

Brekke, Kjell Arne

Working Paper — Digitized Version

Utilitarianism, Equivalence Scales and Logarithmic Utility

Discussion Papers, No. 118

Provided in Cooperation with:

Research Department, Statistics Norway, Oslo

Suggested Citation: Brekke, Kjell Arne (1994) : Utilitarianism, Equivalence Scales and Logarithmic Utility, Discussion Papers, No. 118, Statistics Norway, Research Department, Oslo

This Version is available at:

<https://hdl.handle.net/10419/192102>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

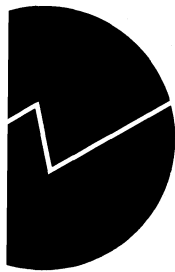
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Kjell Arne Brekke

**Utilitarianism, Equivalence Scales
and Logarithmic Utility**

Discussion



Kjell Arne Brekke

Utilitarianism, Equivalence Scales and Logarithmic Utility

Abstract:

It is shown that if social welfare is the sum of logarithmic utility function, the optimal income distribution and the welfare effect of any income redistribution is independent of the equivalence scales. In optimum all households have the same per capita income. Based on this observation it is discussed to what extent traditional welfare theory can be said to be concerned about fair income distribution.

Keywords: Equivalence scales, income distribution, logarithmic utility.

JEL classification: D10, D31, D63.

Acknowledgement: Helpful comments from Dale Jorgenson, Rolf Aaberge and Jørgen Aasness are gratefully acknowledged.

Correspondence: Kjell Arne Brekke, Statistics Norway, Research Department,
P.O.Box 8131 Dep., 0033 Oslo. **E-mail:** kja@ssb.no

1 Introduction

The logarithmic utility function is probably the most used functional form in applied analysis. Bernoulli (1738) resolved the St.Petersburg paradox and introduced expected utility by arguing that people have logarithmic utility. For a review of different attempts to measure cardinal utility, see Tinbergen (1991). More recently Jorgenson and Slesnick (1983) and Jorgenson (1991) have used logarithmic utilities in combination with equivalence scales. This note will point at a striking observation about this combination.

We will show that the equivalence scales does not at all matter for the evaluation of social welfare, defined as the sum of logarithmic utility functions. For any set of equivalence scales, the optimal income distribution is that all households have the same per capital consumption. Given the functional form of the utility function, the equivalence scales determines both the ordinal level comparison and the cardinal unit comparison of utility between household. Since Arrows impossibility theorem (Arrow, 1963) and later the results of Parks (1976) and Kemps and Ng (1976), such comparisons has been known to be essential to social welfare functions of the Bergson Samuelson type. It may thus be a bit of a surprise that the equivalence scale does not at all affect the optimization of this welfare functions.

2 Welfare and equivalence scales

2.1 The main result

Let $u(y, z)$ be the utility function of the household h with income y and characteristics z , and let n_h denote the number of individuals in this household. Assuming that the utility function is logarithmic, we normalize the utility function for the reference household z_0 such that $u(y, z_0) = \ln(y)$. The utility function of household z can now be written as

$$u(y, z) = \ln\left(\frac{y}{m(z)}\right) = \ln(y) - \ln(m(z)),$$

where $m(z)$ is the equivalence scale of this household. We note first that a shift in the equivalence scale only affects the last term, and hence the marginal utility of this household is independent of the equivalence scale.

Assuming that all individuals in the household have the same utility, the total utility of the household h with income y_h and characteristics z_h is $n_h u(y_h; z_h)$. If the welfare function is utilitarian, i.e., the sum of all individual utility functions, social welfare is

$$(1) \quad \sum_{h=1}^H n_h \ln\left(\frac{y_h}{m(z_h)}\right) = \sum_{h=1}^H n_h \ln(y_h) - \sum_{h=1}^H n_h \ln(m(z_h)),$$

where H is the number of households. Maximizing this welfare subject to the budget constraint $\sum_h y_h = W$, where W is total wealth, we get $\frac{n_h}{y_h} = \lambda$, where λ is the shadow price on the budget constraint. For any two household h and h' we thus have

$$(2) \quad \frac{y_h}{n_h} = \frac{y_{h'}}{n_{h'}}.$$

Thus all households should have the same per capita income.

