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Abstract

The suggestion to tax people on earnings capacity instead of earnings has been around for a long time and is attractive in terms of economic efficiency. In this paper we reflect on the feasibility of such a system and give an exploratory empirical implementation. We apply the Leyden Welfare Function of Income, a survey based measure of an individual's welfare associated with income, to derive implications for ability taxation. Under the assumption that IQ and schooling reflect earnings capacity, we derive the tax functions using different criteria to distribute the utility loss due to taxation. © 1999 Elsevier Science S.A. All rights reserved.

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It would be wise to devise taxes complementary to the income tax, designed to avoid the difficulties that tax is faced with . . . Such a tax would not be fully practicable, but we have other means of estimating a man's skill-level-such as the notorious IQ test: high values of skill-indexes may be sought

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after so much for prestige that they would not often be misrepresented. With any such method of taxation, the risks of evasion are, of course, quite great: but if it is true, as our results suggest, that the income tax is not a very satisfactory alternative, this objection must be weighed against the great desirability of finding some effective method of offsetting the unmerited favours that some of us receive from our genes and family advantages. (Mirrlees, 1971, p. 208).

1. Introduction

It is widely believed that income taxes in developed countries have large distortionary effects. About a decade ago, several studies were published that found high excess burdens for the United States and other countries, like Sweden and the Netherlands (Stuart, 1981; Browning and Johnson, 1984; Hausman and Ruud, 1984; Stuart, 1984; Browning, 1987; Van Ravestijn and Vijlbrief, 1988; Hartog, 1989). Since that time many countries have implemented tax reform and reduced marginal tax rates, but even so, in many countries deadweight welfare losses must have remained at high levels.

The welfare loss emerges because of the large efforts that are made to avoid paying taxes, by adjusting behavior. Part of the adjustment is in the realm of perfectly legal behavior, another part is the shift of activities into the grey and black zones of semi-legal or outright illegal activities, like tax (and social premium) fraud. The subterranean economy has absorbed a large share of the legal economy. For several countries, estimates of up to 10% of national income have been given (Gutmann, 1977; Van Eck and Kazemier, 1989). And on top of that there are substantial transaction costs: an army of tax inspectors, tax advisors, tax lawyers, all engaged in extensive debate on properly assessing the individual's income level.

Guidance on the structure and graduation of taxes has always been a prime topic of economics. Right from the beginning, a fair distribution of the burden was a stated goal: ''the subjects of every state ought to contribute to the support of the government as nearly as possible in proportion to their respective abilities'', according to Adam Smith. In the late nineteenth century, the discussion started on the proper graduation of the income tax. Should the tax be proportional, or should it be increasing for higher income levels? Taking individual income as given, tax rates were derived from applying John Stuart Mill's principle of equality of sacrifice to the welfare derived from the income (Mill, 1965). The norm was differentiated into equal *absolute*, equal *proportional* and equal *marginal* sacrifice. Of course, each norm has a different implication for income tax rates. However, the intuitive proposition that under diminishing marginal utility of income,

proportional sacrifice would imply progressive income taxes was proven false by Cohen Stuart, 1889.[1]

The modern literature does not start out from given individual incomes. Taking into consideration the efforts needed to generate the income, neoclassical theory points out that efficiency losses can only be prevented by lump sum taxation. Only individually differentiated lump sum taxation would allow costless attainment of desirable equity goals. In an ideal system of taxation, the lump sum tax would be related to individual earnings capacity. Tinbergen's calculation of an optimal income tax (Tinbergen, 1975 chapter 7) and his proposal of a ''tax on talent'' (Tinbergen, 1970a) follow this argument. However, the first-best optimum can only be implemented if the government knows enough about individuals to determine their lump sums. The new literature on optimal taxation that has emerged in the wake of Mirrlees' seminal contribution (Mirrlees, 1971) indeed starts out from the information problem. Mirrlees derives optimum conditions for a non-linear income tax schedule in a model where individuals with different labour skills maximize a utility function in consumption and leisure, and where the government can observe earnings but not skills. So far, the practical implications for tax policy are quite limited. The key parameter of interest is the marginal income tax rate, but the analyses generate no firm prescriptions on whether it should decrease, be constant or increase. As Diamond has recently shown, acceptable cases can be constructed for each of these results (Diamond, 1996). Neither has the literature determined a meaningful range over which it should vary, other than between 0 and 100%. Research along these lines is intellectually exciting but seems still far from settling the location of the compromise between equity and efficiency.[2]

In this paper we present some work that steps in the tradition preceding the information revolution in economic theory. We link individual incomes to individual earnings capacities. From the first-best literature we know that equity could be served without deadweight welfare loss if we were to set individuals' tax liability in relation to their ability or earnings capacity. This is exactly what we do next. We derive Tinbergen's tax on talent from a welfare function that has demonstrated its empirical strength in extensive research, the Leyden Welfare Function of Income. The advantage over other approaches is the fact that individual welfare has been directly measured, rather than postulated or inferred from observed consumption-leisure choices. We apply four different ''sacrifice

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[1] A necessary and sufficient condition for progression (under proportional sacrifice) is a utility function with relative marginal utility decreasing in income. See Cohen Stuart (1889) or Keller and Hartog (1977). For an historic overview of the discussion on sacrifice norms, see Blum and Kalven (1953).

[2] For example, the rule proposed by Piketty (1993), of a tax schedule that not only depends on an individual's income, but also on the distribution of income in society, is interesting but does not seem a ready candidate for implementation.

rules'' and calculate the associated ability taxes. The relevance of this has not been affected by the information revolution, since that revolution has not yet yielded improved recipes for a desirable tax structure.

   By taking this route we face difficult problems. The first problem is how to define and measure those abilities.[3] We assume that ability is multi-dimensional. The dimensions we would propose in the first place are the following candidates

- physical health
- cognitive intelligence as measured by IQ
- social/emotional intelligence
- gender

All these variables can be measured in a more or less satisfactory way. And what is important, they are measured in practice in any western country for the great majority of children. There are two problems with those measures. First, they are subject to measurement error and vary during the development of the child. This can be repaired by repeated measurement over the childhood period, say from 6 to 14. A second objection which might be raised is that parents would strongly persuade their children to *underperform* on those dimensions to prevent high tax liabilities: ''If we tax able men more than dunderheads, we open the door to all forms of falsification: we make stupidity seem profitable-and any man can make himself seem stupid'' (De Villiers Graaff, quoted in Atkinson and Stiglitz, 1980, p. 357). This objection is not devastating. As Mirrlees (1971) noted, the prestige effect may give a counter incentive. The same holds if desirable outcomes are linked to the test performance, such as school admission. In fact, as long as there will be systematic variation in the performance (i.e. not every candidate will willingly score all zero's), we can model behavior and infer true ability from measured scores.[4] Also all (normal) parents will realize that underperformance would be damaging for the children's career and the accumulation of their human capital. We include gender because the earnings ability of females is reduced by the possibility of pregnancy and the obligations of motherhood (although this depends on facilities for child care, etcetera). It is also reflected in the differences in lifetime income between males and females. In our application we will also use schooling as an indicator of ability. This is only valid to the extent that realized schooling levels are determined by ability alone without interference from preferences on effort. In other words, everyone should (have) put in a maximum

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[3]Griliches (1977) points to the restrictive nature of ability measures; according to him ability is something like a ''thing with feathers'' (a Woody Allen quote).

