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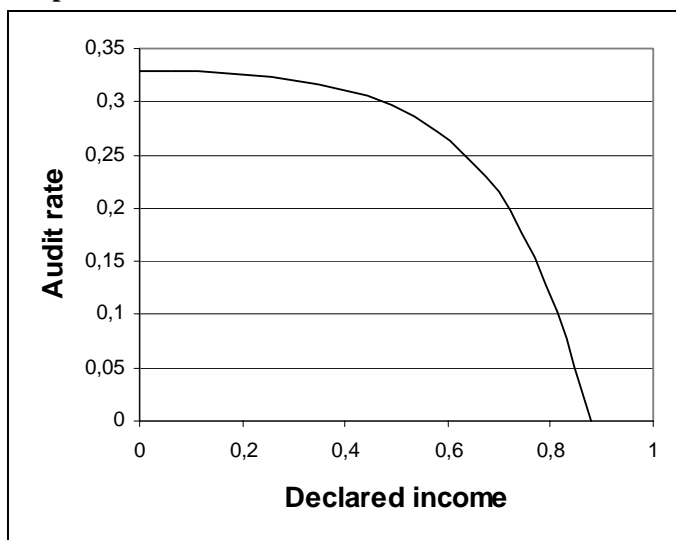
The Effect of Audit Strategy Information on

The Becker model was first applied to tax fraud by Allingham & Sandmo (1973), who used a concave utility function, i.e. one with decreasing marginal utility, in order to determine the optimal amount of fraud when the audit rate is constant and known to the taxpayer. Other applications, which also included the behaviour of the auditor, have been studied by Reinganum & Wilde (1986) and Erard & Feinstein (1994). The theoretical tax fraud models are well described in a survey by Andreoni, Erard & Feinstein (1998).

Reinganum & Wilde (1986) studied the optimal allocation of audit resources to a homogenous group of taxpayers when the cost per audit is given. Such a homogenous group may consist of craftsmen in one-man enterprises or taxi companies with one car. An important assumption is that the only information available to the auditor regarding the individual taxpayer is the declared income. In addition, the auditor knows the distribution of true income, for instance from earlier random audits.

In the model developed by Erard & Feinstein (1994), the cost of an audit is replaced by a constraint that the number of audits is given. The authors also improved the model by introducing the concept of a known fraction of honest taxpayers, i.e. taxpayers who always declare their true income. The remaining taxpayers are assumed to behave rationally. The model has been further developed by Appelgren (2003).

Figure 1: A typical optimal audit-rate function



The basis of the models developed by Reinganum & Wilde and Erard & Feinstein is that the auditor observes declared income only and bases his audit decision on this observation. The models lead to an optimal audit-rate function which decreases with declared income, as illustrated in Figure 1.

PREVIOUS EMPIRICAL RESEARCH

The effects of information about audit activity have been studied previously in field experiments in Minnesota, USA, the United Kingdom and Australia. The limited number of experiments is probably due to high costs and confidentiality issues involved in the use of actual taxpayer data. In the Minnesota and UK experiments, the

effect of tax advisors (paid preparers) is studied since this may have influence on the effect of audit information.

In the Minnesota experiment (Blumenthal et al, 2001), taxpayers were informed that their tax returns would be audited; this led to significantly higher declared incomes for high-opportunity groups (taxpayers with business or farm income) with low and medium incomes. The same effect was not noted for high income earners. A possible explanation for this surprising result is that high-income earners increased their use of tax advisors under the threat of audit, and that those advisors were able to identify legal means for tax evasion, leading to lower declared income.

In the UK experiment (Hasseldine et al, 2007), more than 7,300 small enterprises were studied. They were considered to belong to a high-risk group, with a turnover just below the limit above which a more detailed tax reporting would be required. The companies were divided into six groups, one control group

Does information about a rational audit strategy with a decreasing audit rate reduce tax fraud as compared to information about a random audit strategy?

