Disclosure of Corporate Tax Reports, Tax Enforcement, and Insider Trading*

Jordi Caballé  
Universitat Autònoma de Barcelona, MOVE and Barcelona GSE

Ariadna Dumitrescu  
ESADE Business School, Ramon Llull University

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Abstract

In this paper, we analyze the effects of disclosing corporate tax reports on the performance of financial markets and the use of prices by the tax enforcement agency in order to infer the true corporate cash flows. We model the interaction between a firm and the tax auditing agency, and highlight the role played by the tax report as a public signal used by the market dealer and the role of prices as a signal used by the tax authority. We discuss the determinants of both the reporting strategy of the firm and the auditing policy of the tax authority. Our model suggests that, despite disclosure of the tax reports being beneficial for market performance (as the spreads and trading costs are smaller than under no disclosure), the tax agency might have incentives to not disclose the tax report when its objective is to maximize expected net tax collection.

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E-mail addresses: Caballe: jordi.caballe@uab.es; Dumitrescu: ariadna.dumitrescu@esade.edu.
1 Introduction

In this paper, we study whether it is desirable or not to make firm’s tax statements public. We analyze how the disclosure of the tax report affects both the tax agency revenue and the performance of the financial market where the shares of the firm are traded. We argue that although the disclosure of the tax report improves market performance, it can, depending on market conditions, increase or decrease the expected net revenue of the tax agency. Therefore, despite of disclosure being beneficial for market performance, the tax agency might decide not to make public the tax report because the release of this report has a negative impact on its revenue.

Corporate disclosure is essential for the functioning of financial markets. However, the extent to which firms benefit from increased disclosure still remains a very controversial issue. In the United States the tax return information was public from the time of Civil War and it was restricted only in 1976, when the Tax Reform Act of 1976 made the tax return confidential. The debate on disclosure of corporate tax return information became more active after the problems of Enron, WorldCom and other important U.S. corporations. As Hanlon (2003) points out tax statements required under Generally Accepted Accounting Principles do not easily permit the users of financial statements to estimate taxable income. Thus, limited disclosure can create divergence between book and tax income because the firm may under-report to the IRS while they may over-report to the shareholders. “Book profits and tax profits can be wildly different – a divergence, by the way, that increased markedly in the 1990s” (The Corporate Reform Tax Cut, 29 January 2003, The Wall Street Journal).

The debate reached a peak in July 2002, when the Senator Charles Grassley, the chairman of the Senate Finance Committee wrote a letter to the Secretary of the Treasury and the Chairman of the Securities and Exchange Commission to put forward for consideration the question of whether the corporate tax returns should be made public and the effect the disclosure of the tax return would have on public welfare. The debate among academics, practitioners, government policy makers and media was very intensive. On the one hand, the disclosure of tax return information is considered to be beneficial for the well-functioning of financial markets as it encourages tax compliance. On the other hand, the disclosure is seen to prevent tax enforcement because of the dilution of the information content of tax return; it could also reveal information that can put the firms which are forced to disclose information at a disadvantage versus those which are not forced to disclose any information (see Lenter et al., 2003). In addition, the tax return disclosure approaches the deficiencies of the financial requirements such as the lack of informativeness and specificity. The responses of the Security and Exchange Commission and Treasury Department’s were negative, the principal claim being that disclosure was beneficial only in certain circumstances and it does not bring about a significant improvement in the task of SEC’s ability to protect investors. However, despite of the fact that this objective is
not satisfied, the disclosure of corporate tax return might improve the functioning of financial markets. As a result of this debate, in 2003 a bill that asked for public disclosure of corporate tax return information was submitted to the Congress but it failed. In 2006, the accounting norms represented by Financial Accounting Standards Board (FASB) Financial Interpretation No. 48, Accounting for Uncertainty in Income Taxes (FIN 48) standardized financial reporting of tax uncertainty providing measurement of income tax reserves in financial statements and it made mandatory its public disclosure.¹

In 2012 the President Obama’s Framework for Business Tax Reform called for an increase in disclosure of annual corporate income tax: “Corporate tax reform should increase transparency and reduce the gap between book income, reported to shareholders, and taxable income reported to IRS. These reforms could include greater disclosure of annual corporate income tax payments.”² As Hasegawa et al. (2013) point out this debate took place in the complete absence of empirical evidence of taxpayers responses to income tax disclosure. And, in the absence of any theoretical framework that could show the effects of the public disclosure of the corporate tax report. Our paper, aims to fill in partially the lack of theoretical models that study the effect of disclosure of the tax report on the financial markets and on the tax compliance.

Our paper is connected therefore to three strands of the literature: the literature on tax compliance/tax evasion, the literature on disclosure of information by firms, and the literature on the use of information revealed by the security prices. The literature on tax evasion points out that the way in which an individual/firm perceives his/its economic opportunities to be affected by the tax code and by the instruments of tax enforcement is extremely important because the tax system and its enforcement may induce the taxpayer to hide or misrepresent some of his activities. The taxpayer may perceive certain choices with regard to tax declaration, financial transactions, or economic activity to be potentially costly in that they are subject to the threat of exposure and penalty. If so, then this perception would influence such choices and these choices on their turn affect in different ways the functioning of the economy.

The literature that analyzes the taxpayer compliance has as a starting point the papers that take a portfolio approach, using as weights the probability of being caught and paying a penalty. Thus, Allingham and Sandmo (1972), Yitzhaki (1974) and Polinsky and Shavell (1979) consider the case of the individual decision to evade payoff taxes when all the taxpayers face a constant probability of auditing by the tax agency. This assumption was criticized by Reinganum

¹See Mills et al. (2010), Blouin et al. (2010) and Lisowsky et al. (2013) for a detailed FIN 48 analysis.
²Other recent regulations in place are targeting specific industries. Thus the Dodd–Frank Wall Street Reform and Consumer Protection Act, signed on July 2010, requires that SEC registrants in an extraction industry must annually report payments made by the company to the U.S. and foreign governements by projects and by country. The payments to be disclosed include taxes, royalties, bonuses and dividends. On February 28, 2013, the European Union Parliament approved country-by-country reporting for European banks of data on employees, profits, and taxes paid.
and Wilde (1986), who point out that the payoff report contains information about the true realization of the payoff and, consequently, that the probability of auditing should depend on the report made by the taxpayers. They model tax compliance as a game with incomplete information where first the tax payer reports his payoff, and then the tax auditing agency chooses the auditing probability depending on the payoff reported by the taxpayer. While the above papers incorporated the uncertainty about the tax liabilities, another strand of research was concerned with the other sources of randomness that alter the interaction between the taxpayers and the tax auditing agency. Mainly, they incorporated in their models the fact that the tax code is complex and can lead to involuntary mistakes even when the taxpayers want to comply with the law. Thus, Scotchmer and Slemrod (1989) consider the case where the ambiguity of the law gives place to a random auditing policy depending on the interpretation given to the law. Reinganum and Wilde (1998) incorporate in the model the taxpayers’s uncertainty about auditing cost while Caballé and Panadés (2005) allow for both mistakes made by taxpayers and uncertainty about auditing cost. Beck and Jung (1989a) examine tax compliance in an environment in which taxpayers are also uncertain regarding their tax liability (because of the tax law complexity) and by simultaneously considering different tax rate structures and risk-taking attitudes, while Beck and Jung (1989b) examine this problem taking into account that audit probabilities are endogenous. Crocker and Slemrod (2005) and Chen and Chu (2005) study also the problem of tax compliance in a principal-agent framework while Sansing (1993), Mills and Sansing (2000), Beck et al. (2000) and Mills et al. (2010) allow the tax auditing agency to observe a signal regarding the taxpayer, which affects their strategic interaction.3

Our work is also in line with the stream of literature that is concerned with the role of information disclosure by firms, and the consequence of the disclosure on asset prices and on the trader’s welfare. Disclosure can be interpreted as a choice of an accounting technique or a committed policy of making earnings or other forecasts. In general, the research in this field focuses on the role played by disclosure in reducing the asymmetry of information among investors that can introduce adverse selection into the financial market and study its consequences on firm valuation. Thus, in a rational expectations equilibrium model with endogenous information collection, Diamond (1985) shows that the welfare of stockholders may be improved by disclosing data that can reduce the asymmetry of information among investors. Diamond and Verrecchia (1991) complete the analysis begun in Diamond (1985) by showing that disclosure policies that reduce the asymmetry of information also increase the market liquidity of a security. The increase in the liquidity of the stock is very important for firms because it reduces the cost of capital and therefore increases the value of the firm (see Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), and Amihud (2002)). Verrechia (2001)

3For a more extended review of both theoretical and empirical tax research see Shackelford and Shevlin (2001) and Hanlon and Heitzman (2010).
points out also that the corporate disclosure is very important for reducing the transactions costs that result from differences in information of the investors participating in the financial market or what he calls "the information asymmetry component of the cost of capital". On one hand, it reduces the incentives of the traders to become privately informed (so it reduces the probability of informed trading) and on the other hand, it reduces the uncertainty about the firm value and therefore the potential gains from being informed.

The theoretical literature gave rise to a significant empirical literature that studies the costs and the benefits of information disclosure by firms and the economic consequences of regulation disclosure and changes in regulation (most recent in the US Sarbanes-Oxley Act and Regulation Fair Disclosure). For detailed surveys see Leuz and Wysocki (2008), Healy and Palepu (2001) and Core (2001).

The previous theoretical disclosure literature is concerned mainly with how information about the firm is disseminated through financial reporting and how managers in charge of information disclosure affect the information environment and therefore the liquidity of the firm’s stock. Though the effects of mandatory disclosure of the tax report and the value of the firm has been studied before, the literature concerned with the effects of the tax report disclosure on the performance of the financial markets has been scant. This paper provides, as far as we know, the first model to analyze how disclosure of the tax report and the strategic interaction between the firm and the tax agency affects the performance of the financial markets where the firm’s shares are traded. Recent research studies the link between tax avoidance and the value of the firm (showing that tax avoidance activities can facilitate managerial opportunism, such as earnings manipulation and outright resource diversion and therefore have an effect on firm value) but not the effect of tax avoidance on the liquidity of the firm’s shares. Thus, Desai et al. (2007) develop a model in which corporate tax sheltering activity and the diversion of rents by managers are interrelated. Desai and Dharmapala (2009) find that there is a positive impact of tax avoidance on firm value for firms with good governance while Hanlon and Slemrod (2009) find a negative stock market reaction to news concerning company involvement in tax shelters. Kim et al. (2010) explores the association between the extent of a firm’s tax avoidance and its future stock price crash risk. The above studies present theoretical models and empirical evidence challenging the view that postulates that tax avoidance enhances the value of the firm since the cash savings from tax avoiding activities can be interpreted as cash flows appropriated by the firm from the tax authorities, which increases expected future cash flows. The only paper closer to our work is Lee et al. (2013) who examine empirically the relation between tax avoidance and firm’s cost of equity and show that non-aggressive tax planning induce lower cost of equity capital. Finally, our paper is also related to an even more recent literature that emphasizes the informative content of prices (see Bond et al., 2011, and the references therein). According to this literature, the prices of financial assets reveal information that can be used for decision
taking and, moreover, there is a feedback effect due to the fact that firm managers are aware of this potential use of prices and modify their actions so that the value of the firm is adjusted accordingly. In our setup, the tax agency observes the market value of the firm and can infer partially the cash flow of the firm. Then, the manager optimally reacts by manipulating the market value of the firm through the selection of the accuracy of the tax report sent to the tax enforcement agency and potentially observed by the market dealer.

We model the strategic interaction between a tax enforcement agency and a firm, when there is an insider trader (the manager who has the possibility of trading in financial markets based on the information he possesses about the firm) and the effects of this interaction on the performance of the financial market. More specifically, we are interested in understanding how tax report disclosure affects stock valuation and liquidity and how the interaction between the tax auditing agency and the firm changes the behavior of the insider while trading in the financial markets. Note that the tax report strategically chosen by the manager has an effect both on the strategy of the tax enforcement agency and on the trading strategy of the insider.

