Optimal Taxation and Tax Reform for Two-Earner Households

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Abstract

This paper is concerned with the question of how two-earner households should be taxed. One reason for the importance of this issue is simply the quantitative significance of households formed around couples. A second reason is that the economic theory of optimal taxation and tax reform, at least as it is presented in the mainstream literature, provides little guidance on this issue, resting as it does on models of the single person household. An old insight in the earlier public finance literature is that any discussion of the taxation of two-person households necessarily involves the recognition of the importance of household production. In this paper we analyse optimal linear taxation and tax reform to put the "conventional wisdom", which says that it is optimal to tax women on a separate, lower tax schedule than men, on a firmer basis. We also discuss some recent literature on the nonlinear taxation of two-earner households. What emerges clearly from the analysis is how centrally important the relationship between productivity in household production and female labour supply really is, and how little we know about it empirically.

1 Introduction

The large growth in female labour force participation that occurred in the 1950's to 1980's has made the question of taxing two-earner households one of the central issues in tax policy, yet it is relatively neglected in the theoretical literature.[1] This paper summarises and extends the main results in that part of the literature concerned with optimal linear income taxation and tax reform, emphasising the importance of household production and its relevance to the taxation problem.

Attention tends to focus on the relative merits of joint taxation (income splitting), individual taxation and selective taxation. Under the first, incomes are added together, divided by two, and the resulting average income taxed according to a given tax schedule. Under the second, the couple's incomes are taxed separately but on the same rate schedule. Under the third, not only are incomes taxed separately, but the tax schedules also differ. The paper by Boskin and Sheshinski (1983) is generally regarded as having established the conventional wisdom in this area, namely that selective, and not joint, or even independent, taxation is optimal.[2] That is, not only should women be taxed separately from men, but they should be taxed on a lower rate schedule. This conventional wisdom was challenged by Piggott and Whalley (1996), who argued for the second best optimality of joint taxation, but Apps and Rees (1999b) show that their argument is flawed.

Nonetheless, we suggest in the following section of this paper that, though perhaps intuitively appealing, the Boskin-Sheshinski analysis itself does not establish a solid basis for the conventional wisdom. The general conclusion that tax rates on men and women should differ is almost certainly correct. That is, joint taxation is optimal in a set of cases of measure zero. However, their argument that the tax rate on women should be lower is open to question. In the kind of model that Boskin and Sheshinski use, we cannot rule out the possibility that, although on efficiency grounds alone their result holds,[3] the female tax rate could be a better instrument of income redistribution *across households* than the male tax rate, and equity effects could outweigh efficiency effects to result in a higher tax rate on women. However, we show that if there is positive assortative matching, in the sense that the female wage rate increases with the male wage rate across households, and if the covariance across households between the marginal social utility of income and the difference between male and female earnings is negative, then

[1] For example it is not discussed at all in two leading public finance texts, Myles (1995) and Salanié (2003), nor in the survey by Auerbach and Hynes (2002), while it is mentioned as an important issue, but not further analysed, in Atkinson and Stiglitz (1988).

[2] See also Feldstein and Feenberg (1996).

[3] Consistent with the intuition of Munnell (1980) and Rosen (1977).

the tax rate on men should certainly be higher than that on women. Since the empirical evidence appears to provide support for these conditions, this places the conventional wisdom on a much firmer basis.

However, the model used by Boskin and Sheshinski suffers from the limitation that it ignores household production. Thus in their model household wage income is an accurate indicator of household utility possibilities. If we take account of household production and the considerable across-household heterogeneity in female labour supply that in fact exists, household income becomes a much less reliable indicator of household utility possibilities,[4] and a linear tax system based on market income may generate significant inequities, even if these are not so great as under a joint tax system. We show this in section 4, having developed in section 3 a simple model of household production.

A limitation of the linear taxation model is that it constrains the marginal tax rates on all primary earners to be the same right across the wage distribution, and similarly for all second earners. Thus it rules out the possibility of considering whether and how the marginal tax rate on one earner should vary with the wage or earnings of the other. An important property of joint taxation is that, since the marginal tax rate both earners face varies with their joint income, with marginal rates increasing with income an increase in the income of one individual raises the tax rate on the other. If, on the other hand, the marginal rate falls with joint income over some range,[5] this cross effect would be negative. Is this non-zero interdependence a desirable attribute of a tax system? In Section 5, we consider briefly the literature on the nonlinear taxation of couples to throw some light on this question.

2 The Boskin-Sheshinski Model

This model, based on the optimal linear income tax analysis of Sheshinski (1972), could be viewed as making the smallest possible extension to the model of the individual worker/consumer just necessary to analyse taxation of two-person households. Its main contribution is to make precise the intu-

[4] As recognised by Munnell (1980).

[5] Although this is almost never a feature of *formal* tax systems, features of the social transfer system such as earned income tax credit schemes with high withdrawal rates can cause this to be a feature of the *effective* tax system. For further discussion and illustration see Apps and Rees (2009), Ch. 6.

ition that selective taxation could be optimal because the elasticity of female labour supply is higher than that of male labour supply.