TEST DESIGN

This paper concerns an empirical test of the effect of information to taxpayers concerning different audit strategies. The test was carried out by the Linköping Regional Office of the Swedish Tax Agency in 2003-2004 on approximately 900 sole proprietors. The primary objective was to investigate whether information to taxpayers about a near-optimal audit strategy reduces tax fraud compared to information about a more conventional audit strategy, i.e. pure random audits. Information concerning the use of tax advisors/paid preparers was not collected.

The opportunities for tax evasion for individuals with income from employment are limited in Sweden as employers supply the tax authorities with statements on employee remuneration. It is therefore natural to perform an experiment on a group of enterprises. In order to obtain a large homogenous group, sole proprietors mainly in craft trades were selected.

The test was conducted on sole proprietors without employees and with little or no income from employment (maximum SEK 10,000 in the year 2002, where 1 SEK is approximately equal to 0.1 Euro). These owners were supposed to support themselves with their business. Further, the sample was limited to men below the age of 55 in order to concentrate on a high risk group (younger men are more fraudulent than women and older men). The trades included were craftsmen in the building industry, auto-repair craftsmen and hairdressers. Those trades were selected by the Tax Agency as they are the largest groups of sole proprietorships.

According to the theoretical work referred to above, the optimal audit strategy for a homogeneous group of taxpayers is to concentrate audits on those who declare the lowest income. In the experiment, however, the total net cash flow of the household was used instead as the basis for audit selection. Net cash flow is defined as declared income after tax, adjusted for non-cash items like depreciation and allocation to tax allocation reserves, as well as for cash items not included in income such as amortisation and new borrowing.

Three groups were studied, each with around 300 firms.

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|-------------------|--|
| A. Rational Group | The members were informed by mail that audits would concentrate on taxpayers who declare the lowest net cash flow (Appendix 1) |
| B. Random Group | The members were informed by mail that taxpayers to be audited would be selected at random (Appendix 2) |
| C. Control Group | The members were informed by mail that audits would be carried out at random (Appendix 3) |

Agency expected a possible negative reaction to the audit letters, especially from the Rational Group. Therefore, a service phone number was provided in the audit letters. The Tax Agency registered a total of only 11 phone calls, none of which with negative or critical content.

The effect of the strategy information in the audit letters was measured by comparing declared income for 2003 with declared income for 2002. The hypothesis was that the Rational Group would show a larger increase compared to the Control Group, and that the Random Group would fall between the other two since all information to taxpayers regarding audits is assumed to have a certain deterrent effect.

In the analysis, it was evident that additional delimitations should have been made in the selection of taxpayers. First, firms with income from employment in the year 2003 should have been excluded, in consistency with the exclusion of such firms in 2002. Moreover, a ns wR

Table 1. Industry classification of participating firms, excluding firms with subcontractors

Industry	SNI code
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2.0%. If a change in audit strategy would result in a change in declared income by 4%, the change would be statistically significant at the 5% level.

Actual data for the three groups are shown in Tables 3 and 4. The expectation regarding the standard deviation was apparently wrong, as the standard deviation was 35-50% of the average income instead of 25%. Furthermore, the size of the groups was reduced due to the additional limitations made above. Therefore, the difference in income change between groups had to be between 6 and 10% in order to be statistically significant.

Table 3. Average income, average income change and standard deviation in income change, excluding firms with subcontractors

Amounts in SEK 1000	Group size	Average income 2002	Average increase 2002-2003	Standard deviation	Relative standard deviation
Rational Group	118	134	27.2	50	37%
Random Group	158	150	17.0	58	39%
Control Group	142	149	13.4	56	38%

Table 4. Average income, average income change and standard deviation in income change, including firms with subcontractors

Amounts in SEK 1000	Group size	Average income 2002	Average increase 2002-2003	Standard deviation	Relative standard deviation
Rational Group	248	154	19.5	77	50%
Random Group	269	164	14.0	55	34%
Control Group	251	157	11.6	54	34%

Testing

The results of a simple statistical test are shown in Tables 5 and 6, where the

In regard to the income change, the Random Group falls between the two other groups. However, the Random Group does not show a significantly higher income change than the Control Group, nor does it show a significantly lower income change than the Rational Group. The groups have thus been too small to permit any clear conclusions as to whether the results are due to the effect of information in general or to the effect of information on the near-optimal audit strategy.

