Discussion Papers No. 392, October 2004
Statistics Norway, Research Department

Turid Åvitsland and Jørgen Aasness

Combining CGE and microsimulation models: Effects on equality of VAT reforms

Abstract:
The effects on the degree of equality of reforms in indirect taxation are analysed by using a microsimulation model of the Norwegian economy subsequent to a CGE model. The two main reforms studied are substitution of a uniform VAT rate on all goods and services and substitution of the non-uniform Norwegian VAT reform of 2001 for the previous, differentiated system. A main characteristic of the non-uniform reform is the halving of the VAT rate on food. All reforms are made public revenue neutral by changes in the VAT rate. Producer prices, pre-tax nominal incomes, wealth and transfers are all exogenous in the microsimulation model. In this paper we feed percentage changes in corresponding variables from the CGE model into the microsimulation model in order to enrich the microsimulation analyses. The non-uniform VAT reform leads to a clear increase in equality while the change in equality concerning the uniform reform is close to 0. With the uniform VAT reform, as opposed to the non-uniform, decompositions show that taking CGE effects into account has a large impact on the degree of equality. Changed producer prices and changed pre-tax nominal incomes, wealth and transfers both contribute to this.

Keywords: CGE and microsimulation models, "Macro-micro" links, Indirect taxation, VAT reforms, Equality.

JEL classification: D3, D58, D61, D63, H2

Acknowledgement: The authors would like to thank Kirsten Hansen, Mohamed F. Hussein and Bård Lian for assistance with applying the microsimulation model. We would also like to thank Brita Bye for initiating the project and for reading and commenting on an earlier draft, Ådne Cappelen for comments and the Norwegian Research Council for financial support (grant no. 143631/510).

Address: Jørgen Aasness, Statistics Norway, Research Department.
E-mail: jorgen.aasness@ssb.no

Turid Åvitsland, Statistics Norway, Research Department. E-mail: turid.avitsland@ssb.no

Discussion Papers comprise research papers intended for international journals or books. A preprint of a Discussion Paper may be longer and more elaborate than a standard journal article, as it may include intermediate calculations and background material etc.

Abstracts with downloadable Discussion Papers
in PDF are available on the Internet:
http://www.ssb.no
http://ideas.repec.org/s/ssb/dispap.html

For printed Discussion Papers contact:

Statistics Norway
Sales- and subscription service
NO-2225 Kongsvinger

Telephone: +47 62 88 55 00
Telefax: +47 62 88 55 95
E-mail: Salg-abonnement@ssb.no

1. Introduction

When evaluating tax reforms, effects on efficiency and equality are of prime interest. The standard tool for applied, efficiency analyses of tax reforms in specific economies is computable general equilibrium (CGE) models. Often these include only one representative consumer, making it impossible to study effects on equality between different households. CGE models with more than one consumer do exist but are likely to have only a small number of representative household groups. This fact may imply that the equality part of the analysis will tend to be too crude. Microsimulation models are therefore apt to be the preferred instrument when applied, equality analyses of tax reforms in specific economies are undertaken. However, these models often assume unchanged producer prices, pre-tax nominal incomes, wealth and transfers and may therefore miss valuable information because of their partial nature.

Efficiency effects in the Norwegian economy of three indirect taxation reforms, made public revenue neutral by changes in the VAT rate, have earlier been analysed by Bye, Strøm and Åvitsland (2004). They employed a CGE model with one representative consumer, disregarding equality effects. In this paper we analyse effects on equality of the same three indirect taxation reforms. For this purpose, a microsimulation model of the Norwegian economy is used subsequent to the mentioned CGE model. Producer prices, pre-tax nominal incomes, wealth and transfers are all exogenous in this microsimulation model and percentage changes in such variables from the CGE anlyses are fed into the microsimulation model. By combining CGE and microsimulation models in such a way, the equality analyses are enriched by taking into account potentially important information from the general equilibrium analyses.

Davies (2003) offers a critical survey concerning research on complementing microsimulation with CGE or macroeconomic models. He distinguishes between cases where the different model types have been merged and cases where the models have been treated in a sequential manner. Our procedure belongs to the latter. Davies (2003) stresses the paper by Bourguignon, Robilliard and Robinson (2003) as an example of the sequential approach. Bourguignon et al. (2003) employ a simple CGE model and a microsimulation model where individual incomes are endogenous and consumer prices are exogenous. The CGE model is calibrated so that aggregate individual incomes are equal to corresponding values in the microsimulation model in the baseline scenario. CGE changes in incomes are then fed into the microsimulation model by adjustment of previously estimated intercepts. The

CGE model's prices are also implemented in the microsimulation model. Their method relies on a set of assumptions that yield a degree of separability between the macro, or CGE, part of the model and the micro-econometric modeling of income generation at the household level. We employ a more advanced CGE model. Our microsimulation model is more detailed than the one used in Bourguignon et al. (2003) and both pre-tax incomes and consumer prices are exogenous in our microsimulation model. Our procedure for combining the two models includes features that ensure a certain degree of consistency, but there is not complete consistency. In particular, the change in total private consumption expenditure is not identical in the CGE and microsimulation models. However, sensitivity analysis indicates that this last inconsistency is unimportant for our results on equality effects of policy reforms.[1]

Distributional effects of taxes may be analysed at a specific moment in time or over the life cycle. Davies, St-Hilaire and Whalley (1984) find that variations in consumption's share of income is smaller in life cycle than annual data. This reduces the regressivity of taxes assumed to be born by consumption, like sales and excise taxes. In this paper we analyse distributional effects using a static microsimulation model to compare different steady state solutions of a dynamic CGE model.

The three reforms analysed in this paper are evaluated against a baseline scenario which describes the Norwegian, non-uniform, system of indirect taxation in 1995. The first reform analysed is the *general VAT reform*, where all goods and services are subject to the same VAT rate. The second reform analysed is *abolition of the investment tax*, where the investment tax is set equal to zero. This reform is both analysed separately and as part of the general VAT reform. The third reform analysed is the *political VAT reform*. This reform introduces another non-uniform VAT system, of which a main characteristic is the halving of the VAT rate on food and non-alcoholic beverages. This VAT system was actually implemented in Norway in 2001. All the three reforms are in the CGE analysis made public revenue neutral by changes in the VAT rate.

Ballard, Scholz and Shoven (1987) analyse welfare effects of adopting different VAT systems for the US. There is no VAT in their baseline scenario. They employ a CGE model with 12 consumer groups, differentiated by income class. The analysed reforms include a uniform VAT and a differentiated VAT system. The reforms are made revenue neutral by lowering the personal income tax, both in an additive and a multiplicative way. They find that rate differentiation produces a less regressive

[1] The mentioned CGE model has also been integrated with a detailed microeconometric model of labour supply, see Aaberge et al. (2004).

distribution of welfare gains and losses than those of a uniform VAT. However, for three of their four VAT simulations, the VAT is a regressive tax-policy change.

We find that the degree of equality, measured by 1 minus the Gini-coefficient, is clearly increased with the political VAT reform. For the general VAT reform the change in equality is close to 0. Decompositions show that for both the political and general VAT reform the change in consumer prices contributes to increase the degree of equality. This fact is most distinct with the political VAT reform and may be explained by the halving of the VAT rate on food and non-alcoholic beverages. The change in after-tax disposable income implies a reduction in the degree of equality with the general VAT reform but is of no importance concerning the political VAT reform.

Other decompositions show that including CGE effects has a large impact on the degree of equality concerning the general VAT reform. More specifically, both changed producer prices and changed pre-tax nominal incomes, wealth and transfers contribute to reduce the increase in equality. For the political reform, including CGE effects is not important.

The paper is organised as follows; section 2 gives a short description of the CGE model and microsimulation model employed in the analyses. Section 3 describes the policy experiments in more detail. Section 4 deals with how the CGE and microsimulation models are combined and evaluates our linking procedure. The numerical equality results are given in section 5, including some decompositions. Section 6 concludes.

2. Basic features of the models

2.1 The CGE model

The model employed in Bye et al. (2004) is a numerical intertemporal general equilibrium model for the Norwegian economy.[2] The model gives a detailed description of taxes, production and consumption structures in the Norwegian economy. The model has 41 private and 8 governmental production activities and 24 commodity groups. The next sections briefly outline some of the important features of the model. A more detailed description of the model is found in Bye (2000) and Fæhn and Holmøy (2000).

---

[2] The model has been developed by Statistics Norway. Previous versions of the model have been used routinely by the Norwegian Ministry of Finance for long-term forecasting and policy analyses.

Producer behavior and technology

The structure of the production technology is represented by a nested tree-structure of CES-aggregates. All factors are completely mobile and malleable[3]. The model of producer behavior is described in detail by Holmøy and Hægeland (1997). The model incorporates both the small open economy assumption of given world market prices, and avoids complete specialization through decreasing returns to scale. Producer behavior is generally specified at the firm level. All producers are considered as price takers in the world market, but have market power in the home market. Empirical analyses of Norwegian producer behavior support the existence of some domestic market power, see Klette (1994) and Bowitz and Cappelen (2001).

Consumer behavior

Total consumption, labor supply and savings result from the decisions of an infinitely lived representative consumer, maximizing intertemporal utility with perfect foresight. The consumer chooses a path of full consumption subject to an intertemporal budget constraint, which ensures that the present value of material consumption in all future periods does not exceed total wealth (current non-human wealth plus the present value of after tax labor income and net transfers). The distribution of full consumption on material consumption and leisure is determined by a translated CES utility function, cf. Bye (2003). Total material consumption is allocated across 24 different commodity groups according to a complete demand system based on a five level nested utility tree. Each subutility function is a translated CES where the "minimum" consumptions are linear functions of the number of children and the number of adults in the household. Fixed costs are included and economies of scale in household production are thus taken into account. The aggregate demand functions are derived by exact aggregation across all households in the population, where the number of households, adults and children in Norway are the only demographic variables that enter the aggregate demand. The same aggregate demand function can also be derived from a representative, utility maximizing consumer, where the demographic variables then can be interpreted as exogenous preference variables for the representative agent. See Aasness, Bye and Mysen (1996) for a theoretical outline, Aasness and Holtsmark (1993) for specification and calibration of an earlier version of the model, and Wold (1998) for a detailed description of the current model.

