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Jonas Agell and Mats Persson

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Institute for International Economic Studies
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Tax arbitrage and labor supply¤

Jonas Agell* and Mats Persson**

Abstract
We examine how tax avoidance in the form of trade in well-functioning asset markets affects the basic labor supply model. We show that tax arbitrage has potentially dramatic implications for positive, normative and econometric analysis of how taxes affect work incentives.

Keywords: Labor supply; Progressive income taxation; Tax arbitrage

JEL classification: H21, H23, H24

*Department of Economics, Uppsala University, Box 513, S-751 20 Uppsala, Sweden
**Institute for International Economic Studies, S-106 91 Stockholm, Sweden

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1. Introduction

In the 1970s and 1980s, Sweden imposed the industrialized world's most steeply progressive income tax schedule. Due to the compound impact of income taxes, value added taxes, and payroll taxes, the marginal tax wedges (differences between productivity and real take home pay) for some broad categories of employees was in the range 80-90 percent. The gut reaction of most economists would certainly be that tax distortions of such magnitudes ought to imply a high and easily detectable cost in the form of lost work hours. Even so, recent studies suggest that the response in work effort was quite modest. A recent evaluation of the major 1990-91 Tax Reform Act conveys a similar picture. Despite marginal rate cuts by between 24 and 27 percentage points for large groups of full-time employees, labor supply appeared unresponsive.[1]

Do Swedes bother less about incentives than people at large? We believe the answer is no. There are many ways of rationalizing a small labor supply response to high tax wedges. Lindbeck (1995) maintains that because of the slow-moving influence of habits and social norms, it may take a long time until disincentive effects harm the economy. Sandmo (1991) discusses the possibility that the welfare state may mitigate tax disincentives by public spending programs that promote labor supply. Similarly, Bergstrom and Blomquist (1996) suggest that the extensive provision of heavily subsidized child care favors market work in spite of high taxes. According to Summers, Gruber and Vergara (1993), the corporatist Swedish wage bargaining system may have internalized some of the negative labor supply disincentive effects.

But there might be an even simpler reason for the modest labor supply response. There is good reason to believe that the statutory rate of tax progression

[1] For a survey of Swedish labor supply studies, and an extensive discussion of the Swedish "tax reform of the century", see Agell, Englund, and Södersten (1998).

exaggerated the labor supply distortions that confronted Swedes with high incomes and high education. Two decades ago, Nobel Laureate Gunnar Myrdal (1978) complained that high marginal tax rates had created so strong incentives for high-income individuals to exploit a variety of tax avoidance schemes that the tax system no longer redistributed income. The tax system *looked* egalitarian, but in practice taxpayers restored the incentive structure by perfectly legal asset transactions. A decade later the perception that the rich and the highly educated could avoid the bite of the progressive income tax had reached the highest political circles. At a press conference in 1988, the Social Democratic Minister of Finance and the leader of the powerful confederation of blue-collar workers seemed to agree that thirty years of egalitarian tax policy had come to a dead end. Both men denounced the old tax system as being 'rotten', or 'perverse'. Due to the pervasive nature of tax avoidance, spurred by high marginal tax rates and financial deregulation, high-income individuals escaped their fair share of the tax burden. Two years later tax rates were drastically lowered.

The observation that the study of labor supply may require an integrated analysis of how decisions on tax planning and asset trade affect budget sets is not novel. In an overview of the lessons from the U.S. Tax Reform Act of 1986 (TRA86), Auerbach and Slemrod (1997) conclude that the most responsive decisions were financial and accounting activities that primarily seemed to serve the purpose of affecting reported income, while 'real' activities like labor supply, savings, and investment seemed to respond very little. As a consequence, "…the statutory tax rate is not a reliable measure of how the tax system affects the opportunities of individuals and firms, and the true budget sets reflects not only the apparent relative prices that would prevail in the absence of avoidance, but also how real behavior facilitates avoidance and vice versa" (Auerbach and Slemrod, p. 627).

From empirical observations such as these it is surprising that the labor supply literature abstracts from issues of tax planning and tax arbitrage. The econometric analysis of labor supply typically treats an individual's asset income as exogenous, and determined independently of the supply of hours; see e.g. Hausman (1981), MaCurdy, Green and Paarsch (1990) and Blomquist (1996). The positive analysis of how tax changes affect labor supply implicitly assumes that the effective marginal tax rate changes in tandem with the statutory marginal tax rate. The normative analysis of income taxation following Mirrlees (1971) rests on the assumption that the optimal income tax schedule is some nonlinear function applied to true labor income.

In the following, we examine how tax avoidance in the form of trade in well-functioning asset markets interacts with the basic labor supply model.[2] In the words of Stiglitz (1985), we study mainly those 'paper transactions', which at a negligible social resource cost lead to a reduction in tax liabilities whenever marginal tax rates differ across individuals. Within the simplest model, we show that unlimited trade in perfect asset markets has a number of striking implications. Tax arbitrage will continue until all individuals have the same marginal tax rates and taxable incomes. In the process the gains from tax arbitrage will be concentrated to the tails of the wage distribution, while individuals with average wages might lose out. We also show that it is easy to construct examples where tax arbitrage leads to increased efficiency.

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[2] In this context we should mention two related strands of literature. First, there is the literature on tax evasion, following the seminal work of Allingham and Sandmo (1972). Within this tradition several contributions study how labor supply and evasion decisions interact; see e.g. Sandmo (1981) and Cowell (1990). Second, there is the more recent literature on the theory of labor supply in the presence of a general tax avoidance technology, see Mayshar (1991), Slemrod (1994) and Feldstein (1995). Our analysis differs from the former body of literature in that we focus on legal tax avoidance, and from the latter in that we focus on asset trade and equilibrium asset prices.

When we introduce various – seemingly realistic – limitations on the arbitrage process marginal tax rates and taxable incomes will no longer be the same for all individuals. But the distribution of taxable income will still be more compressed than the wage distribution, and the formal rate of tax progression will still exaggerate the labor supply disincentives of high-wage individuals. A final insight, which appears robust across models, is that a failure to account for tax arbitrage in econometric work on labor supply and in applied work on income distribution may lead to serious problems.