A household has the utility function $u(y, l_f, l_m)$, where y is a market consumption good, and $l_i \geq 0$, $i = f, m$, is the labour supply of household member[6] i. The household faces the budget constraint

$$y = a + \sum_{i=f,m} (1 - t_i)x_i$$

where a is the lump sum transfer in a linear tax system and t_i is the marginal tax rate on i's gross income $x_i \equiv w_i l_i$, with w_i the exogenously given gross market wage. Thus a household is characterised by a pair of wage rates (w_f, w_m), otherwise households are identical. Since this is a linear tax problem we do not have to assume that a household's wage pair is observable. There is a given population joint density function $f(w_f, w_m)$, everywhere positive on $\Omega = [w_f^0, w_f^1] \otimes [w_m^0, w_m^1] \subset \mathbf{R}_+^2$, which tells us how households are distributed according to the innate productivities in market work of their members, as measured by their market wage rates.

To focus attention on what we regard as the most important aspects of the results, we assume that the household utility function[7] takes the quasilinear form

$$u = y - u_f(l_f) - u_m(l_m) \quad u_i^{'} > 0, u_i^{''} > 0, \quad i = f, m$$

which, however, we find more convenient to write in terms of gross incomes

$$u = y - v_f(x_f) - v_m(x_m); \quad v_i(x_i) \equiv u_i(\frac{x_i}{w_i}) \quad i = f, m$$

Solving the household's utility maximisation problem yields demands $y(a, t_f, t_m)$, $x_i(t_i)$ and the indirect utility function $v(a, t_f, t_m)$ such that

$$\frac{\partial v}{\partial a} = 1; \ \frac{\partial v}{\partial t_i} = -x_i \ \frac{\partial v}{\partial w_i} = (1 - t_i)l_i$$

Note that

$$x_i^{'}(t_i) = w_i \frac{dl_i}{dt_i}$$

[6] Although it could just as well be thought of as referring to a single individual with two sorts of labour supply or leisure.

[7] Clearly the model can say nothing about the within-household welfare distribution.

is a compensated derivative, because of the absence of income effects. For the same reason, it is straightforward to confirm that labour supplies and gross incomes are strictly increasing in the wage rate and decreasing in the tax rate. Thus household utility is strictly increasing in household income. Note that the choice of utility function sets the effects of one partner's wage on the labour supply of the other to zero. This makes it much easier to derive the main insights of the analysis without doing too much injustice to the facts.[8]

To find the optimal tax system we introduce the social welfare function $W(.)$, which is strictly increasing, strictly concave and differentiable in the utility of every household, and the planner's problem is then

$$\max_{a,t_f,t_m} \iint\limits_{\Omega} W[v(a,t_f,t_m)]f(w_f,w_m)dw_f dw_m$$

subject to the tax revenue constraint

$$\iint\limits_{\Omega} [t_f x_f + t_m x_m] f(w_f,w_m)dw_f dw_m - a - G \geq 0$$

where $G \geq 0$ is a per household revenue requirement. The first order condition with respect to the lump sum a can be written

$$\iint\limits_{\Omega} \frac{W'}{\lambda} f(w_f,w_m)dw_f dw_m = 1$$

where $\lambda > 0$ is the marginal social cost of tax revenue and W'/λ the marginal social utility of income to a household with characteristic (w_f, w_m). Thus the optimal a equates the average marginal social utility of income to the marginal cost of the lump sum. We denote a household's marginal social utility of income W'/λ by s, and its mean by $\bar{s}$. Thus the condition sets $\bar{s} = 1$. Because of the assumptions on $W(.)$, households with relatively low wage pairs will have values of s above the average, those with relatively high wage pairs, below.

[8] Empirical evidence seems to suggest no significant effects of a wife's wage on husband's labour supply and only very weak negative effects of husband's wage on wife's labour supply.

The first order conditions on the marginal tax rates, using the above condition, can be written as

$$t_i^* = \frac{Cov[s, x_i]}{\bar{x}_i^{'}} \quad i = f, m$$

where

$$Cov[s, x_i] = \iint\limits_{\Omega} (\frac{W^{'}}{\lambda} - 1) x_i f(w_f, w_m) dw_f dw_m$$

is the covariance of the marginal social utility of household income and the gross household income of individual i, and

$$\bar{x}_i^{'} = \iint\limits_{\Omega} x_i^{'}(t_i^*) f(w_f, w_m) dw_f dw_m$$

is the average compensated derivative of gross income with respect to the tax rate, and is negative.

Now the argument that $t_f^* < t_m^*$ is based on the empirical evidence suggesting that $-\bar{x}_f^{'} > -\bar{x}_m^{'}$, but this clearly considers only part of the optimal tax formula, and is in general neither necessary nor sufficient for the result. In other words, though taxing women at a given rate creates a higher average deadweight loss than taxing men at the same rate, the policy maker's willingness to trade off efficiency for equity might imply that the tax rate on women could optimally be higher than that on men, if the covariance between the marginal social utility of household income and women's gross income is in absolute value sufficiently higher than that of men, so that the corresponding redistributive effects make that worthwhile.

