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Labor supply prediction when tax avoidance matters*

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Abstract

We examine how tax avoidance in the form of trade in well-functioning asset markets affects the empirical study of labor supply. We discuss the implications for tax policy analysis, and we show that a failure to account for avoidance responses may lead to huge errors when predicting how tax reform affects labor supply, tax revenue, and the welfare cost of taxation. In conclusion we argue that our model may explain a number of otherwise hard to understand dimensions of tax payer response.

Keywords: Labor supply, tax avoidance, asset markets, tax reform simulation
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1. Introduction

How labor supply responds to taxation is one of the most intensively researched issues in empirical public finance. During the past decades a large number of studies have explored various dimensions of labor supply choice, and how tax reform affects hours supply. The static model of labor supply has been extended in several directions, including how to model decisions on labor force participation, and the joint labor supply of spouses. Other studies have focused on intertemporal labor supply, and on the impact of quantity constraints that force employees to work 'normal' hours. In the process there has also been a fair amount of controversy on how to design estimation methods that account for the econometric problems created by piecewise linear budget constraints.[1]

To this line of literature, which has advanced to a high level of methodological sophistication, we add a point which is conceptual rather than technical. Unlike previous studies we assume that tax payers supply labor while exploiting the opportunity for tax avoidance in the form of trade in well-functioning asset markets. Judging from the already enormous literature on labor supply one may argue that the value added from yet another permutation is low. We believe, though, that the mechanisms analyzed in the present paper are quite relevant in countries with high marginal tax rates, non-uniform capital taxation, and developed financial markets. In countries with less developed financial markets, lower marginal tax rates, and/or uniform capital taxation, there is less scope for avoidance. Even so, the pace of innovation in financial markets, and the documented ingenuity of tax payers in exploiting asymmetries in the tax code, suggest that our topic is of general interest.

In a companion paper, Agell and Persson (1998), we show that tax avoidance in the form of asset trade has dramatic implications for the normative and positive theory of labor supply and taxation. In this paper we turn to the implications for empirical tax policy analysis. One of the hoped-for effects from the wave of tax reforms that swept industrialized countries during the 1980s and early 1990s was that reduced tax progression would boost work incentives. A common ingredient to the reform process was micro-simulation analysis of labor supply response.[2] We show that failure to account for tax avoidance may lead to predictions about labor supply, tax revenue, and excess burden which are wide off the mark, quantitatively and qualitatively. For high-income earners the forecast errors might be on the order of several hundred percent.

2. Some stylized facts on tax avoidance

A general avoidance strategy is to claim deductible expenses against fully taxable income, and to report income in forms granted preferential tax treatment. In Sweden, before the 1990-91 tax reform, high-income earners could exploit a number of asset transactions to escape taxation. These transactions ranged from complex schemes of transforming corporate income into low-taxed capital gains, to much simpler operations that exploited the fact that net negative asset income was subtracted without limitation

[1] For recent surveys of the literature, see Blomquist (1996), Blundell (1996), and Heckman (1993). For a general discussion of how the functional specification of labor supply equations affects the analysis of tax and benefit reforms, see Blundell, Meghir, Symons and Walker (1988).

[2] See e.g. the articles in the 1990 special issue of *The Journal of Human Resources* (volume XXV, issue 3). For recent micro-simulation studies of labor supply response to tax reform, see e.g. Blomquist, Eklöf and Newey (1998) and Aronsson and Palme (1998), who examine the Swedish tax reform of 1990-91, Aaberge, Dagsvik and Strøm (1995), who analyze the labor supply effects from Norwegian tax reform, and Ziliak and Kniesner (1999), who report tax reform simulations using a life-cycle labor supply model, estimated on U.S. data. None of these papers allows for an avoidance response.

from labor income when calculating taxable income.[3] People seem to have responded accordingly.

Microeconometric studies indicate that Swedes with high labor income, and high marginal tax rates, were much more prone to own tax-favored assets, and to go into debt (e.g. Agell and Edin (1990)). Moreover, Malmér and Persson (1994) show that deductions for interest expenses, realized capital losses, and private pension savings by far exceeded reported asset income for people in the top decile of the earnings distribution. In 1980, when the income tax was highly progressive, these capital deficits allowed the average individual in decile 10 to reduce the average tax on labor income from 52.6 to 42.1 percent.[4] Malmér and Persson also show that these capital deficits gradually dissolved later on, when the government reduced tax progression.

The Swedish experience is not unique. The Nordic tax reforms of the late 1980s were preceded by concerns that there was a huge discrepancy between formal and real tax progression. Similarly, Lang, Nöhrbaß and Stahl (1997) conclude that various write-off opportunities caused a sharp reduction of the effective marginal tax rates of high-income households in Germany. Also, research on U.S. tax reforms suggests that avoidance activities responded more than ”real” decisions, like labor supply and savings.[5]

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[3] These schemes of buying low-taxed assets using borrowed money were not confined to traditional tax shelters like housing and works of art. There was also the opportunity to invest, within limits, in untaxed pension plans or favored savings accounts, or to engage in tax avoidance through intra-family debt transactions. For further details, see Agell, Englund and Södersten (1998).

[4] Even more strikingly, Malmér and Persson report that a third of the individuals in the highest decile reduced the actual tax on labor income by more than 25 percent, and that a tenth of them halved the same tax rate. For other empirical evidence suggesting that the formal rate of tax progression very much exaggerated the effective one, see Hansson and Norrman (1986), who conclude that the 1982 Swedish income tax can be characterized as *de facto* proportional.

[5] See the seminal paper by Feldstein (1995a) on the responsiveness of taxable income to marginal tax rates. For an overview of the lessons from TRA86, see Auerbach and Slemrod (1997).

3. Labor supply in the presence of asset trade

There are many ways of introducing tax avoidance in the basic labor supply model.[6] Recent interesting theoretical papers include Mayshar (1991), Feldstein (1995b) and Slemrod (1998).[7] Feldstein considers the case when tax avoidance takes the form of consumption of goods that are tax-favored either through deductions or exclusions, and adds these categories to a utility function that also includes leisure and non-favored consumption. Mayshar and Slemrod stick to the basic, two-good labor supply model, but introduce a general tax avoidance technology, intended to reflect a richer but unspecified structural model. Agell and Persson (1998) differ from Feldstein in emphasizing portfolio rather than consumption choice as the main avoidance channel, and from Mayshar and Slemrod in writing down a complete structural avoidance model.

Apart from its apparent consistency with the Swedish evidence, we believe that the portfolio approach has some appealing properties. It allows for the fact that not all tax payers engage in tax avoidance. Because of constraints on short sales, avoidance will be concentrated among the rich. Also, it brings out that many avoidance operations involve both a buyer and a seller. This demand and supply approach highlights, in a quite intuitive manner, the influence of relative asset yields in shaping the budget constraints of avoiders. Finally, based on partial equilibrium analysis, Feldstein (1995b) has argued that tax avoidance increases the excess burden from income taxation to a considerable extent. But as we discuss below, the portfolio approach conveys the message that the efficiency implications hinge on general equilibrium considerations.

Agell and Persson (1998) demonstrate that unlimited tax avoidance in a perfect

[6] Here we should mention the literature on the interaction between labor supply and illegal tax evasion; see e.g. Sandmo (1981) and Cowell (1990). Our focus is different, as we study legal tax avoidance.
[7] As far as we know the only econometric labor supply study that explicitly allows for tax avoidance is

asset market – along the lines of the tax clientele model of Miller (1977) – leads to complete equalization of all effective marginal tax rates on labor income. They also show that one can derive more realistic predictions by introducing seemingly plausible constraints on short sales. Taxable incomes will then no longer be equalized across taxpayers, and the extent of avoidance will differ systematically between income groups. People with high incomes engage in tax avoidance, and their labor supply incentives deviate radically from what is predicted by the standard model. People with low or average incomes face a binding credit constraint, and their labor supply incentives are determined in exactly the same way as is predicted by the standard model. In the present paper we pursue this line of analysis further, studying the implications for empirical labor supply and welfare analysis.