This result reflects a delicate balance between two different effects. Note that the higher the ratio $\frac{n_h}{m(z_h)}$, the better off is the household in the optimum, and the better off the household is, the lower its marginal utility. But at the same time the ratio $\frac{n_h}{m(z_h)}$ measures the efficiency of the household. While it takes $n_h \Delta y$ to increase the income of n_h single households with the amount Δy , a similar improvement of utility for the n_h individuals in the household h only takes $m(z_h) \Delta y$. This is true provided the households and the single persons was initially equally well off. Thus the society gets more utility per dollar by giving it to the household rather than to the single person. A shift in the equivalence scale will shift both the level of utility and the efficiency of the household. With logarithmic utility these two effects just balances, and the optimum income distribution is not affected by a shift in the equivalence scales.

This result is only valid when the utility function is logarithmic and the social welfare function is sum of individual utility. Moreover it only applies to income distribution. To illustrate the importance of them, we consider how altering these assumption would affect the result. We first consider the assumption that utility is logarithmic.

2.2 CRRA-utilities

The logarithmic utility function is a special case of the CRRA class of utility functions

$$u(y) = \begin{cases} \frac{1}{1-\alpha} y^{1-\alpha} & \text{for } \alpha \geq 0, \alpha \neq 1 \\ \ln(y) & \text{for } \alpha = 1 \end{cases}$$

Within this class of utility function the optimal income distribution is easily shown to satisfy, for $\alpha \neq 0$,

$$\frac{y_h}{n_h} \left(\frac{m(z_h)}{n_h} \right)^{\frac{1-\alpha}{\alpha}} = \frac{y_{h'}}{n_{h'}} \left(\frac{m(z_{h'})}{n_{h'}} \right)^{\frac{1-\alpha}{\alpha}}.$$

In this case the equivalence scales have very different effect depending on the size of α . One extreme case is $\alpha = 0$, then the household with the highest $\frac{n_h}{m(z_h)}$ ratio get all the income. The reason for this is that marginal utility is insensitive to the level of income. A family with many members relative to their equivalence scale will thus generate most utility per dollar independent of the initial income distribution.

The other extreme is $\alpha = \infty$. in this case the marginal utility is extremely sensitive to the income level, and completely dominates the effect of scale efficiency. Since

$$\lim_{\alpha \rightarrow \infty} \frac{y_h}{n_h} \left(\frac{m(z_h)}{n_h} \right)^{\frac{1-\alpha}{\alpha}} = \frac{y_h}{m(z_h)},$$

the optimum income is distributed so that all are equally well off.

2.3 Weighting household utility

Within the utilitarian tradition of maximizing total utility, the household utility should be given a weight equal to the number of individuals in the household. But this is not the only choice used in the literature. In the welfare function introduced by Jorgenson and Slesnick (1983), each household is given a weight equal to its equivalence scale. In the limiting case with no 'inequality aversion', their welfare function is proportional to

$$\sum_{h=1}^H m(z_h) \ln\left(\frac{y_h}{m(z_h)}\right).$$

In this case the optimal income distribution is to make everybody equally well off in terms of utility. (This is seen from (2) simply by substituting m for n .) But why should the household utility be weighted this way?

There is n_h members of the household no matter what it takes to make them as well off as the reference household. The utilitarian welfare function is thus to use n_h as weights. On the other hand, the famous argument of utilitarianism due to Harsanyi (1955) only proved that welfare should be a weighted sum of individual utilities. The welfare weights used by Jorgenson and Slesnick (1983) is thus consistent with Harsanyi's theorem. The observation that utility is equally distributed when $m(z_h)$ is chosen as weight may then be used to justify this approach. Note that the standard assumption that all household share their resources

to give everybody within the household the same utility, implies that the households uses similar weights within the household.

