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Abstract:
This paper employs a particular labor supply model to examine the welfare effects from replacing current tax systems in Italy, Norway and Sweden by proportional taxation on labor income. The results show that there are high efficiency costs for Norway and low costs for Italy and Sweden associated with the current progressive labor income taxes. However, there appears to be large variation in the distribution of welfare gains/losses. "Rich" households – defined by their pre-tax-reform income – tend to benefit more than "poor" households from replacing the current progressive tax systems by proportional taxation.

Keywords: Labor supply, taxation, distribution of income and welfare.

JEL classification: H23, H31, J22.

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1. Introduction*

During the post-war decades goods, services, labor and capital have gradually become more mobile across nations. This process of increased international mobility may have improved the allocation of resources and given substantial gains from trade. To reinforce this line of development in Europe the European Union (EU) has introduced the so-called four liberties which means that goods, services, labor and capital are now allowed to move freely across the EU borders. These four liberties can now be enjoyed not only by citizens and firms within EU, but also by countries that are members of the European-Economic-Area.

Increased mobility of goods, services, labor and capital creates a new climate of competition which makes it costly to maintain tax systems that differ substantially across nations. The more mobile the tax base turns out to be, the more costly it is to implement higher national tax rates than in other countries. We refer to Musgrave (1969) for an early discussion of these issues.

Labor has normally been considered to be the least mobile factor, at least when judged on the basis of European data. The dismantling of country-specific barriers may increase the mobility in European labor markets. Cultural differences and language problems may, on the other hand, have a substantial negative effect on mobility. Yet, the removal of mobility costs and the fact that (some) high skilled workers and professionals are rather mobile, may in the long run prevent European nations from allowing for significant differences in the taxation of labor income. Thus, tax system competition may arise as a result of EU's introduction of the four liberties

Since progressive tax systems normally tax the income of skilled workers and professionals more heavily than the income of the lesser skilled, tax system competition will most likely move the tax systems towards a proportional (European) tax structure; see Sinn (1995) for a theoretical discussion where the tax competition equilibrium implies zero tax rates. However, by relaxing the extreme mobility costs assumptions of Sinn (1995), a tax competition equilibrium with a positive proportional tax rate may be plausible.

Capital is conventionally considered to be a mobile factor, and the introduction of EU's four liberties has removed the last barriers against free capital movements throughout Western Europe. This fact has made the taxation of capital and firm income approximately proportional and quite similar in European countries. There are three major reasons why the mobility-induced proportional capital and firm income taxation may change the progressive taxation of labor income towards a proportional tax system. Firstly, progressive labor income taxes may be perceived unfair by a voting majority of wage earners when firms face proportional taxes. Second, if capital and firm income are taxed differently from labor income, this may give incentives to black market and/or tax evasion activities. To handle this type of economic crime problems government authorities may find it appropriate to change

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taxation towards proportional taxes. Finally, as suggested by Gordon and Nielsen (1995), when labor income is taxed at a progressive rate but firm income is taxed at an uniform (proportional) rate, the progressive labor income tax may cause an efficiency cost. To avoid this cost governments have to change the tax system *where it can be changed.* Thus, there are good reasons to expect that taxation of labor income in Europe — with no formal coordination of tax systems at the European level — gradually will be changed towards a proportional tax system. If so, one may ask what would be the effects on distributions of income and welfare of this change in tax structures.

The Scandinavian countries have gradually developed the welfare state institutions during this century. An important element in this development was the construction of institutions for redistributing income through progressive taxation, social benefits and transfers, wage policy, public education and public health care. The economic implications of these welfare state institutions have been questioned recently, primarily due to substantial efficiency losses. In particular, it has been pointed to the negative impact on overall economic efficiency from having progressive income taxes. Apart from anecdotal evidences and studies based on aggregated data there are, however, few empirical welfare analyses that take into account the heterogeneity among households and firms and thus the impact on the distribution of individual welfare of changes in the structure, see Atkinson (1995).

The objective of this paper is to examine the welfare effects from replacing current tax systems by a proportional labor income tax. To broaden the relevance of our study we compare Italy, which has a low degree of progression in the taxation of labor income by Scandinavian standards, with Norway and Sweden. Based on microeconometric labor supply models, we have simulated labor supply responses and welfare gains and losses for married couples from replacing the country-specific 1992-tax systems by proportional taxation. The tax rates are chosen so as to keep the tax revenues fixed and equal to the country-specific 1992-revenues. The simulation results show that the proportional tax rates vary between 25 and 29 per cent which appear to be close to the current tax rates on capital income. The mean welfare effect from introducing proportional taxation is found to be positive which suggest that there are efficiency costs associated with the current progressive labor income taxes. However, the results reveal large variation in the distribution of welfare gains/losses. Rich households — defined by their pre-tax-reform income — tend to benefit more than the poor. Moreover, the losers tend to have lower pre-tax-reform incomes than the winners.

