CES Working Paper Series

INDIVIDUAL VS. JOINT TAXATION IN MODELS WITH HOUSEHOLD PRODUCTION

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Working Paper No. 147

October 1997

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Abstract

In a recent paper, Piggott and Whalley (1996) argue for the superiority of joint taxation over individual taxation on the grounds that the "conventional wisdom" ignores the existence of household production, and that in the presence of this the usual Ramsey-type argument breaks down. We show in a formal model of 2-person households with domestic production that this is not in fact the case: individual taxation will in general be superior and the grounds on which it can be shown to be so involve a standard Ramsey-like condition.

Keywords: taxation, household, production

JEL Code: H21, H31, J22

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Individual vs. Joint Taxation in Models with Household Production

Patricia F. Apps and Ray Rees

1 Introduction.

In a recent paper, Piggott and Whalley (1996) challenge the "conventional wisdom" which says that the individual rather than the household should be the unit of taxation, and argue instead for joint taxation. Their point of departure is a point well taken. The literature on which this wisdom is based, in particular Boskin and Sheshinski (1983), ignores the existence of household production.[1] The general argument is a nice one in the theory of

[1]Though it should be pointed out that an earlier contribution by Boskin (1975) emphasised the importance of household production and, using a 2-sector general equilibrium

the second best. In the absence of taxation of market wage income, the marginal rates of technical substitution between primary and secondary labor in market and in household production would be equated to each other, while the marginal rate of substitution between the market and household good would be equal to the marginal rate of transformation between them, thus achieving Pareto efficiency. Introduction of income taxation leads to a distortion of the relation between the marginal rate of substitution and the marginal rate of transformation, which is the focus of concern in the literature[2], and, given the differing econometric estimates of the elasticities of male and female labor supplies, standard Ramsey-rule considerations would argue for taxing primary and secondary workers at different marginal rates. However, income taxation also introduces a distortion between the marginal rates of technical substitution in household and market production, which would be eliminated if the marginal tax rates were equalised. Thus moving from individual to joint taxation, which equalises the marginal tax rates could on balance increase welfare because the welfare gain from the elimination of the distortion in production could outweigh the loss from increasing the consumption distortion. Indeed the argument has very much the flavour of the Diamond-Mirrlees (1971) proposition that productive efficiency is in general optimal in the presence of commodity taxation.

In the paper this general argument is substantiated by using a Computable General Equilibrium (CGE) model to show that for specific functional forms and particular regions of the parameter space that purport to be in some sense reasonable, movement from individual to joint taxation does indeed generate net welfare gains. The reason given for adopting this approach is the non-tractability of an analytical treatment. The first purpose of this comment is to show that an analytical treatment of this issue is perfectly tractable, and furthermore demonstrates that the conventional wisdom is essentially correct, even in the presence of two-person households with domestic production: Individual taxation is almost certainly superior to joint taxation, and the criterion on which this can be judged is a simple Ramsey-like test based upon labor supply elasticities.

The fallacy in the Piggott-Whalley reasoning lies in its failure to take account of the main conclusion of the theory of the second best. In general,

model. sought to estimate the welfare losses arising out of the distortionary effects of taxing market and not household production.

[2]In which "household production" is to be read as "leisure".

a second best optimum will involve a trade-off between the two distortions, rather than the complete elimination of one of them. That indeed is the basic message of the theory. Thus joint taxation is unlikely to be a second best optimum. It could of course be argued that the achievement of optimal taxes is in any case an impossibility and we should instead be concerned with looking simply for welfare improvements to existing policies - this is the motivation of the tax reform approach[3]. However, the fact remains that if joint taxation is not a second best optimum it will always be possible to find welfare improving departures from such a position, which must therefore imply individual taxation. The Piggott-Whalley calculations show that a move from an existing tax structure (which, incidentally, we do not regard as a realistic one, for reasons given below), with unequal marginal tax rates for primary and secondary workers, to joint taxation, which equalizes these tax rates, can increase welfare. It must then be possible to achieve a further welfare improvement by departing in some direction from the joint taxation structure reached, as long as it is not a second best optimum. We now go on to provide a formal analysis of these points.

2 Tax Reform and Household Production.

The model we use is essentially that discussed in Apps and Rees (1997), of which that in Section II of Piggott and Whalley can be seen as a special case. The economy consists of N identical households, each of which produces a domestic good y according to a standard constant returns to scale production function

$$y = f(t_1, t_2) \tag{1}$$

where t_i is the time input of household member $i = 1, 2$, with the primary worker designated as 1. The domestic good is consumed by partner i in the amount y_i. Pure leisure, or the direct consumption of own time, is z_i, and there is a market good x with individual consumptions x_i. The utility functions are[4]

$$u^i(x_i, y_i, z_i), \; i = 1, 2, \tag{2}$$

[3]For an outstanding recent exposition of this see Guesnerie (1995).

