

THE WELFARE EFFECTS OF UNCERTAIN TAX POLICIES

ILTAE KIM*

Uncertainty about tax policies affects both individual behavior: to work, to save, and to spend and economic welfare of a representative consumer-taxpayer. In this paper, unlike previous studies, individuals make saving and labor supply decisions simultaneously. We use a two period model in which both saving and labor supply are distinct sources of present disutility and alternative sources of future income, consider the case in which tax-base uncertainty increases expected tax revenues, and find that the government may be able to charge the tax rate so that the welfare of a representative, risk-averse consumer increases, in spite of the presence of greater tax-base risk. Our analysis reveals that a set of assumption about attitudes towards risk that is sufficient to conclude that the introduction of randomization of the tax base increases economic well-being.

I. INTRODUCTION

Few would doubt that uncertainty¹ affects the entire range of economic behavior, including decisions to work, to save, and to invest. In recent years, there has developed an extensive literature on the implications for the economic welfare of uncertain tax policy. Paradoxically, increased uncertainty about tax policy can be welfareenhancing, even in a world of identical, risk-averse individuals, in the presence of existing taxes. This argument, which was initially propounded by Weiss(1976) and Stiglitz(1982) and extended to the case of random taxation across individuals at a point in time by Chang and Wildasin(1986), invokes the theory of the second-best. Essentially, if increased tax uncertainty induces individuals to work and save more, then government revenues would increase in the absence of

*College of Business Administration, Chonnam National University. This paper is a revised version of Chapter 4 in my dissertation at the University of Georgia. An earlier version of this paper was presented at the annual meeting of Korean Economic Association held in February, 1991. The author thanks Arthur Snow, Ronald S. Warren, Jr., and two anonymous referees for helpful comments on an earlier version.

¹In this paper, we use the terms "risk" and "uncertainty" synonymously to denote a situation of Knightian risk(1921), in which it is assumed that probability estimates are calculable on the basis of an objective classification of instances.

a tax-rate reduction and risk-averse individuals are worse off. However, the reduction in tax rate required to maintain revenues at a constant (expected) level would decrease the welfare-reducing distortions associated with existing taxation. The relative magnitudes of the two opposing effects are an empirical question and Skinner (1988) has provided evidence that removing all uncertainty about future tax policy in the U.S. would have produced an annual welfare gain of approximately 15 billion dollars in 1986.

Recently, Alm (1988) has reopened the theoretical debate by distinguishing between the effects of increased risk about the tax base and the tax rate on individual saving, labor supply, and economic welfare. Alm (1988) concludes that, under certain stipulated conditions on preferences, increased tax-base risk reduces saving and labor supply but may increase welfare. However, under the same assumptions about preference, increased tax-rate risk also reduces saving and labor supply but unambiguously decreases welfare.

In discussing conclusions to his analysis, Alm (1988, p.244) describes that "[I]ndividuals typically make [saving and labor supply] decisions simultaneously, yet these decisions are examined separately here." Indeed, this special feature of his model has implications for the importance of the distinction between tax-base risk and tax-rate risk that Alm emphasizes. Stiglitz (1982) analyzed the welfare effect of uncertain taxation using the model of labor supply that ignores the saving decision. In these models, there is only one source of future income (saving and labor supply). Hence, the framework of these studies is not well-developed since saving and labor supply decisions were made independently.

In this paper, we use a two-period model of the joint determination of saving and labor supply under uncertainty that is particularly well-suited to analyze the effects of uncertain tax policy on economic welfare and establish conditions on preference that determine the effect of an expected, iso-revenue increase in tax-base uncertainty on economic welfare of a representative individual.

The paper is organized in the following way. Section 2 presents a two-period model in which both saving and labor supply are alternative sources of present disutility and future income. With gross-of-tax wage and interest rates fixed, the individual is assumed to make his saving and labor supply decisions simultaneously, prior to the resolution of uncertainty about the tax base. In section 3, we analyze the effect of an expected, iso-revenue increase in tax-base uncertainty on the welfare of a representative taxpayer-consumer. Finally, in Section 4 we summarize our findings and provide some concluding remarks.

