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Abstract

Monetary or in-kind transfers can be used as an incentive for consumers to request official receipts for goods they purchase. A novel system of in-kind transfers in the form of lottery tickets has recently been introduced in China. Price subsidies (often granted through tax deductions or refunds) are also widely used. This paper extends the standard model of commodity tax evasion for firms (in a competitive market and under the conjectural variation approach) in order to describe the effects of subsidies on tax evasion and in terms of incidence and of government revenue. The role of search costs and of enforcement costs is also taken into account.

JEL codes: H31, H32, K42.

1 Introduction

In China a novel system for fighting sales tax evasion has recently been introduced[1]. To encourage customers to request official receipts as proof of payment in the service and retail commerce sectors, local tax authorities in many provinces have introduced a new type of receipt that doubles as a lottery ticket. To prevent forging of receipts, businesses must purchase special, patented machines for printing them. Records of the printed receipts are automatically transmitted to the tax authorities and are used to calculate the taxes payable on sales. The receipts can be used as scratch cards to win small amounts of cash, but they also serve as lottery tickets for winning larger amounts.

In the Chinese experiment, lottery receipts act as an in-kind subsidy offering incentives to consumers who request legal transactions. If the market value of the lottery tickets is easy to establish and readily raised, the system is equivalent to a monetary subsidy scheme. The Chinese experiment is thus an example of an approach that relies on rewarding consumers to foster compliance in the

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[1] For a description of this system and an evaluation of its effects see Wan [10].

field of commodity taxation. Subsidies to consumption are also often granted in developed countries for a variety of purposes, not least of which is fighting tax evasion. Subsidies are often introduced by allowing fixed percent of expenses for specific items to be deducted from the income tax base.

This paper examines the pros and cons of the consumption-subsidy approach and describes the effects of subsidies on tax evasion and in terms of incidence and of government revenue. After a brief overview of the standard firm tax evasion model in Section 2, the role of monetary subsidies is discussed in Section 3. In Section 4, in-kind subsidies are analyzed. Empirical evidence concerning the working of subsidies is reported in Section 5 and Section 6 concludes.

2 The basic tax evasion model

Following Cremer and Gahvari [2], Etro [4] and Cowell [1], consider a firm in a competitive market. Production occurs at constant returns to scale and m is the marginal and average cost. There are many identical firms: let us call x the firm's output and X the industry output. The product is sold at a consumer price P. There is an *ad valorem* tax at the (tax inclusive) rate $t < 1$.

The firm can cheat the government at a total cost given by $g(\beta) Px$, where β is the share of sales concealed and $g(\beta)$ is a strictly increasing convex function. The concealment cost per unit of revenue $g(\beta)$ may increase as firms seek to evade taxes by attempting to hide or camouflage their activity, leading to increasing inefficiency and waste[2].

Audits occur with a given probability p and perfectly reveal any cheating. Evasion is punished with a sanction which is a multiple $s > 0$ of the evaded tax. The firm's expected profit is given by:

$$\{P[1 - t[1 - \beta(1 - p(1+s))] - g(\beta)] - m\} x = \{P[1 - t^e - g(\beta)] - m\} x \qquad (1)$$

where t^e represents the expected tax rate. Let us assume that $[1 - p(1+s)] > 0$ holds, that is, the expected return on tax evasion is positive. Let us also assume that parameter values are such that full evasion does not occur, resulting in an interior solution with reference to the share of sales concealed. From the F.O.C. with respect to β, one gets:

$$\frac{\partial g(\beta)}{\partial \beta} = t[1 - p(1+s)] \qquad (2)$$

that is, the marginal cost of concealment $\frac{\partial g(\beta)}{\partial \beta}$ must equal the expected marginal benefit $t[1 - p(1+s)]$ when β is optimally chosen. The decision about tax

[2] One can also describe the total cost of evasion as:

$$f(\beta)\beta P x$$

where $f(\beta)$ is the cost per unit of sales concealed and is strictly increasing in β. This formulation reduces to the one used in the text as long as $g(\beta) = f(\beta)\beta$. On this topic also see Virmani [9] and Cowell [1].

evasion is thus separable in this model from that concerning output[3].

The equilibrium price P can be calculated by considering that expected profits are zero in a competitive market equilibrium. Thus, by setting:

$$\{P\left[1 - t^e - g\left(\beta\right)\right] - m\} x = 0$$

one gets:

$$P = \frac{m}{1 - t^e - g(\beta)} \tag{3}$$

where the optimal β value is considered in the denominator. The wedge between the consumer price P and the marginal cost grows as the expected tax rate and the unit concealment cost increase. In equilibrium, the industry output X equals the quantity demanded at price P and each firm earns zero expected profits. The market equilibrium is represented in Figure 1.

If firms were fully compliant, the demand net of tax would be D'. As a result of tax evasion, the expected tax is lower, the demand net of the expected tax is D'' and the industry output $X^{''} > X^{'}$ is thus larger than without tax evasion, while the price $P'' < P'$ is lower[4].

3 Monetary Subsidies

Assume now that in a competitive market with tax evasion the tax administration decides to grant consumers a proportional subsidy rtP_p each time a legal transaction takes place, where $r < 1$ and P_p is the producer price. Hence, consumer demand shifts upwards. For legal transactions, the subsidy introduces a wedge between the producer price P_p and the consumer price $P_c = P_p(1 - rt)$. This policy aims at rewarding consumers who "police" transactions, and can be considered as a substitute for other interventions having the same aim, such as increasing the probability of monitoring, increasing sanctions or punishing consumers who accept illegal transactions. One potential advantage of the subsidy-based approach is that it can help overcome asymmetries of information, since consumers are directly involved in each transaction while auditors are not. In fact, the proponents of this approach seek to extend and complete the chain of conflicting interests characteristic of VAT. While sanctions for consumers might be able to perform a similar role, subsidies are politically more viable.

Let us assume that the choice of making a legal transaction bears no cost to the consumer, as, e.g., there are no enforcement costs (the psychological or transaction costs of reporting non-compliance to the tax auditor, in order to enforce the law). Moreover, at a cost, the tax administration can fully detect and disregard illegitimate claims, paying subsidies only when they are actually due.

