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A Theoretical and Experimental Study**

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# **Self-regulation and Meta-regulation – Regulating the Members or the SRO.**

## **A Theoretical and Experimental Study\***

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### **Abstract**

Regulatory investigations by Self-Regulatory organizations (SROs) are usually considered cheaper than investigations by a government. However, in practice, oversight by an SRO is mostly still supplemented by governmental oversight. The government may exert oversight over the SRO itself, a construction referred to as “meta-regulation” or “co-regulation”, or oversee members of the SRO. Indeed, the overall performance of SROs has been mixed, and theoretical models show that they have incentives to set lax standards or to cover up detected violations. Nonetheless, some research indicates that meta-regulation, oversight of the SRO itself, may not be necessary in some settings. Using a costly-state-verification model, DeMarzo et al. (2001; 2005) show that when the government implicitly threatens to conduct additional investigations of SRO members, a relatively “good” outcome can be established as an equilibrium. In this “good” outcome, the SRO chooses to follow high performance standards in order to pre-empt any (relatively costly) governmental investigation. As a result, no costly governmental investigations of the SRO members take place, and no meta-regulation of the SRO is necessary.

I extend this model to include plausible settings in which the actual rigor of oversight by the SRO can be verified only ex-post. I show that in such settings, an SRO may have incentives to announce stricter regimes than it effectively implements and that, as a result, a “bad”, Pareto-inefficient outcome may be established as an equilibrium. In the “bad” outcome, the SRO relinquishes all oversight to the government. The predictions of this model are supported by experimental tests. The “good” equilibrium could be re-established with sufficient meta-regulation of the SRO. The results thus suggest a continuing need for meta-regulation in these settings. This form of meta-regulation may be of a relatively light nature, limited to verifying and sanctioning that the SRO implements its announced policies.

**Keywords:** Self-regulatory organizations, meta-regulation, co-regulation, regulation, governmental oversight, simultaneous versus sequential games, costly state verification.

**JEL Classification:** C72, G18, G28, K20, L44

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## 1. INTRODUCTION

A self-regulatory organization (SRO) is a non-governmental organization owned and operated by its members, with the power to create and enforce industry regulations and standards (DeMarzo et al., 2005; Gupta and Lad, 1983). SROs can be found in not-for-profit sectors, education, healthcare, and the energy industry, as well as in the accounting, financial, and legal professions (Carson, 2011; DeMarzo et al., 2005; Hilary and Lennox, 2005; Maute, 2008; Ortmann and Mysliveček, 2010; Ortmann and Svitkova, 2010; Rees, 1997; Sidel, 2005; Studdert et al., 2004; Welch, Mazur and Bretschneider, 2000). Examples of SROs include the US Financial Industry Regulatory Authority in the securities industry (DeMarzo et al., 2005; FINRA, 2018), the Russian National Association of Stock Market Participants (Sungatullina et al. 2018), the so-called Donors Forums in not-for-profit sectors in Central and Eastern Europe (Ortmann and Svitkova, 2010), and the Institute of Nuclear Power Operations in the nuclear power industry (Rees, 1997).

Self-Regulatory Organizations (SROs) have been recognized as being capable of conducting regulatory investigations at lower cost than the government, as SROs have more information and are better able to interpret the information available (Braithwaite, 1982; DeMarzo et al., 2005). However, SROs have mixed records when it comes to actually curbing market abuse by members (Van der Heijden, 2015; deLeon and Rivera, 2008; Ronit, 2012). Further, theoretical models indicate that SROs are afflicted by incentive-incompatibility problems. DeMarzo et al. (2005) show they have incentives to set lax oversight standards that benefit their members rather than consumers. Núñez (2007) show they have incentives to cover up detected violations.

Indeed, in practice, oversight by an SRO is mostly still supplemented by forms of governmental oversight (Carson, 2011; Van der Heijden, 2015). A government may exert oversight over the members of the SRO or over the SRO itself. The latter type of oversight is often referred to as "meta-regulation" (Gupta and Lad, 1983, p.423) and sometimes as "co-regulation" (Gunningham and Rees, 1997, p.366). It has been suggested that governmental meta-regulation of an SRO may be essential for good performance (deLeon and Rivera, 2008; Gupta and Lad, 1983; Morgenstern and Pizer, 2007; Ronit, 2012). Indeed, many examples exist of meta-regulation of SROs (Carson, 2011; Aguilar, 2013). However, no clear consensus exists about how invasive the regulation of an SRO should be, as there is a trade-off between granting an SRO

sufficient freedom and flexibility to develop its own regulatory priorities, and assuring that any oversight SRO is effective (Carson, 2011).