[4]Psychologists acknowledge that people may show misleading behavior strategically. They have come up with tests accounting for this type of distortions. Unfortunately, there are no tests available yet detecting people who fake stupidity while taking IQ tests. However, in applications people who fake the ideal profile are detected by so-called social desirability tests, see Crown and Marlowe (1964). A similar principle is easily transformed into an IQ setting.

effort to obtain his or her best schooling level (and type). A more subtle approach would model the relation between ability, effort and schooling, but that would be asking too much for the present exercise. In view of the large literature on schooling choices and the relation to ability, there is no doubt that such extensions are feasible. Finally, it might be argued that social parental background is partially determining the earnings capacity of individuals. The same may hold for inherited wealth. We abstained from including those factors in order to avoid too many political and philosophical undertones in this first approach.

As a matter of fact we do not have an ideal dataset, where all the variables listed are known. But we do have at our disposal a unique dataset in which both individual childhood IQ is measured and the individual welfare evaluation of income. As an interesting starting point for the exercise to be developed in this paper, we shall assume that ability is wholly determined by IQ and the number of years in education. At the end of the paper we shall remind you of the fact that ability is only incompletely measured, but that it would be possible to repeat our exercise on a more satisfactorily defined ability measure. Under this assumption we can answer a question that in the development of the literature was never answered empirically: indeed, if we knew individual ability, how would we tax it? Perhaps, in a sense we write a forgotten chapter in the historical development of the literature on optimal income taxation. But we think there is more value in the exercise than just that. We see at least three arguments for proceeding. The first argument is mere academic interest. True, not an all overriding argument, but certainly valid. The notion of a tax on ability has been around almost for ever like the Holy Grail. So why not take the opportunity created by our dataset to see what it would look like? The second argument is the argument of setting a standard of reference. Since the ability tax plays a role in our theories, it is interesting to have a well-developed illustration. And third, maybe most importantly, it is a reference for further research. We intend to continue this line of research by investigating implications of taxes based on observable characteristics, that are either exogenous (such as age) or perhaps are fairly constant (such as occupation). We think it makes perfectly good sense to investigate the properties of taxes on observable individual characteristics other than income. Of course, the best of these are characteristics that are fixed for the individual and serve as a good predictor of earnings capacity. There are indeed historic examples where earnings capacity (or ability to pay) was proxied by other variables: occupation, social rank. In 1680, Holland moved from a tax on corn to a poll tax. The tax level was fixed for an individual, but differentiated by occupation.[5] If occupations are (close to) hereditary, an occupation tax is (close to) a differentiated lump sum tax. The Poll Tax Act of 1660 in England is an even better example. It was based on exogenously determined social rank: £100 for a duke, £60 for an earl, £30 for a baronet, £10 for a squire (Hahn, 1973). In view of the high cost of income taxation, it is worthwhile to start

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[5]It was also differentiated by wealth, though. See De Vries and Van der Woude (1995), p. 134.

thinking along those lines again, seeking for better indicators of earnings capacity than just realized earnings. The ability tax may then serve as a point of reference. In no way are we suggesting that the ability tax as we calculate it here is a scheme that should immediately be implemented.

Our trip towards individualized lump sum ability taxation has the following stops. We first introduce the ingredients to calculate the tax rates. In Section 2 we briefly introduce the Leyden method of welfare measurement and present an estimated earnings function and welfare function. Furthermore, we shed some light on how response behavior might explain behavioral distortions due to tax reforms. We then move on to derive the tax rates on ability from applying sacrifice norms to the Leyden welfare function of income in Section 3. Section 4 gives conclusions and a reflection on the meaning of the results.

2. Towards individualized lump sum taxation

According to standard welfare theory lump sum taxation is superior to a tax on individual endogenous variables. By limiting the consequences to income effects and preventing substitution effects it avoids deadweight welfare losses. Distributive goals should be reached by variation of the lump sum tax between individuals according to earnings capacity. To accomplish that we have to identify variables that affect earnings capacity and use these as a tax base.

Now, as discussed in the introduction, our analysis is not meant as a ready-made blueprint for a new rate structure. Rather, it is a reconnaissance of unexplored territory. The tricky part is of course the prediction of earnings capacity. We use IQ, and also schooling, from a dataset of individuals interviewed as 12 year old school kids in 1952 and re-interviewed in 1993. Hence, IQ scores and schooling choices have been determined without the individuals anticipating in 1952 that these variables would be used as a tax base. In our exercise they are truly pre-determined variables.

We first introduce our welfare function, the Leyden welfare function of income, or WFI. Second, we note that ability affects earnings-we establish this relation by estimating an earnings function. Third, we extend the WFI with ability, as ability may have a direct effect on utility as well. We now know how ability affects welfare, both directly (through the WFI) and indirectly, as ability generates income and income yields welfare. By imposing distribution norms on the welfare distribution in Section 3 we can calculate by how much ability should be taxed. This is an individual lump sum tax: fixed for the individual, differentiated between individuals.

2.1. Knowing welfare: the Leyden welfare function of income

If we want taxation to be based on welfare, it obviously helps if we know something about welfare, what it depends on and how it varies between

individuals. When we use the concept of welfare with reference to taxation, it is obvious that this must be a cardinal welfare concept, for otherwise equalization of proportional or marginal sacrifice will be impossible. We will apply the results of welfare measurement according to the so-called Leyden method, initiated by Van Praag (1968), Van Praag (1971) and Van Praag and Kapteyn (1973). We present a brief outline of this approach. For a more complete review we refer to Van Praag and Frijters (1997).

The notion that nearly all individuals are able to evaluate their situation in relative terms by positioning it somewhere between a ''worst' situation and a ''best' situation has been adopted by the Leyden school. The empirical literature around the Leyden welfare function of income (WFI) is based on a specific survey question module, the so-called Income Evaluation Question or IEQ (Van Praag, 1971). It runs as follows:

Which monthly household after tax income would you in your circumstances consider to be very bad? Bad? Insufficient? Sufficient? Good? Very good?

About $.......very bad.
About $.......bad.
About $.......insufficient.
About $.......sufficient.
About $.......good.
About $.......very good.

The answers of the IEQ will be denoted as c_1, c_2, c_3, c_4, c_5 and c_6. If we accept that the answers linked to the verbal qualifiers ''very bad, bad, insufficient, sufficient, good'' and ''very good'' are evaluations of welfare derived from these various income levels, the IEQ gives us six points on an individual welfare function (see Van Praag, 1991).[6] Verbal qualifiers have to be translated into numerical values. In the Leyden literature this is done by equalizing ''very bad'' to 1/12, ''bad'' to 3/12, and so on. Empirical and theoretical arguments may be found in Van Praag (1971), Van Praag (1991), Van Praag (1994) or Kapteyn (1977). In psychological literature a similar translation is suggested by Parducci (1995). On theoretical and empirical grounds $U(y)$ is approximated by a lognormal distribution function (see Van Praag, 1968, 1991 and Van Herwaarden and Kapteyn, 1981). Then, utility or welfare can be written as

$$U(y) = \Lambda(y; \mu, \sigma) = N\left(\frac{\ln y - \mu}{\sigma}; 0, 1\right) \tag{2.1}$$

[6]When we use the concept of welfare we shall understand it as welfare as derived from income. Hence the concept is more narrow than well-being. Elsewhere the two concepts are compared (see Plug and Van Praag, 1995a,b; Van Praag and Plug, 1995). We use welfare and utility interchangeably.