2.4 Aversion to inequality

The welfare function of Jorgenson and Slesnick (1983) also deviates from the utilitarian by an aversion to inequality. Aversion to inequality may be represented through a non-linear social welfare function. Let social welfare be $W(u_1, \dots, u_I)$, where I is the number of *individuals* in the society. Each individual has the utility of its household, thus each households utility appears n_h times in the welfare function. Inequality aversion would be represented as the assumption that $W''_{u_i} < 0$, i.e., an extra unit of utility to individual i in household h contributes less to social welfare the higher utility household h has. Maximizing social welfare with logarithmic utility subject to the social budget constraint, give that for any two households

$$\frac{y_h}{n_h} = \frac{W'_{u_h}}{W'_{u_{h'}}} \frac{y_{h'}}{n_{h'}}.$$

Thus per capita income should be proportional to the social value of household utility, $W'_{u_h} = W'_{u_i}$ where i is any member of household h . The higher the equivalence scale the household has the lower its welfare and hence the higher is the social value of household utility, and hence the larger share of the total wealth will the household get in optimum.

2.5 Price changes

An important application of equivalence scales is the study of the effects of price changes. Generally the equivalence scale will depend on the price vector, p , thus the equivalence scale may be written $m(p, z_h)$. A shift in the price will affect the last term of the welfare function (1) and hence these effects will depend on the equivalence scales. Thus, even with utilitarian welfare functions and logarithmic utility, equivalence scales are needed to evaluate the welfare effects of shift in relative prices.

3 Equality and utilitarianism

Utilitarianism only requires interpersonal comparison of utility differences, comparison of utility levels is not needed. The equivalence scale determines how much a household need to be as well off as a reference household, which is an level comparisons. In the particular case

of logarithmic utilities, the equivalence scale has no effect on marginal utility, and hence has no effect on a utilitarian maximization. The conclusion of this paper is in this sense intuitively obvious.

On the other hand, the measures of inequality in income distribution proposed by Atkinson (1970) may be given an utilitarian interpretation. If everybody has the same utility function and marginal utility is decreasing, the optimal income distribution is total equality, and the inequality measure is the welfare loss compared to the case where the same total income is equally distributed. From this perspective it seems surprising that the equivalence scale does not at all matter.

Under the heading "equality of what" Sen (1992) argues that all moral philosophies are concerned about equality in some space. Rawls (1972) argues for equal rights and equal distribution of primary goods. Dworkin (1981) argues for equal distribution of resources, and Sen himself for equality in terms of functionings or capabilities and utilitarians argues that marginal utility should be equal. In a review of Sen (1992), Sugden (1993) questions this argument. He points out that while it is true that utilitarianism prescribes equal marginal utility, it is misleading to interpret this as a concern about equality; it is just an equivalent statement of the objective to maximize total utility. It does not make sense to say that utilitarians consider marginal utility to be so important that it should be distributed fairly, while the same statement with marginal utility replaced with primary goods, would be a reasonable description of Rawls position. The above result further illustrates this point.

Consider the distribution of income between two single-person households, one able and one strongly handicapped. The utilitarians may agree that the handicapped person needs much more income than the able to be equally well off, that is the equivalence scale may be quite high. The welfare effect of a redistribution of income between them will, however, be independent of such consideration. If the equivalence scale is low, close to 1, the disabled is almost as well off as the able, and need no extra income, while if the equivalence scale is high, the disabled is much worse off if their income is equal. Still a redistribution is not optimal, since the disabled is less efficient to produce utility from a dollar. The one parameter that determines both ordinal level and cardinal unit comparability does not matter. The inequality in terms of utility may be quite substantial, depending upon how much it takes for the disabled to be as well off as the able person. No matter how large the equivalence scale is, the utilitarian optimum is equal per capita income.