This indeterminacy is also of course present in Boskin and Sheshinski's paper, though the greater generality and complexity of their model perhaps makes it less obvious. In order to be able to say something more definite, they take a model based on specific social welfare and household utility functions and "plausible" parameter values, and solve numerically for the marginal tax rates. The result is that the male marginal tax rate is higher than the female.

One example seems to us to constitute a very inadequate basis for an entire conventional wisdom. It is certainly true that equality of the marginal tax rates appears as a highly special case, requiring equality of the ratios of equity and efficiency terms in each case, and so joint taxation is almost certain to be suboptimal, but the results of this model so far do not make a conclusive case for taxing women at a lower rate than men. The optimal tax analysis suggests a departure from income splitting, but it does not tell us much about the appropriate direction of this departure. In fact, the analysis is unnecessary to give the basic result, since joint taxation amounts to imposing on the optimal tax problem the constraint that the marginal tax rates be equal, and such a constraint cannot increase the value of the objective function at the optimum.

To make this a little more precise, write

$$Cov[s, x_i] = \rho_i \sigma_i \sigma_s \quad i = f, m$$

with ρ_i the correlation coefficient between s and x_i, σ_i the standard deviation of x_i, and σ_s the standard deviation of s. Then we have

Proposition 1:

$$t_f^* < t_m^* \Leftrightarrow \frac{\rho_f \sigma_f}{\rho_m \sigma_m} < \frac{\bar{x}_f'}{\bar{x}_m'}$$

It is an open question empirically, whether this condition is satisfied. All we can really conclude from Boskin and Sheshinski's example is that the assumed functional forms and parameter values lead to satisfaction of this condition.

However, we can take the discussion further and put the conventional wisdom on a firmer foundation if we assume:

Assortative matching: across households, the female wage is a monotonic increasing function of the male wage;

Diverging incomes: as the male wage increases, the couple's earnings difference $x_m - x_f$ increases monotonically.

Then we have

Proposition 2: Assortative matching and diverging incomes are sufficient (given $-\bar{x}_f' > -\bar{x}_m'$) to ensure $t_f^* < t_m^*$.

Proof: We can write

$$Cov[s, x_m] - Cov[s, x_f] = Cov[s, x_m - x_f] = \iint\limits_{\Omega} (s-1)[x_m - x_f] f(w_f, w_m) dw_f dw_m \tag{1}$$

Given assortative matching, we know that s is falling monotonically with w_m while given diverging incomes we know that $x_m - x_f$ is increasing monotonically with w_m, thus $Cov[s, x_m - x_f] < 0$, and so

$$-Cov[s, x_m] > -Cov[s, x_f] \tag{2}$$

and the male covariance is higher in absolute value. Hence the male tax rate is both more effective as a redistributive instrument and less costly in terms of deadweight loss, and so it will be optimally higher than the female.

The empirical evidence[9] suggests that, at least in the most developed countries, assortative matching and diverging incomes are reasonable assumptions, and so we have a more solid foundation for the conventional wisdom.

An important limitation of the Boskin-Sheshinski model, as our discussion in the introduction suggests, is that it omits household production. Why should this matter? After all, it could be argued, all that is really important are the labour supply (gross income) derivatives and the covariance of gross income with the marginal social utility of household income. Whether substitution at the margin is between market work and leisure, or market work and household production, is, on this argument, just a matter of detail that does not really have substantive implications.

What makes this argument untenable is the large variation across households in female labour supply[10] and the implication that gross income may well not correctly reflect utility possibilities. In the Boskin-Sheshinski model, the household's utility possibilities necessarily increase with household market income, which is therefore an appropriate welfare measure for purposes of income taxation. A central consequence of taking account of household production, in a way that also explains the empirical evidence on female labour supply, is that household income may be a poor, and possibly negative, indicator of household welfare, which in turn should have important policy implications. In the next section we set up a simple household model incorporating household production, and use it in the rest of this paper to explore issues in the taxation of couples, beginning with an extension of the optimal linear taxation model.

[9] See Apps and Rees (2009), Ch 1.

[10] See for example Rees (2007) for the case of Germany and Apps and Rees (2009) for the additional countries USA, UK and Australia.

3 The Household Production Model

We introduce domestic goods z_i produced respectively by $i = f, m$, with each being consumed by both members of the household, and write the household utility function now as

$$u = y + \phi(z_f) + \mu(z_m)$$

The household good z_f is produced according to the production function

$$z_f = kh_f$$

where the productivity parameter $k \in [k_0, k_1] \subset \mathbf{R}_+$ *varies across households*, and h_f is the time f spends in domestic production. We assume that males in all households are equally productive in household production, because we want to take the primary effect of productivity variation across households to be on female labour supply. By choice of units, we can therefore set the time spent by m in household production,[11] $h_m = z_m$. The implicit price, p, of the domestic good z_f, is equal to its marginal cost, given by

$$p = \frac{(1 - t_f)w_f}{k}$$

and so

$$\frac{\partial p}{\partial t_f} = \frac{-w_f}{k}$$

The price of z_m is $q = (1 - t_m)w_m$. The individuals have time constraints

$$l_i + h_i = 1 \quad i = f, m$$

where total time is normalised at 1. The household budget constraint is

$$y = a + (1 - t_f)w_f l_f + (1 - t_m)w_m l_m$$

which, using the time constraints, can be written as

$$y + pz_f + qz_m = Y$$

[11] What distinguishes z_m from "leisure" is that it is consumed by both individuals. It may, but need not, be a household public good.

