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LIFETIME AND ANNUAL MARGINAL COSTS OF REDISTRIBUTION IN ENGLAND, SWEDEN, AND THE UNITED STATES

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Abstract—Both the annual and lifetime marginal costs of redistribution (MCR) in England, Sweden, and the United States are calculated. The annual MCR is $2 90 in the United States, $3 53 in England, and $6 77 in Sweden The lifetime MCR is $4 46 in the United States and $7 96 in England The lifetime MCR in Sweden indicates that additional redistribution reduces the incomes of both the poor and non-poor This study also shows that when there is greater income equality, the marginal tax rate at which the incomes of the poor and non-poor begin to be reduced will be at lower and lower levels.

I. Introduction

Marginal costs of redistribution (*MCR*) have been estimated by Browning and Johnson (1984), by Ballard (1986), and implicitly in the optimal income tax literature. However, the estimates are all limited by the use of annual rather than lifetime data. Horowitz (1990) has shown that examining lifetime effects can produce significantly different results. This paper uses the simulation of my 1990 paper to compare the *MCR* for the United States, England, and Sweden.

Using Browning's (1987a) method of calculating efficiency costs, the *MCR* calculations in this paper are made by separating the population into five quintiles and dividing the upper four income quintiles' loss in real income by the bottom quintile's gain in real income This calculation yields the additional cost to upper quintiles to redistribute one additional dollar to the bottom quintile.

Only the labor–leisure distortion is considered in calculating the *MCR*. The simulation includes neither administrative nor compliance costs nor effects of increases in the wage tax on either saving or the choice of occupation Including those effects would increase the *MCR*. Consequently, these results are suggestive of *MCR* values rather than precise estimates.

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Considering labor supply effects, the *MCR* differs among countries only as a result of differences in one or more of four factors: (1) the marginal wage tax rate (*MTR*), (2) the compensated labor supply elasticity (ϵ), (3) the distribution of labor earnings and (4) the system of redistribution The *MCR* will be greater if (1) the *MTR* is higher, (2) ϵ is higher, or (3) labor earnings are distributed more equally. Since lifetime earnings are more equal than annual earnings, the lifetime *MCR* will be higher than the annual *MCR*.[1]

This study uses a linear income tax (LIT) redistribution system. Under a LIT, additional tax revenue is raised from an increase in the *MTR* and is redistributed equally per household. A LIT may seem to be an inefficient method of transferring income.[2] However, the Redistribution and Optimal Income Tax literatures commonly use the LIT because it is simple and sufficiently accurate. Also, Browning and Johnson (1984, pp. 180–181) present evidence that a proportional increase in taxes and transfers would redistribute income comparably to an increase in a LIT

II. Simulation of the MCR

Annual and lifetime *MCR* are calculated by a simulation that uses an extension of the dynamic labor supply model developed by Heckman and MaCurdy (1980), MaCurdy (1981), and Killingsworth (1983). There are 50 lifetime wage profiles in the simulation for each country. Each profile consists of 11 time periods, each of which is 5 years long. It is assumed that each household begins the 11 time periods at age 20 and ends at age 74, when a household ends its economic life, another household with exactly the same lifetime wage profile begins at age 20 Since there are 11 households in each profile and 50 profiles, there are

[1] The *MCR* is higher when earnings are more equal because less is redistributed not because the efficiency loss increases Browning (1987b) and Horowitz (1990) illustrate this point

[2] A LIT and a negative income tax with a constant tax rate are equivalent because everyone's marginal and average tax rates are equivalent.