Consider an individual with an hourly wage rate *w*, labor supply ℓ, and a time endowment of *z* hours. The utility function is $u(c,\ z-\ell)$, quasi-concave, and twice continuously differentiable. The government imposes an income tax schedule $T(B)$, where *B* is taxable income. We assume that the tax schedule is continuously differentiable, that $0 \le T'(.) < 1$, and that the tax schedule is progressive in the sense that $T''(.) > 0$. The only thing that distinguishes our set-up from the standard, static labor supply model is that agents can buy and sell assets with different tax status. More specifically, we assume that an individual has some wealth *W*, which is to be allocated between a tax-exempt (denoted *X*) and a fully taxable asset (denoted *D*). We let *r* denote the interest rate on taxable claims, and r the interest rate on tax-exempt claims. We treat both assets as risk-free. We may think of the tax-exempt asset as representing tax shelters like pensions savings, gold, land, etc., while the taxable asset represents ordinary bank

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Triest (1992), who estimates a model with leisure, and taxable and tax deductible consumption.

lending, positive or negative. The taxable asset dominates the tax-exempt one, in the sense that $r > \bar{r}$.[8] There is a constraint on short sales of the tax-exempt asset, implying that $X \geq 0$, but people may go short in the taxable asset. If so, the resulting interest expense *rD* is fully tax deductible.

Exploiting the wealth constraint $D = W - X$, the maximization problem becomes

$$\begin{aligned} &\underset{\ell,\, X}{Max}\ u(c, z-\ell) \\ &s.t.\ \ c = rX + w\ell + \bar{r}(W - X) - T(w\ell + \bar{r}(W - X)), \quad X \geq 0. \end{aligned} \tag{1}$$

In the standard labor supply model, the individual optimizes with respect to ℓ, while treating asset choice *X* as a constant. In our model the individual optimizes with respect to both ℓ and *X*, and the first-order conditions become

$$\frac{u_2(c, z-\ell)}{u_1(c, z-\ell)} = w(1 - T'(w\ell + \bar{r}(W - X))) \tag{2}$$

$$\begin{aligned} &r - \bar{r}(1 - T'(w\ell + \bar{r}(W - X))) \leq 0 \\ &\qquad\qquad = 0 \quad if \quad X > 0. \end{aligned} \tag{3}$$

The complementary slackness condition (3) has important implications for the shape of the labor supply function. Individuals who face a binding constraint on short sales react to different labor supply incentives than individuals who are at an interior optimum.

Consider first the case of an interior solution. For these individuals, denoted by superscript "*A*" for "avoider", tax avoidance is driven to the point where the after-tax return on the taxable asset $\bar{r}\left(1 - T'(w\ell + \bar{r}(W - X)\right)$ equals r. Since everyone faces the same asset yields *r* and $\bar{r}$ in a competitive capital market, (3) implies that all individuals at an interior portfolio equilibrium will have the same marginal tax rate. Tax avoidance will thus transform the nonlinear statutory tax schedule into an effective linear schedule

[8] Here, we treat $\bar{r}$ and *r* as two exogenous constants (think of a small open economy). In section 6 below,

with slope $1-r/r$. For future reference it is important to note that this implies that

$$\frac{u_2^A}{u_1^A} = w\frac{r}{r}. \qquad (4)$$

Eq. (4) implies that the effective tax wedge for avoiders is determined in asset markets. The tax system affects work incentives only to the extent that the tax function $T(.)$ affects the relative return on taxable and tax-exempt assets. Since the marginal tax rate is a monotone function of taxable income, all avoiders report the same taxable income:

$$B^A = T'^{-1}(1-r/r) \qquad (5)$$

When two individuals have different marginal tax rates, they can make a profit from trading assets. The one with the low income sells the tax-exempt asset and purchases the taxed asset, while the one with the high income does the opposite. This process continues until taxable incomes are equalized, and total tax payments minimized.

However, because of the constraint on short sales the process of tax arbitrage might be cut short. People with relatively low taxable incomes, who face an incentive to go short in the tax-exempt asset, will find that the non-negativity constraint prevents them from doing so. For this group of people all wealth will be invested in the taxable asset, and their labor supply will be determined in exactly the same way as is predicted by the standard labor supply model. Non-avoiders decide on work hours while treating their asset portfolio as exogenous, and accounting for the fact that they – unlike avoiders – face a tax system where the marginal tax rate is an increasing function of their labor income. To derive the labor supply function of non-avoiders, henceforth denoted by superscript "*NA*", we set $X = 0$ in (2).

In sum, for tax avoiders, we have the response functions

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we deal with the case when r and r are endogenous, and determined in general equilibrium.

$$\ell^A = \ell^A(w, W)$$
$$X^A = X^A(w, W), \tag{6}$$

with corresponding indirect utility $v^A(w, W)$. For non-avoiders, we have

$$\ell^{NA} = \ell^{NA}(w, W) \tag{7}$$

with $X^{NA} \equiv 0$, and with indirect utility $v^{NA}(w, W)$. The two subgroups are separated by some switch-point condition, that is, a curve in the (w, W) plane defined by $v^A(w, W) = v^{NA}(w, W)$, which can be more compactly written as

$$f(w, W) = 0. \tag{8}$$

Everybody with $f(w, W) \geq 0$ behaves according to (6), while everybody with $f(w, W) < 0$ sets $X = 0$ and behave according to (7). For the interpretation of (6) and (7), note that all functional forms are conditioned on the tax system; if there is a change in *T*(.), the labor supply function and the switch-point condition will also change.

4. Three propositions

Over the years a main application of labor supply analysis has been prediction of how tax reform affects hours supply, tax revenue, and excess burdens. In the context of the major tax reforms that were implemented a decade ago, a number of studies have assessed the direction and magnitude of these effects; see e.g. the works referred to in footnote 2 above. However, these state-of-the-art studies do not allow for an avoidance response. As we show below, this omission is potentially quite serious.

Consider a tax reform that changes the tax function *T*(.). What are the implications for the labor supply of avoiders? It is easy to show the following:

Proposition 1. *For any arbitrary tax reform the labor supply of a tax avoider is only affected by an income effect. This result holds for any individual who is at an interior portfolio equilibrium both before and after the tax reform.*

The proof follows directly from the first order condition in eq. (4). A tax reform generates a substitution effect only if it affects the wedge imposed between the marginal rate of substitution on the LHS and the marginal rate of transformation on the RHS. Because this wedge is determined in asset markets, and equal to $1-r/r$, a tax reform can have no direct impact on the wedge.[9]

To forecast the revenue effects of alternative tax systems, one must assess how tax reform affects taxable income. In the standard model, the wage and income elasticities of labor supply are decisive in evaluating revenue effects. In our model, however, taxable income of avoiders is determined independently of preferences:

Proposition 2. *Taxable income of tax avoiders is determined by the curvature of the tax function, and by the relative return on tax-exempt and taxable assets. Parameters from tax avoiders' utility functions play no role.*

The proof follows directly from eq. (5).[10] As a corollary, one can show that the choice of actually becoming an avoider does depend on the utility function. This follows from the derivation of the switch-point condition in (8).

[9] We discuss the case when tax reform affects endogenous asset yields in section 6.
[10] In a more general model, where assets differ with respect to risk, the preferences of tax avoiders will of course have an impact on their portfolio choice and thus on their taxable income.