The paper is organized as follows. Section 2 gives a description of our policy evaluation methodology which is based on a particular framework of modelling labor supply. The modelling approach differs from conventional empirical models of labor supply in several respects. Firstly, it is designed to account for observed as well as unobserved heterogeneity in tastes and choice constraints, which means that it is able to take into account the presence of quantity constraints in the market. Second, it is well suited for dealing with joint labor supply decisions of married couples, and complex non-convex budget sets. The empirical specifications of the model and the estimation results, based on Italian, Norwegian and Swedish tax return data for married couples, are given in Appendix 1. Section 3 reports the policy simulation results, and Section 4 summarizes our findings.

2. Methodological issues

Our policy evaluation methodology relies on a particular framework for modelling labor supply behavior, developed in Dagsvik (1994) and employed by Aaberge et al. (1995). This modelling approach differs from the conventional empirical models of labor supply, in which labor supply is derived from utility maximization with consumption and leisure as the only choice variables of the household. By contrast, our framework acknowledges the importance of location of the workplace and social environment and working conditions for the choice of job by modelling labor supply behavior as a discrete choice problem, where the alternatives are "job-packages". These job-packages are characterized by specific attributes such as wage rates, hours of work and other non-pecuniary variables. In addition, this framework is able to take into account that there are important quantity constraints in the market, in the sense that different types of jobs are not equally available to every agent. Agents differ by qualifications, and jobs differ with respect to qualifications required.

Labor supply models are helpful devices for examining individual welfare effects from tax reforms. The welfare effects are measured by various Hicks-compensating measures, see Auerbach (1985), Hausman (1981) and King (1987) for a discussion of alternative money metrics of welfare change, and Hammond (1990) for arguments in favor of using Equivalent Variation (EV). Loosely speaking, EV is measured as the amount of money that has to be added to/subtracted from the household's disposable income under the initial tax rules in order to make the household indifferent between the intial and the alternative tax system. Note that EV is measured at the household level. EV sums up the household's net welfare gain/loss associated with behavioral responses induced by tax reforms, say, increased consumption and reduced leisure.

An empirical micro-model — such as the one we apply here — is designed to account for observed as well as unobserved heterogeneity. Unobserved heterogeneity arises from the fact that as econometricians we are unable to observe all factors that affect individual tastes and opportunities. These unobservables are modelled as random variables, which imply that a money metric of welfare change, such as EV, at the household level becomes a random variable; see King (1987) and Atkinson (1990). In other words, micro-econometric models (which accounts for observed and unobserved heterogeneity in tastes and choice constraints) allow the analyst to study the distribution of EV. Like Hammond (1990) we are skeptical as to introducing a social welfare function. The reason is that a specific social welfare function relies on an arbitrarily chosen cardinalization of the utility function. As an alternative, we present the frequency distribution of EV conditional on the pre-tax-reform income of the households. The mean of this distribution is the overall mean welfare gain/loss which indeed can be interpreted as being derived from an utilitarian social welfare function. Note that conventional empirical analyses of tax reforms solely report the mean EV, see e.g. Hausman (1985), Hausman and Poterba (1987) and Blomquist (1983), whilst the present approach allows for an evaluation that identifies both losers and winners.

2.1. A brief outline of the labor supply model

Each agent faces a different set of non-market and market opportunities (jobs). Let $B_i(h, w)$, denote the set of jobs with hours $h > 0$, and wage rate $w > 0$, that are feasible to agent *i*. $B_i(0,0)$ is the set of non-market opportunities. Let $U_i(C, h, j)$ denote the utility for agent i of consumption *C*, hours h and opportunity *j*, where $j \in B_i(h, w)$, $h \geq 0$, $w \geq 0$. The argument of the utility function accounts for the fact that the agent's preferences may vary across job types.

The economic budget constraint is given by

$$C = f(wh, I), \tag{1}$$

where *I* is non-labor income and *f* is a function that transforms gross income into after-tax income. The price index of the composite good (called consumption) is equal to one. When inserting the budget constraint into the utility function we get $U_i\ (f(wh, I), h, j)$.

