In order to detect tax evasion, tax authorities increasingly make use of third-party reported information on taxpayers’ wealth as well as certain consumption expenditures. When consumption or changes in wealth cannot be justified by self-reported income, the tax authority may decide to initiate an audit. I determine the consequences of such audit policies for the optimal tax structure. In particular, I identify under what conditions third-party reported consumption should be subject to higher (or lower) tax rates than non-reported consumption. On the one hand, as tax evaders shy away from third-party reported consumption, raising taxes on unreported consumption discourages tax evasion. On the other hand, imposing a higher tax on reported consumption further distorts a tax evader’s consumption bundle, and may therefore also discourage tax evasion. The net balance of these countervailing social-welfare effects is crucially driven by the elasticity of substitution between reported and non-reported goods. Government should impose higher (lower) taxes on third-party reported consumption when the elasticity of substitution is sufficiently high (low). Implications for wealth taxation are discussed.

JEL: H21, H23, H26
Keywords: Tax evasion, consumption reporting, optimal commodity taxation, optimal capital taxation
1 Introduction

Every year, governments around the world lose out on a significant chunk of revenue due to individuals’ tax evasion practices. To fight this, tax authorities are making ever more use of methods of indirect income measurement. These methods rely on data on individuals’ financial transactions and consumptive expenditures from sources other than tax payers’ self-reported income statements – that is, they rely on third-party reported consumption expenditures. This type of information is used to obtain a better estimate of tax payers’ true income, and thereby improve tax audit policy. If an individual’s self-reported income is insufficiently high to justify his third-party reported expenditures, he becomes an attractive target for a formal tax audit.

Indirect income measurement has made press headlines on a number of striking occasions. Both the Italian and Greek police have been known to halt expensive luxury cars and yachts only to pass on ownership information to their respective tax authorities – which then used this information to determine whether the person has reported sufficient income to justify ownership of such expensive items. The opening quote of this paper indicates anecdotal evidence that Italians – afraid of being caught by the tax authority – responded by eschewing luxury cars. Further examples of third-party reported information on individual expenditures that are used for tax audit purposes include aerial photography to determine ownership of houses and swimming pools (Casaburi and Troiano, 2016), electronic payments through credit card companies (Slemrod et al., 2017), and financial data more generally such as changes in wealth (Kleven et al., 2011). Indeed, beyond the headline-grabbing instances of third-party reported consumption, it has by now become common practice among many tax authorities to make use of auxiliary third-party reported information on tax payers’ expenditures and financial statements when evaluating their self-reported income.

The goods and transactions that are subject to third-party reporting
are special in another sense as they are typically also subject to separate
taxes. Thus, around the same time that Italian police were stopping lux-
ury car owners to send along their data to the tax authority, the Italian
government implemented supplementary taxes on luxury cars, yachts, and
private jets with the explicit goal to raise some revenue from tax evaders
who were – rightly or wrongly – seen as big consumers of luxury goods.
And most countries have separate taxes for real estate property, wealth, and
income from wealth – which are typical third-party reported items. But
the welfare-theoretical basis of such taxes in the presence of third-party
reported consumption taxes is entirely unexplored. As such it is unclear
how goods that are subject to third-party reporting should optimally be
taxed. This paper is a first attempt at filling this gap.

I do so by expanding the canonical optimal-tax model of Stiglitz (1982)
and Stern (1982) with the possibility of evading income taxes as well as
third-party reported consumption. There are two types of individual that
differ in their earning capacity. Individuals decide how much income to
earn, how much income to report, and how to spread income across third-
party reported and non-third-party reported consumption. It is assumed
that individuals need to incur concealment costs to perfectly hide income
from the tax authority. A government with redistributive preferences opti-
mally sets nonlinear income and proportional commodity taxes subject to
a budget constraint and incentive constraints that require high-productive
workers to prefer their own reported income over that of low-productive
workers. This captures the fact that if taxes are too progressive, high-
productive workers would prefer reporting low-productive income by work-
ing less and evading more. The key effect of third-party reported consump-
tion in this context, is that it relaxes incentive constraints by forcing tax
evaders to distort their own consumption bundle away from third-party
reported commodities – thereby making evasion less attractive.