[4]A departure from the Piggott-Whalley paper is to allow the household to consist of individuals with their own utility functions. This adds little of interest here given the concern chiefly with efficiency, but it will allow us to make some remarks about equity as well.

and the time constraints are

$$l_i + t_i + z_i = T, \; i = 1, 2 \tag{3}$$

where l_i is the market labor supply of individual i. Finally the household budget constraint is

$$\sum_{i=1,2} x_i = \alpha + \sum_{i=1,2} \beta_i w_i l_i, \tag{4}$$

where α is the lump sum payment made to each household and $1 - \beta_i$ is the marginal tax rate paid by i under the given tax system. Under individual taxation $\beta_1 \lesseqgtr \beta_2$ whereas under joint taxation $\beta_1 = \beta_2$.

The substantive assumption we make to solve for the equilibrium household resource allocation is that this is Pareto efficient. This could be regarded as a characterisation of household as opposed to individual rationality. It means that household members behave sufficiently cooperatively that all possibilities of costless welfare improvement are exhausted. This of course leaves open the question of welfare distribution within the household. This is handled as follows. Each member has a reservation utility level that has to be weakly exceeded for him or her to remain within the household. We assume that these constraints are non-binding at the equilibrium household resource allocation. The actual distributional outcome is defined by a constraint giving a level of 2's utility. This is assumed to be a differentiable function of the components of the household's full income, the lump sum α and the net of tax wage rates $\beta_i w_i$, as well as other variables not specified.

However an equivalent, and, as it turns out, more useful approach, is to apply the Second Theorem of Welfare Economics to model the household *as if* it chooses its time allocation so as to minimize the cost of producing the domestic good and distributes its full income between the household members, who then choose their consumptions so as to maximise their individual utilities. The given prices appearing in the individual budget constraints are that of the market good, set at unity, the implicit price of the domestic good. p, and the price of leisure, $\beta_i w_i$, the net of tax wage. For appropriate choices of income shares this results in the identical resource allocation[5].

[5]For further discussion of this approach see Apps and Rees (1988), (1997). The hypothesis of Pareto efficiency is of course non-trivial. It was suggested as an approach to household decision taking by Samuelson (1956). For evidence that it may not hold see Udry (1996).

To characterize the household equilibrium we can therefore define the full income shares

$$s_i = \alpha_i + \beta_i w_i T \tag{5}$$

where $\alpha_i \lesseqgtr 0$ is a lump sum transfer to i, with $\sum \alpha_i = \alpha$. The sum of these transfers must equal the lump sum transfer from the tax system, α, but the intra-household transfer itself could be negative for one household member. This simply reflects the distributional choices of the household members, with each α_i a (differentiable) function of α and the net of tax wage rates, among other things. Each individual then solves the problem

$$\max u^i(x_i, y_i, z_i) \;\; s.t. \; x_i + p y_i + \beta_i w_i z_i = s_i \;\; i = 1, 2 \tag{6}$$

to yield demand functions $x_i(p, \beta_i w_i, s_i)$, $y_i(p, \beta_i w_i, s_i)$, $z_i(p, \beta_i w_i, s_i)$, the individual marginal utilities of income λ_i and the indirect utility functions $v_i(p, \beta_i w_i, s_i)$ with partial derivatives (obtained by straightforward application of Roy's Identity)

$$\frac{\partial v_i}{\partial p} = -\lambda_i y_i \tag{7}$$

$$\frac{\partial v_i}{\partial \beta_i w_i} = -\lambda_i (z_i - T) + \lambda_i \frac{\partial \alpha_i}{\partial \beta_i w_i} \tag{8}$$

$$\frac{\partial v_i}{\partial s_i} = \lambda_i \;\; i = 1, 2, \tag{9}$$

We now need to say something about the derivation of the (implicit) price of the domestic good. The marginal cost of the domestic good to the household is $c(\beta_1 w_1, \beta_2 w_2)$, which, because of the constant returns assumption, is independent of output. Its derivatives c_i are the amounts of the respective time inputs required per unit of output. The implicit price of the domestic good at the household equilibrium is set equal to this marginal cost

$$p = c(\beta_1 w_1, \beta_2 w_2) \tag{10}$$

implying

$$\frac{\partial p}{\partial \beta_i w_i} = c_i \tag{11}$$

Given these results for the model of household choice. which is intended to replace the standard model of the one-person household dividing time

between market work and leisure only, we are in a position to carry out the analysis of tax reform.