However, some research suggests that meta-regulation of an SRO may not always be needed. DeMarzo et al. (2005),<sup>1</sup> using the costly-state-verification model of Townsend (1979), Border and Sobel (1987), and Mookherjee and Png (1989), show that, for financial transactions, while an SRO has incentives to set lax investigation standards, its incentives change when the government implicitly threatens to conduct additional investigations of its members. With such a threat, a relatively "good" outcome can be established as an equilibrium. In this "good" outcome, the SRO chooses to follow high standards in order to pre-empt any (relatively costly) governmental investigations. As a result, none take place. Moreover, the "good" outcome requires no meta-regulation of the SRO, thus not risking its flexibility. The predictions of the model were supported by economics experiments we reported in an earlier companion paper (Van Koten & Ortmann, 2016).

However, due to the assumption that the interaction between the government and the SRO happens in a specific order, DeMarzo et al. (2005) may not be universally applicable. DeMarzo et al. (2005) assume that the government observes, ex-ante, the investigation standards chosen by the SRO and then sets its own investigation standards. As a result, the interaction is one of sequential moves, with the SRO moving first and the government moving second. Owing to this order of sequential moves, the decision by the government can function as an implicit threat, thus leading to the "good" outcome without a need for meta-regulation of the SRO.

However, it may not always be possible for the government to reliably observe the investigation standard chosen by the SRO. After all, the investigation standards actually implemented are often only observable ex-post. Of course, the SRO may announce its investigation standards before the government makes its decision, but it is not certain whether the SRO intends to actually implement these standards. Therefore, a central question is whether the SRO has incentives to implement different (less stringent) investigation standards than it announces. If the SRO has such incentives, then additional mechanisms, such as governmental meta-regulation, may be necessary to implement the "good" outcome as in DeMarzo et al. (2005).<sup>2</sup>

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<sup>1</sup> DeMarzo et al. (2005) has been cited 134 times according to Google Scholar and 44 times according to Thomsons Reuters Web of Science (accessed on 06.09.2018).

<sup>2</sup> Reputational mechanisms may also be a viable solution, but will not be a focus of this paper.

In this paper, I study this question by extending the model of DeMarzo et al. (2005). I assume that the SRO and the government announce their investigation standards at the beginning of a period, and I focus on settings where the SRO may deviate from its announced standards. In the first setting, the government cannot deviate from what it announces. Thus, the government's announcement is credible and the decision (on the investigation standard) of the SRO and the government is sequential, with the government moving first. In the second setting, the government may also deviate from what it announced. Thus, neither the SRO nor the government can trust each other's announcement, and the decisions of the SRO and the government occur simultaneously. These settings contrast with the model of DeMarzo et al. (2005), where the decision is sequential, with the SRO moving first and the government moving second.

Deriving the one-shot game Nash-equilibrium for both settings, I show that the SRO relinquishes all investigations to the government. The outcome is thus the opposite of the "good" equilibrium in DeMarzo et al. (2005). The crucial difference in the assumption is that the SRO can announce different investigation standards than it eventually implements. If the SRO were bound to factually implement its announced investigation standards, the "good" outcome of DeMarzo et al. (2005) would be realized. I also show that the reliability of the government announcement is basically immaterial to these results.

Using the design in our companion paper Van Koten & Ortmann (2016, p.89-96), economic experiments have been performed to test the equilibria derived for simultaneous decisions. Economics experiments are a useful tool to test theoretical predictions, especially when it is difficult to collect appropriate empirical data (Smith, 2007). In an economics experiment, human decision makers are exposed to economic laboratory environments with specific embedded incentives and tested to see whether they behave in line with the theoretical predictions. This enables an evaluation of the theory under the "best shot" circumstances of the laboratory (Plott, 1982, p.1520). The experimental results support the theoretical predictions.

The results suggest a continuing need for meta-regulation of SROs. The ideal form of meta-regulation is likely to be relatively light, restricted to verifying and sanctioning that the SRO implements its announced policies.

I describe and solve the model in section 2. Section 3 presents experimental evidence and section 4 concludes with a discussion.