In line with standard optimal tax theory, the government uses its non-
linear income tax to ensure redistribution from rich to poor. Commodity
taxes are optimally positive, essentially because they allow the government
to recoup some of the lost revenue from income-tax evaders. Importantly,
I show that optimal commodity taxes are generally not uniform across
goods. This conclusion holds even if preferences are homothetic – contra-
dicting earlier studies (cf. Atkinson and Stiglitz, 1976; Boadway, Marchand, and Pestieau, 1994). Indeed, there are two countervailing arguments to tax third-party reported commodities differently from non-reported commodities. On the one hand, tax evaders skew their consumption pattern away from third-party reported goods in order to avoid detection. As a result, taxing non-reported goods relaxes incentive constraints because tax evaders consume disproportionately much of these goods. On the other hand, taxing third-party reported goods further distorts evaders’ consumption bundle towards non-reported goods. Because their consumption bundle was already distorted in the first place, this additional distortion represents a first-order utility loss for tax evaders, relaxing incentive constraints.

The higher the substitution elasticity between both goods, the more a tax distorts consumption bundles, and thus the more important the second argument in favor of higher taxes on third-party reported goods. Indeed, I show for homothetic preferences that taxes on third-party reported goods should exceed those on other goods if and only if the elasticity of substitution between both types of good exceed one. If the elasticity of substitution is smaller than 1, non-reported goods should be taxed more heavily. Unfortunately, for most categories of third-party reported goods, substitution elasticities are hard to get by. One exception to this is wealth, i.e., future consumption. Indeed, a large literature suggests that the intertemporal elasticity of substitution is less than one (Hall, 1988; Vissing-Jørgensen, 2002; Guvenen, 2006). This suggests that, if information on (changes in) wealth is used in tax audit policy, this generates an argument against the taxation of wealth. I show that this holds a fortiori when wealth taxes may themselves be evaded.

Related papers on the importance of third-party reporting include Kleven et al. (2011); Kleven (2014); Pomeranz (2015); Naritomi (2013); Slemrod et al. (2017); Almunia and Lopez-Rodriguez (2018). Other papers on optimal taxation with tax evasion include Cremer, Marchand, and Pestieau (1990); Kaplow (1990); Cremer and Gahvari (1993, 1994, 1995); Boadway, Marchand, and Pestieau (1994); Grochulski (2007); Huang and Rios (2016). However, none of these papers discuss the implications of third-party reported consumption or wealth. Finally, there is a small literature on optimal audit strategies when the tax authority can observe some con-
sumption, but these studies are not concerned with the implications for optimal taxation, see Yaniv (2003, 2013); Levaggi and Menoncin (2016); Bronsert (2016).

Section 2 introduces the theoretical model, Section 3 presents optimal income and commodity tax results, Section 4 draws lessons for the optimal taxation of wealth, and Section 5 concludes.

2 Theoretical framework

2.1 Individuals

2.1.1 Preferences and constraints

We assume there are two types of individuals, denoted by \( i \in \{H, L\} \). Individuals denoted by \( H \) (\( L \)) have a high (low) innate earnings ability. Population shares of both types are given by \( n_i \) such that \( n^H + n^L = 1 \). High-ability individuals only differ from low-ability individuals in terms of their wage rates \( w^i \), with \( w^H > w^L \). Individuals provide labor supply \( l^i \), which yields gross labor income \( z^i \equiv w^i l^i \). Individuals report an amount \( y^i \) to the tax authority; thus, they evade taxes if \( y^i < z^i \). We denote the amount of underreported income by \( e^i \equiv z^i - y^i \). In order to successfully evade taxes, individuals incur some concealment costs \( g(e^i) \). These costs are assumed to be strictly convex in the amount of evasion, with both total and marginal costs equal to zero under full compliance: \( g(0) = g'(0) = 0 \), and \( g''(e) > 0 \), and thus \( g'(e) > 0 \) for \( e > 0 \) and \( g'(e) < 0 \). As the government does not observe actual labor income, it conditions its income tax on reported income. Individual \( i \)'s income tax liability is denoted by \( T(y^i) \) and is a potentially nonlinear function of reported income. We denote the income report net of taxes by \( m^i \equiv y^i - T(y^i) \).