Government and intertemporal equilibrium

The government collects taxes, distributes transfers, and purchases goods and services from the industries and abroad. Overall government expenditure is exogenous and increases at a constant rate

[3] Except in the production of electricity, see Holmøy, Nordén and Strøm (1994).

equal to the steady state growth rate of the model. The model incorporates a detailed account of the government's revenues and expenditures. In the policy experiments it is required that the nominal deficit and real government spending follow the same path as in the baseline scenario, implying revenue neutrality in each period.

2.2 The microsimulation model

We have used the model LOTTE-Konsum, developed at Statistics Norway, cf. Aasness (1995) for the basic outline of the microsimulation model and Aasness, Benedictow and Hussein (2002) for a recent application. LOTTE-Konsum calculates savings, total consumption expenditure, consumption expenditure for 24 commodity groups, the number of consumption units and price indexes for each household, taking into consideration that different households have different consumption patterns. LOTTE-Konsum also calculates different measures of distributional effects for the model population, which represents the entire Norwegian population. We have developed a specific version of the model for our particular application, in order to achieve approximate consistency with the CGE analysis.

LOTTE-Konsum is based on consumer theory and econometric analysis of consumer behaviour and standard of living, and welfare theory for aggregation of standard of living over households and individuals in a population. A model for direct taxes, LOTTE, is used as a pre-model for LOTTE-Konsum. Personal pre-tax incomes, wealth and transfers are exogenous in this model, while personal tax payments are endogenous. The resulting disposable after-tax income from LOTTE is used as exogenous input into LOTTE-Konsum, cf. Aasness et al. (1995). LOTTE uses a model population of approximately 15 000 households with about 40 000 individuals, weighted to be representative for the Norwegian population. Consumer prices are exogenous in the microsimulation model.

As a measure of *the standard of living* for each individual in a household, we use total consumption per consumption unit in the household.[4] This implies that all persons belonging to the same household

---

[4] The standard of living for household k, and all its members, in situation t is $w_{kt} = c_{kt}/e_k = y_{kt}/(P_{kt}e_k)$, where total consumption of the household (c_{kt}) is defined as $c_{kt} = y_{kt}/P_{kt}$, i.e. total consumption expenditure (y_{kt}) divided by a household specific price index (P_{kt}), and e_k is the number of equivalent adults in the household in base year prices. Aasness (1995) shows that this can be interpreted as a money metric utility.

The household demand system is used to derive a system of Engel functions in base year prices and predicting non-negative budget shares for 24 commodities, adding to one, for each of the 15 000 households in the model. These budget shares are used in Laspeyres price indexes (P_{kt}) for each household k and local tax reform t. Such price indexes are approximately equal to any utility based price index for local reforms. It is the distribution of these price indexes, and the underlying distribution of budget shares, that determine the distributional effects of indirect taxes in our model. The household demand system used to generate the budget shares is the same as the one used in the CGE model, except for a modification in order to take into account corner solutions for some of the households. The microsimulation model is calibrated so that the macro budget shares for the 24 commodities are the same in the micro model and the CGE model in the base year.

has the same standard of living, a relevant assumption in the absence of information about the internal distributions within the households.[5] The households are considered as producers of standard of living for its members. We allow for the existence of economies of scale in the households, which means that the number of consumption units in a household is smaller than the number of persons in the household. For instance, a household consisting of two adults will need less than twice the income of a single adult to achieve the same standard of living. Furthermore, we assume that children need less consumption than adults to achieve the same standard of living. This is reflected in the model by a larger increase in the number of consumption units when a household is extended with an adult than with a child. This implies that large households, and families with children in particular, are relatively efficient as producers of standard of living.

An equivalence scale is used to calculate the number of consumption units in the households.[6] There exists no generally accepted foundation for empirical determination of equivalence scales. Therefore, the choice of equivalence scale is a controversial subject, see e.g. Buhman, Rainwater, Schmaus and Smeeding (1988), Atkinson (1992) and Nelson (1993). In this paper we employ the so-called OECD-scale, which implies that if the cost of living for a one-person household is normalised to 1, the cost of keeping the standard of living constant when the household is expanded with an adult is 0.7, and with a child 0.5. Several empirical studies of Norwegian consumer expenditure surveys find support for the hypothesis that the OECD-scale provides a suitable approximation, see Bojer (1977), Herigstad (1979) and Røed Larsen and Aasness (1996). We also perform sensitivity analyses of policy results with respect to the choice of equivalence scale within a wide class of scales, cf. footnote 6 and 16 for details and Aasness (1997) for discussions of sensitivity analysis within this type of continuous class of scales.

3. Baseline scenario and policy alternatives

The VAT is a tax formally paid by the purchaser of a good or service. All the different stages in the production process are participating in the calculation and collection of the VAT. A company may either be a) subject to the VAT, meaning there is a VAT on its sales[7] but VAT paid on the company's

---

[5] This can be rationalized by a household maximin welfare function of the individual utilities, cf. Blackorby and Donaldson (1993). Like them we use *household* demand functions and aggregate *individual* well-being across the population.

[6] The number of consumption units in household k, in base year prices, is defined as $e_k = (1\text{-}f(e)) + ez_{1k} + f(e)z_{2k}$, where z_{1k} and z_{2k} are the number of children and adults respectively, e is the cost of living for a child relative to a single adult, and f(e) is the cost of living for an additional adult relative to a single adult. The parameter e is assumed to lie in the interval [0,1], see Aasness (1997) or Aasness, Benedictow and Hussein (2002) for details.

[7] A special case is a VAT rate set equal to 0 (zero-rating).

purchases of material inputs and investment goods are refunded or b) not subject to the VAT, meaning there is no VAT on its sales but the VAT paid on the company's purchases of material inputs and investment goods is not refunded. The destination principle also applies, meaning that exports subject to the VAT have a rate set equal to zero, while imports subject to the VAT have the Norwegian rate attached to it.

The system of indirect taxation in 1995 (the benchmark year in both the CGE and microsimulation models) was characterized by a general liability to pay VAT on goods. There were few exemptions. There was no general liability to pay VAT on services but some were explicitly mentioned in the law and were to have a positive VAT rate. Many services were not subject to the VAT, however. Generally, the VAT rate was equal to 23 per cent. Paying of the investment tax was connected with paying of the VAT: If the company was subject to a VAT on its sales, and thereby did not pay any VAT on its material inputs or investment goods, an investment tax had to be paid. However, in addition several exemptions were specified in the investment tax Act.

The described system of indirect taxation in 1995, in addition to other taxes in the Norwegian economy, is implemented in the *baseline scenario* both in the CGE and microsimulation model.

The first policy alternative, called the *general VAT reform*, consists of a general VAT rate equal to 23 per cent on all goods and services[8]. In addition, there is VAT on the purchase of new investments in dwellings and cars, but there is no VAT on services from these consumer durables. The investment tax is simultaneously set equal to zero. The second policy alternative, called *abolition of the investment tax*[9], only sets the investment tax equal to zero.

The third policy alternative, called *the political VAT reform*, analyses the following characteristics of the actual, Norwegian VAT reform of 2001: Some more services are subject to the VAT, the general VAT rate is increased from 23 to 24 per cent and the VAT rate on food and non-alcoholic beverages is set equal to 12 per cent. In principle, the somewhat extended scope of the VAT should have led more companies to pay the investment tax. Since the investment tax was to be abolished later on, exemptions were introduced for the affected companies. The investment tax in *the political VAT reform* is therefore equal to the investment tax in the baseline scenario.

---

[8] The only exceptions from this are the banks' interest rate differential and non-profit institutions serving households where the VAT rate equals zero.

All policy alternatives are made public revenue neutral in the CGE simulations by changes in the VAT rate. The increase in the general VAT rate necessary to ensure public revenue neutrality is 1.05, 2.09 and 1.54 percentage points with the general VAT reform, abolition of the investment tax and the political VAT reform, respectively. For more details about the system of indirect taxation in the baseline scenario and the three policy alternatives, see Bye et al. (2004).

4. Combining the CGE and microsimulation model

In this paper we combine the CGE and microsimulation models by multiplying consumer prices, nominal pre-tax incomes, wealth and transfers in the microsimulation model by percentage changes in corresponding variables in the CGE model. The microsimulation model calculates personal taxes, after-tax household disposable income, total household consumption expenditure, household specific price indexes and standard of living of each person.

The two models have the following features in common: Both describe the Norwegian economy, the demand system for material consumption is almost identical in the two models, with the same 24 commodity groups, both are characterized by the VAT rates present in 1995 and both are calibrated to the benchmark year 1995. The latter fact, in addition to the fact that Bye et al. (2004) simulate the baseline scenario by keeping all exogenous variables constant at their benchmark values[10], imply that both models are characterized by 1995-prices. Two important differences between the CGE and microsimulation models are that the former has an endogenous leisure variable and is intertemporal, while the latter does not include any leisure variable and describes the situation in a particular year.

As already mentioned, we multiply microsimulation variables by percentage changes in corresponding CGE variables. These changes refer to changes from baseline scenario to policy alternative j in the CGE model's steady state.

$$(1)\ MSV^{j,t} = \frac{CGEV^{j,t^*}}{CGEV^{base,t^*}} MSV^{base,t} \Leftrightarrow \frac{MSV^{j,t}}{MSV^{base,t}} = \frac{CGEV^{j,t^*}}{CGEV^{base,t^*}}\ .$$

[9] The investment tax was actually abolished in Norway in 2002.

