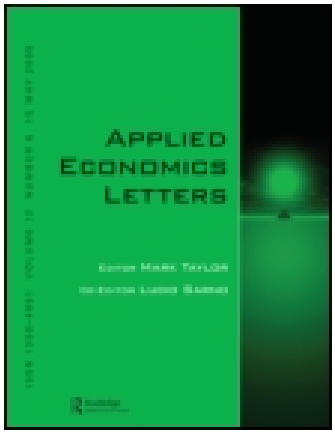

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Home production and the welfare cost of labour supply tax distortions

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The traditional model of household labour supply incorporates leisure into preferences rather than focusing on how relative costs of production at home and via market activity determine market labour supply. In part, this reflects the lack of simple closed form solutions for the home production model. This article uses numerical techniques to compare the welfare costs of tax distortions of labour supply in models with and without home production. When observationally equivalent models of each type are calibrated to the same aggregate labour supply elasticity, the home production model of labour supply produces a much smaller welfare cost of tax distortions of labour supply than the standard model. Our results thus suggest that home production is important for understanding the welfare effects of labour tax policies.

Keywords: welfare cost; labour supply; home production; tax distortions

JEL Classification: J20; J22

I. Introduction

The home production sector is large. According to Michigan Time Use Survey, a married couple spend only slightly less time working in home production than in the labour market (Benhabib *et al.*, 1991). According to Eisner's (1988) survey, estimates of the value of output of home production are in the range of 20–50% of measured market GNP. Although there have been a large number of papers that have studied the influence of home production in labour economics and its role in macro models, there is relatively less work on the role of home production in public finance literature.[1] This article explores some public finance implications of home production.

In this article, we ask to what extent home production matters for the welfare costs of tax distortions of labour supply. We analyse the behaviour of two models, a standard model of labour supply and a home production model of labour supply, each parameterized through calibration to the same aggregate data, and in this sense observationally equivalent. We compare the welfare costs of tax distortions of labour supply in these two models and find that the welfare cost of tax distortions of labour supply is much smaller in the home production model than in the standard model. That is, the welfare loss implied by a labour income tax of 30% in the home production model is only one-eighth of that in the standard model.

The intuition behind the result is simple. In the standard model, agents face a choice between labour supply and leisure. The labour income tax produces a welfare loss because it reduces the benefit from supplying labour to the market and thus induces agents to work less and enjoy more leisure. In the simple version of the home production model, however, the choice is only between production in the market sector and production at home. The labour income tax only tar-

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[1] Becker (1965), Gronau (1977, 1986), Greenwood and Hercowitz (1991), etc.

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gets the market sector and thus increases its production cost relative to the home production sector. The welfare loss of this distortion will be small when home production is a close substitute for production in the market sector.

This article is closely related to the public finance literature on the welfare costs of tax distortions of labour supply.[2] It is also related to the literature that studies the macroeconomic implications and labour supply implications from home production.[3]

The rest of the article is organized as follows: We present the two models in Section II and calibrate them in Section III. We conduct numerical simulation exercises and present our main results in Section IV and conclude in Section V.

II. The Model

The standard model

We start with the standard model of labour supply behaviour in the presence of a labour income tax, which can be characterized by the solution to an optimization problem

$$\max_{c,l} U(c,l) = \left(\delta c^{\frac{\sigma-1}{\sigma}} + (1-\delta)(1-l)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

s.t.

$$Pc = w(1-t)l + R \tag{2}$$

$$twl = R \tag{3}$$

where c is the consumption of goods, l the labour supply, w the wage rate, P the price of the consumption good, t the labour income tax rate and R the tax revenue that is transferred back to the agent. The labour endowment is normalized to be one unit.

With revenues recycled in lump sum form, the effect of a labour income tax is to change both the slope of the budget constraint and the labour supply behaviour. However, to generate an optimal solution in the presence of taxes, when using the equation representation of the model (Equations 1–3), some additional structure is needed. This is because if (1) is maximized subject to (2) and (3), substituting (3) into (2) simply returns the solution (even in the presence of taxes) to the no-tax solution. Something else is needed to generate a tax-distorted optimal outcome.

Adding a tax-distorted first-order condition

$$\frac{U_c}{U_l} = -\frac{P}{w(1-t)} \tag{4}$$

as an additional constraint to the optimization problem (1), (2) and (3) forces the with-tax solution to be different from the no-tax solution. Alternatively, treating R in (2) as parametric, and requiring it to be consistent with its value in (3), rather than directly substituting between the equations, again forces the slope of the with-tax budget constraint to be $\frac{P}{w(1-t)}$, and optimizing behaviour in the presence of taxes is different from the no-tax equilibrium.