II. THE MODEL

The setting for our analysis is the partial equilibrium model, in which a representative consumer lives for two periods, the "present" and "future". The individual is endowed with M units of the numeraire good and T units of time and derives

utility from present consumption of the numeraire(c) and leisure or non-market time(n) and from future nominal income(Y). Assume that c , n , and Y are normal goods. Future nominal income consists of the gross return to saving($s = M - c$) and the earnings from market labor($h = T - n$). The numeraire, c , has a price of unity. The wage rate and interest rate are denoted w and r , respectively. In this model, a comprehensive income tax is assumed so that the same rate applies to income from saving and labor supply. Here, the rate at which saving(capital income) and labor income are taxed is non-stochastic.

In the presence of tax-base uncertainty, the tax base α is a random variable. The after-tax gross return to saving is given by $[1 + r(1 - \alpha)](M - c)$; that is, some random fraction α of interest income is subject to a tax rate t . When $\alpha = 1$, all interest income is taxable, whereas interest income is excluded from the tax base, when $\alpha = 0$. Labor income is also taxed at rate t ; however, only the random fraction α of labor income is included in the income tax base. Thus, net-of-tax labor income is $w(1 - \alpha)(T - n)$. The future nominal after-tax-income from saving and labor supply amounts to

$$(1) Y = [1 + r(1 - \alpha)](M - c) + w(1 - \alpha)(T - n) > 0$$

and accrues in the future period.² In this case, Y is random because the tax base is random.

The assumption that income from labor supply accrues in the future period implies that the consumer cannot liquidate for present consumption the capital value of human capital endowment. Thus, the consumer is acted in an institutional environment where labor income is not paid in advance of having supplied labor. As a result, the returns to present saving and labor supply are received by the consumer contemporaneously in the future period.

Assume that the consumer has a von Neumann-Morgenstern utility function $U(c, n, Y)$, which is three continuously differentiable, concave(implying risk aversion), and intertemporally separable³ so that $U_{cY} = U_{nY} = 0$.⁴ The consumer's problem is to choose c and n to maximize

²The consumer's problem can be interpreted as a rolling plan model with a one-period horizon. When the future period becomes the present, future income(Y) becomes the endowment M . By assuming $Y > 0$, we confine attention to interior solutions and rule out bankruptcy.

³See Killingsworth(1983, p.221) for a discussion of some implications of the assumption of intertemporal separability for dynamic models of labor supply. If this assumption is relaxed, third-order cross-partial derivatives of the utility function would arise in the sufficient conditions on preferences to determine the comparative statics effects of tax-base uncertainty. In particular, assumptions that "own" effects(U_{YY}) dominate "cross" effects(e.g., U_{cY}) would be required, in a condition analogous to (17) below, in order to extend our results for the time-separable case to the nonseparable case.

⁴Throughout, we use subscripts to denote differentiation, so that, for example, U_{cn} denotes the cross-partial derivative of U with respect to c and n

$$(2) V(c, n, Y) = EU(c, n, Y) = \int U(c, n, Y) dF(\alpha)$$

where α is a random variable defined over $[0, 1]$ and $F(\alpha)$ is the subjective probability distribution function of α .⁵

Let $f(\alpha; \varnothing)$ be a member of a family of probability density functions indexed by α and denoted by $F(\alpha; \varnothing) = \int dF_k(k; \varnothing)$ the corresponding distribution function, where $\alpha = \bar{\alpha} + \varnothing\epsilon$, and \varnothing is a random variable with zero mean and finite variance, and \varnothing is the risk parameter. Uncertainty about the tax base is represented by a probability distribution function $F(\alpha; \varnothing)$, which is assumed to be continuously differentiable with a support contained in a compact interval. An increase in the risk parameter \varnothing induces an increase in risk about the tax base α , in the sense of Rothschild and Stiglitz (1970); i.e., a mean-preserving increase in risk (increase in uncertainty), if the change in F satisfies the two integral conditions:

$$(3) \int_0^1 F_{\varnothing}(\alpha; \varnothing) d\alpha = 0$$

and

$$(4) \int_0^b F_{\varnothing}(\alpha; \varnothing) d\alpha \geq 0$$

for all b , with the strict inequality holding for some non-extreme values and the equality in (4) holding for the extreme values of b .