References

- [1] Atkinson, A.B. (1970): "On the Measurement of Inequality", *Journal of Economic Theory*, Vol 2, pp. 244-263.
- [2] Arrow, K.J. (1963): *Social Choice and Individual Values*, John Wiley and Sons, New York, second edition (first edition 1951).
- [3] Bernoulli, D. (1738): "Specimen theoriae novae de mensura sortis", printed in English translation in *Econometrica*, 1954, Vol 22, pp23-36.
- [4] Dworkin, G. (1981): "What is equality? Part 1: Equality of Welfare" and "What is Equality? Part 2: Equality of Resources", *Philosophy and Public Affairs*, Vol 10.
- [5] Harsanyi, J. D. (1955): "Cardinal Welfare, Individual Ethics and Interpersonal Comparison of Utility", *Journal of Political Economy*, Vol 63.
- [6] Jorgenson, D. W. and D. T. Slesnick (1983): "Individual and Social Cost of Living Indexes," in Diewert and Montmarquette (eds.): *Price Level Measurement*, Ottawa: Statistics Canada.
- [7] Jorgenson, D. W. (1990): "Aggregate Consumer Behavior and the Measurement of Social Welfare", *Econometrica*, Vol 58, pp 1007-1040.
- [8] Kemp, M. C. and Y. -K. Ng (1976): "On the existence of Social Welfare Functions: Social Orderings and Social Decision Functions," *Economica*, 43, pp 59-66.
- [9] Parks, R.P. (1976): "An Impossibility Theorem for Fixed Preferences: A Dictatorial Bergson-Samuelson Social Welfare Function," *Review of Economic Studies*, 43, pp 447-450.
- [10] Rawls, J. (1971): *A Theory of Justice*, Harvard University Press, Cambridge, Massachusetts
- [11] Sen, A.K. (1992): *Inequality reexamined*, Cambridge: Harvard University Press.
- [12] Sugden, (1993): "Welfare, Resources and Capabilities: A Review of *Inequality Reexamined* by Amartya Sen", *Journal of Economic Literature*, Vol XXXI, pp 1947-1962