For the case of *Subcontractors Included* (Table 6), no significant income changes have

Median tests

In addition to the tests above, using the average income/profit increase between years, we have also studied the median of the income/profit increase since this parameter is independent of extreme outliers. In three of the four cases, the Rational Group is significantly better than the Control Group, thus the results are quite similar to those obtained from using the increase in average income/profit.

Test summary

Comparisons have been drawn for the three groups in eight combinations (average/median, income/profit, with/without subcontractors). In addition, the average profit case has been studied with and without extreme outliers. Thus, ten cases in all have been evaluated. In nine of these, the ordering of the three groups was as expected, i.e. with the greatest changes between years for the Rational Group and the smallest changes for the Control Group.

Table 7. Significance level for eight tests

Significance level	Rational Group vs Control Group	Rational Group vs Random Group
Subcontr. Excluded		
Average income change	3.6%	12%
Average profit change, extreme outliers excluded	3%	45%
Median income change	12%	25%
Median profit change	5.0%	91%
Subcontr. Included		
Average income change	18%	35%
Average profit change, extreme outliers excluded	0.4%	0.7%
Median income change	1.9%	13%
Median profit change	1.0%	19%

In six of the eight cases, the income/profit increase was significantly larger for the Rational Group than for the Control Group. In view of the limited volume of data in the study, however, it cannot be determined with statistical significance whether this result is due to the quality of the rational audit strategy or to the audit information in general.

DISCUSSION AND CONCLUSIONS**Method of measurement**

The selected method of measuring changes in tax-fraud behaviour by changes in declared income or profit between years, is low in cost but has several drawbacks. Income and profit changes may have other causes, such as changes in business volume, changes in profitability, investment, sale of assets etc. The data include several firms with zero sales in one or both years, those firms were not excluded as the low declared sales volume may be due to large-scale fraud.

A better measure of fraud would possibly be obtained with random audits but this method is much more costly. As shown below, random audits were made in the Random Group, but unfortunately not in the other groups. It should be remarked that

audits do not discover all fraud, especially not hidden income which is kept out of the accounts.

The quality of the study may have been affected by the use of net household cash flow as a parameter for the audit strategy when the effect of the strategy is measured as the change in declared income. A taxpayer with a high net household cash flow, perhaps due to employment income from his spouse, has no incentive to reduce any fraudulent behaviour as he does not expect to become audited. On the other hand, the incentive works as intended for taxpayers with a low net household cash flow.

Main conclusions

The statistical tests indicate strongly that information concerning the use of rational, “near-optimal” audit strategies is superior to information concerning random audits and that audit information is general is superior to no information.

It can be stated with statistical significance

net cash flow. In the enclosure to this letter, you can see a sample calculation of net cash flow.

If most of the taxpayers in the group have a lower net cash flow than you, your tax return will not be audited. On the other hand, if your tax return is one of those with the lowest net cash flow, it will be selected for audit.

There need not be any error

There need not be any error in your tax return just because you have a low net cash flow. But a low net cash flow may be an indication of unreported income.

This audit concerns your business income. If you also have income from employment or capital, your tax return may be audited for other reasons – in that case there would be no difference between your tax return and all others.

Advance notice

Normally an audit comes as a surprise. We now want to test what happens when let taxpayers know before they file their tax returns how we will select which returns will be audited. We hope that as a result more taxpayers will file correct returns in the first place.

If you have questions regarding this letter, please call NN at XX.