The first-order conditions for an interior maximum of (2) are

$$(5) 0 = V_c = U_c - E[1 + r(1 - \alpha t)] U_Y$$

and

$$(6) 0 = V_n = U_n - wE(1 - \alpha t) U_Y.$$

Moreover, the assumption of risk aversion ($U_{YY} < 0$) implies

$$(7) V_{cc} = U_{cc} + E[1 + r(1 - \alpha t)]^2 U_{YY} < 0$$

$$(8) V_{nn} = U_{nn} + E[w(1 - \alpha t)]^2 U_{YY} < 0$$

$$(9) V_{cn} = U_{cn} + E[1 + r(1 - \alpha t)][w(1 - \alpha t)] U_{YY}.$$

⁵Note that we omit the limits of integration when integration is performed over the full range of the random variable.

If c and n are Edgeworth-Pareto substitutes ($U_{cn} < 0$),⁶ then V_{cn} is negative. The consumer's choice of a present consumption bundle is denoted by (c^*, n^*) so that optimal saving and labor supply are $s^* = M - c^*$ and $h^* = T - n^*$, respectively. In this framework, the individual is assumed to make his saving and labor supply decisions simultaneously, prior to the resolution of uncertainty about future income.

From the first-order conditions (5) and (6) for intertemporal utility maximization (2), the comparative statics effects of the tax-base risk on consumption and leisure can be derived using a general definition of increased risk formulated by Rothschild and Stiglitz(1970), who stated preference conditions sufficient to sign the response of the optimal values of the decision variables to increased risk if it satisfies the two conditions (3) and (4). However, since we are concerned with obtaining conditions on preference sufficient to determine that increased tax-base uncertainty increases economic welfare, we do not explicitly analyze the effect of increased tax uncertainty on saving and labor supply.⁷

III. THE WELFARE EFFECTS

In this section, we determine that conditions on preference are sufficient to conclude that increased tax-base risk increases economic welfare under circumstances in which greater uncertainty increases expected tax revenues. If greater tax-base risk is not accompanied by any kind of compensating government policies, then randomization of the tax-base unambiguously decreases a risk-averse individual's welfare. Suppose, however, that greater tax-base risk increases expected tax revenues and that the government lowers the tax rate so as to maintain expected revenue constant. The individual is made worse off by the greater risk arising from greater tax-base uncertainty but is made better off by the lower tax rate. We assume that the second effect dominated the first so that uncertain tax policies increase social welfare.

To analyze these welfare effects, we follow Stiglitz(1982) and assume that an individual faces the tax base $(\alpha + \pi)$ with probability $1/2$ and faces the tax base $(\alpha - \pi)$ with probability $1/2$, where $\pi > 0$.⁸ The government chooses π in order to maximize the expected utility, W , of the individual,⁹ subject to the constraints that

⁶Richard(1975) defines multivariate risk-averse preferences and demonstrates their equivalence to the restriction that U_{cn} be less than zero.

⁷The case of the effects of uncertain taxation on saving and labor supply is considered in greater detail in Itae Kim, Arthur Snow, and Ronald S. Warren, Jr.(1990).

⁸The introduction of π corresponds to an increase in risk in terms of a mean-preserving spread in the distribution of a random variable which keeps the mean of the distribution constant and represents a movement of probability density from the center to the tails of the distribution, in the sense of Rothschild and Stiglitz(1970;1971).