We do not suggest that our analysis is universally applicable. The kind of mechanisms that we examine here seems most relevant in countries with high marginal tax rates, non-uniform capital taxation, and well-developed financial markets. As we discuss in the next section, Sweden seems to fit these conditions quite well – at least before the 1990-91 tax reform. In countries with less developed financial markets, lower marginal tax rates, and/or uniform capital taxation, there is much less scope for tax arbitrage. Even so, the rapid pace of innovation in financial markets seems to suggest that our topic is of more general interest.

2. Labor income versus taxable income: some stylized facts

The general strategy of tax planners is to claim deductible expenses against fully taxable income, and report income in forms granted preferential tax treatment. The incentive for doing so is of course greater in countries with high statutory tax rates. High-income earners can then exploit a number of asset transactions to escape taxation. In Sweden before the 1990-91 tax reform these transactions ranged from sophisticated schemes of transforming corporate source income into low-taxed capital gains, to much simpler operations that exploited the fact that until 1985 net negative asset income was subtracted without limitation from labor income when calculating taxable income. These latter schemes of purchasing low-taxed assets using borrowed money were not constrained by the supply of traditional tax shelters like housing and works of art. Because of the treatment of parents and children as separate tax payers, intra-family debt contracts were used as a tax planning device. Parents in high tax brackets claimed tax deductions while their children with no earned income reported positive interest income. There was also the opportunity to invest, within limits, borrowed money in an untaxed pension plan or tax favored savings account.[3]

People seem to have responded to these incentives. According to the income distribution survey of Statistics Sweden (HINK), which contains data from the tax returns of a representative cross-section of 30,000 individuals, people with high labor income used to be much more heavily indebted than the average individual; see Edin, Englund, and Ekman (1995). Microeconometric studies on data sets from the late 1970s indicate that individuals with high marginal tax rates were much more prone to own tax-favored assets, and to go into debt; see Agell and Edin (1990). According to the revenue statistics, people claimed tax deductions to such an extent that the personal capital income tax caused a substantial aggregate revenue loss.

Malmér and Persson (1994) provide a direct estimate of to what extent people used asset transactions to lower their tax on labor income. In Table 1 we reproduce their results based on the 1980 cross-section of HINK. Each individual in the 20-64 age group is sorted into deciles by reported labor income. Column 1 reports the average labor income (including certain social benefits) in each decile. Column 2

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[3] For further discussion of tax planning techniques in Sweden, see Lindencrona (1993), and Agell, Englund, and Södersten (1998).

shows the tax ('simulated tax') that should have materialized if people's only source of taxable income had been the labor income reported in the first column (allowing for the 1980 tax brackets, basic deductions, etc.). Column 3 shows the tax ('final tax') that materializes when Malmér and Persson also consider the actual taxes on all kinds of taxable asset income. Columns 4 and 5, finally, show the implied average tax rates.

Starting at the bottom row, which shows the figures for the average individual in the sample, we see that the deductions for interest expenses, realized capital losses, and private pension savings exceeded reported asset income. As a consequence, the final tax falls short of the simulated one, and the average tax on labor income is lowered from 38.1 to 33.9 percent. But these tax reductions are very unevenly distributed. While the discrepancy between simulated and final tax rates is modest in the lower deciles, it is huge in the upper ones. Through various capital transactions the average individual in decile 10 lowered the average tax on labor income from 52.6 to 42.1 percent. Even more strikingly, Malmér and Persson report that a third of the individuals in the highest decile managed to reduce the final tax on labor income by more than 25 percent, and that a tenth of them halved the same tax rate.

From figures such as these it is hard to avoid the conclusion that Myrdal was more right than wrong, and that the formal rate of tax progression very much exaggerated the effective one. This interpretation is given further support by a study of Hansson and Norrman (1986), which concludes that the 1982 Swedish income tax can be characterized as *de facto* proportional, and that the personal capital income tax led to a redistribution of income towards high-income households.[4]

[4] Compared to Malmér and Persson, Hansson and Norrman limit the analysis to the 45-55 age group and consider an income concept that includes a monetary measure of the value of leisure time,

Although it is difficult to compare the extent of tax planning across countries, the Swedish experience does not seem to be unique. In their study of income tax avoidance in Germany, Lang, Nöhrbaß, and Stahl (1997) conclude that various legal and semi-legal tax write-off opportunities led to a dramatic reduction of the effective marginal tax rates of high-income households. In their study of tax arbitrage and tax revenue in the U.S. before TRA86, Gordon and Slemrod (1988) conclude that a move to a more uniform system of capital taxation would raise tax revenue and increase efficiency. Unlike the case of Sweden, however, they find that high-income individuals report net positive capital income.

3. The Simple Model

3.1 Labor Supply

As a point of reference, let us first assume that no arbitrage is possible. An individual with a wage rate w, facing a tax schedule $T(w\ell)$, then solves the optimization problem

$$\begin{aligned} &\underset{\ell}{Max} \quad u(c, 1-\ell) \\ &s.t. \quad c = w\ell - T(w\ell) \end{aligned}$$

Assuming that the problem is well-behaved, this gives rise to a labor supply function of the form

$$\ell = \ell(\underline{\tau}, w), \tag{1}$$

where $\underline{\tau}$ is a vector of parameters summarizing various properties of the tax system. This is the standard formulation used in numerous empirical studies of labor supply.[5]

[5] For simplicity, we have disregarded wealth in this model. The inclusion of an exogenous wealth term in the optimization problem is straightforward.

In this literature, many sophisticated techniques have been developed for taking the non-linearities of the tax schedule into account.

If tax arbitrage is possible, things become quite different. Taxpayers can create a wedge between taxable income and labor income in a number of ways. Here, we will consider an economy with two types of assets, tax-exempt and taxable claims. We will assume that no other form of wealth exists, and that the claims are *inside assets*, that is, all individuals can issue both types of claims. This last assumption is of course a strong simplification (we will relax it in section 4), but it serves the useful purpose of illuminating the essence of the problem.

