E C O N O M I C S B U L L E T I N

Auditing ghosts by prosperity signals

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Abstract

Ghosts are economic agents who evade taxes by failing to file a return. Knowing nothing about them, the tax agency is unable to track them down through audit strategies which are based on reported income. The present paper develops a simple model of the audit decision for a ghost−busting tax agency which bases its audit strategy on signals of prosperous living, such as ownership of high−quality housing. Ghosts have a preference for high−quality housing, but may opt to own houses of a lower quality so as to escape detection. The paper compares the optimal audit rules and net tax collection under signal and blind auditing of the non−declaring population, deriving conditions under which each strategy will dominate the other.

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1. INTRODUCTION

Ghosts, in tax administration jargon, are economic agents (individuals or firms) who evade their taxes by failing to file an income tax return. Knowing nothing about them, the tax agency (henceforth, the IRS) is unable to track them down through audit strategies which are based on reported income. Although posing a major challenge for the design of audit policy, the phenomenon of ghosts has gained very little attention in the tax compliance literature.[1] A notable exception are Cowell and Gordon (1997), who demonstrated, in a context of sales tax evasion, that the existence of ghosts might cause a policy as unsophisticated as random audit to dominate a deterministic strategy such as Reinganum and Wilde's (1985) cut-off rule.[2] Cowell and Gordon, however, addressed the problem of audit design *in the presence* of ghosts. No strategy has been offered in the literature for auditing ghosts themselves.

How then can the IRS track down ghosts? One possibility is to use the population census to investigate individuals of working age who have never filed a return. Another option is to rely on paid informants.[3] Yet there seems to be a more promising way of searching for ghosts. As Cowell (1990) remarked, "even ghosts provide information if you know where to look" (p. 180). Unlike their macabre counterparts, tax ghosts want to live. And since they have evaded their taxes, they may have the ability to live well. The IRS may therefore look for signals of prosperous living (e.g., villas, yachts, latest-model cars) in the economy and audit big spenders for whom it has no records: anyone who spends lavishly but does not declare an income is a likely suspect.[4]

The present paper develops a simple model of the audit decision for a ghost-busting IRS which bases its audit strategy on the premise that one who appears to be living well must be of taxable capacity. More specifically, the IRS is assumed to observe individuals' ownership of high-quality housing, auditing a revenue-maximizing fraction of house owners who did not file a return. Ghosts have a preference for high-quality housing but, informed of the IRS strategy, may opt to own houses of a lower quality so as to escape detection. The paper compares the optimal audit rules and net tax collection under signal and blind auditing of the non-declaring population, showing that signal auditing will unambiguously dominate blind auditing when the burden of taxes is sufficiently low. Otherwise, blind auditing may be a dominant strategy, the conditions for which are formally derived.

2. THE FORMAL SETTING

Consider an economy consisting of workers and retirees only. A fraction α of the population participates in the labor force and a fraction $1-\alpha$ retires. Suppose that income can take just two values, high and low. A fraction β of the labor force earns the high income, h, and a fraction $1-\beta$ earns the low income. Suppose further that retirement is not compulsory, but rather an option considered by individuals who earned the high income in the past. Retirees and low income earners are exempt from paying taxes. Only high income earners must pay part of their income, x ($< h$), as taxes. The IRS does not observe income directly. High income earners are thus required to declare that they are so and remit their taxes to the IRS. A high income

earner might, however, evade his taxes through avoiding declaration, consequently becoming a ghost.[5] If caught, he will be obliged to pay a penalty in proportion λ to his evaded tax. His total payments to the IRS would then amount to fx, where $f = 1 + \lambda$. The IRS cannot influence x and f, which are determined in the law. Its sole objective is to select an audit strategy which maximizes the collection of tax revenue net of audit costs.

