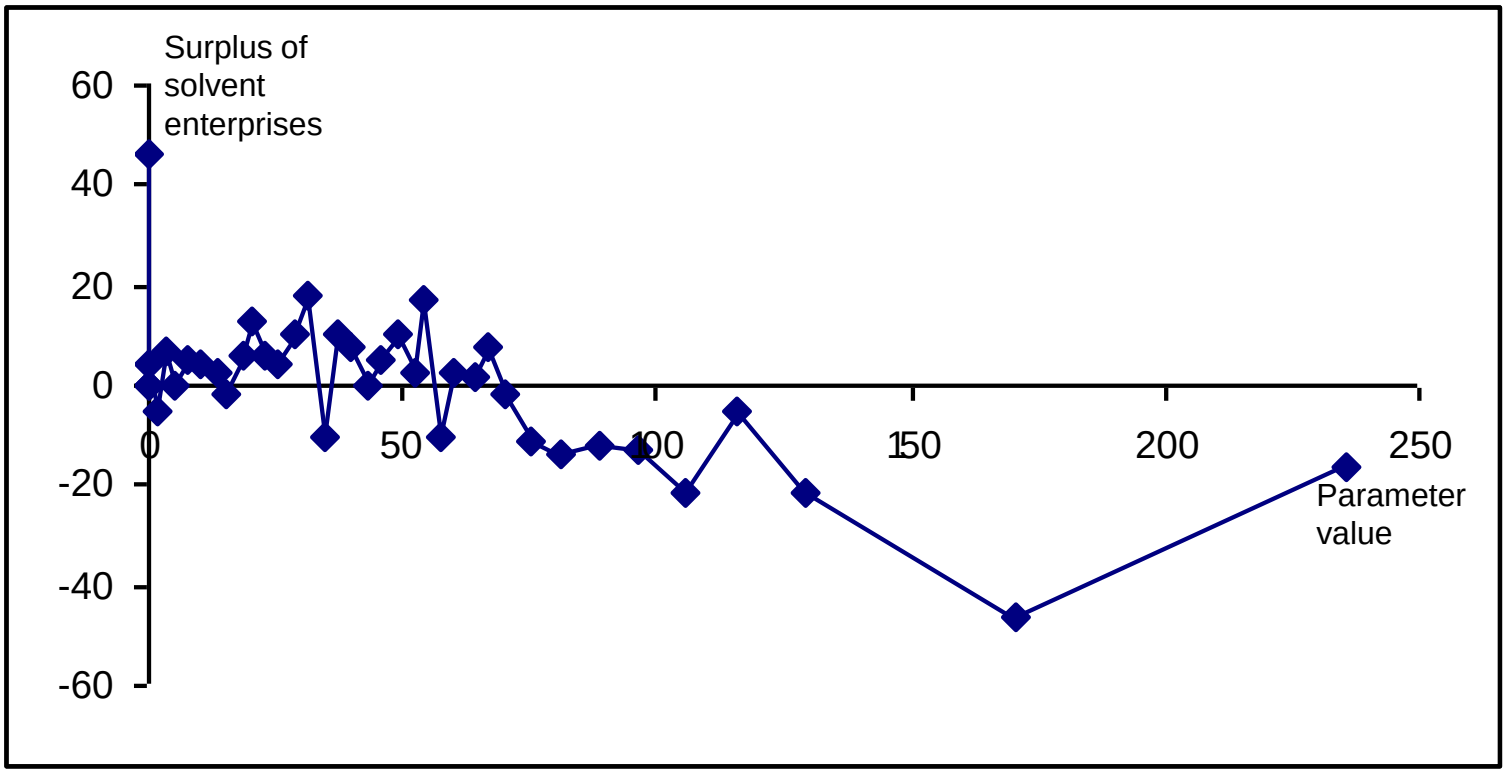

Days of accounts payable

$$\frac{\text{Liabilities relevant to turnover}}{\text{Turnover}} \times 360 =$$

average time until the capital that is used for generating turnover is paid back by turnover

High figures indicate insolvency, low figures indicate solvency

Days of accounts payable
(Frequency Distribution)