TABLE 1.—RESULTS OF INEQUALITY STUDIES

	United States	Sweden	England
1 $GINI_{AI}$	0.35–0.43	0 21–0.31	0.33
2 $GINI_{LI}$	0.19–0.35	0 09–0 14	—
3 CV_{AI}	0.75–0 90	—	0 70
4 CV_{LI}	0.40–0 50	0 19–0 28	—
5 $GINI_{AE}$	0.25–0 47	—	—
6 $GINI_{LE}$	0.19–0.38	0.09–0.14	—
7 CV_{AE}	0 59–0.89	—	—
8 CV_{LE}	0 42–0.84	0 19–0.28	—

TABLE 2.—SUMMARY OF MAJOR PARAMETERS

	United States	Sweden	England
1 $GINI_{AI}$	0 43	0 23	0 40
2 $GINI_{LI}$	0 30	0 12	0 30
3 CV_{AI}	0 87	0 41	0 84
4 CV_{LI}	0 53	0.20	0 55
5 $GINI_{AE}$	0 36	0 17	0 34
6 $GINI_{LE}$	0.32	0.14	0 32
7 CV_{AE}	0.75	0 31	0 74
8 CV_{LE}	0.57	0 24	0.60
9 *MTR*	40%	70%	50%
10 *%TxR*	30%	47%	30%
11 ϵ	0 3	0 3	0 3
12 *Hrs* (*5YRs*)	18,200	18,200	18,200
13 r	0 03	0 03	0 03
14 α	0 81	0 95	0.85
15 β	0 19	0 05	0 15

Note The inequality parameters in rows 1–8 are calculated by the simulation All parameters are for the simulation's central case

550 households in the simulation.[3] The central case estimates are formulated so as to reflect the income distribution patterns for the three countries in question.[4]

Wage and earnings data were taken from the 1983 *Panel Study of Income Dynamics* for the United States. Those for Sweden were from *Statistiska Meddelanden Salaries in Manufacturing, in Construction and in Wholesale and Retail trade 1987* (Tabell 4) and *Statistiska Meddelanden Employees in Primary Local Authorities in 1987* (Tabell 3). The data for England were from *New Earnings Survey 1986, Part E Analyses by Region and Age Group*.[5]

Table 1 shows empirical inequality results The U.S. earnings and income inequality results were calculated by Blinder (1974), Lillard (1977), Davies et al. (1984), and Rycavage and Henle (1990); the Swedish by Blomquist (1981) and Duh (1984); the English by Semple (1975) and Mookherjee and Shorrocks (1982).[6] In tables 1 and 2, *CV* is the coefficient of variation, subscript *AI* represents annual income, *LI* lifetime income, *AE* annual earnings, and *LE* lifetime earnings.

The simulation results in table 2 are close to the empirical estimates in table 1 for the United States and Sweden. The annual simulation results for England show a slightly less equal distribution than the empirical estimates. However, recent evidence by Adams et al. (1988) suggest that the English earnings distribution has become more unequal. The simulation results are in the range consistent with Adams et al. (1988). To test the sensitivity of the *MCR* to the initial earnings distribution, the simulation is also calculated with earnings distributions more equal and less equal than each country's central case.[7]

By optimizing lifetime utility subject to the lifetime budget constraint, the functions for consumption $C(t)$ and leisure $L(t)$ at each time t can be written·

$$C(t) = \frac{\alpha\left[\Sigma_{t=0}^{10}(1+r)^{-t}((1-MTR)W(t)Hrs+G_y)\right]}{(\alpha+\beta)\Sigma_{t=0}^{10}(1+r)^{-t}} \tag{1}$$

$$L(t) = \frac{\beta\left[\Sigma_{t=0}^{10}(1+r)^{-t}((1-MTR)W(t)Hrs+G_y)\right]}{(\alpha+\beta)(1-MTR)W(t)\Sigma_{t=0}^{10}(1+r)^{-t}} \tag{2}$$

$W(t)$ is the period's wage rate, *Hrs* is the total possible hours in each period, G_y is the period's transfer received, and r is the interest rate.[8]

Because of the separable log-additive utility function, the elasticity of substitution equals 1 This may cause the ϵ calculated in the simulation to overstate the empirical ϵ However, α and β are adjusted until ϵ is equal to 0 3 in the central case ϵ is used in calculating the marginal welfare cost (*MWC*).

As shown in table 2, row 9, the central case *MTR* is 40% in the United States, 70% in Sweden, and 50% in

[3] There is one wage earner per household and all households are equivalent except for age and wage differences.