where $Y \equiv a+(1-t_f)w_f+(1-t_m)w_m$ is the household's *net full income*. From this budget constraint it is clear that two households with identical male and female wage rates and differing values of k will have differing utility possibilities, with the household with the lower value of p, *i.e.* the higher female productivity in domestic production, having the higher budget constraint.

This is made explicit if we solve the household's utility maximisation problem to obtain the demand functions $y(p, q, Y)$, $z_f(p)$, $z_m(q)$ and its indirect utility function $v(p, q, Y)$, with

$$\frac{\partial v}{\partial p} = -z_f; \quad \frac{\partial v}{\partial q} = -z_m; \quad \frac{\partial v}{\partial Y} = 1$$

Then obviously the higher the value of k and therefore (for equal female wage rate) the lower is p, the higher the household's utility. For the interpretation of the tax analysis it is also useful to note that

$$\frac{\partial v}{\partial a} = 1; \quad \frac{\partial v}{\partial t_i} = -w_i l_i \quad i = f, m$$

Of key importance is the relation between female market labour supply, and therefore household market labour income, and the productivity parameter k. Unfortunately, this is in general ambiguous. Thus we have

$$l_f = 1 - \frac{z_f(p)}{k}$$

and so

$$\frac{\partial l_f}{\partial k} = \frac{z_f}{k^2} - \frac{z_f'(p)}{k}\frac{\partial p}{\partial k}$$

The first term is positive, and reflects the effect of increasing productivity in reducing the time required to produce a given domestic output. The second term is negative, since demand for domestic output increases as its price falls, and increasing k reduces the price of the domestic good. Thus increasing productivity reduces the time needed to produce a given level of domestic output but increases the demand for it, so the net outcome depends on the relative strength of these two effects. Noting that $\partial p/\partial k = -p/k$, we can write this as

$$\frac{\partial l_f}{\partial k} = \frac{z_f}{k^2}(1 - e)$$

where e is the price elasticity of demand of the domestic good. Thus if this demand is elastic ($e > 1$), female labour supply decreases with productivity, while it increases in the converse case. Moreover, we can derive a very simple relationship between the elasticity of female labour supply with respect to the net wage, e_{w_f}, and this elasticity of demand for the domestic good, which is

$$e = e_{w_f} \frac{l_f}{h_f}$$

Thus if we know a household's female labour supply elasticity and the ratio of market to domestic labour supply, we can predict how variations in its domestic productivity affect female labour supply.

4 Optimal Linear Taxation

Turning now to the optimal linear tax analysis,[12] we extend the Boskin-Sheshinski model in the simplest possible way. First, we adopt the assumption of *assortative matching*, as set out in the previous section. Because of this we from now on write the male wage simply as $w \in [w_0, w_1] \subset \mathbf{R}_+$. We also assume we have the joint density function $f(k, w)$ defined on $\Delta = [k_0, k_1] \bigotimes [w_0, w_1] \subset \mathbf{R}^2_+$. A value of the male wage w corresponds now to a pair of wage rates. Recall that the higher is k, the lower is the implicit price of the household good and so the higher must be the household's utility possibilities.

We set up essentially the same optimal tax problem as before

$$\max_{a, t_f, t_m} \iint\limits_{\Delta} W[v(a, t_f, t_m)] f(k, w) dk dw$$

subject to the revenue constraint

$$\iint\limits_{\Delta} [t_f w_f l_f + w t_m l_m] f(k, w) dk dw - a - G \geq 0$$

The first order condition with respect to the lump sum a can now be written

[12] Sandmo (1990) was the first to analyse optimal linear income taxation in the presence of household production. The key differences to the present paper are that he was concerned with single-person households and assumed the household good was a perfect substitute for a market good.

as

$$\iint_{\Delta} \frac{W'}{\lambda} f(k,w)dkdw = 1$$

and so, again denoting the marginal social utility of income to a household by s, we have its expected value $\bar{s} = 1$. The condition with respect to the i'th tax rate can be written as

$$t_i^* = \frac{Cov[s, x_i]}{\bar{x}_i'} \quad i = f, m$$

with now

$$\begin{aligned} Cov[s, x_i] &= \iint_{\Delta} (\frac{W'}{\lambda} - 1) x_i f(k,w) dkdw \\ \bar{x}_i' &= \iint_{\Delta} x_i' f(k,w) dkdw \end{aligned}$$

Superficially, the results look very similar to those derived in the Boskin-Sheshinski model. While however the denominator terms have the same meanings as before, in fact there are crucial differences, essentially to do with the distributional terms in the numerators.[13] The male tax rate is unaffected by the introduction of household production, because x_m does not vary with k. However, the value of $Cov[s, x_f]$ now depends crucially first, on the relationship between w and k, and secondly, on that between female labour supply, and hence x_f, and k. We can distinguish four cases:

Case 1: w and k vary positively with each other, and l_f varies positively with k.