where N stands for the standard normal distribution function. The welfare parameter μ is estimated by

$$\mu = \frac{1}{6}\sum_{i=1}^{6} \ln c_i \tag{2.2}$$

The parameter σ is estimated analogously by

$$\sigma^2 = \frac{1}{5}\sum_{i=1}^{6} (\ln c_i - \mu)^2 \tag{2.3}$$

Since the IEQ clearly states that the answers have to be given "in your circumstances" the welfare function is measured conditional on these circumstances. Therefore, the two welfare parameters μ and σ vary over individuals and households; the traditional explanation for these differences is that families with different after tax family income y_a and with different family size fs will respond differently to the Income Evaluation Question. The relationship

$$\mu = \beta_0 + \beta_1 \ln fs + \beta_2 \ln y_a \tag{2.4}$$

has been shown to hold.[7] The argument fs is included because children within the household create costs and therefore influence welfare experienced. That is, a family of six will need a higher income to obtain a certain welfare level than a family of four, other things being equal. After tax income y_a is included to reflect the way people adapt their income judgment to changes in their current after tax income. This phenomenon is better known as the preference drift (see Van Praag, 1971). A positive preference drift says that part of additional income is not contributing to higher welfare since aspirations increase as well. A preference drift equal to one would mean that additional income would yield no increase in welfare at all. However, to our knowledge a preference drift equal to one has never been observed. The parameter σ is not easy to explain and is considered to be random over the sample. We will set it constant at the sample average (see Hagenaars, 1986).

2.2. Linking welfare responses to cost functions

The approach we take here is in line with neoclassical theory if we interpret the IEQ as asking for a cost function in the sense of demand theory. This is a sensible

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[7]The method has yielded stable and consistent results in research covering two decades, many countries and many populations. A typical estimate for most Western countries is

$$\mu = \beta_0 + 0.10 fs + 0.60 \ln y_a$$

Up till now there are no rival empirical methods with better credentials. Still, this method of welfare measurement is not beyond discussion, see Hartog (1988), Seidl (1994), Van Praag and Kapteyn (1994).

interpretation, since the questionnaire asks individuals to specify the amount of money they need to attain a particular ''rating'', which we call welfare. Below, we elaborate on this interpretation. The cost function normally depends on in-dividually exogenous variables like prices and wages. Here, we ignore commodity prices as all respondents in a specific sample face approximately the same prices. Wages are not taken as parametrically given: we will use a relation between wages and exogenous ability. Inserting this relation just provides more structure than only considering the reduced-form effect of ability on welfare.[8] But of course it is not a fully specified structural model that links endowments to outcomes through efforts. We leave that for another occasion. Such a full structural model would then also include responses to tax parameters as part of the economic incentives for effort.

The interpretation of the WFI as a cost function has been discussed by among others Danziger et al. (1984), Van Praag and Van der Sar (1988), and Kapteyn (1994). Consider the traditional neo-classical model and assume a simple PIGLOG cost function

$$\ln c = a(p) + ub(p) \tag{2.5}$$

where u stands for an ordinal utility label. We may write this ordinal utility index as an explicit (indirect utility) function of cost level c and prices p looking like

$$u = \frac{\ln c - a(p)}{b(p)} \tag{2.6}$$

For any positive monotonic transformation Ψ of this utility function, the same individual preferences will be described. Hence,

$$\Psi(u) = \Psi\left(\frac{\ln c - a(p)}{b(p)}\right) \tag{2.7}$$

If we compare this equation to the formula of the Leyden welfare function in (2.1) we find a remarkable resemblance, already pointed out by Van Praag (1991) and Kapteyn (1994). They take for Ψ the cumulative standard normal distribution function N and because the parameters μ and σ may as well depend on prices they identify the parameters μ with $a(p)$ and σ with $b(p)$. The Leyden welfare function identifies a traditional neo-classical utility function by means of direct questioning.

This blue-print builds heavily on the assumption that the indirect utility measurement by means of observing consumption patterns and the direct response approach actually measure the same thing. Kapteyn (1994) shows empirically that they do not entirely but also that there is no solid evidence that both measure something completely different.

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[8]This approach does not require the restriction to full-time workers only, as it is the wage rate rather than earnings that determines welfare (in the absence of rationing). But we started this exercise with the reasonably homogenous group of single earner heads of families who worked full-time, see below.

2.3. Data

In 1952 one fourth of the sixth-grade pupils (then about 12 years old) in Holland's southern province of Noord–Brabant were sampled. At that moment their scholastic achievement, intelligence and family background were measured. Thirty years later, the unique observations were still available. In 1983, the same individuals were contacted to collect data on education, labour market status, earnings and so on (some 4700 out of 5800 original observations). As the 1983 edition of the Brabant-data turned out to be a very rich data-set, the 1983-exercise was repeated in 1993 (see Van Praag, 1992). In the latest edition the questionnaire included also questions concerning subjective welfare measurement, one of these being the Income Evaluation Question (IEQ).

In this paper, we restrict ourselves basically to this question for our analysis. The number of Brabant people who responded to the 1993 questionnaire is 2099. From these households a number of observations had to be removed from analysis due to (partial) nonresponse. By aiming at taxing earnings capacity, we need variables to predict it. We only use observations on IQ for the individuals in the original 1952 survey, not for their spouses. In this paper, we do not want to get involved in the complications that arise if there is more than one income earner in the family. So, we can only use the observations where the original respondent is now a single earner of the family. We will also restrict ourselves to individuals who work full time. Of course the notion of taxing earnings capacity rather than actual earnings is perfectly suited to deal with the problem of variable hours, but that is not the purpose of the present paper. Given all these restrictions and the loss of cases due to missing observations on key variables, we end up with a sample of 525 observations. For 333 respondents we could estimate their WFI.[9] Finally, we corrected for extreme IEQ-response behavior by assuming that ''normal'' response behavior has to satisfy

$$0.025 \leq N \left(\frac{\ln y_a - \mu}{\sigma} \right) \leq 0.975 \tag{2.8}$$

In words, ''normal'' respondents evaluate their own after tax income y_a between the values 0.025 and 0.975 on a [0,1]-scale.[10] The final sample under analysis contains 301 observations. A short description of the other variables follows.

The IQ score was constructed from six subtests relating to numbers, words, analogies and spatial orientation in one form or another. The educational variable represents the Dutch educational system in 1952. This system consists basically of two tracks, a vocational and a general one. Although the different education types

[9]The six IEQ-answers are screened according to three criteria. The first requires that the answers are increasing, the second allows at most two answers to be missing and the third criterion states that neither the first two nor the last two answers should be missing.

[10]Of course, this is also a screening device pinpointing possible measurement errors in income or IEQ answers.

are difficult to compare, their respective names and durations give some indication of standing and difficulty. Beginning with the category ''elementary school'', obligatory at six years of age, we distinguish seven final levels with corresponding total number of years

- Elementary school . . . 6 years
- Extended primary . . . 8 years
- Lower vocational . . . 9 years
- Intermediate vocational . . . 10 years
- Intermediate general . . . 11 years
- Higher vocational . . . 15 years
- University . . . 17 years

This table describes the Dutch educational system in the fifties and sixties. For all individuals schooling is set equal to the normative length. That is, the additional minimally required schooling years beyond elementary school plus one year.[11] All individuals are given the highest education level attended. The other variables used are family size *fs* and after- and before-tax household income y_a and y_b. Again, we notice that due to the genesis of the sample all respondents are roughly of the same age. So an age effect could not be distinguished.