Since under these assumptions all consumers can freely choose to engage in legal transactions, firms resorting to illegal transactions are forced into offering

[3] On separability in this case, also see Sandmo [8].

[4] Note that this is a partial equilibrium analysis that does not take into account the effects of the expenditure financed by the tax, etc.

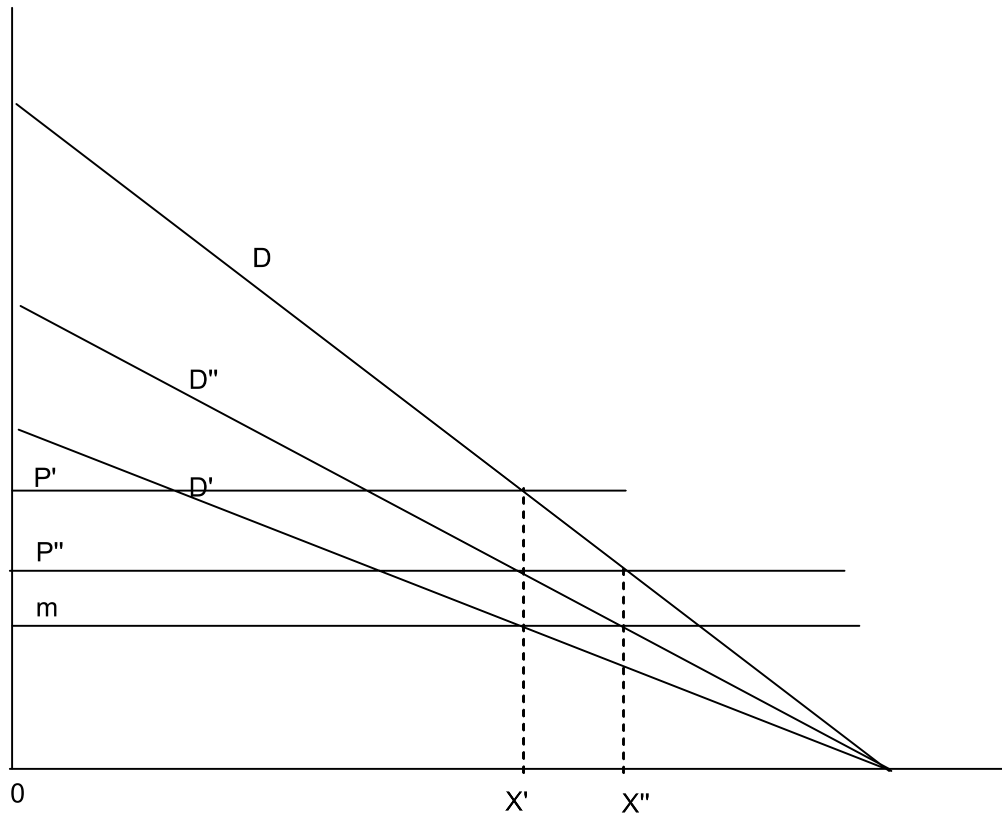

Figure 1: Market equilibrium with tax evasion

the consumer at least the same deal, i.e. they must be ready to receive only $P_p(1-rt)$ per unit of x in order to ensure indifference with respect to legal transactions. Let us consider the firm's expected profit in this case:

$$\{P_p\left[1-t\left[1-\beta\left(1-r-p\left(1+s\right)\right)\right]-g\left(\beta\right)\right]-m\}\,x=\left\{P_p\left[1-t^E-g\left(\beta\right)\right]-m\right\}x \tag{4}$$

where $t^E=t-t\beta\left(1-r-p\left(1+s\right)\right)$ and β is set at its optimal value in this framework. Considering an interior solution, the F.O.C. for profit maximization with respect to β now implies that:

$$\frac{\partial g\left(\beta\right)}{\partial\beta}=\left[1-r-p\left(1+s\right)\right]t \tag{5}$$

It is clear that the expected rate of return on tax evasion $[1-r-p\left(1+s\right)]$, which must be positive when an interior solution is reached, is pushed down as r increases, yielding a lower share of concealed sales β. This result is confirmed by noting that since (5) must hold at the firm's interior optimum, one can differentiate both sides of (5) with respect to r to get:

$$\frac{\partial^2 g\left(\beta\right)}{\partial\beta^2}\frac{\partial\beta}{\partial r}=-t<0 \tag{6}$$

i.e., since $\frac{\partial^2 g(\beta)}{\partial\beta^2}>0$ by assumption (strictly increasing concealment costs), r has a negative impact upon the share of concealed sales β. Moreover, by setting r at a value that satisfies:

$$1-r-p\left(1+s\right)=0$$

tax evasion can be eliminated altogether. While the classical theoretical prescription for eliminating tax evasion is to introduce large enough sanctions, the many potential problems caused by this approach in practice are widely known[5]. Hence, subsidies to consumers may provide a better alternative. Subsidies, in fact, work as sanctions applied with certainty on firms resorting to tax evasion, since the consumers involved must receive compensation. One must bear in mind, however, that subsidies, unlike sanctions, are paid to the consumer and not to the tax administration: government revenue is thus affected. This problem is considered in detail in Section 3.2.

With reference to the effects of subsidies upon tax evasion, note also that from (6), one gets:

$$\frac{\partial\beta}{\partial r}=-\frac{t}{\frac{\partial^2 g(\beta)}{\partial\beta^2}} \tag{7}$$

which means that the effects depend on the tax rate and on the shape of the concealment cost function. The effect is greater if the concealment cost function is about flat at the optimal β value. However, the concealment cost function

[5] See, e.g., Marchese [6].

might grow steep if there are evasion thresholds above which visibility is so high that hiding becomes prohibitively costly.

One may also wonder if, from a welfare point of view, subsidies received by consumers can be considered as substitutes for government revenue. Complete substitutability cannot be assumed, as government revenue can finance the production of public goods or be redistributed according to a given social welfare function, while the distribution of subsidies depends on consumption. Nonetheless, as subsidies do play a beneficial role, the policy deserves consideration, even from a welfare point of view.

