INTERNATIONAL COUNCIL FOR
THE EXPLORATION OF THE SEA

C.M. 1988/B:16
Fish Capture Committee

A NOTE ON THE INVESTMENT APPRAISAL OF NEW FISHING TECHNIQUES

by

B. van Marlen
Netherlands Institute for Fishery Investigations
P.O. Box 68, 1970 AB IJmuiden
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Abstract
Formulae are given to relate future and present cash-flows and to convert these in accepted measures of merit. Depending the amount of certainty concerning future revenues and their expected variability, several economic criteria are derived and objectives concerning these criteria are given. A numerical example of weighing the investment in electrofishing equipment is given and discussed, with a sensibility analysis of the most important variables involved.

1. Introduction.

Economics play a major tole in the design and operation of complex technical systems such as fishing boats.
The central question is: "What will be the return on my investment?"
In fisheries applications the return will depend on the catch rates. Apart form the initial investment in a fishing boat, various operating costs and fixed costs will play a role in the cash-flow balance.
The income will not only be a function of the quantity of fish caught per unit of time, but also on the species involved, the market situation and the quality of the landed product.
Whether a person decides to invest in fisheries also depends on social and psychological factors and on the profitability of other possible investment strategies.
Fundamental to any economic appraisal is the concept of the time value of money, stating that sums of money in the present are valued differently from equal sums in the future. One cannot simply add or substract cash-flows, that occur at different times. The method used is to discount these cash flows to a specified point in time-space, for instance the present.

Of course a proper investment decision is vital for any entrepreneur, fishing skipper or banker, but for scientists wishing to decide which methods earn further experimental effort the problem of fishing economics is of equal importance.

Fishing is an activity, that encorporates a high level of uncertainty. Catch rates vary from time to time, so do market conditions. Fuel costs may alter dramatically as has been the case in 1973, 1979 and 1985.
Uncertainly can be dealt within two distinct ways:
1. By variation of the parameters involved in a deterministic model;
2. By introducing stochastic techniques and perform simulations.

Method 1 is called "sensibility analysis".
The effect of a chosen change in parameter values on a measure of merit can be calculated deterministically. From this exercise one learns to identify the most important variables.

Method 2 is nothing more than throwing a dice and watch the outcome. It requires statistical techniques and decisions concerning acceptable confidence levels.
For complex systems the technique of digital simulation seems the appropriate way. Values of variables are drawn from frequency distributions and preferably the answer should converge with an increasing number of simulation runs.

This paper will not deal with the second approach, but focusses on the deterministic method.

It should be borne in mind, that fisheries economics is basically classified among the economics of natural renewable resources, the productivity of which is subject to limitations. This is a fundamental insight not shared by all people involved in fisheries. Scientists working in stock accessment often have different ideas of acceptable levels of fishing effort than fishing skippers or fisheries management organisations.

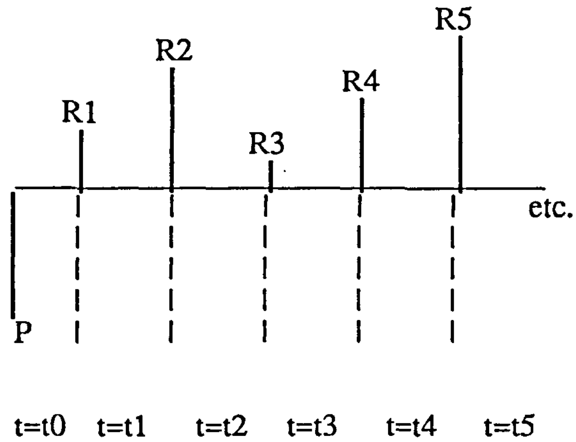
The optimum economical solution of a small scale system like an individual firm or fishing vessel may very well be extremely different from an optimum solution for an entire fleet of fishing boats.
Fleet structure models only now begin to emerge and their practical value for fisheries management purposes needs still to be proven.
The problem is of such complexity, that a system dynamics approach seems the future approach of tackling it, if ever.

This paper will not deal with these topics, but alternatively focusses on the small scale system of appraisal of investment for a particular boat, and her fishing gear.

2. Current economic criteria

The general picture of an investment at some discrete point in time and revenues at other times is given in figure **1**:

figure 1



P = initial investment
Rj = return at time j.

In most calculations revenues are regarded to occur annually at the end of the year, although cash flows in and out continuously.
This assumption simplifies our calculations to a great extend.
Money coming in is regarded as a positive cash flow and money paid out as a negative one (sign convention).

Further important aspects are the <u>time horizon</u> chosen in the calculations and the chosen <u>interest rate</u> or time value of money.
The time horizon is mostly chosen equal to the expected life span of the vessel or equipment concerned, the time value of money depends on the general situation on the capital market (such as bank interest rates for loans) and the risk involved in the enterprise. Higher values are chosen for riskier activities, among which activities at sea. Suggestions for fishing boats vary from 10% up to 20% (4).

Three basic models of simple cashflows are depicted in figure **2** with their discount formulae.
The mathematics are simple, the "SCAF" (<u>s</u>ingle <u>c</u>ompound <u>a</u>mount <u>f</u>actor) for instance is directly convertable to a power of e (1,2,3,4,5,9).

$$\frac{1}{(1+i)^t} = e^{-t} \quad ; \quad = \ln(1+i)$$

Higher interest rates diminish the value of future cash flows quicker with an increasing number of years.
A high level of interest rates invokes the tendency to demand a quick return on capital investments, which contradicts fish stock conservation policies. Fisheries economists

sometimes interpret the difference in views among biologists and fishermen as a discrepancy in their chosen time value of money.

Although most real world situations are more complex than described with these three simple cash-flow models, many problems can be tackled with either one of these three or a combination. For design decisions absolute values do not get a high priority, it is more important to determine the relative differences of various alternatives.

Profits of corporations are generally submitted to taxes. Tax laws vary between countries and are time dependent (2).
The after-tax profitability should be our point of concern and therefore it is needed to establish a relationship between before and after-tax conditions.
Tax is taken normally as a percentage of the profit defined as return minus depreciation allocation and interests paid to a bank when loans are involved.
A scheme of the subdivision of the total revenue is given in figure 3.
Depreciation means allocating money for replacement of the equipment after its live span, and various tax laws allow different depreciation scenarios.
A straight line or linear function is often used.