Individuals live in owned housing. There are only two types of housing, villas and apartments, denoted by V and A, respectively. A villa is of a higher quality than an apartment, thus more expensive to own (i.e. to purchase and maintain). Low income earners cannot afford to own a villa. Only high income earners (whether declaring their income or not) can. The IRS observes villas, viewing them as a signal of taxable capacity. However, villas may also be owned by retirees who earned the high income in the past and purchased their villas at that time.[6] By assumption, retirees do not owe taxes on past income (e.g., there was no income tax in the past).

High income earners are risk neutral. Their utility function is defined on the quality of housing, S (= V, A), and on income left for the consumption of other products. That is, $U = (I - \pi_s) + u(S)$, where I represents after-tax income and π_S (= π_V , π_A) denotes house owning costs. We may rewrite the utility function as $U = I + \varphi(S)$, where $\varphi(S) = u(S) - \pi_S$ denotes the utility derived from housing net of owning costs. For any given level of after-tax income, a high income earner is assumed to be better off owning a villa than in an apartment, hence $\varphi(V) > \varphi(A)$. Still, he may opt to own an apartment if he evades his taxes and the IRS is known to base its audit strategy on villa owning.

3. BLIND AUDITING

Suppose first that the IRS audits a fraction p of the non-declaring population, irrespective of villa owning (henceforth, "blind auditing"). A high income earner, informed of the IRS policy, will thus choose to own a villa regardless of whether or not he evades his taxes. Consequently, his decision of whether to declare his income or to become a ghost reduces to comparing his (expected) after-tax income in each case. He will become a ghost if $h - pfx > h - x$ and declare otherwise.[7] Hence, he will become a ghost if $p < 1/f$, and comply with the tax law if $p \geq 1/f$.

The IRS chooses an audit rate p^* which maximizes its expected net revenue, R, recognizing that the probability of a randomly audited individual to be of high income is $\alpha\beta$. Denoting by c the audit cost per unit, expected net revenue will be

$$R = \begin{cases} (\alpha\beta fx - c)\,pN & if \quad 0 \leq p < \dfrac{1}{f} \\ [\alpha\beta x - p(1-\alpha\beta)c]N & if \quad p \geq \dfrac{1}{f} \end{cases} \tag{1}$$

where N denotes the population size. Notice that if $p \geq 1/f$, the IRS is bound to audit retirees and low income earners only, as high income earners are induced to declare

their income. While the IRS must commit to this policy if it wishes to induce honesty, it will never raise p above $1/f$, as this would only increase audit costs without generating any additional revenue. Clearly, inducing honesty will be desirable if it raises more net revenue than a less stringent policy. A prerequisite for this is, of course, that the net revenue is positive; i.e., that tax collection, $\alpha\beta xN$, is at least as high as collection costs, $p(1-\alpha\beta)cN$. Substituting $p = 1/f$ reveals immediately that this condition also guarantees that inducing honesty is preferable to providing incentives for evasion through lowering the audit rate below $1/f$.[8] We thus conclude that the optimal audit rule for the IRS is

$$p^* = \begin{cases} \dfrac{1}{f} & \text{if} \quad \alpha\beta x \geq (1-\alpha\beta)\dfrac{c}{f} \\ 0 & \text{otherwise,} \end{cases} \tag{2}$$

which is analogous to a result obtained by Chaudhuri (1997) for a one-period problem of optimal auditing.[9]

4. SIGNAL AUDITING

Suppose now that the IRS audits a fraction p of villa owners who have not declared their income (henceforth, "signal auditing"). A high income earner, informed of the IRS policy, must now choose between three options:

(a) Declaring his income (henceforth "complying"), in which case his utility will be $\varphi(V) + h - x$.
(b) Becoming a ghost and purchasing a villa (henceforth, "signaling"), in which case his expected utility will be $\varphi(V) + h - pfx$.
(c) Becoming a ghost and purchasing an apartment (henceforth, "sheltering"), in which case his utility will be $\varphi(A) + h$.

While the second option transmits a signal to the IRS and is thus subject to the risk of detection, the third option provides a shelter from detection, guaranteeing foolproof evasion.