In order to understand how the tax report used as an endogenous public signal affects market performance and tax compliance, we model a game with incomplete information where the manager chooses the tax report and the tax auditing agency chooses its auditing effort. Since misleading tax reporting may induce misleading understanding of the financial performance of the firm, the manager is cautious about the report he files with the tax agency. Then, the manager trades in the financial markets based on his private information about the realization of the firm’s payoff. The trading is modeled using a dealer market model similar to Glosten and Milgrom (1985). The interaction between the manager and the tax auditing agency leads to the release of a public signal which is endogenously determined. When the tax report becomes public, the dealer uses this information in setting the prices in the trading stage; and we thus argue that the endogenous public signal plays an important role on market performance in general and liquidity in particular.

We show that, unlike in Glosten and Milgrom (1985), where the liquidation value is exogenously given, the market performance might behave non-monotonically with respect to the noise in the market and that it depends on the tax agency efficiency (measured as a monitoring or auditing cost) and on the tax morale. Thus, market liquidity (measured as the bid-ask spread) in the case where the report is not disclosed is non-monotonic with respect to the auditing cost. On the one hand, for small auditing costs, the tax agency is able to undo the effect of misreporting by the manager. The market maker, who also observes the report uses this information and sets a constant ask price (relative to the auditing cost). On the other hand, the manager’s misreporting introduces some additional noise when the market maker observes a sell (it can be the order of the noise trader, when the manager is strategic and chose to misreport but he was not picked up for trading) and it is costly for the tax agency to monitor. This noise introduced
by the manager, therefore, makes the market maker to set a bid price that increases with the auditing cost. When the auditing cost becomes high enough, since the tax agency is inefficient, the manager’s strategy is always to misreport. The market maker understands that the tax agency is inefficient, the manager can misreport more often and in this case he is more likely to trade against the informed trader and therefore he sets a wider bid-ask spread.

When we study the behavior of the spreads as the probability of trading against an informed trader changes, we argue that, as in Glosten and Milgrom (1985), in cases where the report is not disclosed the market maker sets a wider bid-ask spread when he is more likely to trade against the informed trader. However, in cases where the report is disclosed, since the liquidation value is determined endogenously by the interaction between the manager and the tax agency, the market maker faces a trade-off between a higher probability of trading against the insider manager, and a lower liquidation value induced by higher inspection intensity by the tax agency. A similar result is obtained in cases where the report is disclosed when we look at changes in the tax morale. Here there are three forces in place: lower tax morale induces a market maker who observes a buy to associate it with a higher probability of trading against the insider manager, higher inspection intensity and thus lower liquidation value. Which of these forces is dominant determines the behavior of the spread: we can have either an increasing spread if the effect on likelihood of facing an insider manager dominates, or a U-shaped spread otherwise.

Since we want to understand the capacity of the tax agency to reduce tax evasion, we also study the behavior of the expected net revenue collected by the tax agency. As in other models of tax evasion the more inefficient the tax agency, the lower its net tax revenue is. However, since the inspection strategy is contingent on the tax report of the manager and this is chosen to maximize manager’s profits from the financial market, the inspection intensities depend both on how often the manager is picked up for trading in the financial market and on the tax morale. The expected tax revenue increases thus with the likelihood of the manager to be picked up for trading, since the more often he can make profits, the more incentives he has to misreport and therefore the more penalties he pays to the tax agency when caught. However, the behavior of the expected net revenue might not be monotonic with respect to the tax morale when the auditing cost is relatively small.

Finally, our model contributes to the literature by answering some of the questions in the debate of the benefits of disclosure. We show that the disclosure of the endogenous signal has a beneficial effect on market performance because it reduces bid-ask spreads and trading costs. However, it is not always the case that it is beneficial for the tax agency to disclose this information and therefore, the tax agency might decide not to do so.

The remainder of this paper is organized as follows: Section 2 presents the model. We establish here the information structure and characterize the equilibrium in two situations: when the tax report is disclosed and when it is not. Section 3 presents the results of some
comparative statics exercises for market performance and expected net tax agency’s revenue. Section 4 analyzes the effects of endogenizing the public signal and its public release. Finally, Section 5 summarizes the results. The Appendix contains the main proofs of the paper.

2 The Model

Our model is based on the classical dealer market model of Glosten and Milgrom (1985) and we augment this model with the decisions concerning optimal tax reporting by a manager and auditing by a tax enforcing agency. The interaction between the firm and the tax auditing agency makes the value of the traded security depend on the tax report submitted by the firm’s manager. We will consider two cases: when the tax report is made public and therefore is used by the dealer when setting the prices and when it is not. The manager is engaged in insider trading and can trade securities of his own firm using the information he has and, as the tax report affects both the value of the firm and the security prices in the financial market, the manager faces a trade-off between increasing the value of the firm and increasing the price at which he trades in the financial markets. Thus, the tax report determined endogenously by this trade-off is used as a public signal when it is disclosed to the other market participants.

We consider a firm which owns a project with an uncertain payoff or net cash flow $\hat{y}$. We assume without loss of generality that the payoff is equal to one, $y = 1$, if the project turns out to be successful, which occurs with the exogenous probability $s$. If the project fails the payoff is $y = 0$, which occurs with probability $1 - s$. The manager perfectly observes the realization of the payoff associated with the project. When the project is successful, the manager can be either honest with probability $\alpha$ and report the true value of the project to the tax agency, i.e., he declares $\theta = 1$, where $\theta$ is the reported value send to the tax authority; or he can be strategic with probability $1 - \alpha$. When the payoff is $y = 0$ the manager only can declare the truth, $\theta = 0$, since due to limited liability the firm has no funds to make any tax payment.

The probability $\alpha$ is assumed to be exogenous and it can be interpreted as a measure of the tax morale of the manager or of the effectiveness of corporate governance rules in inducing honest behavior by the manager concerning the fiscal duties. When strategic, the manager chooses to be honest and reports truthfully with probability $p$ (declares $\theta = 1$), and lies with probability $1 - p$ (declares $\theta = 0$), where $p$ is chosen optimally by the manager.

If the manager reports a high outcome, $\theta = 1$, the tax auditing agency does not inspect the firm as no additional revenues would arise from the inspection. Otherwise, the tax agency inspects the firm and in doing so it exerts the amount $\xi$ of effort. When it inspects, the tax agency discovers the truth with the probability $\hat{m}$. We assume for simplicity that $\hat{m}$ is an increasing linear function of the amount of effort exerted by the tax agency, $\hat{m} = \delta \xi$. After the eventual inspection takes place, the firm pays the corresponding taxes and penalties. We assume that the tax law establishes a flat tax rate $\tau \in (0, 1)$ on the firm net cash flow. The penalty the firm pays
in case the manager misreports and is caught is $f \tau$, with the flat penalty rate satisfying $f > 1$ and $f \tau \leq 1$. The latter inequality constraint is a consequence of the assumed limited liability. Since the probability of discovering the truth is $\hat{m}$ and the revenue collected from penalties is $f \tau$, we can define the inspection intensity as $m \equiv \hat{m} f \tau \leq f \tau \leq 1$. Thus, when the tax agency chooses the effort $\xi$ it chooses the probability $\hat{m}$ of discovering the truth and the inspection intensity $m = \hat{m} f \tau = \delta f \tau \xi$. Therefore, choosing the effort in order to maximize its expected net revenue is equivalent to choosing the inspection intensity, $m$. Notice also that the inspection intensity depends on the effort devoted to discover the truth: the higher $\hat{m}$, the higher the effort or the resources devoted to auditing and therefore, the higher the costs. We assume that the auditing costs are quadratic in the effort $\xi$ exerted by the tax agency, and they are equal to $\frac{1}{2} \hat{c} \xi^2$, with $\hat{c} > 0$. This cost function is known by both the auditor and the firm’s manager. Since the probability of discovering the truth is $\hat{m} = \delta \xi$ and the inspection intensity is $m = \hat{m} f \tau$ we can rewrite the auditing costs as

$$\frac{1}{2} \hat{c} \xi^2 = \frac{1}{2} \hat{c} \left( \frac{\hat{m}}{\delta} \right)^2 = \frac{1}{2} \hat{c} \left( \frac{m}{\delta f \tau} \right)^2 = \frac{1}{2} c m^2,$$

where we define $c \equiv \left( \frac{\hat{c}}{\delta f \tau} \right)^2 > 0$.

The tax agency receives the tax report and chooses the inspection intensity $m$ based on the information contained in the tax report. However, since the tax agency observes also the price of the transactions in the financial market, it can also use this information when setting the inspection intensity. Consequently, the inspection intensity depends on the tax report but also on the trading in the financial market.

In the financial market there are two types of investors: an insider, which is the aforementioned manager, and noise traders (or liquidity traders). The traders are only allowed to submit market orders and they can trade a single unit of the asset so that the order size is thus restricted to the set $\{-1, 1\}$. Trade in the financial market occurs after the report has been submitted and before taxes and potential penalties are paid. The liquidation value $V$ of the asset traded in the financial market is the net payoff after taxes and penalties. The manager is assumed to be risk neutral and uses the information he possesses about the net payoff of the project to compute the expected liquidation value of the asset. The manager buys if $V$ is higher than the ask price and sells if $V$ is lower than the bid price. Notice that the report made by the manager influences the inspection decision of the tax auditing agency and thus affects the value $V$ through two channels: the voluntarily paid taxes and the potential penalty. Therefore, a strategic manager chooses the probability $p$ of reporting truthfully to maximize the expected profit from trading. If the manager is not strategic (i.e., honest), he always reports the true payoff.

Trading takes place through a risk-neutral dealer who faces competition from other market-makers and therefore should make a zero expected profit in equilibrium. The dealer posts ask
and bid quotes, $A$ and $B$, using the information contained in the order flow $\omega$ as well as the tax report $\theta$ submitted by the manager if this report becomes public information. We assume also that the dealer cannot cross-subsidize buys with sells or vice versa and thus we can consider buys and sells separately. When the customer buys (trades at the dealer ask price), the dealer’s realized profit on the trade is $A - V$ and when the customer sells, the dealer’s profit on the trade is $V - B$. In order to avoid the problem of information revelation, we assume that traders arriving in the market are drawn randomly from the population and that the probability that the manager is picked up for trading is $a$. After the traders are randomly selected for trading and the dealer provides bid and ask quotes, the traders choose the direction of trade. The behavior of noise traders is independent of any information in the market and their trading decisions are motivated by exogenous liquidity reasons (portfolio diversification, transitory shocks, etc.). We assume that noise traders buy and sell a unit of the asset randomly with equal probability. The manager trades using instead his information about the payoff of the project. Therefore the higher is $a$, the lower will be the amount of noise in the financial market. Obviously if the payoff of the project is $y = 0$, the manager sells at the bid price, which will be larger than the liquidation value expected by the manager due to all the noise introduced in the market arising from the noise traders and the noisy tax reporting process. In this case the demand $d$ for the asset by the manager is equal to $-1$. Otherwise, when the payoff is $y = 1$, he buys at the ask price offered by the dealer, which for the same reasons will be lower than the liquidation value expected by the manager. In this latter case, we have $d = 1$. Thus, the profit made by the manager when he buys is $V - A$, and when he sells is $B - A$. The trader picked up for trading with the dealer is obliged to trade, i.e., no-trade is not allowed. Finally, if the manager is not picked up for trading, then his demand is simply $d = 0$.

The timing of the model is thus the following:

1. The nature draws the realization of the project’s payoff $y$. The project is successful with probability $s$.

2. The manager observes his private information about the firm’s payoff and the nature chooses whether the manager is honest (which occurs with probability $\alpha$) or strategic. In case the manager is strategic, he chooses the probability $p$ of reporting truthfully.

