Tilburg University

The effect of systematic misperception of income on the subjective poverty line

Tummers, M.P.

Publication date:
1991

Document Version
Publisher's PDF, also known as Version of record

[Link to publication in Tilburg University Research Portal](#)

Citation for published version (APA):
Tummers, M. P. (1991). *The effect of systematic misperception of income on the subjective poverty line*. (Research Memorandum FEW). Faculteit der Economische Wetenschappen.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

CBM

CBM
R

UNIVERSITEIT
BRABANT

POSTBOX 90153
5000 LE TILBURG
THE NETHERLANDS

7626
1991
509

DEPARTMENT OF ECONOMICS
RESEARCH MEMORANDUM

**THE EFFECT OF SYSTEMATIC MISPERCEPTION
OF INCOME ON THE SUBJECTIVE
POVERTY LINE**

Drs. M.P. Tummers

R43

FEW 509

330.571

The Effect of Systematic Misperception of Income on the Subjective Poverty Line

Martijn P. Tummers *

Tilburg University
P.O. Box 90153, 5000 LE Tilburg, The Netherlands

September, 1991

Abstract

Heads of households appear to misperceive their own household income. This misperception of income can be easily assessed, but also asks for some adjustment of the answers to subjective questions where household income serves as a frame of reference. The appropriate extent of adjustment can be estimated. However, it seems more natural to explain the unadjusted answers directly by both misperceived income and accurately measured income. The results show that adjustment of the answer to the so-called Minimum Income Question proportionate to the income misperception, as advocated by Kapteyn et al. (1988), causes an overestimation of the related Subjective Poverty Line for a one-person household and less pronounced household composition effects. The results, from estimated correction and in the case of direct use of misperceived income, are similar.

*The author thanks Peter Kooreman, Arie Kapteyn and Bertrand Melenberg for their invaluable comments. Ruud Muffels took care of the Statutory Poverty Line levels that appear in Table V. The Netherlands Central Bureau of Statistics kindly released the data for publication.

1 Introduction

Empirical evidence indicates that respondents misperceive their own household after tax income (See Kapteyn et al., 1988). Respondents appear to underestimate their household after tax income. As will be explained below, this underestimation turns out to have a downwards biasing effect on the subjective poverty line in empirical implementation. In Kapteyn et al. (1988), a method is presented to remedy this bias. One can adjust the responses to subjective questions if these questions are preceded by a question which measures the respondent's perception of his household after tax income. The misperception of income can be calculated from a comparison of the respondent's perception of the income with the measurement of income as the sum of a lengthy list of components. Next the responses to the subjective questions can be corrected. An alternative is of course to avoid the misperception, by prefacing the subjective questions with the detailed questions about household income components. Here, the focus is on the former case.

Kapteyn et al. (1988) assume that the answers to the subjective questions are biased in the same proportion as income is underestimated by the respondent. In this note, this assumption is tested within the context of the so-called Subjective Poverty Line (SPL). (See Goedhart et al., 1977). Section 2 concisely introduces the SPL concept. Section 3 presents the adjustment procedure as proposed in Kapteyn et al. (1988) and indicates how their assumption can be empirically relaxed¹. An alternative assumption is also given through more direct use of the measurement of the respondent's perception of income in explaining subjective answers. Section 4 contains the estimation results. For comparison the same specification as in Kapteyn et al. (1988) is adopted. Section 5 concludes.

2 The Subjective Poverty Line

The SPL was introduced in Goedhart et al. (1977). It is called 'Subjective' because it springs from the respondents' answers to a survey question, the Minimum Income Question (MIQ). The MIQ runs as follows:

Which after tax income for your household do you, in your circumstances, consider to be absolutely minimal? That is to say that with less you could not make both ends meet.

The MIQ answer, given by the head of household n , is referred to as the respondent's minimum income $y_{min,n}$.

The SPL is operationalized by specifying a relation between $y_{min,n}$ on the one hand and household income and a vector of household characteristics on the other hand. To facilitate comparison, the SPL equation will initially be specified as in

¹This was suggested by a referee of Kapteyn et al. (1988).