Denote by r the risk-free interest rate on taxable claims, and by ρ the risk-free interest rate on tax-exempt claims. As no individual has any initial wealth, a positive holding of taxable claims must be balanced by a negative holding of tax-exempt claims of the same amount, and vice versa. As a matter of convention, we use X to denote borrowing against taxable claims. In line with a conventional global income tax we assume that the interest expense rX is fully deductible when calculating taxable income. Taxable income B is thus $(w\ell - rX)$, and the tax paid[6] is $T(w\ell - rX)$. Throughout we will assume that the tax schedule is continuously differentiable, that $0 < T'(.) < 1$, and that the tax schedule is progressive in the sense that $T''(.) > 0$.[7] An individual with a wage rate w solves the following optimization problem:

$$\begin{aligned} &\underset{\ell, X}{Max} \quad u(c, 1-\ell) \\ &s.t. \quad c = \rho X - rX + w\ell - T(w\ell - rX). \end{aligned} \tag{2}$$

The first-order conditions are

[6] If the individual invests in taxable claims, -*rX* will be a positive number.
[7] This assumption is of course in stark contrast to the result of Mirrlees (1971) that marginal tax rates should decrease at the highest levels of income. However, what interests us here is not the optimal

$$\frac{u_2(c,1-\ell)}{u_1(c,1-\ell)} = w \cdot (1 - T'(w\ell - rX)), \tag{3}$$

$$\frac{\rho}{r} = 1 - T'(w\ell - rX). \tag{4}$$

Equation (4) is our arbitrage condition, saying that the after-tax interest rate on taxable claims must equal the interest rate on tax-exempt claims. Since all individuals face the same relative asset yield ρ / r in a perfect capital market, equation (4) implies that all individuals will have the same marginal tax rate $T'(w\ell - rX)$. Also, since the marginal tax rate is a monotone function of taxable income, everybody will report the same taxable income:

$$w\ell - rX = T'^{-1}(1 - \rho / r) \equiv B(\rho / r). \tag{5}$$

This is intuitively reasonable. With unlimited tax arbitrage, high-income individuals issue taxable claims and hold tax-exempt claims, while low-income individuals hold taxable claims and issue tax-exempt claims. This process continues until all taxable incomes, and hence all marginal tax rates, are equalized. From an efficiency point of view, we may also note that this implies that

$$\frac{u_2(c,1-\ell)}{u_1(c,1-\ell)} = w\frac{\rho}{r}.$$

In the presence of tax arbitrage, individual marginal rates of substitution between consumption and leisure are proportional to the marginal rate of transformation (i.e., the wage rate). The factor of proportionality is to be regarded as a tax wedge, since ρ and r are unequal.

Combining (3), (4), and the budget constraint in (2) gives us labor supply ℓ and asset demand X (or, rather, the demand for interest deductions rX):

income tax, but rather some implications of the tax structures that have been in place in most countries

$$\ell = \ell(\rho / r, w), \tag{6}$$

$$rX = R(\rho / r, w). \tag{7}$$

Note that the labor supply function (6) does not contain a vector $\underline{\tau}$ like the standard supply function (1) did; in fact, it only contains the two scalars ρ / r and w. With tax arbitrage in a perfect asset market, we thus no longer need to bother about the curvature of the tax schedule. All individuals are now confronted with the same *linear* tax system, with an effective marginal tax rate equal to $1 - \rho / r$. Here, one might of course ask why the government would choose a non-linear tax schedule if arbitrage would automatically make the effective tax schedule linear. The answer is either that the non-linear statutory schedule might be the result of some public choice mechanism that is outside the present model; or that the government, having not (yet) read this paper, incorrectly believes that it can impose a non-linear schedule.

The relative asset yield is determined by invoking equilibrium in the asset market. We assume that all agents have identical preferences and differ only with respect to the wage rate *w* which, assuming a linear production technology, is the individual's marginal and average productivity.[8] In a Miller (1977) equilibrium, with purely inside assets, if follows that

$$\int X \, dF(w) = 0 \quad \Rightarrow \quad r \int X \, dF(w) \equiv \int R(\rho / r, w) \, dF(w) = 0 \,, \tag{8}$$

where $F(w)$ is the cumulative distribution function of wages. This condition determines ρ / r and thereby the effective marginal tax rate in the linearized tax schedule. It follows readily that an individual's labor supply in general equilibrium, ℓ^*, depends not only on her own wage but also on various moments of the overall

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for a long time.

[8] These assumptions are not important; they are made in order to facilitate the exposition only.

wage distribution. Asset trade tends to link the labor supply decision to the wage structure, much in the same way as considerations of envy and interdependent utility can produce demand and supply functions that depend on measures of relative income.[9]

We can obtain some characterizations of the equilibrium. Integrating (5) over all individuals, and using the Miller equilibrium condition (8), yields $B(\rho / r) = \overline{w\ell^*}$, where $\overline{w\ell^*}$ is the average labor income in the economy. Substituting this back into (5), we obtain the individual's demand for tax deductions in general equilibrium:

$$rX^* = w\ell^* - \overline{w\ell^*}. \tag{9}$$

As we should expect, individuals with a higher-than-average labor income have a positive demand for tax deductions, while the opposite holds for those with lower-than-average income. Individuals with average labor income will not participate in the arbitrage process. Also, when the tax system is purely redistributive, and when the government's budget is balanced, there is a simple relation between the curvature of the tax schedule and the relative asset yield. An often adopted measure of the degree of tax progression is the measure of residual tax progression:

$$v(B) \equiv \frac{1 - T'(B)}{1 - \frac{T(B)}{B}}. \tag{10}$$

Our assumptions about the marginal tax rate imply that $0 < v(B) < 1$. In equilibrium everyone has the same taxable income $B = \overline{w\ell^*}$. With a purely redistributive tax system and a balanced budget, it follows that $T(B) = T(\overline{w\ell^*}) = 0$. Thus, $v(\overline{w\ell^*}) = 1 - T'(\overline{w\ell^*})$, and by (4)

[9] See e.g. Persson (1995) and the references cited therein.

$$v(\overline{w\ell^*}) = \frac{\rho}{r}.$$

In equilibrium the relative asset yield equals the degree of tax progression of the formal bracket schedule.

A logarithmic example. So far our analysis is fairly general. It turns out, however, that we can obtain surprisingly simple closed-form solutions for a particular parameterization of the model, namely a logarithmic utility function of the form

$$u(c, 1-\ell) = \ln c + \alpha \ln(1-\ell).$$

We also assume that the tax system is characterized by constant residual progression in the sense that v in (10) is a constant. As shown by Jakobsson (1976), this means that disposable income out of a taxable income B is an exponential function of B:

$$B - T(B) = \beta B^{v}, \tag{11}$$

Here, $0<v<1$, and a lower value of v means a higher degree of progressivity, in the sense of disposable income being a more concave function of taxable income. For a given v, we use the parameter β to ensure a balanced budget, and for simplicity, we only deal with a purely redistributive tax system. One can easily show that within our tax arbitrage model, where everybody has the same taxable income, this implies

$$T(B) = 0 \quad \Leftrightarrow \quad \beta = B^{1-v}. \tag{12}$$

In an economy without arbitrage we get the labor supply function

$$\ell = \frac{v}{v+\alpha}. \tag{13}$$

This corresponds to the supply function of the standard model (1), and it exhibits the well-known property that with logarithmic preferences and no initial wealth, labor supply is independent of the wage rate w.