3. Agents trade in the financial market. The event tree for trade is represented in Figure 1.

4. The tax agency chooses, conditional on the tax report and the price of the firm in the stock market, the intensity $m$ of inspection in order to maximize the expected net revenue $R$ collected from taxpayers. The event tree for the tax agency is represented in Figure 2.
Figure 1: The tree diagram of trade
Figure 2: The tree diagram for the tax agency
The tax agency is risk neutral and chooses the inspection intensity \( m \) to maximize the expected total net revenue \( R \) conditional on the manager’s report and the price of the asset. The inspection is contingent therefore upon the report observed by the tax agency \( \theta \) and the direction of trade in the financial market. The revenue of the tax agency can be seen in the event tree in Figure 2. If the payoff of the project is high, \( y = 1 \), and the manager reports correctly, \( \theta = 1 \), the tax agency does not inspect and its revenue in this case is equal to \( \tau \). Notice that this can happen in two cases: when the payoff is high and the manager is honest and when the payoff is also high and the manager is strategic but he chooses to report truthfully \( \theta = 1 \). In case the manager reports \( \theta = 0 \), the tax agency inspects with intensity \( m(1) \) when it observes a transaction at an ask price, i.e., when the trader buys, and \( m(-1) \) when it observes a transaction at a bid price, i.e., when the trader sells. In these cases the firm pays the penalty because the tax agency discovers that the payoff of the project undertaken by the firm was high, \( y = 1 \), but the manager reported \( \theta = 0 \). Finally, if the report is \( \theta = 0 \) but also the payoff of the project is 0, the tax agency inspects also with intensity either \( m(1) \) or \( m(-1) \) depending on the direction of the trade. However, the outcome of the project was indeed low so the tax agency ends up paying the inspection cost but not collecting any penalty. As a result, the expected net revenue of the tax agency when \( \theta = 0 \) and it observes a buy (\( \omega = 1 \)) is

\[
E(R|\theta = 0, \omega = 1) = m(1) P(y = 1|\theta = 0, \omega = 1) - \frac{1}{2}c(m(1))^2,
\]

where \( P(y|\theta, \omega) \) is the probability of the project payoff conditional both on the report and on the direction of trade (or, equivalently, on the price at which the transaction takes place). Recall also that the inspection intensity is \( m(\omega) = \hat{m}(\omega) f\tau \) so that the expected revenue arises from multiplying the expected payoff of the project \( P(y|\theta, \omega) \), the probability \( \hat{m}(\omega) \) of discovering the truth by the tax enforcement agency and the total penalty \( f\tau \) per unit evaded.

The first order condition for the problem of expected revenue maximization when \( \theta = 0 \) and \( \omega = 1 \) is

\[
P(y = 1|\theta = 0, \omega = 1) - cm(1) = 0,
\]

and the optimal inspection intensity \( m^*(1) \) is thus

\[
m^*(1) = \frac{P(y = 1|\theta = 0, \omega = 1)}{c}.
\]

The second order condition for this problem is \( c > 0 \), which is satisfied by assumption.

Similarly, the tax agency chooses the inspection intensity \( m^*(-1) \) to maximize the expected net revenue when \( \theta = 0 \) and it observes a sell, \( \omega = -1 \). In this case, we have

\[
m^*(-1) = \frac{P(y = 1|\theta = 0, \omega = -1)}{c}.
\]

Notice that both inspection intensities have to satisfy the additional constraint of being smaller or equal than \( f\tau \leq 1 \) since \( m(\omega) = \hat{m}(\omega) f\tau \) and \( \hat{m}(\omega) \) is the probability of discovering
the truth by the auditors, which lies in the interval \([0, 1]\). Note that if the auditing cost \(c\) is sufficiently small this constraint will be binding and the inspection intensities become equal to \(f_{\tau}\).

### 2.1 Disclosure of the Tax Report

Let us consider in this section the case where the tax report is made public by the tax agency. As the manager’s tax report affects the intensity of the auditing by the tax agency, there are always two channels through which the report affects the net payoff of the firm. The first direct channel is associated with the voluntary payment of taxes corresponding to the tax report. The second channel arises from the link between the tax report and the inspection decision of the tax agency. Moreover, when the tax report is made public, there is a third channel affecting the manager’s profits. This third channel is associated with the effect that the public tax report has on the pricing strategies of the dealer. Since the manager has to trade in the financial markets to maximize difference between the liquidation value of the firm (the payoff of the project net of taxes and penalties) and the price of the asset, he has to take into account these three effects when deciding his tax report.

Similarly to Glosten and Milgrom (1985), the dealer sets prices such that expected profits are zero so that the gains made to the uninformed are always compensated by the losses incurred to the informed trader. Notice, however, that when the tax report is made public the dealer has an additional piece of information and he posts two ask prices and two bid prices depending on the realization of the tax report \(\theta\). Thus, for a buy order and a high tax report the ask price equals

\[
A(1) \equiv A(\theta = 1) = E[V | \omega = 1 \text{ and } \theta = 1],
\]

while for a buy order and a low report the ask price is

\[
A(0) \equiv A(\theta = 0) = E[V | \omega = 1 \text{ and } \theta = 0].
\]

Similarly the bid price for a high report is

\[
B(1) \equiv B(\theta = 1) = E[V | \omega = -1 \text{ and } \theta = 1],
\]

while for a sell order and a low report the bid price is

\[
B(0) \equiv B(\theta = 0) = E[V | \omega = -1 \text{ and } \theta = 0].
\]

To calculate the above conditional expectations above we need to find the corresponding conditional probabilities by using Bayes’ rule. The next proposition characterizes the equilibrium for the disclosure case:
Proposition 1: The optimal ask and bid prices quoted by the dealer when the tax report is disclosed are

\[
A(0) = \frac{(1 - m(1)) s (1 - \alpha) (1 + a)}{s (1 - \alpha) (1 + a) + (1 - s) (1 - a)},
\]

\[
A(1) = 1 - \tau,
\]

\[
B(0) = \frac{(1 - m(-1)) s (1 - \alpha) (1 - a)}{(1 - \alpha) s (1 - a) + (1 - s) (1 + a)},
\]

\[
B(1) = 1 - \tau.
\]

The equilibrium probability of telling the truth by a strategic manager when the project is successful is \( p^*_D = 0 \).

The optimal inspection intensities set by the tax agency are

\[
m_D(1) = \frac{1}{c} \left[ \frac{s (1 - \alpha) (1 + a)}{s (1 - \alpha) (1 + a) + (1 - s) (1 - a)} \right],
\]

\[
m_D(-1) = \frac{1}{c} \left[ \frac{s (1 - \alpha) (1 - a)}{s (1 - \alpha) (1 - a) + (1 - s) (1 + a)} \right].
\]

The previous subindex \( D \) stands for the disclosure case, i.e., when the tax report is made public. As we have mentioned before, the profit made by the manager is \( V \) minus the ask price, when he buys, and the bid price minus \( V \), when he sells. As we can see from the event tree, he buys whenever \( y = 1 \) and sells when \( y = 0 \). Therefore, we can write the expected profit \( \Pi_D \) of the insider as a function of the probability \( p \) of true reporting when the tax report is disclosed as

\[
\Pi_D(p) = a [s (1 - \alpha) (1 - p)] [(1 - m_D(1)) - A(0)] + (1 - s) B(0)].
\]

Note that the term \((1 - m_D(1)) - A(0)\) is the difference between the expected liquidation value and the price at which the manager buys in case the project is successful, which occurs with probability \( s \), he is strategic, which occurs with probability \( 1 - \alpha \), he misreports, which occurs with probability \( 1 - p \), and he is picked up for trading, which occurs with probability \( a \). Moreover in case the project is unsuccessful and the manager is picked up for trade, which occurs with probability \( a(1 - s) \), the manager sells at the price \( B(0) \) an asset having zero value. Note that when the manager is not picked up for trade or when the project is successful but he is not strategic or he tells the truth even if he is strategic, then the manager obtains zero profits from trading.

The optimal probability of reporting truthfully chosen by the manager is

\[
p^*_D = \arg \max_p \Pi_D(p).
\]
In equilibrium, we obtain that $p_D^* = 0$ because always $(1 - m_D(1)) - A(0) > 0$, i.e., the liquidation value of the asset in the case the strategic manager wants to buy is higher than the ask price (see (1)). Obviously, when the tax report is disclosed the manager tends to be dishonest as the only profits he can obtain as a result of tax planning appear when the report is $\theta = 0$. However, tax dishonesty comes at the price of lower liquidation value due to the potential fines and higher ask and bid prices, which results in a lower profit for the manager at every trade.

Notice that the inspection intensities chosen by the tax agency, $m_D(1)$ and $m_D(-1)$ defined in (5) and (6), respectively, are decreasing in the inspection cost $c$. As expected, the higher the auditing cost, the lower the inspection intensity is. However, the inspection intensities depend also on the tax morale intensity $\alpha$ and the probability $a$ of having a trade initiated by an informed trader. The inspection intensities in both cases decrease with the tax morale $\alpha$ because the higher the expected value of the firm, the higher the incentives of the manager are to declare $\theta = 0$, trade in the financial market, and obtain profits without fully revealing the information about the project’s payoff.

As the probability $a$ of the manager to be picked up for trading increases, the amount of noise in the market decreases and it becomes easier for the tax agency (and the market maker) to disentangle the trades of the manager from the ones of the noise traders. Consequently, when it sees a buy, the tax agency estimates that it is more likely to be the manager who traded based on his information about the payoff and therefore it inspects more often, i.e., $m_D(1)$ increases with $a$. Similarly, when it observes a sell, the tax agency attributes a higher probability of the trade pertaining to noise traders and therefore $m_D(-1)$ decreases with the probability $a$ of the manager being picked up for trading.

### 2.2 No Disclosure of the Tax Report

We consider now the setup in which the tax report is not made public and, therefore, the prices set by the market maker cannot be conditional on the value of the tax report. Since the prices are public information after trade, the tax agency still conditions on the direction of trade as in the disclosure case. Here we will use the subindex $ND$ to denote the case where the tax report is not disclosed.

**Proposition 2** The optimal ask and bid prices quoted by the dealer when the tax report is not disclosed are

$$A_{ND} = \begin{cases} \frac{(1 + a)(1 - \tau)s}{(1 + a)s + (1 - a)(1 - s)} & \text{if } c\tau \left(1 + \frac{(1 - a)(1 - s)}{(1 - a)s(1 + a)}\right) < 1, \\ \frac{(1 + a)s((1 - m_{ND}(1))(1 - \alpha) + (1 - \tau)\alpha)}{(1 + a)s + (1 - a)(1 - s)} & \text{otherwise.} \end{cases}$$

$$B_{ND} = \frac{(1 - a)s((1 - m_{ND}(-1))(1 - p)(1 - \alpha) + (1 - \tau)(p(1 - \alpha) + \alpha))}{(1 - a)s + (1 + a)(1 - s)}.$$
The equilibrium probability of telling the truth of the strategic manager is

\[
P^*_\text{ND} = \begin{cases} 
1 - c\tau \left(1 + \frac{(1 - a)(1 - s)}{(1 - \alpha)s(1 + a)}\right) & \text{if } c\tau \left(1 + \frac{(1 - a)(1 - s)}{(1 - \alpha)s(1 + a)}\right) < 1, \\
0 & \text{otherwise.} 
\end{cases}
\]  

(7)

The inspection intensities are

\[
m_{\text{ND}}(1) = \begin{cases} 
\tau & \text{if } p^*_\text{ND} > 0, \\
\frac{1}{c} \left(\frac{s(1 - \alpha)(1 + a)}{s(1 - \alpha)(1 + a) + (1 - s)(1 - \alpha)}\right) & \text{if } p^*_\text{ND} = 0, 
\end{cases}
\]

\[
m_{\text{ND}}(-1) = \begin{cases} 
\tau(1 - a) \left(\frac{(1 + a)(1 - \alpha)s + (1 - a)(1 - s)}{(1 - a)(1 - \alpha)s + (1 + a)(1 - s)}\right) & \text{if } p^*_\text{ND} > 0, \\
\frac{1}{c} \left(\frac{s(1 - \alpha)(1 - a)}{s(1 - \alpha)(1 - a) + (1 - s)(1 + a)}\right) & \text{if } p^*_\text{ND} = 0. 
\end{cases}
\]

(8)  (9)

Notice that in this case the inspection intensity chosen by the tax agency in the case of observing a buy is constant and equals to the tax rate \(\tau\) when \(p^*_\text{ND} > 0\). Given this strategy of the tax agency in equilibrium, the strategic manager is indifferent between telling the truth and cheating in his tax report. The manager then chooses a mixed strategy concerning the probability of telling the truth whenever the market conditions allow him to do so. However, if the auditing cost \(c\) is high, or if there is a low probability \(\alpha\) of being picked up for trading or a high tax morale \(\alpha\), the strategic manager chooses \(p^*_\text{ND} = 0\), so he always submits a false report.