Kapteyn et al. (1988):

$$\ln y_{\min,n} = \alpha_0 + \alpha_1(1 - \alpha_2)fc_n + \psi(1 - \alpha_2)fc_n \ln y_n + \alpha_2 \ln y_n + (1 - \alpha_2)m_n - \alpha_1(1 - \alpha_2)hc_n - \psi(1 - \alpha_2)hc_n m_n + \epsilon_n \quad (1)$$

where

fc_n	composition of household n
y_n	household after tax income
m_n	mean ln income in the reference group of household n
hc_n	mean household composition in the reference group of household n
ϵ_n	error term

Household composition is specified such that account is taken of both the number of persons in the household and their ages:

$$fc_n = 1 + \ln fs_n + f(a_1) + \sum_{j=2}^{fs_n} f(a_j) \ln(j/j - 1) \quad (2)$$

where

$$\begin{aligned} fs_n & \text{ number of persons in household } n \\ f(a_j) &= 0 & a_j > 18 \\ f(a_j) &= \gamma_2(18 - a_j)^2 + \gamma_3(18 - a_j)^2(36 + a_j) & 0 \leq a_j \leq 18 \end{aligned}$$

where a_j refers to the age of person j and γ_2 and γ_3 are parameters to be estimated.

From equation (1), $y_{\min,n}$ can be written as a function of y_n , for given values of the other variables on the RHS, as set out in Figure 1. The MIQ answers are aggregated into the SPL by the following reasoning. Suppose one obtains an income to the right of $y_{\min,n}^*$ in Figure 1. Take the corresponding minimum income level and return it as income. Through an iterated habituation process that person will end up in the fixed point of the function set out in Figure 1. The SPL is defined by this fixed point of that function, $y_{\min,n}^*$, which equals

$$\exp \frac{\alpha_0 + \alpha_1(1 - \alpha_2)fc_n + (1 - \alpha_2)m_n - \alpha_1(1 - \alpha_2)hc_n - \psi(1 - \alpha_2)hc_n m_n}{(1 - \alpha_2)(1 - \psi fc_n)} \quad (3)$$

The income level $y_{\min}^*$ is the point where a household can just make both ends meet. Eventually, a household is not able to manage with less income and with more income it is. Having estimated the parameters in equation (1), the SPL can be evaluated for various household compositions.

FIGURE 1: The Subjective Poverty Line y_{min}^*

3 Adjusting for Downward Bias

In the definition of the SPL, the respondent's income appears to be a crucial variable. So it is important to know which estimate of his own household income the respondent has in mind when answering the MIQ. If the respondent underestimates this income, it is likely that he will also underestimate $y_{min,n}$. As mentioned before, the factor of downward bias can be calculated from comparison between the respondent's estimate of income and a more accurate measurement of income. Just before the MIQ in the survey, the respondent's perception of his household after tax income is measured by the following question where the respondent can choose out of seven income brackets:

Can you indicate roughly what the total after tax income of your household has been during the past 12 months? Less than Dfl. 17,500; 17,500–20,000; 20,000–24,000; 24,000–28,000; 28,000–34,000; 34,000–43,000; 43,000 or more.

Table I reflects the underestimation of household income.

In order to analyze the systematic difference in Table I between the results from the two income measures, Kapteyn et al. postulate the following relation between income y_n^* , the answer to the income question in brackets, and the income components y_{ni} ($i = 1, \dots, I$) recorded at the end of the questionnaire

$$y_n^* = \left(\sum_{i=1}^I \beta_i y_{ni} \right) e^{\eta_n} \quad (4)$$

TABLE I: COMPARISON OF TWO INCOME MEASURES

Income Bracket	Average Income	N_i
< 17,500	17,201	564
17,500 - 20,000	25,085	355
20,000 - 24,000	28,690	521
24,000 - 28,000	32,128	632
28,000 - 34,000	38,305	635
34,000 - 43,000	45,412	686
> 43,000	65,006	698

Dfl. per year. The second column gives the average income of all households in the corresponding income bracket according to the detailed measurement of income. N_i heads the number of respondents in the income bracket. SEP Oct86.

where the β_i 's are parameters to be estimated and η_n is a normally distributed error term with mean zero and variance σ_η^2 . The values of β_i are expected to lie in the unit interval $[0,1]$. The smaller a parameter β_i , the more the respondents 'forget' the i th income component in response to the income question in brackets. The parameters β_i and σ_η^2 can be estimated by means of maximum likelihood.