Notice now that in case of complying, the taxes paid, x, result in a utility loss of the same magnitude. Hence, x may also be interpreted as the disutility to the individual of paying taxes, henceforth referred to as the "tax burden". This burden could have been avoided through sheltering evasion and giving up utility of $\varphi(V) - \varphi(A)$. Complying thus implies that the extra utility gained from purchasing a villa rather than an apartment exceeds the tax burden. Denoting $\hat{x} \equiv \varphi(V) - \varphi(A)$, consider the following proposition:

Proposition 1: (a) if $x \leq \hat{x}$, a high income earner will always purchase a villa, irrespective of the level of enforcement, complying if $p \geq 1/f$ and signaling if $p < 1/f$. (b) if $x > \hat{x}$, a high income earner will always become a ghost, irrespective of the level of enforcement, signaling if $p \leq \hat{x}/fx$ and sheltering if $p > \hat{x}/fx$.

To prove proposition 1, consider first the individual's choice between complying and sheltering. Comparing the utility levels of these options reveals immediately that complying will be preferable to sheltering if $x \leq \hat{x}$: because the tax burden is low, a high income earner will be better off paying his taxes and living in a villa than becoming a ghost and living in an apartment. However, when $x > \hat{x}$, sheltering will be preferable to complying, as the tax burden will more than offset the extra benefit from living in a villa. Consider now the individual's choice between complying and signaling. Clearly, complying will be preferable if $p \geq 1/f$ and signaling otherwise, since only in the latter case the expected profit from evasion, $(1-p)x - p(f-1)x$, will be positive. This proves part (a) of Proposition 1. Suppose now that $x > \hat{x}$, for which complying is inferior to sheltering, and consider the individual's choice between signaling and sheltering. Clearly, signaling will be preferable if $p \leq \hat{x}/fx$ and sheltering otherwise, which proves part (b) of Proposition 1. Figure 1 illustrates these results graphically.

Whenever the tax and law enforcement parameters induce high income earners to purchase villas, the number of villa owners in the economy will equal the number of high income earners in the labor force, $\alpha\beta N$, plus the number of retirees who have had high income in the past and purchased their villas at that time, $(1-\alpha)N$. This amounts to a total of δN villa owners, where $\delta \equiv \alpha\beta + (1-\alpha) < 1$. The probability that a randomly audited villa owner is presently of high income is $\alpha\beta/\delta$.

When $x \leq \hat{x}$, expected net revenue for the IRS will be $(\alpha\beta fx/\delta - c)p\delta N$ if $0 \leq p < 1/f$ and $[\alpha\beta x/\delta - p(1-\alpha\beta/\delta)c]\delta N$ if $p \geq 1/f$. Simplifying, expected net revenue can be rewritten as:

$$R = \begin{cases} (\alpha\beta fx - \delta c)\, pN & \text{if} \quad 0 \leq p < \dfrac{1}{f} \\ [\alpha\beta x - p(1-\alpha)c]N & \text{if} \quad p \geq \dfrac{1}{f} \end{cases} \tag{3}$$

Notice that setting $p \geq 1/f$ implies now that the IRS will be auditing retired villa owners only, as villa owners who are currently earning the high income are induced to declare their income. Notice also that because $\delta < 1$ and $1-\alpha < 1-\alpha\beta$, audit costs are lower under signal auditing than under blind auditing, whether the audit probability induces honesty or not. The reason for this is that the villa owners' population, δN, is smaller than the total population, N, hence, for any given probability of audit less individuals must be audited under the former strategy than under the latter.