In the arbitrage-economy, individual labor supply becomes

$$\ell = \frac{1}{1+\alpha}\left[1-\frac{\alpha}{w}\left(\frac{1-v}{v}\right)\left(\frac{\rho}{r}\cdot\frac{1}{\beta v}\right)^{1/(v-1)}\right] \tag{14}$$

in partial equilibrium. We see that in an arbitrage-economy, modeling labor supply as (13) gives an incorrect functional form for the labor supply function. Using the general equilibrium condition (8), we can also solve for endogenous taxable income $B(\rho / r)$:

$$B = \frac{v}{v+\alpha}\cdot \overline{w},$$

where $\overline{w}$ is the average wage rate, and where we have used the fact that $\rho / r = v$. Substituting this into the partial equilibrium supply function (14), and using (12), gives us labor supply ℓ^* in general equilibrium:

$$\ell^* = \frac{1}{1+\alpha}\left(1-\alpha\frac{1-v}{v+\alpha}\cdot\frac{\overline{w}}{w}\right). \tag{15}$$

Now, labor supply does depend on the wage rate even with logarithmic preferences and no other wealth. Thus in the arbitrage-economy the response to changes in *v* will be different for different individuals. Comparing labor supply in the arbitrage and no-arbitrage economies, it follows that tax arbitrage leads to lower labor supply for less able individuals ($\overline{w}/w > 1$), and to higher labor supply for the relatively able ones.

3.2 Efficiency and tax incidence

The introduction of tax arbitrage could be the result of a conscious policy decision by the government, like deregulating the capital market, or making certain transactions legal that were not permitted under the earlier legislation. Or it could be the result of technological developments in financial markets that make various kinds of asset trade possible at a reasonably low transaction cost. In either case, it is interesting to know who would gain and who would lose from the introduction of tax arbitrage.

Let us first consider a regime where no tax arbitrage is possible. The indirect utility of an individual with a wage rate w, i.e., the utility resulting from labor supply (1) and its corresponding consumption, is denoted by $V(w)$. Similarly, the indirect utility of the same individual under a regime where tax arbitrage is possible (i.e., the utility resulting from labor supply ℓ^* and its corresponding consumption) is denoted by $V_A(w)$, where the subscript stands for ”arbitrage”. The change in utility from introducing arbitrage is thus $\Delta \equiv V_A(w) - V(w)$.

Assume now that the tax schedule is the same for the two cases (this assumption will be relaxed shortly). Then the introduction of tax arbitrage can make nobody worse off, as everybody can abstain from engaging in asset trade and supply exactly the same amount of labor as before. If someone nevertheless would choose to engage in asset trade, it would be only because this would yield higher utility. The change in relative price between consumption and leisure, being earlier equal to $w(1-T'(w\ell))$, and being now equal to $w\rho / r$, would be greatest for people at the tails of the wage distribution. Thus these people would have the strongest incentives to trade with each other, high-income earners issuing taxable claims and purchasing tax-exempt ones, and low-income earners doing the converse. People with average income $\overline{w\ell}$ would however have nobody to trade with, and no incentive to do so. Thus they would supply the same amount of labor as before, and set $X = 0$.

The utility gain from introducing tax arbitrage would therefore be greatest at the tails of the wage distribution[10], and zero at the mean, as is illustrated by the solid curve in Figure 1. Note, however, that this reasoning is based on the assumption of an unchanged tax schedule. This is obviously unrealistic. Since the very purpose of tax arbitrage is to reduce taxes, it is reasonable to assume that the introduction of arbitrage would lead to a government budget deficit. In order to maintain budget balance, the government would thus have to raise taxes.[11] Thus the average individual would not be unharmed by the introduction of tax arbitrage. Even if she does not engage in asset trade, she would be harmed by the tax increase and thus suffer a fall in utility. The distribution of Δ over income groups would therefore look like the dashed curve in Figure 1, showing a utility loss in the middle of the income distribution.

(Figure 1)

On the other hand, we can not rule out that the introduction of tax arbitrage leads to a budget *surplus* rather than a deficit. This would happen if the reduction of marginal tax rates for people with high wage rates leads to such a large increase in the labor supply among those people that it outweighs the fall in labor supply among those with low wage rates.[12] Then the tax base would increase, and the government could reduce taxes. Thus the average individual would gain from the introduction of tax arbitrage, as would everybody else. The distribution of utility gains would then look like the dotted curve in Figure 1.

[10] Other papers suggesting tax arbitrage might benefit individuals at the outer ends of the income distribution include Gordon and Slemrod (1988), and Agell and Persson (1990).

[11] For the special case of the constant-progressivity tax schedule (11), this means reducing β.

How likely are these different cases? This is of course an empirical question. In any case, it can be shown that for the particular parameterization employed above (logarithmic preferences, a constant-progressivity tax schedule), the introduction of tax arbitrage will always necessitate a tax increase. Thus, if the distribution $F(w)$ is continuous, the people in the middle of the distribution will always lose. This presumes, however, that the ability distribution is continuous, and that an average worker exists. What happens if this is not the case? Clearly, removal of people who do not exploit the scope for tax arbitrage, but pay additional taxes, increases the probability that there will be only winners from the introduction of tax arbitrage.

Consider an economy with two equally sized groups of workers, low-ability workers with a wage rate $w_L \equiv 1-k$ and high-ability workers with a wage rate $w_H \equiv 1+k$. Solving the model for this setup, and for logarithmic preferences and a constant *v*, we can compute the utility gains Δ_L and Δ_H for low- and high-income earners from going from a regime with no tax arbitrage to a regime where arbitrage is possible. The results for the case of $\alpha = 1$ in (*v*, *k*) space is shown in Figure 2.