Denote the factor of underestimation by g_n . The parameters β_i being estimated, this factor can be evaluated as $g_n = \sum_{i=1}^I y_{ni} / \sum_{i=1}^I \hat{\beta}_i y_{ni}$. Kapteyn et al. now assume that the respondent underestimates his minimum income $y_{min,n}$ by the same proportion as his current income y_n . It is however not entirely obvious why the adjustment of y_{min} should be proportionate to the underestimation of y , for in equation (1) y_{min} and y are not linearly related. Moreover it appears that the extent to which y_{min} should be corrected, can be estimated. After substituting the adjusted value $y_{min,n} g_n^\delta$ for $y_{min,n}$, equation (1) becomes

$$\ln y_{min,n} = -\delta \ln g_n + \alpha_0 + \alpha_1(1 - \alpha_2)fc_n + \psi(1 - \alpha_2)fc_n \ln y_n + \alpha_2 \ln y_n + (1 - \alpha_2)m_n - \alpha_1(1 - \alpha_2)hc_n - \psi(1 - \alpha_2)hc_n m_n + \epsilon_n \quad (5)$$

where δ indicates the extent of adjustment. Note that δ is identified so that it is possible to test whether proportional adjustment is appropriate, i.e. $\delta = 1$ vs. $\delta \neq 1$.

From equation (1) readily an alternative specification suggests itself. In the response to the MIQ, income serves as a frame of reference. This is represented by $\ln y_n$ in equation (1). However, $\ln y_n^*$ seems a more natural candidate to capture this frame of reference, or perhaps a combination of $\ln y_n$ and $\ln y_n^*$ is best. So the alternative specification reads

$$\ln y_{\min,n} = \alpha_0 + \alpha_1(1 - \alpha_2)fc_n + (\psi(1 - \alpha_2)fc_n + \alpha_2)((1 - \lambda)\ln y_n + \lambda\ln y_n^*) + (1 - \alpha_2)m_n - \alpha_1(1 - \alpha_2)hc_n - \psi(1 - \alpha_2)hc_nm_n + \epsilon_n \quad (6)$$

The equations (5) and (6) are identical if $\ln g_n = \ln y_n - \ln y_n^*$ and $\delta = \lambda(\psi(1 - \alpha_2)fc_n + \alpha_2)$. For equation (5), $\ln y_{\min,n} + \delta \ln g_n$ is substituted for $\ln y_{\min,n}$ in equation (1) and for equation (6), $\ln y_n$ in equation (1) is replaced by $(1 - \lambda)\ln y_n + \lambda\ln y_n^*$. In estimation, equation (6) results in special cases of equation (5). The concurrences are tabulated in terms of δ and λ in Table III.

TABLE II: CONCURRING SPECIFICATIONS

δ	λ
0	0
$\hat{\lambda}(\psi(1 - \alpha_2)fc_n + \alpha_2)$	$\hat{\lambda}$
$\psi(1 - \alpha_2)fc_n + \alpha_2$	1
$\hat{\delta}$	-
1	-