Much of the interest in the standard labor supply model rests on the view that a correctly estimated (compensated) labor supply elasticity is a vital input when calculating the welfare cost of taxation. However, as first argued by Feldstein (1995b), when people optimize along several margins at the same time, the elasticity of labor supply becomes a potentially quite misleading indicator of the welfare cost of taxation. Our model illustrates this point in a particularly simple manner. It is straightforward to compute the welfare loss associated with tax system $T(.)$. In an equilibrium without taxation, what lump-sum deduction EV would be equivalent to the introduction of $T(.)$? In the taxation equilibrium, indirect utility is $v^A(w,W)$ or $v^{NA}(w,W)$, depending on whether the individual is an avoider. We compute EV as that income change which makes welfare in the no-tax equilibrium, computed from

$$\begin{aligned} &\max_{\ell} u(c, z-\ell) \\ &s.t.\ \ c = w\ell + rW - EV, \end{aligned} \tag{9}$$

equal to indirect utility in the taxation equilibrium. The budget constraint in (9) recognizes that $X = 0$ for everybody in the absence of taxation. Since $r > r$, and since taxes are zero, no one will invest in the low-yielding asset.

Consider next how the welfare cost is computed by a labor supply researcher who does not realize that asset choice is endogenous. Suppose that he has complete information about the utility function, and that all variables – including consumption, leisure, and asset holdings – are measured correctly.[11] As consumption and leisure are measured without error, he observes utility in the taxation equilibrium. But to estimate the welfare cost of taxation, he must consider the optimization problem that would

[11] These assumptions are strong ones. As discussed in Agell and Persson (1998) tax avoidance can be expected to generate systematic errors in the measurement of people's asset income.

have materialized in the absence of taxation. Formally, he defines EV' as that income change which makes welfare in the no-taxation equilibrium, computed from

$$\max_{\ell} u(c, z-\ell)$$
$$s.t.\ \ c = w\ell + rX + r(W-X) - EV', \qquad (9')$$

equal to welfare that is observed in the equilibrium with taxation. As the researcher treats asset choice as exogenous in the optimization, the asset incomes that appear in the budget constraint, rX and $r(W-X)$, are the ones that are observed in the equilibrium with taxation. Comparing problems (9) and (9') we can state:

Proposition 3. *Calculations of the welfare cost of income taxation that treat asset choice as exogenous imply that the perceived welfare cost, EV', will be less than the true welfare cost, EV, by an amount given by*

$$EV = EV' + (r - \bar{r})X,$$

where X is the amount of the tax shelter that is owned in the equilibrium with taxation, and r and $\bar{r}$ are the exogenous rates of return on the taxable and tax-exempt assets.

The proof follows from deriving the indirect utility functions for problems (9) and (9'), equalizing them, and solving for the relation between *EV* and EV'.

In a sense, the proposition demonstrates the obvious. To the extent that taxation leads to an equilibrium with an inefficient asset allocation, an analysis that ignores this underestimates the welfare cost of taxation. It is important to note, though, that the efficiency cost due to avoidance is *additive* to the efficiency cost computed according to the standard approach. This suggests that there is – at least in theory – an easy fix-up of conventional estimates of the efficiency cost of taxation. To arrive at a measure of

the true efficiency cost, all we have to do is to add the monetary value of foregone asset income to the efficiency cost computed in the labor supply literature. In practice, however, this is difficult, since tax avoiders typically invest their wealth in ways that are not recorded by neither the government nor the econometrician.

Although the models are quite different, the gist of **Proposition 3** is obviously well in line with the conclusion of Feldstein (1995b) that labor supply studies that disregard tax avoidance will underestimate the excess burden from the income tax. But as we discuss below, when asset yields r and $\tilde{r}$ are endogenously determined in general equilibrium, the proposition no longer applies.

5. Numerical examples

To illustrate the difference between the conventional labor supply model and one that allows for endogenous asset choice it is helpful to consider some numerical examples. Assume that the utility function is logarithmic, $u(c, z-\ell) = \ln c + a \ln(z-\ell)$. Assume also that the tax system is of the form $T(B) = B - bB^{v}$, where B as before is taxable income, $b > 0$, and $0 < n < 1$. With this parameterization, the marginal tax rate is a continuously increasing function of B; also, we only consider combinations of B, n, and b that guarantee that the marginal tax rate is in the range between zero and one.

Let us start with the behavior of tax avoiders. For this particular parameterization eq. (5) – which defines taxable income of avoiders – becomes

$$B^{A} = \left(\frac{r}{rbv} \right)^{\frac{1}{v-1}}, \qquad (5')$$

while the response functions in (6) can be written (after tedious manipulations) as

$$\ell^A = \frac{1}{w(1+a)} \cdot \left(wz - a\, rW - a\, \frac{1-v}{v} B^A \right)$$
$$X^A = \frac{1}{r(1+a)} \cdot \left(wz + rW - \frac{v+a}{v} B^A \right) \qquad (6')$$

For people at corner solutions, i.e. non-avoiders, we obtain

$$\ell^{NA} = \frac{vz}{v+a} - \frac{a\, rW}{(v+a)w}. \qquad (7')$$

The switch-point condition is equally simple:

$$f(w, W) \equiv wz + rW - \frac{v+a}{v} B^A = 0. \qquad (8')$$

Individuals with a full income $wz + rW \geq (n+a)B^A / n$ will be in an unconstrained optimum, while individuals with lower full income will be in a constrained optimum. Thus, rich individuals (in terms of full income) face a perfect capital market and supply labor according to (6'), while poor individuals face a binding credit constraint and supply labor according to (7'). With these equations it is easy to examine how tax reform, in the form of changes in the progressivity parameter n, affects labor supply, tax payments, and equivalent variations for different types of individuals. It is also easy to examine how tax reform affects the switching condition, and the relative size of the group of people that engage in tax avoidance.

Consider next the labor supply function that comes out of a standard labor supply model, where people maximize utility with respect to ℓ, treating taxable and nontaxable capital income as exogenous. Denoting non-taxable assets by $\overline{X}$, where the bar is used to emphasize that it is treated as exogenous, we thus have taxable wealth equal to $(W - \overline{X})$ which also is treated as exogenous. For our choice of parametric functions, the standard labor supply function is defined implicitly, via the first order condition

$$\frac{wbv(w\ell + r(W - \overline{X}))^{n-1}}{r\overline{X} + b(w\ell + r(W - \overline{X}))^{n}} = \frac{a}{z - \ell}. \qquad (10)$$

If $\overline{X} = 0$, it is easy to see that this reduces to (7').

5.1 Comparing the models

Figure 1 graphs the labor supply function that comes out of the standard model (10), for the following parameter values: $a = 1$, z = 4800 (hours), $W = 500{,}000$ Swedish crowns,[12] $\overline{X} = 0$, and $r = 0.03$. We use three different values of v: a slightly progressive tax system (v = 0.9), one with moderate progression (v = 0.65), and a highly[13] progressive one (v = 0.55). For each value of v, we adjust the other parameter of the tax function, b, so as to ensure that an individual with a taxable income of 180,000 crowns pays an average income tax rate of 30 percent.[14] One may note the nonlinear nature of the labor supply function, suggesting that the (uncompensated) wage elasticities are large for low-wage individuals, and quite small for high-wage individuals. When it comes to the tax system the important observation is that labor supply responds forcefully to changes in v. As v decreases the labor supply function shifts downwards. For an individual with a wage rate of 200, a decrease in v from 0.9 to 0.55 lowers annual labor supply by 579 hours!

