Fly-By-Night Firms, Credit, and Regulation: A Simple Model

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Abstract

"Fly-by-night" is a derisive term for a firm that appears to be untrustworthy and/or transient. Previous studies have focused on general fly-by-night firms' behavior and their interaction with the credit market, while much less has been done to show how they approach government regulation. After a brief explanation of the importance of studying fly-by-night firms and a discussion of some relevant literature, this paper presents a simple model that permits a liability-holding fly-by-night entrepreneur to choose between complying or not complying with a governmental regulation. Though perhaps most useful as a classroom exercise, the model could be used to examine what factors affect the compliance decision and in what way. I find that (i) if we assume fly-by-night firms have relatively lower probabilities of project success, then they are unambiguously less likely to comply with governmental regulations; (ii) an increase in the interest rate on business loans decreases the probability of compliance; and (iii) from a regulatory standpoint, an increase in inspection rates deters non-compliance, but an increase in the non-compliance fine may not exert deterrence if strategic default is an option.

JEL Codes: L29, L59

Keywords: Fly-by-night firms, regulation, loan default, regulator-agent game

1. Introduction

In the world of business, the term "fly-by-night" is typically used to describe a person or firm that is unreliable, untrustworthy, transient, or financially irresponsible—one who runs away to escape debts or one who masks its true quality. Such firms can harm consumers, creditors, and the laborers they employ. Consumers of fly-by-night goods and services are prone to overpay for these goods, given their true quality. Creditors of fly-by-night entrepreneurs are at risk of not being repaid the money they are owed. Employees of fly-by-night entrepreneurs are at risk of both having their reputations tarnished and not receiving their due wages. For example, the firm could default and not honor its payroll.

Thus, studying, detecting, and exposing fly-by-night entrepreneurs can benefit several parties. Since it would be naive always to expect a truthful answer when asking firm owners about their true nature or the true quality of their product, we need other tools to help study or detect the presence of fly-by-nights. Economic theory is one such tool. Modeling the decision-making process of firms can aid in the explanation of these decisions.

The current fly-by-night literature has focused on firms' general behavior and how they interact with the credit market. Little has been done to show how these firms deal with government regulation. Using a game-theoretic framework, this analysis attempts to do just that. Here, a fly-by-night entrepreneur plays a regulator-agent game against a regulatory agent. In this simultaneous-move game, the entrepreneur chooses whether or not to comply with some imposed regulation, and the regulator chooses the level of inspection. The model's outcome helps demonstrate what factors determine the choice made by the entrepreneur.

The rest of the paper is structured in the following manner: Section 2 highlights several previous studies within both the fly-by-night and regulation literatures, the basis upon which my model draws some of its assumptions. In Section 3, I set up the model, work through it, and perform some comparative statics. Section 4 concludes the analysis by discussing the implications of the model.

2. Previous Studies

Becker (1968) provided the "benchmark" model, as it were, for regulation compliance. Non-compliance fines are treated as any other cost of doing business. The model includes an enforcement agency whose efforts impact the expected penalties. Firms make a binary compliance decision and are assumed to act to minimize the sum of expected compliance costs plus expected penalties. The model concludes (somewhat obviously) that increasing either inspection rates or non-compliance penalties raises population compliance.

Becker's (1968) benchmark model has a long list of simplifying assumptions, and many authors have expanded upon it and studied other aspects of regulation and compliance. For example, some authors (e.g., Heyes (1993)) have focused on inspectability and contested enforcement; some (e.g., Kaplow and Shavell (1994)) self-reporting; some (e.g., Harrington (1988)) have extended the model to incorporate multiple periods; some (e.g., Sandmo (1998)) have incorporated risk aversion; and some (e.g., Bebchuk and Kaplow (1992)) have incorporated imperfect information. While the model presented here is abstract enough so that the regulation need not refer to a specific type, the example given is that of an environmental regulation on the production process of the entrepreneur's project. Heyes (2000) provides a good discussion of the literature on the implementation of environmental regulation, its enforcement, and compliance.