We will assume that

$$U_i\ (f(wh, I), h, j) = v(f(wh, I), h)\varepsilon_{ij}(h, w) \tag{2}$$

where $v(C, h)$ is a positive, deterministic function which is quasi-concave in (C, h), increasing in the first argument and decreasing in the second. The term $\varepsilon_{ij}(h, w)$ is a random taste-shifter that is supposed to capture the effect of unobservable attributes associated with opportunity *j*. Note that this term is viewed as random from the econometrician's point of view, while it is assumed known to the agent. Specifically, $\{\varepsilon_{ij}(h, w)\}$ accounts for the fact that for a given agent, tastes may vary over opportunities, hours and wages, and for a given opportunity, tastes may vary across agents. Finally, define

$$V_i(h, w) = max_{j \in B_i(h,w)}\ U_i\ (f(wh, I), h, j). \tag{3}$$

$V_i(h, w)$ is the conditional indirect utility function, given hours of work and the wage rate. In other words, for agent i, $V_i(h, w)$ is the utility of the most preferred opportunity among the feasible opportunities with hours h and wage rate w.

From (2) and (3) we get

$$V_i(h, w) = \psi(h, w) e_i(h, w) \tag{4}$$

where

$$e_i(h, w) = max_{j \in B_i(h,w)} \varepsilon_{ij}(h, w) \tag{5}$$

and

$$\psi(h, w) = v(f(wh, I), h). \tag{6}$$

Recall that hours and wage rates are fixed for each job so that when a job has been chosen, then hours and wage rate follow. The individual agent is assumed to choose the job that maximizes utility. The corresponding hours and wage rate, (h, w), therefore follow from maximizing $V_i(h, w)$.

In order to derive the structure of the choice probabilities of realized hours and wage rates we have to make further assumptions about the distribution of the random components in this model. These probabilities enter the likelihood function which is used when estimating the unknown parameters of the model. In our setting we assume that in addition to the taste shifters the opportunity sets are also random to the econometrician.

Let $n_i(h, w)$ be the number of jobs in $B_i(h, w)$ and let $\tilde{g}(h, w)$ be the mean of

$$\frac{n_i(h, w)}{\sum_{x>0} \sum_{y>0} n_i(x, y) + n_i(0,0)}$$

across agents. Assume that the taste-shifters are i.i.d. with distribution

$$P(\varepsilon_{ij}(h, w) \le y) = exp\left(-\frac{1}{y}\right). \tag{7}$$

In Dagsvik (1994) it is demonstrated that equation (7) follows from the assumption that agents have preferences over job-types that satisfy the "independence from irrelevant alternatives" property. The taste-shifters are assumed to be stochastically independent of the choice sets $\{B_i(h, w)\}$. For expository reasons we suppress the fact that parameters of the opportunity sets and preferences also depend on observed covariates.

Let $\varphi(h, w)$ be the probability that agent i shall choose a job with hours and wage rate (h, w). If the mean of $\sum_{x,y} n_i(x, y)$ is large, it can be shown that the assumptions introduced above imply that

$$\varphi(h, w) \equiv P\left[V_i(h, w) = \max_{x,y} V_i(x, y)\right] = \frac{\psi(h, w)\tilde{g}(h, w)}{\psi(0,0)\tilde{g}(0,0) + \sum_{x>0}\sum_{y>0} \psi(x, y)\tilde{g}(x, y)}, \tag{8}$$

for $h > 0, w > 0$. For the sake of interpretation it is convenient to express (8) as

$$\varphi(h, w) = \frac{\psi(h, w)\, g_0\, g(h, w)}{\psi(0,0) + g_0 \sum_{x>0}\sum_{y>0} \psi(x, y)\, g(x, y)} \tag{9}$$

where

$$g(h, w) = \frac{\tilde{g}(h, w)}{\sum_{x>0}\sum_{y>0} \tilde{g}(x, y)} \tag{10}$$

for $h > 0, w > 0,$ and

$$g_0 = \frac{\sum_{x>0}\sum_{y>0} \tilde{g}(x, y)}{\tilde{g}(0,0)}. \tag{11}$$

The probability of not working equals

$$\varphi(0,0) = \frac{\psi(0,0)\, g_0}{\psi(0,0) + g_0 \sum_{x>0}\sum_{y>0} \psi(x, y)\, g(x, y)}. \tag{12}$$

The function $g(h, w)$ is denoted the conditional opportunity density of hours and wage rates, and it can be interpreted as the mean of the fraction of feasible jobs with hours h and wage rate w. Similarly, g_0 is the mean of the fraction of opportunities that are feasible job-opportunities. Note that the opportunity density, $g(\cdot,\cdot)$ may depend on the production technology of the firms as well as of the wage setting policies of the firms and the unions.

The functional form of (9) and (12) is particularly attractive. The labor supply density $\varphi(h, w)$ is expressed as a simple function of the structural term of the utility function, $\psi(\cdot)$, and of $g_0 g(\cdot)$, which is an aggregate representation of the set of feasible job opportunities.