⁹Since all individuals are assumed to be identical, maximizing the individual's expected utility is equivalent to maximizing the expected social welfare level.

the individual act optimally and that the government keep the expected tax revenues constant. Formally, the government's objective function is

$$(10) \quad W = \max \frac{1}{2} \{ U[c, n, [1 + r(1 - (\alpha + \pi)t)] (M - c) + w[1 - (\alpha + \pi)t] (T - n)] \\ + U[c, n, [1 + r(1 - (\alpha - \pi)t)] (M - c) + w[1 - (\alpha - \pi)t] (T - n)] \}.$$

The revenue constraint is

$$(11) \quad G = \alpha t [r(M - c) + w(T - n)].$$

If, at $\pi = 0$, it is the case that

$$\left. \frac{dW}{d\pi} \right|_{\pi=0} = 0 \quad \text{but} \quad \left. \frac{d^2W}{d\pi^2} \right|_{\pi=0} > 0,$$

then the introduction of uncertainty increases individual welfare.

In the appendix, it is shown that the first-order and second-order conditions for the government's optimization problem, evaluated at $\pi = 0$, are

$$(12) \quad \left. \frac{dW}{d\pi} \right|_{\pi=0} = 0$$

$$(13) \quad \left. \frac{d^2W}{d\pi^2} \right|_{\pi=0} = t^2 [r(M - c) + w(T - n)]^2 U_{YY}(c, n, Y) \\ - \alpha [r(M - c) + w(T - n)] U_Y \left. \frac{d^2t}{d\pi^2} \right|_{G=\bar{G}},$$

where $\left. \frac{dt}{d\pi} \right|_{G=\bar{G}}$ is the change in the tax rate that is necessary to keep expected

government revenue constant at \bar{G} and $\left. \frac{d^2t}{d\pi^2} \right|_{G=\bar{G}}$ is the second derivative.

Therefore, the necessary and sufficient condition for greater tax-base risk to increase social welfare is that

$$(14) \quad \left. \frac{d^2t}{d\pi^2} \right|_{G=\bar{G}} < \frac{t^2 [r(M - c) + w(T - n)] U_{YY}}{\alpha U_Y};$$

that is, $\left. \frac{d^2t}{d\pi^2} \right|_{G=\bar{G}}$ must be negative and greater in absolute value than the right-hand side of inequality (14).

From (11), we obtain

$$(15) \left. \frac{d^2t}{d\pi^2} \right|_{G=\bar{G}} = \frac{t[r(\partial^2c/\partial\pi^2) + w(\partial^2n/\partial\pi^2)]}{[r(M-c) + w(T-n)] - t[r(\partial c/\partial t) + w(\partial n/\partial t)]}$$

when evaluated at $\pi = 0$. If the tax rate is restricted to a level such that a greater tax rate yields more expected tax revenues, then the denominator of equation(15) is positive. Consequently $\left. \frac{d^2t}{d\pi^2} \right|_{G=\bar{G}}$ is negative if $\frac{\partial^2c}{\partial\pi^2}$ is large (and negative) relative to $\frac{\partial^2n}{\partial\pi^2}$.

From the first-order conditions for a maximum of (2), in response to an increase in π , individual decreases consumption, if c and n are normal goods, the utility function exhibits non-decreasing absolute risk aversion (NDARA), and the restrictions on preference are satisfied:

$$(16) U_{cn} \leq 0,$$

$$(17) 2U_{YY} + YU_{YYY} > 0,^{10}$$

and

$$(18) 2U_{YY} + (1-\alpha t)(rs^* + wh^*)U_{YYY} < 0.$$

That is, the condition under which the introduction of some risk into an initially riskless setting increases welfare is the same as the condition under which greater risk decreases consumption and the effect of tax-base uncertainty on consumption is greater than that of tax-base uncertainty on leisure.