Figure 2 shows what the standard labor supply function predicts about the incidence of the tax burden among individuals with different wage rates. We report the average tax rate, computed as the ratio between taxes paid and labor income. Because v

[12] At the exchange rate of September 1, 1999, one USD is worth 8.26 crowns.
[13] It is of some interest to note that Englund and Persson (1982), based on Swedish revenue statistics, estimated that v was as low as 0.3 in the years when the income tax was the most progressive.
[14] For our expository purpose, this crude way of introducing an equal revenue requirement is quite sufficient. A fuller analysis should of course make explicit use of the government budget balance

is less than one, and because an individual's labor income increases with her wage, the average tax rate is an increasing function of the wage rate. We can also see that the income tax becomes more progressive as v decreases – when $v = 0.55$ the average tax rate increases quite rapidly with the wage rate. But as can be seen from figure 3, the implied redistribution from high-wage to low wage individuals occurs at an economic efficiency cost. The average excess burden (defined as the ratio between the total excess burden and labor income) increases with the wage rate – as high-wage individuals face higher marginal tax rates, their labor supply decisions are more distorted.[15] The average excess burden also increases with the degree of tax progression; taxation is more distortionary when $v = 0.55$ than when $v = 0.9$.

Figures 4-6 show the results that come out of our tax avoidance model, represented by eqs. (5') to (8'). We assume that $r = 0.01$, and that all other parameter values remain unchanged. Some inspection of figure 4 reveals that the labor supply function that materializes when the tax system is only slightly progressive is identical to the one that comes out from the standard model (the upper curve in figure 1). When $v = 0.9$ the marginal tax rate increases very slowly with taxable income, and only people with extremely high wages (not shown) face marginal tax rates that are high enough to justify a shift from high-yielding taxable assets to low-yielding tax-exempt ones.

When v decreases from 0.9 to 0.65, people with lower – but in a relative sense still quite high – wages will find it worthwhile to become tax avoiders. These

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requirement; this would however require a host of assumptions regarding the joint distribution of wages and wealth without adding additional insights.

[15] To compute the average excess burden, we proceed as follows. For each individual we first compute the equivalent variation, defined in the manner of **Proposition 3**. We then subtract the tax payments of the individual, and divide what remains by her labor income. It is of course more common to divide the

individuals now face a linear rather than nonlinear tax system, and their labor supply function has a form which differs from the one of non-avoiders. The change in functional form occurs at the wage rate – 228 crowns – which corresponds to the kink point *A* in figure 4. Thus, to the left of point *A*, the curve of figure 4 is identical to the corresponding curve in figure 1. Individuals with wages in excess of 228 crowns have higher wage elasticities than those with lower wage rates. When *v* decreases further to 0.55 the kink point moves leftwards, according to the switch-point condition (8'), indicating that tax avoidance gains momentum also among the relatively poor. With this steeply progressive tax system the wage elasticity increases discontinuously at an hourly wage rate of 145 crowns.

From the perspective of the empirical study of labor supply, figure 4 suggests that the common view that it is important to estimate models that allow low-wage individuals (females in particular) to have larger gross wage elasticities than people with higher wages needs to be qualified. In countries where the tax system opens up for tax arbitrage, it appears just as important to estimate models that allow for the possibility that the high-wage population has a labor supply function with a relatively large wage elasticity.

Figure 5 shows how tax avoidance affects the incidence of the progressive income tax. Here, too, it is instructive to compare the curves to the corresponding ones in figure 2. When $v = 0.9$ no one engages in tax avoidance, and the average tax rate increases slowly with the wage rate. When *v* drops to 0.65 we note a radical departure from the standard analysis. When tax progression increases, the average tax rate decreases for people at *both* tails of the wage distribution. Because of high formal marginal tax rates, high-wage individuals – situated to the right of the kink point *A* –

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excess burden by the amount of tax revenue. But as many individuals pay negative or zero taxes in our

engage in arbitrage operations that reduce taxable income and the average tax rate. At the other tail of the wage distribution, the average tax rate decreases for the standard reason. As a consequence, the tax system is progressive when we consider people with low and average wages, but *de facto* regressive for people with high wages.[16]

Figure 6, finally, shows how tax avoidance affects estimates of the efficiency cost of taxation. As implied by **Proposition 3**, tax avoidance creates welfare losses that should be added to those of the standard labor supply model. For tax avoiders, with wages to the right of *A*, the excess burden increases rapidly with the wage rate. Avoiders reduce their tax payments, but in the process resources are wasted, in the form of an inefficient allocation of assets. This efficiency cost increases with the wage rate, as a higher wage rate induces avoiders to increase their holdings of the low-yielding tax-exempt asset.

5.2 Tax reform simulation

Consider the following hypothetical situation. Starting in a situation with a proportional tax system ($v = 1$) the government contemplates to increase tax progression, i.e., to reduce v. To assess the likely effects the government calls upon the advice from an economist equipped with the standard labor supply model. This economist has perfect information about preferences, wages and initial asset holdings (initially everyone is at a corner solution, with zero holdings of the tax-exempt asset), but executes his tax reform simulations under the erroneous assumption that hours supply is the only margin of choice. We assume that the true data-generating process is represented by the avoidance model of eqs. (5')-(8'). Figures 7-9 compare the resulting

simulations, such diagrams would not make sense.

[16] For anyone who has followed the Scandinavian debate this result is no surprise. A main motive for the major tax reforms that reduced the formal rate of tax progression during the late 1980s and early 1990s

tax reform simulations for a representative individual, with $w = 250$ and $W = 900{,}000$ (all other parameters are the same as in the previous section).

For moderate decreases in *v*, the representative labor supply economist comes up with accurate forecasts. But when *v* approaches 0.67, our hypothetical tax payer starts to engage in arbitrage. As a consequence, the forecast errors grow rapidly when *v* is reduced further. Figure 7 shows that while the representative labor supply economist predicts that labor supply will continue to decrease, the data generating process in fact implies that labor supply will increase somewhat. This is a direct consequence of **Proposition 1**. According to the standard model a further increase in progressivity (i.e., a reduction in n) reduces labor supply via a concomitant negative substitution effect. According to the avoidance model, however, a further increase in progressivity will only create an income effect. In our view this result may go a long way towards explaining why Swedes with high incomes did not appear to reduce their labor supply during the 1970s, when the Swedish income tax turned steeply progressive.

The forecast errors carry over to other variables that would interest policymakers. As an illustration of **Proposition 2**, figure 8 shows that the standard model considerably understates the reduction in taxable income as *v* is reduced. Finally, as an illustration of **Proposition 3**, figure 9 shows that the standard model also understates the increase in the excess burden.

6. General equilibrium aspects

In an open economy, it might appear reasonable to assume that asset yields are independent of domestic tax policy. But in an economy where the supplies of taxable

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was the view that there was a huge discrepancy between formal and effective tax progression.

and tax-exempt assets are less than perfectly elastic, it seems reasonable to proceed under the assumption that domestic tax policy affects the relative asset yield r/r.

It is straightforward to introduce endogenous asset yields in our model. A basic observation is that although there are two assets in our model, there is only one independent equilibrium condition. Thus, we can only solve for relative asset returns. We now make the strong assumption that the tax-exempt asset is in fixed supply, denoted *S*. This would be the case if *X* is, for example, land. We then integrate the asset demand function in (6) over all tax avoiders to obtain market demand for tax shelters, and solve for the value of r/r that makes demand equal to supply:

$$\int_{f(w,W)\geq 0} X^A(w,W)\, dF(w,W) = S\ , \qquad (11)$$

where $F(w,W)$ is the joint cumulative distribution function of wages and initial wealth.[17] Using (11) we can examine how tax reform affects the relative asset yield. Equipped with this information we can proceed to examine the implications for labor supply, tax revenue, and the welfare cost of taxation.