[10] An exception is parts of the tax system, which are substituted by the tax code of 2000. There are not any major differences between the tax code in 1995 and the tax code implemented in the CGE model, though.

$MSV^{j,t}$ and $MSV^{base,t}$ are the microsimulation variable in year t in policy alternative j and the baseline scenario, respectively. $CGEV^{j,t^*}$ and $CGEV^{base,t^*}$ are the CGE variable in year t^* in policy alternative j and the baseline scenario, respectively. In our case, t is equal to the base year (1995) in the microsimulation (and CGE) model. t^* is equal to the CGE analysis' steady state. Since Bye et al. (2004) simulate the baseline scenario by keeping all exogenous variables constant at their benchmark values the CGE model's steady state may be interpreted as representing the Norwegian economy in 1995 after it has "calmed down". The assumption we make is therefore that the ratio between a microsimulation variable in policy alternative j and baseline scenario in 1995 is equal to the corresponding ratio in the CGE model's "1995", that is the 1995-economy after it has "calmed down".

4.1 Consumer prices

There is perfect correspondence between the classification of goods and services in the CGE and microsimulation models. Linking consumer prices in the two models is therefore unproblematic. The numerical changes in consumer prices from the CGE analyses that are used as input in the microsimulation model, are presented in appendix A.

4.2 Income and wealth

As opposed to the CGE model, the microsimulation model contains a very detailed description of the tax system for personal taxpayers. This implies that the model also contains incomes and wealth at a very detailed level. In addition, the two models are based on data from different sources and there are differences in the definition of incomes in these two datasets, see Epland and Frøiland (2002). Accordingly, there is no simple one-to-one correspondence between incomes and wealth in the microsimulation and CGE models.

We have chosen to use national incomes and wealth from the CGE model. We therefore implicitly assume that households receive constant shares of the different income and wealth components in both baseline and policy alternatives such that we can employ percentage changes in the mentioned variables as exogenous input into the microsimulation model[11]. Broadly speaking, we have linked incomes in the microsimulation and CGE models as shown in table 1. The numerical changes from the CGE analyses are shown in appendix A.

[11] In our CGE simulations, public sector's net savings and net wealth are unchanged from baseline scenario to policy alternative. This implies that changes in net national savings and net wealth are equal to the private sector's change in these variables.

Table 1. Linking incomes in the microsimulation and CGE models

Microsimulation model	CGE model
Wage income	Total wage and salary payments net of social taxes for employees
Self-employed taxable income	Self-employed's risk-adjusted[1)], net[2)], pre-tax[3)] return on real capital + calculated wage income for self-employed
Dividends	Limited liability companies' risk-adjusted[1)], net[2)], pre-tax[3)] return on real capital
Interest income from foreign debtors and interest on loans to foreign creditors	Interest rate multiplied by net national debt

1) See Bye and Åvitsland (2003) and Bye et al. (2004) for an explanation of risk-adjustment in the CGE model.

2) That is after depreciation.

3) But after paying of VAT and/or investment tax on material inputs and investment goods.

We have linked wealth in the microsimulation and CGE models as shown in table 2. The numerical changes from the CGE model are reported in appendix A.

Table 2. Linking wealth in the microsimulation and CGE models

Microsimulation model	CGE model
Bank deposits abroad and debt abroad	Net national debt
Shares	Value of the real capital stock in limited liability companies
Value of dwellings for taxation purposes, private cars, self-employed's cars and machinery, self-employed's fishing boats	Value of dwellings, private cars, self-employed's cars and machinery, self-employed's fishing boats

In addition, expenses and some components of income and wealth in the microsimulation model are absent in the CGE model. We have chosen to keep these variables constant, including interest income from Norwegian debtors, interest on loans to Norwegian creditors[12], domestic bank deposits and domestic debt.

A detailed description of assumptions and the linking of income and wealth in the two models are given in appendix B.1 and B.2.

4.3 Transfers

In the CGE model, the different transfers, that is pensions, sickness benefits, unemployment benefits, child benefits, other transfers from Central Government and other transfers from Local Government,

[12] The pre-tax income concept used in the microsimulation model includes interest income but excludes interest on debt. Stipulated capital income stemming from housing is also excluded. Dwelling services are part of private consumption expenditure.

automatically change as a result of changes in the wage rate, total wage payments or the price index of aggregate private consumption. The detailed linking of transfers in the two models is reported in appendix B.3. The numerical changes in transfers from the CGE analyses are reported in appendix A.

4.4 Leisure and savings

Leisure

Leisure is part of the utility function in the CGE model, but not in the microsimulation model. Higher (lower) incomes due to increased (lower) labour supply are fed into the microsimulation model but the corresponding decrease (increase) in leisure is not taken into account. Therefore, only the positive (negative) aspects of increased (decreased) labour supply are included in the microsimulation model.

Savings

There is a somewhat analogous problem concerning savings: In steady state, net savings in real capital are zero, but real capital wealth may have increased (decreased) from baseline scenario to a policy alternative due to positive (negative) savings in real capital earlier in the path. We employ changes in income and wealth from the CGE model's steady state when linking the microsimulation and CGE model. This means that only the gains (losses) from increased (decreased) savings in real capital are taken into account when we link the two models. A similar argument applies to financial savings.

4.5 Evaluation of the linking procedure

In order to evaluate our sequential linking procedure, we compare aggregate private consumption expenditure in current prices in the two models. Both the level in the baseline scenario and the change and percentage change from baseline scenario to the three policy alternatives are compared, see table 3.

Table 3. Aggregate private consumption expenditure. Current purchaser prices. Microsimulation results versus CGE results. Billion NOK and percentage change

	General VAT reform		Abolition of investment tax		Political VAT reform	
	Microsim.	CGE	Microsim.	CGE	Microsim.	CGE
VCB in baseline scenario	452.75	428.22	452.75	428.22	452.75	428.22
Change in VCB from baseline scenario	13.14	15.25	3.54	3.84	0.03	0.07
Percentage change in VCB from baseline scenario	2.90	3.56	0.78	0.90	0.01	0.02

VCB: Aggregate private consumption expenditure measured in purchaser prices.

Numbers from the baseline scenario apply to the year 1995 in the microsimulation model, while these numbers apply to the steady state in the CGE model. The steady state numbers may, as mentioned earlier, be interpreted as representing the economy in 1995 after it has "calmed down".

Concerning evaluation of our linking procedure, the impression is that it gives quite reasonable results. There is not complete consistency, visualized by the fact that the change in aggregate private consumption expenditure is not identical in the two models. The differences between the results from the CGE and microsimulation models are not significant, however, cf. footnote 17.

5. Results

The distribution of the standard of living over a population can be summarised in several ways. In this paper, we focus on the simple aggregated measure equality (E), defined as (1 - G), where G is the Gini-coefficient[13]. The equality measure varies between 0 and 1, and the value increases when the distribution of the standard of living becomes more equal.

It is difficult to grasp whether a change in the degree of equality is large or not. We therefore "translate" a change in the degree of equality into a change in the standard of living per person, while simultaneously keeping Sen welfare constant. Sen welfare is defined as: S = WE, where S is Sen welfare, W is average standard of living per person and E is the degree of equality, cf. Sen (1974) for an axiomatic basis. The average standard of living per person, W, is in this paper measured by the real consumption expenditure per equivalent adult, taken from the microsimulation model in 1995 and E is defined as above. When Sen welfare is to be unchanged from baseline scenario to the three policy alternatives, a reforms' increase (decrease) in equality must be compensated by a decrease (increase) in the standard of living per person. Appendix C may be consulted for details.

Table 4 shows the absolute change in the degree of equality from baseline scenario to the three policy alternatives for our main simulations, 1), and for different decompositions, 2) - 8). It also shows the change in the degree of equality "translated" into a change in the standard of living per person for given Sen welfare.

---

[13] The Gini-coefficient is the most common measure of inequality in the economic literature, see Aaberge (2001) for an axiomatic foundation of the Gini-coefficient.

Table 4. Absolute change in the degree of equality from baseline scenario. Translation of this into an absolute change in NOK (Euro[14]) in the standard of living per person (W[15]) for given Sen welfare

	General VAT reform		Abolition of investment tax		Political VAT reform	
Reform in micro-simulation model	Equality	Translated into W, NOK (Euro)	Equality	Translated into W, NOK (Euro)	Equality	Translated into W, NOK (Euro)
1) a+b+c+d+e	0.00012	-69 (-8)	-0.00040	228 (27)	0.00176	-1013 (-120)
2) a	0.00118	-677 (-80)	-0.00038	217 (26)	0.00157	-903 (-107)
3) a+c+d+e	0.00057	-326 (-39)	-0.00064	364 (43)	0.00162	-932 (-111)
4) a+b	0.00073	-418 (-50)	-0.00014	80 (9)	0.00170	-978 (-116)
5) c+d+e	-0.00061	347 (41)	-0.00026	148 (18)	0.00005	-29 (-3)
6) c	-0.00231	1306 (155)	-0.00064	364 (43)	0.00001	-6 (-1)
7) d	-0.00089	506 (60)	-0.00026	148 (18)	-0.00002	11 (1)
8) e	0.00248	-1432 (-170)	0.00063	-361 (-43)	0.00005	-29 (-3)

a: changed VAT rates on consumer goods and services

b: changed producer prices from the CGE simulations

c: changed pre-tax incomes, excl. of dividends, and changed pre-tax wealth from the CGE simulations

d: changed pre-tax dividends from the CGE simulations

e: changed pre-tax transfers from the CGE simulations

Our main simulations, that is the case where all CGE effects are taken into account, (cf. 1) in table 4) show that equality is clearly increased with the political VAT reform. With the general VAT reform and abolition of the investment tax the changes in equality are close to 0[16,17].