Issued in the series Discussion Papers

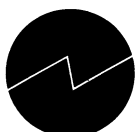
- | | | | |
|--------|--|--------|--|
| No. 1 | <i>I. Aslaksen and O. Bjerkholt (1985):</i> Certainty Equivalence Procedures in the Macroeconomic Planning of an Oil Economy | No. 24 | <i>J.K. Dagsvik and R. Aaberge (1987):</i> Stochastic Properties and Functional Forms of Life Cycle Models for Transitions into and out of Employment |
| No. 3 | <i>E. Biørn (1985):</i> On the Prediction of Population Totals from Sample surveys Based on Rotating Panels | No. 25 | <i>T.J. Klette (1987):</i> Taxing or Subsidising an Exporting Industry |
| No. 4 | <i>P. Frenger (1985):</i> A Short Run Dynamic Equilibrium Model of the Norwegian Production Sectors | No. 26 | <i>K.J. Berger, O. Bjerkholt and Ø. Olsen (1987):</i> What are the Options for non-OPEC Countries |
| No. 5 | <i>I. Aslaksen and O. Bjerkholt (1985):</i> Certainty Equivalence Procedures in Decision-Making under Uncertainty: An Empirical Application | No. 27 | <i>A. Aaheim (1987):</i> Depletion of Large Gas Fields with Thin Oil Layers and Uncertain Stocks |
| No. 6 | <i>E. Biørn (1985):</i> Depreciation Profiles and the User Cost of Capital | No. 28 | <i>J.K. Dagsvik (1987):</i> A Modification of Heckman's Two Stage Estimation Procedure that is Applicable when the Budget Set is Convex |
| No. 7 | <i>P. Frenger (1985):</i> A Directional Shadow Elasticity of Substitution | No. 29 | <i>K. Berger, Å. Cappelen and I. Svendsen (1988):</i> Investment Booms in an Oil Economy - The Norwegian Case |
| No. 8 | <i>S. Longva, L. Lorentsen and Ø. Olsen (1985):</i> The Multi-Sectoral Model MSG-4, Formal Structure and Empirical Characteristics | No. 30 | <i>A. Rygh Swensen (1988):</i> Estimating Change in a Proportion by Combining Measurements from a True and a Fallible Classifier |
| No. 9 | <i>J. Fagerberg and G. Sollie (1985):</i> The Method of Constant Market Shares Revisited | No. 31 | <i>J.K. Dagsvik (1988):</i> The Continuous Generalized Extreme Value Model with Special Reference to Static Models of Labor Supply |
| No. 10 | <i>E. Biørn (1985):</i> Specification of Consumer Demand Models with Stochastic Elements in the Utility Function and the first Order Conditions | No. 32 | <i>K. Berger, M. Hoel, S. Holden and Ø. Olsen (1988):</i> The Oil Market as an Oligopoly |
| No. 11 | <i>E. Biørn, E. Holmøy and Ø. Olsen (1985):</i> Gross and Net Capital, Productivity and the form of the Survival Function. Some Norwegian Evidence | No. 33 | <i>I.A.K. Anderson, J.K. Dagsvik, S. Strøm and T. Wennemo (1988):</i> Non-Convex Budget Set, Hours Restrictions and Labor Supply in Sweden |
| No. 12 | <i>J.K. Dagsvik (1985):</i> Markov Chains Generated by Maximizing Components of Multidimensional Extremal Processes | No. 34 | <i>E. Holmøy and Ø. Olsen (1988):</i> A Note on Myopic Decision Rules in the Neoclassical Theory of Producer Behaviour, 1988 |