In the fifties, participation in higher education was more restricted than in modern times. Education from age 6 up to 12 years was obligatory. The tuition fees were only a fraction of the real cost with grants and loans available for poor families. Nevertheless, it has to be realized that poor families were confronted with a considerable opportunity cost, as the continuation of education after the obligatory age implied that the child could not contribute to the parental household income. In the context of trying to assess structural pre-career earning power this is not so much of a problem as the decision on continued education in the Dutch 1952 situation was a parental decision, strongly guided by the teacher advice, on which the child itself had marginal influence only. The distribution of the sample according to IQ and education is presented in Table 1. In Table 1 IQ is subdivided in classes. The 75-class represents those people having an IQ lower than 80. The 85-class scored between 81 and 90 on the IQ scale. All classes are defined accordingly except for the 135-class. This class represents people having an IQ higher than 130. As expected, education increases with IQ score, but there is a large amount of dispersion in the relation.

2.4. Predicting earnings capacity

We define and measure welfare because we base the four tax recipes on welfare. And because we use earnings capacity to assess taxes, we have to define and measure earnings capacity as well. In Section 1 we listed a set of basic individual

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[11]As such, the education variable can be defined as a natural logarithm.

Table 1
Distribution of the sample

IQ	75	85	95	105	115	125	135	Subtotal
Elementary school	7	3	6	5	2			23
Extended primary	3	12	24	14	9	1		63
Lower vocational		5	9	22	8	4	1	49
Intermediate vocational		6	8	28	13	6		61
Intermediate general		1		2	4	1	2	10
Higher vocational		7	7	28	19	12	2	75
University				5	4	7	4	20
Subtotal	10	34	54	104	59	31	9	301

earnings determinants. In this paper, however, we are restricted by the dataset and we have to make do with the usual variables gender and education to which we can add IQ, measured at the age of 12. Unfortunately, the age variable had to be dropped as explanatory variable because all respondents in our sample are roughly the same age. To predict earnings capacity we assume

$$\ln y_a = \alpha_0 + \alpha_1 iq + \epsilon \tag{2.9}$$

where we take *iq* as the IQ test score divided by 100. To control for gender effects we add a gender dummy. The equation is estimated only for full-time single earners. Unobserved ability ends up in the error. The earnings capacity estimates may be inaccurate for two reasons. Firstly, the IQ measure is only an exogenous variable if people refrain from cheating their IQ test. If not, we have to deal with the endogeneity of the IQ score. Secondly, we expect the impact of the measurement error on earnings capacity to be high; IQ is a rather narrow instrument to reflect on a broad concept like earnings capacity. Alternatively, we add years of schooling to the list of variables and predict earnings capacity as follows

$$\ln y_a = \alpha_0 + \alpha_1 iq + \alpha_2 \ln e + \epsilon \tag{2.10}$$

where we take *e* to be the total years of education. Hereby, we gain precision by reducing the measurement error but lose with respect to the accuracy of OLS estimates. We realize that endogeneity of schooling may render our OLS-estimate inadequate, as argued by Card (1994) and others.

We will continue using both variables as capacity predictors. In Table 2 we present the estimates of the net earnings function. The gender effect is quite strong; in this sample women's net earnings are still close to 60% of male earnings. The IQ parameter of net earnings is about 1 if we ignore education, about a quarter if we add education. The education elasticity is about 2/3. If we were to use the standard Mincer specification, the net return to education would be 6%; a conventional result for the Netherlands (cf. Hartog et al. (1993)).

It is now standard practice to use the Mincer specification, relating log earnings

Table 2
Net income functions (ln y_a)

Intercept	7.232	*0.152*	6.426	*0.146*	7.307	*0.127*
Personal qualities						
Gender	−0.426	*0.060*	−0.415	*0.050*	−0.406	*0.050*
IQ	0.953	*0.144*	0.246	*0.135*	0.259	*0.134*
ln years educated			0.664	*0.058*		
Years educated					0.060	*0.005*
R^2	0.205		0.444		0.449	
N	301		301		301	

Standard errors in italics.

to years of education. In order to facilitate comparison with other studies we also present the estimates for the traditional Mincer specification. In our model specification, it is more convenient to use the (natural) logarithm of years educated. We feel excused to deviate from the Mincer specification for two reasons. Firstly, the use of the (natural) logarithm of years educated is not rejected by the data. Whether we apply the Mincer specification or the specification in equation (2.10) has no strong effect on the coefficients of the other variables, and neither affects the correlation coefficient. Secondly, the Mincer specification implies a constant rate of return to education. In our specification there is a diminishing marginal return to years of schooling

$$\frac{\partial \ln y}{\partial e} = \frac{\partial \ln y}{\partial \ln e} \frac{\partial \ln e}{\partial e} = \frac{\alpha_2}{e} \tag{2.11}$$

A diminishing return for increasing schooling levels is one of the stylized features established in the international survey by Psacharopoulos (1985) or Card (1994). The rate of return to education in our specification equals $0.664/e$ for net earnings. In Table 3 the gross earnings estimates are presented. All coefficients are larger in absolute value than in the net specification. The rate of return to education is $0.805/e$ for gross earnings.

Table 3
Gross income functions (ln y_b)

Intercept	7.395	*0.182*	6.417	*0.173*	7.485	*0.151*
Personal qualities						
Gender	−0.477	*0.072*	−0.464	*0.060*	−0.453	*0.060*
IQ	1.224	*0.172*	0.366	*0.161*	0.386	*0.160*
ln years educated			0.805	*0.069*		
Years educated					0.073	*0.006*
R^2	0.206		0.451		0.454	
N	301		301		301	

Standard errors in italics.

It is also interesting to look at the substitution ratio between IQ and education. We find the constant yield curve

$$\alpha_1 iq + \alpha_2 \ln e = \ln y_a - \alpha_0 \tag{2.12}$$

The earnings function reveals the substitution ratios of IQ and years educated, keeping ability constant. We see that it becomes increasingly easy to replace a loss in education length by more IQ at higher levels of education. Or to put it differently, an increase in IQ is harder to replace by more education at higher levels of education than at lower levels of education.

2.5. Extending the WFI

Above we discussed the welfare function known as the Leyden WFI and we mentioned how empirical research has established a relation between μ and two explanatory variables, viz., actual income and family size. The Brabant dataset allows us to extend this relation with other variables. The variables of interest in the context of this paper are IQ and the schooling variable e. We suppose that the capacity to derive welfare (satisfaction) from income must be affected by one's schooling and by one's IQ. More precisely, we extend equation (2.4) as

$$\mu = \beta_0 + \beta_1 \ln fs + \beta_2 \ln y_a + \beta_3 iq + \beta_4 \ln e \tag{2.13}$$

Schooling deeply affects individuals and one may expect strong influence on perceptions, tastes, and the art of spending income. IQ, standing for more or less innate properties, may operate as a taste shifter between individuals, although we are not sure a priori of the sign of the effect. People with a higher IQ may have more needs leading to an increase in μ, but on the other hand more intelligence may enhance the efficiency of the spending process as well.

Estimation results are given in Table 4. We find first of all the usual income and family size effects. The former is the well established preference drift effect. As stated earlier, there is a welfare leakage because part of additional income increases aspirations as well. A preference drift of 0.5 to 0.6 and a family size

Table 4
Leyden welfare function (μ)

Intercept	2.638	*0.266*	2.882	*0.276*	3.052	*0.306*
ln household size	0.116	*0.028*	0.116	*0.028*	0.116	*0.028*
ln household income	0.596	*0.034*	0.539	*0.039*	0.542	*0.040*
Personal qualities						
IQ	0.272	*0.091*	0.165	*0.097*	0.178	*0.097*
ln years educated			0.143	*0.049*		
Years educated					0.012	*0.004*
R^2	0.604		0.614		0.612	
N	301		301		301	

Standard errors in italics.

elasticity of 0.11 are fully in line with the results commonly found.[12] The interesting new variables in this context are IQ and years educated *e*. Increasing IQ by 10 points raises μ by 2 to 3%. We have experimented with a quadratic function in IQ, but it turned out that a linear specification is sufficient. In the ''years educated'' specification we see that increasing schooling by one year raises μ by about 1%. The effect of education is highly significant. In isolation, IQ is also very significant, but with education added, its effect is strongly diminished: with higher IQ and more schooling, more income is needed to attain a given welfare level, intelligence and schooling raise ''needs''.