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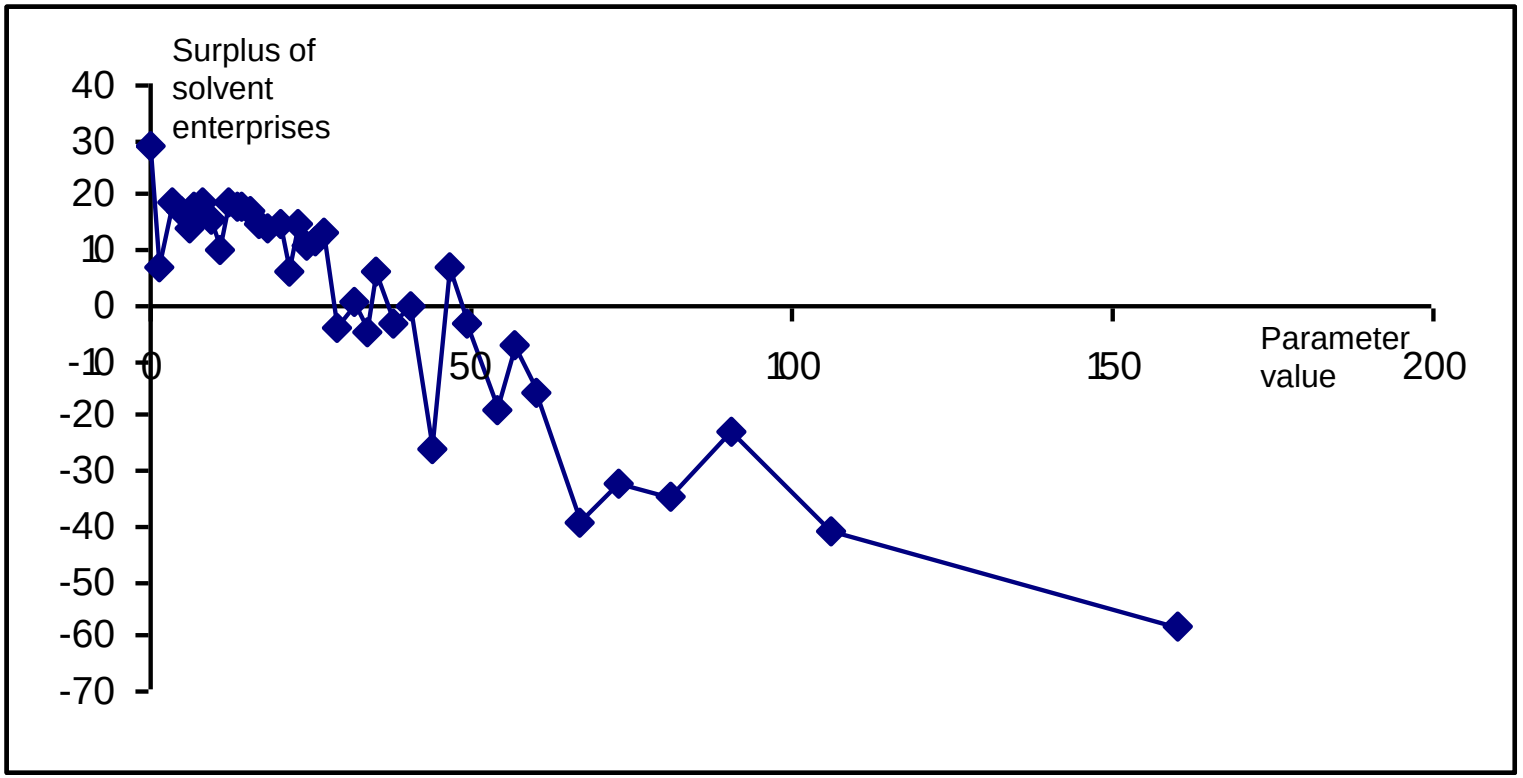

Liability Capital structure

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$$\frac{\text{Liabilities to banks + liabilities from prom.notes + accounts payable}}{\text{total liabilities}}$$

=

$$\frac{\underline{\text{Liabilities arousing from turnover}}}{\text{total liabilities}}$$

=

share of liablities that is used for turnover

High figures indicate insolvency, low figures indicate solvency

Liability Capital structure
(Frequency Distribution)

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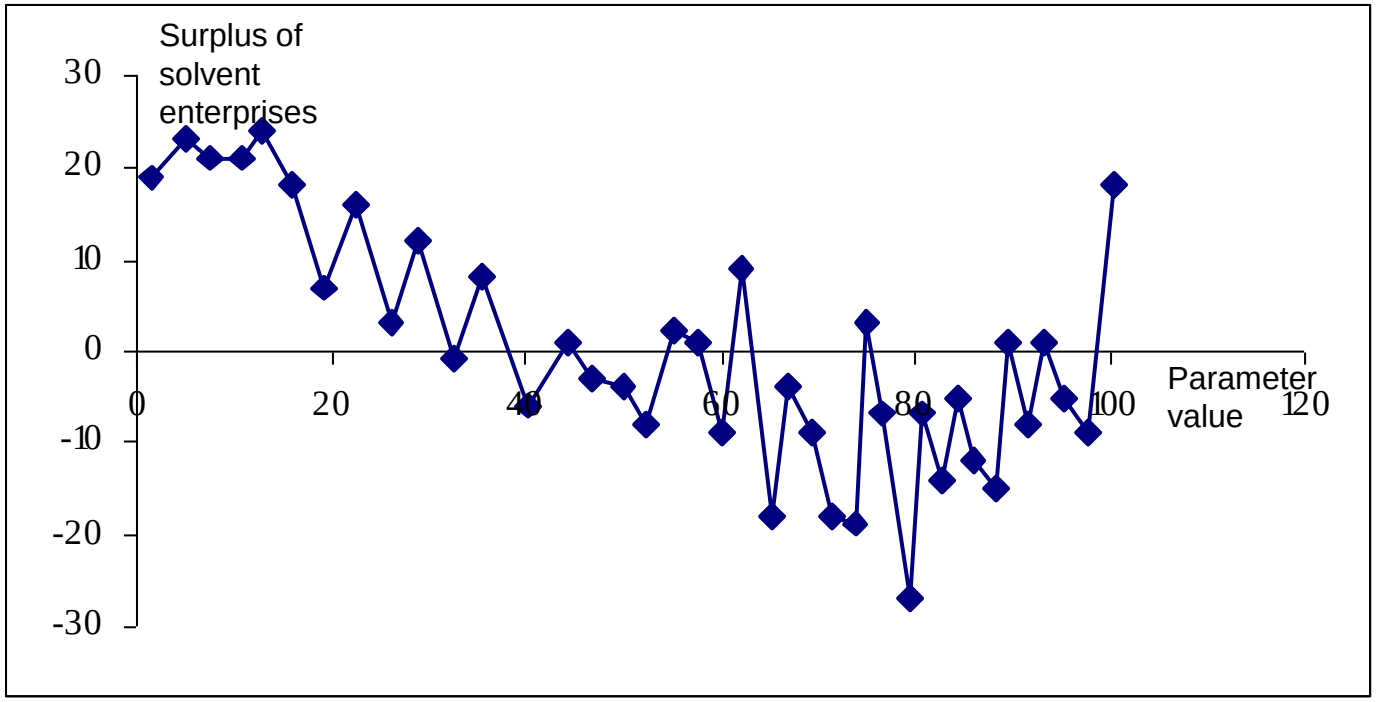

Liquidity ratio

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$$\frac{\text{Current assets}}{\text{Current liabilities}} =$$

ability to pay back short term liablities within a time of three month

High figures indicate solvency, low figures indicate insolvency

Liquidity ratio
(Frequency Distribution)