---

[14] The exchange rate used in the calculations is equal to 8.42 NOK per Euro.

[15] W is equal to 130491 NOK (15498 Euro) in 1995.

[16] All of these conclusions hold when we perform sensitivity analyses with respect to the choice of equivalence scale (cf. footnote 6).

[17] Since our linking procedure does not ensure complete consistency, visualized by the fact that the change in aggregate private consumption expenditure is not identical in the two models, we have undertaken the following exercise: The main simulation of the general VAT reform (cf. 1) in table 4) is undertaken while simultaneously changing proportionally all incomes, wealth and transfers so that the resulting percentage change in aggregate private consumption expenditure in the microsimulation model is identical with the percentage change in the CGE model. The result shows that the change in equality is still close to 0 (-0.00005).

Decompositions show that for both the general and political VAT reform the change in consumer prices (cf. 4) in table 4) contributes to increase the degree of equality. This effect is largest for the political VAT reform, but is also distinct for the general VAT reform. The political VAT reform is characterized by a reduction in the VAT rate on food from 23 to 12 per cent. Generally, persons with a low standard of living have a larger budget share of food than persons with a high standard of living. This implies that the reduced VAT rate on food contributes to increase the degree of equality. Both the political and the general VAT reform introduce VAT on more services (the former only introduces VAT on *some* more services, while the latter introduces VAT on all services not subject to the VAT in the baseline scenario). Generally, persons with a low standard of living have a smaller budget share of services than persons with a high standard of living. These facts contribute to increase the degree of equality in the political and general VAT reform.

The partial effect on the degree of equality of changed after-tax disposable income (cf. 5) in table 4) is clearly negative with the general VAT reform and of no importance with the political VAT reform. Concerning the general VAT reform, increased transfers imply a large increase in the degree of equality (cf. 8) in table 4). Generally, transfers constitute a larger share of income for persons with a low standard of living than for persons with a high standard of living. This together with the fact that the increase in transfers is large due to a large increase in wages (in the CGE model many transfers depend upon wages), explain why the degree of equality is much increased. On the other hand, other components of after-tax disposable income have the opposite effect on the degree of equality: The increase in dividends has a clear negative effect on the degree of equality (cf. 7) in table 4) since dividends generally constitute a smaller share of income for persons with a low standard of living than for persons with a high standard of living. The increase in incomes, exclusive of dividends, and the change in wealth lead to a distinct reduction in the degree of equality (cf. 6) in table 4). This may be explained by the fact that wage income generally constitutes a smaller share of income for persons with a low standard of living than for persons with a high standard of living. The all in all negative effect on equality of changed after-tax disposable income is approximately cancelled out by the positive effect on equality of changed consumer prices concerning the general VAT reform.

With abolition of the investment tax, both changed consumer prices and changed after-tax disposable income lead to changes in equality which are close to 0.

Concerning the general VAT reform, there is a clear effect on the degree of equality from including CGE effects as compared with the case where such effects are absent (cf. 1) and 2), respectively, in table 4). More specifically, the degree of equality is close to zero when CGE effects are taken into account while the degree of equality is increased by 0.001 when CGE effects are not included. As compared with the case where CGE effects are absent (cf. 2) in table 4), including changes in producer prices (cf. 4) in table 4) and changes in pre-tax incomes, wealth and transfers (cf. 3) in table 4) both contribute to reduce the increase in the degree of equality.

With the political VAT reform, and especially with abolition of the investment tax, the effect on the degree of equality of including CGE effects, as compared with the case where such effects are absent, is of no importance. Concerning abolition of the investment tax, the partial effect of including changes in producer prices (cf. 4) in table 4) implies a smaller reduction in equality as compared with the case where CGE effects are absent (cf. 2) in table 4). On the other hand, only changing pre-tax incomes, wealth and transfers (cf. 3) in table 4) leads to a larger reduction in equality as compared with the case where CGE effects are absent (cf. 2) in table 4). Taken together, the first effect on equality is cancelled out by the second such that the degree of equality is the same in the two cases where CGE effects are included and excluded.

6. Concluding remarks

In this paper we have used a microsimulation model of the Norwegian economy subsequent to a CGE model to analyse effects on the degree of equality of three indirect taxation reforms. Efficiency effects of these three reforms have earlier been analysed by Bye et al. (2004) by employing a CGE model with one representative consumer.

The three reforms analysed in this paper are evaluated against a baseline scenario which describes the Norwegian, non-uniform, system of indirect taxation in 1995. The first reform analysed is the *general VAT reform*, where all goods and services are subject to the same VAT rate. The second reform analysed is *abolition of the investment tax*, where the investment tax is set equal to zero. This reform is both analysed separately and as part of the general VAT reform. The third reform analysed is the *political VAT reform*. This reform introduces another non-uniform VAT system, of which a main characteristic is the halving of the VAT rate on food and non-alcoholic beverages. This VAT system was actually implemented in Norway in 2001. All the three reforms are in the CGE analysis made public revenue neutral by changes in the VAT rate[18].

[18] Bye et al. (2004) find that welfare is increased with the general VAT reform, while it is reduced with the other two reforms; the political VAT reform experiencing the largest reduction.

Consumer prices, pre-tax nominal incomes, wealth and transfers are all exogenous in the microsimulation model and percentage changes in such variables from the CGE anlyses are fed into the microsimulation model. By combining CGE and microsimulation models in such a way, the equality analyses are enriched by taking into account potentially important information from the efficiency analyses.

We find that equality is clearly increased with the political VAT reform. Concerning the general VAT reform and abolition of the investment tax the changes in equality are close to 0. Decompositions show that for both the political and general VAT reforms the change in consumer prices contributes to increase the degree of equality. This fact is most distinct with the political VAT reform. The change in after-tax disposable income implies a reduction in the degree of equality with the general VAT reform but is of no importance concerning the political VAT reform. With abolition of the investment tax, both the change in consumer prices and the change in after-tax disposable income contribute to a change in the degree of equality which is close to zero.

Other decompositions show that including CGE effects, as compared with the case where CGE effects are not taken into account, has a large impact on the degree of equality concerning the general VAT reform. Both changed producer prices and changed pre-tax nominal incomes, wealth and transfers contribute to reduce the increase in equality. With the other two reforms, including CGE effects is not important.

References

Aaberge, R. (2001): Axiomatic characterization of the Gini coefficient and Lorenz curve orderings, *Journal of Economic Theory 101*, 115-132.

Aaberge, R., U. Colombino, E. Holmøy, B. Strøm and T. Wennemo (2004): Population ageing and fiscal sustainability: An integrated micro-macro analysis of required tax changes, Discussion Paper 367, Statistics Norway.

Aasness, J. (1995): A microsimulation model of consumer behavior for tax analyses, Paper presented at the Nordic seminar on microsimulation models, Oslo, May 1995.

Aasness, J. (1997): "Effects on poverty, inequality and welfare of child benefit and food subsidies» in N. Keilman, J. Lyngstad, H. Bojer, and I. Thomsen (eds): *Poverty and economic inequality in industrialized western countries*, Oslo: Scandinavian University Press, 123-140.

Aasness, J., A. Benedictow and M. F. Hussein (2002): Distributional efficiency of direct and indirect taxes, *Rapport 69, Economic Research Programme on Taxation*, Oslo: Norges Forskningsråd.

Aasness, J, T. Bye, and H. T. Mysen (1996): Welfare effects of emission taxes in Norway, *Energy Economics 18*, 335-346.

Aasness, J., E. Fjærli, H. A. Gravningsmyhr, A. M. K. Holmøy and Bård Lian (1995): The Norwegian microsimulation model LOTTE: Applications to personal and corporate taxes and social security benefits, DAE Working Papers no 9533, Microsimulation Unit, Department of Applied Economics, University of Cambridge.

Aasness, J. and B. Holtsmark (1993): Consumer demand in a general equilibrium model for environmental analysis, Discussion Paper 105, Statistics Norway.

Atkinson, A.B. (1992): Measuring poverty and differences in family composition, *Economica 59,* 1-16.

Ballard, C. L., J. K. Scholz and J. B. Shoven (1987): "The value-added tax: A general equilibrium look at its efficiency and incidence", in M. Feldstein (eds.) *The effects of taxation on capital accumulation*, University of Chicago Press, Chicago and London, 445-474.

Blackorby, C. and D. Donaldson (1993): Adult-equivalence scales and the economic implementation of interpersonal comparisons of well-being, *Social Choice and Welfare 10*, 335-61.

Bojer, H. (1977): The effects on consumption of household size and composition, *European Economic Review* **9**, 169-193.

Bourguignon, F., A.-S. Robilliard and S. Robinson (2003): Representative versus real households in the macro-economic modeling of inequality, *Working Paper,* Département et laboratoire d'économie théorique et appliquée, Paris.

Bowitz, E. and Å. Cappelen (2001): Modeling income policies: some Norwegian experiences 1973-1993, *Economic Modelling* **18**, 349-379.

Buhman, B., L. Rainwater, G. Schmaus, and T.M. Smeeding (1988), Equivalence scales, well-being, inequality, and poverty: sensitivity estimates across ten countries using the Luxembourg Income Study (LIS) database, *Review of Income and Wealth 34*, 115-142.

Bye, B. (2000): Environmental tax reform and producer foresight: An intertemporal computable general equilibrium analysis, *Journal of Policy Modeling* **22** (6), 719-752.

Bye, B. (2003): Consumer behaviour in the MSG-6 model - a revised version, *Manuscript*, Statistics Norway.

Bye, B., and E. Holmøy (1997): Household behaviour in the MSG-6 model, *Documents 97/13*, Oslo: Statistics Norway.