How do IQ and schooling affect the evaluation of income? In order to get an answer on this question we decompose the effect of IQ and schooling into two separate effects. The first effect arises because the perception of welfare is *directly* influenced by IQ and schooling. The second effect is that IQ and schooling affect welfare *indirectly via the market* through income. These welfare effects can be properly addressed by means of equivalence scales. Just as has been done for family equivalence scales (see Van Praag and Warnaar, 1997), it is possible to define IQ-equivalence scales or education-equivalence scales. If earnings capacity is defined by childhood IQ only, we can calculate how much money an individual with an IQ of iq_A needs to be as well off as an individual with an IQ of iq_B. If m is the equivalence scale, equality in utility reads as

$$U(m \cdot y(iq_A)) = U(y(iq_B)) \tag{2.14}$$

To present this within the Leyden framework, let us assume two individuals with IQ values iq_A and iq_B. Their incomes according to equation (2.9) will be $y(iq_A)$ and $y(iq_B)$, all other things left equal. Their welfare function will be described by μ_A and μ_B, respectively, where

$$\mu_A = \beta_0 + \beta_1 \ln fs_A + \beta_2 \ln y(iq_A) + \beta_3 iq_A \tag{2.15}$$

The parameter μ_B is analogously defined. When σ is assumed constant over the sample and household A and B are equal in size, equivalence in welfare implies

$$\ln(m \cdot y_A) - \mu(m \cdot y_A) = \ln y_B - \mu_B \tag{2.16}$$

Hence,

$$(1 - \beta_2) \ln(m \cdot y(iq_A)) - \beta_3 iq_A = (1 - \beta_2) \ln y(iq_B) - \beta_3 iq_B \tag{2.17}$$

Using the predicted earnings capacity in equation (2.9), the Leyden equivalence intelligence scale m is defined as

[12]We have not included gender in the welfare function. The motivation can be found in Plug and Van Praag (1996) where it is argued that both spouses in one-earner families share their opinion on family income.

$$\ln m = -\alpha_1 \Delta iq + \frac{\beta_3}{1 - \beta_2} \Delta iq \qquad (2.18)$$

where Δiq is the difference between the IQ levels iq_A and iq_B. We interpret the second term at the right hand side as the pure equivalence effect, while the first term reflects the market-correction effect. The pure equivalence effect reflects the equivalence scale proper: additional income is needed for higher IQ levels in order to maintain welfare, acknowledging the welfare leakage caused by preference drift. The market-correction effect reflects the fact that an individual with a higher IQ earns on average $\alpha_1 \Delta iq$ more from equation (2.9). It's the labour market's contribution to an individual's welfare, which can be deducted from the equivalence effect.

Table 5 presents both the pure and the market-correction effect associated respectively with the welfare function given in the first column of Table 4 and the net earnings function given in the first column of Table 3. Our point of reference is set at an IQ equal to 105, the sample average. The first entry shows that individuals with IQ 75 reach the same utility level as individuals with average IQ (105) at 82% of the latter's income. They would be equally satisfied with their income as the reference person if they would get 82% of the reference income. However, the market gives them 33% less.[13] If we combine both welfare effects, their present income should increase by 9% (0.817 times 1.331 equals 1.088). Hence, increasing IQ requires higher income to maintain welfare, but as the market-compensation effect indicates, the labour market generates overcompensa-

Table 5
Leyden Equivalence scales

IQ	Pure	Market correction	Total
75	0.817	1.331	1.088
85	0.874	1.210	1.058
95	0.935	1.100	1.028
105	1.000	1.000	1.000
115	1.070	0.909	0.972
125	1.144	0.826	0.946
135	1.224	0.751	0.920

Ability is defined by IQ only.

[13] In this situation the equivalence scales are outcomes of the following calculations
$$\exp(-\alpha_1 \Delta iq) = \exp(-0.953 \times (0.75 - 1.05)) = 1.331$$

$$\exp(\beta_3/(1 - \beta_2)\Delta iq) = \exp((0.272/0.404)) \times (0.75 - 1.05)) = 0.817.$$

tion. Low IQ people are worse off in terms of earnings capacity, earnings and welfare compared to high IQ people. In fact, what we observe here is the welfare effect of Mill's famous non-competing groups.

The exercise can be repeated after adding years educated as explanatory variable. Now, the point of reference is an intermediate general education and an IQ of 105 ($iq = 1.05$). The effects are now based on the third column in Tables 2 and 4. Results are given in Table 6. We note that with IQ given, individuals need a higher income to maintain welfare if they acquired more education, and that the pure difference between elementary education only and a university education is substantial. But we also note that the Dutch labour market undercompensates the lower educated and overcompensates the higher educated. The overcompensation of university educated relative to elementary schooling only is quite substantial. More education pays off in terms of both earnings and welfare, the wage premium for schooling surpasses the compensating differential needed for constant utility. The same table shows the effect of IQ when education is held constant. More able individuals still get a higher income, but now, conditional on given education, the labour market gives undercompensation. Note finally that the combined effects of IQ and years educated can be found by multiplication of the two equivalence scales. For example, the joint welfare effect for an individual with university education and an IQ score of 135 adds up to an effect of −10% (0.857 times 1.034 equals 0.905). If both years of schooling and childhood IQ define earnings capacity we observe more or less similar findings as described in Table 5. Highly

Table 6
Leyden Equivalence scales

Education (ln e)	Pure	Market correction	Total
Elementary school	0.829	1.496	1.239
Extended primary	0.906	1.235	1.119
Lower vocational	0.940	1.143	1.074
Intermediate vocational	0.971	1.065	1.034
Intermediate general	1.000	1.000	1.000
Higher vocational	1.101	0.814	0.896
University	1.145	0.749	0.857
IQ			
75	0.898	1.077	0.967
85	0.931	1.050	0.978
95	0.965	1.025	0.989
105	1.000	1.000	1.000
115	1.036	0.976	1.011
125	1.074	0.952	1.023
135	1.113	0.929	1.034

Ability is defined by IQ and schooling.

educated people with high IQ's are better off in terms of earnings capacity, earnings and welfare.

3. The results: tax rates on ability

Now that we have all the ingredients, we operationalize our tax on earnings capacity from norms aiming at taxing utility, as envisaged in the older sacrifice literature. We assume that earnings capacity $y(a)$ is determined by ability a. We will perform our analyses using two ability measures, just IQ and IQ jointly with education. We assume that utility is derived from income and that it also depends on intervening variables other than income. The utility function is the welfare function of income introduced in Section 2.1. We assume that earnings y depend on ability and on other factors which may be taken as random, at least they are not correlated with ability. That is, we assume

$$\ln y = \ln y(a) + \epsilon \tag{3.1}$$

where $y(a)$ is the structural part representing earnings capacity. The error term ϵ reflects other variables and random factors. As we assume (and find) that ability and earnings capacity are monotonically related, it is not confusing to replace the latent variable ''ability'' by $y(a)$.