Parallel to the theoretical literature, an empirical literature on the compliance and enforcement of regulations has developed. For example, Gray and Deily (1996) examine air pollution data from the United States steel industry to estimate plant-level compliance and enforcement functions. The authors find that greater enforcement does indeed lead to greater compliance while greater compliance leads to less enforcement. Perhaps more interesting is that they find that firm characteristics (e.g., firm size, diversification, and gross cash flows) have little impact on compliance decisions. Feinstein (1989) collects data from over 1000 Nuclear Regulatory Commission inspections and performs a similar study of nuclear power plants while Epple and Visscher (1984), in a well-known paper, examine the occurrence, detection, and deterrence of marine oil spills. For further studies of this type, consult Fuller (1987), Harrison (1995), Laplante and Rilstone (1996), and Regens et al. (1997).

The literature on fly-by-night firms is quite scant. Faulhaber and Yao (1989) explain the effect of information asymmetry on the number of fly-by-night firms in an industry or an economy. The authors note that the lower the information asymmetry in an industry, the higher the quality becomes, and thus allowing fewer fly-by-night firms to enter. While their analysis mainly focused on the information asymmetry between the firms and consumers, Faulhaber and Yao also discussed the effect of asymmetry between firms and lenders. In certain markets, those with high levels of information asymmetry, lenders may loan to risky firms at the same or a similar rate as they loan to nearly riskless firms. If the lender is aware of the likelihood of a project's success, however, then he or she will take this information into account when determining the interest rate on the loan. In the model presented here, the entrepreneur is assumed to have already received a business loan to finance a project.

Boyd and Ingberman (2003) assert that premature dissolution is common among fly-by-nights and is actually a rational corporate response to the threat of future liability. By definition, fly-by-night firms often engage in risky projects. Such a firm could choose to dissolve or default if they find themselves facing a large future liability. I incorporate this realization into my model by assuming the entrepreneurs have the option of dissolution/default if the risky business project they are engaging in fails or if they receive a non-compliance fine from a regulatory agent that is greater than their expected profits.

3. The Model

3.1 *Assumptions and Variable Definitions*

The model begins with an entrepreneur who has already decided to take on a single project in the pursuit of profit. This project has some probability of success p where $0 < p < 1$ and, thus, a $(1-p)$ probability of failure. A failed project yields zero revenue for the entrepreneur. A successful project results in R revenue for the entrepreneur. Revenue here refers to its strict definition (income a firm receives from its business activities) and is not to be confused with profit (which is revenue minus all business costs).

The entrepreneur is assumed to be initially assetless and therefore must take out a loan to pay for the project's production inputs. The loan amount is denoted by variable K and the interest rate on the loan denoted by r. The market for loans is assumed to be perfectly competitive, and this assumption also negates the need for a third player, the loan officer. If the project fails, the entrepreneur will default and not repay the loan or the interest.

Assume also that there exists some sort of regulation pertaining to the production process of the project. An example of such a regulation could be a government-imposed environmental regulation such as one requiring the entrepreneur to use scrubbers on smoke stacks.[1] The variable C will represent the entrepreneur's cost of complying with the regulation. Keeping with the environmental regulation example, this would include the cost of buying, installing, and maintaining the scrubbers. The entrepreneur has to decide whether or not to comply with the regulation. As we assume away any moral cost[2] of compliance, the entrepreneur will only consider the expected profits of each option when deciding whether or not to comply. If he or she decides not to comply, there is some probability m where $0 < m < 1$ that they will be caught and, thus, probability $(1-m)$ they will "get away" with non-compliance. For simplicity, assume that if the entrepreneur is inspected, then the chance of getting caught is 100 percent. Thus, m can now be thought of as the probability of being inspected by the regulator.[3]

If caught, the entrepreneur must pay a fine of some monetary amount F which is assumed to be some value such that $F > R - (1+r)K$. In words, the fine is larger than the entrepreneur's profit since R is revenue and $(1+r)K$ is the amount of the loan repayment or costs. Since this would incur a net loss on the entrepreneur, if he is caught, he will default and receive a net profit of zero. The variable B will denote the overall bonus or reward given to the regulatory agent in charge of inspection for catching and turning in an entrepreneur who did not comply and is common to regulator-agent games. This could include, but is

1 Scrubber systems are air pollution control devices that are used to remove some of the particulates and/or gases from industrial exhaust streams.

2 In this context, moral cost refers to the non-monetary (emotional/psychological) costs of not abiding by the regulation.

3 This point is made because a few regulator-agent models in the literature allow for the possibility of being inspected and still not getting caught. For the purposes of this analysis, allowing for this scenario would further complicate the mathematics while not adding much to the results.

not limited to, a simple monetary bonus, an increase in funding, or simply the benefit of maintaining the current level of funding.