For higher values of \(\alpha\) and lower values of the tax morale \(\alpha\) and the auditing cost \(c\), the probability of telling the truth increases as the manager’s potential gains from trade in the financial market are higher than the possible penalties if he is inspected and caught. Notice, however, that despite of the fact that the manager plays a mixed reporting strategy, the tax agency and the market maker together are able to undo the effect of his mixed strategy and the maximum expected profit he makes when he buys does not depend on \(p^*_\text{ND}\) and is just equal to \(s(1 - \tau - A_{\text{ND}})\). Therefore, his incentives for tax planning are smaller as this activity increases his profits only through the uncertainty that introduces in the financial market, which is embedded in asset prices but not in the likelihood of getting these profits.

Note that the higher is tax morale \(\alpha\), the probability of being strategic is lower. However, when the manager is strategic he tends to lie more. Notice also that \(p^*_\text{ND} > 0\) implies that \(m_D(1) > m_{\text{ND}}(1)\) and \(m_D(-1) > m_{\text{ND}}(1)\) for all values of the parameters of the model. When \(p^*_\text{ND} = 0\), tax reports are totally non-informative so that the inspection intensities are obviously equal in both the disclosure and no-disclosure case. As it can be seen from (9) in the case where the manager chooses \(p^*_\text{ND} > 0\), the inspection intensity in case of observing a buy does not depend on the other parameters of the model. However, the inspection intensity in the
case of observing a sell, it does depend on the other variables. The tax agency can in this case inspect less when the tax morale is high and when the noise in the market is low, because in this case it can infer that it is more unlikely to face a strategic informed trader who sells. The inspection intensity in this case does not depend on the inefficiency arising from the auditing cost c.

3 Market Performance

In this section we analyze the performance of the financial market by looking at the size of the bid-ask spreads, the insider’s expected profit, and the expected net revenue for the tax agency when the parameter values of our model change. Note that the bid-ask spread measures the liquidity (or depth) of the market since a large spread means that prices are very sensitive to direction of the trade so that buyers end up paying a large price while sellers end up getting a low price. Obviously, a large spread is detrimental for the noise traders as its expected cost of trading becomes also large. Once we have determined the optimal reporting strategy of a strategic manager, we proceed first to calculate the expected bid-ask spread and the expected profit of the manager. These two market indicators are characterized in the following Corollary:

Corollary 3 (a) The expected spread and the manager’s expected profit when the tax report is disclosed are

\[ E(S_D) = \frac{(1 - m_D (1)) (1 + a)}{(1 - \alpha) s (1 + a) + (1 - s) (1 - a)} - \frac{(1 - m_D (-1)) (1 - a)}{(1 - \alpha) s (1 - a) + (1 - s) (1 + a)} \times \frac{1}{(1 - \alpha) s [(1 - \alpha) s + (1 - s)]}, \]

\[ E(\Pi_D) = a \left[ (1 - \alpha) s ((1 - m_D (1)) - A(0)) + (1 - s) B(0) \right]. \]

(b) The spread and the manager’s expected profit when the tax report is not disclosed are

\[ S_{ND} = A_{ND} - B_{ND}, \]

\[ E(\Pi_{ND}) = a (s (1 - \tau - A_{ND}) + (1 - s) B_{ND}) \]

where \( m_D (1), m_D (-1), A(0), B(0), A_{ND}, \) and \( B_{ND} \) are defined in the previous Propositions 1 and 2.

(c) The expected net revenue of the tax agency when the tax report is disclosed is

\[ E(R_D) = \alpha s \tau + \frac{((1 - \alpha) s (1 + a))^2}{4c ((1 + a) (1 - \alpha) s + (1 - a) (1 - s))}, \]

\[ + \frac{((1 - \alpha) s (1 - a))^2}{4c ((1 - a) (1 - \alpha) s + (1 + a) (1 - s))}. \]
and the expected net revenue of the tax agency when the tax report is not disclosed is

\[
E(R_{ND}) = (\alpha + p_{ND}(1 - \alpha)) s\tau + \frac{((1 - p_{ND})(1 - \alpha)s(1 + a))^2}{4c((1 + a)(1 - \alpha)s + (1 - a)(1 - s))} \\
+ \frac{((1 - p_{ND})(1 - \alpha)s(1 - a))^2}{4c((1 - a)(1 - \alpha)s + (1 + a)(1 - s))},
\]

where \( p_{ND} \) is defined in Proposition 2.

To understand the performance of the financial markets, we perform comparative statics with respect to the auditing costs \( c \), the probability \( a \) of the manager to be picked up for trading, and the tax morale \( \alpha \).

First, we analyze how the auditing cost affects market performance. Notice first that, in the case where the tax report is disclosed, for small values of the auditing cost \( c \), when the market maker observes \( \theta = 0 \) he sets an ask price lower than the bid price. This is due to the fact that for small values of the auditing cost, it is not costly to inspect and hence the inspection intensity might reach its maximum value \( f\tau \). Thus, there exist two values of the audit cost, \( c^*_- \) and \( c^*_+ \) with \( c^*_- < c^*_+ \), such that for any \( c < c^*_- \) we have \( m_D(-1) = f\tau \) and for any \( c < c^*_+ \) we have that \( m_D(1) = f\tau \). Therefore, there exists a value of the audit cost

\[
c^{**} \equiv 2s(1 - \alpha) \frac{1 - sa + a^2(1 - s - sa)}{((1 - \alpha)s(1 + a) + (1 - s)(1 - a))((1 - \alpha)s(1 - a) + (1 - s)(1 + a))} \in (c^*_+, 1),
\]

such that for \( c \geq c^{**} \) the market maker sets an ask price \( A(0) > B(0) \). From now on we consider in our analysis only the cases where \( c \geq c^{**} \) so as to ensure that the ask price is higher than the bid price.

We showed above that, under public disclosure, the relationship between the inspection intensities \( m_D(1) \) and \( m_D(-1) \) and the auditing cost \( c \) is monotonically decreasing. However, if the tax report is not publicly disclosed and \( p_{ND}^* > 0 \) then the inspection intensities \( m_ND(1) \) and \( m_ND(-1) \) do not depend on the auditing cost \( c \), while if \( p_{ND}^* = 0 \) then the inspection intensities \( m_ND(1) \) and \( m_ND(-1) \) decrease with \( c \). Notice that the auditing cost does not affect the expectations of the market maker about trading against the manager but they do affect the expected liquidation value of the asset to be traded in the financial market through the inspection intensity. In the case where the report is disclosed, when the market maker observes a sell or a buy together with \( \theta = 0 \), the liquidation value of the firm depends negatively on \( m_D(1) \) and \( m_D(-1) \), respectively. Moreover, since these inspection intensities both decrease with \( c \), it results that both the ask price \( A(0) \) and \( B(0) \) increase with the auditing cost \( c \) (see Figure 3, Panel A). Thus, the inefficiency of the tax agency is transmitted to the financial market and the spread becomes wider as the auditing cost increases. Since in the case \( \theta = 1 \) the market maker knows for sure that he trades against the informed manger, he sets the ask price equal to the bid price and equal to the expected value of the firm \( 1 - \tau \). As the probability of observing a low report, \( \theta_0 \equiv Pr(\theta = \theta_0) = (1 - \alpha)s + (1 - s) \), does not depend on the auditing cost, the
expected ask and bid price have a similar behavior as the ask and bid price in the case $\theta = 0$ when the auditing cost vary (see Figure 3, Panel B). The same effect is found when $p_{ND}^* = 0$ in the no-disclosure case (see Figure 3, Panel C). However, when $p_{ND}^* > 0$ the inspection intensities do not depend on the auditing cost and therefore neither the liquidation value does. When the market maker observes a buy, he understands that the expected liquidation value is the same in the case of paying taxes honestly and when the manager is strategic, reports $\theta = 0$, and he is inspected by the tax enforcement agency, i.e., the liquidation value is equal to $1 - \tau$ as follows from the fact that $m_{ND}(1) = \tau$. Hence, the probability of telling the truth does not affect the expectation of the market maker when he observes a buy and this implies that the ask price in this case does not depend on the auditing cost. However, since $m_{ND}(-1) < \tau$, if the market maker receives a sell order he understands that it is more likely that the order comes from a noise trader than from a strategic manager reporting $\theta = 0$. Since this happens with the probability $1 - p_{ND}$, and $p_{ND}$ decreases monotonically with $c$, it results that the bid price increases with the auditing cost $c$. Notice that, when the value of the cost $c$ reaches the level

$$c_{***} = \frac{1}{\tau} \left( \frac{(1 - \alpha) s (1 + a)}{(1 - \alpha) s (1 + a) + (1 - a) (1 - s)} \right),$$

then for any $c \geq c_{***}$ we have that $p_{ND}^* = 0$ and, therefore, the behavior of the spread is similar to the case under disclosure.

Notice that in the disclosure case when $c$ increases, it is more costly for the tax auditing agency to monitor, the manager chooses to report $\theta = 0$, and therefore this report is less informative for the market maker. Consequently, when $c$ increases it is more difficult for the market maker to disentangle the noise traders from the insider manager and therefore he sets a higher spread (see Figure 4, Panel A). Since in the case $\theta = 1$ the market maker sets the ask
price equal to the bid price, the spread is always equal to 0. As a result, the expected spread equals the spread when $\theta = 0$ multiplied by the probability $\theta_0$ of having a low tax report and, therefore, it has the same behavior as the spread arising in the case $\theta = 0$ (see Figure 4, Panel B). However, in the no-disclosure case, we have non-monotonicity of the spread with respect to the auditing cost. Thus for any $c \in (c^{**}, c^{***})$, the ask price is constant and the bid price increases with the auditing cost $c$, and this implies that the bid-ask spread decreases. However, when $c$ becomes larger than $c^{***}$, we are in a situation similar to the disclosure case as the tax agency is inefficient and, thus, the optimal strategy of the manager is to misreport always, $p_{ND}^* = 0$.

The market maker understands that the tax agency is inefficient, the manager can misreport more often, and in this case he is more likely to trade against the informed trader. Therefore, the market maker sets a wider bid-ask spread. Since the ask price increases faster than the bid price with the auditing cost, we observe that the spread increases (see Figure 4, Panel C).

We also see that in both cases the expected profit of the manager increases with the auditing cost (see Figure 5). In the disclosure case higher auditing cost increases the expected profit of the manager because the profit from trading increases with the auditing cost $c$, both when the manager is strategic and declares $\theta = 0$ (since $(1 - m_D(1)) - A(0)$ is a decreasing function of $m_D(1)$) and when the manager is honest and sells (as $B(0)$ increases with the auditing cost).

Similarly, in the no-disclosure case we find that the expected profit of the manager increases with the auditing cost because the bid increases with the auditing cost and therefore the profit when the manager sells increases. Notice, however, that here the market maker is able to cancel out any inefficiency introduced by the cost of auditing if the manager buys. Therefore, the profit of the manager when he buys does not depend on the auditing cost. Consequently, when the
auditing cost is high, the manager is able to introduce noise by misreporting and he trades very aggressively on his private information in the financial market.