| No. 13 | <i>E. Biørn, M. Jensen and M. Reymert (1985):</i> KVARTS - A Quarterly Model of the Norwegian Economy | No. 35 | <i>E. Biørn and H. Olsen (1988):</i> Production - Demand Adjustment in Norwegian Manufacturing: A Quarterly Error Correction Model, 1988 |
| No. 14 | <i>R. Aaberge (1986):</i> On the Problem of Measuring Inequality | No. 36 | <i>J.K. Dagsvik and S. Strøm (1988):</i> A Labor Supply Model for Married Couples with Non-Convex Budget Sets and Latent Rationing, 1988 |
| No. 15 | <i>A.-M. Jensen and T. Schweder (1986):</i> The Engine of Fertility - Influenced by Interbirth Employment | No. 37 | <i>T. Skoglund and A. Stokka (1988):</i> Problems of Linking Single-Region and Multiregional Economic Models, 1988 |
| No. 16 | <i>E. Biørn (1986):</i> Energy Price Changes, and Induced Scrapping and Revaluation of Capital - A Putty-Clay Model | No. 38 | <i>T.J. Klette (1988):</i> The Norwegian Aluminium Industry, Electricity prices and Welfare, 1988 |
| No. 17 | <i>E. Biørn and P. Frenger (1986):</i> Expectations, Substitution, and Scrapping in a Putty-Clay Model | No. 39 | <i>I. Aslaksen, O. Bjerkholt and K.A. Brekke (1988):</i> Optimal Sequencing of Hydroelectric and Thermal Power Generation under Energy Price Uncertainty and Demand Fluctuations, 1988 |
| No. 18 | <i>R. Bergan, Å. Cappelen, S. Longva and N.M. Siølen (1986):</i> MODAG A - A Medium Term Annual Macroeconomic Model of the Norwegian Economy | No. 40 | <i>O. Bjerkholt and K.A. Brekke (1988):</i> Optimal Starting and Stopping Rules for Resource Depletion when Price is Exogenous and Stochastic, 1988 |
| No. 19 | <i>E. Biørn and H. Olsen (1986):</i> A Generalized Single Equation Error Correction Model and its Application to Quarterly Data | No. 41 | <i>J. Aasness, E. Biørn and T. Skjerpen (1988):</i> Engel Functions, Panel Data and Latent Variables, 1988 |
| No. 20 | <i>K.H. Alfsen, D.A. Hanson and S. Glomsrød (1986):</i> Direct and Indirect Effects of reducing SO ₂ Emissions: Experimental Calculations of the MSG-4E Model | No. 42 | <i>R. Aaberge, Ø. Kravdal and T. Wennemo (1989):</i> Unobserved Heterogeneity in Models of Marriage Dissolution, 1989 |
| No. 21 | <i>J.K. Dagsvik (1987):</i> Econometric Analysis of Labor Supply in a Life Cycle Context with Uncertainty | No. 43 | <i>K.A. Mork, H.T. Mysen and Ø. Olsen (1989):</i> Business Cycles and Oil Price Fluctuations: Some evidence for six OECD countries. 1989 |
| No. 22 | <i>K.A. Brekke, E. Gjelsvik and B.H. Vatne (1987):</i> A Dynamic Supply Side Game Applied to the European Gas Market | | |
| No. 23 | <i>S. Bartlett, J.K. Dagsvik, Ø. Olsen and S. Strøm (1987):</i> Fuel Choice and the Demand for Natural Gas in Western European Households | | |