The extension of the model to deal with the joint decisions of husband and wife is analogous to the case of single person households. Then the household is assumed to have preferences over consumption and leisure for the husband and wife. For further details we refer to Dagsvik and Strøm (1995) and Aaberge et al. (1995). Empirical specifications and estimation results are reported in Appendix 1.

The estimated models are used to simulate the changes in individual behavior resulting from changes in the 1992 tax systems in Italy, Norway and Sweden. The objective of the simulation experiments is to evaluate labor supply responses, distribution of income and welfare gains and losses caused by replacing the country-specific tax system as of 1992 by proportional taxation. Welfare gains and losses are measured by Equivalent Variation (EV). To describe the method of calculation it appears convenient to introduce the following notation. Let

$$\tilde{V}_i(EV, f) \equiv \max_{h,w} \max_{j \in B_i(h,w)} \left(U_i\left(EV + f(hw, I), h, j\right)\right). \tag{13}$$

Note that $\tilde{V}_i(EV, f)$ is the indirect utility for agent i under tax regime f, when the agent is endowed with non-taxable non-labor income EV.

We define equivalent variations for the agent as the amount EV determined by

$$\tilde{V}_i(EV, f_0) = \tilde{V}_i(0, f_1) \tag{14}$$

where the subscript 0 denotes the initial (reference) tax regime, and subscript 1 the alternative tax regime. Since the utility function is random so is also EV. The various parameters describing the distribution of EV are assessed by means of stochastic simulations.

3. Results of tax simulations

The multi-person version of the model outlined in the preceding section is employed to simulate labor supply responses and individual welfare effects from introducing proportional taxes. The tax reform simulations are performed in a partial equilibrium setting, as in Browning (1987). In our framework, this means that the distribution of offered wages and hours are considered as exogenously given and thus unaffected by a change of tax systems., i.e. the opportunity densities (g_0 and g) in (9) and (12) are kept fixed. The total number of jobs are assumed to increase (decrease) with increasing (decreasing) labor supply.

For all three countries the estimated microeconometric models are applied for simulating distributions of labor supply and income in the reference year 1992. In the simulations the tax revenue for the reference year is kept constant and the model is used to assess the proportional tax rate.

The results of Tables 1-3 demonstrate that the labor supply responses from replacing the 1992-tax-regime ("current tax regime") by a proportional tax are rather strong in Norway, in particular for females. Moreover, labor supply responses decrease with increasing pre-tax-reform household income.

"Poor" households experience reduced marginal tax rates and increased average tax rate. Thus, the substitution as well as the income effect predict higher labor supply. For the "rich" households both the marginal and the average tax rates decrease. Consequently, the substitution and income effects for "rich" households have different signs and thus have counteracting impacts on labor supply. Note, however, that the "poor" households are observed to work shorter hours than the "rich" under the 1992-tax-regime.

As an implication of these labor supply responses gross as well as disposable income increase for almost all households in all three countries. The increase in income for the "poorest" households in Norway is rather strong and follows from the strong labor supply responses. Note that the total tax revenues are kept constant at the 1992 national levels.

Table 4 reports the Gini coefficients of gross and disposable household income. The results for Norway demonstrate that even inequality in the distribution of disposable income decreases substantially, which mainly is due to the strong labor supply responses among "poor" households. By contrast, for Sweden we find that the inequality in the distribution of disposable income increases. For Italy we find only minor changes in income inequality.

Table 1. Participation rates, annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes by disposable household income in 1992. Italy

		Participation rates per cent		Annual hours of work				Households, 1000 ITL 1992		
				Given participation		In the total population		Gross income	Taxes	Disposable income
		F	M	F	M	F	M			
1992-tax rules	I	4.3	97.0	1529	1832	66	1777	19756	3656	16100
	II	38.5	96.3	1691	2036	651	1961	44877	10845	34032
	III	70.0	94.4	1809	2053	1265	1939	90452	21047	69405
	IV	38.2	96.2	1711	2017	654	1940	46920	11146	35774
Proportional taxes[1)]	I	4.3	97.5	1398	1855	62	1809	20394	4882	15512
	II	36.5	96.2	1712	2058	625	1981	45717	10931	34786
	III	67.4	94.6	1819	2091	1225	1979	91544	19132	72411
	IV	36.4	96.2	1729	2041	692	1963	47765	11146	36619

1) The proportional tax rate of 23.3 per cent is determined by model simulation when the tax revenue is held fixed equal to the 1992 tax revenue.

Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 2. Participation rates, annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes by disposable household income in 1992. Norway

		Participation rates per cent		Annual hours of work: Given participation		Annual hours of work: In the total population		Households, NOK 1992: Gross income	Households, NOK 1992: Taxes	Households, NOK 1992: Disposable income
		F	M	F	M	F	M			
	I	41.5	74.1	926	1833	386	1360	160158	36454	123705
1992-	II	77.3	98.4	1494	2432	1154	2394	372208	115816	256392
tax rules	III	96.4	99.9	2279	2846	2198	2846	650958	235295	415662
	IV	75.4	96.0	1562	2427	1178	2331	383495	119437	264058
	I	73.2	96.2	1756	2660	1286	2557	413326	102137	311189
Proportional	II	80.6	99.5	1761	2743	1419	2729	471282	116107	355175
taxes[1)]	III	95.8	99.9	2311	2906	2213	2902	672104	163658	508446
	IV	81.4	99.2	1825	2751	1485	2730	485481	119445	366036

1) The proportional tax rate of 25.4 per cent is determined by model simulation when the tax revenue is held fixed equal to the 1992 tax revenue.

Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 3. Annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes. Sweden

		Annual hours of work, given participation: F	Annual hours of work, given participation: M	Households, SEK 1992: Gross income	Households, SEK 1992: Taxes	Households, SEK 1992: Disposable income
	I	1 147	1 903	221 966	55 757	166 209
1992-	II	1 690	2 117	382 603	110 792	271 811
tax rules	III	1 847	2 339	706 351	245 257	461 094
	IV	1 656	2 126	401 227	119 838	281 389
	I	1 188	1 977	232 468	67 835	164 632
Proportional	II	1 721	2 209	399 407	115 211	284 195
taxes[1)]	III	1 874	2 464	741 690	208 837	532 853
	IV	1 683	2 211	416 952	119 839	297 113

1) The proportional tax rate of 29.5 per cent is determined by model simulation when the tax revenue is held fixed equal to the 1992 tax revenue.

Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 4. Gini coefficients of distributions of gross and disposable income for couples in Italy, Norway and Sweden

Tax system	Nation	Gross income	Disposable income
1992 tax rules	Italy	.243	.234
	Norway	.205	.177
	Sweden	.192	.164
Proportional taxation	Italy	.238	.238
	Norway	.165	.165
	Sweden	.202	.202

The mean EV in all three countries is positive which suggests that there are efficiency costs related to the 1992 tax regimes compared to proportional taxation. Tables 5-7 report the mean EV relative to the tax revenue and show that this welfare measure of the cost of taxation varies from 1.5 per cent for Italy, 4.8 per cent for Sweden, to as much as 34.2 per cent for Norway. The predicted high mean welfare gain in Norway is primarily due to the strong female labor supply responses.

King (1987) argues that a small mean welfare gain may shadow for a large variation in gains and losses across households. Thus, King stresses the importance of accounting for heterogeneity when making welfare assessments of tax reforms. Hammond (1990) puts forward the same warnings. Our results confirm the relevance of these warnings. Although only one per cent of the population lose from the considered tax reform in Norway, between 55 and 60 per cent lose in Italy and Sweden. In Italy the mean welfare loss among the losers is 1 029 000 ITL, while the mean gain among the winners is 1 890 000 ITL. In Sweden the mean loss among the losers is 8 252 SEK, while the mean gain among the winners is approximately three times higher. For further details see Tables 1-7.

Table 5. Distribution of equivalent variation by household income[1)] under 1992-taxes. Italy

	Equivalent variations, 1000 ITL 1992							
	Total		Losers			Winners		
	Mean	EV relative to average tax Per cent	Per cent of population	Mean	EV relative to average tax Per cent	Per cent of population	Mean	EV relative to average tax Per cent
I	165	4.5	58.5	-1032	-28.0	41.5	1860	51.8
II	120	1.1	60.1	-1030	-9.6	39.9	1855	16.7
III	517	2.5	51.8	-1008	-4.8	48.2	2157	10.3
IV	164	1.5	59.1	-1029	-9.4	40.9	1890	16.5

1) Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 6. Distribution of equivalent variation by household income[1] under 1992-taxes. Norway

	Equivalent variations, NOK 1992							
	Total		Losers			Winners		
	Mean	EV relative to average tax Per cent	Per cent of population	Mean	EV relative to average tax Per cent	Per cent of population	Mean	EV relative to average tax Per cent
I	21799	59.8	8.6	-3694	-11.8	91.4	24132	65.1
II	38199	33.0	0.3	-1301	-2.2	99.7	38288	33.0
III	80811	34.3	0.0	-	-	100.0	80811	34.3
IV	40804	34.2	1.0	-3425	-9.9	99.0	41258	34.2

1) Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 7. Distribution of equivalent variation by household income[1] under 1992-taxes. Sweden