This is the case in which the female's productivity in market and in household production are positively related, and where her higher domestic productivity allows her to supply more time to the market.[14] Then, as in the Boskin-Sheshinski model, $Cov[s, x_f] < 0$, and $t_f > 0$. We can also derive

[13] This does tell us that introduction of household production is not essential as long as our only concern is with deadweight loss, *i.e.* efficiency rather than equity. On the other hand the fact that substitution between market work and non-market work is what really determines female labour supply elasticities may well have implications for econometric model specifications.

[14] Recall the discussion in section 2 earlier.

the counterpart of Proposition 2: $t_f < t_m$ if $x_m - x_f$ increases with w. So in this case nothing much qualitatively is added by introducing household production.

Case 2: w and k vary positively with each other, and l_f varies inversely with k.

In this case, the elasticity of demand for the household good is sufficiently high that female labour supply falls as k increases, other things being equal. This will therefore reduce the extent to which x_f increases as w increases, and so strengthens Proposition 2. Moreover, it is even possible that $Cov[s, x_f]$ becomes positive, implying a negative female tax rate. For this to happen, the effect of increasing k on reducing l_f must be sufficiently strong that gross income x_f actually falls as w and k increase, therefore causing s and x_f to move in the same direction across households. In this case, a positive female tax rate would be a regressive instrument of welfare redistribution.

Case 3: w and k vary inversely with each other, and l_f varies positively with k.

This is the case in which a woman's market and household productivity vary inversely[15] It seems plausible to assume that the increase in wage rates would outweigh the falling k in raising household utility and so reducing s. Reducing k will at least partially offset increasing w in increasing x_f, so, as in Case 2, we have a strengthening of Proposition 2, with even the possibility of a negative optimal tax rate for women.

Case 4: w and k vary inversely with each other, and l_f varies inversely with k.

Assuming, as in Case 3, that with increasing w we still have falling s, we also now have that x_f is certainly increasing, and so this case is essentially similar to case 1.

Finally, we have the result that the kind of vertical inequity in the joint taxation system pointed out by Munnell (1980) does not disappear in the optimal linear tax system, though it would be moderated. Thus consider, in a joint taxation system, two households with the same gross income. They pay the same tax under this system. Suppose however that one household has zero female labour supply and the entire income is earned by the male spouse, while in the other both labour supplies are positive. Given that the first

[15] We may think this case to be empirically less likely, because the higher the household's wage rates the higher might be its physical capital as well as the wife's human capital, both of which might be expected to increase her productivity in household production, but *a priori* we cannot rule the case out.

household has a higher wage, it must have the lower marginal social utility of income, unless female labour supply increases with household productivity, and the value of k is so much higher in the second household than the first, that it has the higher utility possibilities. If this is not the case, joint taxation is regressive.

Under selective taxation, the second household would face a lower tax bill than the first, because the male in this household would pay less tax on his lower gross income, and the female would pay less tax still, both because of her lower gross income and because $t_f < t_m$. Thus moving from joint to selective taxation (though not to independent taxation in a simple linear tax system, since this is equivalent to joint taxation) would go some way to correcting the regressivity of the joint tax system in this regard. Note that the introduction of household production is what allows us to reject gross household income as an adequate measure of the household's utility possibilities. In the next section we look more closely at the effects of a switch from joint to independent taxation by presenting it as a problem in tax reform.

Finally, even under optimal selective taxation, in the case where female labour supply varies inversely with domestic productivity, there could still be a great deal of vertical inequity in the tax system, essentially because the female income tax rate captures the effects of variation in domestic productivity only very imperfectly. Take two households with the same wage rates and therefore male gross incomes. The household with the lower female gross income, and therefore smaller total tax bill, will actually have the higher level of utility possibilities. The importance of such inequity in reality obviously depends on the direction and strength of the relation between domestic productivity and female labour supply, about which nothing is known empirically.

5 Tax Reform

The optimal tax analysis can provide important insights, but from the point of view of actual tax policy, an analysis of tax reform, *i.e.* the search for welfare improving directions of change from an initial non-optimal position, may be more relevant. In this section we consider two examples of tax reform problems,[16] using them again to highlight the central importance of the rela-

[16] See Apps and Rees (1999a) for analysis of other possible cases.

tion between female labour supply and productivity in household production in determining the conclusions.