In the next section, the estimation results are given for both equation (5) and (6). Assuming that ϵ_n and η_n are independent and follow a normal distribution the parameters are estimated by maximizing the loglikelihood

$$L = \sum_{n=1}^N \left(\ln P_n - \frac{1}{2} \ln(\sigma_\epsilon^2 + \delta^2 \sigma_\eta^2) - \frac{1}{2} \frac{e_n^2}{\sigma_\epsilon^2 + \delta^2 \sigma_\eta^2} \right) \quad (7)$$

where

$$P_n = \Phi \left(\frac{\ln ub_n - \ln \sum_{i=1}^I \beta_i y_{ni} - \frac{\delta \sigma_\eta^2}{\sigma_\epsilon^2 + \delta^2 \sigma_\eta^2} * e_n}{\sigma_\epsilon \sigma_\eta / \sqrt{\sigma_\epsilon^2 + \delta^2 \sigma_\eta^2}} \right) - \Phi \left(\frac{\ln lb_n - \ln \sum_{i=1}^I \beta_i y_{ni} - \frac{\delta \sigma_\eta^2}{\sigma_\epsilon^2 + \delta^2 \sigma_\eta^2} * e_n}{\sigma_\epsilon \sigma_\eta / \sqrt{\sigma_\epsilon^2 + \delta^2 \sigma_\eta^2}} \right)$$

where $e_n = \epsilon_n + \delta \eta_n$, Φ is the cumulative standard normal distribution function and ub_n and lb_n are respectively the upper and lower bound of the income bracket y_n^* is part of.

4 Estimation results

The data are from the October 1986 wave of the Social Economic Panel survey conducted by the Netherlands Central Bureau of Statistics. Table III lists the income components distinguished, y_{ni} .

TABLE III: INCOME COMPONENTS

Head of household's wages, salaries, benefits	β_1
Head of household's fringe benefits	β_2
Rent subsidies	β_3
Household allowances	β_4
Profits, employer's contribution to health insurance premiums, scholarships	β_5
Head of household's other income	β_6
Spouse's income	β_7
Eldest child's income	β_8
Other household members' income	β_9

Table IV presents the estimation results for equations (4) and (5). The estimated parameters $\hat{\beta}_i$ indicate that the head of household's wages etc. appear to be recalled almost completely. Components like incomes of children and other household members, rent subsidies and head of household's other income are often forgotten.

Clearly, the hypothesis $\delta = 1$ has to be rejected. A striking result is that $\delta = 0$ performs even better than $\delta = 1$. The three columns in the middle do not manifest much within difference. The estimation result $\lambda > 1$ is difficult to interpret. At a high significance level ($\chi^2_{1,0.01} = 6.63$) however, the restriction $\lambda = 1$ holds, which signifies that only income as perceived by the head of the household, y_n^* , is the frame of reference when completing the survey.

To compare the results between the columns in Table IV, Figure 2 presents the five corresponding age functions $f(\text{age})$ and Table IV exhibits the implied poverty lines for various household compositions. The poverty lines have been computed with m_n and hs_n set equal to their sample means.

Except for $\delta = 0$, the age functions look rather similar. Although the age functions show a dip, the poverty lines in Table V rise when household size in number of persons increases. Household size in number of persons compensates the age dips below zero. For $\delta = 1$, i.e. overadjustment of $\ln y_{\min,n}$ according to Table IV, the poverty line for a one-person household appears to be overestimated with respect to δ unrestricted. Similarly the economies of scale are overestimated in this case.

Just for comparison the last column of Table V contains the levels of the statutory poverty line for the selected household compositions. The levels are based on the Social Assistance Act and include holiday and family allowances. The steeper household composition compensation does offset the lower starting level of a one-person

TABLE IV: ESTIMATION RESULTS EQUATIONS (4) AND (5)