3.1 The incidence of monetary subsidies

Let us now consider the equilibrium producer price of legal transactions P_p, which can be calculated by setting the expected profits (4) to zero:

$$P_p = \frac{m}{1 - t - g(\beta) + t\beta(1 - r - p(1+s))} = \frac{m}{1 - t^E - g(\beta)} \tag{8}$$

Let us differentiate (8) with respect[6] to r:

$$\begin{aligned} \frac{\partial P_p}{\partial r} &= \frac{mt\beta}{\left[1 - t^E - g(\beta)\right]^2} \\ &= P_p \frac{t\beta}{1 - t^E - g(\beta)} \end{aligned} \tag{9}$$

The derivative has a positive sign. The producer price increase thus implies that consumers never fully benefit from the subsidy, that is, the subsidy is at least partially shifted backward to suppliers. One may wonder whether there might be backward overshifting, which would imply a consumer price increase, i.e., $\frac{\partial P_c}{\partial r} > 0$. The consumer price is given by:

$$P_c = \frac{m(1 - rt)}{1 - t - g(\beta) + t\beta(1 - r - p(1+s))} = \frac{m(1 - rt)}{1 - t^E - g(\beta)}$$

Let us calculate:

$$\begin{aligned} \frac{\partial P_c}{\partial r} &= \frac{mt\left[\beta(1 - rt) - \left(1 - t^E - g(\beta)\right)\right]}{\left[1 - t^E - g(\beta)\right]^2} \\ &= \frac{m(1 - rt)\,t\left[\beta - \frac{1 - t^E - g(\beta)}{1 - rt}\right]}{\left[1 - t^E - g(\beta)\right]^2} \\ &= P_c t\left(\frac{\beta}{1 - t^E - g(\beta)} - \frac{1}{1 - rt}\right) \end{aligned} \tag{10}$$

Thus overshifting occurs if the term in parenthesis in (10) is > 0. Taking the limits within this parenthesis immediately establishes the following:

[6] While β depends on r, since we are considering the maximum value function and the optimal value β, the envelope theorem states that only the partial derivative with respect to parameter r must be considered.

Lemma 1 $\beta \to 1$ *implies that* $\frac{\beta}{[1-t^{E}-g(\beta)]} \to \frac{1}{1-g(1)-tp(1+s)-rt} > \frac{1}{1-rt}$

Lemma 1 implies that very large levels of tax evasion favor the occurrence of overshifting. The intuition for this result is that the firm must collect some extra revenue in order to be able to adjust the reward for illegal transactions when the subsidy increases. This extra revenue is larger than the increase of rewards, since it must cover also the expected tax and the concealment cost per unit of revenue. When tax evasion is widespread virtually all transactions are burdened. While the subsidy increase also negatively affects tax evasion, as shown by (7), this is only a second order effect.

The market equilibrium when subsidies are introduced is illustrated in Figure 2. Agents involved in legal transactions (whose share of the market is $(1-\beta)$) receive the transfer and their demand thus shifts up from D *official* to D' *official cum subsidy.* They pay a gross price P_p while their actual net price is P_c. Agents involved in illegal transactions (whose market share is β) pay[7] P_c. In the example shown in the figure, $P_p > P > P_c$, where P is the equilibrium price in absence of subsidies, i.e., in this example, the consumer price is lower when the subsidy is granted.

Consumers are indifferent as to whether the transaction is legal or illegal[8]. When it is legal, there is a wedge between the price received by the firm P_p and that (net of subsidy) paid by the consumer P_c. In the absence of tax evasion consumers benefit in full from the consumer price drop resulting from the subsidy. With tax evasion, instead, the consumer price decreases less or even increases, as producers bear a cost to extend the same benefit to consumers who are partners to illegal transactions as well. In any case, whenever the subsidy implies a drop in consumer price, a larger total amount X is produced.

3.2 Net tax revenue

Let us now consider, with reference to the basic model, the tax revenue net of the cost for running audits $c(p)$, which is assumed to be increasing in the probability of audit. When no subsidy is paid, the net tax revenue is given by:

$$t\left[(1-\beta)+p\beta\,(1+s)\right]PX(P)-c(p)$$

When the subsidy is introduced, further costs arise in order to avoid illegitimate requests for subsidies. Since retail sales are considered, the number of transactions is likely to depend on the amount of output. As each transaction can potentially give rise to a false receipt, we assume that costs borne by the tax administration to avoid fakes $h\left(X\left(P_c\right)\right)$ are increasing in output. When the subsidy is granted, the net revenue can then be written as:

$$t\left[(1-r)\,(1-\beta)+p\beta\,(1+s)\right]P_pX(P_c)-c(p)-h\left(X\left(P_c\right)\right). \qquad (11)$$

[7] In describing the firm's profit in equation (4) and afterwards we rely on the fact that $P_c = P_p\,(1-rt)$.

[8] The standard assumption of amorality is followed in this paper.