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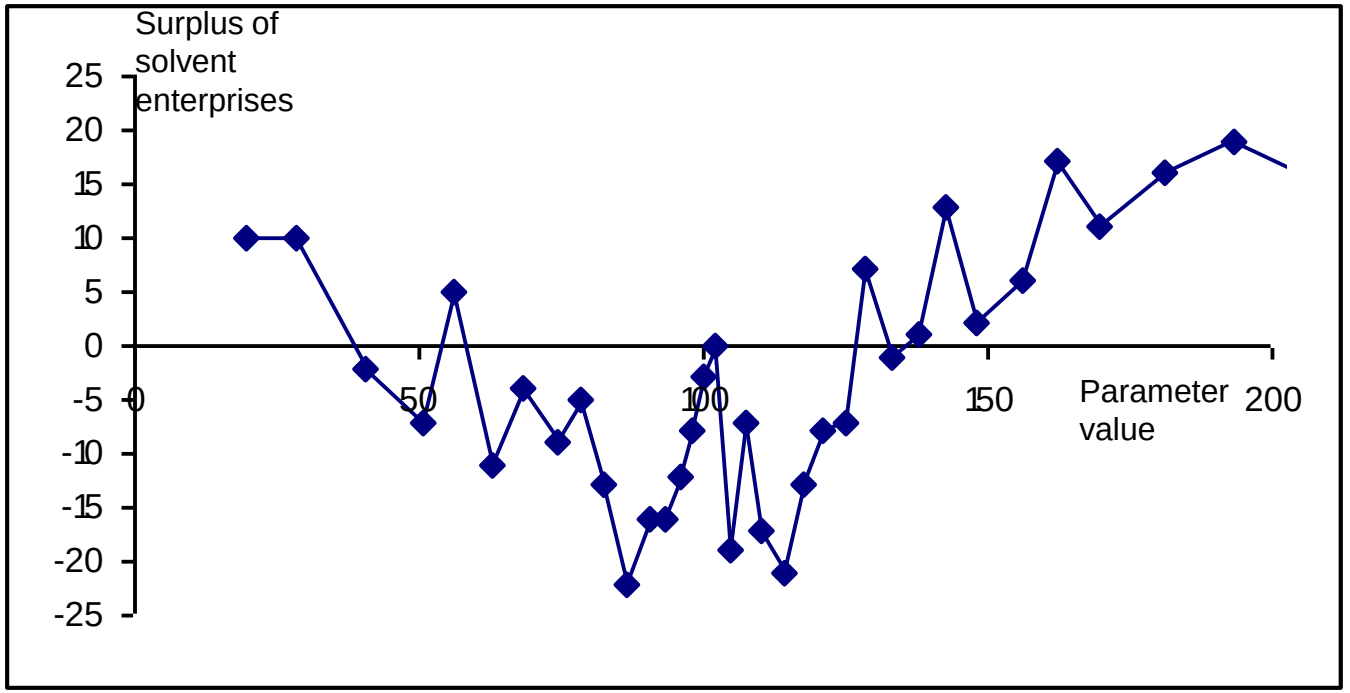

Capital recovery ratio

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$$\frac{\text{Liquidty + finished goods}}{\text{balance sheet total - liquidity}}$$

=

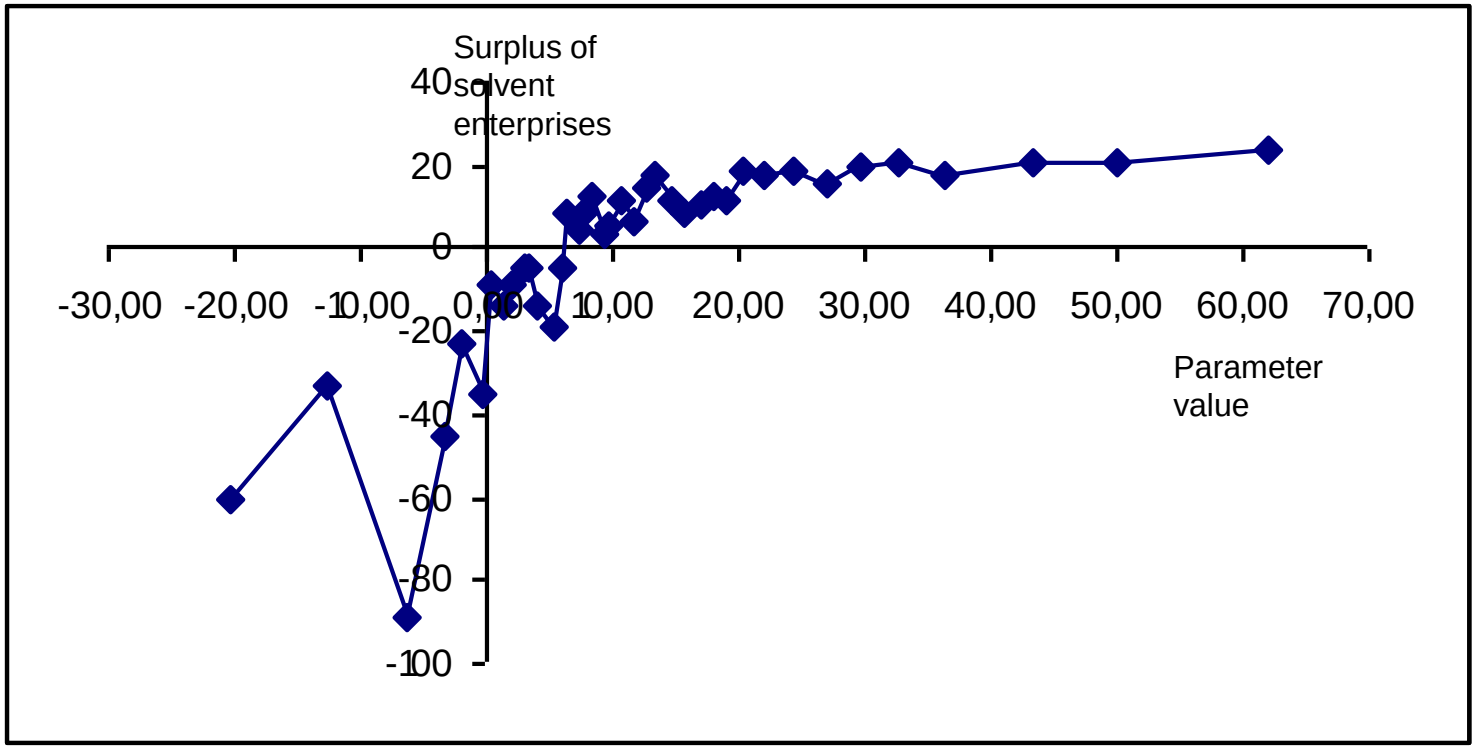
Liquid means in a very groad sense in relation to long term assets