Once we treat asset yields as endogenous rather than exogenous, some of the most striking differences between our model and the standard labor supply model disappear. When the tax system affects the relative asset yield, tax reform creates substitution effects also for those who engage in tax avoidance. These market determined substitution effects have the same sign as those that come out of the standard model. Consider a tax reform that increases the progressivity of the formal tax code. In the standard model the labor supply of high-wage individuals tends to decrease

[17] In (11) r and r are subsumed in the functional forms of the switching condition and the asset demand function. This is clear from eqs. (5'), (6'), and (8'). Another observation is that the wealth variable in (11) becomes endogenous, as soon as it is variations in asset prices that deliver changes in equilibrium returns. Tax changes will then bring about endogenous wealth effects. The discussion in the text

because of a negative substitution effect. In our model with an endogenous asset yield the labor supply of tax avoiders is affected by a negative substitution effect because increased formal tax progression leads to a decrease in r / r. When formal tax progression increases, there is an increased demand for tax shelters. But as tax shelters are in fixed supply this excess demand must be choked down by a relative return adjustment that makes it less favorable to own the tax-exempt asset. In the process the effective marginal tax rate that confronts tax avoiders will increase.

Another important deviation from our previous analysis concerns the computation of the welfare cost of taxation. When the tax-exempt asset is in fixed supply, it is no longer the case that tax avoidance imposes an excess burden which is additional to the standard labor supply distortion. The mix of tax-exempt and taxable assets is an exogenous one, which does not depend on the design of the tax system. Although people still engage in asset trade to avoid taxation, no real resource costs are used up in the process.[18] Clearly, the assumption that assets are in fixed supply is not a realistic one. Though works of art and diamonds (two traditional tax shelters) are in fixed supply from the point of view of the world as a whole, their supplies are endogenous for a small open economy. In such an economy, the only typical tax-favored asset which is in fixed supply is (unimproved) land. By contrast, the majority of assets that serve as vehicles for tax avoidance – residential real estate, luxury consumer durables, pension savings, investments in foreign assets (the income of which is typically not reported to the domestic tax authorities), etc. – are in endogenous

presupposes that it is variations in dividends that deliver changes in equilibrium returns.

[18] At the individual level, some people will hold more of the asset, and some will hold less, than they would have in the absence of taxation. These effects will however average out in the aggregate.

supply. As a consequence, we view our preceding analysis as a relevant guide to the labor supply implications of tax avoidance.

7. Conclusions

The Nordic discussion has for long recognized that the statutory rate of tax progression may considerably overstate the actual rate of tax progression. More than two decades ago Nobel Laureate Gunnar Myrdal (1978) argued that high marginal tax rates had created so strong incentives for high-income Swedes to exploit a variety of tax avoidance schemes that the tax system no longer redistributed income. The perception that high marginal tax rates could be circumvented by people with access to modern financial markets was also important in paving the way for the major tax reforms that were implemented in Scandinavian countries during the late 1980s and early 1990s.

In the present paper we have formalized these ideas, and we have stated some implications for the empirical analysis of labor supply. We show that the standard approach of analyzing labor supply, which treats asset choice as exogenously given, may give a very biased impression of how progressive income taxation affects hours supply, efficiency, income distribution and tax revenue. The standard approach *overestimates* the negative hours response to an increase in tax progression of people with high wages. It also *overstates* the extent of income redistribution that takes place, and the revenue gains for the government. But by neglecting the role of portfolio adjustments, the standard approach also *underestimates* (subject to the qualifications discussed in section 6) the overall efficiency losses imposed by high marginal tax rates.

Our model seems consistent with important observations about tax payer response. First, a frequently noted puzzle is why Swedes with high incomes did not

appear to reduce their labor supply in spite of drastic marginal tax hikes during the 1970s. Our model provides an easy explanation. Due to various financial operations people with high wages could largely undo the increase in tax progressivity. Second, the Swedish “tax reform of the century”, implemented in 1990-91, implied drastically reduced tax progression, and a move away from a system of global income taxation towards a dual income tax, with separate tax schedules for earned income and capital income. While interest expenses remained deductible, the value of deductions was much reduced. These tax changes implied sharply reduced returns to a strategy of purchasing tax favored assets with borrowed money. Our model predicts that such a change ought to have a large effect on asset composition, but a small effect on labor supply. Precisely this pattern is borne out by the data. In the early 1990s households’ investments in tax shelters came to a virtual standstill, while households began to pay off their debts at a very high rate. At the same time, there seems to be reason to conclude that the lower marginal tax rates on earned income led to a quite modest increase in labor supply.

Judging from the history of taxation, the battle between avoiders and tax authorities is a never-ending one. When the authorities design rules to combat existing forms of avoidance, the added complexity of the tax code often seems to open up for new avoidance measures. Also, in times of financial innovation, there seems to be a marked increase in avoidance activity. The transactions that we have modeled are most relevant in countries which run a classical system of income taxation, where taxable income is the sum of labor and capital income. Some countries have recently introduced measures that limit taxpayers’ ability to deduct capital deficits from their labor income (in fact, the very reason for introducing such measures seems to be the

mechanism analyzed in this paper). But these measures do not exhaust the scope for tax avoidance. The opportunity to shift income between personal and corporate tax bases remains, and can be used to reduce taxes on labor income.[19] Also, the integration of international markets opens up for a host of new avoidance techniques. Developing labor supply models that allow for such avoidance methods as well seems like a promising topic.

[19] The Swedish case is discussed in Agell, Englund and Södersten (1998). For an interesting analysis of income shifting in the U.S., see Gordon and Slemrod (1998).

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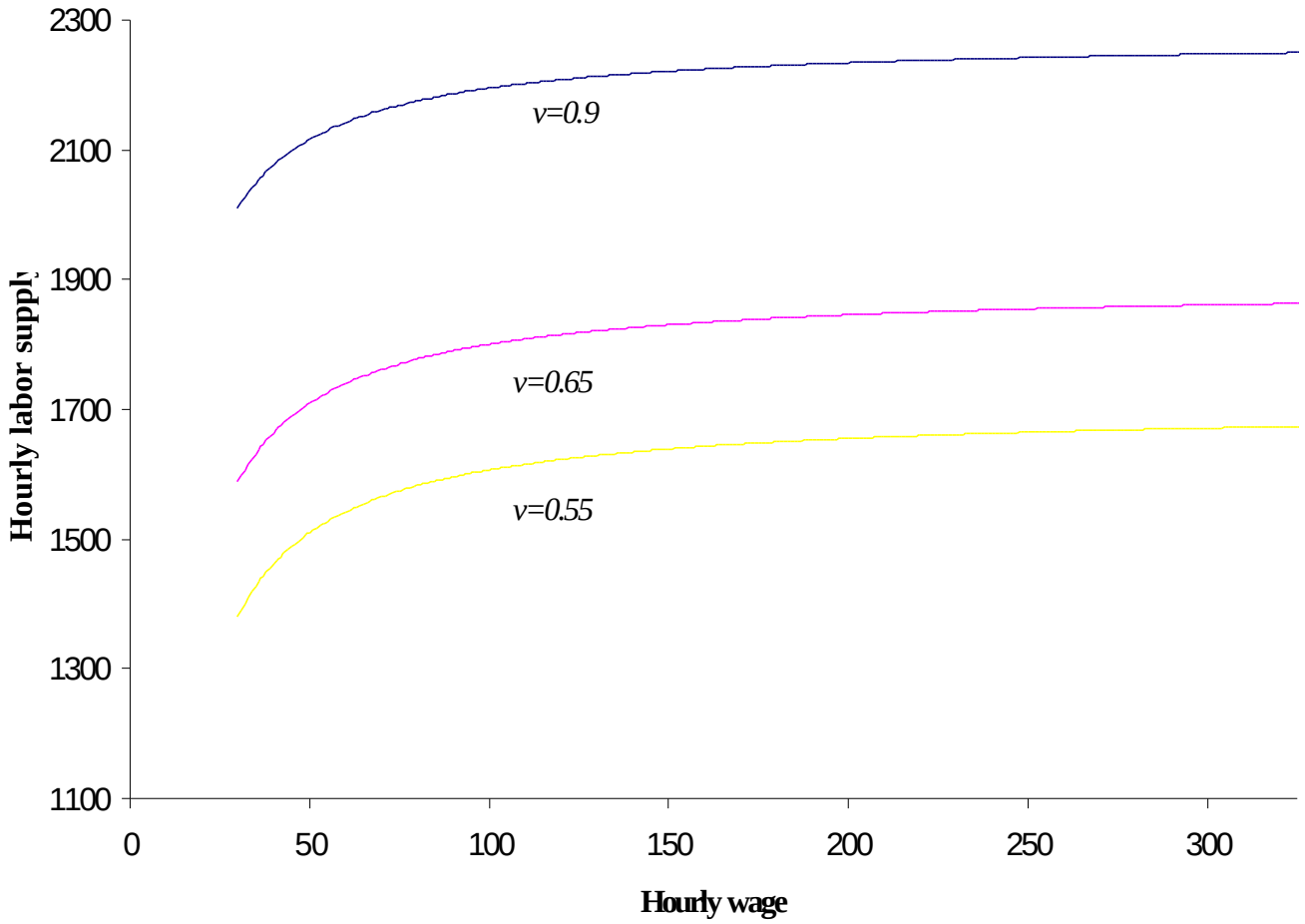
Figure 1. Standard labor supply model