(Figure 2)

We see, first, that one has to take the non-negativity constraint on labor supply seriously. By (15), ℓ^* can be negative for small values of *w*. We have therefore simply assumed that the parameters are such that labor supply will be positive, the parameter configurations in the (*v*, *k*) space not satisfying this being in the upper left part of

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[12] For the sake of argument we assume that the substitution effect dominates the income effect so that a reduction in the marginal tax rate leads to an increased labor supply. This is of course not self-evident; for the opposite case a similar type of reasoning can be applied.

Figure 2. For other, admissible, parameter configurations, we see that it is easy to find cases where both high- and low-income earners would gain from the introduction of tax arbitrage, i.e., where both Δ_H and Δ_L are positive.

Finally, a word of caution is warranted. In this model, we have assumed that tax arbitrage is costless, and it is therefore hardly surprising that one can find cases where the introduction of such arbitrage is welfare-enhancing in the sense of Pareto. In practice, there are real resource costs associated with most tax avoidance schemes, ranging from transactions costs and legal fees to costs associated with an inefficient allocation of risk, consumption, and productive capital. For example, since much tax avoidance activities involve real estate, an important cost probably consists of an oversized housing sector, and the possibility that the introduction of tax arbitrage leads to a Pareto improvement then becomes correspondingly smaller.

4. Introducing limitations on the arbitrage process

In the preceding section, we have seen how a simple arbitrage technology will lead to labor supply responses that are quite different from the ones commonly analyzed in the literature. The most striking implication is that unlimited arbitrage will lead to a complete equalization of taxable incomes, and of the effective marginal tax rates on labor income. Although data for some countries indicate that tax avoidance leads to a substantial compression of the distribution of taxable income relative to the distribution of labor income, incomes are of course not completely equalized – a fact that suggests that there are limits to the arbitrage process. Obvious explanations are that imperfections in the capital market make it difficult to completely avoid taxation, or that the government is efficient in closing the loopholes that open up for arbitrage in the first place.[13] In this section we will explore two ways of incorporating such considerations in the analysis, limitations on short sales, and tax arbitrage in an asset that yields a direct utility service. We discuss some implications for applied work on labor supply and income distribution in section 5.

4.1 Outside assets and constraints on short sales

As in the previous section, we model a situation when the only reason for asset trade is the desire to avoid taxation when marginal tax rates differ across individuals. But we now assume that the tax exempt asset is an outside asset in fixed total supply, and that this asset (which we for simplicity refer to as land) can not be sold short. We assume that land is productive, in the sense that each land unit produces ρ units of the consumption good.[14] The introduction of land means that there is an additional layer of heterogeneity in the model. Each individual is now identified by the vector $(w, \overline{X})$, where $\overline{X}$ is the initial land endowment.

Asset trade proceeds as follows. At the beginning of the period, individuals exchange land endowments for taxable consumption loans. This exchange takes place at the per unit land price P. For any individual the proceeds from sales/purchases of land can then be written as $P(X - \overline{X})$, where X is the holding of land at the end of the period, when production occurs. Due to the restriction on short sales, $X \geq 0$. As there can be no net savings in our one-period model, any change in an individual's land value is matched by a corresponding transaction of the opposite sign in the taxable

[13] For a general discussion of how capital market imperfections and government regulations affect the scope for tax arbitrage, see Stiglitz (1983).

[14] We thus maintain the notion of a two-good economy, where individuals derive utility from consumption and leisure. Also, we assume that the production function for the consumption good is linear in its two arguments, labor and land, which implies that the marginal product of each factor is independent of the other factor.

asset. Specifically, an individual who spends a positive amount $P(X-\overline{X})$ on land increases tax deductible debt with the same amount. As before, *r* is the interest rate on the taxable asset.

The individual maximizes

$$\underset{\ell,\,X}{Max} \quad u(c, 1-\ell)$$

$$s.t. \quad c = \rho X - \tilde{r}(X-\overline{X}) + w\ell - T(w\ell - \tilde{r}(X-\overline{X})) \tag{16}$$

$$X \geq 0$$

where $\tilde{r} \equiv rP$. The first-order conditions become

$$\frac{u_2(c,1-\ell)}{u_1(c,1-\ell)} = w(1-T'(w\ell - \tilde{r}(X-\overline{X})) \tag{17}$$

$$\rho - \tilde{r}(1-T'(w\ell - \tilde{r}(X-\overline{X})) \leq 0 \qquad\qquad = 0 \quad if \quad X > 0 \tag{18}$$

The complementary slackness condition (18) has important implications for the shape of the labor supply function. Individuals who face a binding quantity constraint in the credit market react to different labor supply incentives than individuals who are at an interior portfolio optimum. Consider first the case of an interior solution, when (18) holds as an equality. For individuals for which $X > 0$, tax arbitrage is driven to the point where the after-tax return on the taxable asset equals ρ. For these workers, the constraint on short sales is not an issue, and labor supply is determined in a way that parallels our previous analysis. The relevant marginal tax rate is the yield ratio $\rho/\tilde{r}$, the same for everyone. It is easy to show that the behavioral functions take the form

$$\ell = \ell(\rho/\tilde{r}, w, \tilde{r}\overline{X}) \tag{19}$$

$$\tilde{r}X = X(\rho/\tilde{r}, w, \tilde{r}\overline{X}), \tag{20}$$

i.e., the tax system is linearized. Compared with the analysis in section 3, the only novelty is that (19) and (20) include a wealth effect from the initial land endowment.

To derive the labor supply function for workers who are at a corner solution, we simply set $X = 0$ in (17). We then have

$$\ell = \ell(\underline{\tau}, w, \tilde{r}\overline{X}), \tag{21}$$

The labor supply functions of individuals who are at a corner solution will be of the same format as those materializing from the standard labor supply model in the presence of a nonlinear tax system, and with an exogenous income from wealth, $\tilde{r}\overline{X}$. In particular, the labor supply function will depend on a vector of parameters, $\underline{\tau}$, describing global properties of the tax system. Although individuals at corners engage in intra-marginal asset trade, what matters for the form of the labor supply function is the extent of tax arbitrage on the margin.