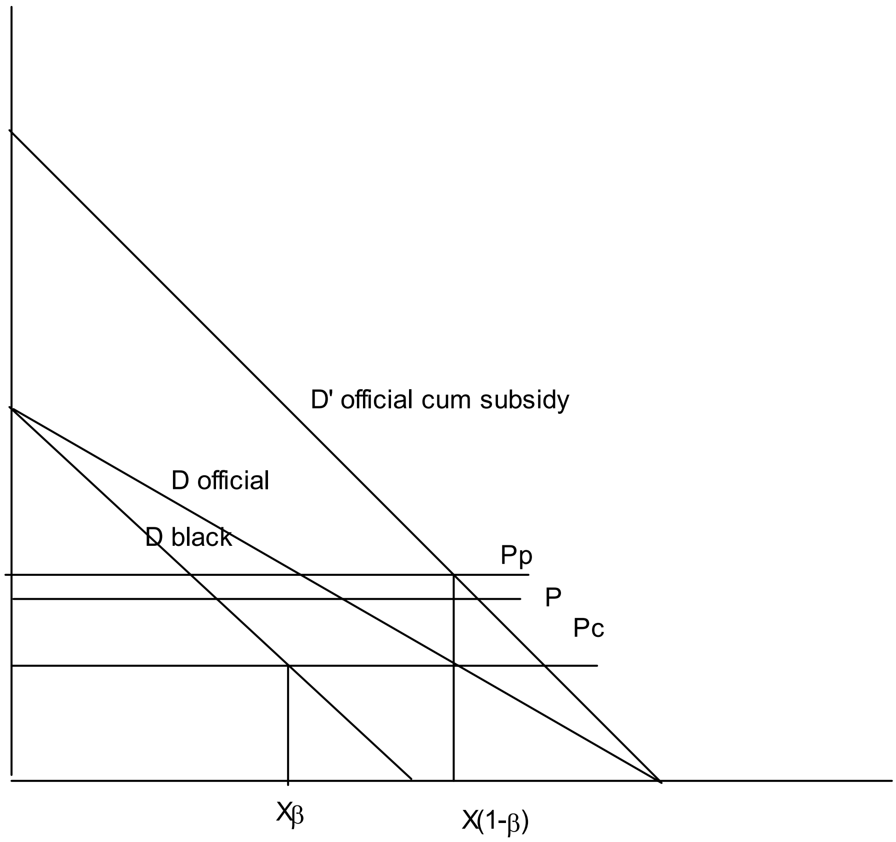

Figure 2: Market equlibrium with subsidies

Let us call $f(r) = t\left[(1-r)(1-\beta) + p\beta(1+s)\right]$ the actual marginal revenue rate.

Lemma 2 *Sufficient conditions for a tax revenue increase occur if: i)* $\beta \to 1$ *and ii) the market demand is anelastic.*

Proof. By differentiating the revenue (11) with respect to r, one gets:

$$f(r)P_p\frac{\partial X}{\partial P_c}\frac{\partial P_c}{\partial r}+f(r)X\left(P_c\right)\frac{\partial P_p}{\partial r}+P_pX(P_c)\frac{\partial f(r)}{\partial r}-\frac{\partial h\left(X\left(P_c\right)\right)}{\partial X}\frac{\partial X}{\partial P_c}\frac{\partial P_c}{\partial r} \quad (12)$$

where $\frac{\partial f(r)}{\partial r}$ is given by:

$$\frac{\partial f(r)}{\partial r} = -t\left[1-\beta\right] - t\left[1-r-p\left(1+s\right)\right]\frac{\partial \beta}{\partial r} \quad (13)$$

The first and the last term in (12) are equal to zero since $\frac{\partial X}{\partial P_c} = 0$ by assumption. The second term is positive, as the producer price is increasing in the subsidy. The third term might be either positive or negative. More specifically, the sign of (13) depends on two components. Namely, a loss of revenue from legal transactions, which now also involve some outlay by the government in order to pay for the subsidy r; and a gain due to the reduction of the concealment rate β. However, if $\beta \to 1$ the first term $\to 0$ and thus $\frac{\partial f(r)}{\partial r} > 0$. ■

Of course there are many other cases not taken into account by Lemma 2 in which the subsidy policy might be beneficial. Consider, e.g., a case in which, while $\beta << 1$, the reduction in tax evasion nevertheless entails benefits large enough to overcome the costs of the policy. Positive results could be achieved even if the consumer price increase entails an output contraction. Generally speaking, at any rate, the subsidy policy is more likely to be beneficial if tax evasion is widespread (as this reduces the amount paid out to reward legal transactions), if the subsidy exerts an expansionary effect on the market[9], and if the reduction of tax evasion prompted by the policy is large. What we have termed administrative costs (i.e., $h\left(X\left(P_c\right)\right)$), also play a very important role. It has been assumed in fact that the administrative effort is sufficient to ensure that no illegitimate claims are rewarded: if this assumption is relaxed, the tax revenue definition must be modified to take into account the corresponding leakages of resources.

3.3 Imperfect competition

In discussing the effects of monetary subsidies under imperfect competition, we take the conjectural variations approach, according to which the industry is composed of n identical firms, each of which makes the same conjectures about the other firms' reactions to her choices, resulting in a symmetrical equilibrium.

[9] There is, however, a trade-off between this and the former effect according to Lemma 1.

In this framework the profit function of firm i is given by:

$$\left\{ \frac{P_c(X)}{1-rt} \left[1 - t^E - g(\beta)\right] - m \right\} x_i$$

where $P_c(X)$ is the inverse market demand and $\frac{P_c(X)}{1-rt}$ is the "gross" inverse demand that is relevant for the firm. The F.O.C. for profit maximization with respect to β is given by:

$$\frac{P_c(X)}{1-rt} \left\{ t\left[1 - p(1+s) - r\right] - \frac{\partial g(\beta)}{\partial \beta} \right\} x_i = 0$$

which holds whenever:

$$\frac{\partial g(\beta)}{\partial \beta} = t\left[1 - p(1+s) - r\right]$$

which is identical with condition (5) above. The separability of the decision about tax evasion from that about output thus carries over to the case of imperfect competition, and the effects of subsidies upon the share of tax evasion β are similar to those previously discussed.

Naturally, the F.O.C. with respect to the firm's output is different under imperfect and perfect competition: what takes place under different conjectures about the other firms' reaction is illustrated in the Appendix. Noncompetitive markets can thus differ from competitive ones in the degree of backward shifting of the subsidy that occurs. While the producer price is always increasing in r, the increase can be larger or smaller than under competition. The parameters determining the reaction are the standard ones considered in the theory of tax incidence under imperfect competition[10].

3.4 Search costs

Let us turn once again to subsidies in a competitive market, this time dropping the assumption that consumers can always opt for legal transactions without incurring any costs. To focus upon search costs, let us assume that enforcement costs are prohibitively high (i.e., larger than the subsidy). Hence, consumers will consider the option of searching for the opportunity of transacting legally. To keep the model simple, let us assume that each consumer buys just one unit of the good. Moreover, every consumer takes as given the value of all the variables relevant to her choice (the Nash conjecture). It is assumed also that all consumers bear the same cost $\gamma P_p < rtP_p$ for eliciting a new transaction proposal, either from the same or from another firm[11]. Search costs are thus described as proportional to the market producer price of the good. Since a higher price P_p involves a smaller equilibrium output, it is also likely that it is

[10] See, e.g., Myles [7], Part III, Chapters 11 and 12.