## 2. THE MODEL

### 2.1 Setup

A part of the setup of the model closely follows DeMarzo et al. (2005). The main interaction in the model is between an SRO and the government (GOV). Both set investigation standards as an oversight policy for trading between agents and customers. It is common knowledge that the SRO maximizes the sum of utility of all agents and the GOV maximizes the sum of utility of all customers. The trade involves an agent who can provide a service to a customer, such as making an investment. The outcome of the investment is modeled as a random variable  $W$  that can have high ( $w^H$ ) or low ( $w^L$ ) realizations, with probability  $\pi^H$  and  $\pi^L$ , respectively. The realized outcomes are observed by the agent, but not by the customer. For high realizations this gives the agent an incentive to falsely report a low outcome and to keep the difference  $w^H - w^L$ . The contract between the customer and the agent is modeled such that the customer offers the agent a contract  $z[W]$ , that obliges the agent to return  $z[W]$  to the customer, and leaves the agent the rest,  $W - z[W]$ , as a rent.

As in DeMarzo et al. (2005), I make the following assumptions to keep the model tractable. Agents are assumed to be risk averse, to have zero initial wealth, to face a limited liability constraint and to have preferences that can be represented by a strictly concave utility function  $u$  that is twice differentiable and has been normalized such that  $u[0] = 0$ . Customers are heterogeneous in their outside options. There is a continuum of customers distributed with a log-concave cdf  $F[\cdot]$  over  $[\underline{\omega}, \bar{\omega}]$ . There are at least as many (identical) agents as customers, such that for each customer an agent is available for dealing. Customers are assumed to be risk-neutral.<sup>3</sup> The customer offers the contract as a take-it-or-leave-it offer to the agent. The cost of regulation is fully borne by the customers.

DeMarzo et al. (2005) show that the analysis can be restricted to incentive-compatible contracts without loss of generality. For the contract to be incentive-compatible (thus guaranteeing that the agent abstains from fraud in equilibrium), it must grant the agent a sufficiently high rent in the form of a success fee. The drawback of

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<sup>3</sup> The zero initial wealth and limited liability of agents imply that the maximum penalty on agents is bound and that agents cannot compete away all rents by paying customers to do business with them. The risk neutrality of customers abstracts from their demand for insurance in the optimal contract. See also DeMarzo et al. (2005) for more details.

granting a rent is that it is costly for customers and lowers efficiency by dissuading customers with good outside options from investing.

Alternatively, incentive-compatibility can be supported by regulation. Regulators, the SRO or the GOV, set investigation standards that specify the proportion of low realized outcomes that will be investigated and the financial penalty for the agent in the case of fraud. Indicate the investigation proportions chosen by the SRO and the GOV as  $p_s$  and  $p_G$ , respectively. As investigations are costly, the proportion is generally less than 1.<sup>4</sup> As in DeMarzo et al. (2005), I assume that regulators do not duplicate investigations and that the SRO investigates first.<sup>5</sup> Thus, when the GOV decides that an agent must be investigated, it first checks if the agent has already been investigated by the SRO. It can then be easily shown that the total proportion of investigation is cumulative,  $p_{TOT} = p_s + p_G$ .<sup>6</sup> The higher the proportion  $p_{TOT}$ , the lower the incentive for an agent to commit fraud, and thus the lower the rent  $W - z[W | p_{TOT}]$  that customers have to offer to agents. However, investigations come at a cost that must be paid by the customers. The total expected cost of investigations is equal to  $c_{TOT} = p_s c_s + p_G c_G$ .

When only the GOV exerts oversight over the agents, DeMarzo et al. (2005) shows that the relatively high investigation costs act as a limiting factor, and as a result the GOV sets the proportion of outcomes that it investigates,  $p_G$ , moderately high. When only the SRO regulates, DeMarzo et al. (2005) shows that the preference for a high rent leads the SRO to set the proportion of outcomes that it investigates,  $p_s$ , very low.

Table 1 shows the timing and order of moves for the present model (on the left and in the middle). For comparison, the model of DeMarzo et al. (2005) is also included in (on the right-hand side).

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<sup>4</sup> As in DeMarzo et al. (2005), the proportion can also be interpreted as the depth or rigor of the investigation.

<sup>5</sup> This assumption could be rationalized assuming that the low outcome is reported both to the SRO and the GOV, but that the SRO is quicker to react than the GOV. This is not unreasonable, as governmental, bureaucratic organizations are often much slower than private ones. Moreover, it is rational for the GOV to move slower and give the SRO a chance to do the investigation first, as the SRO has lower investigation costs. Alternatively, assuming that the GOV moves first does not change the results.