Rearranging the first-order condition,

$$\frac{1-l}{c} = \left[\frac{P(1-\delta)}{w(1-t)\delta}\right]^{\sigma} \tag{5}$$

The above equation together with the budget constraint (Equation 2) implies an optimal solution for labour supply as follows:

$$l^* = \frac{P}{P + \left(\frac{P(1-\delta)}{w(1-t)\delta}\right)^{\sigma} w} \tag{6}$$

Assuming that there exist homogeneous agents of measure one, the aggregate labour supply in the model is $L = l^*$. The (uncompensated) labour supply elasticity can be calculated numerically by using a small perturbation in the wage rate around the benchmark model values:

$$e = -\frac{\Delta L}{L}\frac{w}{\Delta w} \tag{7}$$

The home production model

The home production model of labour supply with taxes does not incorporate leisure into the utility function, but instead features a continuum of consumption goods with a measure of one over a hundred. The consumption goods of type X and with two possible production technologies can be produced either in a firm or at home

$$l_m(X) = k_m + \lambda_m X^{\sigma_m} \tag{8}$$

$$l_h(X) = k_h + \lambda_h X^{\sigma_h} \tag{9}$$

[2] Ballard, *et al*. (1985), Bhattarai and Whalley (2003), etc.
[3] Becker (1965), Gronau (1977, 1986), Benhabib *et al*. (1991), Greenwood and Hercowitz (1991), etc.

where $l_m(\cdot)$ is the labour needed to produce one unit of good X in the firm, and $l_h(\cdot)$ is the labour needed to produce one unit of good X at home. It is assumed that $X \in [0, 100]$ and the representative agent is endowed with one unit of labour. The location of the production for each type of consumption goods is chosen to minimize production costs. If $\frac{l_m(X)}{1-t} < l_h(X)$, then the consumption good of type X would be produced at home. Here t is the labour income tax. In the home production model, the labour income tax, t, increases the relative production cost of consumption goods in the market and thus induces agents to produce more types of consumption goods at home. For simplicity, the agent's preferences are designed so that their optimal consumption bundle always consists of the same amount of each type of consumption goods and described by a Leontief utility function, that is, $u() = \min(\{c_X\}_0^{100})$.

Let X^* satisfy the following condition $\frac{l_m(X^*)}{1-t} = l_h(X^*)$. Assuming that $l_m(0) < l_h(0)$ and the two production functions satisfy a single-crossing property, the aggregate market labour supply in this model is

$$L = \int_0^{X^*} l_m(X)dX \tag{10}$$

The (uncompensated) labour supply elasticity in the model can be expressed as follows:

$$e = \frac{\Delta L}{L}\frac{1-t}{\Delta t} \tag{11}$$

We can numerically calculate its value using a small change in the labour income tax rate around the benchmark model values.

III. Calibration

In this section, we calibrate the two models. The following calibration strategy is adopted. We predetermine some parameter values and then calibrate the remaining parameter values to match moments calculated from the data.

The standard model

The wage, w, and the price of consumption goods, P, are both normalized to one. The labour income tax rate, t, is set equal to 0 in the benchmark economy. The rest of the parameters, δ and σ, are calibrated to match the empirical moments. The share parameters in the CES utility function reflect the relative weights on consumption and leisure in the utility function. These values are critical for agents' optimal labour–leisure decision. Thus, the value of δ is chosen to match the fraction of time allocated to work and following Bhattarai and Whalley (2003), the fraction of time allocated to work is set at $40/70 = 0.571$.[4] σ is the elasticity parameter in utility, and its value is chosen to match empirical estimates of labour supply elasticity in the literature, that is, 0.3.[5]

Table 1 presents the calibration specification for the standard model.

The home production model

We calibrate the home production model to match the same moments used in the calibration of the standard model. We assume the tax rate, t, to be zero in the calibration. Note that the home production model has six parameters and there are only two moments used in calibration. Therefore, there may be many configurations of the model that can match the moments. We present one of them here. Table 2 summarizes the calibration results of the home production model.