A basic formula for Capital Recovery Functions (CRF) is, for depreciation equals investment P / number of years n.

$$CRF^1 = CRF\,(1 - t) + t/n$$

{ t = tax rate
{ ^{1} means after tax
{ n = number of years

The choise of a suitable economic criterion depends on the following checklist:

1. Are revenues predictable or not?
2. Are revenues fluctuating or uniform?
3. When unknown, are revenues expected to vary between alternatives or are they equal?
4. Do life spans of alternatives differ or are they equal?

Figure 4 gives a scheme to determine the criteria to use depending on the answer to abovementioned questions.
A definition of these criteria is (Defenitions of SPWF, UPWF, R, P are given in figure 2):

1. Net Present Value (NPV)

$$NPV = \sum_{k=1}^{N} (SPWF(k,i) * R(k)) + P$$

or

$$NPV = UPWF(N,i) * R + P$$

(for uniform cash flows)

$$NPVI = NPV/P$$

2. Internal Rate of Return (IRR or EIRR)

IRR = that value of i that makes NPV = 0

3. Capital Recovery Factor (CRF)

CRF = -R/P for uniform cash flows.

4. Pay Out Period (POP)

POP = - P/R = 1/CRF

When N is known CRF can be converted to i, or when i is given N can be determined from:

$$N = \frac{\ln(1 + (P/R) * i)}{\ln(1 + i)}$$

5. Average Annual Costs (AAC)

AAC = Y + CRF(N,i) * P

Y = yearly operating costs.

6. Present Worth of Costs (PW)

$$PW = P + \sum_{k=1}^{N} (SPWF(k,i) * y(k))$$

7. Required Catch Rate (RCR)

Compare with Required Freight Rate (RFR) in merchant shipping

$$RCR = \frac{AAC}{C}$$

C = total catch per year

With these criteria the following policies exist to obtain the optimum solution:

Criterion	**Objective**
NPV	Maximize
IRR	Maximize
CRF	Maximize
POP	Minimize
AAC	Minimize
PW	Minimize
RCR	Minimize

3. Numerical Example: Investment in electrofishing equipment

The initial investment in the fishing boat is unknown. The boat has been fishing for a number of years and revenues are known over the past. The question is whether an additional investment ΔP in electrofishing equipment will pay off in a reasonable time interval. Yearly average fuel costs are assumed to be known.
A reduction in gear drag is to be expected from various experiments done with electrofishing (7).
Measurements on the drag of convertional gears indicate a gross gain of 30% lesser drag. Generating the electric field diminishes this presumably to some 20% (8).
The boats' operational profile is unknown, but it is assumed that fishing takes place for 2/3 of the time. Only when fishing, savings in fuel will occur.

Net fuel savings are therefore:

$$2/3 * 20\% = 13\%$$

This value is taken throughout the calculations.

Some costs are assumed to cancel each other. Tickler chains wear out quickly and need regular replacement, electrodes (+) dissolve dependent on the material used and also need to be replaced regularly. The additional maintenance costs for both systems are assumed to be equal and therefore not of interest in the calculations. Only differences count!

Electric fishing may lead to an increase in catches, although research done so far indicate a shift in the balance of species caught. Usually higher catches are reported for sole (Solea Solea) and lower for plaice (Pleuronectis Platessa).
Catching more fish, although a wish of every fishermen, is not popular with fisheries managers for most species. Therefore a scenario of equal catches has also been worked out.
Replacing tickler chains by parallel electrodes diminishes the catch of benthos and the propagation of sand clouds through the nets. These effects improve the quality of the fish landed on deck.
Electrified fish are less "sandblasted" and less damaged.
This effect is amplified by a lower towing speed, which is mostly the case for electrofishing.
Reduction of damage may result in a bigger chance of survival for discards and higher prices on the market.
For the latter reason the effect of an increase in total earnings of 5% and 10% is also analysed.

Electronic equipment depreciates quickly due to the high rate of change in technology.
A depreciation period (life span) of 5 years is taken therefore.
A choise of interest rate used in many publications is i' = 10% (after tax), which can be converted to i = 18.4% (before tax) with the formula on page 5.

The effect of this particular choice on the outcome can be determined by varying the interest rate used. For i' = 6% (i = 11.2%), the results are slightly different, but not their general tendency.

The fuel oil price is hard to predict and its effect is analysed by variation over a range of values from *f* 0,50 / liter up to *f* 0,90 / liter.

Finally the amount of money to be invested was not known at the start of the development into a commercial product.

A variation over three values shows the impact of this variable.

An average yearly income of ƒ 2.400.000,- is taken, being a representative value for beamtrawlers in the range of 1300 - 1500 hp (for 1985), with a total fuel consumption of 1.200.000,- liters (dm3).

It is common practice to define a "defender" and a "challenger". The defender is the conventional tickler chain fishing gear, the challenger the electrical stimulation system, with three income scenarios (+ 0%; + 5%; + 10%).

The results of the calculations of CRF, IRR, NPV and POP are given in table I a..f for three levels of investment and two different interest rates, and also in Figures 5 to 9.

Very significant is the effect of a slight raise in earnings. Pay Out Periods fall rapidly to acceptable levels under three years when yearly income is increased by several percent. This should encourage fishermen to pay attention to obtain the highest prices, by improving the quality of their landed fish.
Equal income will only lead to acceptable Pay Out Periods at considerably higher fuel prices than today (ƒ 0,90 / liter).

A smaller investment is of course beneficial, although its effect is certainly weaker than a raise in income.
The other criteria show similar results.
Net Present Value (NPV) turns out to incline linearly with increasing fuel prices.
Best values are found for the smallest investment and the highest raise in earnings. With equal earnings as the defender a fuel price level of at least ƒ 0,60 - ƒ 0,80 per liter is needed for the challenger to be superior, of course dependent of the investment sum.
Lower interest rates raise the NPV-curves, without changing their relative position.

The Internal Rate of Return (IRR) increases with increasing fuel prices for all challengers, with higher values for higher levels of income. The curves suggest an optimum at much higher price levels beyond the current range.

The final conclusion is, that investment in an electric fishing system will be profitable when a minor raise in income follows. Such a raise may result from an improve-ment in the quality of the fish or a shift to species of higher commercial value.

When only savings in fuel costs contribute to the profitability, the initial investment should be kept at a minimum. A low time value of money favours the decision to invest, so are high fuel prices.
Government subsidies may lower the threshold for investment as they decrease the investment sum.