=

share of the capital that has been made available through ordinary business

high figures indicate solvency, low figures indicate insolvency

Capital recovery ratio
(Frequency Distribution)



Debt repayment capability
(Frequency Distribution)

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$$\frac{\text{Liquidty inflow + finished goods}}{\text{balance sheet total - liquidity}}$$

=

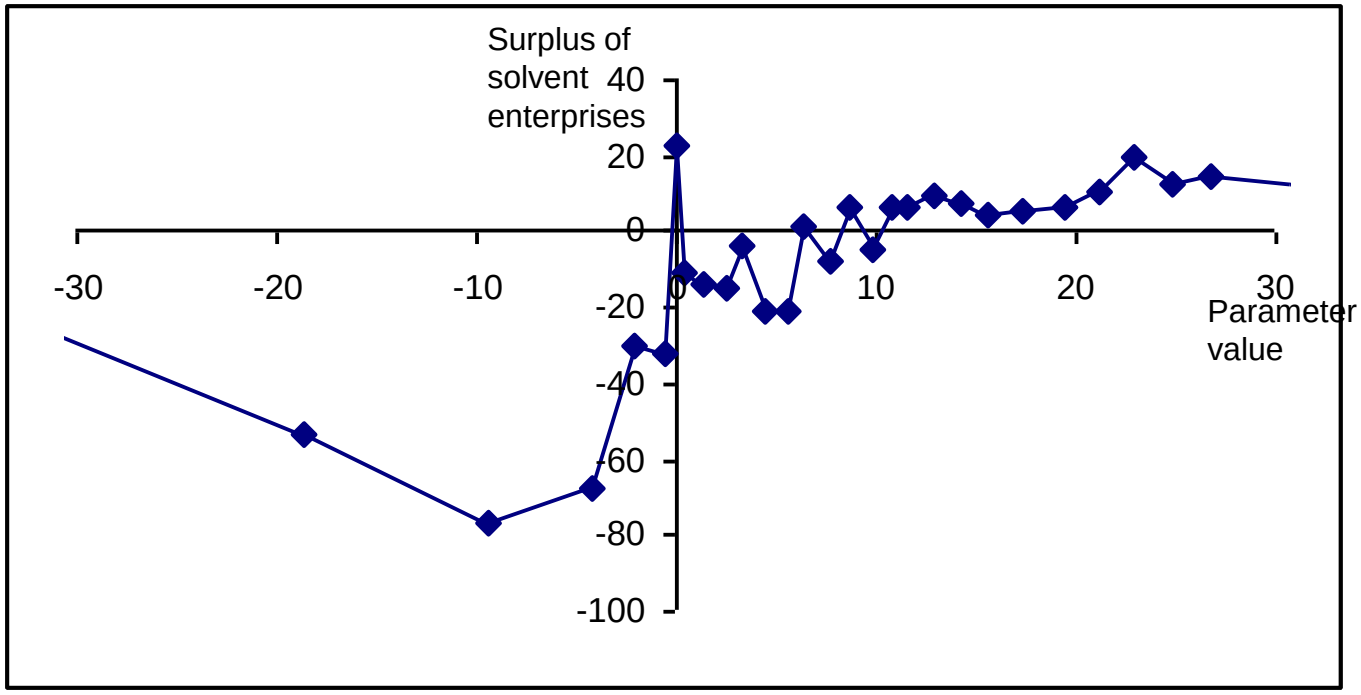
internal finance power in relation to net liabilities

=

ability to pay back debts out of the ordinary business process

high figures indicate solvency, low figures indicate insolvency

Debt repayment capability
(Frequency Distribution)



Net income ratio

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$$\frac{\text{Liquidty + finished goods}}{\text{Turnover}}$$