5.1 The Flat Rate Case

We use the model of the previous section to analyse a tax reform consisting of a (local) revenue neutral movement away from a position where all households face the same tax rate, i.e. we initially have a flat rate tax system, which is also of course a joint taxation system. We shall relax this assumption below, but for the moment it is useful to highlight certain aspects of the results. Thus the marginal tax rates t_f and t_m are equal initially, and we consider differentials $dt_f < 0 < dt_m$ which, because of revenue neutrality, have to satisfy

$$dt_f = -\beta dt_m$$

where

$$\beta = \frac{\iint\limits_{\Delta} [x_m + t_m x_m'] f(k,w) dk dw}{\iint\limits_{\Delta} [x_f + t_f x_f'] f(k,w) dk dw} = \frac{\bar{x}_m + t_m \bar{x}_m'}{\bar{x}_f + t_f \bar{x}_f'}$$

Since we assume both $\bar{x}_f < \bar{x}_m$ and $\bar{x}_f' < \bar{x}_m' < 0$ we will have $\beta > 1$. Any one household is made better off by this reform if and only if

$$dv = (\beta x_f - x_m) dt_m > 0$$

i.e. iff

$$\beta > \frac{x_m}{x_f}$$

Thus a household is more likely to be made better off the lower its ratio of gross male to gross female income, and it is straightforward to show that *all* households *could* be better off, and at least *some* households *must* be. For the latter, we have

Proposition 3: *For the given tax reform, on the assumptions $\bar{x}_f < \bar{x}_m$ and $\bar{x}_f' < \bar{x}_m' < 0$ at least some households are made better off.*

Proof: Suppose to the contrary that all households are made worse off. Then we must have for all households

$$\begin{aligned}\beta &< \frac{x_m}{x_f} \\ &\Rightarrow \beta < \frac{\bar{x}_m}{\bar{x}_f} \\ &\Rightarrow \frac{\bar{x}_m'}{\bar{x}_f'} > \frac{\bar{x}_m}{\bar{x}_f}\end{aligned}$$

which contradicts the assumptions.

It is possible to construct special cases in which the condition is satisfied for all households, but it has to be accepted that empirically, since x_f may be zero for some households, we should expect some households would be made worse off. Again, however, the welfare effects depend on the relationship between household productivity and female labour supply, since this determines whether the households which may be made worse off by this reform, the ones with a sufficiently high ratio x_m/x_f, are in fact higher or lower in the initial welfare distribution.

5.2 A Progressive Joint Tax System

Suppose we start with a tax system in which there is income splitting, and the marginal tax rate increases with joint household income. We want to consider the desirability of progressive income taxation in this context. To simplify, we assume that there are just two household types, $h = 1, 2$, distinguished by different values of household productivity k_h. Also, we take initially the case in which everyone, both male and female, has the same market wage, w. Thus the differences in female labour supply are due entirely to differences in domestic productivity, as are the differences in household pre-tax utility possibilities. Both men will have the same labour supplies and gross incomes x_m, and we assume that household 2 has the higher female labour supply and gross income, $x_{f2} > x_{f1}$. Each household receives the same lump sum, a, but household h pays a marginal tax rate t_h, with $t_2 > t_1$. There are n_h households of type h. The government revenue constraint is now

$$\sum_{h=1}^{2} n_h[t_h \sum_{i=f,m} x_{ih} - a] - R \geq 0$$

where $R \geq 0$ is an aggregate revenue requirement. We take the social welfare function as having the same general form as that used in the optimal tax analysis, specialised to this simple case:

$$S = \sum_{h=1}^{2} n_h W[v_h(t_h)] \quad W^{'} > 0, W^{''} < 0$$

We consider a tax reform consisting of revenue neutral changes in the tax rates, dt_h. The question of interest is: When is a *reduction* in the progressivity of the tax system social welfare enhancing?

Note first that the tax rate changes must satisfy

$$dt_1 = -\gamma dt_2$$

where

$$\gamma = \frac{n_2 \sum_i (x_{i2} + t_2 x_{i2}^{'})}{n_1 \sum_i (x_{i1} + t_1 x_{i1}^{'})}$$

We then ask, under what condition will the change $dt_2 < 0$ satisfy

$$dS = -\sum_{h=1}^{2} n_h W_h^{'} \sum_{i=f,m} x_{ih} dt_h > 0$$

so that a reduction in progressivity is welfare increasing. This is given by the simple condition

$$\frac{W_2^{'}}{W_1^{'}} > \frac{1-e_2}{1-e_1}$$

where

$$e_h \equiv -\frac{t_h}{\sum_i x_{ih}} \sum_i \frac{\partial x_{ih}}{\partial t_h} > 0$$

is an aggregate household elasticity of gross income with respect to the tax rate. Now if these elasticities are equal, a necessary and sufficient condition for a reduction in progressivity is that female labour supply be inversely related to domestic productivity. However, Heckman (1995) argues that the evidence on male and female labour supply elasticities suggests that higher female labour supply elasticities result from the fact that labour supplies are more elastic for individuals, of either gender, who have low labour supply. Thus it may well be the case that household 1 will have a higher elasticity than household 2, in which case the condition becomes more stringent. On the other hand, if $x_{f1} = 0$, and $\partial x_{f1}/\partial t_1 = 0$, and the male labour supply elasticities are just equal, then we certainly have $e_2 > e_1$, and overall welfare could be increased even if $W_2' < W_1'$,which could be the case for example if a small difference in domestic productivities leads to a substantial increase in female labour supply.