Next, we study how the amount of noise in the market affects the performance of the financial market. The less noise there is in the market (i.e. the higher the probability \(a\) is), the more often the informed trader is picked up for trading. Therefore, in both cases the market maker’s expectations about facing the manager when trading increase with \(a\). In the disclosure case, the tax agency understands that when it sees a buy order it is more likely that the firm is good and that the order to buy comes from the informed manager and therefore it increases its inspection intensity \(m_D(1)\). Similarly, when it sees a low report \(\theta = 0\) and a sell, it infers that it is more likely to have a bad firm and an order coming from a noise trader so that its inspection intensity \(m_D(-1)\) decreases with \(a\). The dealer also understands this and wants to set higher ask prices and lower bid prices in the case \(\theta = 0\). However, the liquidation value of the firm when \(\theta = 0\) decreases with \(a\) because of the penalties paid when the manager is inspected and caught, and therefore in the case of the ask price the market maker faces a trade-off between lower liquidation value and higher probability of trading against the manager. Therefore, the ask price \(A(0)\) has an inverted U-shape with respect to \(a\) (see Figure 6, Panel A). Since the bid-ask spread is 0 when \(\theta = 1\) and the probability of having a low report \(\theta = 0\) does not depend on \(a\), the expected bid-ask spread has a similar shape (see Figure 6, Panel B). In the no-disclosure case, the ask price is only exposed to the first effect, because, independently of which are the parameters values, the liquidation value is equal to \(1 - \tau\), which does not depend on \(a\). Consequently, the ask price increases with \(a\) and the bid price decreases with \(a\) since the market maker expects to trade more often against the informed manager (see Figure 6, Panel C). When we analyze the spread,
Figure 6: Ask and Bid Prices. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $c = 1.2$, $\tau = 0.3$.

in both cases the market maker’s expectations of facing the manager when buying increases faster than the market maker’s expectations of facing the manager when selling. However, in the disclosure case, as $\alpha$ becomes larger we find the same trade-off in the spread since the bid always decreases with $\alpha$ and the ask price increases initially faster but eventually decreases (see Figure 7).

We can also analyze how the expected profit changes when the noise trading varies. As one can see in Figure 8, the expected profit in both the disclosure and the no-disclosure case has an inverted U-shape with respect to $\alpha$ because there is a trade-off for the manager: the higher $\alpha$, the higher are his chances to be picked up for trading but also the lower his profit in each instance of trading because the market maker can more easily understand that his order is informed.

Finally, let us discuss the effect of tax morale on the indicators of market performance. In the case where the report is disclosed, we have three channels through which tax morale affects prices. Similarly to noise trading, tax morale affects the liquidation value of the asset and the market makers’ expectations of trading with the informed manager. Moreover, the tax morale effect is quantified here as the probability $\alpha$ of facing an honest manager. Therefore, it directly determines the probability of having a strategic or honest manager and therefore it affects the probability of having a low report $\theta = 0$. We have seen that the lower the tax morale $\alpha$, the higher are the inspection intensities in both cases $m_D(1)$ and $m_D(-1)$, and that the inspection intensity chosen by the tax agency when it observes a buy increases at a higher speed than the inspection intensity when it observes a sell. The market maker’s expectation of trading against an informed manager when he observes a low report decreases with $\alpha$. Therefore, we have in both the ask price $A(0)$ and the bid price $B(0)$ a trade-off between higher inspection cost (and
Figure 7: Spreads. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $c = 1.2$, $\tau = 0.3$.

Figure 8: Manager’s Expected Profit. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $c = 1.2$, $\tau = 0.3$. 
therefore lower liquidation value) and higher probability for the manager to be identified as the informed trader. In the case of the bid price, the effect the tax morale has on the inspection intensity $m_{D}(-1)$ seems to be always dominated, and therefore, the bid price decreases with $\alpha$. However, in the case of the ask price the effect the tax morale has on the inspection intensity $m_{D}(1)$ may dominate when $\alpha$ is low and $a$ and $s$ are high, and thus the ask price $A(0)$ may decrease for low values of $\alpha$. In this case, the market maker understands that is very likely to trade against the informed trader and therefore for low values of $\alpha$ he anticipates that the firm is intensively inspected and so that the liquidation value is going to be small (see Figure 9, Panel A). As explained above, tax morale affects not only the ask and bid prices when $\theta = 0$, but also the probability $\theta_{0}$ of trading at these prices (the lower $\alpha$ is, the higher is this probability) and therefore the aforementioned trade-off in the expected ask price is going to be even more pronounced (see Figure 9, Panel A). However, for smaller values of $s$ the effect of the market maker's ability to identify the informed trader seems to be dominating and therefore we can have the situation in Figure 10, Panel A, where both the ask price $A(0)$ and bid price $B(0)$ decrease with $\alpha$, and the expected ask price decreases with $\alpha$ (see Figure 10, Panel B). Notice that the expected bid price increases with $\alpha$ despite of the fact that in this case $B(0)$ decreases with $\alpha$. This is so because $\theta_{1} = 1 - \theta_{0}$, the probability of having a low tax report, increases with $\alpha$, and $B(0) < B(1) = 1 - \tau$. Finally, if the tax report is not disclosed we have two cases depending on whether $p_{ND}^{*}$ is strictly positive or not. When there is a positive probability that the manager is lying, reporting $\theta = 0$, $p_{ND}^{*} > 0$, the inspection intensity is $m_{ND}(1) = \tau$, and it does not depend on the tax morale, and $m_{ND}(-1)$ decreases with $\alpha$. As a result, the ask price $A_{ND}$ is not affected by $\alpha$ because the expected liquidation value is $1 - \tau$, and the market maker and the tax agency are able to undo the effects of the strategic behavior of the manager. For the bid price, $B_{ND}$, since $m_{ND}(-1) \neq \tau$, the expected liquidation value depends on the tax morale through two channels. On the one hand the liquidation value when the manager lies but he is caught, $1 - m_{ND}(-1)$, depends on the tax morale. On the other hand, the probability $(1 - p_{ND}^{*})(1 - \alpha) s$ that the manager lies and the probability $(p_{ND}^{*}(1 - \alpha) + \alpha) s$ of being honest both depend on the tax morale. So, since $p_{ND}^{*}$ decreases with $\alpha$, when the manager lies and gets caught the liquidation value decreases with $\alpha$. The liquidation value when the manger is honest is $(1 - \tau)(p_{ND}^{*}(1 - \alpha) + \alpha) s$ and increases with $\alpha$. Since $m_{ND}(-1)$ is smaller than $\tau$, the first effect appears to be more important here and the bid price ends up being decreasing in $\alpha$, (see Figure 9 and 10, Panel C). Notice that, unlike the disclosure case, when the tax report is not disclosed this pattern can be found for all the values of the parameters. In the case the tax morale $\alpha$ is high, then we have $p_{ND}^{*} = 0$ and the probability that the manager lies is $(1 - \alpha) s$. Thus, we have a trade-off also in the expected liquidation value when the manager lies and he is caught: lower tax morale leads to a lower liquidation value $1 - m_{ND}(-1)$ but to a higher probability of this to occur $(1 - \alpha) s$. Therefore the ask price $A_{ND}$ may have a U-shape as shown.
in Figure 10, Panel C, for high values of $\alpha$. For the high values of $\alpha$ implying that $p_{ND}^* = 0$, we find that the bid price decreases unambiguously with $\alpha$.

In the case where the tax report is disclosed, depending on which effects dominate, the behavior of the prices is translated into the spread when $\theta = 0$ and expected spread (see Figures 11 and 12, Panels A and B). Interestingly, in the case the tax report is not disclosed we always have a U-shape, because the ask price $A_{ND}$ when increases it does faster than the bid price $B_{ND}$. Of course, as the tax morale $\alpha$ increases and the ask price starts to decrease or becomes constant (for $p_{ND}^* > 0$), since the bid price decreases with $\alpha$, we find that the spread increases with $\alpha$ (see Figures 11 and 12, Panel C).

Finally, the lower the tax morale $\alpha$, the higher the expected profit is because, both in the case of selling and buying, despite the manager’ making lower profits in each instance he can trade, he has more opportunities to make positive profits (see Figure 13). Notice that the manager is always honest when $\alpha = 1$ and reports $\theta = 1$ so that we have full revelation and therefore both the spread and the expected profit of the manager become equal to zero.

Finally, in the next Corollary we perform the comparative statics for the expected net revenue of the tax agency:

**Corollary 4** (i) The tax agency’s expected net revenue, both in the disclosure and the no-disclosure case, decreases with the auditing cost $c$.

(ii) The tax agency’s expected net revenue, both in the disclosure and the no-disclosure case, increases with the probability $\alpha$ of informed trading.

(iii) There exist an auditing cost $c_\alpha$ such that (a) if $c \geq c_\alpha$ the tax agency’s expected net revenue in the disclosure case is U-shaped with respect to the probability $\alpha$ of having a honest
Figure 10: Ask and Bid Prices. Parameter Values: $s = 0.2$, $a = 0.5$, $c = 1.2$, $\tau = 0.3$.

Figure 11: Spreads. Parameter Values: $s = 0.5$, $a = 0.5$, $c = 1.2$, $\tau = 0.3$. 

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Figure 12: Spreads. Parameter Values: $s = 0.2$, $a = 0.5$, $c = 1.2$, $\tau = 0.3$.

Figure 13: Manager’s Expected Profit. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $c = 1.2$, $\tau = 0.3$. 
manager, (b) if $c < c_\alpha$ the tax agency’s expected net revenue in the disclosure is increasing in the probability $\alpha$ of having a honest manager. The tax agency’s expected net revenue in the no-disclosure case increases with $\alpha$.

In the disclosure case, the expected net revenue of the tax agency is affected by changes in auditing cost only through the penalties collected (the taxes voluntarily paid do not depend on $c$). As a result, since the inspection intensities $m_D(1)$ and $m_D(-1)$ both decrease with $c$, the total net tax revenue collected in case of inspection decreases with $c$ so that the total expected net revenue decreases with $c$ (see Figure 14). However, in the no-disclosure case, we have a trade-off. On the one hand, the higher auditing cost is, the lower the probability $p_{ND}$ of telling the truth by the manager and, thus, the lower the expected revenue collected by the tax agency from voluntarily reported taxes. On the other hand, the higher auditing cost is, the higher the amount the tax agency collects from penalties is since the probability of collecting penalties increases with the auditing cost. However, this last effect does not dominate the negative direct effect on voluntary tax collection and, therefore, we also find in this case that the expected tax net revenue decreases with the auditing cost.

When we study how the expected tax net revenue changes when the probability $a$ of informed trading changes, we see also that in the disclosure case this change only has an effect through the amount of penalties collected and not through the taxes honestly paid. In this case we saw that the inspection intensities $m_D(1)$ and $m_D(-1)$ increase and decrease, respectively, with $a$. However, since they enter quadratically in the calculations of the penalties, they do not drive the behavior of the expected tax revenue. What drives this behavior are the probabilities of collecting these penalties, i.e., how often the manager is inspected and
caught. As explained above, we have two situations when this can happen. When the tax agency observes a low report $\theta = 0$ and a buy we have that the probability of this event is $P(\theta = 0, \omega = 1) = \frac{1}{2}((1 + a)(1 - \alpha)s + (1 - a)(1 - s))$ and this probability increases with the probability $a$ of the manager being picked up for trading. This is so because the tax agency believes is more likely to face an informed trader when the firm is good and $\omega = 1$. Similarly, when the tax agency observes a low report $\theta = 0$ and a sell we have that the probability of this event is $P(\theta = 0, \omega = -1) = \frac{1}{2}((1 - a)(1 - \alpha)s + (1 + a)(1 - s))$ and this probability decreases with the probability $a$ of the manager’s being picked up for trading because the tax agency believes that in the case of a bad firm it is more likely that the order to buy was placed by a noise trader). However, since the intensity of inspection in the case of observing a buy is higher than the intensity in the case of observing a sell, $m_D(1) > m_D(-1)$, the penalties collected in the first case dominate the effect of the penalties in the second case. As a result, the expected net tax revenue if the tax report is disclosed increases with $a$ (see Figure 15). In the case where the tax report is not disclosed, both the penalties when observing a buy and a sell decrease with $a$ because the higher the probability $a$ of the manager’s being picked up for trading, the higher the probability $p_{ND}$ that the manager tells the truth is and, hence, the less often the manager pays these penalties. However, this decrease is always offset by the taxes voluntarily paid since these taxes increase with the probability $p_{ND}$ of the manager’s telling the truth.