[4] The 50 lifetime wage profiles are formed by calculating the relative frequency that wages occur in each age group from real data The relative frequencies are then used with a random number generator to assign the wage data by age group to the lifetime wage profiles The lifetime wage profiles are adjusted until the degrees of annual and lifetime earnings and income inequality calculated in the simulation are in the ranges of the empirical studies.

[5] The Swedish and English data were converted into hourly earnings by assuming that full-time work is 40 hours a week and 2000 hours a year All wages are then converted into dollars. Results are insensitive to differences in exchange rates

[6] Lifetime English inequality measures were not found Since annual English inequality is similar to the annual inequality in the United States, the lifetime U.S inequality measures were used for England

[7] An infinite number of wage profiles can be constructed which are consistent with a given Gini Coefficient However, in the simulation there is almost no effect on the annual *MCR* and little effect on the lifetime *MCR* when the Gini is constant and the *CV* varies.

[8] Horowitz (1990) presents the derivations of equations (1) and (2)

England.[9] The 40% U.S. *MTR* is based on Browning's (1987a) estimate that the U.S. *MTR* is 43%. The 70% Swedish *MTR* is based on Stuart's (1981) estimate that Sweden's *MTR* is slightly more than 08% and Hansson and Stuart's (1985) estimate that Sweden's *MTR* is 73%. No estimates could be found for England's overall *MTR*. However, an estimate of 50% was calculated by summing the 33% direct *MTR* from Zabalza and Arrufat (1988) with an approximately 10% National Insurance contribution of employers and a 7% Value Added Tax (VAT). The VAT is actually 15% but it does not fully fall on earnings. The simulation is also calculated for *MTR*s 5 percentage points above and below each country's central case *MTR*.

G_y is calculated by dividing the tax revenue allocated to government transfer payments by the number of households in the simulation. All the tax revenue from a 1 percentage point increase in the *MTR* is used for transfers. However, row 10 in table 2 shows the percentage of tax revenue used for income transfers (*%TxR*) before the increase in the *MTR*.[10] The simulation is also calculated for *%TxR* 10 percentage points above and below each country's central case *%TxR*.

Killingsworth and Heckman (1986) and Pencavel (1986) suggest that ϵ is between 0.07 and 0.76. Because of the large variation in the estimates of ϵ, a conservative estimate of 0.3 is used as the central case estimate. The simulation is also calculated for ϵ of 0.2 and 0.4.

Other parameters include *Hrs*, r, α, and β. *Hrs* equals 18,200 (10hrs × 7days × 52wks × 5yrs) Horowitz (1990) found that changing the total hours had little effect on the simulation results. r equals 3%. The simulation is also calculated with r equal to 0% and 6%. α and β are chosen so that the ϵ approximately equals 0.3 in the central case. Table 2 rows 14 and 15 show the values for α and β.

A household's net benefit or loss in each period from the increase in the tax-transfer program equals the additional transfers received minus both the additional taxes paid and the *MWC*. The lifetime net gain or loss is calculated by discounting each period's net gain or loss to period zero. The *MWC* is calculated using the following equation developed by Browning (1987a):[11]

$$MWC = (.5\Delta MTR + MTR)\frac{W(t)H_2\epsilon}{(1 - MTR)}\Delta MTR \tag{3}$$

[9] The *MTR* is a weighted average *MTR* for all taxes and income tested transfers that fall on earnings

[10] *Government Financial Statistics, 1987*, p 52 Horowitz (1990) used a broader definition for *%TxR*

[11] Even though an explicit utility function is assumed, Browning's method was used to calculate the *MWC* This is because Browning's method greatly reduced the number of calculations and increased the efficiency of the simulation

TABLE 3.—SIMULATION RESULTS FOR THE UNITED STATES

	Varied Inputs				Results	
	MTR	r	ϵ	*%TxR*	Annual *MCR*	Lifetime *MCR*
1	41%	3%	3	3	−$2.90	−$4 46
2	36%	3%	3	3	−$2.62	−$3 93
3	46%	3%	.3	3	−$3 21	−$5.08
4	41%	0%	3	3	−$2.88	−$4 07
5	41%	6%	.3	3	−$2 94	−$3.98
6	41%	3%	2	3	−$2 26	−$3.20
7	41%	3%	.4	3	−$3.54	−$5.91
8[a]	41%	3%	3	3	−$3 03	−$6 87
9[b]	41%	3%	.3	3	−$2 88	−$3.56
10	41%	3%	.3	2	−$3 08	−$4 96
11	41%	3%	3	4	−$2.75	−$4 06