Reasons for governmental support may be a better fish quality, increased selection properties, fewer damage to benthos and improved working conditions. Some of these arguments are backed up by current experiments, but in other cases hard evidence still needs to be found.

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Legend to Dutch text in tables and figures

Dutch	English equivalent
gasolieprijs	fuel oil price
bedragen	sums of money, amounts
wekkers	tickler chains
alternatieven elektrisch	options electrified trawls
bruto jaarbesomming	gross yearly earnings
extra besomming	additional earnings
totaal gasolie verbruik	total fuel consumption
totale gasoliekosten	total fuel costs
besparing op gasoliekosten	fuel cost savings
resulterende extra inkomsten	resulting extra income
investering	investment, principal
terugverdientijd	pay-out period
rentevoet	interest rate
voorlopige cijfers	preliminary data
alleen boomkor	beamtrawl fishery only
netto konstante waarde	net present value
interne rentevoet	internal rate of return

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Tabel Ia ECONOMISCHE EVALUATIE

gasolieprijs 40 cent/liter N= 5 jaar

Bedragen * ƒ 1000,—	wekkers A	B+0%	alternatieven elektrisch C+5%	D+10%
bruto jaarbesomming	2400	2400	2520	2640
extra besomming	0	0	120	240
totaal gasolie verbruik (liters)	1.200.000	1.044.000	1.044.000	1.044.000
totale gasoliekosten	480	418	418	418
besparing op gas-oliekosten (-13%)	0	62	62	62
resulterende extra inkomsten R	0	62	182	302
Investering P_1	0	300	300	300
CRF 1	-	0.2067	0.6067	1.0067
IRR 1	-	1.10	53.56	97.30
POP 1 (18,4%)	-	13.09	2.14	1.20
NPV 1	-	108	264	636
POP 1 (11,2%)	-	7.35	1.92	1.11
NPV 1	-	-72	369	811
Investering P2	0	350	350	350
CRF 2	-	0.1771	0.5200	0.8629
IRR 2	-	-	43.43	81.96
POP 2 (18,4%)	-		2.59	1.42
NPV 2	-	158	214	586
POP 2 (11,2%)	-	9.42	2.28	1.31
NPV 2	-	122	319	761
Investering P3	0	400	400	400
CRF 3	-	0.1550	0.4550	0.7550
IRR 3	-	-	35.56	70.22
POP 3 (18,4%)	-		3.07	1.65
NPV 3	-	-208	164	536
POP 3 (11,2%)	-	12.08	2.66	1.51
NPV 3	-	-172	269	711

TABEL Ib ECONOMISCHE EVALUATIE:

gasolieprijs 50 cent/liter N= 5 jaar

bedragen * ƒ1000,--	wekkers A	B(+0%)	alternatieven elektrisch C (+5%)	D (+10%)
bruto jaarbesomming	2400	2400	2520	2640
extra besomming	0	0	120	240
totaal gasolie verbruik (liters)	1.200.000	1.044.000	1.044.000	1.044.000
totale gasoliekosten	600	522	522	522
besparing gasolie-kosten (-13%)	0	78	78	78
resulterende extra inkomsten R	0	78	198	318
Investering P_1	0	300	300	300
CRF1	-	0.2600	0.6600	1.0600
IRR1	-	9.43	59.63	102.92
POP1 (18,4%)	-	7.28	1.94	1.13
NPV1	-	-58	314	685
POP1 (11,2%)	-	5.31	1.75	1.05
NPV1	-	-13	428	869
Investering P2	0	350	350	350
CRF2	-	0.2229	0.5657	0.9086
IRR2	-	3.72	48.82	86.87
POP2 (18,4%)	-	10.34	2.33	1.34
NPV2	-	-108	264	635
POP2 (11,2%)	-	6.58	2.08	1.24
NPV2	-	-63	378	819
Investering P3	0	400	400	400
CRF3	-	0.1950	0.4950	0.7950
IRR3	-	-	40.44	74.60
POP3 (18,4%)	-	17.02	2.75	1.56
NPV3	-	-158	214	585
POP3 (11,2%)	-	8.05	2.42	1.43
NPV3	-	-113	328	769

TABEL Ic ECONOMISCHE EVALUATIE

gasolieprijs 60 cent/liter N=5 jaar.

bedragen * ƒ1000,--	wekkers A	B(+0%)	alternatieven elektrisch C(+5%)	D(10%)
bruto jaarbesomming	2400	2400	2520	2640
extra besomming	0	0	120	240
totaal gasolie verbruik (liters)	1.200.000	1.044.000	1.044.000	1.044.000
totale gasoliekosten	720	626	626	626
besparing op gasolie-kosten (-13%)	0	94	94	94
resulterende extra inkomsten R	0	94	214	334
Investering P_1	0	300	300	300
CRF1	-	0.3133	0.7133	1.1133
IRR1	-	17.11	65.61	108.51
POP1 (18,4%)	-	5.24	1.77	1.07
NPV1	-	-9.	363	735
POP1 (11,2%)	-	4.17	1.61	1.00
NPV1	-	46	487	928
Investering P2	0	350	350	350
CRF2	-	0.2686	0.6114	0.9543
IRR2	-	10.71	54.11	91.75
POP2 (18,4%)	-	6.84	2.12	1.27
NPV2	-	-59	313	685
POP2 (11,2%)	-	5.08	1.91	1.18
NPV2	-	-4	437	878
Investering P3	0	400	400	400
CRF3	-	0.2350	0.5350	0.8350
IRR3	-	5.63	45.21	78.95
POP3 (18,4%)	-	9.05	2.50	1.47
NPV3	-	-109	263	635
POP3 (11,2%)	-	6.10	2.21	1.36
NPV3	-	-54	387	828

ECONOMISCHE EVALUATIE: N=5 jaar

Tabel Id gasolieprijs 70 cent/liter.