Best regards
Bertil Olofson
Director, Linköping Region

Best regards
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Director, Linköping Regional Office, Swedish Tax Agency

APPENDIX 3: DISTRIBUTION OF INCOME CHANGE BETWEEN YEARS

The distributions of income change for the *Rational* and *Control* groups in the case *Subcontractors Excluded* are shown in Figures A3:1 and A3:2. Is the income change between 2002 and 2003 normally distributed?

Figure A3:1. Distribution of income change for the Rational Group, Subcontractors Excluded

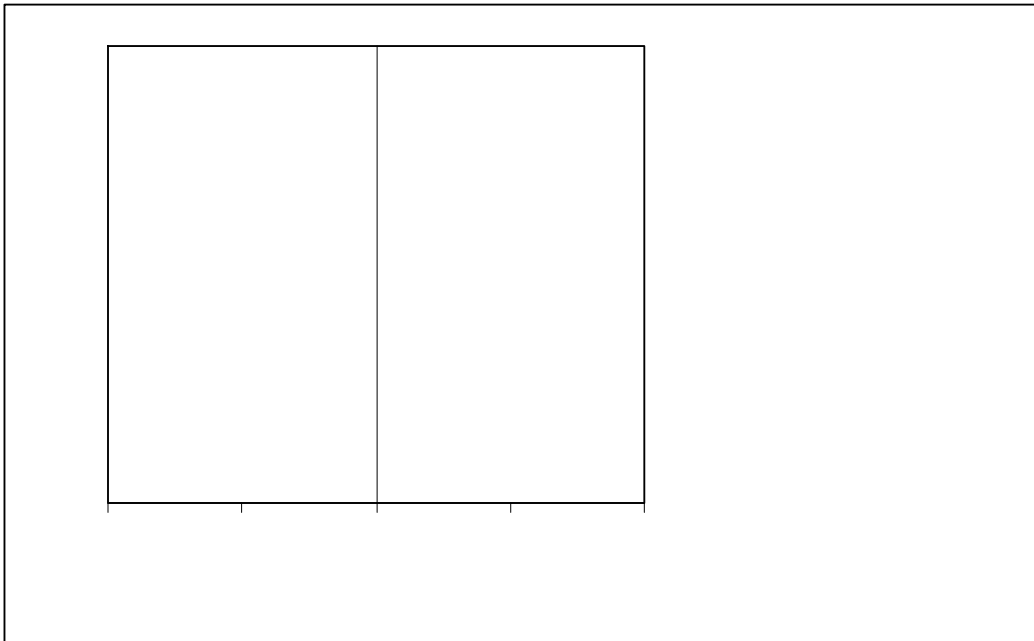


Figure A3:2. Distribution of income change for the Control Group, Subcontractors Excluded