δ	0	$\lambda(\psi(1 - \alpha_2)fc_n + \alpha_2)$	0.40(0.02)	1	
λ	0	1.11(0.05)	1	-	
$\hat{\alpha}_0$	-0.43(0.03)	-0.38(0.01)	-0.39(0.01)	-0.38(0.01)	-0.30(0.01)
$\hat{\alpha}_1$	3.88(0.78)	-0.12(0.25)	-0.13(0.25)	0.48(0.32)	-2.00(0.21)
$\hat{\alpha}_2$	0.54(0.04)	0.34(0.03)	0.35(0.03)	0.39(0.03)	0.29(0.04)
$\hat{\gamma}_2$	0.05(0.01)	0.03(0.01)	0.03(0.01)	0.03(0.01)	0.03(0.01)
$\hat{\gamma}_3$	$-1 \cdot 10^{-3}$ ($3 \cdot 10^{-4}$)	$-1 \cdot 10^{-3}$ ($2 \cdot 10^{-4}$)	$-1 \cdot 10^{-3}$ ($3 \cdot 10^{-4}$)	$-1 \cdot 10^{-3}$ ($3 \cdot 10^{-4}$)	$-1 \cdot 10^{-3}$ ($2 \cdot 10^{-4}$)
$\hat{\psi}$	-0.35(0.07)	0.03(0.02)	0.03(0.02)	-0.03(0.03)	0.21(0.02)
$\hat{\beta}_1$	0.91(0.01)	0.91(0.01)	0.90(0.01)	0.90(0.01)	0.90(0.01)
$\hat{\beta}_2$	0.95(0.07)	0.77(0.06)	0.78(0.06)	0.79(0.06)	0.84(0.04)
$\hat{\beta}_3$	0.39(0.08)	0.42(0.08)	0.41(0.08)	0.42(0.08)	0.63(0.08)
$\hat{\beta}_4$	0.44(0.07)	0.79(0.07)	0.79(0.07)	0.78(0.07)	0.75(0.06)
$\hat{\beta}_5$	0.73(0.02)	0.68(0.02)	0.68(0.02)	0.68(0.02)	0.69(0.02)
$\hat{\beta}_6$	0.45(0.03)	0.45(0.03)	0.45(0.03)	0.45(0.03)	0.48(0.03)
$\hat{\beta}_7$	0.87(0.02)	0.90(0.02)	0.90(0.02)	0.90(0.02)	0.86(0.02)
$\hat{\beta}_8$	0.43(0.03)	0.42(0.03)	0.42(0.03)	0.42(0.03)	0.41(0.03)
$\hat{\beta}_9$	0.48(0.04)	0.48(0.05)	0.48(0.05)	0.48(0.05)	0.48(0.04)
$\hat{\sigma}_\epsilon$	0.31(0.003)	0.29(0.003)	0.29(0.003)	0.29(0.003)	0.31(0.004)
$\hat{\sigma}_\eta$	0.29(0.004)	0.30(0.004)	0.30(0.004)	0.29(0.003)	0.29(0.004)
L	-3543.6	-3312.2	-3315.3	-3312.5	-3803.0

$N = 4091$, standard errors in parentheses.

FIGURE 2: Age Functions, - - $\delta = 0$, - - $\lambda = \hat{\lambda}$, - - $\lambda = 1$, — — $\delta = \hat{\delta}$, — $\delta = 1$.

TABLE V: POVERTY LINES

Household Composition	$\delta = 0$	$\lambda = \hat{\lambda}$	$\lambda = 1$	$\delta = \hat{\delta}$	$\delta = 1$	Statutory Poverty Line
1 Adult	14,239	15,310	15,181	15,091	15,489	13,218
2 Adults	18,095	17,415	17,091	17,537	16,387	18,882
2 Adults + 6	18,298	18,359	18,017	18,564	16,832	19,963
2 Adults + 12	19,100	18,481	18,070	18,702	16,942	20,233
2 Adults + 12,6	19,240	19,199	18,772	19,462	17,337	22,071
2 Adults + 12,6,1	20,575	20,430	19,969	20,788	18,158	23,360
2 Adults + 12,6,2,1	21,222	21,290	20,811	21,681	18,834	24,933
2 Adults + 18,12,6,1	21,996	21,335	20,742	21,723	19,000	28,281

Dfl. per year.

household. The statutory poverty line levels end up to be higher than the subjective poverty line levels for all selected household compositions, except for the first one, no matter the specification.