Disposable income after concealment costs and taxes is spent on the consumption of two commodities, denoted by \( c^i \) and \( x^i \). The tax authority receives third-party reports on individual consumption of good \( x^i \), but not

\footnote{Individuals who face a negative marginal tax rate may want to report more income than they actually earn and therefore set \( e < 0 \). I assume that overreporting also comes with increasing concealment costs. This explains that concealment costs are decreasing in \( e \) for \( e < 0 \).}
of good $c^i$. Below, I discuss how third-party reports affect the economy’s equilibrium. Production of both goods takes place with linear technology, so that both producer prices can be normalized to 1. The government imposes proportional commodity taxes $t_c$ and $t_x$ so that consumer prices are given by $1 + t_c$ and $1 + t_x$. Individual budget constraints are given by:

\[(1 + t_c)c^i + (1 + t_x)x^i = y^i - T(y^i) + e^i - g(e^i),\]

Thus, total consumption expenditures (left-hand side) must equal disposable income (right-hand side), where disposable income equals the sum of reported income net of income taxes and the underreported income net of concealment costs.

Utility of individual $i$ is given by

\[(2)\quad U^i = u(c^i, x^i) - h\left(\frac{y^i + e^i}{w^i}\right),\]

with $u(\cdot)$ subutility of consumption and $h(\cdot)$ disutility of work – notice that $l^i = (y^i + e^i)/w^i$. I assume that disutility of work is strictly convex, $h', h'' > 0$. I moreover assume that the subutility function of consumption exhibits a constant elasticity of substitution. Together with homogeneous preferences and weak separability between consumption and labor supply, this ensures that optimal consumption taxes are uniform in the absence of third-party reported consumption expenditures – whether it is in a setting without tax evasion (Atkinson and Stiglitz, 1976), or with tax evasion (Boadway, Marchand, and Pestieau, 1994).\(^2\)

### 2.1.2 Equilibrium behavior

Use the budget constraint to substitute for $c^i$ in the utility function, and maximize with respect to the income report, evasion, and consumption to

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\(^2\)In the absence of tax evasion, weak separability and homogeneous preferences are sufficient to obtain uniform consumption taxes; with tax evasion but without third-party consumption reports, weak separability, homogeneous preferences, and homothetic subutility of consumption are sufficient.
obtain first-order conditions for equilibrium behavior:

\[
\frac{dU^i}{dy^i} = 0 \implies h'(l^i) = \left(1 - T'(y^i) + \frac{1}{1+t_c}\right) w^i u^i_c
\]

\[
\frac{dU^i}{de^i} = 0 \implies h'(l^i) = \left(1 - g'(e^i) + \frac{1}{1+t_c}\right) w^i u^i_c
\]

\[
\frac{dU^i}{dx^i} = 0 \implies \frac{u^i_c}{w^i_c} = \frac{1+t_x}{1+t_c},
\]

where subscripts denote partial derivatives. As usual, marginal disutility of earning and reporting an additional monetary unit must equal the marginal utility of consuming the resulting net-of-tax income (eq. (3)). Marginal disutility of earning and evading an additional monetary unit must equal the marginal utility of consuming the resulting income net of concealment costs (eq. 4). And the marginal utility of spending a monetary unit on \(c\) or \(x\) must be equal. Of course, the first two first-order conditions imply that individual behavior ensures \(T'(y^i) = g'(e^i)\). That is, individuals must on the margin be indifferent between reporting or evading an additional unit of earnings.

Along with the budget constraint, eq. (4) implicitly determines tax evasion as a function \(e^i = e(y^i, m^i, x^i, w^i, t_c, t_x)\). Along with the budget constraint, this allows me to substitute \(c^i\) and \(e^i\) out of the utility function. This yields what I refer to as a conditional indirect utility function \(U^i = U(y^i, m^i, x^i, w^i, t_c, t_x)\), which can be written as follows:

\[
U(y^i, m^i, x^i, w^i, t_c, t_x) \equiv u\left(\frac{m^i + e - g(e) - (1 + t_x)x^i}{1+t_c}, x^i\right) - h\left(\frac{e + y^i}{w^i}\right),
\]

where I suppressed function arguments for \(e(\cdot)\). Note that \(U(\cdot)\) is a conditional indirect utility function as it only imposes equilibrium tax evasion, but not equilibrium income reports or consumption – i.e., I did not substitute for the first-order conditions in eqs. (3) and (5). Finally, for future reference, notice that the first-order conditions in eqs. (4) and (5), together with the budget constraint, determine consumption \(c^i\) and \(x^i\) as functions \(x^i = x(y^i, m^i, w^i, t_c, t_x)\) and \(c^i = c(y^i, m^i, w^i, t_c, t_x)\).
2.2 Government