[11] This symplifying assumption can be justified if the consumer, in order to receive a new proposal from the same supplier, must, e.g., visit it anew.

more difficult to find the good and that search costs are higher[12]. If searching implies a net expected gain for an agent with an offer of an illegal transaction in hand, she will accept it only if she also receives at least her reservation compensation $r^* t P_p$, which must take a value such that:

$$-\gamma P_p + t P_p (r - r^*)(1-\beta) = 0 \ .$$

where the l.h.s. computes the additional costs γP_p and the expected additional benefit $t P_p [r - r^*](1-\beta)$ of making a further search. Hence the reservation compensation is:

$$r^* t P_p = r t P_p - \frac{\gamma P_p}{(1-\beta)} \text{ if } rt > \frac{\gamma}{(1-\beta)}$$

The agent might, however, be discouraged form searching, i.e.

$$r^* t P_p = 0 \qquad\qquad \text{if } rt \leq \frac{\gamma}{(1-\beta)}$$

Note that when $r^* > 0$ the reservation rate r^* is decreasing in β, i.e., customer compensation decreases as tax evasion increases.

In order to describe the market equilibrium in this case, let us assume that firms, too, behave in a Nash fashion, i.e., they take as given the reservation compensation $r^* t P_p$ currently requested for illegal transactions.

Proposition 1 *If subsidies are introduced, the equilibrium share of tax evasion is higher when consumers bear search costs. Subsidies lose any disciplining effect upon tax evasion if $\gamma \geqslant rt(1-\beta)$, i.e. if search costs are so high that consumers are discouraged from searching and decide to accept illegal transactions without requesting any compensation.*

Proof. The expected profit for the firm in this case is:

$$\{P_p [1 - t[1 - \beta(1 - r^* - p(1+s))] - g(\beta)] - m\} x \tag{14}$$

while, if $rt \leq \frac{\gamma}{(1-\overline{\beta})}$, $r^* = 0$ and expected profit is given by (1). From the F.O.C. for the maximization of (14) with respect to β one gets:

$$\frac{\partial g(\beta)}{\partial \beta} = [1 - r - p(1+s)] t + \frac{\gamma}{(1-\overline{\beta})} \tag{15}$$

where $\overline{\beta}$ denotes the share of tax evasion taken as given by consumers in order to determine their reservation discount. In equilibrium, $\overline{\beta} = \beta$ must hold and then, by comparing (15) to (5) it turns out that tax evasion must be greater if there

[12] If one assumes instead that search costs are constant, the separability of evasion and production decisions no longer holds. In this case, the model becomes more cumbersome, while the main results that will be presented in this section (the vanishing effect of subsidies upon tax evasion when there are search costs and the existence of multiple equilibria) still hold.

are search costs. If instead $\gamma \geqslant rt\,(1-\beta)$ the F.O.C. for profit maximization is (2) and subsidies have no impact on tax evasion. ■

Note that the effects of search costs might imply that the transfer policy has a negative impact upon tax revenue; if the effects in terms of reduction of tax evasion are negligible, the main implication of the policy is likely to be the outlay of resources in order to finance transfers for legal transactions. Only the expansionary effects of the policy on the economy output might mitigate these consequences upon tax revenue.

To further assess the role of search costs, note that in equilibrium the F.O.C. (15) can be rewritten as:

$$[1 - r - p\,(1+s)]\,t + \frac{\gamma}{(1-\beta)} - \frac{\partial g\,(\beta)}{\partial \beta} = 0 \qquad (16)$$

This condition implies that multiple equilibria are possible, i.e., more than one level of tax evasion share β is viable[13] (see Figure 3). This effect stems from network externalities: whenever a firm decides to evade, it originates a positive externality for the whole set of suppliers, as the search costs for the customers increase and the compensation requested for accepting an illegal transaction falls. As typically happens in these cases, once a critical mass of tax evasion is reached, it can jump to much larger values. Hence for a given γ value there might be a small share of tax evasion β with low values of both the opportunity cost of search and concealment costs, or a large β value with the opposite implications. The Nash conjecture implies, however, that firms are not able to internalize the network effects.

However, in non competitive markets where suppliers are able to collude, they might internalize the positive externality originated by illegal deals, thus reaching equilibria characterized by widespread tax evasion.

A second possible scenario is that in which enforcement costs ζ per unit of expenditure, which for the sake of simplicity are assumed to be constant and equal to marginal costs, are not prohibitive as they are lower than rt. In this case enforcement costs would become relevant at the evasion level β for which $\frac{\gamma}{(1-\beta)} \geq \zeta$. Above this threshold consumers stop searching and report to tax auditors. The compensation that must be paid to those who enter an illegal transaction per unit of expenditure would thus become $rt - \zeta$.

4 In-kind transfers

Let us now consider the case in which the government decides to encourage legal transactions by introducing an in-kind transfer rather than a monetary subsidy, i.e., it offers consumers participating in legal transactions a quantity $tP_p x$ of good $\theta \neq x$. It is also assumed in this section that the market for good x is competitive and that the consumer bears no cost in opting for a legal transaction.

[13] The following values of the parameters have been used to draw Figure 3: $t = 0.4$, $r = 0.9$, $s = 0.8$, $p = 0.01$, while $g\,(\beta) = 0.2\beta^2$.