bedragen * ƒ1000,--	wekkers A	B(+0%)	alternatieven elektrisch C(+5%)	D(+10%)
bruto jaarbesomming	2400	2400	2520	2640
extra besomming	0	0	120	240
totaal gasolie verbruik (liters)	1.200.000	1.044.000	1.044.000	1.044.000
totale gasoliekosten	840	731	731	731
besparing op gasoliekosten (-13%)	0	109	109	109
extra inkomsten R	0	109	229	349
Investering P_1	0	300	300	300
CRF1	-	0.3633	0.7633	1.1633
IRR1	-	23.88	71.13	113.72
POP1 (18,4%)	-	4.18	1.63	1.02
NPV1	-	38	410	782
POP1 (11,2%)	-	3.47	1.49	0.95
NPV1	-	101	542	983
Investering P2	0	350	350	350
CRF2	-	0.3114	0.6543	0.9971
IRR2	-	16.84	58.99	96.29
POP2 (18,4%)	-	5.29	1.96	1.21
NPV2	-	-12	360	732
POP2 (11,2%)	-	4.20	1.77	1.12
NPV2	-	51	492	933
Investering P3	0	400	400	400
CRF3	-	0.2725	0.5725	0.8725
IRR3	-	11.28	49.61	83.00
POP3 (18,4%)	-	6.66	2.30	1.40
NPV3	-	-62	310	682
POP3 (11,2%)	-	4.99	2.05	1.29
NPV3	-	1	442	883

ECONOMISCHE EVALUATIE: N=5 jaar

Tabel Ie gasolieprijs 80 cent/liter.

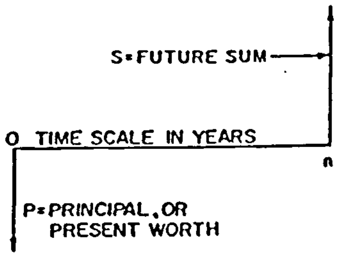
bedragen * ƒ 1000,--	wekkers A	B	alternatieven elektrisch C	D
bruto jaarbesomming	2400	2400	2520	2640
extra besomming	0	0	120	240
totaal gasolie verbruik (liters)	1.200.000	1.044.000	1.044.000	1.044.000
totale gasoliekosten	960	835	835	835
besparing op gas-kosten (-13%)	0	125	125	125
resulterende extra inkomsten R	0	125	245	365
Investering P_1	0	300	300	300
CRF1	-	0.4167	0.8167	1.2167
IRR1	-	30.77	76.96	119.27
POP1 (18,4%)	-	3.45	1.51	0.97
NPV1	-	87	459	831
POP1 (11,2%)	-	2.95	1.39	0.91
NPV1	-	160	601	1042
Investering P2	0	350	350	350
CRF2	-	0.3571	0.7000	1.0429
IRR2	-	23.06	64.12	101.12
POP2 (18,4%)	-	4.29	1.81	1.15
NPV2	-	37	409	781
POP2 (11,2%)	-	3.54	1.64	1.07
NPV2	-	110	551	781
Investering P3	0	400	400	400
CRF3	-	0.3125	0.6125	0.9125
IRR3	-	16.99	54.23	87.29
POP3 (18,4%)	-	5.26	2.12	1.33
NPV3	-	-13	359	731
POP3 (11,2%)	-	4.18	1.90	1.23
NPV3	-	60	501	942

ECONOMISCHE EVALUATIE: N=5 jaar

Tabel If gasolieprijs 90 cent/liter.

bedragen * ƒ 1000,--	wekkers A	B	alternatieven elektrisch C	D
Bruto jaarbesomming	2400	2400	2520	2640
extra besomming	0	0	120	240
totaal gasolie verbruik (liters)	1.200.000	1.044.000	1.044.000	1.044.000
totale gasoliekosten	1080	940	940	940
besparing op gasoliekosten (-13%)	0	140	140	140
resulterende extra inkomsten R	0	140	260	380
Investering P_1	0	300	300	300
CRF1	-	0.4667	0.8667	1.2667
IRR1	-	37.00	82.37	124.44
POP1 (18,4%)	-	2.97	1.41	0.93
NPV1	-	134	506	878
POP1 (11,2%)	-	2.59	1.30	0.87
NPV1	-	215	656	1097
Investering P2	0	350	350	350
CRF2	-	0.4000	0.7429	1.0857
IRR2	-	28.65	68.88	105.62
POP2 (18,4%)	-	3.65	1.69	1.10
NPV2	-	84	456	828
POP2 (11,2%)	-	3.09	1.54	1.03
NPV2	-	165	606	1047
Investering P3	0	400	400	400
CRF3	-	0.3500	0.6500	0.9500
IIR3	-	22.11	58.50	91.29
POP3 (18,4%)	-	4.42	1.97	1.27
NPV3	-	34	406	778
POP3 (11,2%)	-	3.63	1.78	1.18
NPV3	-	115	556	997

Figure 2



(A)

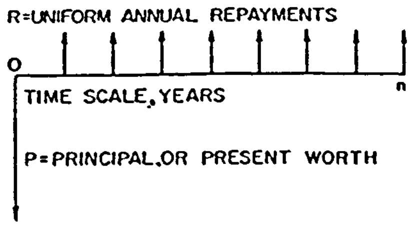
$$S = [SCAF]\ P$$

$$[SCAF] = (1 + i)^n$$

$$P = [SPWF]\ S$$

$$[SPWF] = \frac{1}{(1 + i)^n}$$

$$[SCAF] = \frac{1}{[SPWF]}$$



(B)

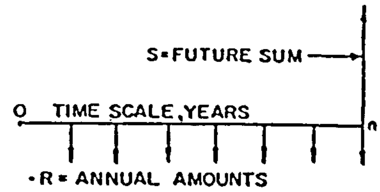
$$R = [CRF]\ P$$

$$[CRF] = \frac{i(1 + i)^n}{(1 + i)^n - 1}$$

$$P = [UPWF]\ R$$

$$[UPWF] = \frac{(1 + i)^n - 1}{i(1 + i)^n}$$

$$[UPWF] = \frac{1}{[CRF]}$$



(C)

$$S = [UCAF] \cdot R$$

$$[UCAF] = \frac{(1 + i)^n - 1}{i}$$

$$R = [SFF]\ S$$

$$[SFF] = \frac{i}{(1 + i)^n - 1}$$

Nomenclature

AAC = average annual cost (including capital)
BCR = benefit-cost ratio
CC = capitalized cost (present worth of perpetual service)
CRF = capital recovery factor
CRF′ = capital recovery factor after tax
EiRR = equated interest rate of return
i = nominal interest rate, compounded annually
i' = interest rate after tax
L = resale or scrap value
n = number of years
P = principal, investment, or present worth of future amounts
PW = present worth of both invested and future costs
R = annual return (revenue less direct costs), annual repayments on a loan (returning capital plus interest)
R' = annual return after tax
RFR = required freight rate
S = a future sum of money
SCAF = single payment compound amount factor
SFF = sinking fund factor
SPWF = single payment present worth factor
t = tax rate in proportion to annual profits before tax
UCAF = uniform series compound amount factor
UPWF = uniform series present worth factor
Y = annual direct costs (wages, repairs, insurance, supplies, fuel, and so on)