=

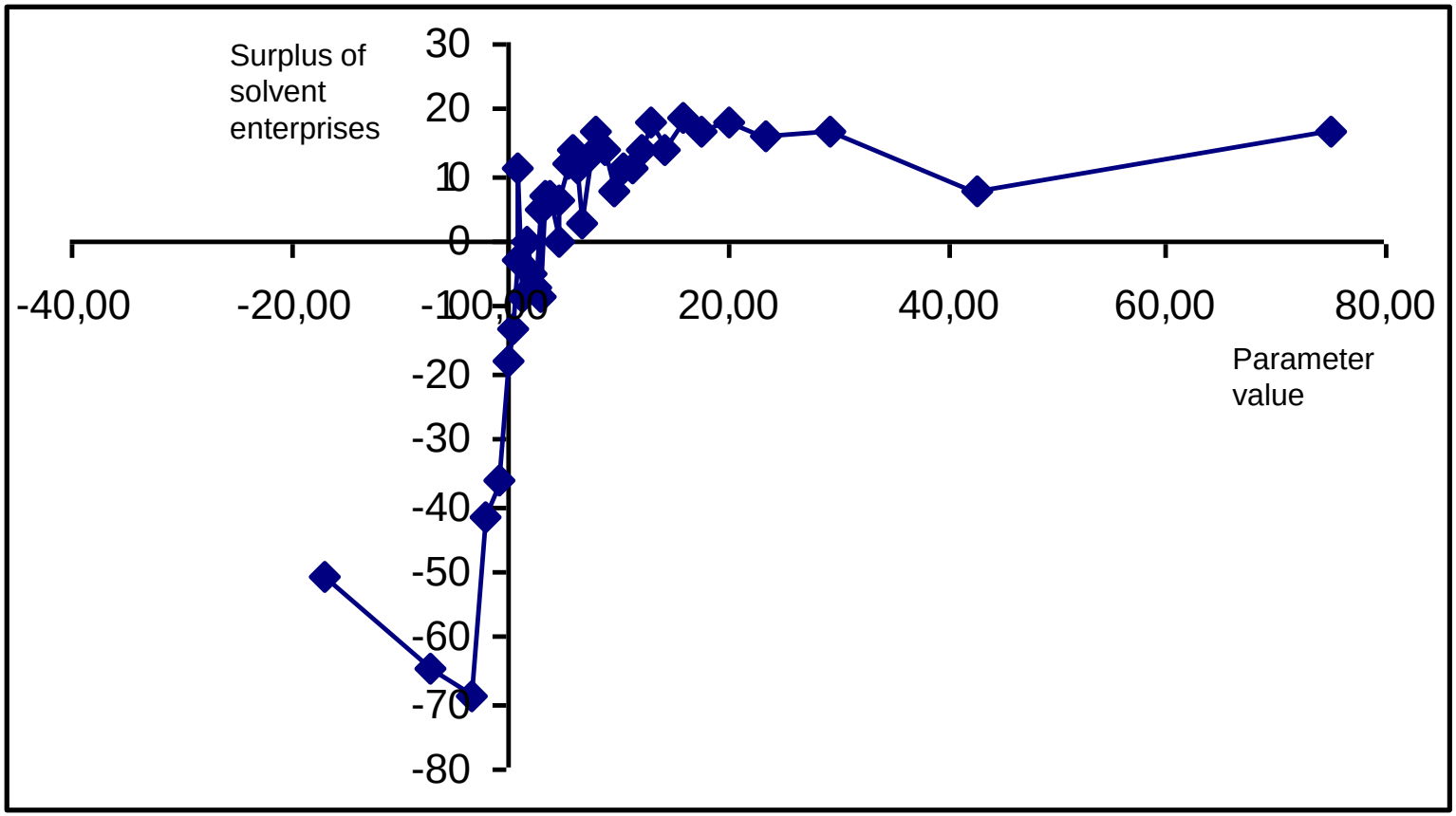
internal finance power in relation to turnover

=

indicates the share of turnover that remains in the enterprise

high figures indicate solvency, low figures indicate insolvency

Net income ratio
(Frequency Distribution)



Return on capital

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$$\frac{\text{Results before interests and taxes}}{\text{total capital}}$$

=

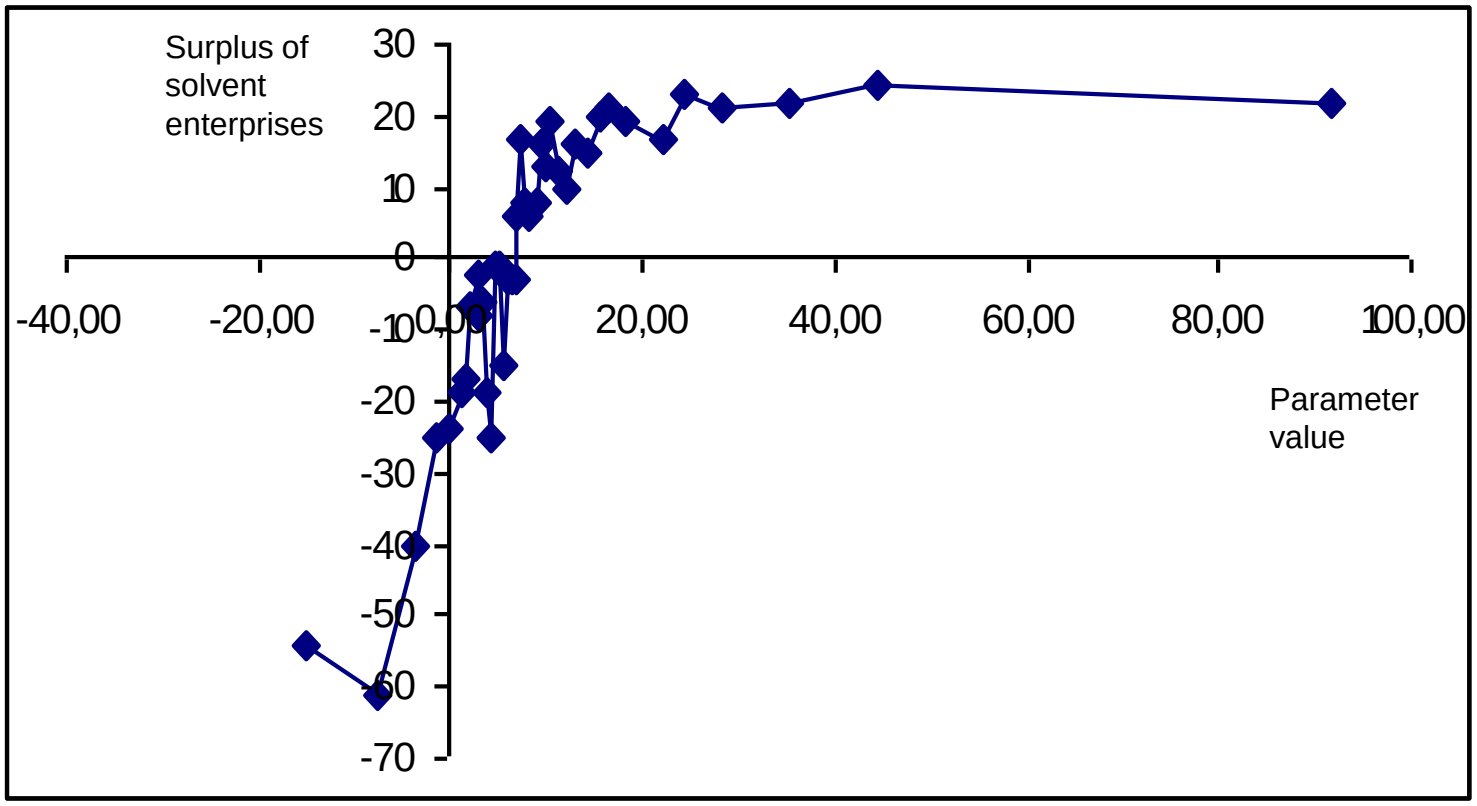
relation to the companies overall results in relation to the total capital