- No. 44 *B. Bye, T. Bye and L. Lorentsen (1989)*: SIMEN. Studies of Industry, Environment and Energy towards 2000, 1989
- No. 45 *O. Bjerkholt, E. Gjelsvik and Ø. Olsen (1989)*: Gas Trade and Demand in Northwest Europe: Regulation, Bargaining and Competition
- No. 46 *L.S. Stambøl and K.Ø. Sørensen (1989)*: Migration Analysis and Regional Population Projections, 1989
- No. 47 *V. Christiansen (1990)*: A Note on the Short Run Versus Long Run Welfare Gain from a Tax Reform, 1990
- No. 48 *S. Glomsrød, H. Vennemo and T. Johnsen (1990)*: Stabilization of Emissions of CO₂: A Computable General Equilibrium Assessment, 1990
- No. 49 *J. Aasness (1990)*: Properties of Demand Functions for Linear Consumption Aggregates, 1990
- No. 50 *J.G. de Leon (1990)*: Empirical EDA Models to Fit and Project Time Series of Age-Specific Mortality Rates, 1990
- No. 51 *J.G. de Leon (1990)*: Recent Developments in Parity Progression Intensities in Norway. An Analysis Based on Population Register Data
- No. 52 *R. Aaberge and T. Wennemo (1990)*: Non-Stationary Inflow and Duration of Unemployment
- No. 53 *R. Aaberge, J.K. Dagsvik and S. Strøm (1990)*: Labor Supply, Income Distribution and Excess Burden of Personal Income Taxation in Sweden
- No. 54 *R. Aaberge, J.K. Dagsvik and S. Strøm (1990)*: Labor Supply, Income Distribution and Excess Burden of Personal Income Taxation in Norway
- No. 55 *H. Vennemo (1990)*: Optimal Taxation in Applied General Equilibrium Models Adopting the Armington Assumption
- No. 56 *N.M. Stølen (1990)*: Is there a NAIRU in Norway?
- No. 57 *Å. Cappelen (1991)*: Macroeconomic Modelling: The Norwegian Experience
- No. 58 *J. Dagsvik and R. Aaberge (1991)*: Household Production, Consumption and Time Allocation in Peru
- No. 59 *R. Aaberge and J. Dagsvik (1991)*: Inequality in Distribution of Hours of Work and Consumption in Peru
- No. 60 *T.J. Klette (1991)*: On the Importance of R&D and Ownership for Productivity Growth. Evidence from Norwegian Micro-Data 1976-85
- No. 61 *K.H. Alfsen (1991)*: Use of Macroeconomic Models in Analysis of Environmental Problems in Norway and Consequences for Environmental Statistics
- No. 62 *H. Vennemo (1991)*: An Applied General Equilibrium Assessment of the Marginal Cost of Public Funds in Norway
- No. 63 *H. Vennemo (1991)*: The Marginal Cost of Public Funds: A Comment on the Literature
- No. 64 *A. Brendemoen and H. Vennemo (1991)*: A climate convention and the Norwegian economy: A CGE assessment
- No. 65 *K. A. Brekke (1991)*: Net National Product as a Welfare Indicator
- No. 66 *E. Bowitz and E. Storm (1991)*: Will Restrictive Demand Policy Improve Public Sector Balance?
- No. 67 *Å. Cappelen (1991)*: MODAG. A Medium Term Macroeconomic Model of the Norwegian Economy
- No. 68 *B. Bye (1992)*: Modelling Consumers' Energy Demand
- No. 69 *K. H. Alfsen, A. Brendemoen and S. Glomsrød (1992)*: Benefits of Climate Policies: Some Tentative Calculations
- No. 70 *R. Aaberge, Xiaojie Chen, Jing Li and Xuezheng Li (1992)*: The Structure of Economic Inequality among Households Living in Urban Sichuan and Liaoning, 1990
- No. 71 *K.H. Alfsen, K.A. Brekke, F. Brunvoll, H. Lurås, K. Nyborg and H.W. Sæbø (1992)*: Environmental Indicators
- No. 72 *B. Bye and E. Holmøy (1992)*: Dynamic Equilibrium Adjustments to a Terms of Trade Disturbance
- No. 73 *O. Aukrust (1992)*: The Scandinavian Contribution to National Accounting
- No. 74 *J. Aasness, E. Eide and T. Skjerpen (1992)*: A Criminometric Study Using Panel Data and Latent Variables
- No. 75 *R. Aaberge and Xuezheng Li (1992)*: The Trend in Income Inequality in Urban Sichuan and Liaoning, 1986-1990
- No. 76 *J.K. Dagsvik and Steinar Strøm (1992)*: Labor Supply with Non-convex Budget Sets, Hours Restriction and Non-pecuniary Job-attributes
- No. 77 *J.K. Dagsvik (1992)*: Intertemporal Discrete Choice, Random Tastes and Functional Form
- No. 78 *H. Vennemo (1993)*: Tax Reforms when Utility is Composed of Additive Functions
- No. 79 *J. K. Dagsvik (1993)*: Discrete and Continuous Choice, Max-stable Processes and Independence from Irrelevant Attributes
- No. 80 *J. K. Dagsvik (1993)*: How Large is the Class of Generalized Extreme Value Random Utility Models?
- No. 81 *H. Birkelund, E. Gjelsvik, M. Aaserud (1993)*: Carbon/energy Taxes and the Energy Market in Western Europe
- No. 82 *E. Bowitz (1993)*: Unemployment and the Growth in the Number of Recipients of Disability Benefits in Norway
- No. 83 *L. Andreassen (1993)*: Theoretical and Econometric Modeling of Disequilibrium
- No. 84 *K.A. Brekke (1993)*: Do Cost-Benefit Analyses favour Environmentalists?
- No. 85 *L. Andreassen (1993)*: Demographic Forecasting with a Dynamic Stochastic Microsimulation Model
- No. 86 *G.B. Asheim and K.A. Brekke (1993)*: Sustainability when Resource Management has Stochastic Consequences
- No. 87 *O. Bjerkholt and Yu Zhu (1993)*: Living Conditions of Urban Chinese Households around 1990
- No. 88 *R. Aaberge (1993)*: Theoretical Foundations of Lorenz Curve Orderings
- No. 89 *J. Aasness, E. Biørn and T. Skjerpen (1993)*: Engel Functions, Panel Data, and Latent Variables - with Detailed Results