To characterize the determination of equilibrium asset prices we need to derive the selection criterion that allocates individuals between the arbitrage and no-arbitrage regimes. Consider an individual for whom the non-negativity constraint is binding. For this individual we can write (18) as

$$\frac{\rho}{\tilde{r}} - 1 + T'\left(w\ell(\underline{\tau}, w, \tilde{r}\overline{X}) + \tilde{r}\overline{X}\right) \equiv \phi(\underline{\tau}, w, \tilde{r}\overline{X}, \rho / \tilde{r}) < 0.$$

In the limit the equation $\phi(\underline{\tau}, w, \tilde{r}\overline{X}, \rho / \tilde{r}) = 0$ then gives us the surface in $(w, \overline{X})$ space that separates those who are at an interior optimum from those who are at a corner solution. For the particular case of a logarithmic utility function and a tax system with constant residual tax progression, analyzed in the previous section, the separating surface can be given a nice intuitive interpretation. After straightforward but tedious manipulations, one can show that the separating hyperplane can be written as

$$w + \tilde{r}\overline{X} = \frac{v+\alpha}{v}\left(\frac{\rho}{\tilde{r}} \cdot \frac{1}{\beta v}\right)^{\frac{1}{v-1}}. \tag{22}$$

Everybody with a full income $w + \tilde{r}\overline{X}$ less than the right-hand side of (22) will be in a constrained optimum, while everybody with a full income that is greater than or equal to the right-hand side will be in an unconstrained optimum. Inherently poor individuals will face a binding credit constraint and a nonlinear tax system, and they will supply labor according to (21). Inherently rich individuals will face a perfect capital market and a linearized tax system, and they will supply labor according to (19).

We can now integrate (20) over all unconstrained individuals to obtain aggregate land demand. In equilibrium, this has to be equal to the total quantity of land available (which we for simplicity set equal to unity):

$$\int_{\phi(.)\geq 0} X(\rho / \tilde{r}, w, \tilde{r}\overline{X})dF(w, \overline{X}) = \tilde{r} \cdot 1, \tag{23}$$

where $F(w, \overline{X})$ now is a joint cumulative distribution function. Equation (23) gives a solution for the endogenous variable $\tilde{r}$, or rather for the price of land, since $\tilde{r} \equiv rP$.

To sum up, when we assume that the tax-exempt asset is not an *inside* asset, but an *outside* one which can be held in positive amounts only, some of the more striking predictions from the simple model in section 3 disappear. Taxable incomes and effective marginal tax rates will now be the same only for that segment of the population which is at an interior portfolio optimum – an affluent subgroup consisting of those with high wages and/or large land endowments. Less affluent individuals do not hold the tax-exempt asset, and their taxable incomes vary across individuals.

Another observation is that constraints on short sales make it less likely that the introduction of tax arbitrage (via a policy decision, or as the consequence of technological innovation in financial markets) produces utility gains at both tails of the wage distribution. Although high-wage and low-wage individuals have strong incentives to engage in asset trade, the quantity constraint prevents low-wage individuals from going short in the tax-exempt asset. As a consequence, only high-wage individuals can reap the full reward from tax arbitrage. Finally, and very much in line with the analysis of the preceding section, we can not rule out the possibility that the introduction of tax arbitrage leads to such a boost to the labor supply of high-wage individuals, that the government could lower taxes. When the income tax distorts the labor supply decision of high-ability individuals to a great extent, everyone may thus benefit from the introduction of tax arbitrage.

4.2 When the tax-exempt asset is an argument in the utility function

In this subsection we will briefly discuss another permutation, which will turn out to have an interesting connection to the simple model of Section 3. Assume that the outside asset *X* appears as an argument in the utility function. Formally, this means that we reformulate (16), with *X* as an argument in the utility function, and with $\rho = 0$:

$$\begin{aligned} &\underset{\ell, X}{Max} \quad u(c, 1-\ell, X) \\ &s.t. \quad c = w\ell - \tilde{r}(X - \overline{X}) - T(w\ell - \tilde{r}(X - \overline{X})) \end{aligned} \tag{24}$$

where *X* is now an ordinary consumption good. In practice, we may think of *X* as housing, or some consumer durable. This model gives a representation of how housing appears in the labor supply decision of an individual in an economy with full interest deductibility; model (16) above has a closer resemblance to a world where *X* is raw land (which gives a constant yield of the consumption good, but which does not appear in the utility function). Working out the first-order conditions gives us solutions for the supply of labor, $\ell(\underline{\tau}, w, \tilde{r}, \overline{X})$, and for the demand for housing, $X(\underline{\tau}, w, \tilde{r}, \overline{X})$. These solutions will differ from those in section 3 in the sense that both first-order conditions of (24) will involve marginal utilities. Several implications follow.

First, since marginal utilities are different for different individuals, there will be no equalization of taxable incomes. But for standard utility functions high-wage individuals will consume more housing than they would have done if interest expenses had not been tax deductible. Thus the distribution of taxable income will be compressed relative to the wage distribution.

Second, consider an econometrician who ignores the fact that there are two consumption goods (*c* and *X*), and incorrectly specifies the model as

$$\begin{aligned} &\underset{\ell}{Max} \quad u(c, 1-\ell) \\ &s.t. \quad c = w\ell - \tilde{r}(X - \overline{X}) - T(w\ell - \tilde{r}(X - \overline{X})), \end{aligned}$$

where $\tilde{r}(X - \overline{X})$ is regarded as exogenously given non-labor income. Clearly, the implied labor supply function $\ell(\underline{\tau}, w, \tilde{r}(X - \overline{X}))$ will be mis-specified, too. The problems associated with this are not really due to the econometrician's neglect of tax arbitrage *per se*, but rather to neglecting the fact that there are two consumption goods instead of one. The implications for the econometrics of labor supply of introducing a tax deductible good in the utility function is discussed by Triest (1992).

Third, assume that the government chooses between a system where interest on housing is deductible from taxable income (as in (24)), and a system without deductions (i.e. the budget constraint reads $c = w\ell - \tilde{r}(X - \overline{X}) - T(w\ell)$). Which system is preferable from a welfare point of view?[15] Interest deductions stimulates the housing consumption of high-income earners, which makes the allocation of housing consumption more uneven across income groups than it would otherwise have been. This could imply a welfare loss – but a loss that could be outweighed by an efficiency gain from lower marginal tax rates on the labor income of high-wage individuals. Thus, the common view that tax arbitrage is costly for society is not necessarily correct; depending on the curvature of the tax function, and on the form of the utility function, it could actually be welfare-enhancing. This was true in our simple model of costless paper transactions in section 3, but even in the present model, where deductions lead to a distorted consumption pattern, we can not rule out that arbitrage creates an efficiency gain. Whether this is the case in reality is of course an open question.