Finally, we find that the tax revenue in the disclosure case has a U-shape relative to $\omega$ for relatively small auditing cost. On the one hand, the amount of taxes honestly paid increases with $\alpha$, but on the other, the penalties collected in both cases decrease with $\alpha$ (the lower $\alpha$,
the higher the intensities of auditing and therefore the higher the penalties collected). Hence, depending on the other variables, one effect can dominate the other. For example, for small auditing cost, \( c < c_\alpha \), and high tax morale \( \alpha \) the effect on the taxes honestly paid is stronger than the one on penalties. For low tax morale, though, this is reversed (see Figure 16). The same happens when the auditing cost is high, i.e. \( c \geq c_\alpha \), (see Figure 17) as the first effect dominates for all the values of \( \alpha \). Similarly, in the case where the tax report is not disclosed the effect on taxes honestly collected offsets the effect on the penalties and therefore the expected tax revenue always increases with \( \alpha \).

4 Endogenous Disclosure versus No Disclosure of Tax Reports

The tax report sent by the firm to the tax enforcing agency is an endogenous signal about the state of the nature faced by the firm. This signal can be disclosed by the tax enforcement agency and, thus, used by the market maker in order to make a better prediction about the firm’s value when setting the price. Moreover, if the report is made public then the insider’s trading strategy is affected accordingly. To understand the effect of public disclosure of the tax report signal we compare the market performance and the tax agency’s expected net revenue in two economies with and without the tax report being disclosed.

4.1 Market Performance Comparison

We consider two measures of market performance: market liquidity and expected profit of insider trader. As explained above, we measure market liquidity using the expected bid-ask spread. We find that in the disclosure case, the ask price is lower than in the no-disclosure case, and the

Figure 16: Expected Tax Revenue. Parameter Values: \( s = 0.5, a = 0.5, c = 1.2, \tau = 0.3 \).
bid price is higher than in the no-disclosure case. Obviously the disclosure of the tax reports results in a reduction in the degree of asymmetric information between the insider and the market maker and, thus, the market maker could lower the spread, which is the instrument he uses to protect himself against bad trades with the insider. Therefore, as expected, when more information is disclosed the market maker sets a expected spread lower than the spread when there is no disclosure (see Figures 18, 19 and 20).

We obtain a similar situation when we make the comparison between the manager’s expected profit from trading in the disclosure case and the no-disclosure case (see Figures 21, 22 and 23) as the expected profit is higher in the no-disclosure case. This is due to the fact that in the no-disclosure case, when the manager chooses the report endogenously he is able to hide better his inside information than in the disclosure case. Thus, it is more difficult for the market maker to disentangle the manager’s order from that of a noise trader in the case where the tax report is not disclosed and, consequently, the manager’s expected profit is higher in the no-disclosure case. Notice that since the expected profit of the manager is higher in the no-disclosure case, it implies that the trading costs (i.e., the expected profit of the noise traders) are lower in this case. Therefore, policymakers may conclude that the disclosure of the tax report is beneficial for market performance because it reduces both the spread and trading costs.

4.2 Tax Revenue Comparison

We are now interested in analyzing whether disclosure of the tax report is also beneficial for the tax agency from the point of view of the net revenues that can collect. The following corollary tells us that, when the tax report is disclosed the reporting strategy of the manager is affected
Figure 18: Spread Comparison. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $a = 0.5$, $\tau = 0.3$.

Figure 19: Spread Comparison. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $c = 1.2$, $\tau = 0.3$.  

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Figure 20: Spread Comparison. Parameter Values: $s = 0.5$, $a = 0.5$, $c = 1.2$, $\tau = 0.3$.

Figure 21: Expected Profit Comparison. Parameter Values: $s = 0.5$, $a = 0.5$, $c = 1.2$, $\tau = 0.3$. 
Figure 22: Expected Profit Comparison. Parameter Values: $s = 0.5, \alpha = 0.5, c = 1.2, \tau = 0.3$.

Figure 23: Expected Profit Comparison. Parameter Values: $s = 0.5, \alpha = 0.5, a = 0.5, \tau = 0.3$. 
in such a way that the effect on net tax collection is ambiguous.

**Corollary 5** The tax revenue collected by the tax agency may be smaller or larger when the tax report is disclosed than when the tax report is not disclosed. In particular, there exists two values of the auditing cost $c$, $\underline{c}$ and $\overline{c}$, such that $E(R_D) = E(R_{ND})$ for $c \geq \overline{c}$ and $E(R_D) < E(R_{ND})$ for $c < \underline{c}$. Moreover, $E(R_D) > E(R_{ND})$ for values of $c$ sufficiently close to zero.

As we can see in Figures 24, 25 and 26 when the auditing cost $c$ is very large, or when the probability $\alpha$ of informed trading is small, and the probability $\alpha$ of having a non-strategic trader becomes close to 1, the manager in the no-disclosure case never tells the truth, $p_{ND} = 0$. Let us consider, for example, the case of the auditing cost as the discussion regarding the other parameters is very similar. We define, according to

$$\overline{c} \equiv \frac{1}{\tau} \frac{s (1-\alpha)(1+a)}{s (1-\alpha)(1+a) + (1-s)(1-a)},$$

such that for any $c < \overline{c}$, $p_{ND} > 0$ and for any $c \geq \overline{c}$, $p_{ND} = 0$, as follows from (7). As explained above, the expected net return of the tax agency has two components: the taxes voluntarily paid arising from the tax report and the penalties collected in case of inspection. Notice that the taxes voluntarily paid increase with the probability $p_{ND}$ of telling the truth when the manager is strategic while the penalties decrease with $p_{ND}$. Note also that for $c \geq \overline{c}$ there is no difference between the disclosure and the no-disclosure case concerning the strategy followed by the strategic manager, as he always misreports, $p_D = 0$, and the inspection policy followed by the tax agency. However, when the audit cost $c$ becomes slightly smaller than $\overline{c}$, the manager starts telling the truth with positive probability under the no-disclosure case whereas he keeps misreporting under disclosure. Therefore, the positive direct effect on voluntary tax collection results in larger expected net revenues for the tax authority. In this case the tax agency does not have incentives to disclose the tax report. Notice that when the auditing cost is small, the manager’s probability $\alpha$ of being picked up for trading is high, or the tax morale $\alpha$ is low, the tax agency prefers to disclose the signal. For instance, if the audit cost $c$ is very low then the tax agency can audit almost all the low reports ($\theta = 0$). In this case, under no disclosure the manager always tells the truth as $p_{ND}$ converges to 1 as $c$ approaches zero so that the expected tax revenue tends to $s\tau$, which is the maximum amount of tax that can be collected under universal truth-telling. However, under disclosure the manager always reports $\theta = 0$ and, if all those reports are audited then the expected tax revenue becomes $as\tau + (1-\alpha)s\beta\tau$, where the first term of the sum are the taxes paid by honest managers and the second are the fines paid by the strategic manager. Since $\beta > 1$, the expected tax revenue is higher when the tax report is disclosed. Consequently, depending on the parameter values characterizing our economy, it might or might not be beneficial for the tax agency to disclose the tax report.
Figure 24: Expected Tax Revenue. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $a = 0.5$, $\tau = 0.3$.

Figure 25: Expected Tax Revenue Comparison. Parameter Values: $s = 0.5$, $\alpha = 0.5$, $c = 1.2$, $\tau = 0.3$. 
5 Conclusion

In this paper we have developed an insider trading model that allows us to analyze how an endogenous public signal resulting from interaction between a firm and a tax auditing agency may affect trading in the financial markets. We show that uncertainty regarding a firm’s payoff realization, together with the endogeneity produced during the reporting stage, has a sizeable impact on the reporting strategy of the firm, the auditing policy of the tax agency, and the pricing policy adopted by the dealer in the financial market. Thus, the disclosure of the tax report produced by a firm, affects the liquidation value of the firm and brings about substantial changes in the behavior of the market liquidity, the profits of the market participants, and the informativeness of prices.

Our results are also in line with the empirical literature that shows that disclosure of information is beneficial for market performance (Healy et al., 1989; Leuz and Verrecchia, 2000). However, our model suggests that the tax agency might have incentives to not disclose the tax report because that disclosure could result in a smaller tax collection. In addition, our model derives cross-country empirical implications about the disclosure of the tax report, suggesting that in countries with less efficient tax agencies the liquidity of the shares traded in the financial markets is lower. Another empirical implication is the role played by tax morale on market liquidity. There are numerous instruments that governments can use to prevent tax avoidance (regulation, anti-avoidance rules, etc.). When these instruments are not effective, internal corporate governance rules can act as complements to governmental regulation. Both regulation and corporate governance have an effect on tax morale as they correct the incentives of
the manager to behave strategically. Regarding market liquidity, we obtain that it may increase
with tax morale or can be non-monotonic depending on the degree of complementarity between
the market monitoring undertaken by the dealer and the auditing by the tax agency.

We also show that when the tax agency is efficient in auditing (i.e., the inspection cost is
relatively low) it can undo some effects of the strategic behavior by inducing non-monotonicity
of the expected tax revenue collected by the agency. However, if the tax agency is inefficient
(i.e., the inspection cost is high), the expected tax collection increases with tax morale.

Another interesting implication of our model refers to the choice of behaving strategically.
As we mentioned before, when the tax report is not disclosed the manager tends to be more
honest since in this case the tax agency and the market maker can fully undo the effect of
strategic behavior by the manager when he declares a low payoff from the project. However, in
the case that the tax report is disclosed, it is optimal to cheat always.

The results of our model in the case of disclosure of the tax reports, are consistent with the
empirical results on the efficiency of the Internal Revenue Service (IRS) presented by El Ghoul
et al. (2011) who show that a more effective IRS auditing is associated with lower cost of capital
and that the firm’s corporate governance characteristics are very important on the role of IRS
in equity pricing.
Appendix

Proof of Proposition 1.

As in Glosten and Milgrom (1985), the dealer cannot distinguish the informed trader from liquidity traders and he must break even on average due to risk neutrality and potential Bertrand competition. The novelty here is that when he posts the ask and bid prices he observes now two signals. He observes the order flow so he can tell if it is a buyer initiated trade or a seller initiated trade. The order flow \( \omega \) observed by the dealer can take two values: \( \omega = -1 \) when it is a seller initiated trade or \( \omega = 1 \) when it is a buyer initiated trade. In addition, he can observe the tax report, which has been publicly released. In order to set the prices, the dealer computes the expected value of the asset conditional on the information he has. For a buy order when the report is high, \( \theta = 1 \), the ask price is

\[
A(1) = A(\theta = 1) = E[V \mid \omega = 1 \text{ and } \theta = 1],
\]

while for a buy order and low report, \( \theta = 0 \), the ask price is

\[
A(0) = A(\theta = 0) = E[V \mid \omega = 1 \text{ and } \theta = 0].
\]

Similarly the bid price for high report, \( \theta = 1 \), is

\[
B(1) = B(\theta = 1) = E[V \mid \omega = -1 \text{ and } \theta = 1],
\]

while for a sell order and low report, \( \theta = 0 \), the ask price is

\[
B(0) = B(\theta = 0) = E[V \mid \omega = -1 \text{ and } \theta = 0].
\]