As in Piggott and Whalley, the market good is produced by primary and secondary workers under constant returns to scale with exogenously given marginal productivities, here the w_i. Thus wages do not vary following tax rate changes. We characterize any tax reform as a *revenue neutral* pair of infinitesimal changes in the marginal tax rates. We hold the lump sum α constant throughout. The government budget constraint is

$$N\sum(1-\beta_i)w_i l_i - N\alpha - R = 0 \tag{12}$$

where $R \geq 0$ is the revenue requirement. Revenue neutrality requires

$$\sum_{i=1,2}[\sum_{j=1,2}(1-\beta_j)w_j\frac{\partial l_j}{\partial \beta_i} - w_i l_i]d\beta_i = 0 \tag{13}$$

implying

$$d\beta_2 = \mu d\beta_1 \tag{14}$$

with

$$\mu \equiv -\frac{[\sum_{j=1,2}(1-\beta_j)w_j\frac{\partial l_j}{\partial \beta_1} - w_1 l_1]}{[\sum_{j=1,2}(1-\beta_j)w_j\frac{\partial l_j}{\partial \beta_2} - w_2 l_2]} \tag{15}$$

It seems reasonable to assume that the incremental tax revenues resulting from the changes in labour supplies, the first terms in the numerator and denominator, do not exceed the respective tax bases, the second terms in the numerator and denominator, and so we will in everything that follows consider only the case where $\mu < 0$. A revenue neutral tax reform that reduces one tax rate must increase the other.

Consider now the welfare effects of a tax reform. There is a social welfare function $W(v_1, v_2)$ and we can write its total differential, using (7) - (9), and (11), as

$$dW = \sum_i W_i dv_i = \sum_i W_i\lambda_i[-y_i(c_1 w_1 d\beta_1 + c_2 w_2 d\beta_2) - (z_i - T)w_i d\beta_i + d\alpha_i] \tag{16}$$

with $W_i > 0$ the welfare weight on the i'th individual. Notice that the social welfare function is defined, as it should be, on the utilities of *individuals*, not of *households*, which in themselves cannot possess utilities. This in general presents tax analysis with a substantive problem, since there is no reason in

general for the implicit weights attached to the utilities of its members by the household to agree with those of the "social planner"[6]. However since the Piggott-Whalley paper was concerned solely with efficiency we can sidestep this issue completely and simply assume that the distributional preferences of the planner and of households and the resulting distribution of income among individuals and households is such that $W_i\lambda_i = 1,\ i = 1,2$. Now summing through (16) gives the simple result

Proposition 1: the tax reform is welfare improving, given $W_i\lambda_i = 1$, $i = 1,2$, *iff*

$$dW = \sum_i w_i l_i d\beta_i > 0 \tag{17}$$

Proof: simply sum through (16) and recall that:

$$t_i = c_i \sum_{j=1,2} y_j$$

is the time i spends in household production;

$$\sum_i d\alpha_i = 0$$

and finally

$$l_i = T - t_i - z_i \quad i = 1,2$$

The intuition underlying this result is very straightforward, particularly if we consider the analogy between the household and a small economy trading with the rest of the world at fixed prices. The tax reform just changes the household's terms of trade. It will cause reallocations of production and consumption within the household, but we are ignoring the distributional effects of these. The household *overall* can only be better off if the value of its income at "world prices" increases, and this is precisely condition (17).

To show the Ramsey-like nature of this result, recall (14) and (15) and write the condition as

$$(w_1 l_1 + \mu w_2 l_2)d\beta_1 > 0 \tag{18}$$

[6]This issue is further discussed in Apps and Rees (1988). It makes the problem of estimating the household sharing rule of central concern to empirical tax policy. For discussion of conditions under which this may or may not be done, see Apps and Rees (1997a) and Chiappori (1997).