<sup>6</sup> The total probability of an investigation is equal to the probability of the SRO investigating,  $p_s$ , plus the probability of the SRO not investigating,  $1 - p_s$ , times the conditional probability of the GOV investigating conditional on the SRO not investigating. This results in  $p_s + (1 - p_s)p_G / (1 - p_s) = p_s + p_G$ . See also footnote 17 in DeMarzo et al. (2005).

	<b>Prime decision makers</b>	<b>The present model (Simultaneous moves)</b>	<b>The present model (Sequential moves, GOV first)</b>	<b>DeMarzo et al. (2005) (Sequential moves, SRO first)</b>
Stage 1	<b>SRO and GOV</b> (set investigation probability)	The SRO and the GOV simultaneously set their regulatory regimes by each choosing an investigation probability $p_s$ and $p_g$ , respectively.	The GOV sets its regulatory regime by choosing the investigation probability $p_g$ , which is observed by the SRO. The SRO then sets its regulatory regime by choosing the investigation probability $p_s$ .	The SRO sets its regulatory regime by choosing the investigation probability $p_s$ , which is observed by the GOV. The GOV then sets its regulatory regime by choosing the investigation probability $p_g$ .
Stage 2	<b>Customers</b> (either take outside option or offer an incentive-compatible contract)	Customers offer agents, as a take-it-or-leave-it offer, an incentive-compatible contract $z[W   p_{TOR}]$ that results in a rent for the agent in the amount of $w^L - z[w^L   p_{TOR}]$ ( $w^H - z[w^H   p_{TOR}]$ ) when the outcome is low (high). Customers pay transaction fees $t_s + t_g$ . Only customers that expect a utility (net of the transaction fees) larger than their outside option offer agents a contract.		
Stage 3	<b>Nature:</b> (decide, at random, the investment outcome)	With probability $\pi^L$ ( $\pi^H$ ) the low (high) outcome, $w^L$ ( $w^H$ ), is realized. The outcome is private knowledge of the agent.		
Stage 4	<b>Nature:</b> (decide, at random, if the agent with low outcomes are investigated and by whom)	First it is determined, with probability $p_s$ , for each agent with a low outcome if she will be investigated by the SRO. For each agent the SRO investigates, the SRO pays investigation cost $c_s$ . Agents that deceive pay penalty $x_s$ . Then it is determined, with probability $p_g$ , for each agent with a low outcome that has not been investigated by the SRO if she will be investigated by the GOV. For each agent the GOV investigates, the GOV pays the investigation cost $c_g > c_s$ . Agents that deceive pay penalty $x_g$ .		

TABLE 1 Timing and order of moves

In stage 1, the GOV and the SRO, in the present models, set their investigation probabilities simultaneously or sequentially with the GOV moving first, while, in the model of DeMarzo et al. (2005), they set them sequentially with the SRO moving first. The remaining stages are identical for both models.

Lemma 1, applying the derivations in DeMarzo et al. (2005), states that the above problems can be represented by solving the problems GOVP' and SROP' below.<sup>7</sup>

<sup>7</sup> Lemma 1 reformulates the problem, using a number of basic results, such as applying fines only for untruthful revelations, not granting a rent for the low outcome, truthful revelation, and that the constraints CIR' and AIC' hold with equality in equilibrium. See DeMarzo et al. (2001; 2005) for further details.

**Lemma 1** The optimal solutions to the decision problems of the consumer, the GOV and the SRO can be determined by solving the GOVP' and SROP' problems.

**GOV Problem (GOVP')**

$$a_G[p_S] = \text{Max}_{z^H, p_G} \pi^L w^L + \pi^H z^H - \pi^L (p_S c_S + p_G c_G)$$

$$\text{AIC':} \quad u[w^H - z^H] = (1 - p_G - p_S) \cdot u[w^H - w^L]$$

$$\text{NZG:} \quad p_G \geq 0$$

**SRO Problem (SROP')**

**Stage 1:**

$$V[a | p_G] = \text{Max}_{z^H, p_S} [\pi^H \cdot u[w^H - z^H]], \text{ s.t.}$$

$$\text{CIR':} \quad \pi^L w^L + \pi^H z^H - \pi^L (p_S c_S + p_G c_G) = a$$

$$\text{AIC':} \quad u[w^H - z^H] = (1 - p_G - p_S) \cdot u[w^H - w^L]$$

$$\text{NZS:} \quad p_S \geq 0$$

**Stage 2:**

$$\Pi_S[a | p_G] = \text{Max}_a F[a]V[a | p_G] \text{ and } a_S[p_G] = \text{ArgMax}_a F[a]V[a | p_G]$$

Proof: see Appendix A1.