6 Nonlinear Taxation of Two-Earner Households

There is a relatively small literature on the problem of extending the Mirrlees approach to optimal income taxation, in which the planner offers a menu of tax rates designed to induce individual worker/consumers to self-select according to their wage type, to the case of two-earner households. A reason for this is that, as the literature on two-dimensional screening models[17] makes clear, the incentive compatibility constraints that have to be satisfied by the optimal tax function are complex and typically allow a large number of logically possible solutions: general results are hard to obtain. The approach in the literature on the optimal taxation of couples has been to make some kind of strong simplifying assumptions to render the problem tractable.

One group of papers, by Schrøyen (2003), Apps and Rees (2006) and Brett (2007), take the case of two-person households in which each individual may be one of two possible wage types, leading to four possible household types. Even in this relatively simple and restricted case, the logically possible number of binding incentive constraints is large and general results are few. Perhaps the main general result is that the constraint imposed by linear taxation, effectively ruling out the possibility that one earner's tax rate can vary with the income or wage type of the other, is indeed a real restriction: In each of these papers the optimal tax rate on an individual's income depends both on her own wage type and on the wage type of her partner. However, it would be a mistake, in contradiction to the main lesson of the theory of second best, to conclude from this that joint taxation, which allows this interdependence in a restricted way, must therefore be superior to individual taxation. Indeed, the paper by Cremer et al (2009), which allows each in-

[17] See for example Armstrong (1996), Armstrong and Rochet (1999), and Rochet and Stole (2003).

dividual to be one of an arbitrarily large but finite number of wage types, poses the question: under which conditions will the tax base optimally be joint as opposed to individual income. The answer is: almost never! The paper gives a complete characterisation of these conditions and discusses the structure of the optimal tax system in some interesting special cases.

The paper by Kleven et al (2010) is the most closely related to Mirrlees' original approach, in that it allows each household member to be one of a continuum of types. Since we know from the two-dimensional screening literature that this alone will not allow a general characterisation of the optimal tax function, the first question to ask is: what assumptions are made to render the problem tractable? The answer in a nutshell is: strong assumptions are made about the nature of the labour market faced by the second earner, which effectively allow the problem to be formulated as one of characterising tax functions for each of two separate continua of household types, rather than a single function for a double continuum of types. The incentive compatibility conditions take the form of two separate sets of standard, downward-binding constraints, and this greatly simplifies the problem. However, the assumptions on the second earner labour market are completely counterfactual, and it is not at all clear to what extent the results of the analysis are sufficiently robust that they can provide guidance for the formulation of tax policy in practice. We now consider the model in some detail.

Each household contains a primary and a second earner.The primary earner has a productivity type n drawn from a given bounded interval[18] $[n_0, n_1]$, and chooses a labour supply that determines an earnings level z. On the other hand, the second earner labour market has a single given wage, w, and workers on this market can only choose either to work full time, with labour supply $l = 1$, or not at all, $l = 0$. In reality, primary earners typically work either full time or not at all,[19] while second earners are distributed fairly continuously over the spectrum from zero to full time, with roughly equal spikes at these two end points.[20] Also of course second earners' wages in fact vary widely, with a strong positive correlation with the primary earner's wage type - positive assortative matching. Thus these assumptions are strongly

[18]The notation we use here stays as closely as possible to that in Kleven et al, and therefore departs from that used previously in this paper.

[19]There is also the important question of whether those who do not work actually choose this, or are simply involuntarily unemployed.

[20]See Apps and Rees (2009) Ch. 1, for data on major OECD countries.

counterfactual.

At each wage type of the primary earner, the second earner takes on a type q drawn from an interval $[q_0, \infty) \subset \mathbf{R}_{++}$. There are two interpretations for this type q, and the paper provides a separate analysis and results for each case. On the one hand, q may be a fixed cost of going out to work. On the other hand, it may be a value of the second earner's productivity in household production, the alternative to market work. Here, we follow the paper in discussing mainly the former interpretation.

The household's utility function is

$$u = c - nh(z/n) - ql \quad l \in \{0,1\},\ n \in [n_0, n_1] \tag{3}$$

where c is consumption, and $h(.)$ is an effort cost function, strictly convex and increasing. Consumption is defined by

$$c = z + wl - T_l(z) \quad l \in \{0,1\} \tag{4}$$

where $T_l(.)$ is a tax function, assumed continuously differentiable, so that the primary earner's optimal labour supply z^* satisfies $h'(z^*/n) = 1 - T_l'(z^*)$.

Thus we see that the planner is looking for two optimal tax functions, defined on the earnings of the primary earner in a household of type $l \in \{0,1\}$. There is no explicit tax rate on the second earner's income *per se*, so some care must be taken in translating results in this model to statements about the actual tax rate applied to a second earner's income in any real tax system. Since the second earner's decision is entirely a participation decision, with no variation in labour supply at the intensive margin, the tax on the second earner is an implicit participation tax: It results from the fact that if she chooses $l = 1$ rather than $l = 0$, her partner's tax function shifts from $T_0(z)$ to $T_1(z)$, inducing corresponding changes in his choice of z if the functions' slopes differ.