[a] $GINI_{AF}$ = 33, $GINI_{LE}$ = 23, CV_{AE} = 60, CV_{LE} = 40
[b] $GINI_{AF}$ = 41, $GINI_{LE}$ = 39, CV_{AE} = 85, CV_{LE} = 69

where H_2 is the labor supply before the increase in the *MTR*

The annual *MCR* is calculated by first determining the annual before tax after transfer (*BTAT*) income for the households. Since a period is 5 years, the annual income is the period income divided by 5. The period income is found by adding wages, transfers, and capital income earned in each period.[12] The households are then ranked by income into quintiles. The average real net losses for the top four quintiles are added and the total is divided by the average real net gains of the bottom quintile.

The lifetime *MCR* is calculated in almost the same way as the annual *MCR*. However, because of the assumption of perfect capital markets, a household gains lifetime *BTAT* income from just lifetime earnings and transfers.[13]

III. Results

Tables 3, 4, and 5, contain the simulation estimates of the *MCR* for the United States, England, and Sweden.

In tables 3, 4, and 5, row 1 shows the central case estimates of the real annual marginal cost of redistributing $1 to the lowest quintile. The annual *MCR* is $2.90 in the United States, $3.53 in England, and $6.77 in Sweden. The lifetime *MCR* is $4.46 in the United States, $7.96 in England, and $14.28 in Sweden. In Sweden the lifetime *MCR* appear as positive numbers rather than negative numbers because the additional

[12] Capital income is the interest earned on what was not consumed previously

[13] In calculating the lifetime *MCR*, the transition period is ignored

TABLE 4.—SIMULATION RESULTS FOR ENGLAND

	Varied Inputs				Results	
	MTR	*r*	ε	*%TxR*	Annual *MCR*	Lifetime *MCR*
1	51%	3%	.3	3	−$3 53	−$7.96
2	46%	3%	.3	.3	−$3 17	−$6 86
3	56%	3%	3	3	−$3 98	−$9.41
4	51%	0%	3	3	−$3.53	−$5 66
5	51%	6%	3	3	−$3.72	−$8 77
6	51%	3%	2	3	−$2.69	−$5 34
7	51%	3%	.4	3	−$4 38	−$11 42
8[a]	51%	3%	3	3	−$3 65	−$13 42
9[b]	51%	3%	3	.3	−$3 52	−$5.15
10	51%	3%	.3	2	−$3.68	−$8 81
11	51%	3%	.3	4	−$3 42	−$7 28

[a] $GINI_{AE}$ = 30, $GINI_{LE}$ = 25, CV_{AE} = 62, CV_{LE} = 44
[b] $GINI_{AE}$ = 45, $GINI_{LE}$ = 48, CV_{AE} = 84, CV_{LE} = 93

TABLE 5.—SIMULATION RESULTS FOR SWEDEN

	Varied Inputs				Results	
	MTR	*r*	ε	*%TxR*	Annual *MCR*	Lifetime *MCR*
1	71%	3%	3	.4	−$6 77	$14 28
2	66%	3%	.3	.4	−$5 53	$18 55
3	76%	3%	3	4	−$8 78	$11 69
4	71%	0%	3	4	−$6 74	$31.73
5	71%	6%	3	4	−$7 24	$10 92
6	71%	3%	2	4	−$4 73	$28 74
7	71%	3%	4	4	−$8 95	$11.22
8[a]	71%	3%	3	4	−$8 61	$6 44
9[b]	71%	3%	3	4	−$6 45	$18 86
10	71%	3%	3	3	−$6 89	$13 44
11	71%	3%	.3	5	−$6 76	$14 43