NOTES:
1 Other abbreviations are explained wherever used.
2 The numerical examples use Prof. Wilbert Steffy's code for identifying the components of the various interest factors. When used in a calculation, the symbol may be followed immediately by its numerical value. Thus, for example, the present worth of $1,000 per year for the next 5 years, with 10 percent interest, would be shown as follows:

$$P = [UPWF]_5^{.10}\ 3.791 \times \$1{,}000 = \$3{,}791$$

from: *Principles of Engineering Economy in Ship Design*
by H. Benford

Figure 3 - Division of revenue

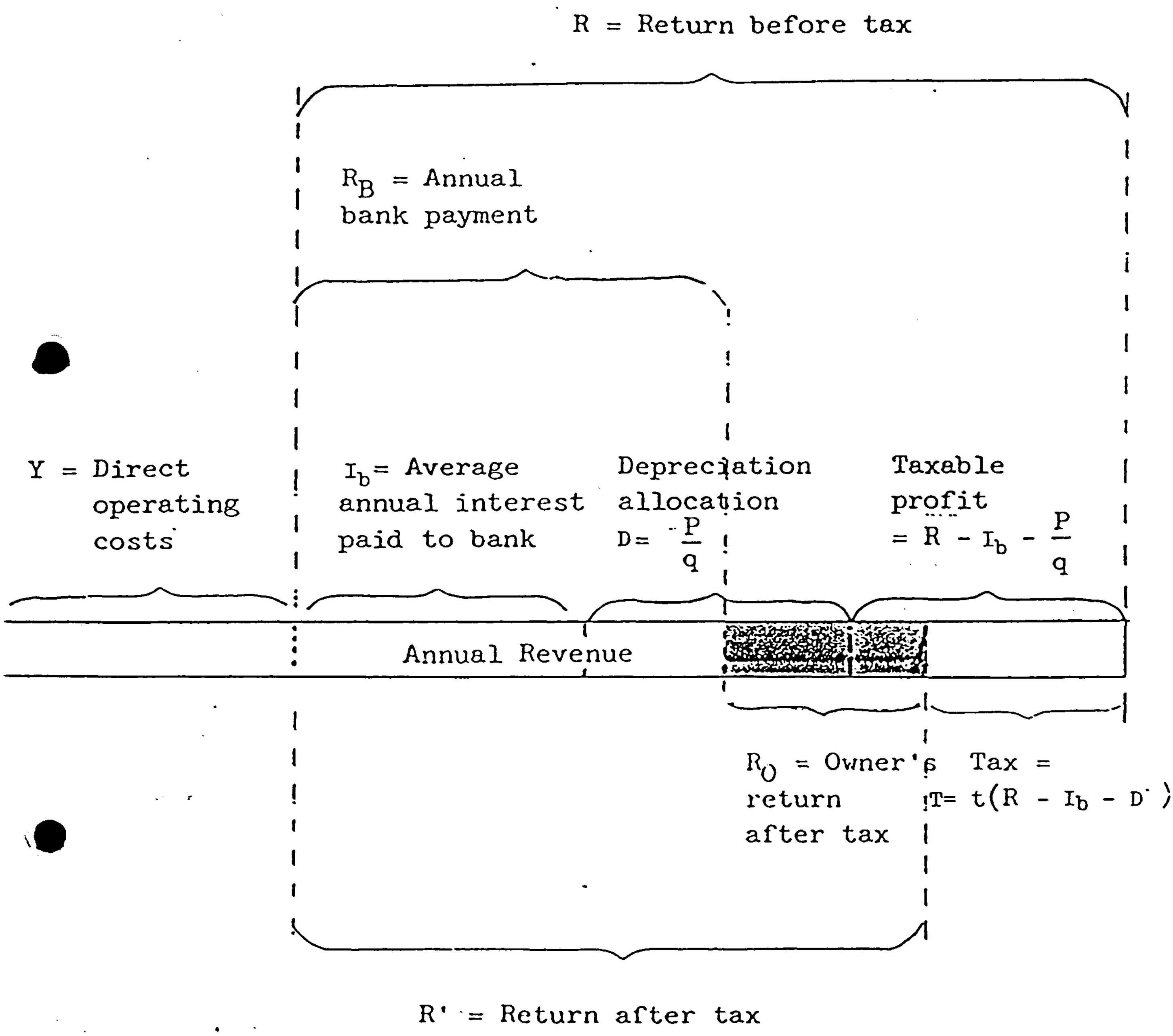
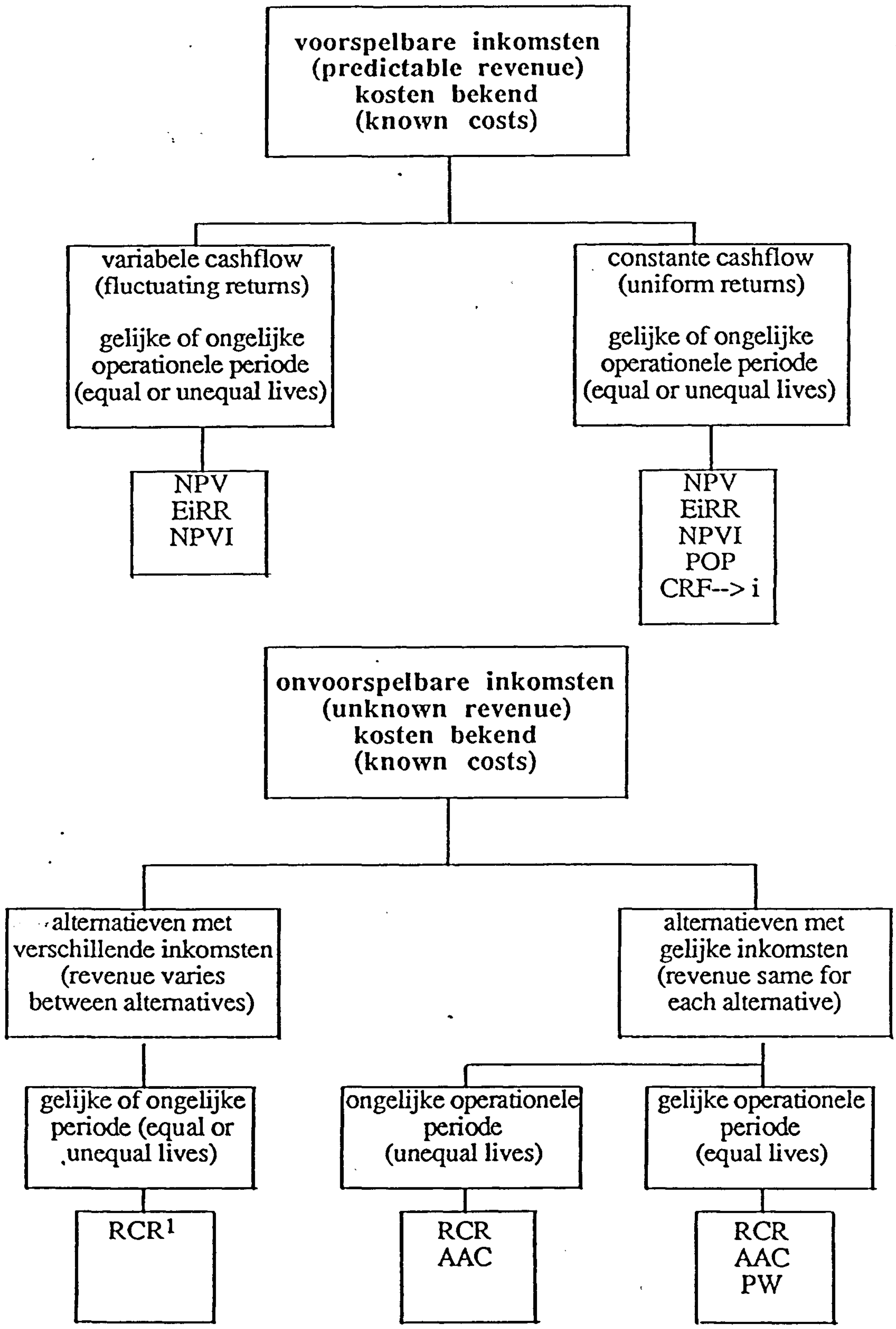