That this is an upward shift is implied by the specification of q and the assumed redistributive preferences of the planner. In effect, at any z, there are only two household types, those in which the second earner works in the market and earns w, making a contribution to gross household income of $w - q$, and those in which she does not. Given the tax functions $T_l(.)$, there will be at each z a unique critical value of q separating the second earners who do and do not work on the market. All households of type $l = 1$ have a lower q than those of type $l = 0$, implying that their households are strictly better off, and therefore the planner wants to redistribute, for any given z, away from the first type toward the second. There is no problem of asymmetric information here, since whether the second earner works or not is assumed observable, and a household with a q below the critical level can never gain by pretending to have a value above it. Thus, in choosing the two $T_l(.)$ functions, the two subsets of households just have to be screened on the single dimension n, the productivity of the primary earner.

The main result in the paper is what the authors term "negative jointness". For all z, the gap between the tax functions, $T_1(z) - T_0(z)$, falls as z increases. Thus the higher the primary earner wage type n, the smaller the implicit participation tax rate - increase in his net tax burden - associated with his partner going out to work.

The paper gives a very clear intuition for this result.[21] Define $g_l(n)$ as the average value of the marginal social utility of income of households in the subset $l = 0, 1$, single- and two-earner households respectively.The strength of the planner's desire to redistribute at any value of n is driven by the difference $g_0(n) - g_1(n)$, which is positive. To fix ideas, suppose that, as n increases, the extra utility enjoyed on average by type 1 households as compared to the average for type 0 households remains the same. If the marginal social welfare function is a strictly convex function of household utilities, then the higher the wage type n, and average utility levels, the smaller will be the difference $g_0(n) - g_1(n)$, and so the smaller the extent of redistribution from type 1 to type 0 households. This narrows the gap between the two tax functions. Or, as the paper more succinctly puts it, the utility difference between the household types becomes relatively less important the higher the absolute levels of utility enjoyed by the households of each type, thus reducing the extent of redistribution.

The case in which q is interpreted as productivity in household production is the mirror image of the one just discussed. Now, households with high q will be better off, because they generate more consumption in the household than if they worked in the market. Second earners who participate in the labour market are the ones with low household productivity. Thus redistribution

[21] The proof however is not so easy, and further restrictions are required in order to make it go through. Specifically: q and n are independently distributed, which rules out the possibility that higher primary wage types are more likely to have partners with higher labour income, which is however a type of assortative matching supported by the data; the optimal tax functions $T_l(.)$ nowhere exhibit "bunching"; the first derivative of the social welfare function, $\Psi'(.)$, is strictly convex, thus ruling out the case of a utilitarian planner; together with some technical restrictions on the distribution function of q.

will take place from type 0 to type 1 households, there is an implicit subsidy to two-earner households.

The ability of this model to inform tax policy in practice is in our view severely limited by its assumptions about the nature of the labour market for second earners, which are however the source of its tractability. Suppose for example that positive associative matching implies that the second earner's wage increase with the productivity type of her partner. Then the "negative jointness" result may cease to hold since the difference in utilities enjoyed by households of the two types could widen as n increases. But in any case, allowing wage differences in the second earner labour market reintroduces the two-dimensional screening problem, unless we assume that second-earner productivities are somehow observable when primary earners' are not.

Although the paper breaks new ground in the literature on optimal nonlinear taxation by introducing household production and costs of labour force participation,[22] it does so in an artificial and unrealistic way. The major costs associated with labour force participation by second earners are child care costs, and these have more of the characterisitics of a tax - a charge per hour worked - than a fixed cost of participation. Why else would so many second earners work part time? *Both* productivity in household production and the costs of working, in particular the cost of child care, are important in determining second-earner labour supply, and the way in which they interact is certainly not captured by the extremely stylised formulation adopted in the paper under discussion. Ultimately, the problem is that the set of households earning a given income under a given tax system are likely to vary along at least four dimensions: the productivities of both primary and second earner in market work, the latter's productivity in household production and her (variable) cost of working. It is not at all clear to us that a reasonable set of assumptions could be found that would make an approach based on a screening model both tractable and relevant to actual tax policy.

7 Conclusions

This paper has been concerned with the question of how two-earner households should be taxed. One reason for the importance of this issue is simply

[22] These have however long been taken into account in other areas of the taxation literature, see for example the discussion in the Introduction to this symposium and the references cited there.

the quantitative significance of households formed around couples. A second reason is that the economic theory of optimal taxation and tax reform, at least as it is presented in the mainstream literature, provides little guidance on this issue, resting as it does on models of the single person household. An old insight in the earlier public finance literature is that any discussion of the taxation of two-person households necessarily involves the recognition of the importance of household production. In this paper we have tried to show how a simple model of household production can be used to help the analysis of optimal taxation and tax reform, and to put the "conventional wisdom", which says that it is optimal to tax women on a separate, lower tax schedule than men, on a firmer basis. What emerges clearly from the analysis is how centrally important the relationship between productivity in household production and female labour supply really is, and how little we know about it empirically.

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