Using the event tree in Figure 1 and Bayes rule we calculate first the probabilities of each of this state occurring, conditional on the two signals received by the dealer. I define \( \hat{m}_D(1) \) and \( \hat{m}_D(-1) \) the probabilities of discovering the truth when the tax authority observes a buy and a sell, respectively. Then, the ask price when the tax report is high, \( \theta = 1 \), equals

\[
A(1) = 1 \cdot \Pr[V = 1] \cdot \{\omega = 1 \cap \{\theta = 1\} \} + (1 - \tau) \Pr[V = 1 - \tau] \cdot \{\omega = 1 \cap \{\theta = 1\} \}
\]

\[+(1 - f\tau) \Pr[V = 1 - f\tau] \cdot \{\omega = 1 \cap \{\theta = 1\} \} + 0 \cdot \Pr[V = 0] \cdot \{\omega = 1 \cap \{\theta = 1\} \} = (1 - \tau),\]

while the ask price when the tax report is low, \( \theta = 0 \), is,

\[
A(0) = 1 \cdot \Pr[V = 1] \cdot \{\omega = 1 \cap \{\theta = 0\} \} + (1 - \tau) \Pr[V = 1 - \tau] \cdot \{\omega = 1 \cap \{\theta = 0\} \}
\]

\[+(1 - f\tau) \Pr[V = 1 - f\tau] \cdot \{\omega = 1 \cap \{\theta = 0\} \} + 0 \cdot \Pr[V = 0] \cdot \{\omega = 1 \cap \{\theta = 0\} \}
\]

\[= \frac{[1 - \hat{m}_D(1) + (1 - f\tau) (1 - \hat{m}_D(1))] (1 - p) (1 - \alpha) s (1 + a)}{(1 - p) (1 - \alpha) s (1 + a) + (1 - s) (1 - a)}
\]

\[= \frac{(1 - m_D(1)) (1 - p) (1 - \alpha) s (1 + a)}{(1 - p) (1 - \alpha) s (1 + a) + (1 - s) (1 - a)}.\]
Similarly, for a sell order we have two bid prices the bid in case of high report, $\theta = 1$,

$$B(1) = 1 \cdot \Pr[V = 1|\{\omega = -1\} \cap \{\theta = 1\}] + (1 - \tau) \Pr[V = 1 - \tau|\{\omega = -1\} \cap \{\theta = 1\}],$$

and the bid in case of low report, $\theta = 0$, is

$$B(0) = 1 \cdot \Pr[V = 1|\{\omega = -1\} \cap \{\theta = 0\}] + (1 - \tau) \Pr[V = 1 - \tau|\{\omega = -1\} \cap \{\theta = 0\}],$$

and the expected profit of the manager is

$$E(\Pi) = a [(1 - p) (1 - \alpha) s [(1 - m_D (1)) - A(0)] + (1 - s) B(0)].$$

Proof of Proposition 2. In the case the market maker cannot see the tax report, he sets prices conditioning only on the order flow that he observes. Consequently, the ask price equals
to

\[ A_{ND} = E[V \mid \omega = 1] = 1 \cdot \Pr[V = 1 \mid \omega = 1] \]
\[ + (1 - \tau) \Pr[V = 1 - \tau \mid \omega = 1] + (1 - f\tau) \Pr[V = 1 - f\tau \mid \omega = 1] \]
\[ + 0 \cdot \Pr[V = 0 \mid \omega = 1] \]
\[ = \frac{(1 + a) \left( (1 - m_{ND}(1)) (1 - p) (1 - \alpha) s + (1 - \tau) s (p (1 - \alpha) + \alpha) \right)}{(1 + a) \left( (1 - p) (1 - \alpha) s + s (p (1 - \alpha) + \alpha) \right) + (1 - a) (1 - s)} \]

Similarly, when the market maker observes a sell order he sets the prices

\[ B_{ND} = E[V \mid \omega = -1] = 1 \cdot \Pr[V = 1 \mid \omega = -1] \]
\[ + (1 - \tau) \Pr[V = 1 - \tau \mid \omega = -1] + (1 - f\tau) \Pr[V = 1 - f\tau \mid \omega = -1] \]
\[ + 0 \cdot \Pr[V = 0 \mid \omega = -1] = \]
\[ = \frac{(1 - a) \left( (1 - p) (1 - \alpha) s (1 - m_{ND}(-1)) + (p (1 - \alpha) + \alpha) s (1 - \tau) \right)}{(1 - a) \left( (1 - p) (1 - \alpha) s + (p (1 - \alpha) s + as) \right) + (1 + a) (1 - s)} \]
\[ = \frac{(1 - a) \left( (1 - m_{ND}(-1)) (1 - p) (1 - \alpha) s + (1 - \tau) (p (1 - \alpha) + \alpha) s \right)}{(1 - a) s + (1 + a) (1 - s)} \]

The expected profit of the manager equals to

\[ E(\Pi_{ND}) = \]
\[ a [(1 - p) (1 - \alpha) s ((1 - m(1)) - A_{ND}) + s [p (1 - \alpha) + \alpha] (1 - \tau - A_{ND}) + (1 - s) B_{ND}] \]

The first order condition with respect to \( p \) in order to maximize \( E(\Pi_{ND}) \) is

\[ - (1 - \alpha) s ((1 - m_{ND}(1)) - A_{ND}) + s [p (1 - \alpha) + \alpha] (1 - \tau - A_{ND}) = 0, \]

so that \( p \in (0, 1) \) if \( m_{ND}(1) = \tau \). If \( m_{ND}(1) > \tau \), then \( p = 1 \), whereas, if \( m_{ND}(1) < \tau \), then \( p = 0 \). Under no disclosure the inspection intensity when the trader buys is equal to

\[ m_{ND}(1) = \frac{1}{c} \left[ \frac{(1 - p) (1 - \alpha) s (1 + a)}{(1 + a) (1 - \alpha) s + (1 - a) (1 - s)} \right], \]

and, if we make \( m_{ND}(1) = \tau \), we obtain that the optimal \( p \) is

\[ p^* = 1 - c\tau \left( 1 + \frac{(1 - a) (1 - s)}{(1 - \alpha) s (1 + a)} \right), \]

provided \( p^* \in (0, 1) \). Therefore, in this case, the inspection intensity when the trader buys is equal to

\[ m_{ND}(-1) = \frac{1}{c} \left[ \frac{(1 - p) (1 - \alpha) s (1 - a)}{(1 - a) (1 - \alpha) s + (1 + a) (1 - s)} \right] \]
\[ = \frac{\tau}{(1 + a) \left[ \frac{(1 - a) (1 - \alpha) s + (1 - a) (1 - s)}{(1 - a) (1 - \alpha) s + (1 + a) (1 - s)} \right]} \].
Replacing \( p \) in the previous expression we get

\[
A_{ND} = \frac{(1 + a)((1 - m_{ND}(1))(1 - p)(1 - \alpha)s + (1 - \tau)(p(1 - \alpha) + \alpha)s)}{(1 + a)s + (1 - a)(1 - s)}
\]

and

\[
B_{ND} = \frac{(1 - a)}{(1 - a)s + (1 + a)(1 - s)} \times \left[ \left(1 - \tau(1 - a)\right) \frac{(1 + a)(1 - \alpha)s + (1 - a)(1 - s)}{(1 - a)(1 - \alpha)s + (1 + a)(1 - s)} \right] \times \left[ \left(1 - \tau\right) \left(1 + \frac{(1-a)(1-s)}{(1-\alpha)s(1+\alpha)} \right) \right] \cdot \left(1 - \alpha\right) s
\]

\[
+ (1 - \tau) \left(1 - \tau\right) \left(1 + \frac{(1-a)(1-s)}{(1-\alpha)s(1+\alpha)} \right) \left(1 - \alpha + \alpha\right) s.
\]

Notice that, if \( m_{ND}(1) < \tau \) for all \( p \in (0, 1) \), then \( \tau \left(1 + \frac{(1-a)(1-s)}{(1-\alpha)s(1+\alpha)} \right) > 1 \), and, therefore, we have a corner solution, \( p = 0 \). In this case, we have the following prices:

\[
A_{ND} = \frac{(1 + a)(1 - m_{ND}(1))(1 - \alpha)s + (1 - \tau)(\alpha)s}{(1 + a)s + (1 - a)(1 - s)},
\]

\[
B_{ND} = \frac{(1 - a)(1 - m_{ND}(-1))(1 - \alpha)s + (1 - \tau)(\alpha)s}{(1 - a)s + (1 + a)(1 - s)},
\]

and inspection intensities:

\[
m_{ND}(1) = \frac{1}{c} \left[ \frac{s(1 - \alpha)(1 + a)}{s(1 - \alpha)(1 + a) + (1 - s)(1 - a)} \right],
\]

\[
m_{ND}(-1) = \frac{1}{c} \left[ \frac{s(1 - \alpha)(1 - a)}{s(1 - \alpha)(1 - a) + (1 - s)(1 + a)} \right].
\]

**Proof of Corollary 3.** We define the following probabilities

\[
\theta_0 \equiv \Pr(\theta = \theta_0) = (1 - p)(1 - \alpha)s + (1 - s),
\]

\[
\theta_1 \equiv \Pr(\theta = \theta_1) = p(1 - \alpha)s + \alpha s,
\]

When \( p = 0 \), we have \( \theta_0 = (1 - \alpha)s + (1 - s) \), \( \theta_1 = \alpha s \) and, therefore, the expected prices are equal to

\[
E(A) = A(0)\theta_0 + A(1)\theta_1 = \frac{(1 - m_D(1))(1 - \alpha)s(1 + a)}{(1 - \alpha)s(1 + a) + (1 - s)(1 - a)} ((1 - \alpha)s + (1 - s)) + (1 - \tau)\alpha s,
\]

\[
E(B) = B(0)\theta_0 + B(1)\theta_1 = \frac{(1 - m_D(-1))(1 - \alpha)s(1 - a)}{(1 - \alpha)s(1 - a) + (1 - s)(1 + a)} ((1 - \alpha)s + (1 - s)) + (1 - \tau)\alpha s.
\]
Therefore, the expected spread is
\[
E(S) = E(A) - E(B) = \frac{(1 - m(1)) (1 - \alpha) s (1 + a)}{(1 - \alpha) s (1 + a) + (1 - s) (1 - a)} [(1 - \alpha) s + (1 - s)] + (1 - \tau) \alpha s - \\
\frac{[(1 - m(1)) (1 - \alpha) s (1 + a) + (1 - s) (1 - a)][(1 - \alpha) s + (1 - s)] + (1 - \tau) \alpha s}{(1 - m(1)) (1 + a) + (1 - s) (1 + a)} \\
\times (1 - \alpha) s ((1 - \alpha) s + (1 - s)).
\]

The expected revenue collected by the tax agency in the disclosure case is
\[
E(R_D) = P(\theta = 1) \tau + P(\theta = 0, \omega = 1) \frac{P(y = 1|\theta = 0, \omega = 1)}{2c}^2 + \\
+P(\theta = 0, \omega = -1) \frac{P(y = 1|\theta = 0, \omega = -1)}{2c}^2 \\
= \alpha s \tau + \frac{1}{2} ((1 + a) (1 - \alpha) s + (1 - a) (1 - s)) \frac{(1 - \alpha) s ((1 - \alpha) s + (1 - a) (1 - s))}{2c}^2 \\
+ \frac{1}{2} ((1 - a) (1 - \alpha) s + (1 + a) (1 - s)) \frac{(1 - \alpha) s ((1 - \alpha) s + (1 + a) (1 - s))}{2c}^2 \\
= \alpha s \tau + \frac{1}{4c} ((1 - \alpha) s (1 + a))^2 + \frac{1}{4c} ((1 - \alpha) s (1 - a))^2.
\]

The expected revenue of tax agency under no disclosure equals to
\[
E(R_{ND}) = P(\theta = 1) \tau + P(\theta = 0, \omega = 1) \frac{P(y = 1|\theta = 0, \omega = 1)}{2c}^2 + \\
+P(\theta = 0, \omega = -1) \frac{P(y = 1|\theta = 0, \omega = -1)}{2c}^2 \\
= (\alpha + p(1 - \alpha)) + \frac{1}{2} ((1 + a) (1 - \alpha) s + (1 - a) (1 - s)) \frac{(1 - \alpha) s ((1 - \alpha) s + (1 - a) (1 - s))}{2c}^2 \\
+ \frac{1}{2} ((1 - a) (1 - \alpha) s + (1 + a) (1 - s)) \frac{(1 - \alpha) s ((1 - \alpha) s + (1 + a) (1 - s))}{2c}^2 \\
= (\alpha + p_{ND}(1 - \alpha)) s \tau + \frac{1}{4c} ((1 - p_{ND}) (1 - \alpha) s (1 + a))^2 \\
+ \frac{1}{4c} ((1 - p_{ND}) (1 - \alpha) s (1 - a))^2.
\]

**Proof of Corollary 4.** (i) The derivative of the expected revenue in the no-disclosure case is
\[
\frac{\partial E(R)}{\partial c} = \\
\frac{s^2 (1 - \alpha)^2 [s - s (1 - \alpha) + 3a^2 s - 3a^2 + a^2 s (1 - \alpha) - 1]}{2c^2 (-a - s + s (1 - \alpha) + as + as (1 - \alpha) + 1)(-a + s - s (1 - \alpha) + as + as (1 - \alpha) - 1)} \leq 0,
\]
for all $0 \leq \alpha, a, s \leq 1$.  