Figure 4 - Economic Criteria



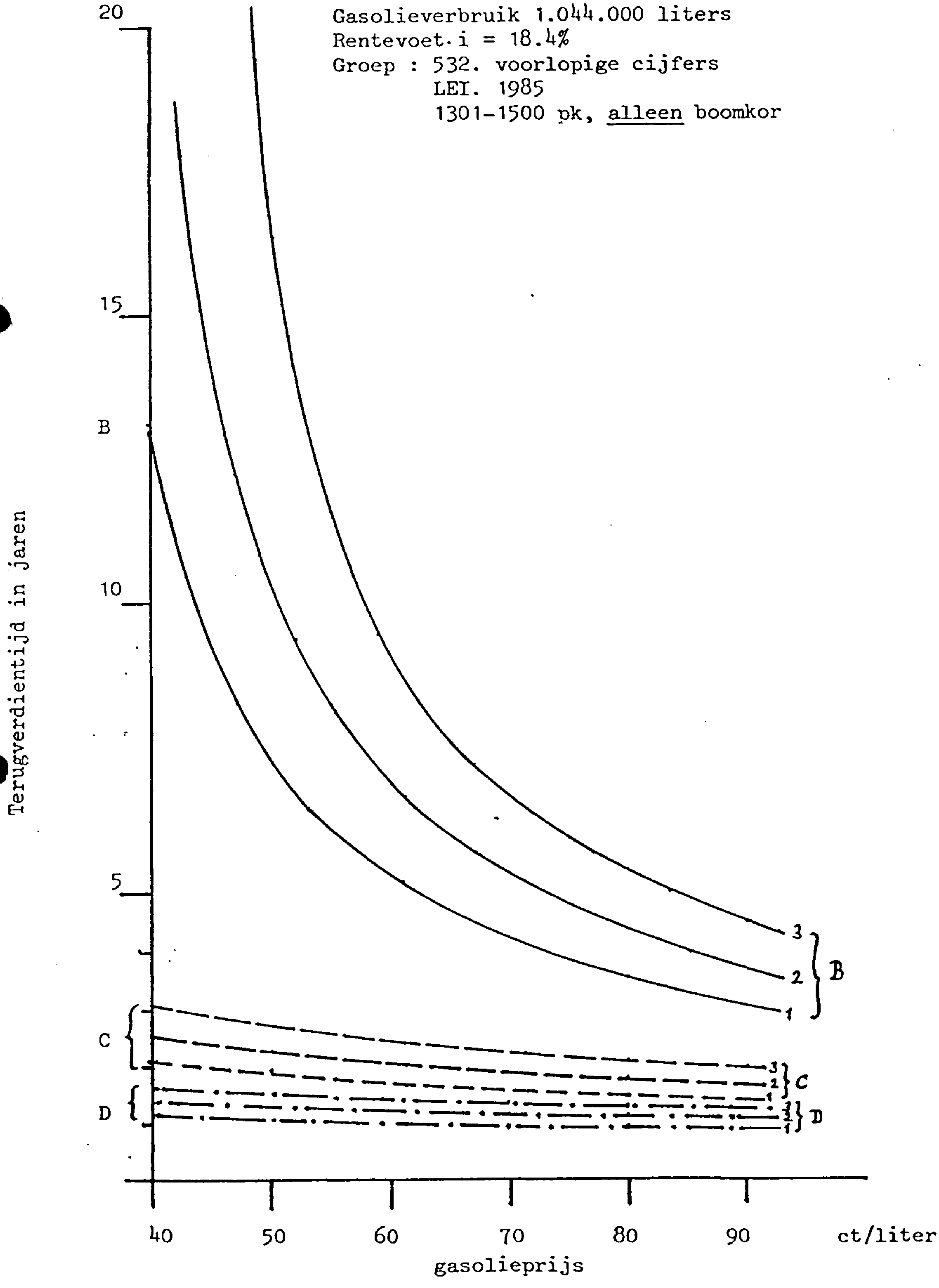
1 AAC/landed catch per year (required catch rate).