Bye, B., B. Strøm and T. Åvitsland (2004): Welfare effects of VAT reforms: A general equilibrium analysis, *Manuscript,* Revised version of *Discussion Paper 343*, Oslo: Statistics Norway.

Bye, B. and T. Åvitsland (2003): The welfare effects of housing taxation in a distorted economy: A general equilibrium analysis, *Economic Modelling* **20**(5), 895-921.

Davies, J. (2003): Microsimulation, CGE and Macro Modelling for Transition and Developing Countries, *Paper prepared for the UNU/WIDER conference on Inequality, Poverty and Human Well-being 30-31 May 2003, Helsinki, Finland.*

Davies, J., F. St-Hilaire and J. Whalley (1984): Some Calculations of Lifetime Tax Incidence, *American Economic Review*, **74** (4), 633-649.

Epland, J. and G. Frøiland (2002): Husholdningenes inntekter: En sammenlikning av nasjonalregnskapet og inntektsundersøkelsens inntektsbegreper, *Notater 2002/76*, Statistisk sentralbyrå.

Fæhn, T. and E. Holmøy (2000): "Welfare effect of trade liberalisation in distorted economies: A dynamic general equilibrium assessment for Norway". In Harrison, G. W. et al. (eds): *Using dynamic general equilibrium models for policy analysis*, North-Holland, Amsterdam.

Herigstad, H. (1979): Forbrukseiningar, *Rapporter 79/16*, Statistisk sentralbyrå.

Holmøy, E., and T. Hægeland (1997): Aggregate Productivity Effects and Technology Shocks in a Model of Heterogeneous Firms: The Importance of Equilibrium Adjustments, *Discussion Paper 198*, Oslo: Statistics Norway.

Holmøy, E., B. M. Larsen and H. Vennemo (1993): Historiske brukerpriser på realkapital, *Rapporter 93/9*, Statistics Norway.

Holmøy, E., G. Nordén, and B. Strøm (1994): MSG-5, A complete description of the system of equations, *Rapporter 94/19*, Oslo: Statistics Norway.

Klette, T. J. (1994): Estimating price-cost margins and scale economies from a panel of micro data, *Discussion Papers 130*, Oslo: Statistics Norway.

Nelson, J. (1993): Household equivalence scales: theory versus policy? *Journal of Labor Economics 11*, 471-493.

Røed Larsen, E. and J. Aasness (1996): Kostnader ved barn og ekvivalensskalaer basert på Engels metode og forbruksundersøkelsen 1989-91, *Offentlige overføringer til barnefamilier*, NOU 1996:13, Oslo: Akademika, 305-317.

Sen, A. (1974): Informational bases of alternative welfare approaches: aggregation and income distribution, *Journal of Public Economics* 4, 387-403.

Wold, I. S. (1998): Modellering av husholdningenes transportkonsum for en analyse av grønne skatter: Muligheter og problemer innenfor rammen av en nyttetremodell, Notater 98/98, Statistisk sentralbyrå.

Simulated changes in consumer prices, income, wealth and transfers

Table A.1. Consumer prices when producer prices are endogenous. Percentage changes from baseline scenario. Long run effects

	General VAT reform	Abolition of investment tax	Political VAT reform
Food	1.289	1.373	-7.015
Beverages and tobacco	0.790	1.434	-0.789
Electricity	2.441	0.055	1.777
Fuels	2.253	1.302	1.922
Petrol and Car Maintenance	2.602	1.304	2.764
Clothing and Footwear	0.576	1.296	2.113
Goods for Recreation Activities	0.725	1.377	2.070
Furniture and Durable Consumer Goods	1.722	1.261	1.923
Electrical Household Equipment	0.757	1.395	2.076
Health Services	20.322	0.172	-0.134
Medicines and Medical Goods	0.640	1.229	1.879
Gross Rents	0.343	0.546	1.547
User Cost of Cars etc.	0.634	1.321	1.954
Road Transport etc., Local	18.905	-0.107	0.615
Road Transport etc., Long-distance	18.329	-0.062	0.669
Air Transport etc.	16.315	0.644	-0.186
Railway and Tramway Transport, Local	15.315	0.486	0.897
Railway Transport, Long-distance	15.488	0.481	0.871
Water Transport, Local	23.780	0.089	0.231
Water Transport, Long-distance	23.916	0.045	0.115
Postal and Telecommunication Services	1.496	0.470	2.029
Other Goods	6.300	0.917	1.612
Other Services	9.796	0.990	1.641
Direct Purchases Abroad by Resident Households	0.00	0.00	0.000

Table A.2. Consumer prices when producer prices are constant. Percentage changes from baseline scenario. Long run effects

	General VAT reform	Abolition of investment tax	Political VAT reform
Food	1.363	1.652	-7.082
Beverages and tobacco	0.847	1.676	-0.816
Electricity	3.611	1.494	1.823
Fuels	2.464	1.623	1.979
Petrol and Car Maintenance	3.952	1.498	2.665
Clothing and Footwear	0.872	1.724	2.104
Goods for Recreation Activities	0.898	1.698	2.072
Furniture and Durable Consumer Goods	2.081	1.603	1.956
Electrical Household Equipment	0.904	1.704	2.078
Health Services	24.050	0.000	0.000
Medicines and Medical Goods	0.937	1.692	1.871
Gross Rents	0.752	0.104	0.127
User Cost of Cars etc.	0.807	1.596	1.947
Road Transport etc., Local	24.050	0.000	0.000
Road Transport etc., Long-distance	23.444	0.044	0.054
Air Transport etc.	24.050	0.000	0.000
Railway and Tramway Transport, Local	24.050	0.000	0.000
Railway Transport, Long-distance	23.675	0.027	0.033
Water Transport, Local	24.050	0.000	0.000
Water Transport, Long-distance	24.050	0.000	0.000
Postal and Telecommunication Services	2.271	1.592	3.217
Other Goods	6.458	1.268	1.636
Other Services	13.369	0.781	1.521
Direct Purchases Abroad by Resident Households	0.000	0.000	0.000

Table A.3. Nominal incomes. Percentage changes from baseline scenario. Long run effects

	General VAT reform	Abolition of investment tax	Political VAT reform
Total wage and salary payments net of social taxes for employees	3.674	1.014	0.000
A: Wage and salary payments net of social taxes for self-employed[1)] in agriculture	3.796	0.921	0.054
B: Wage and salary payments net of social taxes for self-employed[1)] in forestry	3.754	0.925	0.048
C: Wage and salary payments net of social taxes for self-employed[1)] in fishing	3.203	0.750	0.039
D: Wage and salary payments net of social taxes for self-employed[1)] in the rest of the industries[2)]	3.979	1.110	-0.146
Return on real capital for self-employed in agriculture; pre-tax[3)], risk-adjusted[4)], net of depreciation + A	2.719	0.580	0.038
Return on real capital for self-employed in forestry; pre-tax[3)], risk-adjusted[4)], net of depreciation + B	1.555	0.214	0.019
Return on real capital for self-employed in fishing; pre-tax[3)], risk-adjusted[4)], net of depreciation + C	2.968	0.694	0.034
Return on real capital for self-employed in the rest of the industries[2)]; pre-tax[3)], risk-adjusted[4)], net of depreciation+D	4.352	1.221	-0.095
Return on real capital in limited liability companies; pre-tax[3)], risk-adjusted[4)], net of depreciation	5.281	1.543	0.112
Interest rate multiplied by net national debt	43.111	11.158	-4.008

1) We assume that the wage rate received by self-employed is equal to the wage rate received by employees.

2) That is all private production sectors, with the exception of agriculture, forestry, fishing, dwelling services, production of electricity, oil and gas exploration and drilling, production and pipeline transport of oil and gas, ocean transport and imputed service charges from financial institutions.

3) But after paying of VAT and/or investment tax.

4) See Bye and Åvitsland (2003) and Bye et al. (2004) for an explanation of risk-adjustment in the CGE model.

Table A.4. Nominal wealth. Percentage changes from baseline scenario. Long run effects

	General VAT reform	Abolition of investment tax	Political VAT reform
Net national debt	43.111	11.158	-4.008
Value[1)] of real capital stock[2)] in limited liability companies	5.112	1.571	0.115
Market value[3)] of dwelling capital	1.719	0.672	0.717
Market value[3)] of cars	5.386	0.772	0.280
Market value[3)] of cars and machinery[2)] for self-employed	-4.094	-2.346	-0.105
Market value[3)] of fishing boats for self-employed	1.379	0.595	0.009

1) Measured in purchaser price indexes, exclusive of VAT and/or the investment tax.

2) Comprising all private production sectors, with the exception of dwelling services, production of electricity, oil and gas exploration and drilling, production and pipeline transport of oil and gas, ocean transport and imputed service charges from financial institutions.

3) Measured in purchaser price indexes, inclusive of VAT and/or the investment tax.

Table A.5. Transfers. Percentage changes from baseline scenario. Long run effects

	General VAT reform	Abolition of investment tax	Political VAT reform
Pension	3.821	0.943	0.067
Sickness benefits etc.	3.674	1.014	0.000
Unemployment benefits	3.674	1.014	0.000
Child benefits	3.821	0.943	0.067
Other transfers, Central Government	3.821	0.943	0.067
Other transfers, Local Government	3.142	0.915	0.266

The symbol and name of the microsimulation variables (MSV) are first mentioned. Next, the symbol and name of the corresponding CGE variables (CGEV) are written down. This means that all microsimulation variables under the heading 1) MSV are exogenously changed by the percentage change in the variable under the heading 1) CGEV, and so forth. Assumptions made are then clarified, together with other comments. B.1 deals with income variables, B.2 with wealth variables and B.3 with transfer variables.