5 Conclusions

If in a questionnaire, the Minimum Income Question is not preceded by detailed questions on household income to avoid misperception of this income by the head of the household when answering the MIQ, the answer should be corrected. Prefacing the MIQ with a measure of the perception of household income enables adjustment in explaining the answer to the MIQ. If one prefers to adjust the answers, it is possible to estimate the appropriate size of adjustment. Also the measurement of perceived income may be used more directly in explaining the MIQ answers. Either approach shows that adjustment proportionate to income misperception leads to both an overestimation of the Subjective Poverty Line for a one-person household and an overestimation of the economies of scale with an increasing number of household members.

References

- GOEDHART, T., V. HALBERSTADT, A. KAPTEYN, AND B.M.S. VAN PRAAG. 1977. "The Poverty Line: Concept and Measurement." *The Journal of Human Resources* 12(4):503-20.
- KAPTEYN, A., P. KOOREMAN, AND R. WILLEMSE. 1988. "Some Methodological Issues in the Implementation of Subjective Poverty Definitions." *The Journal of Human Resources* 23(2):222-42.

IN 1990 REEDS VERSCHENEN

- 419 Bertrand Melenberg, Rob Alessie
A method to construct moments in the multi-good life cycle consumption model
- 420 J. Kriens
On the differentiability of the set of efficient (μ, σ^2) combinations in the Markowitz portfolio selection method
- 421 Steffen Jørgensen, Peter M. Kort
Optimal dynamic investment policies under concave-convex adjustment costs
- 422 J.P.C. Blanc
Cyclic polling systems: limited service versus Bernoulli schedules
- 423 M.H.C. Paardekooper
Parallel normreducing transformations for the algebraic eigenvalue problem
- 424 Hans Gremmen
On the political (ir)relevance of classical customs union theory
- 425 Ed Nijssen
Marketingstrategie in Machtspectief
- 426 Jack P.C. Kleijnen
Regression Metamodels for Simulation with Common Random Numbers: Comparison of Techniques
- 427 Harry H. Tigelaar
The correlation structure of stationary bilinear processes
- 428 Drs. C.H. Veld en Drs. A.H.F. Verboven
De waardering van aandelenwarrants en langlopende call-opties
- 429 Theo van de Klundert en Anton B. van Schaik
Liquidity Constraints and the Keynesian Corridor
- 430 Gert Nieuwenhuis
Central limit theorems for sequences with $m(n)$ -dependent main part
- 431 Hans J. Gremmen
Macro-Economic Implications of Profit Optimizing Investment Behaviour
- 432 J.M. Schumacher
System-Theoretic Trends in Econometrics
- 433 Peter M. Kort, Paul M.J.J. van Loon, Mikuláš Luptacik
Optimal Dynamic Environmental Policies of a Profit Maximizing Firm
- 434 Raymond Gradus
Optimal Dynamic Profit Taxation: The Derivation of Feedback Stackelberg Equilibria

- 435 Jack P.C. Kleijnen
Statistics and Deterministic Simulation Models: Why Not?
- 436 M.J.G. van Eijs, R.J.M. Heuts, J.P.C. Kleijnen
Analysis and comparison of two strategies for multi-item inventory systems with joint replenishment costs
- 437 Jan A. Weststrate
Waiting times in a two-queue model with exhaustive and Bernoulli service
- 438 Alfons Daems
Typologie van non-profit organisaties
- 439 Drs. C.H. Veld en Drs. J. Grazell
Motieven voor de uitgifte van converteerbare obligatieleningen en warrantobligatieleningen
- 440 Jack P.C. Kleijnen
Sensitivity analysis of simulation experiments: regression analysis and statistical design
- 441 C.H. Veld en A.H.F. Verboven
De waardering van conversierechten van Nederlandse converteerbare obligaties
- 442 Drs. C.H. Veld en Drs. P.J.W. Duffhues
Verslaggevingsaspecten van aandelenwarrants
- 443 Jack P.C. Kleijnen and Ben Annink
Vector computers, Monte Carlo simulation, and regression analysis: an introduction
- 444 Alfons Daems
"Non-market failures": Imperfecties in de budgetsector
- 445 J.P.C. Blanc
The power-series algorithm applied to cyclic polling systems
- 446 L.W.G. Strijbosch and R.M.J. Heuts
Modelling (s,Q) inventory systems: parametric versus non-parametric approximations for the lead time demand distribution
- 447 Jack P.C. Kleijnen
Supercomputers for Monte Carlo simulation: cross-validation versus Rao's test in multivariate regression
- 448 Jack P.C. Kleijnen, Greet van Ham and Jan Rotmans
Techniques for sensitivity analysis of simulation models: a case study of the CO₂ greenhouse effect
- 449 Harrie A.A. Verbon and Marijn J.M. Verhoeven
Decision-making on pension schemes: expectation-formation under demographic change