3.2 *The Entrepreneur's Compliance Decision Process*

With the game set and assumptions made, the compliance decision process can now be investigated. Since the entrepreneur can simply default if the project fails or if he gets caught not complying with the regulation, the entrepreneur's decision on whether or not to comply with the regulation can be expressed by the relatively simple inequality

$$p[R-(1+r)K]-C \geq p(1-m)[R-(1+r)K]. \tag{1}$$

If default is not an option, Equation (1) would contain more terms.[4] The left-hand side of this inequality describes the expected value of compliance while the right-hand side does the same for non-compliance. If the left-hand side of Equation (1) is greater than or equal to the right, then the entrepreneur will comply with the regulation. If not, then he will choose not to comply and take the chance of getting caught.

This decision can be further examined in terms of the key variables. Reducing Equation (1) in terms of project revenue yields

$$R \geq K(1+r)+\frac{C}{mp}. \tag{2}$$

A high value of *R* will result in compliance and a value less than the right-hand side of Equation (2) will result in non-compliance. A similar simplification can be made for the probability of detection *m*. Solving Equation (1) for *m* yields

$$m \geq \frac{C}{p[R-(1+r)K]}. \tag{3}$$

Here, a high value of *m* results in compliance and a value less than the right-hand side of Equation (3) results in non-compliance. Since fly-by-night firms are often characterized by a low probability of project success, then it can be especially valuable to look at the compliance decision in terms of *p*. Holding *m* constant, Figure 1 shows the critical value of project success (call it p^*) where p^* separates those entrepreneurs who will comply with the regulation (those with $p > p^*$) from those who will not (those with $p < p^*$).

4 See the Appendix for this full inequality.

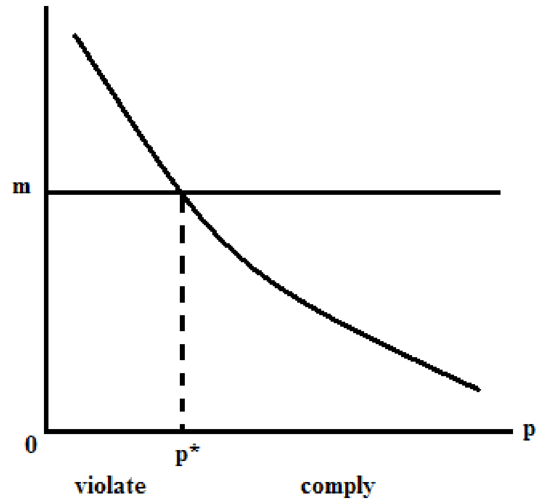

Figure 1: **Compliance and the probability of project success**

Thus, the riskier the project, the more likely the firm will violate the regulation. At the same time, Equation (2) shows that relatively larger values of project revenue result in compliance. Normally, firms only partake in risky projects when the revenue that success would yield is large. A fly-by-night-minded entrepreneur, however, may act differently and engage in risky projects more readily.

3.3 *The Loan*

Now, I turn to the credit market. The loan given to the entrepreneur will exhibit the property

$$K = [\alpha p(1-m) + (1-\alpha)p](1+r)K \tag{4}$$

where α represents the proportion of firms that do not comply with the governmental regulation and $0 < \alpha < 1$. This is because a value of K less than the right-hand side of the above equation would result in a loss to the lender. Hence, they would not lend in such a scenario. If project failure still yielded some positive revenue (for example, if resources could be sold for scrap) or if the non-compliance fine was not larger than $R - (1+r)K$, then Equation (4) would contain more terms.[5] Equation (4) is a strict equality since the market for loans was assumed to be perfectly competitive.

Reducing Equation (4) in terms of the gross interest rate $(1+r)$ yields

$$(1+r) = \frac{1}{p(1-\alpha m)}. \tag{5}$$

While the lender is not a player (decision maker) in the game, it is important to consider this property of the loan so that it may be applied to the model. Looking at the loan in terms of the gross interest rate, as in Equation (5), shows that r is negatively correlated with the probability of project success while positively correlated with the inspection rate. I now turn to the second player, the regulator.