Clearly, the condition for the greater tax-base risk to increase welfare is that tax-base risk increases saving ($d^2s/d\pi^2 > 0$) and this effect is large relative to $d^2h/d\pi^2$. This condition suggests that this case occurs under circumstances under which greater uncertainty increases expected tax revenues. If the effects of the reduction in the tax rate dominate the risk effect, then greater risk about the tax base increases social welfare.

IV. CONCLUSIONS

The model studied in this paper assumes that individuals make saving and labor supply decisions simultaneously, prior to the resolution of uncertainty about the

¹⁰By definition, non-increasing absolute risk aversion (NIARA) requires $U_{YYY} \geq U_{YY}^2/U_Y$ and relative risk aversion (RRA) above two requires $-YU_{YY}/U_Y > 2$ or, equivalently, $U_{YY}^2/U_Y > -2U_{YY}/Y$. Thus, NIARA and $RRA > 2$ imply $U_{YYY} > -2U_{YY}/Y$.

tax base. We have established conditions on preference that determine the effect of an expected, iso-revenue increase in tax-base uncertainty on economic welfare of a representative individual using individual's joint decision concerning saving and labor supply. To carry out this analysis, we used a two-period model in which both saving and labor supply are sources of present disutility and of future income.

We demonstrate that, in the case where greater tax-base risk increases tax revenues, if the government lowers tax rates so as to keep expected tax revenues constant, the welfare effect of an uncertain tax base is positive. The condition that ensures that the introduction of randomization of the tax base is desirable is that such risk increases saving and the effect of tax-base uncertainty on saving is greater than that of tax-base uncertainty on labor supply.

APPENDIX

This appendix provides derivation of first and second-order condition obtained in this paper. To derive equations(12) and (13), we differentiate W with respect to π and obtain

$$\begin{aligned}
 \text{(A-1)} \quad \frac{dW}{d\pi} &= 1/2 \, t[r(M-c) + w(T-n)] \{ -U_Y [c, n, [1 + r(1 - (\alpha + \pi)t)]] \\
 &\quad (M-c) + w(1 - (\alpha + \pi)t) (T-n)] + U_Y [c, n, [1 + r(1 - (\alpha - \pi)t)]] (M-c) + \\
 &\quad w(1 - (\alpha - \pi)t) (T-n)] \} \\
 &\quad + W_c \frac{dc}{d\pi} \\
 &\quad + W_n \frac{dn}{d\pi} \\
 &\quad - \frac{1}{2} [r(M-c) + w(T-n)] \{ U_Y [c, n, [1 + r(1 - (\alpha + \pi)t)]] (M-c) + \\
 &\quad w(1 - (\alpha + \pi)t) (T-n)] (\alpha + \pi) + U_Y [c, n, [1 + r(1 - (\alpha - \pi)t)]] (M-c) + \\
 &\quad w(1 - (\alpha - \pi)t) (T-n)] (\alpha - \pi) \} \frac{dt}{d\pi} ,
 \end{aligned}$$

$$\text{where } W_c = \frac{\partial W}{\partial c} \text{ and } W_n = \frac{\partial W}{\partial n} .$$

To evaluate (A-1), we use equation(11) to obtain

$$\text{(A-2)} \quad \left. \frac{dt}{d\pi} \right|_{G=\bar{G}} = t[r(dc/d\pi) + w(dn/d\pi)]/[r(M-c) + w(T-n)].$$

$$\text{Since } dc/d\pi = \frac{\partial c}{\partial \pi} + \frac{\partial c}{\partial t} (dt/d\pi) \text{ and}$$

$$dn/d\pi = \frac{\partial n}{\partial \pi} + \frac{\partial n}{\partial t} (dt/d\pi),$$

$$(A-3) \left. \frac{dt}{d\pi} \right|_{G=\bar{G}} = \frac{t[r(\partial c/\partial \pi) + w(\partial n/\partial \pi)]}{[r(M-c) + w(T-n)] - t[r(\partial c/\partial t) + w(\partial n/\partial t)]}$$

Since preferences are assumed to be intertemporally separable,

$$(A-4) \frac{\partial c}{\partial \pi} = 0 \text{ and } \frac{\partial n}{\partial \pi} = 0.$$

At $\pi=0$, the first term of (A-1) is obviously zero; the second and third terms are zero since utility maximization implies

$$(A-5) W_c = W_n = 0,$$

and the fourth term is zero since, from (A-3) and (A-4), $\left. \frac{dt}{d\pi} \right|_{G=\bar{G}} = 0$

Thus, equation (12) is obtained.