Figuur 5 - Verband tussen terugverdientijd en gasolieprijs bij verschillende investeringsbedragen

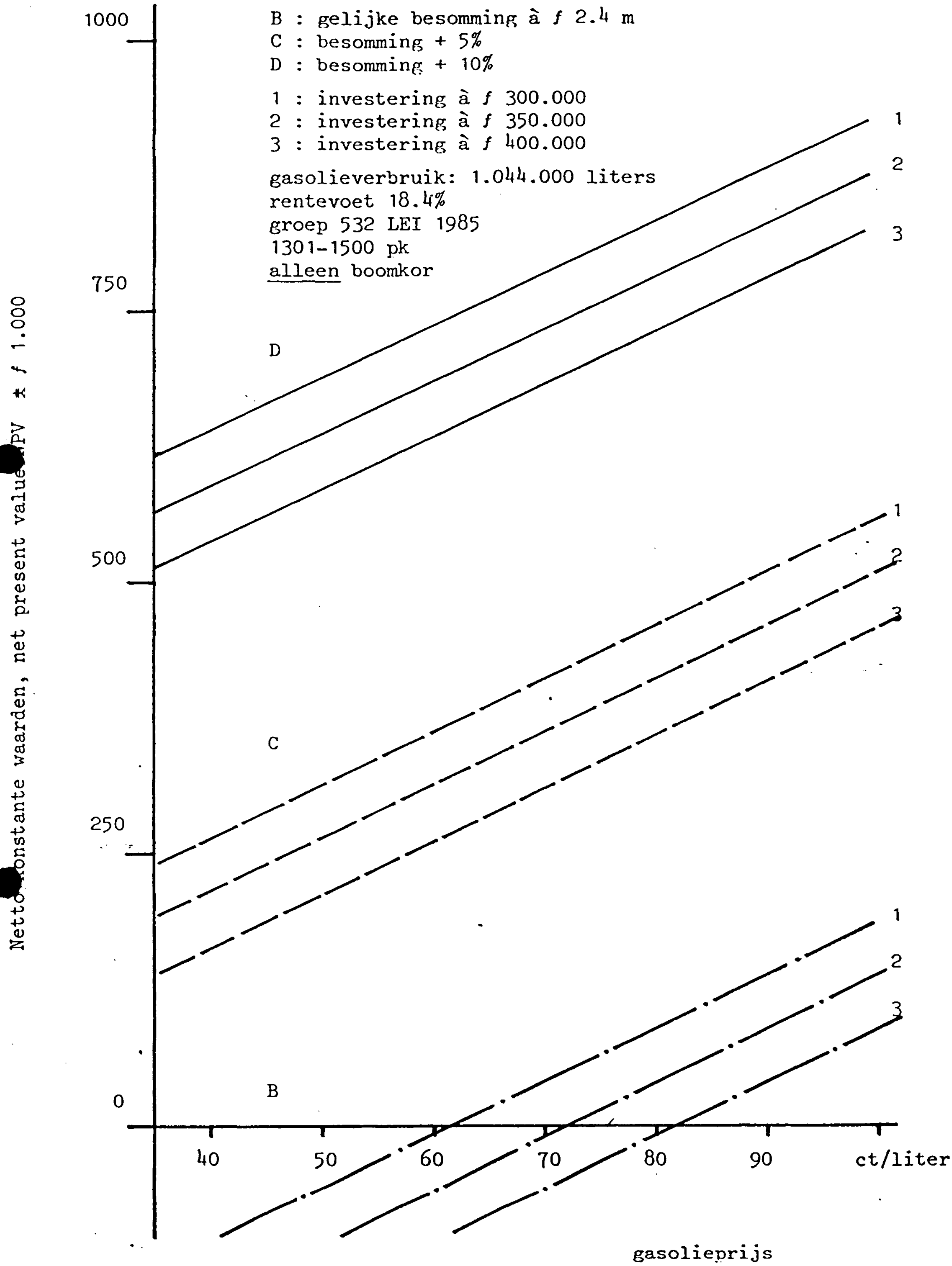
B : besomming gelijk à ƒ 2.4 m
C : besomming + 5%
D : besomming + 10%

1 : investering á ƒ 300.000
2 : investering á ƒ 350.000
3 : investering á ƒ 400.000

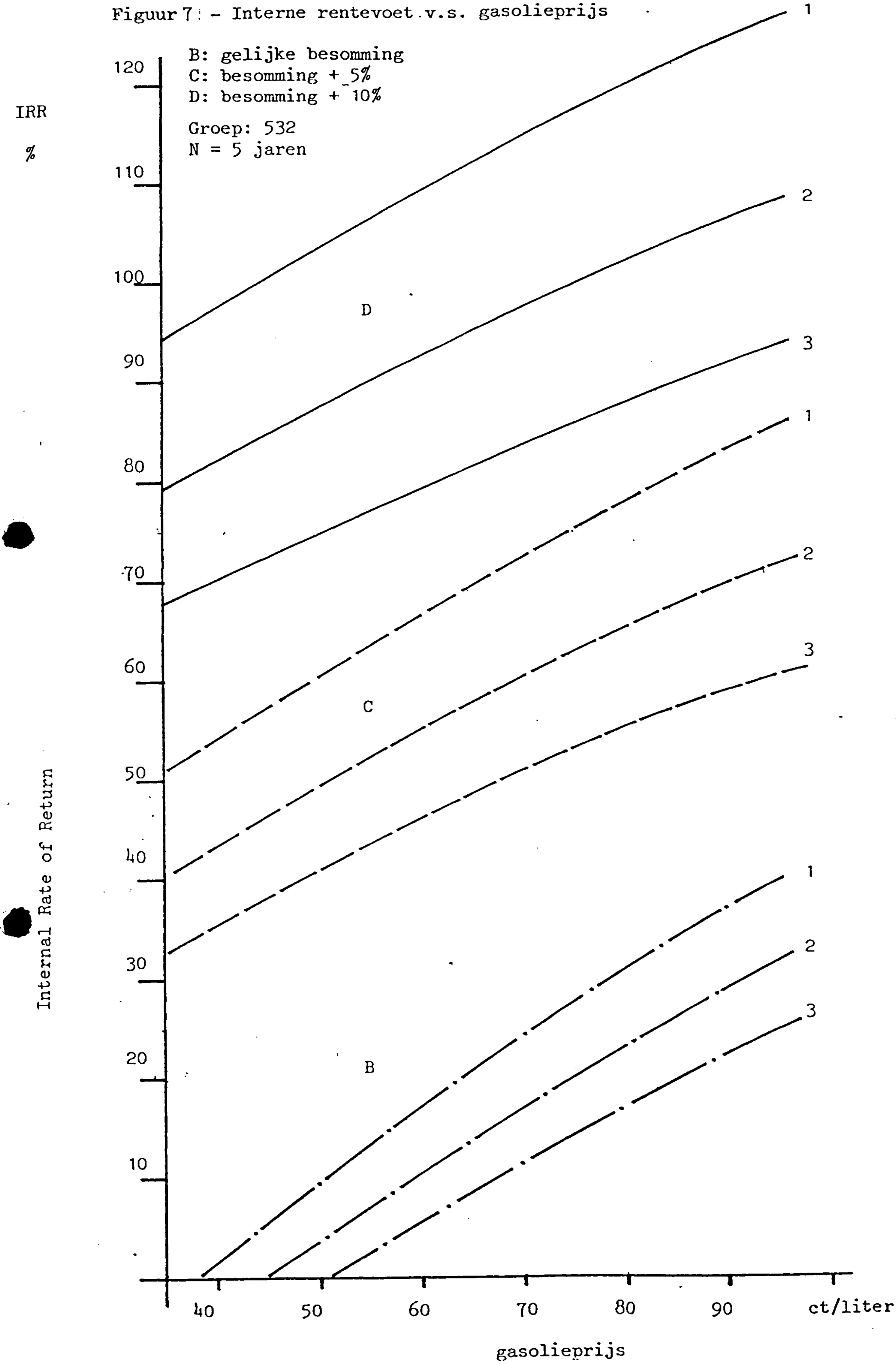
Gasolieverbruik 1.044.000 liters
Rentevoet i = 18.4%
Groep : 532. voorlopige cijfers
LEI. 1985
1301-1500 pk, alleen boomkor