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Similarly, we have that

$$\frac{\partial E (R_{ND})}{\partial c} = \frac{\tau^2 (a - 1) (s - 1) + s (1 - \alpha) (a + 1) (-4a + s(1 - \alpha) - a^2 s + 4as + a^2 + a^2 s (1 - \alpha) - 1)}{(a + 1)^2 ((a + 1) (s - 1) + s (1 - \alpha) (a - 1))} \leq 0,$$

for all $0 \leq \alpha, a, s \leq 1$.

(ii) We next perform the comparative statics with respect to the the probability $a$ of the informed trader being picked up for trading,

$$\frac{\partial E (R)}{\partial a} = \frac{4as^2(1 - \alpha)^2 (1 - s)^2 (1 - s + s(1 - \alpha))}{c ((a - 1) (s - 1) + s (1 - \alpha) (a + 1))^2 ((a + 1) (s - 1) + s (1 - \alpha) (a - 1))^2} \geq 0,$$

$$\frac{\partial E (R_{ND})}{\partial a} = \frac{4a^2 \tau^2 (1 - s)^2 [a - 2s + 2s(1 - \alpha) + a^2 s - as - a^2 - as(1 - \alpha) + a^2 s (1 - \alpha) + 2]}{(a + 1)^2 ((a + 1) (s - 1) + s (1 - \alpha) (a - 1))^2} \geq 0.$$

(iii) We first calculate $\frac{\partial E (R)}{\partial \alpha}$ and define $F (\alpha) \equiv \frac{\partial E (R)}{\partial \alpha}$. Notice that $F (1) = s \sigma > 0$ and

$$F (0) = \frac{2(1 + a - 2as)(1 - a + 2as)}{c(1 + a - 2as)^3 ((a - 1)(s - 1) + s (1 - \alpha) (a + 1))^2} (-2s + 2s \sigma - 4a^2 s + 6a^2 s + 10a^2 s^2 - 8a^2 s^3 + 4a^2 s^4 - 27a^4 s^2 + 20a^4 s^3 + s^2 - 4a^2 c \sigma + 2a^4 c \sigma - 16a^2 c s^2 \tau + 48a^4 c s \sigma^2 - 64a^4 c s^3 \tau + 32a^4 c s^4 \tau + 16a^2 c s \tau - 16a^2 c s \tau) .$$

We define

$$c_\alpha \equiv \frac{s (2 - s - 10a^2 s + 27a^4 s + 8a^2 s^2 - 4a^2 s^3 - 40a^4 s^2 + 20a^4 s^3 + 4a^2 - 6a^4)}{2 \sigma (1 + a - 2as - 1)^2 ((1 - a + 2as))^2}$$

and we find that if $c \geq c_\alpha$ then $F (0) \leq 0$, and if $c < c_\alpha$, then $F (0) > 0$. We also find that $F' (\alpha) < 0$ since

$$F' (\alpha) = -s^2 (a - 1)^2 (a + 1)^2 (s - 1)^2 (s \alpha - 1)$$

$$\times \frac{(-2s + s^2 (1 - \alpha)^2 + 2s(1 - \alpha) - 6a^2 s + 2s^2 (1 - \alpha) + 3a^2 s^2 + 3a^2 s^2 + 6a^2 s^2 (1 - \alpha) + 3a^2 s^2 (1 - \alpha) - 6a^2 s (1 - \alpha) + 1)}{c(1 + a - 2as)^3 ((a - 1)(s - 1) + s (1 - \alpha) (a + 1))^2} .$$

Therefore, it results that if $c \geq c_\alpha$, $\frac{\partial E (R)}{\partial \alpha} > 0$ for all $\alpha$ and, if $c < c_\alpha$, there exists $\alpha^* \in (0, 1)$ such that $\frac{\partial E (R)}{\partial \alpha} > 0$ for $\alpha \in (\alpha^*, 1)$ and $\frac{\partial E (R)}{\partial \alpha} \leq 0$ for $\alpha \in [0, \alpha^*)$.

On the other hand,

$$\frac{\partial E (R_{ND})}{\partial \alpha} = \frac{cs \tau^2}{2 (a + 1)^2 ((a + 1) (s - 1) + s (1 - \alpha) (a - 1))^2} G (\alpha) ,$$

where $G (\alpha) \equiv -4a + 2s - s^2 (1 - \alpha)^2 - 2s (1 - \alpha) - 4as + 28a^2 s - 8a^3 s + 2a^4 s + 2a^2 s^2 (1 - \alpha) - 14a^2 s^2 + 4a^3 s^2 - a^4 s^2 + 8as - 14a^2 + 4a^3 - a^4 - s^2 - 4a^3 s^2 (1 - \alpha) - 2a^4 s^2 (1 - \alpha) - 4as (1 - \alpha) + 2a^2 s^2 (1 - \alpha)^2 - a^2 s^2 (1 - \alpha)^2 + 4as^2 (1 - \alpha) + 4a^3 s (1 - \alpha) + 2a^4 s (1 - \alpha) - 1.$

We find that $G' (\alpha) = -2s (a - 1) (a + 1)^2 (s - 1) (s - 1) + 8s (1 - \alpha) + as + as (1 - \alpha) - 1 < 0$, $G (0) = -(4a + 14a^2 - 4a^3 + a^4 + 1) (s - 1)^2 < 0$ and $G (1) = -4a + 28a^2 s - 4a^3 s + 4a^4 s -$
12a^2s^2 - 4a^4s^2 + 4as - 14a^2 + 4a^3 - a^4 - 1 < 0. Therefore, \( G(\alpha) < 0 \) for all \( \alpha \in (0, 1) \) and this implies that \( \frac{\partial E (R_{ND})}{\partial \alpha} > 0 \), for all \( \alpha \in (0, 1) \).

**Proof of Corollary 5.** In order to prove that there are cases where the tax revenue collected by the tax agency might be lower in the case the tax report is disclosed, we evaluate the derivatives of the two functions that characterize the net tax revenue collection with respect the auditing cost \( c \) at the point where \( p_{ND} \) becomes equal to 0. We know from (7) that there exists a value of the auditing cost

\[
\tau = \frac{1}{\tau} \frac{s (1 - \alpha) (1 + a)}{s (1 - \alpha) (1 + a) + (1 - s) (1 - a)},
\]

such that for any \( c < \tau \), \( p_{ND} > 0 \) and for any \( c \geq \tau \), \( p_{ND} = 0 \).

We define by \( f(c) \) the tax revenue in the case the tax report is disclosed,

\[
f(c) = as\tau + \frac{1}{4c} ((1 - \alpha) s (1 + a)) \frac{(1 - \alpha) s (1 + a)}{(1 - a) s + (1 - a) (1 - s)} + \frac{1}{4c} ((1 - \alpha) s (1 - a)) \frac{(1 - \alpha) s (1 - a)}{(1 - a) s + (1 + a) (1 - s)},
\]

and \( g(c) \) the tax revenue in the case the tax report is not disclosed

\[
g(c) = (\alpha + p(1 - \alpha)) \frac{s\tau}{4c} + \frac{1}{4c} ((1 - \alpha) s (1 + a)) \frac{(1 - \alpha) s (1 + a)}{(1 - a) s + (1 - a) (1 - s)} + \frac{1}{4c} ((1 - \alpha) s (1 - a)) \frac{(1 - \alpha) s (1 - a)}{(1 - a) s + (1 + a) (1 - s)}.
\]

Note that \( f(\tau) = g(\tau) \). We evaluate now the two left derivatives of the function \( f \) and \( g \) at \( \tau \) with respect \( c \) and obtain

\[
\lim_{c \to \tau^-} f'(c) \equiv f'_-(\tau) = -\frac{1}{2} \tau^2 (-a - s + s (1 - \alpha) + as + as (1 - \alpha) + 1) \times \left[ \frac{s - s (1 - \alpha) + 3a^2 s - 3a^2 + a^2 s (1 - \alpha) - 1}{(a + 1)^2 (-a + s - s (1 - \alpha) + as + as (1 - \alpha) - 1)} \right],
\]

\[
\lim_{c \to \tau^-} g'(c) \equiv g'_-(\tau) = -\frac{1}{2} \tau^2 (-a - s + s (1 - \alpha) + as + as (1 - \alpha) + 1) \times \left[ \frac{-4a + s - s (1 - \alpha) - a^2 s + 4as + a^2 + a^2 s (1 - \alpha) - 1}{(a + 1)^2 (-a + s - s (1 - \alpha) + as + as (1 - \alpha) - 1)} \right].
\]

therefore,

\[
g'_-(\tau) - f'_-(\tau) = \frac{2a\tau^2 (s - 1) (a - 1)}{(a + 1)^2} \frac{-a - sa + as + as (1 - \alpha) + 1}{-a - sa + as + as (1 - \alpha) - 1},
\]

and we can see that

\[
\text{sign} \left[ g'_-(\tau) - f'_-(\tau) \right] = \text{sign} \left( \frac{-a - sa + as + as (1 - \alpha) + 1}{-a - sa + as + as (1 - \alpha) - 1} \right).
\]

Let us consider the following two cases:

**Case 1:** \( s > \frac{1}{2 - \alpha} \)

In this case we have that \( \text{sign} \left[ g'_-(\tau) - f'_-(\tau) \right] = 0 \) when \( a \) takes the values \( a_1 = \frac{1 - sa}{1 - s (2 - \alpha)} < 0 \) and \( a_2 = -\frac{1 - sa}{1 - s (2 - \alpha)} > 1 \). Notice that for any \( a < a_1 \) we have that \(-a - sa + as + as (1 - \alpha) + 1 < 0 \) and for any \( a \geq a_1 \) we have that \(-a - sa + as + as (1 - \alpha) + 1 > 0 \).
Moreover, for any \( a < a_2 \) we have that \(-a - s\alpha + as + as(1 - \alpha) - 1 < 0\) and for any \( a \geq a_1 \) we have that \(-a - s\alpha + as + as(1 - \alpha) - 1 > 0\). Therefore, since \( a_2 < 0 < 1 < a_1 \), we get that for any \( a \in [0, 1] \), \( \text{sign} \left[ g'_- (\tau) - f'_- (\tau) \right] < 0 \)

**Case 2: \( s \leq \frac{1}{2 - \alpha} \)**

In this case, we have that \( a_2 < 0 \) and \( a_1 > 1 \), and, therefore, again for any \( a \in [0, 1] \), \( \text{sign} \left( g' (\tau) - f' (\tau) \right) < 0 \).

As \( g'_- (\tau) - f'_- (\tau) < 0 \) for all \( a \in [0, 1] \), the slope of the net tax revenue is higher for the no-disclosure case since both left derivatives are negative. This implies in turn that there exist an open interval \((\tilde{\tau}, \tau)\) such that \( g (c) > f (c) \) for \( c \in (\tilde{\tau}, \tau) \).

As we argue in the main text if the auditing cost \( c \) is sufficiently low, then all low reports are inspected. Therefore, under no disclosure the manager always tells the truth as \( p_{ND} \) converges to 1 as \( c \) tends to 0 so that the expected tax revenue tends to \( s\tau \). However, under disclosure the manager always reports \( \theta = 0 \) and, if all those reports are audited then the expected tax revenue becomes \( as\tau + (1 - \alpha)sf\tau \), where the first term of the sum are the taxes paid by the honest manager and the second are the fines paid by the strategic manager. Since \( f > 1 \), then a no-disclosure policy dominates a disclosure policy from the tax agency viewpoint since the former generates larger expected revenues.
References