3.1. Applying the WFI to sacrifice norms

We consider four taxation principles:

- absolute utility equality
- marginal utility equality
- imposition of equal proportional sacrifices
- imposition of equal absolute sacrifices

The latter two rules are taken from the old, nineteenth century literature. The first is a radical egalitarian norm, the second follows from maximizing a Benthamite social welfare function (with pre-tax incomes fixed). Note in passing that for all these tax recipes we require an interpersonally comparable welfare index as embodied by the Leyden welfare function. Only for the first egalitarian tax recipe we can do with ordinal comparability. Before we continue, we introduce some definitions. Let the absolute tax be $t(a)$ and tax rate be $g = t/y_b$ where y_b stands for before tax-income.

3.1.1. Equal utility

The enjoyment of equal utility derived from earnings capacity after the deduction of tax $y_a(iq)$[14] requires

$$U(y_a(iq)) = \alpha \tag{3.2}$$

Using equation (2.13) we find

$$t(iq, y_b(iq)) = y_b(iq) - y_a(iq) = y_b(iq) - \exp\left(\frac{c + \beta_0 + \beta_3 iq}{1 - \beta_2}\right) \tag{3.3}$$

where c is a constant, written as

$$c = \sigma N^{-1}(\alpha) \tag{3.4}$$

3.1.2. Equal marginal utility

The enjoyment of equal marginal utility derived from the earning talents after the deduction of tax requires

$$\frac{\partial U(y_a(iq))}{\partial y_a(iq)} = U'(y_a(iq)) = \alpha \tag{3.5}$$

Using the WFI, this requirement equals

$$\frac{\partial U(y_a(iq))}{\partial y_a(iq)} = \frac{1}{y_a(iq)\sigma\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\left(\frac{\ln y_a(iq) - \mu}{\sigma}\right)^2\right\} = \alpha \tag{3.6}$$

Taking logarithms on both sides, we find a quadratic equation

$$\theta_0(\ln y_a(iq))^2 + \theta_1 \ln y_a(iq) + \theta_2 = 0 \tag{3.7}$$

where

$$\theta_0 = (1 - \beta_2)^2$$

$$\theta_1 = 2\sigma^2 - 2(1 - \beta_2)(\beta_0 + \beta_3 iq)$$

$$\theta_2 = (\beta_0 + \beta_3 iq)^2 + c$$

This equation has two roots in $\ln y_a(iq)$. For obvious reasons we take the largest root. The ratio between before and after talent taxation is

$$t(iq, y_b(iq)) = y_b(iq) - \exp\left(\frac{-\theta_1 + \sqrt{\theta_1 - 4\theta_0\theta_2}}{2\theta_0}\right) \tag{3.8}$$

where c is a constant written as

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[14]For simplicity we look at earnings capacity measured by childhood IQ only. The exercise extending the list of intervening variables is straightforward.

$$c = 2\sigma^2 \ln(\alpha\sigma\sqrt{2\pi}) \tag{3.9}$$

3.1.3. Equal proportional sacrifice

Proportional sacrifice of utility requires

$$(1 - \alpha)U(y_b(iq)) = U(y_a(iq)) \tag{3.10}$$

The tax function t reads

$$t(iq, y_b(iq)) = y_b(iq) - \exp\left(\frac{\sigma N^{-1}((1 - \alpha)U(y_b(iq))) + \beta_0 + \beta_3 iq}{1 - \beta_2}\right) \tag{3.11}$$

3.1.4. Equal absolute sacrifice

Equal sacrifice of absolute utility requires

$$U(y_b(iq)) - U(y_a(iq)) = \alpha \tag{3.12}$$

The tax recipe of equal absolute sacrifice becomes

$$t(iq, y_b(iq)) = y_b(iq) - \exp\left(\frac{\sigma N^{-1}(U(y_b(iq)) - \alpha) + \beta_0 + \beta_3 iq}{1 - \beta_2}\right) \tag{3.13}$$

We will calculate the four tax schedules under the constraint that total tax revenue will be equal to the present revenue in the 1993 dataset. The total tax revenue is

$$R = \sum_{k=1}^{N} t(iq_k) \tag{3.14}$$

We repeat this exercise where we determine the ability tax using IQ and schooling combined.

There is the possibility that a person does not earn enough to pay his ability tax. To prevent this, we allow for welfare payments.[15] Like the actual Dutch tax and welfare system, our model accounts for a minimum net income. This implies that whenever some tax payers get a net income below the threshold, we activate a lower limit. In order to accommodate for differences in household size, we also apply the Leyden household equivalence scale (see Van Praag and Kapteyn, 1973). In Leyden type poverty analysis (see Hagenaars, 1986) the poverty threshold is set at a welfare value 0.4 (severe poverty) or at 0.5 (poverty). These values correspond to verbal qualifications of "insufficient" and "nearly insufficient". The value of 0.4 reasonably coincides with the actual Dutch social minimum income. These levels are arbitrarily chosen but are a standing convention. Of

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[15]If people are entitled to receive welfare payments, claims for enhancing efficiency gains are slightly damaged. However, given the exploratory nature of this paper we will continue and ignore these behavioral distortions. In our exercise, only a few Brabant people were unable to pay their alleged ability tax. Therefore, we believe that in this situation these efficiency losses can be neglected.

course, we might also have applied the actual social minimum as reflected in minimum wage and minimum benefit levels, but applying the Leyden social minimum has all the charm of a coherent structure.

4. Results

Results are presented in Tables 7 and 8. In Table 7 IQ serves as the single ability indicator. The column $y(a)$ presents actual net earnings capacity (income predicted from IQ) for the given IQ level. It is the average for men and women, weighted by the actual proportion of each at the given IQ level. The next column gives the actual "taxes" paid. We notice that all people in our data set are full-time working single earners. We have estimated gross and net earnings functions, and the gap between predicted gross and predicted net earnings equals predicted actual taxes. The tax is given as the amount paid and as a percentage of predicted gross income. It includes both the Dutch income tax and social security contributions. The next four columns show the tax amounts under the four regimes: equal utility, equal marginal utility, equal proportional sacrifice, equal absolute sacrifice. A striking result is the remarkably small difference between actual taxes paid and "optimal" taxes calculated under the four regimes. Imposing the rule of equal marginal utility would imply the largest change in the tax rates, with the range going from 31–40% to 21–44%.

In Table 8 we give the results for the case where earnings capacity is predicted from IQ and education together. The average tax rates are again quite close to the actual average rates for the two rules of equal sacrifice. Another striking result is

Table 7
Four different tax recipes on ability as measured IQ

IQ	$y(a)$	$t(a)$	$t_1(a)$	$t_2(a)$	$t_3(a)$	$t_4(a)$
75	2884	1299 (31%)	1336 (31%)	881 (21%)	1430 (34%)	1441 (34%)
85	3091	1501 (32%)	1365 (29%)	1127 (23%)	1538 (33%)	1564 (33%)
95	3401	1788 (34%)	1766 (33%)	1621 (30%)	1827 (35%)	1837 (35%)
105	3686	2082 (35%)	2051 (34%)	2074 (34%)	2068 (35%)	2073 (35%)
115	3874	2316 (37%)	2403 (37%)	2469 (38%)	2315 (36%)	2300 (36%)
125	4305	2770 (38%)	2888 (39%)	3205 (43%)	2718 (37%)	2689 (37%)
135	4424	2991 (40%)	2982 (38%)	3465 (44%)	2810 (37%)	2784 (37%)

Actual net earning capacity $y(a)$ per month in Dfl.
$t(a)$ = actual taxes paid.
$t_1(a)$ = taxes under equal utility.
$t_2(a)$ = taxes under equal marginal utility.
$t_3(a)$ = taxes under equal proportional sacrifice.
$t_4(a)$ = taxes under equal absolute sacrifice, between parentheses: associated average rate.