- 450 Drs. W. Reijnders en Drs. P. Verstappen
Logistiek management marketinginstrument van de jaren negentig
- 451 Alfons J. Daems
Budgeting the non-profit organization
An agency theoretic approach
- 452 W.H. Haemers, D.G. Higman, S.A. Hobart
Strongly regular graphs induced by polarities of symmetric designs
- 453 M.J.G. van Eijs
Two notes on the joint replenishment problem under constant demand
- 454 B.B. van der Genugten
Iterated WLS using residuals for improved efficiency in the linear model with completely unknown heteroskedasticity
- 455 F.A. van der Duyn Schouten and S.G. Vanneste
Two Simple Control Policies for a Multicomponent Maintenance System
- 456 Geert J. Almekinders and Sylvester C.W. Eijffinger
Objectives and effectiveness of foreign exchange market intervention
A survey of the empirical literature
- 457 Saskia Oortwijn, Peter Borm, Hans Keiding and Stef Tijs
Extensions of the τ -value to NTU-games
- 458 Willem H. Haemers, Christopher Parker, Vera Pless and Vladimir D. Tonchev
A design and a code invariant under the simple group Co_3
- 459 J.P.C. Blanc
Performance evaluation of polling systems by means of the power-series algorithm
- 460 Leo W.G. Strijbosch, Arno G.M. van Doorne, Willem J. Selen
A simplified MOLP algorithm: The MOLP-S procedure
- 461 Arie Kapteyn and Aart de Zeeuw
Changing incentives for economic research in The Netherlands
- 462 W. Spanjers
Equilibrium with co-ordination and exchange institutions: A comment
- 463 Sylvester Eijffinger and Adrian van Rixtel
The Japanese financial system and monetary policy: A descriptive review
- 464 Hans Kremers and Dolf Talman
A new algorithm for the linear complementarity problem allowing for an arbitrary starting point
- 465 René van den Brink, Robert P. Gilles
A social power index for hierarchically structured populations of economic agents

IN 1991 REEDS VERSCHENEN

- 466 Prof.Dr. Th.C.M.J. van de Klundert - Prof.Dr. A.B.T.M. van Schaik
Economische groei in Nederland in een internationaal perspectief
- 467 Dr. Sylvester C.W. Eijffinger
The convergence of monetary policy - Germany and France as an example
- 468 E. Nijssen
Strategisch gedrag, planning en prestatie. Een inductieve studie binnen de computerbranche
- 469 Anne van den Nouweland, Peter Borm, Guillermo Owen and Stef Tijs
Cost allocation and communication
- 470 Drs. J. Grazell en Drs. C.H. Veld
Motieven voor de uitgifte van converteerbare obligatieleningen en warrant-obligatieleningen: een agency-theoretische benadering
- 471 P.C. van Batenburg, J. Kriens, W.M. Lammerts van Bueren and R.H. Veenstra
Audit Assurance Model and Bayesian Discovery Sampling
- 472 Marcel Kerkhofs
Identification and Estimation of Household Production Models
- 473 Robert P. Gilles, Guillermo Owen, René van den Brink
Games with Permission Structures: The Conjunctive Approach
- 474 Jack P.C. Kleijnen
Sensitivity Analysis of Simulation Experiments: Tutorial on Regression Analysis and Statistical Design
- 475 C.P.M. van Hoesel
An $O(n \log n)$ algorithm for the two-machine flow shop problem with controllable machine speeds
- 476 Stephan G. Vanneste
A Markov Model for Opportunity Maintenance
- 477 F.A. van der Duyn Schouten, M.J.G. van Eijs, R.M.J. Heuts
Coordinated replenishment systems with discount opportunities
- 478 A. van den Nouweland, J. Potters, S. Tijs and J. Zarzuelo
Cores and related solution concepts for multi-choice games
- 479 Drs. C.H. Veld
Warrant pricing: a review of theoretical and empirical research
- 480 E. Nijssen
De Miles and Snow-typologie: Een exploratieve studie in de meubel-
branche
- 481 Harry G. Barkema
Are managers indeed motivated by their bonuses?