[a] $GINI_{AE}$ = 15, $GINI_{LE}$ = 08, CV_{AE} = 28, CV_{LE} = 13
[b] $GINI_{AE}$ = 19, $GINI_{LE}$ = 18, CV_{AE} = 34, CV_{LE} = 31

redistribution reduces the incomes of both the upper and lower income groups.[14]

Additional estimates are as follows: row 2 (row 3) of tables 3, 4, and 5 demonstrates that the *MCR* is lower (higher) when the *MTR*s are lower (higher). Row 4 (row 5) illustrates that the lifetime *MCR* is usually higher (lower) with a higher (lower) *r* because the taxes paid in the households' middle (older) years are given more weight, relative to the transfers received in the older (middle) years. Case 6 (case 7) the *MCR* increases (decreases) when ε is higher (lower). Case 8 (case 9) shows that the *MCR* increases (decreases) when earnings are more (less) equal. In case 10 (case 11) the *MCR* increases (decreases) when the *%TxR* decreases (increases).

Table 6 shows the lifetime and annual *MCR* in the United States, England, and Sweden when the *MTR*s are varied from 10% to 90%. As shown above, normally the *MCR* increases as the *MTR* increases and as incomes are more equal.[15]

Table 6 also demonstrates that when there is greater equality, the incomes of both the poor and the non-poor begin to be reduced at lower *MTR*s.[16] At *MTR*s of approximately 60% and above, Sweden's lifetime *MCR* is positive which implies that the poor and non-poor are worse off. In the United States and England both the poor and non-poor are not worse off until the *MTR* is above approximately 90%.[17]

[14] With a positive *MCR*, a lower number means a higher *MCR*. For example, if upper income quintiles lose $1 while lower income quintiles lose $0 10 (a 10/1 ratio) because of redistribution, the *MCR* is lower than if upper and lower income quintiles both lose $1 (a 1/1 ratio).

[15] Because of approximations in the simulation small differences in the *MCR* are not significant. For example, Sweden's annual *MCR* is only 3 to 14 cents less tan the U S 's or England's for *MTR* of 10% to 40%

[16] The very large values in the eighth row of columns 2 and 4, the ninth row of column 6, and the fifth row of column 7, are because the *MCR* is about to or has just changed from negative to positive Also as stated in footnote 14 when the *MCR* is positive, larger numbers mean lower *MCR*.

[17] The English results begin to differ dramatically from the U S. results at an *MTR* of 80% because the English data are slightly more equal than the U S data. Thus the English will reach the backward bend of their income distribution frontier first

TABLE 6 —*MCR* FOR DIFFERENT *MTR*s

MTR (1)	U S Annual *MCR* (2)	U S Life *MCR* (3)	England Annual *MCR* (4)	England Life *MCR* (5)	Sweden Annual *MCR* (6)	Sweden Life *MCR* (7)
10	−1 53	−1 99	−1 52	−2.74	−1.42	−3 51
20	−1 95	−2 69	−1 94	−3.63	−1.81	−5 83
30	−2.39	−3 46	−2 38	−4 64	−2 29	−10 16
40	−2.90	−4.46	−2 88	−5 97	−2 87	−22 55
50	−3 55	−5 88	−3 53	−7 96	−3 65	−1102
60	−4 56	−8 21	−4 56	−11 46	−5 00	27 91
70	−5 93	−14 08	−5.91	−21 88	−6 77	14.28
80	−9 40	−39 55	−9 40	−141 64	−12 62	9 93
90	−28 85	47 76	−29.11	31 98	11792	7 71

IV. Summary

When the three countries are compared, the *MCR* is higher in Sweden than in England or the United States, although the specific results are sensitive to parameter values. In fact, when examined from the lifetime point of view, it appears that Sweden has reached the backward bend of its income distribution frontier.

As shown in table 6, because Sweden has greater equality, the backward bend of Sweden's income redistribution frontier begins at a lower *MTR* than England's or that of the United States In other words, when there is more equality, incomes of both poor and non-poor begin to be reduced at lower *MTR*s This implies that as countries use tax-transfer policies to move toward economic equality the *MTR* at which the incomes of the poor and non-poor begin to be reduced will be at lower and lower levels.

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