- No. 90 *Ingvild Svendsen (1993)*: Testing the Rational Expectations Hypothesis Using Norwegian Microeconomic Data Testing the REH. Using Norwegian Microeconomic Data
- No. 91 *Einar Bowütz, Asbjørn Rødseth and Erik Storm (1993)*: Fiscal Expansion, the Budget Deficit and the Economy: Norway 1988-91
- No. 92 *Rolf Aaberge, Ugo Colombino and Steinar Strøm (1993)*: Labor Supply in Italy
- No. 93 *Tor Jakob Klette (1993)*: Is Price Equal to Marginal Costs? An Integrated Study of Price-Cost Margins and Scale Economies among Norwegian Manufacturing Establishments 1975-90
- No. 94 *John K. Dagsvik (1993)*: Choice Probabilities and Equilibrium Conditions in a Matching Market with Flexible Contracts
- No. 95 *Tom Kornstad (1993)*: Empirical Approaches for Analysing Consumption and Labour Supply in a Life Cycle Perspective
- No. 96 *Tom Kornstad (1993)*: An Empirical Life Cycle Model of Savings, Labour Supply and Consumption without Intertemporal Separability
- No. 97 *Snorre Kverndokk (1993)*: Coalitions and Side Payments in International CO₂ Treaties
- No. 98 *Torbjørn Eika (1993)*: Wage Equations in Macro Models. Phillips Curve versus Error Correction Model Determination of Wages in Large-Scale UK Macro Models
- No. 99 *Anne Brendemoen and Haakon Vennemo (1993)*: The Marginal Cost of Funds in the Presence of External Effects
- No. 100 *Kjersti-Gro Lindquist (1993)*: Empirical Modelling of Norwegian Exports: A Disaggregated Approach
- No. 101 *Anne Sofie Jore, Terje Skjærpen and Anders Rygh Swensen (1993)*: Testing for Purchasing Power Parity and Interest Rate Parities on Norwegian Data
- No. 102 *Runa Nesbakken and Steinar Strøm (1993)*: The Choice of Space Heating System and Energy Consumption in Norwegian Households (Will be issued later)
- No. 103 *Asbjørn Aaheim and Karine Nyborg (1993)*: "Green National Product": Good Intentions, Poor Device?
- No. 104 *Knut H. Alfsen, Hugo Birkelund and Morten Aaserud (1993)*: Secondary benefits of the EC Carbon/ Energy Tax
- No. 105 *Jørgen Aasness and Bjart Holtmark (1993)*: Consumer Demand in a General Equilibrium Model for Environmental Analysis
- No. 106 *Kjersti-Gro Lindquist (1993)*: The Existence of Factor Substitution in the Primary Aluminium Industry: A Multivariate Error Correction Approach on Norwegian Panel Data
- No. 107 *Snorre Kverndokk (1994)*: Depletion of Fossil Fuels and the Impacts of Global Warming
- No. 108 *Knut A. Magnussen (1994)*: Precautionary Saving and Old-Age Pensions
- No. 109 *Frode Johansen (1994)*: Investment and Financial Constraints: An Empirical Analysis of Norwegian Firms
- No. 110 *Kjell Arne Brekke and Pål Børing (1994)*: The Volatility of Oil Wealth under Uncertainty about Parameter Values
- No. 111 *Margaret J. Simpson (1994)*: Foreign Control and Norwegian Manufacturing Performance
- No. 112 *Yngve Willassen and Tor Jakob Klette (1994)*: Correlated Measurement Errors, Bound on Parameters, and a Model of Producer Behavior
- No. 113 *Dag Wetterwald (1994)*: Car ownership and private car use. A microeconomic analysis based on Norwegian data
- No. 114 *Knut Einar Rosendahl (1994)*: Does Improved Environmental Policy Enhance Economic Growth? Endogenous Growth Theory Applied to Developing Countries
- No. 115 *Leif Andreassen, Dennis Fredriksen and Olav Ljones (1994)*: The Future Burden of Public Pension Benefits. A Microsimulation Study
- No. 116 *Anne Brendemoen (1994)*: Car Ownership Decisions in Norwegian Households.
- No. 117 *Audun Langørgen (1994)*: A Macromodel of Local Government Spending Behaviour in Norway
- No. 118 *Kjell Arne Brekke (1994)*: Utilitarianism, Equivalence Scales and Logarithmic Utility

Statistics Norway
Research Department
P.O.B. 8131 Dep.
N-0033 Oslo

Tel.: +47-22 86 45 00
Fax: +47-22 11 12 38



Statistics Norway
Research Department