=

interests of the used capital, to be compared with the market interest

high figures indicate solvency, low figures indicate insolvency

Return on capital
(Frequency Distribution)



Own funds ratio

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$$\frac{\text{equity capital}}{\text{balance sheet total}}$$

=

actual equity capital in relation to the total capital

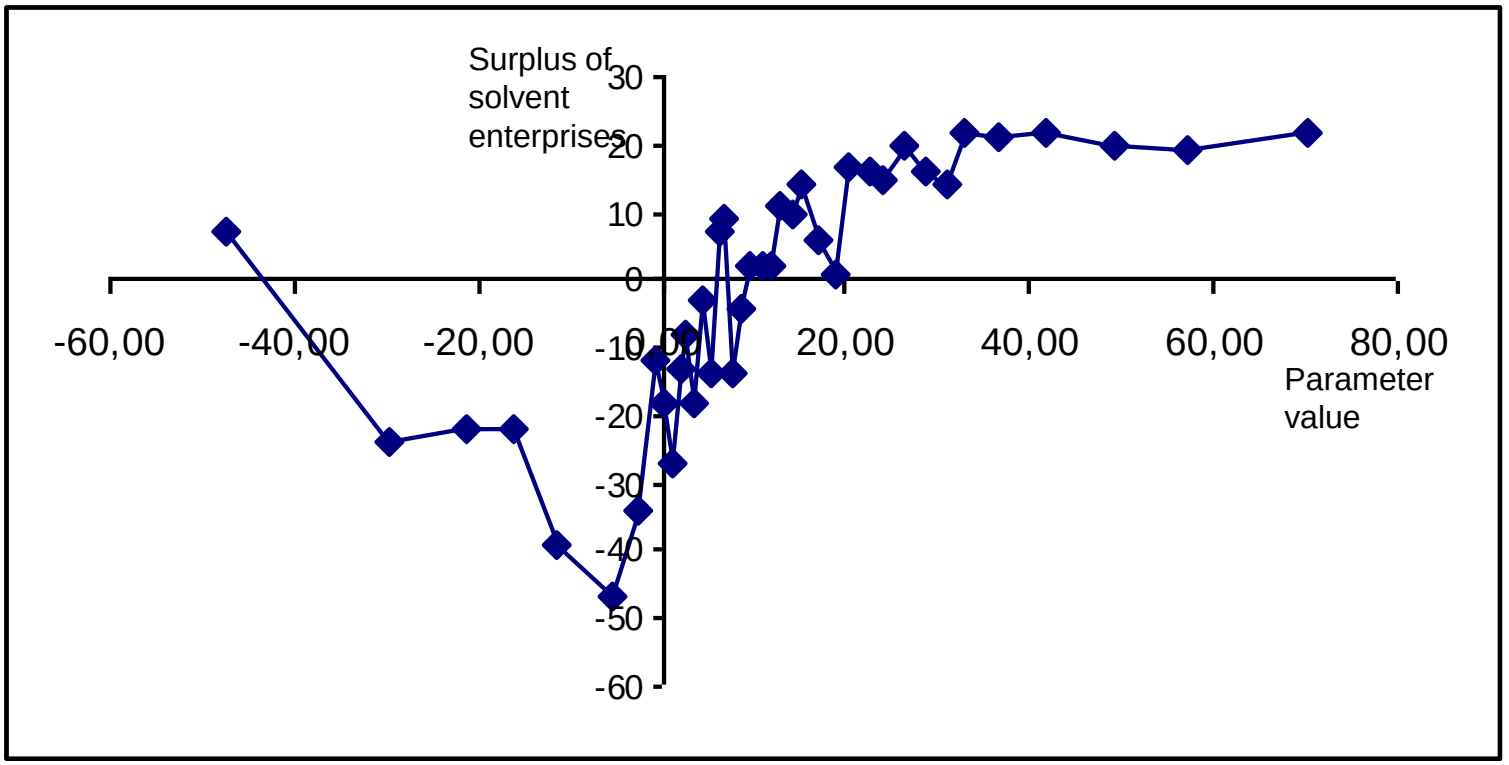
=

Indication of confidence of the company owner in the value of the company, Indicator for succes in previous periods, Basis for credit decision of banks

high figures indicate solvency, low figures indicate insolvency

Own funds ratio
(Frequency Distribution)

DEUTSCHE BUNDESBANK



Own funds / provision ratio

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$$\frac{\text{Equity capital + Provisions}}{\text{total balance sheet}}$$

=

Implications like own funds ratio with a broader basis of liability for the donor of credit

high figures indicate solvency, low figures indicate

Own funds / provision ratio

(Frequency Distribution)