Figur 2. Average tax rate in the standard labor supply model

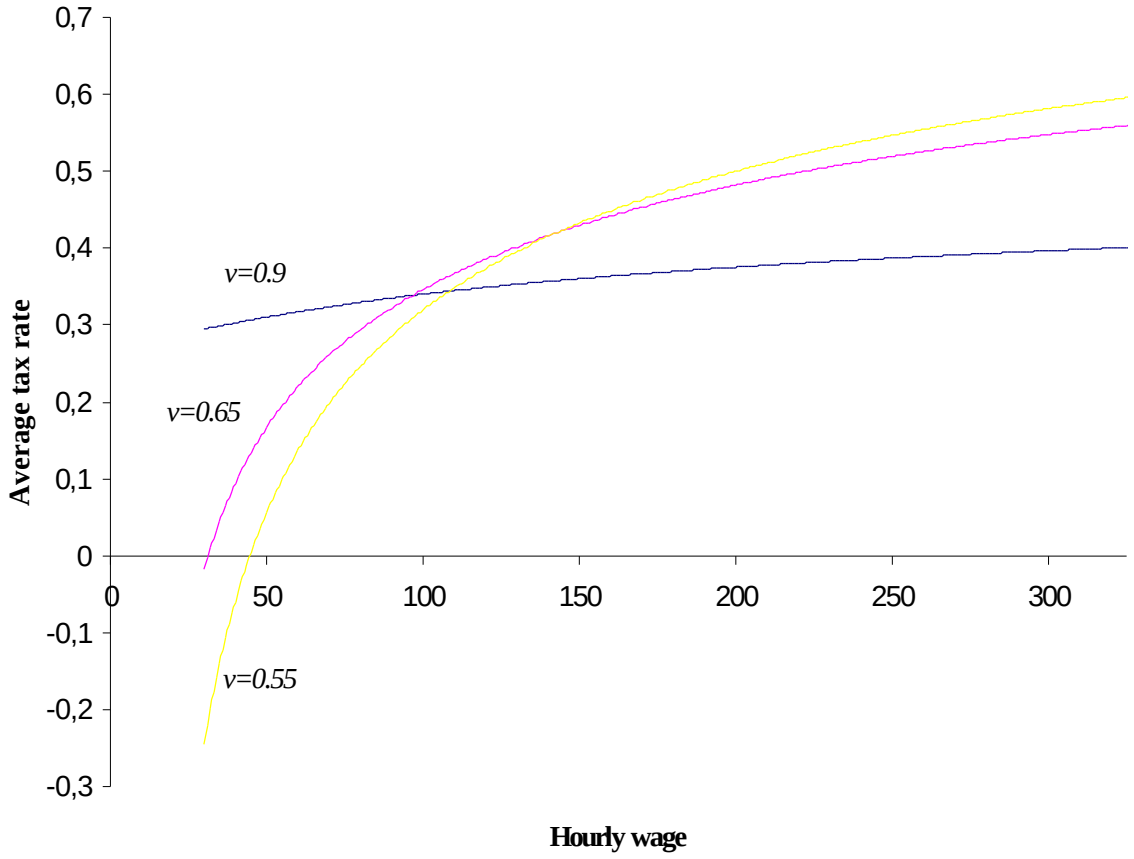


Figure 3. Average excess burden in the standard model

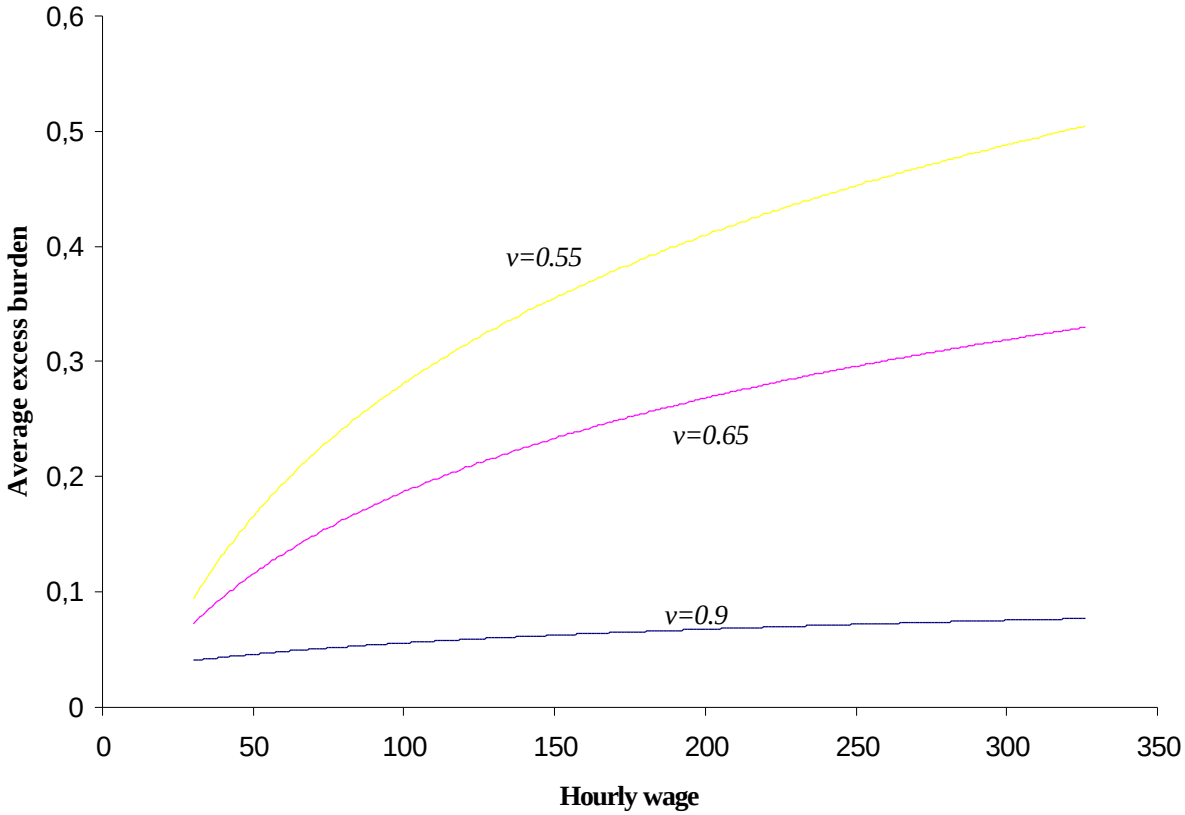


Figure 4. Labor supply in the presence of tax avoidance