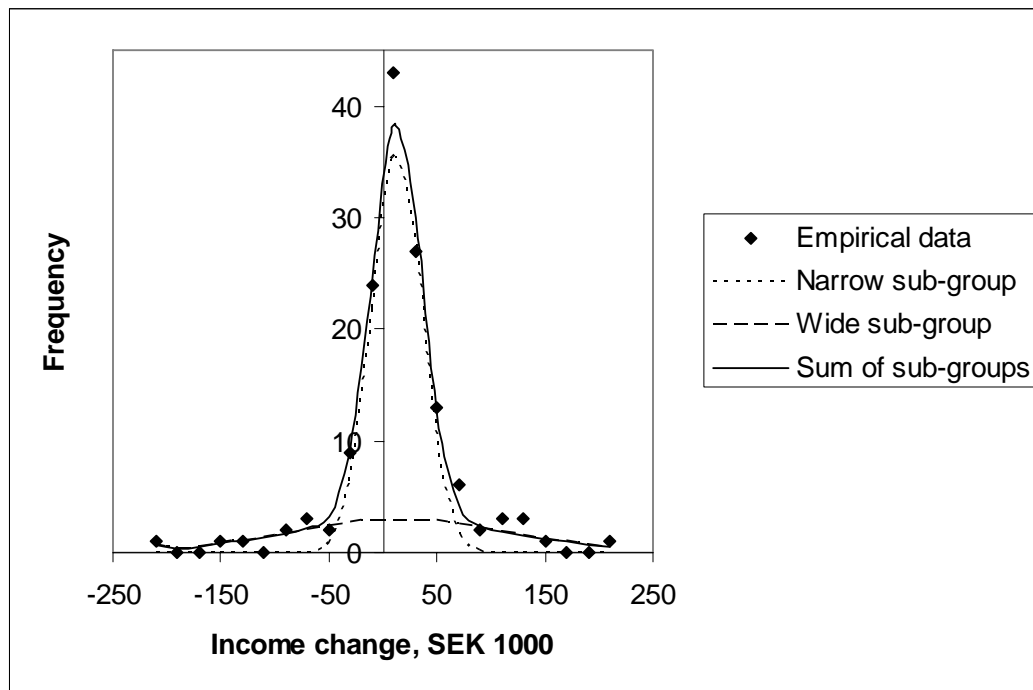


Table A3:1. Comparison between standard deviation and quartile distance

Amounts in SEK 1000	Group	Standard dev.	Quartile distance	Ratio
Subcontractors Excluded	Rational	50	56	0.89
	Random	58	48	1.21
	Control	56	36	1.56
Subcontractors Included	Rational	77	56	1.37
	Random	55	53	1.04
	Control	54	42	1.29

A possible approximation of the income change distribution is that each group consists of two normally distributed sub-groups, one with a small standard deviation (narrow

Table A3:2. Maximum likelihood estimates for two normally distributed sub-groups, subcontractors excluded

Amounts in SEK 1000	Narrow sub-group			Wide sub-group		
	Mean	Standard deviation	Weight factor	Mean	Standard deviation	Weight factor
Rational Group	16.6	26.2	0.539	39.5	66.1	0.461
Random Group	12.9	21.2	0.678	20.7	93.5	0.322
Control Group	12.9	22.4	0.734	15.7	101.4	0.266

It is striking that the mean values and standard deviations for the three narrow sub-groups are so similar. This finding gives rise to a hypothesis that the populations consist of two distinct groups, one with stable income from year to year and one with volatile income. When information regarding future audits is supplied, the members of the volatile group respond with an increase in declared income, i.e. there is a reduction in fraud.

It must be emphasised that the above results are quite uncertain because of the limited size of the groups. The same results were not obtained for the case *Subcontractors Included*, possibly because those groups are less homogenous.

APPENDIX 4: DIRECT AND INDIRECT EFFECTS

The Swedish Tax Agency has carried out audits according to its announced strategies, i.e. on taxpayers with the lowest net household cash flow in the Rational Group and randomly in the Random Group. No audits were conducted in the Control Group. An equal number of audits were made in the Rational and Random groups. They resulted in SEK 846,000 and SEK 260,000 respectively in increased taxes and tax penalties. Thus the direct effect of a transition from random to rational audits is SEK 586,000, a strong indicator that the latter strategy is considerably more efficient than random auditing.

The direct effect should be compared to the indirect, deterrent effect, which for the case of *Subcontractors Excluded* is an average income increase amounting to SEK 10,200 according to Table 7, i.e. SEK 1,204,000 for 118 taxpayers. With the Swedish local tax rate around 30%, the indirect effect on public revenues would be about SEK 360,000. The corresponding numbers for the case of *Subcontractors Included* are SEK 5,500 for 248 taxpayers, with a revenue effect of roughly SEK 410,000.

Since the Tax Agency did not exclude taxpayers with subcontractors in the selection of audit targets, the comparison should be made with the case *Subcontractors Included*. The direct effect of switching from random to rational audits, SEK 586,000, should thus be compared to the indirect effect of SEK 410,000.