With this calibration, the production technologies (Equations 8 and 9) over [0,100] are shown in Fig. 1. As can be seen, for the consumption goods $X < X^*$, production in the market sector is cheaper. However, for the consumption goods $X \geq X^*$, home production

Table 1. Calibration specification: the standard model

Parameter	Value	Moments to match
Price of goods, P	1	Normalization
Wage, w	1	Normalization
Weight, δ	0.542	Fraction of time devoted to work, $\frac{40}{70}$
Elasticity, σ	0.415	Labour supply elasticity, 0.3

Table 2. Calibration results: the home production model

Parameter	Value
k_m	50.0
k_h	200.0
λ_m	0.1E−13
λ_h	−2.0
σ_m	9.05
σ_h	1.0

[4] A typical individual has about 70 hours of available time per week and works for 40 hours.
[5] See Bhattarai and Whalley (2003) for a detailed explanation of this estimate.

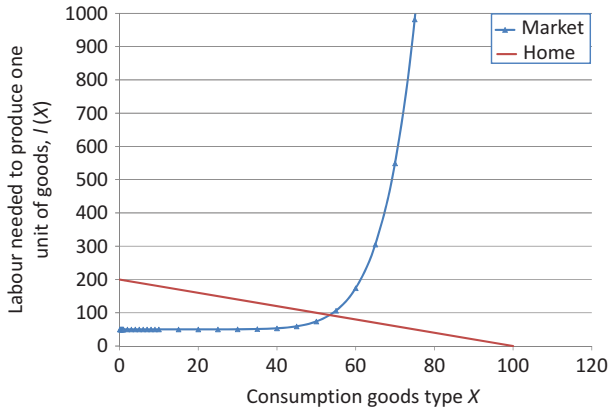

Fig. 1. Production technologies in the home production model

is cheaper. As X reaches its maximum value of 100, production in the market becomes extremely costly.[6]

IV. Welfare Results and Further Discussion

In this section, we report results from our main exercise, that is, to quantify the welfare costs of tax distortions of labour supply in the two models. We focus on the welfare costs of a 30% labour income tax, approximately the rate facing the average American. The measure of welfare cost adopted is the Hicksian compensating variation, that is, the change in income required to make the representative agent indifferent to living in the economy with a 30% labour income tax, as opposed to the economy without labour income tax. Table 3 reports these welfare costs in both models.

As can be seen, the welfare cost of tax distortions of labour supply in the home production model is approximately one-eighth of that in the standard model. This result suggests that the treatment of home production is important in assessing the welfare effects of labour income tax policies.

Table 3. Welfare cost of tax distortions of labor supply (for a 30% income tax)

Standard model	Home production model
5.5%	0.69%

V. Conclusion

In this article, we compare the welfare costs of tax distortions of labour supply in a standard model of labour supply and a home production model of labour supply. Using numerical simulation techniques, we show that the welfare cost of tax distortions of labour supply in the home production model is significantly smaller than that in a standard model of labour supply. These results suggest that home production matters for the size of the welfare effects of tax policies.

In general, our findings in this article suggest that home production does not only play an important role in labour economics and macroeconomic models, but should also influence public finance literature. In this article, we only consider the implications of home production for the effects of labour income tax policy. However, it is possible that home production is also important for understanding the effects of other public policies (especially those related to labour supply decisions), which are left for future research.

References

Ballard, C. L., Shoven, J. B. and Whalley, J. (1985) General equilibrium computations of the marginal welfare costs of taxes in the United States, *American Economic Review*, **75**, 128–38.

Becker, G. S. (1965) A theory of the allocation of time, *Economic Journal*, **75**, 493–517.

Benhabib, J., Rogerson, R. and Wright R. (1991) Homework in macroeconomics: house-hold production and aggregate fluctuations, *Journal of Political Economy*, **99**, 1166–87.

Bhattarai, K. and Whalley, J. (2003) Discreteness and the welfare cost of labor supply tax distortions, *International Economic Review*, **44**, 1117–33.

Eisner, R. (1988) Extended accounts for national income and product, *Journal of Economic Literature*, **26**, 1611–84.

Greenwood, J. and Hercowitz, Z. (1991) The allocation of capital and time over the business cycle, *Journal of Political Economy*, **99**, 1188–214.

Gronau, R. (1977) Leisure, home production, and work – the theory of the allocation of time revisited, *Journal of Political Economy*, **85**, 1099–123.

Gronau, R. (1986) Home production – a survey, in *Handbook of Labor Economics*, vol. 1 (Eds.) O. C. Ashenfelter and R. Layard, North-Holland, Amsterdam, pp. 273–304.

[6] Examples of such goods are home services, such as personal care.