Figuur 6 - Netto kon_tante waarde (NPV) als funktie van de gasolieprijs bij verschillende investeringsbedragen en besommingswaarden



Figuur 7 - Interne rentevoet v.s. gasolieprijs

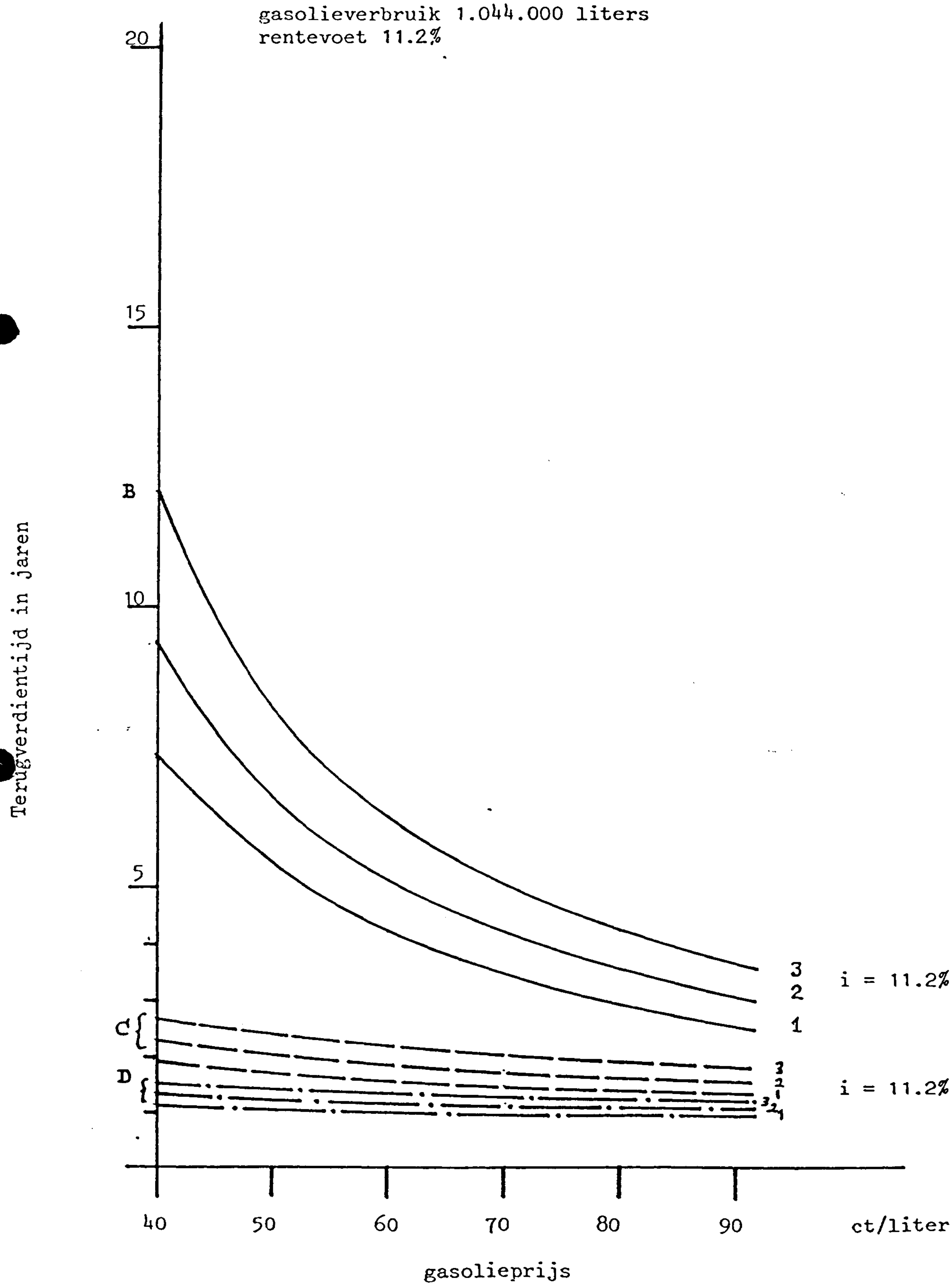


Figuur 8 - Verband tussen terugverdientijd en gasolieprijs bij verschillende investeringsbedragen

B: besomming gelijk à *f* 2.4 m
C: besomming + 5%
D: besomming + 10%

1: investering à *f* 300.000
2: investering à *f* 350.000
3: investering à *f* 400.000

gasolieverbruik 1.044.000 liters
rentevoet 11.2%



Figuur 9 – Netto kontante waarde (NPV) als funktie van de gasolieprijs bij verschillende investeringsbedragen en besommingswaarden