Following the arguments of the previous section, the optimal audit rule in the case of $x \leq \hat{x}$ will be

$$p^* = \begin{cases} \dfrac{1}{f} & \text{if} \quad \alpha\beta x \geq (1-\alpha)\dfrac{c}{f} \\ 0 & \text{otherwise.} \end{cases} \tag{4}$$

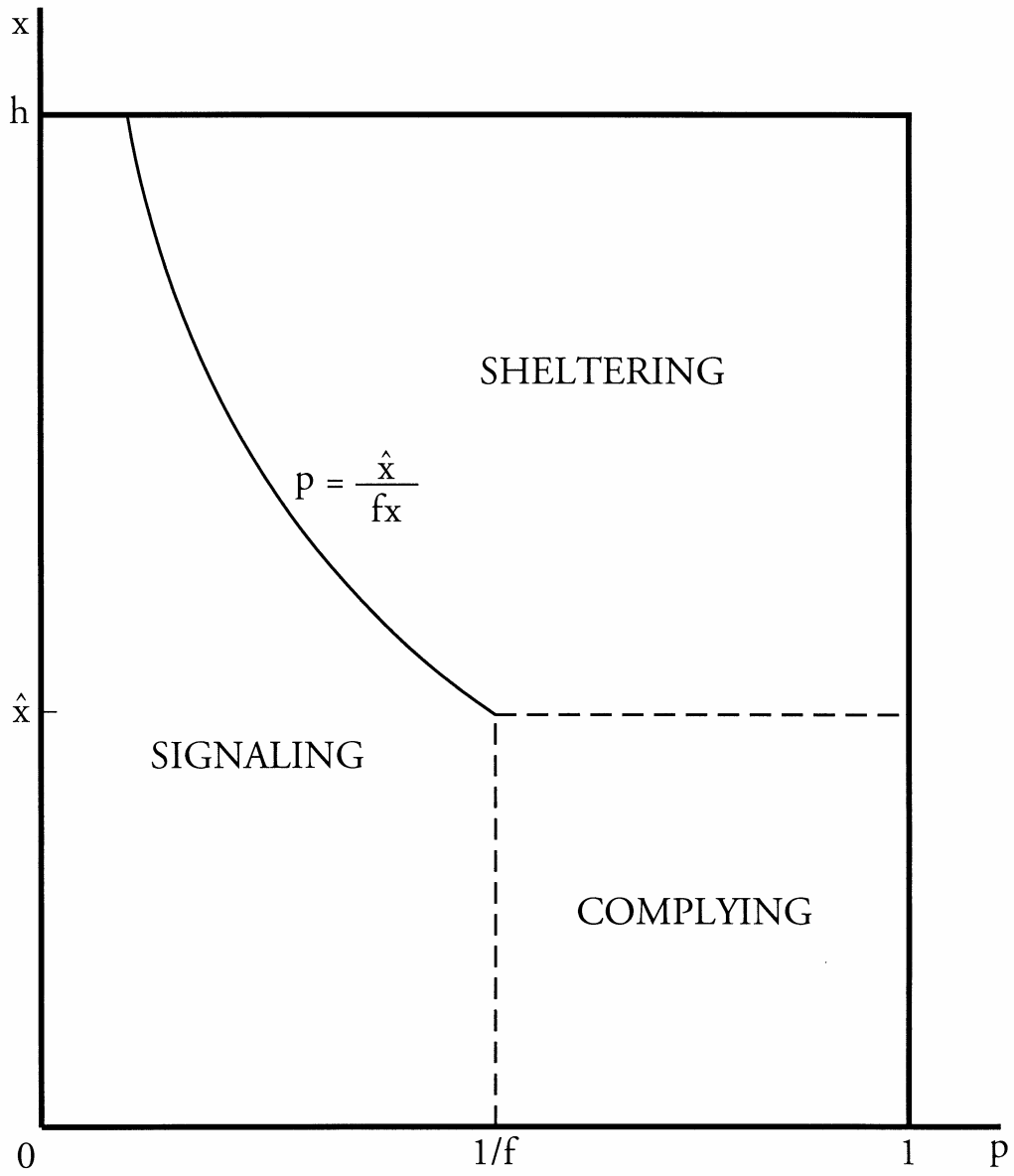

Figure 1: The individual's choice under signal auditing

However, when $x > \hat{x}$, expected net revenue will be given by

$$R = \begin{cases} (\alpha\beta fx - \delta c)\, pN & \text{if} \quad 0 \le p < \dfrac{\hat{x}}{fx} \\ -\ p(1-\alpha)cN & \text{if} \quad p \ge \dfrac{\hat{x}}{fx} \end{cases} \tag{5}$$