5 For this "more complete" loan equation, see the Appendix.

3.4 *The Regulator*

Like the entrepreneur, the regulator wishes to maximize his or her own "revenue." The critical decision is how much effort to put into inspection. Hence, in this simplistic game, the regulator chooses m. Choosing a larger value of m, the regulator both increases the number of potentially caught non-compliers and increases the amount of work they have to do (what one could call the cost of inspection). I assume the regulator's objective function to be:

$$Bm\alpha - \frac{1}{2}m^2. \tag{6}$$

Thus, the regulator chooses the optimal m given B and α. This objective function was chosen because it has the necessary properties. First, increases in the bonus received for catching a non-complier and increases in the percentage of firms that are non-compliers both result in higher optimal inspection rates. Second, increases in inspection rates exponentially increase the cost of inspection. Lastly, it yields a simple derivative. Taking the first order derivative of Equation (6) with respect to m and setting this equal to zero, as in Equation (7), gives the optimal inspection effort:

$$\delta m: B\alpha - m = 0 \Rightarrow m = B\alpha \tag{7}$$

3.5 Non-Compliers

Writing the entrepreneur's compliance decision in terms of revenue *(R),* as in Equation (2), as a strict equality gives a critical "comply or not" value of R. I denote this value in the expression:

$$\underline{R} \leq \hat{R} = (1+r)K + \frac{C}{mp} \leq \bar{R}. \tag{8}$$

Recall that entrepreneurs with values of R below choose not to comply with the regulation, *ceteris paribus,* and this portion of entrepreneurs is denoted as α. This implies *(1-*α*)* denotes the portion of entrepreneurs that comply. Name the lower and upper bounds of the critical "comply or not" value of revenue and , respectively. One can normalize the distance (or difference) between these lower and upper bounds (-) to unity. Figure 2 presents a simple visual representation of the portion of complying firms taking into account this normalization.

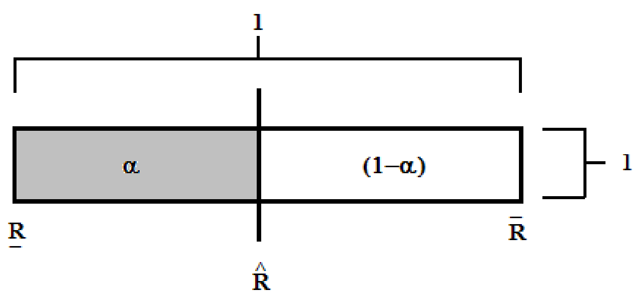

Figure 2: The portion of firms that will comply

In general terms, α is now:

$$\alpha = \frac{\hat{R}-\underline{R}}{\bar{R}-\underline{R}}. \tag{9}$$

Plugging the critical value from Equation (8) into Equation (9) gives:

$$\alpha = \frac{1}{\bar{R}-\underline{R}}\left[\frac{C}{mp} + (1+r)K - \underline{R}\right], \tag{10}$$

which is a more explicit definition of the portion of firms that will choose not to comply with the regulation.

3.6 *Combining Compliance, Inspection, and the Loan*

In this section, I combine what has been learned of the portion of non-compliers, the gross interest rate, and the optimal inspection rate so that comparative statics can be performed in Section 3.8. Plugging the optimal inspection rate from Equation (7) into the previously derived equilibrium gross interest rate, Equation (5), gives the formula:

$$(1+r) = \frac{1}{p(1-\alpha^2 B)}. \tag{11}$$

Then, plugging Equation (11) and Equation (7) into yields:

$$\underline{R} \leq \hat{R} = \frac{K}{p(1-\alpha^2 B)} + \frac{C}{\alpha B p} \leq \bar{R}. \tag{12}$$

Now we can take this new information and incorporate it into α which gives:

$$\alpha = \frac{C}{\alpha B p} + \frac{K}{p(1-\alpha^2 B)} - \underline{R}. \tag{13}$$

Notice the normalization was also used to obtain the above formula. Thus, we have derived a new expression for the portion of entrepreneurs who will choose not to comply with the regulation that takes into account the decision made by the regulator and the characteristics of the credit market.

3.7 *Equilibrium Inspection and Compliance*

Figure 3 displays the equilibrium values of α and *m* in a graphical framework. Recall Equation (7) is the regulator's optimal choice of *m* given α. As one would expect, the greater the proportion of non-complying firms, the higher the regulator's optimal *m*—

hence the positively sloping curve labeled Equation (7). The slope of this line is B. Also recall that Equation (10) implies that for larger values of α, m must decrease for the lender to lend at the same interest rate—hence the negatively sloping curve labeled Equation (10).