Table 8
Four different tax recipes on ability as measured IQ and schooling

	$y(a)$	$t(a)$	$t_1(a)$	$t_2(a)$	$t_3(a)$	$t_4(a)$
IQ=75						
Elementary school	2458	985 (28%)	762 (22%)	235 (6%)	1038 (30%)	1080 (31%)
Extended primary	2957	1343 (31%)	1374 (31%)	945 (21%)	1451 (33%)	1466 (34%)
IQ=85						
Elementary school	2514	1046 (29%)	670 (18%)	227 (6%)	1033 (29%)	1087 (30%)
Extended primary	2945	1378 (31%)	1276 (28%)	931 (20%)	1421 (32%)	1446 (33%)
Lower vocational	3066	1500 (32%)	1279 (25%)	1093 (22%)	1489 (31%)	1522 (32%)
Intermediate vocational	3539	1855 (34%)	1863 (34%)	1733 (32%)	1893 (35%)	1901 (35%)
Intermediate general	3760	2040 (35%)	1558 (26%)	1822 (31%)	1839 (31%)	1886 (32%)
Higher vocational	4616	2821 (37%)	3381 (45%)	3541 (47%)	3028 (40%)	2972 (39%)
IQ=95						
Elementary school	2568	1107 (30%)	899 (24%)	413 (11%)	1142 (31%)	1179 (32%)
Extended primary	3111	1527 (32%)	1346 (29%)	1091 (23%)	1515 (32%)	1543 (33%)
Lower vocational	3243	1660 (33%)	1432 (28%)	1302 (25%)	1622 (32%)	1653 (33%)
Intermediate vocational	3316	1752 (34%)	1435 (26%)	1378 (24%)	1653 (31%)	1690 (32%)
Higher vocational	4733	2986 (38%)	3684 (47%)	3834 (49%)	3255 (42%)	3184 (41%)
IQ=105						
Elementary school	2463	1087 (30%)	699 (18%)	375 (9%)	1019 (27%)	1088 (30%)
Extended primary	3179	1611 (33%)	1272 (26%)	1133 (23%)	1522 (31%)	1562 (32%)
Lower vocational	3241	1706 (34%)	1476 (28%)	1336 (25%)	1640 (32%)	1669 (33%)
Intermediate vocational	3605	1993 (35%)	1837 (32%)	1833 (32%)	1924 (34%)	1940 (34%)
Intermediate general	3954	2298 (36%)	2431 (38%)	2452 (39%)	2313 (37%)	2299 (36%)
Higher vocational	4725	3049 (39%)	3547 (44%)	3815 (48%)	3217 (40%)	3159 (40%)
University	5273	3586 (40%)	4096 (46%)	4698 (53%)	3646 (41%)	3573 (40%)
IQ=115						
Elementary school	2696	1255 (31%)	813 (20%)	502 (12%)	1194 (30%)	1247 (31%)
Extended primary	3254	1705 (34%)	1503 (30%)	1332 (26%)	1649 (33%)	1674 (33%)
Lower vocational	3066	1617 (34%)	1302 (25%)	1117 (20%)	1527 (31%)	1562 (32%)
Intermediate vocational	3683	2100 (36%)	2067 (36%)	2033 (34%)	2057 (35%)	2060 (35%)
Intermediate general	3697	2160 (36%)	2065 (34%)	2080 (33%)	2074 (34%)	2079 (35%)
Higher vocational	4420	2865 (39%)	2999 (39%)	3304 (43%)	2817 (37%)	2788 (37%)
University	5418	3806 (41%)	5056 (54%)	5296 (57%)	4361 (47%)	4233 (45%)
IQ=125						
Extended primary	3309	1774 (34%)	1636 (32%)	1454 (28%)	1720 (33%)	1738 (34%)
Lower vocational	3297	1826 (35%)	1525 (27%)	1453 (25%)	1717 (32%)	1747 (33%)
Intermediate vocational	3663	2146 (36%)	1844 (29%)	1937 (31%)	1982 (33%)	2008 (34%)
Intermediate general	4108	2509 (37%)	2785 (42%)	2809 (42%)	2556 (38%)	2523 (38%)
Higher vocational	4788	3245 (40%)	3709 (45%)	4046 (49%)	3331 (41%)	3268 (40%)
University	5260	3740 (41%)	3980 (42%)	4749 (51%)	3626 (39%)	3567 (39%)
IQ=135						
Lower vocational	2439	1246 (33%)	539 (14%)	210 (5%)	1021 (27%)	1090 (29%)
Intermediate general	2787	1544 (35%)	663 (15%)	604 (13%)	1216 (28%)	1295 (29%)
Higher vocational	5173	3637 (41%)	3785 (42%)	4557 (51%)	3448 (39%)	3398 (38%)
University	5667	4194 (42%)	4798 (48%)	5598 (56%)	4203 (42%)	4103 (41%)

Actual net earning capacity $y(a)$ per month in Dfl. $t(a)$=actual taxes paid. $t_1(a)$=taxes under equal utility. $t_2(a)$=taxes under equal marginal utility. $t_3(a)$=taxes under equal proportional sacrifice. $t_4(a)$=taxes under equal absolute sacrifice, between parentheses: associated average rate g.

the relatively small difference between the last two different tax criteria. Taken together, these results suggest that applying any of these optimality rules leads to a tax structure with small effects on the tax rate for the average tax payer. The big change of course is in the elimination of tax dispersion within a group of equal earnings capacity. We find large within-group discrepancies if we impose equal utility or equal marginal utility. Indeed, in line with the earlier result we find that the radical rule of equal post-tax utility implies a very progressive tax rate on earnings capacity. The results also fit in with those reported by Keller and Hartog (1977) explaining actual tax rates from proportional sacrifice. In an earlier exercise we regressed individual actual after-tax income linearly on after-tax income derived from any of the four tax principles. Equal utility and equal marginal yielded correlation coefficients of 0.53, the sacrifice rules yielded 0.87 (all regressions had a significant negative intercept and a slope significantly above 1).

Clearly then taxation according to the sacrifice rules implies taxation that on average would not deviate dramatically from actual taxation. But when we fix taxes as an individualized lump sum, the most interesting feature is the dispersion in the difference between actual and ''optimal'' rates. We will investigate this only for the case of equal proportional sacrifice. We have seen that proportional sacrifice is a rule that is very well capable of tracking actual tax rates. Moreover, we consider it an attractive principle of taxation as it imposes an equal relative burden on every tax payer.

In Table 9 we give the results. For each IQ-education combination we have taken the difference between reported gross and reported net income, and hence taxes paid, for all individuals observed in that group. Based on the individual's IQ and education, we have predicted the individual lump sum tax, and we have calculated the difference between actual tax and lump sum tax. In Table 9 we characterize the distribution of these tax differences by presenting the mean difference, the mean absolute difference and the standard deviation of that difference, denoted as Δt, Δt^* and σ_t.