Suppose the tax reform in question represents a move away from joint taxation, with $\beta_1 = \beta_2$, to individual taxation, with a higher marginal tax rate on the primary earner. In that case $d\beta_1 < 0$, and so (18) becomes

$$-\mu > \frac{w_1 l_1}{w_2 l_2} \tag{19}$$

Recalling the definition of μ in (15) then leads to

Proposition 2. In the initial situation of joint taxation, a revenue neutral tax reform that reduces the marginal tax rate on secondary workers and increases that on primary workers is welfare increasing iff

$$\sigma_1 + \frac{w_2 l_2}{w_1 l_1}\sigma_{21} < \sigma_2 + \frac{w_1 l_1}{w_2 l_2}\sigma_{12} \tag{20}$$

where σ_i is the uncompensated elasticity of the labor supply of worker i with respect to the net wage and σ_{ij} is the uncompensated cross-elasticity of i's labor supply with respect to j's net wage, $i, j = 1, 2, i \neq j$.

Proof: Just insert the expression for μ from (15) into (19) and rearrange, defining

$$\sigma_i \equiv \frac{\beta_i w_i}{l_i}\frac{\partial l_i}{\partial \beta_i w_i},\ \sigma_{ij} \equiv \frac{\beta_j w_j}{l_i}\frac{\partial l_i}{\partial \beta_j w_j}\ \ i, j = 1, 2, i \neq j. \tag{21}$$

Empirically it seems very likely that the condition in this proposition is satisfied. The evidence suggests that female labor supply elasticities are significantly higher than those of males, male labor supply is almost completely unresponsive to the partner's net wage, while female labor supply varies significantly and negatively with the partner's net wage.

3 Concluding Remarks

In their computations, Piggott and Whalley show that a move from an existing individual tax regime, which is meant to represent an actual status quo, to a regime of joint taxation brings welfare gains in a model of the Australian economy. As well as being intended to reinforce their theoretical point, which we have tried to deal with in the previous section, this has implications for the current debate over tax reform in Australia and possibly other countries

as well. However we would argue that their characterization of the initial situation is quite inaccurate, in a way that appears to give empirical relevance and support to their theoretical position. Their methodology results in grossly understated marginal tax rates for secondary workers relative to those for primary workers. In each case the marginal rate for the representative individual of a worker type is calculated as the average of the marginal rates applying across the earned income distribution of that worker type. While this gives a reasonable approximation of the marginal rate faced by the representative primary worker, it does not do so for the representative secondary worker. This is because there is relatively little variation in hours of work by primary workers, but wide variation among secondary workers. Secondary workers are either non-participants facing a zero marginal rate, or participants facing much higher rates than the calculated average, which is therefore well below the marginal rate that actually faces representative *participating* secondary workers.

We believe that the situation can be illustrated schematically in Figure 1. The figure shows welfare as a function of the ratio of the marginal tax rate of secondary to that of primary workers, ρ. Piggott and Whalley choose an unrealistically low value of this ratio, at say ρ_0, then show that a move to $\rho = 1$ increases welfare. The point made in the previous section is that then there is a reverse move which increases welfare. However it could also quite well be the case that the true status quo is a point such as ρ_1, in which case the suggested reform does not yield a welfare improvement.

Figure 1 about here.

A final remark concerns the value of basing the analysis on a model of a two-person household with domestic production. Condition (20) could just as well have been derived from a model with a household utility function defined on two types of leisure and a composite consumption good. with time simply allocated between labor supply and leisure. What does the broader approach bring, other than perhaps descriptive realism (though the assumption of Pareto efficiency of household allocations may still be found worrisome)? One answer is that the broader analysis is required if distributional issues are to be taken seriously[7]. After all if only efficiency matters why not simply impose a lump sum tax[8]? The two-person formulation allows

[7] That is, as far as the issue of taxation is concerned. The introduction of household production is also very important for the specification and empirical estimation of labor supply models. For further discussion of this see Apps, Killingsworth and Rees (1997).

[8] The last attempt to do so, by the Thatcher government in the UK in 1991, failed

intra-household distributional issues to be explicitly considered. Even more importantly in our opinion, a model that analyses the choice of tax unit in terms of a single representative household cannot address the most controversial issue in family taxation. Empirically there is considerable variation in female labor supply across households, even after controlling for demographic characteristics and wage rates. Alternative tax regimes, for example individual vs. joint taxation, differ considerably in the tax burdens they imply for households in which the female specializes in domestic production, as compared to those in which she has a high market labor supply. These differences in the degree of specialization can be explained by differences in productivity levels in household production, and models which capture this can be used to provide a rigorous analysis of the equity and efficiency implications of the alternative tax systems[9], in a way that simply cannot be done in a model of a single representative household. The model presented here lends itself readily to this kind of extension, even if it has more structure than is strictly required for the present purpose.

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precisely because it was perceived as unjust that people with widely differing incomes should pay the same amount of tax.

[9] For examples of this see Apps and Rees (1997b), (1997c).

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