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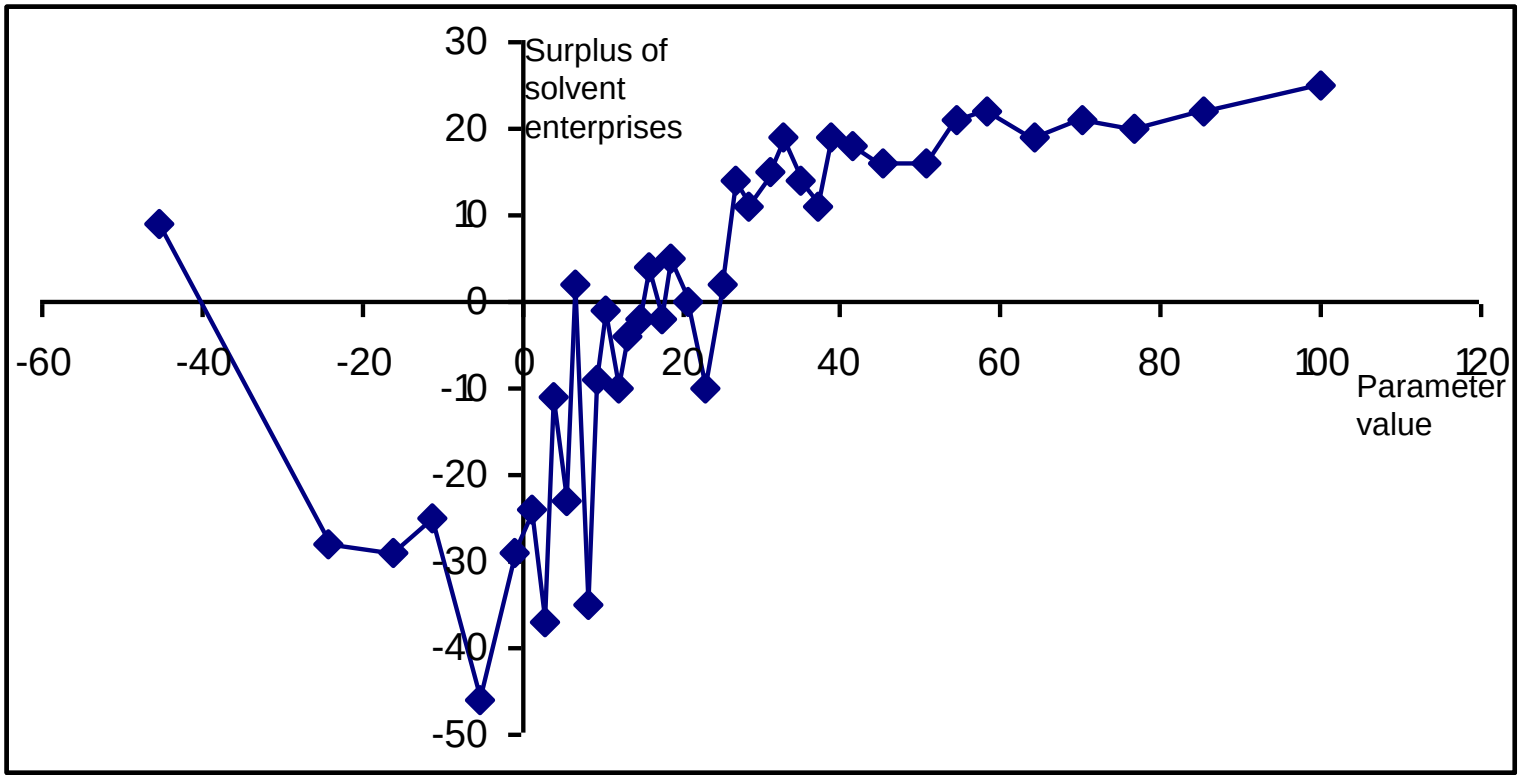

Own funds / Pension Provision ratio

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$$\frac{\text{own funds + pensiion provisions}}{\text{total balance sheet}}$$

=

Implications like own funds ratio with a broader basis of liability for the donor of credit

high figures indicate solvency, low figures indicate insolvency

Own funds / Pension Provision ratio
(Frequency Distribution)

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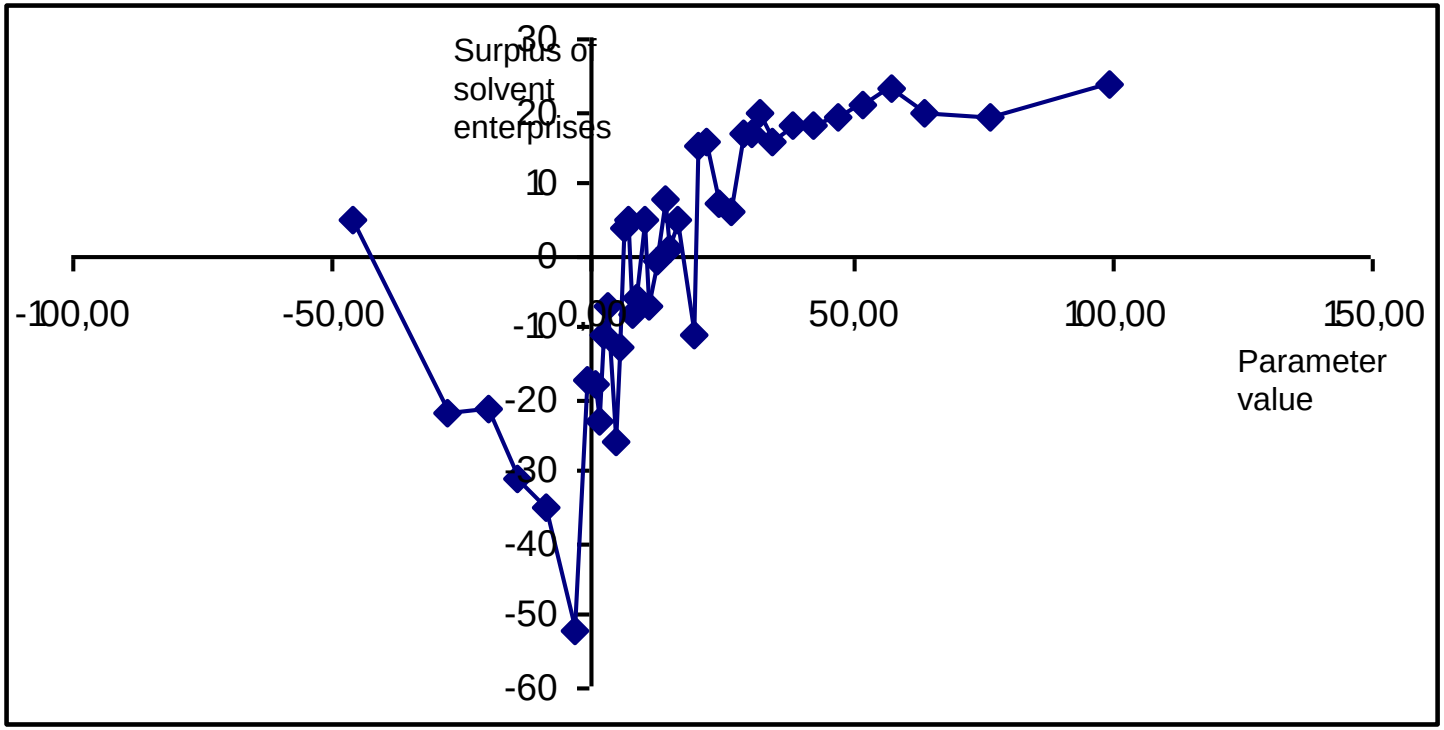