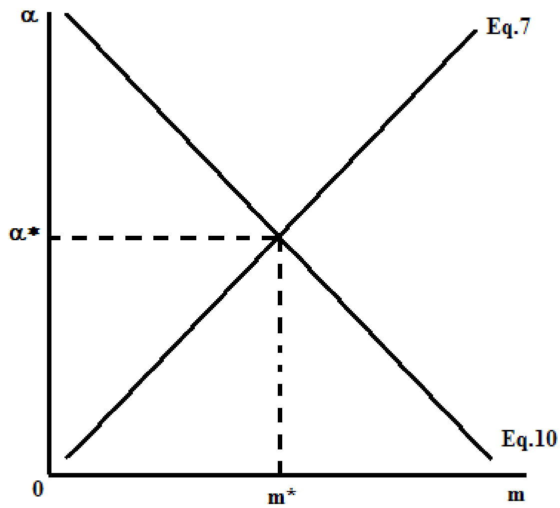

Figure 3: Equilibrium compliance and inspection rates

The intersection of the two curves gives an equilibrium level of inspection (m^*) and an equilibrium portion of non-compliers (α^*).

3.8 Comparative Statics

For those less familiar with economic theory, comparative statics is the comparison of two different economic outcomes, before and after a change in some parameter. First, I will examine the impact of a change in the interest rate on business loans on the portion of firms that choose not to comply with regulations, that is, the effect of r on α. The equilibrium gross interest rate from Equation (5) can be rewritten as:

$$(1-\alpha m)(1+r)p = 1. \tag{14}$$

For further simplicity, we might rewrite the gross interest rate *(1+r)* as θ. Consequently, plugging the regulator›s optimal decision from Equation (7) into Equation (14) yields:

$$\theta p(1-\alpha^2 B) = 1. \tag{15}$$

From Equation (15), it is easy to see that if the interest rate increases, then, *ceteris paribus*, α must increase to keep the equality steady. Thus, an increase in the interest rate results in an increase in the number of non-complying firms.

Another important relationship, that was already discussed briefly in Section 3.2, is that of the probability of project success and the compliance rate. That is, the impact of a change in p on α. As of Section 3.2, the properties of the loan and the regulator›s decision process had not yet entered the model, so it might be prudent to revisit this impact. Recall the value derived previously for from Equation (12), here with the bounds dropped from the expression:

$$\hat{R} = \frac{K}{p(1-\alpha^2 B)} + \frac{C}{\alpha B p}. \tag{16}$$

From Equation (16), it can be shown that an increase in the value of p, *ceteris paribus*, would result in a decrease in α. In words, the higher the probability of project success, the smaller the portion of non-complying firms.

4 Discussion

This simple model results in three key findings. First, if we assume that fly-by-night firms are those with a low value of project success (p) or define them as such, then, *ceteris paribus*; fly-by-nights are unambiguously less likely to comply with regulations. This assumes there is some positive financial cost of compliance. Second, it has been shown that an increase in the interest rate on commercial loans makes non-compliance even more likely.

The third finding is perhaps the most interesting. From a regulatory standpoint, the entrepreneur's compliance decision shows that an increase in inspection (m) would deter non-compliance but an increase in the fine (F) would not. This results in the following policy implication. To encourage compliance, regulatory agents should increase inspection rates instead of raising the non-compliance penalty. This finding, however, rests heavily on the assumptions of the model; namely that $F > R - (1+r)K$ and, therefore, the entrepreneur can and likely will strategically default if caught being non-compliant. In the framework of this simple model, the way to increase inspection rates is to get policymakers to increase B, the benefit to the regulatory agent of catching a non-complier.

While relatively simple, this model could be used as a base for future models. Several aspects could be altered to fit more specific scenarios. Assumptions like the initial "asset-lessness" of the entrepreneur could be relaxed. Additional complexities could also be added. For example, an informal credit market could be included increasing the loan options of the entrepreneur. Alternatively or additionally, one could allow for corruption on part of the regulator making the payment of bribes an option for the fly-by-night entrepreneur. Unchanged, the model can serve as a classroom demonstration, particularly as an example of an extended regulator-agent game.