	Equivalent variations, SEK 1992							
	Total		Losers			Winners		
	Mean	EV relative to average tax Per cent	Per cent of population	Mean	EV relative to average tax Per cent	Per cent of population	Mean	EV relative to average tax Per cent
I	-8451	-15.2	95.2	-9420	-17.5	4.8	10503	13.0
II	1960	1.8	58.4	-8350	-9.6	41.6	16433	11.3
III	49962	20.4	3.6	-7642	-7.2	96.4	52139	20.3
IV	5722	4.8	56.6	-8525	-10.5	43.4	24291	14.3

1) Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

4. Conclusions

Tax system competition may change the current progressive tax systems in Europe towards a proportional tax on taxable income. This process may lead to proportional tax rates that differ slightly (25-30 per cent) to account for initial differences in tax revenues across nations. This specific change in tax structure may reduce the efficiency loss caused by progressive tax rates on labor income.

Our study demonstrates that the welfare effects from introducing proportional taxes vary largely depending on how responsive labor supply shows to be. Based on three empirical microeconometric labor supply models we find that the labor supply responses are high in Norway and modest in Italy and Sweden. The weak labor supply responses for Italy are primarily due to the fact that the 1992 tax system did not differ significantly from a proportional tax system, whilst the low responses in Sweden may be due to stricter regulations of working hours which are accounted for in the model.

The transition from progressive to proportional taxation reinforces the efficiency gains from a freer trade in Europe caused by the dismantling of borders. Then one may ask whether the reduction in loss of efficiency is attained at the cost of increased income and welfare inequality. Our results, however, do not indicate any sharp increase in income inequality. On the contrary, in the case of Norway we find that the inequality in the distribution of gross household income is reduced to an extent that even makes the distribution of after-tax household income more equal. However, when the value of leisure is taken into account, we find that the welfare of rich households — in particular in Norway — increases far more than the welfare of poor households.

Appendix 1. Empirical specifications and estimation results

Norway

Let the subscript F and M denote female and male, respectively. In the case of married couples the structural part of the utility function defined by (6) is

$$\begin{aligned} log\, v(C, h_F, h_M) = \alpha_2 \left(\frac{(10^{-4} C)^{\alpha_1} - 1}{\alpha_1} \right) + \left(\frac{L_M^{\alpha_3} - 1}{\alpha_3} \right) \left(\alpha_4 + \alpha_5 \, log\, A_M + \alpha_6 (log\, A_M)^2 \right) \\ + \left(\frac{L_F^{\alpha_7} - 1}{\alpha_7} \right) \left(\alpha_8 + \alpha_9 \, log\, A_F + \alpha_{10} (log\, A_F)^2 + \alpha_{11}\, CU6 + \alpha_{12}\, CO6 \right) + \alpha_{13}\, L_F\, L_M \end{aligned} \tag{15}$$

where A_F, A_M are the age of the wife and the husband, respectively, $CU6$ and $CO6$ are number of children less than 6 and above 6 years, L_K is leisure for gender $k = M, F$, defined as

$$L_K = 1 - h_K / 8760, \tag{16}$$

and α_j, $j = 1,2,\ldots,13$, are unknown parameters.

If $\alpha_1 < 1, \alpha_3 < 1, \alpha_7 < 1, \alpha_2 > 0,$

$$\alpha_4 + \alpha_5 \, log\, A_M + \alpha_6 (log\, A_M)^2 > 0,$$

and

$$\alpha_8 + \alpha_9 \, log\, A_F + \alpha_{10} (log\, A_F)^2 + \alpha_{11}\, CU6 + \alpha_{12}\, CO6 > 0$$

then $log\, v(C, h_F, h_M)$ is increasing in C, decreasing in (h_F, h_M) and strictly concave in (C, h_F, h_M).

It is assumed that the offered hours is not correlated with offered wage rates, which may be justified by the fact that in most countries working hours are regulated by law or set in central negotiations between unions and employers associations. The fraction of jobs with a given number of hours is assumed to be consistent with a uniform distribution of hours apart from a peak at full-time hours for males and part-time hours for females. The fraction of jobs with a given wage rate is assumed to be a log normal density with gender-specific means that depend on length of schooling and on experience. "Experience" is defined as age minus length of schooling minus six.

The results from estimating the model on Norwegian data from 1986 are given in Table 8.

Note that the most parameters are rather precisely determined and have the theoretically expected signs.

The estimates are in accordance with the theory in the sense the mean utility function is an increasing and strictly concave function in consumption and leisure. The males marginal mean utility of leisure in Norway attains a minimum at the age of 41.9 years and in the case of females, at the age of 35 years. The wife's education turns out to affect the fraction of feasible job opportunities such that a higher educated woman has more job opportunities than a less educated one. (Implied by $\hat{\alpha}_{15} < 0.$)

For the estimate of the wage opportunity density we refer to Aaberge et al. (1995) who also report various aggregate labor supply elasticities.