Define the optimal investigation probability for the GOV and the resulting customer profit as a function of the investigation probability of the SRO and visa versa:  $p_G[\cdot]$  and  $a_G[\cdot]$  for the GOV and  $p_S[\cdot]$  and  $a_S[\cdot]$  for the SRO. The solutions when one single regulator is exerting oversight play a central role. Therefore I define, for the SRO,  $p_{S^0} = p_S[0]$ , and, for the GOV,  $p_{G^0} = p_G[0]$ , with the resulting customer profit given as  $a_{S^0} = a_S[0]$  and  $a_{G^0} = a_G[0]$ , respectively. Lemma 2 now presents the reaction function for the GOV.

**Lemma 2**

For any  $p_S \in [0, p_{G^0}]$ , the solution to the problem GOVP' is characterised by the GOV reaction function  $p_G[p_S] = p_{G^0} - p_S$  with the resulting customer profit given by  $a_G[p_S] = a_{G^0} + \pi^L p_S \Delta c$ .

Proof, see Appendix A1.

The GOV thus always aims for the same level of *total* investigation probability, namely  $p_{G^0}$ , regardless of the degree of participation by the SRO. In other words, the GOV will choose an investigation probability that tops up any investigation probability by the SRO that falls short of  $p_{G^0}$ .

Lemma 3 summarizes a basic property of the optimal choice by the SRO.

**Lemma 3**

For any  $p_G \in [0, p_{G^0}]$ , the optimal level of customer profit in the problem SROP' is given by a SRO reaction function  $a_s[p_G]$  that is decreasing in  $p_G$ .

Proof, see Appendix A1.

As investigations by the GOV are costlier than those conducted by the SRO, participation by the GOV raises costs. Lemma 3 shows that these costs are not completely absorbed by the SRO, but are also partly passed on to customers. The SRO lowers the customer profits by lowering its investigation probability. As a result, the higher the participation of the GOV in the investigations, the lower the participation of the SRO.

**Proposition 1**

When the GOV and the SRO set their investigation probabilities simultaneously, then, provided oversight by the GOV is effective in the sense that  $p_{S^0} < p_{G^0}$  and  $a_{S^0} < a_{G^0}$ , the SRO conducts no investigations,  $p_S = 0$ , and the GOV conducts investigations given by  $p_{G^0}$ .

Proof, see Appendix A1.

Proposition 1 shows that the GOV and the SRO cannot both conduct investigations. In case they were, for the GOV, the SRO would always show too little participation, thus the GOV would deviate to an investigation probability that tops up any investigation probability by the SRO that falls short of  $p_{G^0}$ . For the SRO, any GOV participation increases costs, thus the SRO would deviate to an investigation probability

that decreases the total level of oversight below  $p_{G^0}$ , lowering the customer profit below the (already low) level of  $a_{S^0} < a_{G^0}$ . As a result, in equilibrium, the SRO conducts no investigations, and the GOV conducts investigations at the same level as if there were no SRO. This is a suboptimal outcome, as investigations by the SRO are less costly than those conducted by the GOV.

When the GOV makes a reliable announcement, the investigation probabilities are set sequentially, with the GOV moving first. Proposition 2 shows that this results in the same outcome as with simultaneous moves.

### **Proposition 2**

When the GOV and the SRO set their investigation probabilities sequentially, with the GOV moving first, then, provided that oversight by the GOV is effective in the sense that  $p_{S^0} < p_{G^0}$  and  $a_{S^0} < a_{G^0}$ , the SRO conducts no investigations,  $p_S = 0$ , and the GOV conducts investigations given by  $p_{G^0}$ .

Proof, see Appendix A1.

In Proposition 2, the same intuition is at work as for Proposition 1, and the SRO relinquishes all investigations to the GOV.

## 4. EXPERIMENTAL TEST

In this section I present an experimental test of the predictions of model with simultaneous moves. A similar form of experimental testing has been performed, using the same design, together with treatments, to test the model of DeMarzo et al. (2005) which we have published in the companion paper Van Koten and Ortmann (2016, p. 89-96). Once SRO and GOV have set their investigation probabilities, clients and agents are assumed to make the Nash-equilibrium choices as derived above. The test is thus focused on the behavior of SRO and GOV, which are the key protagonists of the model.