Notice that if $p > \hat{x}/fx$, the IRS will gain nothing in revenue, auditing retired villa owners only, as current high income earners are induced to shelter their evasion through the purchase of apartments. The optimal audit rule for the IRS thus becomes

$$p^* = \begin{cases} \dfrac{\hat{x}}{fx} & \text{if} \quad \alpha\beta x \ge \delta c \\ 0 & \text{otherwise.} \end{cases} \tag{6}$$

Because honesty cannot be induced in this case, the only possible way for the IRS to collect some revenue is to induce ghosts to reveal themselves through signaling. This can be achieved only by keeping the audit probability below the limit of $\hat{x}/fx$.

5. SIGNAL VERSUS BLIND AUDITING

We now compare the desirability to the IRS of adopting the alternative audit strategies, distinguishing between the case of $x \le \hat{x}$ and $x > \hat{x}$. In any given case, one strategy will be said to dominate the other if there exists a set of parameter values for which it yields more net revenue than the other and there exists no set of parameter values for which it yields less revenue than the other.

Proposition 2: (a) if $x \le \hat{x}$, signal auditing will always dominate blind auditing. (b) if $x > \hat{x}$, signal auditing will dominate blind auditing if $\alpha\beta fx < (1-\alpha\beta)c$; otherwise, blind auditing will dominate signal auditing if $\alpha\beta fx < \delta c$ or if $\alpha\beta fx \ge \delta c$ and $(1-\alpha\beta) \le \delta$.

To prove Proposition 2, consider first the case of $x \le \hat{x}$ and suppose that $\alpha\beta fx \ge (1-\alpha\beta)c$. The optimal policy under blind auditing will be to set the audit rate at $1/f$ and induce honesty. Because $1-\alpha\beta > 1-\alpha$, this will also be the optimal policy under signal auditing, only net revenue will be higher because audit costs are lower. Hence, signal auditing will dominate blind auditing. Suppose, alternatively, that $\alpha\beta fx < (1-\alpha\beta)c$. The optimal policy under blind auditing will be to set the audit probability at zero and gain no tax revenue. If $\alpha\beta fx < (1-\alpha)c$, this will also be the optimal policy under signal auditing. However, if $\alpha\beta fx \ge (1-\alpha)c$, the optimal policy under signal auditing will be to audit with probability $1/f$ and induce honesty. Hence, signal auditing will again dominate blind auditing. This proves part (a) of Proposition 2.

Consider now the case of $x > \hat{x}$ and suppose first that $\alpha\beta fx < (1-\alpha\beta)c$. Under blind auditing, net revenue will be zero. If $\alpha\beta fx < \delta c$, net revenue will be zero under signal auditing as well. However, if $\alpha\beta fx \ge \delta c$, the optimal policy under signal auditing will

be to audit with $p = \hat{x}/fx$ and gain positive revenue. Hence, signal auditing will dominate blind auditing. Suppose, alternatively, that $\alpha\beta fx \geq (1-\alpha\beta)c$. Under blind auditing, the optimal policy is to induce honesty. If $\alpha\beta fx < \delta c$, blind auditing will certainly dominate signal auditing, as the optimal policy under the latter strategy is not to audit at all. If, alternatively, $\alpha\beta fx \geq \delta c$, the optimal policy under signal auditing is to audit as well, yet at a lower intensity than under blind auditing. If $(1-\alpha\beta) > \delta$, net revenue per audit will be higher under signal auditing, thus the latter strategy may dominate the former. However, if $(1-\alpha\beta) \leq \delta$, blind auditing will unambiguously dominate signal auditing, being carried out more intensively as well as yielding a higher net revenue per audit. This proves part (b) of Proposition 2.