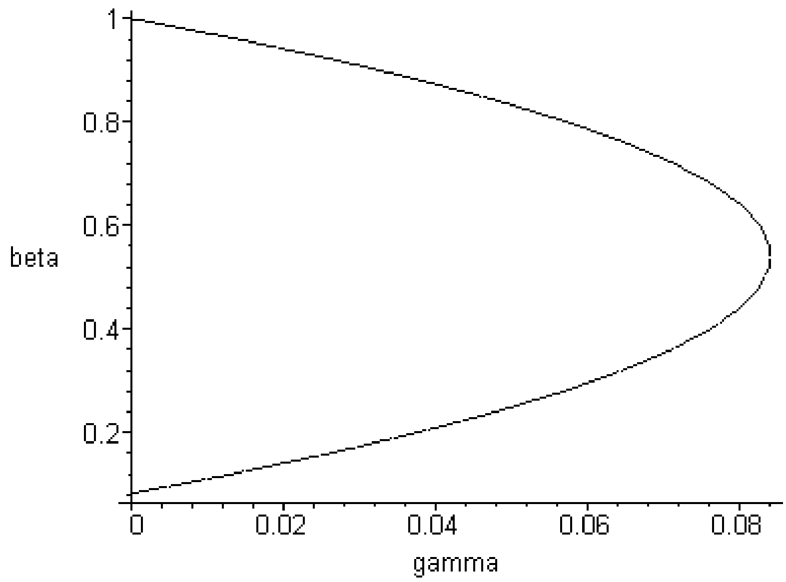

Figure 3: Share of tax evasion β as a function of search costs

As long as there is a market price for good θ and the transaction costs for reselling it are negligible, the analysis in Section 3 directly applies, as the in-kind transfer has a clear-cut monetary value. If, instead, one or both of these conditions are lacking, the firm faces the problem of compensating those who participate in illegal transactions. The firm might resort to the supply of a closely substitutive good, in order to give a gift to those who participate in illegal transactions, at conditions that parallel those of the legal market. In the example of the lottery mentioned in the Introduction, an illegal gambling system might provide this opportunity. The likelihood of such an evolution depends on the costs of supplying the substitute good, which could, e.g., be low if an illegal market already exists and has gained credibility and if enforcement against it is mild. In-kind compensations in terms of goods which are not close substitutes might involve high transaction costs. They thus seem rather unlikely, at least under the assumption of a competitive market for good x, in which the supplier has no customer base and market power to exploit.

If no substitute good can be supplied, monetary compensation must be paid to those who accept illegal transactions. The compensation cannot be lower than the marginal willingness to pay for good θ. To discuss the implications of this approach in a simple framework, let us assume that consumers cannot buy neither sell[14] good θ, but can only receive it as a reward for opting for

[14] Because no market exists, due, e.g., to prohibitive transaction costs, legal barriers to entry, etc.

a legal transaction. Moreover, each consumer h makes an identical and small expenditure for good x, so that $tP_px \leq 1$. The quantity of good θ to which the customer is entitled is thus marginal, and hence it seems reasonable to assume that each agent's demand price (equal to the willingness to accept) is constant within the relevant interval. The compensation requested by each consumer for an illegal transaction is thus $c_h tP_p x$, where c_h is the unit compensation. Let us assume that the distribution of c_h is uniform and lies on the interval $[0, 1]$. Good θ is produced by the government at a constant marginal cost δ. It is assumed that at least some consumers have a willingness to accept larger than the marginal cost δ, i.e., there is a $\widetilde{c}_h \leq 1$ such that $\widetilde{c}_h > \delta$, or, equivalently, it is assumed that $\delta < 1$. Let us also assume that each firm producing x behaves according to a Nash conjecture, i.e., it takes as given the unit compensation $\overline{c_h^*}$ observed in the market. Hence it chooses its evasion share β in a fashion paralleling that previously described, i.e., according to the F.O.C.:

$$\frac{\partial g(\beta)}{\partial \beta} = \left[1 - \overline{c_h^*} - p(1+s)\right] t \tag{17}$$

Proposition 2 *If in-kind transfers are introduced and there are no search costs, ceteris paribus the tax evasion share β is smaller than in the absence of transfers of any type. In-kind transfers outperform money subsidies in fighting tax evasion as long as the value attributed to good θ by the marginal agent accepting an illegal transaction is larger than its marginal cost for the government.*

Proof. In equilibrium, the compensation paid for illegal transactions must be equal to the marginal demanded compensation. Under the assumption that the requested compensation is uniformly distributed over the unit interval, β represents both $\Pr(0 \leq c_h \leq \beta)$ and the marginal demanded compensation. Hence:

$$c_h^* = \beta \tag{18}$$

Thus condition (17) in equilibrium becomes:

$$\frac{\partial g(\beta)}{\partial \beta} + \beta t = [1 - p(1+s)]\, t$$

which implies a smaller tax evasion share than when condition (2) applies. This proves the first statement. With reference to the comparison with money transfers, if $c_h^* = \beta \geq \widetilde{c}_h > \delta$, the government can induce firms to pay a larger compensation for illegal transactions by resorting to the in-kind transfer than by setting $r = \delta$. ■

Condition (18) implies that the larger the share of illegal transactions β, the larger is the compensation demanded by the marginal consumer. If the share of tax evasion is small, firms might conduct illegal transactions with agents whose evaluation of θ is low, while when there is a larger share of tax evasion even agents with larger demand prices for good θ must be involved. Note also that in this scenario each firm's decision to evade taxes gives rise to a kind of negative externality for the group of suppliers as a whole, as it pushes up the compensation that must be paid to all consumers who participate in illegal transactions. The disciplining effect of the increase of the compensation, which operates in this framework, is thus reinforced by the fact that firms are not able to internalize the negative externality.

With in-kind transfer the zero-profit condition becomes:

$$\{P_p\left[1-t\left[1-\beta\left(1-c_h^*-p\left(1+s\right)\right)\right]-g\left(\beta\right)\right]-m\}\,x=0 \tag{19}$$

By substituting (18) into (19) and solving for P_p one gets:

$$P_p=\frac{m}{1-t-g\left(\beta\right)+t\beta(1-p\left(1+s\right))-t\beta^2} \tag{20}$$

In this framework, the larger the share of tax evasion β, the larger[15] is P_p. This effect is explained by the increasing compensation requested by the agents who participate in illegal transactions when tax evasion increases, and represents a kind of self-adjusting mechanism that pushes the tax base upward when tax evasion increases which is not available under monetary transfers.