B.1 Combining income variables in the CGE and microsimulation models

1) MSV

K2101, wage income and unemployment benefits for employees
K21013, of this: wage income only into the basis for calculation of member's premium to the National Insurance Scheme
K2102, income entitled to the seaman's deduction
K2103, income stemming from child care in one's own home
K2104, profit from payments in kind
K2105, other income stemming from labour
K2401, children's wage income (children under 13 years of age)
K1607, calculated personal income limited liability company, liberal occupation
K1608, calculated personal income limited liability company, other industry
K3212, contribution to private/public Norwegian pension scheme in connection with the employment
XEKSTRA, adjustment of personal income
XELF, own wages in an enterprise
XGLF, basis for deduction of wages
XKAG, basis for return to capital
XKN, corrected self-employed, taxable income
XLAKT, wage costs concerning active owners

1) CGEV

yww, total wage and salary payments net of social taxes

2) MSV

K1601, calculated personal income one-man enterprise, primary industry

K1604, calculated personal income partner-assessed company, primary industry

K1612, part of wage income/pension stemming from enterprise from which the person in question receives calculated personal income, primary industry

K1701, remuneration for work to partner in partner-assessed company where personal income is not calculated, primary industry

2) CGEV

$ww_{11}ls_{11} + ww_{12}ls_{12} + ww_{13}ls_{13}$

ww_j is wage per hour to wage earners in production sector j in current prices and net of social taxes, ls_j is number of hours worked by self-employed in production sector j, $j = 11$ (agriculture), *12* (forestry) and *13* (fishing).

3) MSV

K1602, calculated personal income one-man enterprise, liberal occupation

K1605, calculated personal income partner-assessed company, liberal occupation

K1613, part of wage income/pension stemming from enterprise from which the person in question receives calculated personal income, liberal occupation

3) CGEV

$ww_{85}ls_{85}$

85 is the industry other private services.

4) MSV

K1603, calculated personal income one-man enterprise, other industry

K1606, calculated personal income partner-assessed company, other industry

K1614, part of wage income/pension stemming from enterprise from which the person in question receives calculated personal income, other industry

K1702, remuneration for work to partner in partner-assessed company where personal income is not calculated, other industry

4) CGEV

$$\sum_{j \in PP \setminus \{PW,11,12,13,85\}} ww_j ls_j$$

PP is all private production sectors and *PW* is the private production sectors *71* (Production of electricity), *68* (Oil and gas exploration and drilling), *64* (Production and pipeline transport of oil and gas), *60* (Ocean transport), *83* (Dwelling services) and *89* (Imputed service charges from financial institutions).

5) MSV

K2701, self-employed, taxable income, agriculture

5) CGEV

$$sse_{11} \sum_{i=10,40,50} (bp_{i,11} - \hat{\delta}_{i,11} - risk)\, pjb_i k_{i,11} + ww_{11} ls_{11}$$

sse_{11} is the share of self-employed in agriculture, $i = 10, 40$ and 50 are respectively buildings, cars and machinery, $bp_{i,11}$ is the user cost of capital type i per NOK invested in agriculture, $\hat{\delta}_{i,11}$ is the depreciation rate of capital type i in agriculture, *risk* is the risk premium, pjb_i is the purchaser price index, exclusive of VAT and the investment tax, for new investment, capital type i and $k_{i,11}$ is the capital stock of type i in agriculture in constant prices.

6) MSV

K2702, self-employed, taxable income, forestry

6) CGEV

$$sse_{12} \sum_{i=10,40,50} (bp_{i,12} - \hat{\delta}_{i,12} - risk)\, pjb_i k_{i,12} + ww_{12} ls_{12}$$

7) MSV

K2703, self-employed, taxable income, fishing

7) CGEV

$$sse_{13} \sum_{i=30,50} (bp_{i,13} - \hat{\delta}_{i,13} - risk)\, pjb_i k_{i,13} + ww_{13} ls_{13}$$

30 is the capital type ships and fishing boats.

8) MSV

K2704, other self-employed, taxable income (inclusive of liberal occupation)

K27041, self-employed, taxable income, partnership company

8) CGEV

$$\sum_{j \in PP \setminus \{PW,11,12,13\}} sse_j \sum_{i=10,40,50,30,80} (bp_{i,j} - \hat{\delta}_{i,j} - risk) pjb_i k_{i,j} + \sum_{j \in PP \setminus \{PW,11,12,13\}} ww_j ls_j$$

80 is the capital type aircraft.

There is a clear coherence between income types 2) to 8) since self-employed, taxable income both consists of capital income and the self-employed's labour income and calculated personal income is meant to reflect the self-employed's labour income. The above expressions for the self-employed's labour income part of self-employed, taxable income and for the calculated personal income are therefore identical. We assume that the self-employed's wage rate is equal to the wage rate received by employees.

All private production sectors with the exception of *71* (Production of electricity), *68* (Oil and gas exploration and drilling), *64* (Production and pipeline transport of oil and gas), *60* (Ocean transport), *83* (Dwelling services) and *89* (Imputed service charges from financial institutions) are included in the above calculations. *68* (Oil and gas exploration and drilling), *64* (Production and pipeline transport of oil and gas) and *60* (Ocean transport) are excluded because of a constant real capital stock and no user costs of real capital attached to them. *89* (Imputed service charges from financial institutions) are not included since there is no real capital stock there. *83* (Dwelling Services) are excluded since this is an artificially constructed private production sector directly attached to private consumption. We have chosen to omit *71* (Production of electricity) since the user cost of capital in this industry differs conceptually from the other user costs and since real capital is "almost exogenous".

Concerning item 5) to 8), we use the net return on real capital for self-employed as an approximation to the self-employed's capital income part of self-employed, taxable income. The net return in these expressions is generally before paying of taxes. An exception is paying of the VAT and the investment tax since we employ the purchaser price index of new investments *exclusive* of VAT and the investment tax. We then think of the difference between the net return on real capital employing respectively the purchaser price index inclusive and exclusive of the VAT and the investment tax as representing the paying of these two taxes. Since the microsimulation model only deals with personal taxes the VAT and the investment tax on inputs are not part of this model.

Gross production in agriculture, forestry and fishing is exogenous in the CGE model. Therefore changes in employment and real capital may only take place through substitution effects, and not through scale effects.

In the microsimulation model, the calculated personal income is either exogenous, as in item 2) to 4), or computed by means of individual variables, as in item 1) (the variables starting with the letter X). The former constitutes the largest part. For practical reasons, we assume that all the "X-variables" in 1), even though they are divided into the two categories primary industry and other industry, are changed by the change in employees' wage income. The self-employed's endogenous calculated personal income will then change by roughly the same percentage.

9) MSV

K3104, dividends from shares giving the right to refundment
K31041, of this: dividends from funds of shares

9) CGEV

$$\sum_{j \in PP \setminus \{PW\}} sllc_j \sum_{i=10,40,50,30,80} (bp_{i,j} - \hat{\delta}_{i,j} - risk)\, pjb_i k_{i,j}$$

$sllc_j$ is the share of limited liability companies in production sector j.

Concerning item 9), we use the percentage change in net return on real capital for limited liability companies as an approximation to the percentage change in dividends. As was the case for items 5) to 8), we employ the purchaser price index of new investments *exclusive* of VAT and the investment tax. In addition, we assume that other taxes than the VAT and the investment tax paid by the limited liability company constitute a constant share of the net return on real capital. We may then think of the percentage change in the expression above as representing the percentage change in the after-tax net return on real capital in limited liability companies. As stated earlier, the microsimulation model only applies to personal taxes.

10) MSV

K3106, income from abroad
K3302, interest on debt to foreign creditors

10) CGEV

$renu \times ngu$

renu is the nominal annual interest rate on positive financial investment in the international capital market and *ngu* is net national debt.

We only have numbers for net national debt. We assume that the individual components, debt and claims, change by the same percentage as the net variable.

11) MSV

K3101, interest on deposits in domestic banks
K3102, other interest: outstanding claims, bonds etc.
K3301, interest on debt to Norwegian creditors

We have chosen to keep these variables constant in the microsimulation model since we do not know the percentage change in debt to Norwegian creditors and claims on Norwegian debtors.

12) MSV

K3107, dividend from abroad

This variable is kept unchanged since the corresponding CGE variable is exogenous.

13) MSV

K2805, taxable gain by selling real property
K3105, taxable gain by selling Norwegian and foreign shares
K3117, gain, gain and loss account
K3118, gain, empty/void negative balance, group A-D
K3306, deductible loss by selling real property
K3308, deductible loss by selling shares
K3317, loss, gain and loss account
K3318, loss, empty positive balance group A-D

All these variables are kept unchanged since the capital gains in the CGE model are equal to 0 in steady state.

14) MSV

K3217, deficit in primary industry
K3218, deficit in other industries
K3219, deficit in partnership companies
K3220, deficit by hiring out real property
K3221, nonlocal deficit
K3309, self-employed's deficit from a previous year that is possible to carry forward

All these variables are kept unchanged since no companies in the CGE model have deficits in equilibrium (companies with deficits have left the industry).

15) MSV

K2804, net income by hiring out real property, not in connection with self-employment

This variable is kept unchanged since all dwellings are owner-occupied and sites are not included in the CGE model.