To evaluate $\left. \frac{d^2 W}{d\pi^2} \right|_{\pi=0}$, we differentiate (A-1) with respect to π and obtain

$$(A-6) \frac{d^2 W}{d\pi^2} = \frac{1}{2} t^2 [r(M-c) + w(T-n)]^2 \{ U_{YY} [c, n, [1 - r(1 - (\alpha + \pi)t)] (M-c) + w(1 - (\alpha + \pi)t) (T-n)] + U_{YY} [c, n, [1 + r(1 - (\alpha - \pi)t)] (M-c) + w(1 - (\alpha - \pi)t) (T-n)] \} \\ + \frac{1}{2} t [r(M-c) + w(T-n)] \{ -dU_Y [c, n, [1 + r(1 - (\alpha + \pi)t)] (M-c) + w(1 - (\alpha + \pi)t) (T-n)]/dc + dU_Y [c, n, [1 + r(1 - (\alpha - \pi)t)] (M-c) + w(1 - (\alpha - \pi)t) (T-n)]/dc \} \frac{dc}{d\pi} \\ + \frac{1}{2} t [r(M-c) + w(T-n)] \{ -dU_Y [c, n, [1 + r(1 - (\alpha + \pi)t)] (M-c) + w(1 - (\alpha + \pi)t) (T-n)]/dn + dU_Y [c, n, [1 + r(1 - (\alpha - \pi)t)] (M-c) + w(1 - (\alpha - \pi)t) (T-n)]/dn \} \frac{dn}{d\pi} \\ + \frac{\partial^2 W}{\partial c^2} (dc/d\pi)^2 \\ + \frac{\partial^2 W}{\partial n^2} (dn/d\pi)^2 \\ + t [r(M-c) + w(T-n)]^2 \{ U_{YY} [c, n, [1 + r(1 - (\alpha + \pi)t)] (M-c) + w(1 - (\alpha + \pi)t) (T-n)] (\alpha + \pi) - U_{YY} [c, n, [1 + r(1 - (\alpha - \pi)t)] (M-c) + w(1 - (\alpha - \pi)t) (T-n)] (\alpha - \pi) \} \frac{dt}{d\pi}$$