Profit / Turnover ratio

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<u>Results before taxes</u>
total operating performance

=

Gross margin of the company

high figures indicate solvency, low figures indicate insolvency

Profit / Turnover ratio

(Frequency Distribution)

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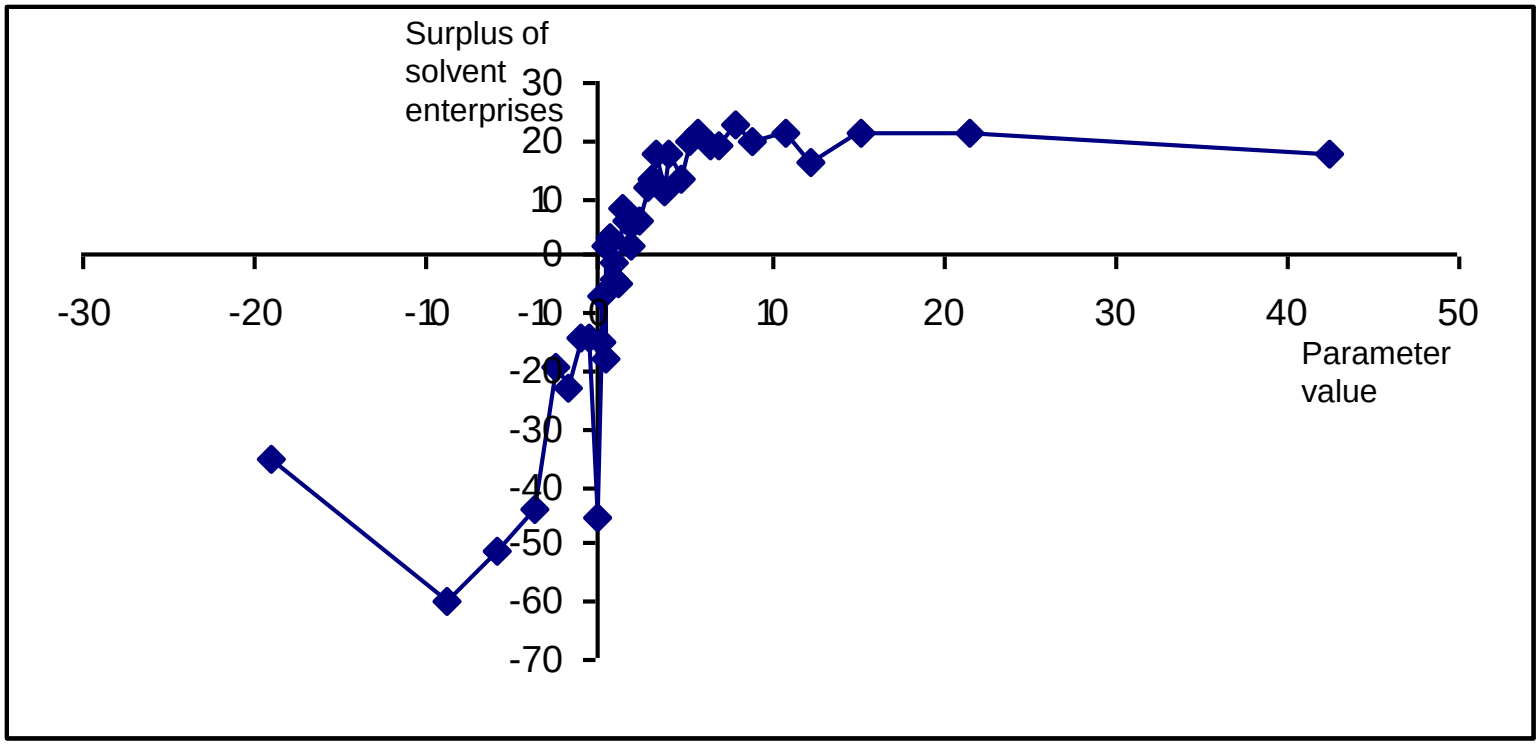

Operating return

operating result
total operating perfomance

=

Result of the production process in relation to the overa performance of the enterprise

=

Evaluation of the economic activity of the enterprise while eliminating special factors that do not occur in the ordinary business process

high figures indicate solvency, low figures indicate insolvency

Operating return
(Frequency Distribution)

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