Table 8. Estimates*) of the parameters of the utility function and of the opportunity density. Norway 1986

Variables	Coefficient	Estimates	t-values
Preferences:			
Consumption	α_1	0.951	16.4
	α_2	1.269	5.6
Male leisure	α_3	-4.312	6.8
	α_4	100.598	3.0
	α_5	-53.091	3.0
	α_6	7.270	3.0
Female leisure	α_7	-2.240	5.5
	α_8	237.438	3.9
	α_9	-130.174	3.9
	α_{10}	18.492	4.1
	α_{11}	3.397	6.4
	α_{12}	1.648	4.8
Leisure interaction term	α_{13}	0	
Opportunities:			
Female opportunity measure	α_{14}	0.063	0.1
	α_{15}	-0.203	3.7
Male opportunity measure	α_{16}	-3.296	4.5
Interaction	α_{17}	1.289	4.5
Full-time peak, males	α_{18}	1.062	11.2
Full-time peak, females	α_{19}	0.710	5.8
Part-time peak, females	α_{20}	0.425	2.5

Sweden

The structural part of the utility function is defined by

$$\begin{aligned} log\, v(C, h_F, h_M) = & \alpha_2 \left(\frac{\left(10^{-5} C - 0.3\right)^{\alpha_1} - 1}{\alpha_1} \right) + \left(\frac{L_M^{\alpha_3} - 1}{\alpha_3} \right) \left(\alpha_4 + \alpha_5 \, log\, A_M + \alpha_6 \left(log\, A_M \right)^2 \right) \\ & + \left(\frac{L_F^{\alpha_7} - 1}{\alpha_7} \right) \left(\alpha_8 + \alpha_9 \, log\, A_F + \alpha_{10} \left(log\, A_F \right)^2 + \alpha_{11} \, CU6 + \alpha_{12} \, CO6 \right) \\ & + \alpha_{13} \, L_F^{0.5\alpha_3} \, L_M^{0.5\alpha_7} \end{aligned} \tag{17}$$

The fraction of jobs with a given number of hours is assumed to be consistent with a uniform distribution of hours apart from a peak at full-time hours for males and peaks at full-time, 2/3 part-time and part-time hours for females. The reason why there are more peaks in the Swedish female case than in the corresponding Norwegian case is that there are more strict regulation of part-time working hours in the Swedish labor market than in the Norwegian.

The Swedish dataset does not allow for the modeling of participation and is thus based on observations for married couples who are working. On the other hand the labor force rates both for males and females are very high in Sweden (highest in the world).

In Table 9 we present the estimates of the Swedish utility function based on household data from 1981.

Table 9. Estimates of the parameters of the utility function and of the opportunity density, Sweden 1981

Variables	Coefficient	Estimates	t-values
Preferences:			
Consumption	α_1	0.574	9.4
	α_2	9.278	11.4
Male leisure	α_3	-4.607	5.8
	α_4	174.644	3.0
	α_5	-91.188	3.0
	α_6	12.371	3.1
Female leisure	α_7	-4.106	6.5
	α_8	153.041	2.5
	α_9	-78.834	2.4
	α_{10}	10.876	2.5
	α_{11}	1.541	3.8
	α_{12}	0.805	3.1
Leisure interaction term	α_{13}	1.698	1.5
Opportunities:			
Full-time peak, males	α_{14}	3.424	47.1
Full-time peak, females	α_{15}	2.814	29.1
2/3 part-time peak, females	α_{16}	1.454	13.5
Part-time peak, females	α_{17}	1.830	18.8

Note that most parameters are rather precisely determined (apart from the cross leisure term) and they have the theoretically expected signs.

The estimates imply that the mean utility function is an increasing and strictly concave function in consumption and leisure. The males marginal mean utility of leisure attains a minimum at the age of 41.9 years and in the case of females, at the age of 35 years, exactly the same as for Norway.

The estimated wage opportunity density and aggregate labor supply elasticities are reported in Aaberge et al. (1990).