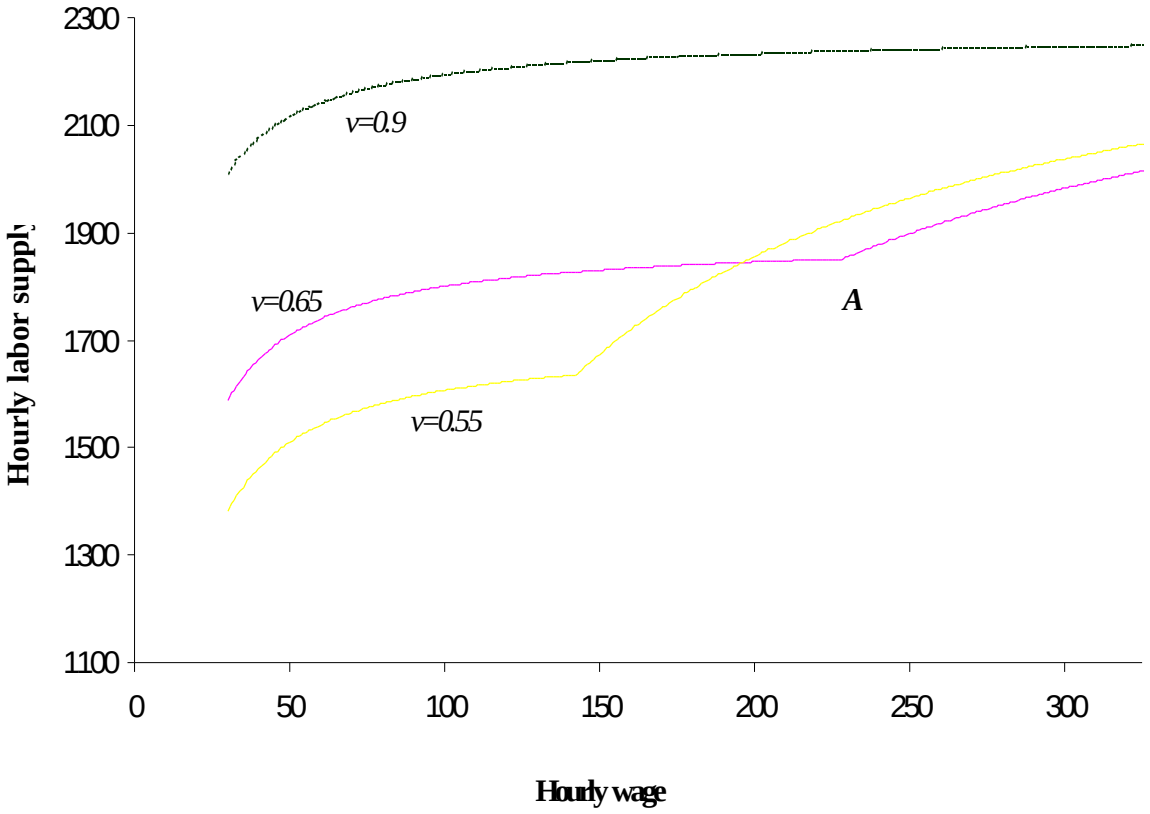


Figure 5. Average tax rate in the presence of tax avoidance

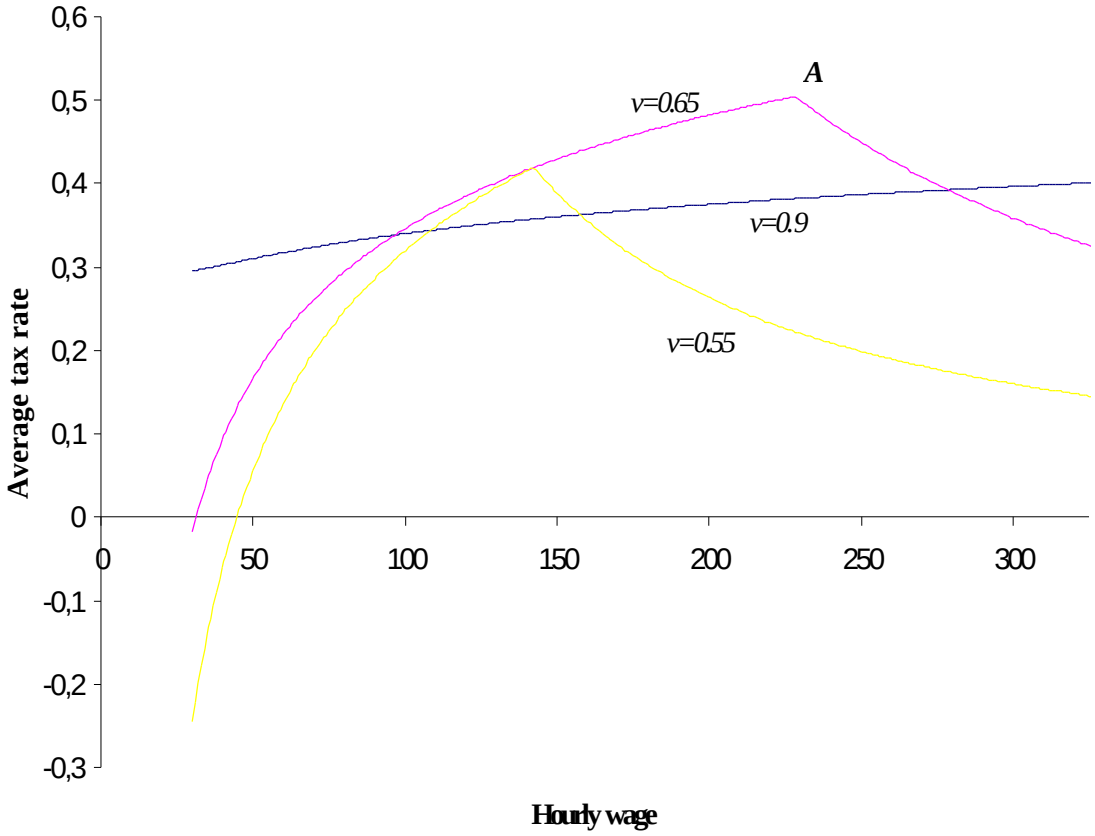


Figure 6. Average excess burden in the presence of tax avoidance

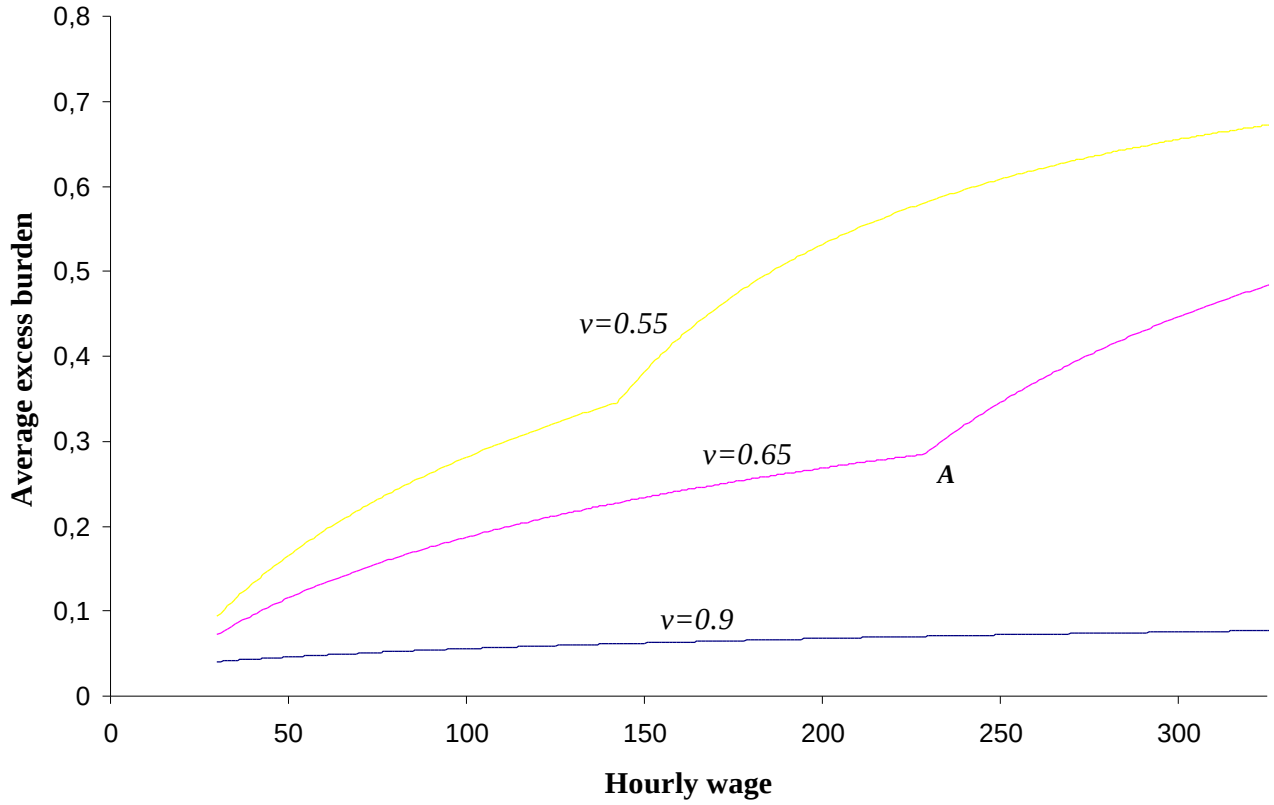