$$\begin{aligned}
& + 1/2 [r(M-c) + w(T-n)] \{ -U_Y [c, n, [1 + r(1-(\alpha + \pi)t)] (M-c) + \\
& w(1-(\alpha + \pi)t) (T-n)] \} (1 + \alpha) \frac{dt}{d\pi} \\
& - 1/2 \{ [r(M-c) + w(T-n)] \frac{1}{dc} d\{ U_Y [c, n, [1 + r(1-(\alpha + \pi)t)] \\
& (M-c) + w(1-(\alpha + \pi)t) (T-n)] (\alpha + \pi) + U_Y [c, n, [1 + r \\
& (1-(\alpha - \pi)t)] \\
& (M-c) + w(1-(\alpha - \pi)t) (T-n)] (\alpha - \pi) \} (dc/d\pi) \} (dt/d\pi) \\
& - 1/2 \{ [r(M-c) + w(T-n)] \frac{1}{dn} d\{ U_Y [c, n, [1 + r(1-(\alpha + \pi)t)] \\
& (M-c) + w(1-(\alpha + \pi)t) (T-n)] (\alpha + \pi) + U_Y [c, n, [1 + r(1-(\alpha - \pi)t)] \\
& (M-c) + w(1-(\alpha - \pi)t) (T-n)] (\alpha - \pi) \} (dn/d\pi) \} (dt/d\pi) \\
& - 1/2 [r(M-c) + w(T-n)] \{ U_Y [c, n, [1 + r(1-(\alpha + \pi)t)] (M-c) + \\
& w(1-(\alpha + \pi)t) (T-n)] (\alpha + \pi) + U_Y [c, n, [1 + r(1-(\alpha - \pi)t)] (M-c) + \\
& w(1-(\alpha - \pi)t) (T-n)] (\alpha - \pi) \} (d^2t/d\pi^2) \\
& + 1/2 [r(M-c) + w(T-n)]^2 \{ U_{YY} [c, n, [1 + r(1-(\alpha + \pi)t)] (M-c) + \\
& w(1-(\alpha + \pi)t) (T-n)] (\alpha + \pi)^2 + U_{YY} [c, n, [1 + r(1-(\alpha - \pi)t)] \\
& (M-c) + w(1-(\alpha - \pi)t) (T-n)] (\alpha - \pi)^2 \} (dt/d\pi)^2 \\
& + W_c (d^2c/d\pi^2) \\
& + W_n (d^2n/d\pi^2) \\
& + \frac{\partial^2 W}{\partial c \partial \pi} (dc/d\pi) \\
& + \frac{\partial^2 W}{\partial n \partial \pi} (dn/d\pi) \\
& + \frac{\partial^2 W}{\partial c \partial t} (dt/d\pi) (dc/d\pi) + \frac{\partial^2 W}{\partial n \partial t} (dt/d\pi) (dn/d\pi)
\end{aligned}$$

The second, third, sixth, and seventh terms are at $\pi = 0$; the twelfth and thirteenth terms are zero because of (A-5); the fourth, fifth, eighth, ninth, fourteenth, and fifteenth terms are zero because of (A-4); and the sixth, seventh, eleventh, sixteenth, and seventeenth terms are zero because, at $\pi = 0$, $dt/d\pi = 0$ [from (A-3) and (A-4)]. Thus, equation(13) is obtained.

REFERENCES

- ALM, J.(1988), "Uncertain Tax Policies, Individual Behavior, and Welfare," *American Economic Review*, March, 78, pp.237-45.
- CHANG, F.R. and WILDASIN, D.E.(1986), "Randomization of Commodity Taxes: An Expenditure Minimization Approach", *Journal of Public Economics*, December, 31, pp.329-45.
- KILLINGSWORTH, M. R.(1983), *Labor Supply*, Cambridge University Press, Cambridge.
- KIM, ILTAE, SNOW, A., and WARREN, R.S.(1990), "The Effects of Uncertain Taxation on

Saving and Labor Supply", mimeo, University of Georgia.

KNIGHT, F.H.(1921), *Risk, Uncertainty, and Profit*, Houghton Mifflin, New York.

RICHARD, S.F.(1975), "Multivariate Risk Aversion, Utility Independence and Separable Utility Functions," *Management Science*, September, 22, pp.12-21.

ROTHSCHILD, M. and STIGLITZ, J.E.(1970), "Increasing Risk: I. A Definition," *Journal of Economic Theory*, September, 2, pp. 225-43.

_____ and _____ (1971), "Increasing Risk II: Its Economic Consequences," *Journal of Economic Theory*, March, 3, pp. 66-84.

SKINNER, J.(1988), "The Welfare Cost of Uncertain Tax Policy," *Journal of Public Economics*, November, 37, pp. 129-45.

STIGLITZ, J. E.(1982) "Utilitarianism and Horizontal Equity," *Journal of public Economics*, June, 18, pp. 1-33.

WEISS, L.(1976), "The Desirability of Cheating Incentives and Randomness in the Optimal Income Tax," *Journal of Political Economy*, December, 84, pp. 1343-52.