Finally, we have assumed that everyone consumes the same type of housing. In reality, people also make a tenure choice decision: low-income earners tend to consume rental housing, while high-income earners tend to live in their own houses. This suggests an arbitrage mechanism reminiscent of the simple model of section 3. In that model, low-income earners issue tax-exempt claims and hold taxable ones, while high-income earners hold tax-exempt claims and issue taxable ones. In a housing market with tenure choice, a typical low-income earner pays a non-deductible rent to a landlord and has some taxable savings in the bank. The typical landlord is a high-income earner who has borrowed (tax-deductible) money from the bank in order to buy an apartment house, the income of which is in general favorably taxed. The

[15] Note that this question is different from that of Feldstein (1995). In a similar model, he asks the following question. Assume that we have full deductibility, like in (24), and that the tax rate is changed. How much does individual welfare change, and how should one properly estimate that change in welfare?

payment streams are thus very similar: in both cases, low-income earners pay non-deductible and non-taxable (or lightly taxed) money to high-income earners, while high-income earners pay tax-deductible and taxable money to low-income earners.

5. Implications for empirical research

The analysis of the previous sections suggests that there are few general results on the incidence and efficiency effects of tax arbitrage. The answers to questions such as "Who gains and who loses from introducing tax arbitrage?", and "Does tax arbitrage lead to a Pareto improvement?", depend on the exact specification of the model. However, more robust insights appear to emerge when we turn to the implications of tax arbitrage and asset trade for empirical research. All our models – irrespective of their precise assumptions – seem to suggest that empirical studies that fail to account for tax arbitrage may come up with estimates that are seriously biased. Let us see why.

5.1 Econometrics of labor supply

In one form or another, the static labor supply function (1) – extended to include a measure of exogenous "non-labor income" – has been at the center of attraction in a large number of microeconometric studies that try to estimate how labor supply reacts to changes in economic incentives. Much of this literature has been preoccupied with the design of econometric techniques capable of dealing with nonlinear tax systems. In this process, the typical individual is modeled as maximizing utility with respect to work hours, subject to a nonlinear budget constraint that treats reported capital income as a given constant. This procedure creates a number of methodological problems.

First, as suggested by our model of constraints on short sales in section 4.1, there is the issue of self-selectivity. Based on initial asset endowments and productivity in the labor market, individuals choose between two labor supply functions. For arbitrageurs, the formal bracket schedule provides no information about marginal work incentives, and some equation like (6), or (19), applies. For individuals who face a binding constraint in the asset market, the formal bracket schedule conveys all the information that is needed about marginal work incentives, and equation (21) applies. Econometric studies that build on the assumption that the labor supply function looks the same for all individuals will come up with biased estimates.

Second, the standard procedure in the literature is to trace out individuals' budget sets by changing the supply of hours, holding capital income constant. However, in the presence of tax arbitrage it is inappropriate to treat (reported) capital income as an exogenous variable in the regression. In our models, individuals' asset transactions are an integral part of the labor supply decision, and the position and slope of individuals' budget sets depend on the simultaneous determination of hours and portfolio composition.

Third, there is the issue of measurement error in net capital income. The prime evidence about labor supply in Sweden, and in many other countries, stems from studies that rely on data from individuals' tax returns. But the essence of tax arbitrage is that people invest their wealth in ways that are imperfectly measured or registered by the tax authorities. The resulting error in the measurement of net capital income will typically be correlated with the gross wage. The income tax returns of high-wage individuals will to a much greater extent than the income tax returns of low-wage individuals understate true capital income. As a consequence, there will be a downward bias in the estimate of the gross wage coefficient. What the econometrician interprets as evidence of a backward bending labor supply function may simply reflect the influence of unobservable asset income.

Of course, the severity of these problems differ quite a lot across countries, and between different time periods. In a situation with binding credit constraints, and low tax rates, it might be quite innocent to ignore the implications of tax arbitrage. Also, the problems may not be equally severe for all subgroups in the labor market. The econometric issues that we raise are likely to be of particular importance for the study of the labor supply decisions of the affluent. These individuals have much to gain from lowering their taxable income, and there is reason to believe that they have easier access to the credit market than other people. [16]

5.2 Income redistribution in the welfare state

A final observation is that our analysis casts strong doubt on the common use of tax return data in applied work on income distribution. According to several studies Sweden ranks, together with some other high-tax countries, as one of the most egalitarian countries in the western industrialized world (see e.g. Gottschalk and Smeeding (1997)). The Gini coefficient for reported disposable income is much smaller in Sweden than in the USA, a finding that often is attributed to the equalizing impact of progressive income taxes and transfers. But for reasons discussed in section 5.1, the reliability of tax return data as an indicator of true economic income is likely to be a decreasing function of the tax rate. We would expect disposable income of the affluent, computed from the income tax returns, to underestimate actual disposable income. Because Swedish high-income earners are confronted with much higher tax rates than their U.S. counterparts, this bias is likely to be larger in the Swedish than in the U.S. data, thereby creating an impression of a much higher degree of equality in Sweden.

6. Concluding remarks

Our analysis rests on a number of strong assumptions. The analysis in section 3 relies on the existence of a perfect asset market, and the analysis of capital market imperfections in section 4 is specific rather than general. There are other ways of introducing assumptions that soften the stark prediction of equal taxable income, the most obvious one being perhaps to introduce uncertainty and risk aversion, which induces individuals not to exploit possible tax arbitrage technologies to a full extent. Also, all our models are single-period ones, and they do not account for the fact that there is an intertemporal dimension to many tax arbitrage strategies (think of the postponed taxation associated with pension plans). Developing models that explore the implications of such alternative mechanisms certainly seem like a worthwhile exercise.

We believe that research on how tax arbitrage interacts with labor supply decisions may shed light on a number of important questions concerning modern systems of income taxation. *First*, what makes people work, given the very high marginal tax rates that can be observed for some countries during some periods? The traditional answer has been that labor supply is rather inelastic. Our proposed answer is different. With the tax avoidance technologies that became increasingly available during the 1980s, those who care about incentives need not pay those high tax rates.

[16] For a recent analysis of the labor supply decisions of the affluent, see Moffitt and Wilhelm (1998).