2.2.1 Social preferences and the budget constraint

The government sets the nonlinear income tax $T(\cdot)$, and proportional commodity taxes $t_c$ and $t_x$. As usual, rather than solving directly for the optimal nonlinear tax schedule, I instead solve for the optimal incentive-compatible allocation $\{y^i, m^i\}$ and subsequently derive its implications for optimal taxes. Social preferences are represented by a weighted sum of individuals’ utility:

\[(7) \quad W \equiv \sum_i n_i a^i U(y^i, m^i, x^i, w^i, t_c, t_x),\]

with $a^i$ type $i$’s social welfare weight. I assume that $a^L > a^H$, which implies a social preference for redistribution from rich to poor. The government’s budget constraint is given by:

\[(8) \quad B \equiv \sum_i n_i (y^i - m^i + t_c c^i + t_x x^i) = 0.\]

Thus, net receipts from the income tax $(y^i - m^i)$ and commodity taxes from all individuals must cancel out. We can add some exogenous revenue requirement without affecting any of our results.

2.2.2 Incentive compatibility and third-party reported consumption expenditures

Social preferences are such that the government would optimally want to redistribute from $H$ types to $L$ types, but it is restricted in doing so by an incentive constraint. It can only redistribute income as long as $H$ types prefer the $\{y^H, m^H\}$ combination that the government intends for them over the $\{y^L, m^L\}$ combination that the government intends for the $L$ types. Following convention, we refer to an $H$-type individual who chooses to report the $L$ type income as a ‘mimicker.’ The government’s incentive constraint stipulates that the high-type utility must exceed the mimicker’s
utility. Hence, the government faces the following incentive constraint:

\[ C \equiv U^H - \bar{U}^H \leq 0 \iff U(y^H, m^H, x^H, w^H, t_c, t_x) - U(y^L, m^L, \bar{x}^H, w^H, t_c, t_x) \geq 0, \]

where an overbar indicates the value of a variable for the mimicker. It is important to note that the mimicker reduces his income report by choosing both lower labor supply and more tax evasion.

We can now illustrate the difference between a world with and without third-party reported consumption. In the absence of third-party reported income, the mimicker simply chooses consumption \( \bar{x}^L \) to maximize his utility: \( \bar{x}^H = \arg \max_x U(y^L, m^L, x, w^H, t_c, t_x) \). With third-party consumption reporting, however, the tax authority knows that an individual is evading taxes if he reports income \( y^L \) but consumes more than \( x^L \). As a result, to avoid an audit, the mimicker needs to also mimic the \( L \) type’s consumption of good \( x \): \( \bar{x}^H = x^L \). Since \( x^L \) is below the mimicker’s utility-maximizing level of consumption, third party-reported consumption distorts the mimicker’s consumption bundle: he consumes less (more) of good \( x \) (c) then he would like. Thus, third-party reporting reduces the mimicker’s utility, thereby relaxing the incentive constraint. From now on, I assume that the government can indeed use third-party reports to ensure that \( \bar{x}^H = x^L \).

2.2.3 First-order conditions for the optimal tax system

I denote the shadow prices of the government budget constraint and the incentive constraint by \( \lambda \) and \( \theta \). The Lagrangian associated with the social planner’s optimization problem can then be written as:

\[ L \equiv \mathcal{W} + \lambda B + \theta C \]

\[ = \sum_i n^i a^i U(y^i, m^i, x^i, w^i, t_c, t_x) \]

\[ + \lambda \sum_i n^i \left( y^i - m^i + t_c c^i + t_x x^i \right) \]

\[ + \theta \left( U(y^H, m^H, x^H, w^H, t_c, t_x) - U(y^L, m^L, \bar{x}^H, w^H, t_c, t_x) \right). \]

---

\(^3\) I assume that the government cannot use the third-party information to impose a nonlinear commodity tax. Because in reality third-party reported consumption expenditures are likely to be incomplete and imperfect, making them practically infeasible as a tax base.
The government maximizes the Lagrangian with respect to \( \{y^i, m^i, t_c, t_x\} \), taking into account that both types of individuals optimally choose \( x^i \) according to the first-order condition in eq. (5).