Appendix

The Entrepreneur's Decision without Strategic Default

The entrepreneur's complete compliance decision could have been expressed as $p[R-(1+r)K]-(1-p)(1+r)K-C \geq p(1-m)[R-(1+r)K]-(1-p)(1-m)(1+r)K+pm[R-(1+r)K-F]-(1-p)m[(1+r)K+F]$ if the option of strategic default had not been allowed. All terms represent monetary amounts. The left side of the inequality refers to regulation compliance while the right side refers to non-compliance. From left to right, the three terms on the left side of the inequality represent project success, project failure, and the cost of compliance. From left to right, the terms on the right side of the inequality represent project success without inspection, project failure without inspection, project success with inspection, and project failure with inspection. Since default was allowed in the model presented in the body of the paper, the terms that describe situations of project failure and/or inspection under non-compliance can be reduced to zero and become irrelevant in the entrepreneur's compliance decision process. Reducing this expression along these lines results in Equation (1): $p[R-(1+r)K]-C \geq p(1-m)[R-(1+r)K]$.

A More Complete Loan Equation

For those interested in a more complete loan equality, it could be expressed as $K=p(1-\alpha)(1+r)K+p\alpha(1-m)(1+r)K+(1-p)(1-\alpha)K+(1-p)\alpha(1-m)K+p\alpha mK+(1-p)\alpha mK$ where K denotes the loan amount. Again, the equation is a strict equality under the assumption of a perfectly competitive market for business loans. From left to right, the right-hand-side terms represent project success and regulation compliance, success and non-compliance without inspection, failure and compliance, failure and non-compliance without inspection, success and non-compliance with inspection, and failure and non-compliance with inspection. Under the assumption that the entrepreneur will default if either caught not complying with the regulation or project failure, then the last four terms become irrelevant and reduce to zero. Thus, the equation can be reduced by multiplying out the zeroed terms and combining some like factors to yield Equation (4).

References

Bebchuk, L. A. & Kaplow, L. (1992). Optimal sanctions when individuals are imperfectly informed about the probability of apprehension. *Journal of Legal Studies,* 11(1), 365-370.

Becker, G. (1968). Crime and punishment: An economic approach. *Journal of Political Economy,* 76(1), 169-217.

Boyd, J. & Ingberman, D. E. (2003). Fly by night or face the music? Premature dissolution and the desirability of extended liability. *The American Law and Economics Review,* 5(1), 189-232.

Epple, D. & Visscher, M. (1984). Environmental pollution: Modeling occurrence, detection and deterrence. *Journal of Law and Economics*, 27(1), 29-60.

Faulhaber, G. R. & Yao, D. A. (1989). Fly-by-night firms and the market for product reviews. *The Journal of Industrial Economics*, 37(1), 65-77.

Feinstein, J. S. (1989). The safety regulation of US nuclear power plants: Violations, inspections and abnormal occurrences. *Journal of Political Economy*, 97(1), 115-154.

Fuller, D. A. (1987). Compliance, avoidance and evasion: Emissions control under imperfect enforcement in steam-electric generation. *RAND Journal of Economics,* 18(1), 124-137.

Gray, W. B. & Deily, M. E. (1996). Compliance and enforcement: Air pollution regulation in the US steel industry. *Journal of Environmental Economics and Management,* 31(1), 96-111.

Harrington, W. (1988). Enforcement leverage when penalties are restricted. *Journal of Public Economics*, 37(1), 29-53.

Harrison, K. (1995). Is cooperation the answer? Canadian environmental enforcement in comparative context. *Journal of Policy Analysis and Management* 14(2), 221-244.

Heyes, A. G. (1993). A model of regulatory enforcement when inspectability is endogenous. *Environmental & Resource Economics*, 4(1), 479-494.

Heyes, A. G. (2000). Implementing environmental regulation: Enforcement and compliance. *The Journal of Regulatory Economics*, 17(2), 107-129.

Kaplow, L. & Shavell, S. (1994). Optimal law enforcement with self-reporting of behavior. *Journal of Political Economy*, 102(3), 583-606.

Laplante, B. & Rilstone, P. (1996). Inspections and emissions of the pulp and paper industry in Quebec. *Journal of Environmental Economics and Management*, 31(1), 19-36.

Regens, J. L., Seldon, B. J., & Elliot, E. (1997). Modeling compliance to environmental regulation: Evidence from manufacturing industries. *Journal of Policy Modeling*, 19(6), 683-696.

Sandmo, A. (1998). Efficient environmental policy with imperfect compliance. Discussion Paper 8/98, Norwegian School of Economics and Business.