Figure 7. How tax progression affects labor supply

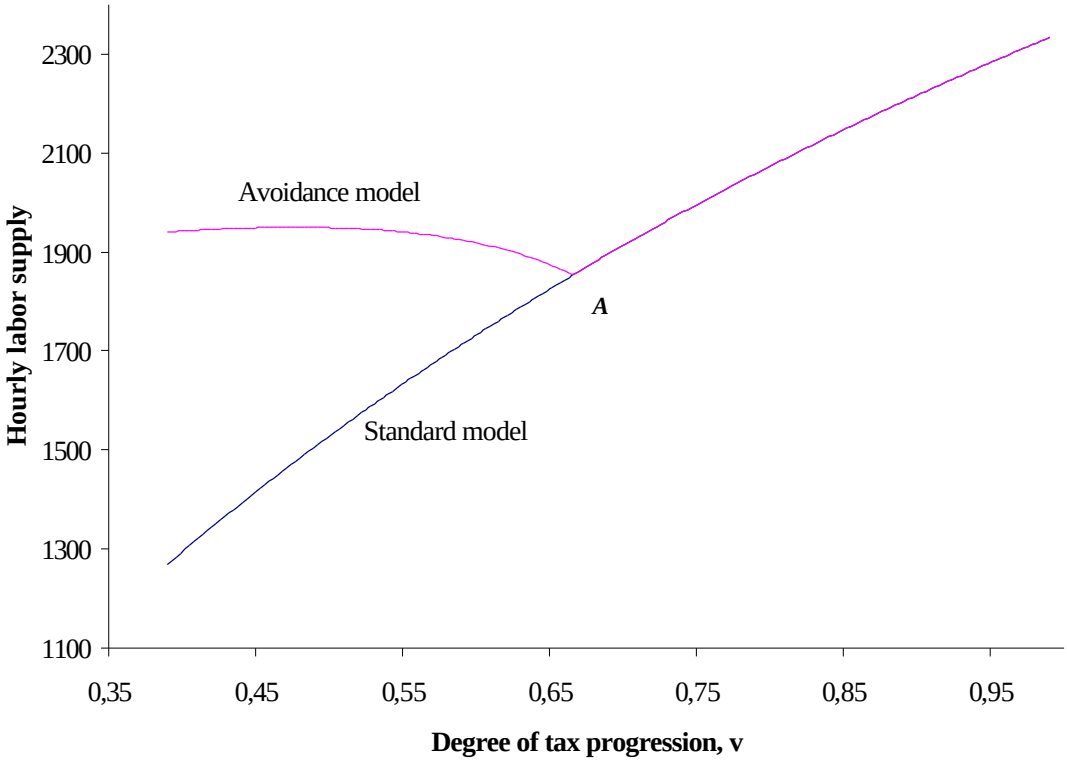


Figure 8. How tax progression affects taxable income

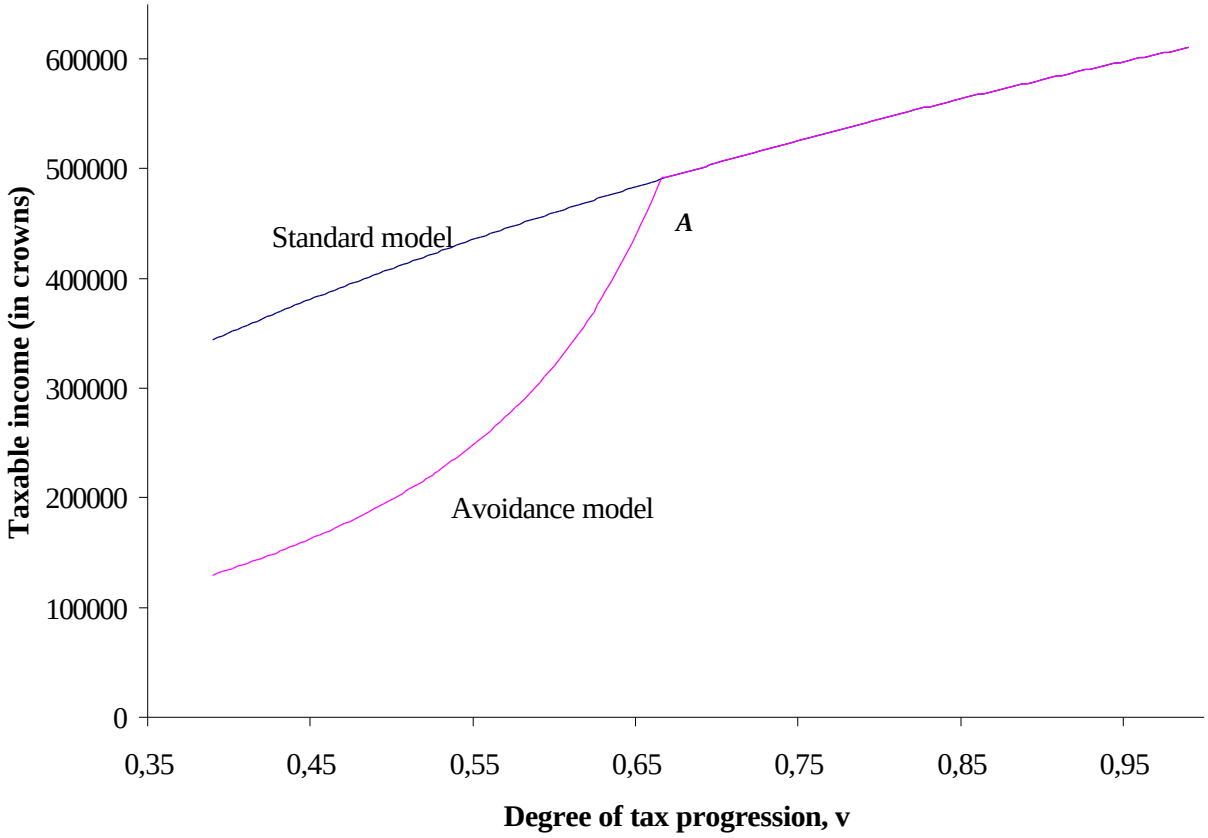


Figure 9. How tax progression affects the total excess burden