Second, how come so many countries turned their tax systems into simple, linear ones during the 1980s and 1990s? Our suggested answer is that during this period, credit markets became increasingly well-functioning. Thus the effective tax schedules became more linear, and the reforms that were undertaken can be seen as a simple recognition of this fact.[17]

Third, are sophisticated non-linear optimal tax schedules in the spirit of Mirrlees (1971) really relevant? In the presence of tax arbitrage such second-best tax schedules are not attainable. Regardless of the ambitions underlying the official, non-linear schedule, the effective tax schedule tends to be linearized. [18] A benevolent government may thus have to settle for a third-best solution, which involves finding an optimal linear, or piece-wise linear, income tax.

Fourth, models that allow for tax arbitrage and asset trade have important implications for the econometric analysis of labor supply, and for applied work on income distribution. Studies that ignore the effect of tax arbitrage and asset trade on labor supply incentives will come up with biased estimates of important elasticities, and international comparisons of income inequality will exaggerate the redistributive achievements of high-tax countries like Sweden.

Fifth, how does tax avoidance affect estimates of the deadweight burden of the income tax? Feldstein (1995) argues that models that account for tax avoidance will produce calculations of excess burdens that are many times larger than those implied by standard Harberger-calculations. A contrary view, from the perspective of a high-tax country, is that tax avoidance may be seen "…as a means of blowing off some

[17] For some interesting discussion and analysis of the reasons for tax reforms in the Nordic countries, see Sørensen (1994) and Nielsen and Sørensen (1997).

[18] For an analysis of how storage and repeat shopping by consumers affect the scope for implementing nonlinear pricing and taxation schemes for goods other than labor supply, see Munro (1998).

steam in order to save the engine from exploding" (Lindencrona (1993), p. 166). Our analysis shows that it is indeed easy to develop examples where asset trade reduces the efficiency cost of income taxation. In the end, whether tax avoidance leads to smaller or greater excess burdens is an empirical question, that depends on country-specifics, like the structure of the tax system, the type of available arbitrage technologies, etc.

Sixth, from a public choice perspective tax arbitrage and a highly progressive tax system can be viewed as an ingenious way of reconciling incompatible political ambitions. High marginal tax rates convey the message that politicians care about the less well off, while a generous attitude towards tax avoidance prevents the very same tax system from destroying the incentives of the rich and the highly educated. The political economy of tax design seems like an important research topic for the future.

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Table 1. Average labor income and tax payments by labor income decile in 1980 (figures are in 1980 kronor)

Labor income group	Labor income	Simulated tax on labor income	Final tax, allowing for all taxes on personal capital income	Tax in percent of labor income	
				Simulated	Final
1	2936	362	561	12.1	18.8
2	22725	5971	5937	25.8	25.6
3	36104	10378	10052	28.2	27.4
4	46827	14643	14015	30.7	29.3
5	56335	18389	17596	31.9	30.6
6	62554	21100	20038	33.0	31.3
7	68744	24540	22906	34.5	32.2
8	74901	28213	25656	36.3	33.0
9	85518	35531	31265	39.8	35.0
10	130579	71599	57361	52.6	42.1
Total	58722	23078	20543	38.1	33.9

Source: Malmér and Persson (1994), and the 1980 income distribution survey of Statistics Sweden.

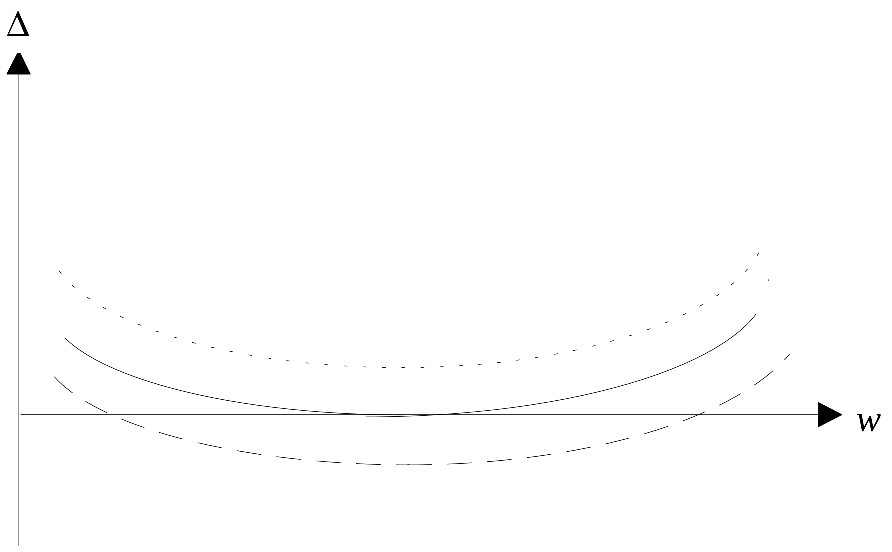

Figure 1

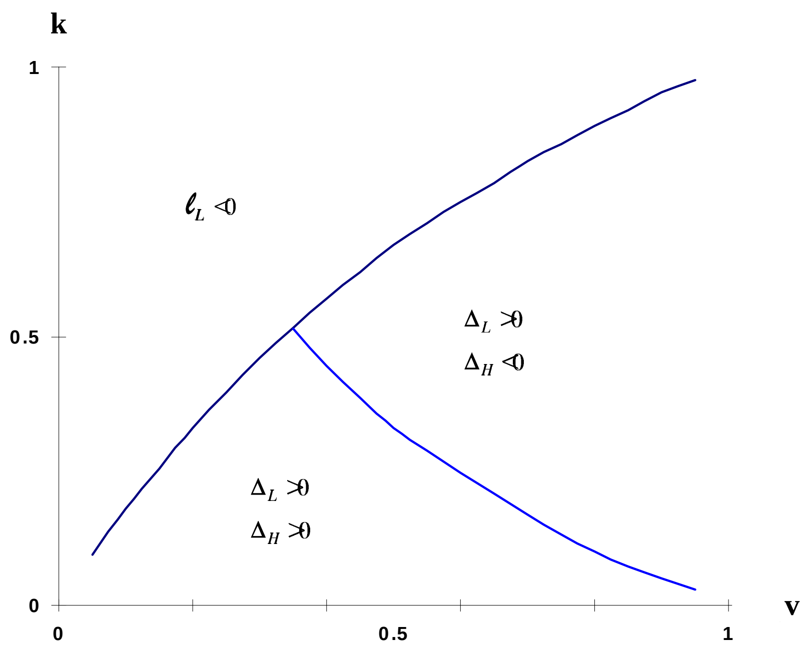

Figure 2

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