All in all, in-kind subsidies which offer to the tax administration the possibility of exploiting some market power seem more effective than monetary transfers. This is due to the fact that in-kind subsidies introduce a kind of pure bundling, as consumers can receive good θ only if they legally buy good x. When Proposition 2 applies, good θ is rationed and the tax administration exploits the consumer's surplus in order to fight tax evasion. However, since good θ is supplied in a less than efficient quantity, there is an efficiency loss. But if good θ entails negative externalities, as in the example of lottery tickets, one may deem the social marginal cost of θ to be larger than the private one, and that some justification for rationing exists.

The analysis developed in Section 3.4 with reference to the role of enforcement and search costs can clearly be extended to the case of in-kind transfers. In this case, too, one can envisage a reduction of the compensation needed to induce customers to accept illegal transactions when they face opportunity costs of search or enforcement costs. Nevertheless, the conclusions reached with reference to the relatively better performance of in-kind subsidies are likely to extend to this case. On the other hand, if the market for good x is noncompetitive and suppliers are able to set compensations for illegal transactions on an individual basis, the role of in-kind subsidies is significantly depotentiated. In a perfectly discriminating monopoly, under the assumptions considered so far about the c_h distribution, in-kind subsidies would, however, still outperform monetary ones

[15] This can be established by differentiating (20) with respect to β. The derivative is:

$$\frac{\partial P_p}{\partial \beta}=\frac{-m\left\{\left[t\left(1-p-ps-\beta\right)-\frac{\partial g(\beta)}{\partial \beta}\right]-\beta\right\}}{\left[1-t-g\left(\beta\right)+t\beta(1-p\left(1+s\right))-t\beta^2\right]^2}.$$

The term in squared brakets in the numerator is 0 as each firm maximizes its profit according to condition (17), and this also holds in equilibrium. Thus the term in curly brackets is negative, so both the numerator and the denominator are positive.

if $\int_0^\beta c_h dc_h > \delta\beta = r\beta$, that is if:

$$\frac{1}{2}\beta^2 > \delta\beta = r\beta$$
$$\beta > 2\delta = 2r.$$

i.e., if tax evasion is so widespread that the equilibrium compensation for illegal transactions is two times the marginal cost of θ.

5 Empirical evidence about refunds and in-kind prizes

To fight VAT tax evasion some developing countries have introduced a refund system for consumers who exhibit receipts.

Berhan and Jenkins [3] study the working of this system in Northern Cyprus and in Bolivia. In Northern Cyprus the scheme has been in use since 1996. The refund was 5% of the taxable purchases until 2000 and 2.5% thereafter, while the standard VAT rate is 13%. Purchases claimed must not surpass a threshold (the monthly salary for employees). Employers collect the receipts for their employees and claim the refunds on their behalf.

In Bolivia, since 1986 there has been a withholding tax on wages, salaries and pensions, introduced with the aim of reinforcing the working of VAT. Consumers deduct the VAT paid on purchases of goods and services, and thus the withholding tax has zero expected net revenue.

Berhan and Jenkins [3] find that these systems are burdened with very large administration and compliance costs, both in comparison with the VAT proceeds and with the corresponding costs of other taxes in the two countries. The process of collecting and verifying claims is extremely time consuming, and the net benefits for taxpayers are low. Moreover, the method is vulnerable to illicit practices. In Northern Cyprus this mainly consists in the collection of receipts issued to foreigners, students, etc., who cannot claim their own refunds. In Bolivia, instead, there is a black market where false receipts are also sold, at a price around 1% of their face value. The Bolivian system seems to work badly overall, yet abolishing it would hurt some groups and therefore does not seem politically viable. Past attempts at reforms aimed at cancelling the refunds, and thus at transforming the withholding tax into a revenue producing tax (while giving up potential benefits on VAT), have resulted in riots.

The Chinese tax lottery experiment began in 1998, and has progressively been extended to include about 8% of districts or cities. It has also to include not only restaurants, beauty salons and real estate agencies but a number of other services and retail sales as well. The experiment has been widely reported on by the media in China. According to Wan [10] and to the sources quoted therein, it has had a positive impact upon business tax[16] revenue and upon the growth of total tax revenue.

The use of lottery tickets in the battle against tax evasion is also being tried out elsewhere in Asia. Lotteries are also often used in the private sector as a marketing device. For example, banks in Latin America offer lottery-linked deposit accounts. Those who keep the account for a given period participate in lotteries for small and large prizes. According to Gillén and Tschoegl [5] these accounts are a cheaper source of funds for banks than other accounts. Lotteries are particularly appealing for low income agents, and behave as inferior goods.

6 Conclusions

Reliance on money or in-kind subsidies as an incentive for consumers to request compliance with sales taxes rests on the assumption that it provides a less costly solution than auditing firms. In fact, consumers have an informative advantage over tax auditors in that they are necessarily in frequent contact with suppliers. While this assumption is reasonable, one must also factor in the costs and the many possible undesired effects stemming from this approach. When the system works smoothly, it is likely to give rise to some kind of "revenge by the market" through the increase of gross or even net prices. The payment of subsidies, which often takes the form of tax deductions, involves high administrative costs. New forms of cheating might appear. For example consumers might try to cash in on subsidies even when they are not entitled to receive them. We whish also to underline how important it is to consider the context in which the subsidy is introduced. If consumers bear no cost from opting for a legal transaction, the impact of subsidies is likely to be significant. Tax evasion becomes less profitable and decreases. If, instead, consumers bear the brunt of costs for reporting violations to the authorities, subsidies might induce them to search for vendors willing to participate in legal transactions. As, however, searching is also costly, the opportunity value of the subsidy decreases. Hence the aforementioned effects of subsidies on tax evasion and prices are diluted and, at the limit, disappear. Multiple equilibria can arise.