Italy

The functional form of the deterministic part of the utility function is defined by

$$\begin{aligned} \log v(C, h_F, h_M) = {} & \left[\alpha_2 (1-K_M)(1-K_F) + \alpha_3 K_F + \alpha_4 K_M\right] e^{\alpha_1 C} \\ & + \left[\alpha_6 + \alpha_7 \log A_M + \alpha_8 (\log A_M)^2\right]\left(\frac{L_M^{\alpha_5} - 1}{\alpha_5}\right) \\ & + \left[\alpha_{10} + \alpha_{11} \log A_F + \alpha_{12} (\log A_F)^2 + \alpha_{13} CU6 + \alpha_{14} CO6\right]\left(\frac{L_F^{\alpha_9} - 1}{\alpha_9}\right) \end{aligned} \tag{18}$$

$K_j = 1$ if spouse j is working; otherwise $K_j = 0$, and the specification implies that the marginal utility of consumption differs with respect to the reported labor market participation. The reason for doing this is the possible existence of non-reported income. The underground economy in Italy is believed to be of some importance. To capture some of these effects on income and hence on consumption, the marginal utility of consumption is specified as (implicitly) shown above.

Since the regional variation of wages is more important than in the Scandinavian countries, and since unemployment in Italy has been rather high by Norwegian/Swedish standards, we will include a discussion of the estimation of the wage opportunity density here. The opportunity measure for wages are specified as follows,

$$log\, W_j(z) = \beta_{0j} + \beta_{1j}\, s_j + \beta_{2j}\, Exp_j + \beta_{3j} \left(Exp_j\right)^2 + \beta_{4j}\, Re\, g_j + \eta_j(z) \tag{19}$$

$j = F, M$, where $(\eta_F(z), \eta_M(z))$ are normally distributed, s_j denotes years of schooling, gender j, Exp_j = experience = $A_j - s_j - 6$ and $Re\, g = 1$ living in Northern Regions (North of Tuscany) and 0 otherwise. Moreover,

$$log(g_{01}) = \alpha_{15} + \alpha_{16}\, Re\, g_F + \alpha_{17} UE_F, \tag{20}$$

and

$$log(g_{10}) = \alpha_{18} + \alpha_{19}\, Re\, g_M + \alpha_{20} UE_M \tag{21}$$

where UE_j is the ratio between the number of unemployed and employed for gender j.

It should be noted that the specifications (20) and (21) imply the following interpretation of the model parameters. If α_{16} and α_{19} are positive, then living in Northern Italy improves the chances of finding a market opportunity, compared to living in Central and Southern Italy. Likewise, negative values of α_{17} and α_{20} indicate that unemployment has a negative impact on job opportunities.

Feasible hours in the market is assumed to be uniformly distributed except for peaks at full-time hours for females and males, which are defined by the interval [1846, 2106]. Note that this interval corresponds to weekly hours between 36 and 40.

The estimation results are reported in Table 10.

Table 10. Estimates of the parameters of the utility function and of the opportunity density, Italy 1987

Variables	Coefficient	Estimates	t-values
Consumption	α_1	$-0.780 \cdot 10^{-4}$	-7.7
	α_2	-15.938	-8.3
	α_3	-10.020	-19.1
	α_4	-15.364	-11.4
Male leisure	α_5	-18.651	-16.4
	α_6	-0.180	-1.4
	α_7	0.102	1.5
	α_8	-0.015	-1.4
Female leisure	α_9	-6.805	-8.1
	α_{10}	34.428	2.2
	α_{11}	-19.039	-2.2
	α_{12}	2.716	2.3
	α_{13}	0.225	1.8
	α_{14}	0.275	2.7
Female opportunity density	α_{15}	-0.952	-2.8
	α_{16}	0.705	6.5
	α_{17}	-0.594	-0.9
Male opportunity density	α_{18}	-0.512	-8.4
	α_{19}	0.310	1.2
	α_{20}	0.243	0.1
Full-time peak, males	α_{21}	2.406	28.0
Full-time peak, females	α_{22}	2.501	51.9

The estimates imply that the deterministic part of the utility function is an increasing and strictly concave function of leisure and consumption. The basic parameters of the utility function are α_1, α_5 and α_9. These parameters are measured with good precision. The marginal utility of consumption and leisure depends also on personal characteristics such as age and number of children. The estimates for the coefficients of these variables are less precise. Children have the expected positive effect on the value of wife's leisure. However, a rather surprising result is that the presence of older children have essentially the same effect as younger ones; as a matter of fact the point estimate for the former ones is even larger (this result, however, accords with other analyses of Italian data, see e.g. Colombino and Del Boca (1990)). A possible explanation might be found in a cohort effect. Women with older children on average belong to older cohorts. For a variety of unobserved factors (attitudes, supply of child-care services, etc.) which change from one cohort to the other, older cohorts presumably tend to use a more "leisure-intensive" technology in child-care.

The estimated parameters of the job-opportunities density confirm – at least for females – a more favourable environment in Northern regions. On the other hand, the effect of unemployment is not measured precisely enough to draw any clear conclusion. For a more comprehensive discussion of the empirical results we refer to Aaberge et al. (1993) who also report the estimated wage opportunity density and various aggregate labor supply elasticities.

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