6. CONCLUSIONS

The present paper has developed a simple model of tax evasion with two types of agents, workers and retirees, two levels of income, high and low, and two forms of observable consumption, apartments and villas. Villas are affordable by high income earners only (whether working or retired). Retirees and low income earners are exempt from paying taxes. High income earners owe taxes but may evade this liability by not declaring their income, consequently becoming ghosts. Ghosts have a preference for villas, but may opt to live in apartments so as to avoid drawing the IRS's attention.

Perceiving villa ownership as a signal of taxable capacity, the paper has focused on the desirability for the IRS of tracking down ghosts through auditing villa owners who have not declared their income. A crucial factor affecting the desirability of signal auditing is the burden of taxes as compared to the extra utility derived from owning a villa. When the tax burden is low, high income earners would be better off paying their taxes and living in villas than becoming ghosts and living in apartments. They might take their chances and evade taxes, but will still be holding on to their villas. Under these circumstances, the IRS would be better off inducing honesty through the less costly strategy of signal auditing than through blindly auditing the non-declaring population. Furthermore, because signal auditing is less costly, it may still be a profitable strategy when blind auditing is too expensive to operate. However, when the tax burden is high, high income earners would never pay their taxes. They would turn into ghosts, opting to live in apartments and shelter their evasion if auditing is too intensive. To induce ghosts to reveal themselves through villa ownership, the IRS must *lower* the audit rate. Consequently, signal auditing might end up yielding less net revenue than the less sophisticated strategy of blind auditing.

N O T E S

[1] There have been some attempts to model the individual's failure to file a return or to provide empirical evidence on the characteristics of non-filers. Yaniv (1988) modeled the employee's decision to evade his non-withheld taxes through non-filing and the consequent effect on his supply of labor. Crane and Nourzad (1993) identified the features that distinguish non-filers from under-reporters, whereas Erard and Ho (1999) estimated an empirical model of the non-filing decision, comparing filers' and non-filers' characteristics and assessing non-filers' tax liabilities.

[2] The reason for this surprising result is that the cut-off scheme, which audits all firms declaring a turnover below some cut-off level and ignores the others, might provide incentives for firms to become ghosts rather than to declare the cut-off level.

[3] See Yaniv (2001) for an analysis of the individual's decision of whether to inform the IRS about other people's evasion and of the IRS's problem of selecting an optimal reward for informants.

[4] In Israel, for example, where withholding rates reach as high as the final tax rates, a wage-earner who holds a single job and whose income does not exceed a certain ceiling is exempt from filing a return. However, once he buys a new car he is likely to receive a letter from the tax agency requiring him to declare his income over the past three years. As reported in Wilkenfeld (1973), taxpayers are quite aware of the signals they transmit to tax inspectors: some taxpayers, attempting to bargain down an assessment of their earning capacity, would deliberately put on their most ragged clothing before visiting the income tax office.

[5] Notice that because low income earners are exempt from declaring their income, a high income earner cannot evade taxes by declaring the low income

[6] Notice that because retirement is not compulsory, the IRS cannot tell by the age of the individual whether he is retired or not.

[7] More fully, a high income earner will become a ghost if the maximum value of his expected utility if becoming a ghost exceeds the maximum value of his utility if declaring his income. Since $\varphi(V)>\varphi(A)$, he will become a ghost if $\varphi(V) + h - pfx > \varphi(V) + h - x$, or if $h - pfx > h - x$

[8] Substituting $p = 1/f$ in $[\alpha x - p(1-\alpha)c]N$, the net revenue when inducing honesty may be written as $[\alpha fx - (1-\alpha)c](1/f)N$. This is greater than the net revenue expected when allowing for evasion through lowering the audit probability, $(\alpha fx - c)pN$, as $(1-\alpha)c < c$ and $1/f > p$.

[9] Chaudhuri addresses the issue of *dynamic* auditing, investigating, under proportional taxation of two income levels (high and low), whether or not auditing rules should be conditioned on the past reports and the auditing status of the taxpayer.

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