The resort to in-kind transfers seems to have one advantage over monetary transfers. At least some consumers are likely to have a large demand price for the good chosen for the in-kind transfer, larger than its marginal cost: even if tax evasion is widespread they will request a legal transaction notwithstanding enforcement or search costs. In this framework, each firm's decision to evade entails a negative externality, as it contributes to exhausting the pool of agents less interested in the good and ready to accept an illegal deal for low compensation. On the other hand, the advantages of the in-kind approach are related to the existence of a market power that the tax administration can exploit and to the resort to a form of bundling, which in general involves an efficiency loss.

Concerning the type of good offered, the recent experiment with lottery receipts in China seems promising. In this case, on the one hand the market

[16] This is a turnover tax paid on gross receipts.

for gambling is routinely regulated and thus the tax administration is likely to posses some market power, while on the other hand rationing consumption is a minor concern as long as gambling produces negative externalities. A further advantage over monetary transfers is the savings in monitoring costs: only the receipts of lottery winners must be collected and checked[17], whereas systems based on refunds usually involve huge costs just for handling a large number of receipts. From the point of view of equity, so long as lotteries are inferior goods they should give rise to transfers that have a larger value for the poor who receive them. On the other hand, among the drawbacks to the lottery scheme, one must include the possible substitution effect upon the demand for other forms of gambling supplied by the government.

A more general caveat with reference to both monetary and in-kind transfers is related to the potential for crowding-out effects in the realm of intrinsic (moral) motivations for paying taxes and obeying fiscal laws. This is a matter for concern, since, in a certain sense, compliance becomes conditional on a compensation.

A Appendix

With n identical firms composing the industry, the profit function of firm i is given by:

$$\left\{\frac{P_c(X)}{1-rt}\left[1-t^E-g(\beta)\right]-m\right\}x_i$$

where t^E is given by:

$$t^E = t\left\{1-\beta[1-p(1+s)-r]\right\}$$

while X is the industry output and is given by:

$$X = x_i + \sum_{j\neq i} x_j$$

By resorting to the approach of conjectural variation, we set:

$$\frac{\partial X}{\partial x_i} = \lambda$$

where $\lambda = n$ corresponds to monopoly pricing, $\lambda = 1$ to Cournot behavior and $\lambda = 0$ to the Bertrand equilibrium entailing marginal cost pricing.

The F.O.C. for profit maximization with respect to x_i is given by:

$$\left[\frac{P_c^{'}\lambda x_i}{1-rt}+\frac{P_c}{1-rt}\right]\left[1-t^E-g(\beta)\right]-m=0$$

where a prime stands for the derivative.

[17] On this topic, see also [3].

Under a symmetrical equilibrium all firms produce the same quantity, i.e.:

$$X = nx_i$$

Hence, by totally differentiating the F.O.C. with respect to x_i and to r one gets[18]:

$$dx_i \left[1 - t^E - g(\beta)\right] \left(\frac{1}{1-rt}\right) \left(P_c^{''} n\lambda x_i + P_c^{'}\lambda + nP_c^{'}\right)$$
$$= dr \left\{ t \left[-\frac{1 - t^E - g(\beta)}{(1-rt)^2} + \beta \left(\frac{1}{1-rt}\right)\right] \left(P_c^{'}\lambda x_i + P_c\right)\right\} \tag{21}$$

By considering the inverse market demand $P_c(nx_i)$ one gets:

$$dP_c = nP_c^{'} dx_i \tag{22}$$

By simplifying (21) and substituting dx_i from (22) into (21) one gets:

$$\frac{dP_c}{dr} = \frac{nP_c^{'} t \left[\beta - \frac{1-t^E-g(\beta)}{1-rt}\right] \left(P_c^{'}\lambda x_i + P_c\right)}{\left[1 - t^E - g(\beta)\right] \left(P_c^{''} n\lambda x_i + P_c^{'}\lambda + nP_c^{'}\right)}$$

which can be rewritten by setting:

$$\mu = \frac{\lambda}{n}$$
$$E = -\frac{P_c^{''}}{P_c^{'}} X = -\frac{P_c^{''}}{P_c^{'}} nx_i$$

where E is Seade's elasticity of the slope of the inverse demand function. Hence:

$$\frac{dP_c}{dr} = \frac{t \left[\beta - \frac{1-t^E-g(\beta)}{1-rt}\right] \left(P_c^{'}\lambda x_i + P_c\right)}{\left[1 - t^E - g(\beta)\right] \left[1 + \mu(1-E)\right]} \tag{23}$$

provided that the stability condition $[1 + \mu(1-E)] > 0$ holds. Moreover, from the F.O.C. for profit maximization one gets:

$$\left[P_c^{'}\lambda x_i + P_c\right] = \frac{m(1-rt)}{\left[1 - t^E - g(\beta)\right]} = P_{cc}$$

[18] By differentiating t^E with respect to r one gets:

$$\frac{\partial g(\beta)}{\partial \beta}\frac{\partial \beta}{\partial r} + t\beta - \frac{\partial \beta}{\partial r} t[1 - p(1+s) - r]$$

Since the F.O.C. with respect to β implies that:

$$t\left[1 - r - p(1+s)\right] = \frac{\partial g(\beta)}{\partial \beta}$$

one can simplify as in the r.h.s. of (21).

where P_{cc} stands for the consumer price under competition. Hence (23) can be rewritten as:

$$\frac{dP_c}{dr} = P_{cc} \frac{t\left[\beta - \frac{\left[1-t^E - g(\beta)\right]}{1-rt}\right]}{\left[1 - t^E - g\left(\beta\right)\right]\left[1 + \mu\left(1 - E\right)\right]} \tag{24}$$

Note that (24) reduces to (10) under perfect competition, as in this case $\lambda = 0 = \mu$. It turns out that backward overshifting is larger under imperfect than under perfect competition if $0 < [1 + \mu(1 - E)] < 1$ holds, i.e., if:

$$1 < E < \frac{1}{\mu} + 1$$

Within this interval, overshifting is larger the larger are E and μ. Note that μ is larger the less competitive is the market. On the other hand, when $E < 1$, a non competitive market is less prone to overshifting than a competitive one. As an example, consider a linear demand, i.e., $E = 0$, and a monopolistic market, i.e., $\mu = 1$: in this case the shifting is $\frac{1}{2}$ of that occurring under competition.

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