As the first columns in Table 9 indicate, low IQ's have to pay extra taxes under the new system and the highest IQ's mostly gain. But there is no monotonic relation between tax changes and IQ or schooling: it is a rather mixed picture. In many cases, the change is not really dramatic. For many entries the dispersion is not higher than Dfl 150 per month. This means that for 95% of the individuals the effect is restricted to a gain or a loss of no more than Dfl 300, roughly some 10\% of net monthly income. These small effects are due to two factors. First, the actual tax rates in the Netherlands can quite well be interpreted from taxation by equal sacrifice. In that sense, there is no shift to a different principle. Second, we restrict our exercise to full-time employees, implying that the effect of a tax on leisure is not included. Hence, from this explorative analysis we can draw the conclusion that shifting to an ability based earnings capacity tax system does not have devastating effects on short run net income positions.

Table 9
Dispersion of taxes under proportional sacrifice - difference between actual and lump-sum taxes

IQ = 75	Δt	Δt^*	σ_t
Elementary school	−53	66	76
Extended primary	−107	107	7

IQ = 85	Δt	Δt^*	σ_t	IQ = 95	Δt	Δt^*	σ_t
Elementary school	13	29	44		−35	77	107
Extended primary	−42	65	54		12	69	91
Lower vocational	10	101	126		37	148	184
Intermediate vocational	−38	157	169		99	152	146
Intermediate general	200	200					
Higher vocational	−207	242	219		−269	280	293

IQ = 105	Δt	Δt^*	σ_t	IQ = 115	Δt	Δt^*	σ_t
Elementary school	67	120	140		60	180	255
Extended primary	88	100	115		55	108	140
Lower vocational	65	99	114		89	93	108
Intermediate vocational	68	154	171		42	98	119
Intermediate general	−15	104	148		85	133	120
Higher vocational	−167	293	360		48	210	281
University	−59	194	268		−554	619	522

IQ = 125	Δt	Δt^*	σ_t	IQ = 135	Δt	Δt^*	σ_t
Extended primary	54	54					
Lower vocational	108	108	148		224	224	
Intermediate vocational	163	163	178				
Intermediate general	−46	46	and	327	327	136	
Higher vocational	−85	298	392		188	188	153
University	114	174	253		−8	145	223

Δt = mean difference.
Δt^* = mean absolute difference.
σ_t = standard deviation of differences.

5. Conclusions

This paper is built on the idea that moving from a tax on earnings to a tax on earnings capacity would bring great advantages. In terms of economic efficiency, taxing earning power does not affect the actual efforts. Taxing actual earnings does. In terms of fairness, it is felt by many that an income tax, which levies the same amount on somebody who earns $30,000 by working one hour a day as on somebody who earns the same amount by working eight hours a day, is not acceptable. It is therefore a valuable effort to search for a viable measure of earning capacity. Such a measure should not only be based on IQ and years of education before starting work, but it should also depend on other ability factors like physical quality, gender, social and emotional intelligence. Moreover it should

depend on age (which we had to exclude for our specific dataset), because income is age-dependent and not constant over the life-cycle.

An obvious first step towards taxing earning capacity is to eliminate the effect of hours worked. A tax on full-time earnings has been proposed before (see e.g. the well-known textbook by Musgrave, 1959). We have experimented a little with variable labour supply, and for men we found only small consequences. Bigger consequences can be anticipated for women. We plan further work in this direction.

Our approach of aiming for a tax on ability, an answer to suggestions made by Tinbergen (1970b) and Mirrlees (1971), Mirrlees (1986), needs a much larger dataset and more research, before it could be operationalized or discussed as a political alternative. Its introduction could only be gradually. However, our exercises show that an ability tax is not a *chimaera* but deserves further research. Its advantage, from an ethical point of view including notions of fairness is obvious.

Tax perception costs would be greatly reduced as the annual assessment of taxable income would not be necessary. The same holds for the administration costs for the citizens to be taxed. If ability is measured early in life, the tax schedule would be known to any individual and uncertainty for individuals might be reduced as well.[16] It would facilitate career planning. Moreover, as taxes would not depend on work effort, the incentive on working hard would be strengthened. Finally, the state tax revenue would be much less dependent on the business cycle.

Reservations on fixing lifetime tax liability from measured childhood ability can be based on number of arguments. First, an individual's earnings is not only dependent on IQ, but on many other ability dimensions: leadership, independence, creativity, ability to cooperate, commercial ability. Tests for such abilities are available as well. A key issue is the problem of measurement error. Here, repeated measurement can help, and perhaps other indicators than test scores should be used, to allow for some system of error correction. Deliberate underachievement on the test, ''playing the dunderhead'' is a problem that can be countered by linking up with positive incentives, such as linking IQ to admission to school (a common practice in many countries) and by estimating a test-behavior model. Mirrlees (1971) even suggests that the danger of evasion is not disturbing at all. If an individual capability like intelligence is valued highly in society, people will perform as best as they can resulting in representative IQ-scores.

Infringement on personal privacy is not a specific problem for ability testing. It also holds for modern income taxation, where income and reasons for exemption are annually assessed. Ability taxation may even be seen as an alleviation, as it

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[16]Schooling levels should be reported to the tax authorities by the school administration, to prevent underreporting by individuals. This is similar to banks reporting interests on savings, as required by Dutch tax law.

does not require an annual impingement into the individual's privacy. Moreover, most individuals have been tested on their IQ and know the result of these tests. Obviously, the score will reflect a social classification, but the present classification according to income has a similar defect. Hence, we do not see why ability taxing would be socially and psychologically more damaging than the present income taxation for many people is.

A tax liability surpassing realized income is not a fundamental problem either. A social minimum can always be upheld, as we demonstrated in our exercises.

Perhaps the greatest reservation lies in the consequences of errors in measuring earnings capacity. Overestimation may set tax liabilities too high, underestimation will let millionaires get away with negligible taxes. First, such errors should be evaluated against the errors, injustices and efficiency losses of the present system of taxing realized incomes. And second, it may be worthwhile investigating a mixture of systems, where deviations between predicted earnings capacity and realized earnings can be taxed at a modest rate. This would provide an error correction mechanism for fairness with small efficiency cost.

We think there are good reasons to continue research along the line initiated here. Our first step would be to investigate the effect of eliminating the impact of working hours on tax liability. Secondly, we would bring in age as an indicator of earnings capacity, and a good one given its unquestionable exogeneity. In our exercise it is absent because age variation is absent in our dataset. But we know that age is an important determinant of earning capacity, and we know that it has a strong quadratic effect on the welfare parameter μ.

And we should work at a structural model, where effort and innate ability are disentangled. Within such a model, the role of schooling will also be sharpened. Initial schooling is fixed over individual's working life, and using it to set tax liability may surely bring efficiency gains. But of course individuals do have a choice and this should be modelled more precisely. A final point which may set a problem for future research, is how schooling later in life, e.g. training on the job, should be accounted for in the tax system.

In laying out the problems of an ability tax, we should not forget that the present system of income taxation is a system with high costs. It is also a system with substantial errors, in the sense that taxable earnings is a far from perfect measure of earnings capacity, or ability to pay. Fairness is hurt to the extent that the high income earners can spend more resources on setting up a negative bias in measured ability to pay. Given these drawbacks, we believe strongly that it is a sensible research effort to look into the consequences of shifting the tax base from realised earnings to predicted earnings capacity. This requires predictors that have sufficient reliability and are easy to measure. Using childhood IQ as a single indicator with a pervasive influence on lifetime tax liability would not receive great support in society, because of the vagaries of economic life in a market economy. Clearly, further work should address this and other issues. But we feel that it is a line of work that is a valuable comparison to the theoretical work on optimal taxation in the footsteps of Mirrlees' pathbreaking contribution.

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