16) MSV

K1505, unused refund deduction from 1994
K2601, received own contributions, annuities, provisions made for a retiring farmer on handing over the farm to his heir or successor etc.
K2602, received contributions etc. to children under 17 years of age
K2603, other contributions, annuities, provisions made for a retiring farmer on handing over the farm to his heir or successor etc.
K2803, part owner's share of income in housing company (not percentage income)
K3103, return on the savings part of life insurance
K3108, other income
K31081, nonlocal income (not assessed on a percentage basis)
K3202, actual expenses in order to acquire income
K3207, extra expenses for board and lodging incurred when working away from home
K3208, travels to/from working place
K3209, travel expenses when visiting home
K3210, parents' deduction
K3211, trade union dues

K3213, seaman's deduction

K3214, special deduction associated with income from fishing

K3215, self-employed's premium to voluntary extra national insurance for sickness benefits in the National Insurance Scheme

K3303, alimony and accommodation and support provided by the new owner of landed property for its former owner inherent in real property with the exception of land/forest

K3304, share of deductible expenses in housing company

K3305, deductible premium for private pension scheme

K3307, other deductions

K12, loan from "Statens Lånekasse" assigned this year

K13, total paid to "Statens Lånekasse" this year

K14, of this interest paid to "Statens Lånekasse" this year

K16, interest balance in "Statens Lånekasse" at the end of the year

K45, tax-free payments

Concerning item 16), none of the variables exist in the CGE model. We have chosen to keep them all unchanged.

B.2 Combining wealth variables in the CGE and microsimulation models

17) MSV

K4601, taxable assets abroad

K4803, debt to foreign creditors

17) CGEV

ngu

Concerning item 17), the same comments and assumptions as for item 10) apply. In addition, we assume that taxable assets abroad mainly consists of bank deposits and not shares.

18) MSV

K4101, bank deposits

K4104, bonds registered in "Verdipapirsentralen"

K4105, other bonds

K4106, outstanding claims

K4801, debt to Norwegian creditors

Since we have chosen to keep the variables in 11) unchanged, we also keep the variables in 18) constant.

19) MSV

K4107, value for taxation purposes of shares in Norwegian companies registered in "Verdipapirsentralen"

K41071, of this: unit in unit trust

K4108, value for taxation purposes of other shares in Norwegian companies

K4109, other securities

19) CGEV

$$\sum_{j \in PP \setminus \{PW\}} sllc_j \sum_{i=10,40,50,30,80} pjb_i k_{i,j}$$

Concerning item 19), we use the percentage change in the value of real capital in limited liability companies as an approximation to the percentage change in the mentioned share values. The value is measured exclusive of VAT and the investment tax. This is so since we think of the market value of shares as a sum of discounted dividends and these dividends are in item 9) measured exclusive of VAT and the investment tax.

20) MSV

IKB, gross value for taxation purposes, own dwelling property (inclusive of flats in housing co-operatives organized for one particular project only)

IKH, gross value for taxation purposes, cottages

K4301, share of housing company's value for taxation purposes

K4302, value for taxation purposes, own dwelling

K4303, value for taxation purposes, cottage

20) CGEV

$$pj_{10,83} k_{10,83}$$

where $pj_{10,83}$ is the purchaser price index, inclusive of VAT, for new investments in dwellings and cottages in the production sector Dwelling services and $k_{10,83}$ is dwellings and cottages in the same production sector. We assume that the value for taxation purposes concerning housing constitutes a constant share of the market value of housing from baseline scenario to the different policy alternatives. *IKB* and *IKH* are used as basis for calculation of capital income stemming from housing. This capital income is not part of the pre-tax income concept in the microsimulation model but is used as basis for calculation of income taxes. *K4301, K4302* and *K4303* are used as basis for calculation of wealth taxes in the microsimulation model.

21) MSV

K4204, private cars, motor cycles

21) CGEV

$$pc_{30}hc_{31}$$

where pc_{30} is the purchaser price index for cars inclusive of VAT and hc_{31} is households' stock of cars in constant prices.

22) MSV

K4401, occupational cars, machinery and fixtures

22) CGEV

$$\sum_{j \in PP \setminus \{PW\}} sse_j \sum_{i=40,50} pj_{i,j} k_{i,j}$$

where $pj_{i,j}$ is the purchaser price index of new investments inclusive of VAT and/or the investment tax, capital type *i*, production sector *j*.

23) MSV

K4404, ships and fishing boats

23) CGEV

$$\sum_{j=13,14,78} sse_j \, pj_{30,j} k_{30,j}$$

where *78* is Coastal and inland water transport.

24) MSV

K4403, stock of goods

K46013, real property abroad (not taxable)

These two variables are kept unchanged since stock of goods and purchase/sale of real capital abroad are exogenous in the CGE model. In addition, sites are not part of the model.

25) MSV

K1504, inheritance, gift
K4102, cash amount and cheques
K4103, free amount, cash amount
K4201, furniture and other movables
K4202, pleasure boats, value < 50 000 NOK
K4203, pleasure boats, value > 50 000 NOK
K4205, caravans
K4304, value for taxation purposes of other real property and forests
K4402, cattle, fur-bearing animals, reindeer
K4501, premium fund, private pension scheme
K4502, gross repurchase value life insurance
K4503, share owner's share of housing company's other wealth
K4504, other taxable wealth
K4802, share owner's share of debt in housing company
K15, debt in "Statens Lånekasse" at the end of the year

None of these variables exist in the CGE model. We have chosen to keep them unchanged.

B.3 Combining transfer variables in the CGE and microsimulation models

26) MSV

K2201, pension from the National Insurance Scheme
K22012, additional payment concerning pension
K2202, other pension, "tjenestepensjon", annuities and private pension insurance, provisions made for a retiring farmer on handing over the farm to his heir or successor in agriculture and forestry
K2204, "ektefelletillegg"
K2301, spouse's pension, National Insurance Scheme
K2302, spouse's other pension
K44, paid out "avtalefestet pensjon" (AFP)

26) CGEV

RU611 + RU612 + RU613

where *RU611* is old-age pension from the Central Government Pension Fund, *RU612* is other old-age pension and *RU613* is disability pension. The percentage change in *RU611+RU612+RU613* is equal to the percentage change in *WWA*, the average wage per man-year for wage earners.

27) MSV

K2705, sickness benefits, liberal occupation

K2706, sickness benefits, primary industry

K2707, sickness benefits, other industry

ENGANGST, once-and-for-all benefit concerning birth

27) CGEV

RU630, sickness benefits etc.

28) MSV

K2107, unemployment benefits to self-employed

28) CGEV

RU650, unemployment benefits

In the microsimulation model, sickness and unemployment benefits have their own entries concerning self-employed. For employees, these benefits are included in their wage income. However, the percentage change in respectively *RU630* and *RU650* is equal to the percentage change in *YWW*, the total wage and salary payments net of social taxes.

29) MSV

child benefit

benefit to little children

breadwinner deduction

29) CGEV

RU640, child benefits

The percentage change in *RU640* is equal to the percentage change in *WWA*.

30) MSV

K11, scholarship from "Statens Lånekasse" assigned this year

K21, housing benefit from "Husbanken"

K2604, children's pension to children under 17 years of age

K34, basic benefit

K35, relief benefit

30) CGEV

RU659, other transfers, Central Government

The percentage change in *RU659* is equal to the percentage change in *WWA*.

31) MSV

K38, social security benefits

31) CGEV

RU666, other transfers, Local Government

The percentage change in *RU666* is equal to the percentage change in *PC*, the National Account price index for aggregate private consumption.

Appendix C

Interpretation of the magnitude of a change in the degree of equality based on a Sen welfare function

We define the Sen welfare function as

(1) $S = WE$,

where S is Sen welfare, W is average standard of living per person and E is a measure of equality. In this paper, we use E = 1-G, where G is the Gini-coefficient. Sen (1974) may be conferred for an axiomatic basis of (1) when E = 1-G. W is in this paper measured by the real consumption expenditure per equivalent adult (taken from the microsimulation model in 1995).

We investigate a change from situation 0 to situation 1, using symbols:

(2) $\Delta S = S_1 - S_0$, $\Delta W = W_1 - W_0$, $\Delta E = E_1 - E_0$.

Equations (1) and (2) imply $\Delta S = S_1 - S_0 = W_1E_1 - W_0E_0 = (W_0 + \Delta W)(E_0 + \Delta E) - W_0E_0 = W_0E_0 + W_0\Delta E + \Delta WE_0 + \Delta W\Delta E - W_0E_0$, thus

(3) $\Delta S = W_0\Delta E + \Delta WE_0 + \Delta W\Delta E$.

Equation (3) and $\Delta S = 0$ imply that $\Delta WE_0 + \Delta W\Delta E = - W_0\Delta E$, i.e. $(E_0 + \Delta E)\,\Delta W = - W_0\Delta E$, thus

(4) $\frac{\Delta W}{W_0} = \frac{-\Delta E}{E_1}$.

This means that if the degree of equality is increased by ΔE, the standard of living per person can be reduced by $\frac{\Delta E}{E_1}100$ per cent and simultaneously keeping Sen welfare unchanged.