As this paper is specifically interested in optimal commodity taxes, we only show the government’s first-order conditions with respect to \( t_c, t_x, m^L \) and \( m^H \):

\[
\frac{\partial L}{\partial m^L} = n^L \left( \frac{u^L_c}{1 + t_c} - \lambda \right) + n^L \lambda \left( t_c \frac{\partial c^L_c}{\partial m^L} + t_x \frac{\partial x^L_c}{\partial m^L} \right) - \theta \left( \frac{\bar{u}^H_c}{1 + t_c} - \frac{\bar{u}_c^H}{\bar{u}_c^H - 1 + t_c} \right) = 0
\]

\[
\frac{\partial L}{\partial m^H} = n^H \left( \frac{u^H_c}{1 + t_c} - \lambda \right) + n^H \lambda \left( t_c \frac{\partial c^H_c}{\partial m^H} + t_x \frac{\partial x^H_c}{\partial m^H} \right) + \theta \left( \frac{u^H_c}{1 + t_c} \right) = 0
\]

\[
\frac{\partial L}{\partial t_c} = \sum_i n^i c^i \left( \lambda - \frac{u^i_c}{1 + t_c} \right) + \sum_i n^i \lambda \left( t_c \frac{\partial c^i_c}{\partial t_c} + t_x \frac{\partial x^i_c}{\partial t_c} \right) - \theta \left( c^H \frac{u^H_c}{1 + t_c} - \bar{c}^H \frac{\bar{u}_c^H}{\bar{u}_c^H - 1 + t_c} \right) - \theta \left( \frac{\bar{u}_c^H}{\bar{u}_c^H - 1 + t_c} \right) = 0
\]

\[
\frac{\partial L}{\partial t_x} = \sum_i n^i x^i \left( \lambda - \frac{u^i_c}{1 + t_c} \right) + \sum_i n^i \lambda \left( t_c \frac{\partial c^i_c}{\partial t_x} + t_x \frac{\partial x^i_c}{\partial t_x} \right) - \theta \left( x^H \frac{u^H_c}{1 + t_c} - \bar{x}^H \frac{\bar{u}_c^H}{\bar{u}_c^H - 1 + t_c} \right) - \theta \left( \frac{\bar{u}_c^H}{\bar{u}_c^H - 1 + t_c} \right) = 0
\]

To better understand the welfare properties of tax policy within this framework, it is useful to briefly consider each first-order condition in turn. Eq. (11) indicates that raising \( L \)-type income has four welfare-relevant effects. The first left-hand side term shows that it raises utility of the poor at the expense of government revenue. The second term represents the fact that an increase in income affects \( L \)-type consumption of both commodities and thereby government revenue. Since the mimicker also receives the \( L \)-type income, an increase in \( m^L \) raises his utility and therefore tightens the incentive constraints. The third term illustrated the associated welfare costs. Finally, the mimicker adjusts his consumption bundle in accordance to the \( L \) type. This generates a first-order effect on the mimicker’s utility, which is represented by the fourth term. Likewise, eq. (12) shows that a higher
income for the $H$ type redistributes resources from the government to $H$ types (first term), affects $H$ type consumption and therefore commodity tax revenue (second term), and raises $H$ type utility relative to the mimicker (third term). Notice that $m^H$ does not affect $L$ type consumption so that the mimicker’s consumption bundle remains unaffected.

The first-order conditions for $t_c$ and $t_x$ in eqs. (13) and (14) contain four terms each. The first term is a redistributive term and gives the social valuation of transferring $c^i dt_c$ or $x^i dt_x$ units of resources from the private to the public sector. The second term represents the government revenue gains or losses associated with the consumption responses to an increase in the commodity tax. The third term represents the commodity tax’s direct effects on the incentive compatibility constraint as it lowers utility of both the $H$-type individual and the $H$-type mimicker. The fourth term represents the commodity tax’s effect on the incentive constraint because it affects the mimicker’s consumption of good $x$. If the mimicker’s consumption pattern is distorted, any reform-induced change in his good-$x$ consumption has a first-order effect on his utility and thus affects the incentive compatibility constraint.

3 Optimal taxes

3.1 Optimal income taxes

First consider optimal income taxes in the absence of commodity taxes, such that $t_c = t_x = 0$. In that case, we obtain the usual result for the optimal labor-income tax.