- 482 Jacob C. Engwerda, André C.M. Ran, Arie L. Rijkeboer
Necessary and sufficient conditions for the existence of a positive definite solution of the matrix equation $X + A^T X^{-1} A = I$
- 483 Peter M. Kort
A dynamic model of the firm with uncertain earnings and adjustment costs
- 484 Raymond H.J.M. Gradus, Peter M. Kort
Optimal taxation on profit and pollution within a macroeconomic framework
- 485 René van den Brink, Robert P. Gilles
Axiomatizations of the Conjunctive Permission Value for Games with Permission Structures
- 486 A.E. Brouwer & W.H. Haemers
The Gewirtz graph - an exercise in the theory of graph spectra
- 487 Pim Adang, Bertrand Melenberg
Intratemporal uncertainty in the multi-good life cycle consumption model: motivation and application
- 488 J.H.J. Roemen
The long term elasticity of the milk supply with respect to the milk price in the Netherlands in the period 1969-1984
- 489 Herbert Hamers
The Shapley-Entrance Game
- 490 Rezaul Kabir and Theo Vermaelen
Insider trading restrictions and the stock market
- 491 Piet A. Verheyen
The economic explanation of the jump of the co-state variable
- 492 Drs. F.L.J.W. Manders en Dr. J.A.C. de Haan
De organisatorische aspecten bij systeemontwikkeling
een beschouwing op besturing en verandering
- 493 Paul C. van Batenburg and J. Kriens
Applications of statistical methods and techniques to auditing and accounting
- 494 Ruud T. Frambach
The diffusion of innovations: the influence of supply-side factors
- 495 J.H.J. Roemen
A decision rule for the (des)investments in the dairy cow stock
- 496 Hans Kremers and Dolf Talman
An SLSPP-algorithm to compute an equilibrium in an economy with linear production technologies

- 497 L.W.G. Strijbosch and R.M.J. Heuts
Investigating several alternatives for estimating the compound lead time demand in an (s,Q) inventory model
- 498 Bert Bettonvil and Jack P.C. Kleijnen
Identifying the important factors in simulation models with many factors
- 499 Drs. H.C.A. Roest, Drs. F.L. Tijssen
Beheersing van het kwaliteitsperceptieproces bij diensten door middel van keurmerken
- 500 B.B. van der Genugten
Density of the F-statistic in the linear model with arbitrarily normal distributed errors
- 501 Harry Barkema and Sytse Douma
The direction, mode and location of corporate expansions
- 502 Gert Nieuwenhuis
Bridging the gap between a stationary point process and its Palm distribution
- 503 Chris Veld
Motives for the use of equity-warrants by Dutch companies
- 504 Pieter K. Jagersma
Een etiologie van horizontale internationale ondernemingsexpansie
- 505 B. Kaper
On M-functions and their application to input-output models
- 506 A.B.T.M. van Schaik
Productiviteit en Arbeidsparticipatie
- 507 Peter Borm, Anne van den Nouweland and Stef Tijs
Cooperation and communication restrictions: a survey
- 508 Willy Spanjers, Robert P. Gilles, Pieter H.M. Ruys
Hierarchical trade and downstream information

Bibliotheek K. U. Brabant

17 000 01066334 3