Recent publications in the series Discussion Papers

303 R. Bjørnstad: (2001): Learned Helplessness, Discouraged Workers, and Multiple Unemployment Equilibria in a Search Model

304 K. G. Salvanes and S. E. Førre (2001): Job Creation, Heterogeneous Workers and Technical Change: Matched Worker/Plant Data Evidence from Norway

305 E. R. Larsen (2001): Revealing Demand for Nature Experience Using Purchase Data of Equipment and Lodging

306 B. Bye and T. Åvitsland (2001): The welfare effects of housing taxation in a distorted economy: A general equilibrium analysis

307 R. Aaberge, U. Colombino and J.E. Roemer (2001): Equality of Opportunity versus Equality of Outcome in Analysing Optimal Income Taxation: Empirical Evidence based on Italian Data

308 T. Kornstad (2001): Are Predicted Lifetime Consumption Profiles Robust with respect to Model Specifications?

309 H. Hungnes (2001): Estimating and Restricting Growth Rates and Cointegration Means. With Applications to Consumption and Money Demand

310 M. Rege and K. Telle (2001): An Experimental Investigation of Social Norms

311 L.C. Zhang (2001): A method of weighting adjustment for survey data subject to nonignorable nonresponse

312 K. R. Wangen and E. Biørn (2001): Prevalence and substitution effects in tobacco consumption. A discrete choice analysis of panel data

313 G.H. Bjertnær (2001): Optimal Combinations of Income Tax and Subsidies for Education

314 K. E. Rosendahl (2002): Cost-effective environmental policy: Implications of induced technological change

315 T. Kornstad and T.O. Thoresen (2002): A Discrete Choice Model for Labor Supply and Child Care

316 A. Bruvoll and K. Nyborg (2002): On the value of households' recycling efforts

317 E. Biørn and T. Skjerpen (2002): Aggregation and Aggregation Biases in Production Functions: A Panel Data Analysis of Translog Models

318 Ø. Døhl (2002): Energy Flexibility and Technological Progress with Multioutput Production. Application on Norwegian Pulp and Paper Industries

319 R. Aaberge (2002): Characterization and Measurement of Duration Dependence in Hazard Rate Models

320 T. J. Klette and A. Raknerud (2002): How and why do Firms differ?

321 J. Aasness and E. Røed Larsen (2002): Distributional and Environmental Effects of Taxes on Transportation

322 E. Røed Larsen (2002): The Political Economy of Global Warming: From Data to Decisions

323 E. Røed Larsen (2002): Searching for Basic Consumption Patterns: Is the Engel Elasticity of Housing Unity?

324 E. Røed Larsen (2002): Estimating Latent Total Consumption in a Household.

325 E. Røed Larsen (2002): Consumption Inequality in Norway in the 80s and 90s.

326 H.C. Bjørnland and H. Hungnes (2002): Fundamental determinants of the long run real exchange rate:The case of Norway.

327 M. Søberg (2002): A laboratory stress-test of bid, double and offer auctions.

328 M. Søberg (2002): Voting rules and endogenous trading institutions: An experimental study.

329 M. Søberg (2002): The Duhem-Quine thesis and experimental economics: A reinterpretation.

330 A. Raknerud (2002): Identification, Estimation and Testing in Panel Data Models with Attrition: The Role of the Missing at Random Assumption

331 M.W. Arneberg, J.K. Dagsvik and Z. Jia (2002): Labor Market Modeling Recognizing Latent Job Attributes and Opportunity Constraints. An Empirical Analysis of Labor Market Behavior of Eritrean Women

332 M. Greaker (2002): Eco-labels, Production Related Externalities and Trade

333 J. T. Lind (2002): Small continuous surveys and the Kalman filter

334 B. Halvorsen and T. Willumsen (2002): Willingness to Pay for Dental Fear Treatment. Is Supplying Fear Treatment Social Beneficial?

335 T. O. Thoresen (2002): Reduced Tax Progressivity in Norway in the Nineties. The Effect from Tax Changes

336 M. Søberg (2002): Price formation in monopolistic markets with endogenous diffusion of trading information: An experimental approach

337 A. Bruvoll og B.M. Larsen (2002): Greenhouse gas emissions in Norway. Do carbon taxes work?

338 B. Halvorsen and R. Nesbakken (2002): A conflict of interests in electricity taxation? A micro econometric analysis of household behaviour

339 R. Aaberge and A. Langørgen (2003): Measuring the Benefits from Public Services: The Effects of Local Government Spending on the Distribution of Income in Norway

340 H. C. Bjørnland and H. Hungnes (2003): The importance of interest rates for forecasting the exchange rate

341 A. Bruvoll, T.Fæhn and Birger Strøm (2003): Quantifying Central Hypotheses on Environmental Kuznets Curves for a Rich Economy: A Computable General Equilibrium Study

342 E. Biørn, T. Skjerpen and K.R. Wangen (2003): Parametric Aggregation of Random Coefficient Cobb-Douglas Production Functions: Evidence from Manufacturing Industries

343 B. Bye, B. Strøm and T. Åvitsland (2003): Welfare effects of VAT reforms: A general equilibrium analysis

344 J.K. Dagsvik and S. Strøm (2003): Analyzing Labor Supply Behavior with Latent Job Opportunity Sets and Institutional Choice Constraints

345 A. Raknerud, T. Skjerpen and A. Rygh Swensen (2003): A linear demand system within a Seemingly Unrelated Time Series Equation framework

346 B.M. Larsen and R.Nesbakken (2003): How to quantify household electricity end-use consumption

347 B. Halvorsen, B. M. Larsen and R. Nesbakken (2003): Possibility for hedging from price increases in residential energy demand

348 S. Johansen and A. R. Swensen (2003): More on Testing Exact Rational Expectations in Cointegrated Vector Autoregressive Models: Restricted Drift Terms

349 B. Holtsmark (2003): The Kyoto Protocol without USA and Australia - with the Russian Federation as a strategic permit seller

350 J. Larsson (2003): Testing the Multiproduct Hypothesis on Norwegian Aluminium Industry Plants

351 T. Bye (2003): On the Price and Volume Effects from Green Certificates in the Energy Market

352 E. Holmøy (2003): Aggregate Industry Behaviour in a Monopolistic Competition Model with Heterogeneous Firms

353 A. O. Ervik, E.Holmøy and T. Hægeland (2003): A Theory-Based Measure of the Output of the Education Sector

354 E. Halvorsen (2003): A Cohort Analysis of Household Saving in Norway

355 I. Aslaksen and T. Synnestvedt (2003): Corporate environmental protection under uncertainty

356 S. Glomsrød and W. Taoyuan (2003): Coal cleaning: A viable strategy for reduced carbon emissions and improved environment in China?

357 A. Bruvoll T. Bye, J. Larsson og K. Telle (2003): Technological changes in the pulp and paper industry and the role of uniform versus selective environmental policy.

358 J.K. Dagsvik, S. Strøm and Z. Jia (2003): A Stochastic Model for the Utility of Income.

359 M. Rege and K. Telle (2003): Indirect Social Sanctions from Monetarily Unaffected Strangers in a Public Good Game.

360 R. Aaberge (2003): Mean-Spread-Preserving Transformation.

361 E. Halvorsen (2003): Financial Deregulation and Household Saving. The Norwegian Experience Revisited

362 E. Røed Larsen (2003): Are Rich Countries Immune to the Resource Curse? Evidence from Norway's Management of Its Oil Riches

363 E. Røed Larsen and Dag Einar Sommervoll (2003): Rising Inequality of Housing? Evidence from Segmented Housing Price Indices

364 R. Bjørnstad and T. Skjerpen (2003): Technology, Trade and Inequality

365 A. Raknerud, D. Rønningen and T. Skjerpen (2003): A method for improved capital measurement by combining accounts and firm investment data

366 B.J. Holtsmark and K.H. Alfsen (2004): PPP-correction of the IPCC emission scenarios - does it matter?

367 R. Aaberge, U. Colombino, E. Holmøy, B. Strøm and T. Wennemo (2004): Population ageing and fiscal sustainability: An integrated micro-macro analysis of required tax changes

368 E. Røed Larsen (2004): Does the CPI Mirror Costs.of.Living? Engel's Law Suggests Not in Norway

369 T. Skjerpen (2004): The dynamic factor model revisited: the identification problem remains

370 J.K. Dagsvik and A.L. Mathiassen (2004): Agricultural Production with Uncertain Water Supply

371 M. Greaker (2004): Industrial Competitiveness and Diffusion of New Pollution Abatement Technology – a new look at the Porter-hypothesis

372 G. Børnes Ringlund, K.E. Rosendahl and T. Skjerpen (2004): Does oilrig activity react to oil price changes? An empirical investigation

373 G. Liu (2004) Estimating Energy Demand Elasticities for OECD Countries. A Dynamic Panel Data Approach

374 K. Telle and J. Larsson (2004): Do environmental regulations hamper productivity growth? How accounting for improvements of firms' environmental performance can change the conclusion

375 K.R. Wangen (2004): Some Fundamental Problems in Becker, Grossman and Murphy's Implementation of Rational Addiction Theory

376 B.J. Holtsmark and K.H. Alfsen (2004): Implementation of the Kyoto Protocol without Russian participation

377 E. Røed Larsen (2004): Escaping the Resource Curse and the Dutch Disease? When and Why Norway Caught up with and Forged ahead of Its Neughbors

378 L. Andreassen (2004): Mortality, fertility and old age care in a two-sex growth model

379 E. Lund Sagen and F. R. Aune (2004): The Future European Natural Gas Market - are lower gas prices attainable?

380 A. Langørgen and D. Rønningen (2004): Local government preferences, individual needs, and the allocation of social assistance

381 K. Telle (2004): Effects of inspections on plants' regulatory and environmental performance - evidence from Norwegian manufacturing industries

382 T. A. Galloway (2004): To What Extent Is a Transition into Employment Associated with an Exit from Poverty

383 J. F. Bjørnstad and E.Ytterstad (2004): Two-Stage Sampling from a Prediction Point of View

384 A. Bruvoll and T. Fæhn (2004): Transboundary environmental policy effects: Markets and emission leakages

385 P.V. Hansen and L. Lindholt (2004): The market power of OPEC 1973-2001

386 N. Keilman and D. Q. Pham (2004): Empirical errors and predicted errors in fertility, mortality and migration forecasts in the European Economic Area

387 G. H. Bjertnæs and T. Fæhn (2004): Energy Taxation in a Small, Open Economy: Efficiency Gains under Political Restraints

388 J.K. Dagsvik and S. Strøm (2004): Sectoral Labor Supply, Choice Restrictions and Functional Form

389 B. Halvorsen (2004): Effects of norms, warm-glow and time use on household recycling

390 I. Aslaksen and T. Synnestvedt (2004): Are the Dixit-Pindyck and the Arrow-Fisher-Henry-Hanemann Option Values Equivalent?

391 G. H. Bjønnes, D. Rime and H. O.Aa. Solheim (2004): Liquidity provision in the overnight foreign exchange market

392 T. Åvitsland and J. Aasness (2004): Combining CGE and microsimulation models: Effects on equality of VAT reforms