**Proposition 1** In the absence of commodity taxes, the optimal nonlinear labor-income tax is such that it redistributes from the rich to the poor, distorts labor supply decisions of the poor, and leaves labor supply decisions of the rich undistorted.

**Proof.** See Appendix. □
3.2 Optimal uniform commodity taxes

Before I turn to the main question of interest, it is useful to derive how commodity taxes should be set if they are restricted to be uniform, so that \( t_c = t_x = t \).

**Proposition 2** The optimal uniform commodity tax is determined by the following optimality condition:

\[
-t \sum_i n^i \lambda \left( \frac{\partial \tilde{c}^i}{\partial t_c} + \frac{\partial \tilde{x}^i}{\partial t_c} + \frac{\partial \tilde{c}^i}{\partial t_x} + \frac{\partial \tilde{x}^i}{\partial t_x} \right) = \theta \bar{u}^H \left( \bar{c}^H - c^L \right) > 0,
\]

where tildes indicate compensated changes, such that \( \frac{\partial \tilde{c}^i}{\partial t_c} = \frac{\partial c^i}{\partial t_c} + c^i \frac{\partial c^i}{\partial m^i} \), etc.

**Proof.** See Appendix. ■

3.3 Optimal differentiated commodity taxes

Finally, the following Proposition establishes under what conditions a tax on third-party reported commodities should be higher than on nonreported commodities. To determine this, I consider an increase in \( t_x \) along with a compensating reduction in \( t_c \), such that the total distortion on labor supply remains constant. I evaluate this reform at \( t_c = t_x = t \).

**Proposition 3** Departing from any initial allocation with uniform commodity taxes, \( t_c = t_x = t \), it is welfare improving to raise taxes on third-party reported consumption and lower it on non-reported consumption if and only if the following condition holds:

\[
\left( \frac{\bar{u}_x^H}{\bar{u}_c^H} - 1 \right) x^L \sigma > \frac{\rho}{1 - \rho} \left( \bar{c}^H - c^L \right),
\]

where \( \sigma \) is the elasticity of substitution between the two consumption goods, and \( \rho \) is the share of the reported consumption good within total consumption.

**Proof.** See Appendix. ■

Proposition 3 highlights the essential tradeoff when differentiating commodity taxes. Notice that the right-hand side of eq. 16 is proportional to
the difference between a mimicker’s and an $L$ type’s consumption of non-reported goods. The larger this difference, the more likely that optimal differentiated commodity taxes on non-reported goods should be higher than those on third-party reported goods. Intuitively, as mimickers consume disproportionately much of non-reported goods, a tax on these goods would relax incentive constraints – allowing the government to redistribute more from rich to poor.

The left-hand side of eq. 16 reflects the main argument in favor of higher taxes on third-party reported goods. It is proportional to the distortion of the mimicker’s consumption bundle – as measured by the deviation between his marginal rate of substitution of $x$ for $c$ and the relative price $1$ – and the elasticity of substitution. Intuitively, raising taxes on reported commodities causes $L$-types to adjust their consumption bundle by substituting non-reported goods for reported goods – and the mimicker’s consumption bundle must follow suit. While this substitution only has second-order effects on $L$-type utility, it inflicts a first-order utility loss on the mimicker. The magnitude of this utility loss is reflected by the pre-existing distortion in his consumption bundle. Hence the left-hand side of eq. 16.

As it turns out, it is possible to further simplify eq. 16. This is done in the following Corollary.

Corollary 1 If the subutility function of consumption exhibits a constant elasticity of substitution, evaluated at uniform taxes, shifting the burden of taxation away from (towards) the nonreported good towards (away from) the reported good improves social welfare if and only if the elasticity of substitution between the two goods is larger (smaller) than 1.

Proof. See Appendix. ■

Thus, there is only one empirical quantity that matters for how commodity taxes should be differentiated. If the substitution elasticity between reported and non-reported goods is 1, it is optimal to have uniform commodity taxes. If the substitution elasticity exceeds 1, it is optimal to tax reported goods at a higher rate than nonreported goods. If the substitution elasticity is less than 1, it is optimal to tax nonreported goods at a higher rate.
4 Implications for wealth taxation

P.M.

5 Conclusion

P.M.

References


A Appendix

A.1 Proof Proposition 1
P.M.

A.2 Proof Proposition 2
P.M.

A.3 Proof Proposition 3
P.M.

A.4 Proof Corollary 1
P.M.