### 4.1 *The overall design*

In Van Koten and Ortmann (2014, p. 9), we presented "plausible" sets of parameterizations in which high and low values are chosen for key variables to conduct a very coarse grid search. We showed that the main variable of consequence, affecting

the payoff contrast between the preferred outcomes, is the probability of success. For the experimental treatments we therefore focused on the parameterization with the lesser payoff contrast, the parameterization referred to as "Baseline", and use the parameterization with the higher payoff contrast, the parameterization referred to as "Alternative", for a robustness test. Table 2 presents the chosen base parameter values for the experiment, and Table 3 depicts the resulting pay-offs for the low and high values of the success probability.

Utility function Clients	Linear ( $U[x] = x$ )
Utility function Agents	$U[x] = m \cdot x^{1-RA} / RA$
Utility scaling factor $m$	=10
Risk Aversion Agents (RA)	=0.5
Low investment outcome ( $L$ )	=20
High investment outcome ( $H$ )	=200
Success Probability (SP)	= LOW (25%) or HIGH (50%)
Outside Option ( $OO$ )	UD over [5,105]
Investigation Cost of SRO ( $ICsro$ )	= LOW (10)
Investigation Cost of GOV ( $ICg$ )	= HIGH (40)

TABLE 2 Parameterizations

		Success Probability								
		LOW 25%		HIGH 50%						
Costs	Baseline Parameterization	Alternative Parameterization								
		GOV		GOV						
		None	Low	High	None	Low	High			
$c_s = 10$	<b>S</b>	None	(10, 1)	(14, 4)	<b>(8, 6)*</b>	S	None	(20, 1)	(52, 19)	<b>(13, 37)*</b>
	<b>R</b>	Low	(17, 7)	(10, 9)	(0, 7)	<b>R</b>	Low	(57, 23)	(31, 40)	(0, 40)
$c_g = 40$	<b>O</b>	High	(11, 13)	(0, 10)	(0, 9)	<b>O</b>	High	(15, 49)	(0, 46)	(0, 43)
		None=0%, Low=32%, High=67%				None=0%, Low=37%, High=89%				

Notes: The Nash-Equilibrium is indicated by "\*".

TABLE 3 Overview of parameterizations

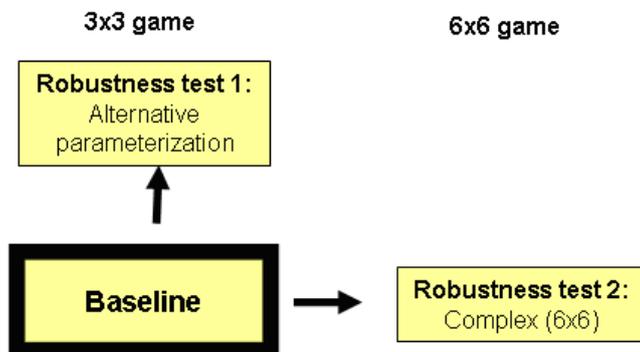


FIGURE 1 Summary of the treatments

Figure 1 presents the treatments. The baseline treatment is the one using the parameterization in Table 3 labeled "Baseline". As a first robustness test ("Alternative parameterization"), a treatment that uses the parameterization in Table 3 labeled "Alternative" was added. As a second robustness test ("Complex (6x6)"), a treatment, using the same parameterization as the Baseline treatment, with a higher degree of complexity was added: The choice resolution was increased from 3x3 to 6x6. Participants thus could choose from a set enlarged to 6 choices: {None, Very Low, Low, Medium, High, Very High}.<sup>8</sup> For an example, see Van Koten and Ortmann (2016, p. 95, Figure 2). This complex representation has the same order of play and parameterization as the baseline treatment. Note that in all robustness tests, the strategy set (SRO, GOV) = (None, High) constitutes a Nash equilibrium. In the complex representation, two more Nash equilibria exist: the strategy sets (SRO, GOV) = (None, Medium) and (None, Very High). We count these responses as Nash equilibrium choices in our tests below. The occurrence of extra Nash equilibria is the result of the relatively flat payoff function for GOV and our implementation in which players options are discrete.<sup>9</sup>

<b>Baseline treatment</b>	3 sessions 72 participants 12 independent observations
<b>Robustness tests</b>	
<b>1. Alternative parameterization (normal form)</b>	3 session 72 participants 12 independent observations
<b>2. Complex (normal form )</b>	3 sessions 72 participants 12 independent observations

TABLE 4 Sessions, participants and independent observations

Table 4 gives an overview of the sessions. A total of 6 sessions were run in December 2011 and a total of 3 sessions in November 2018 in the "LEE" experimental lab of the University of Economics in Prague.<sup>10</sup> In each session 24 participants made decisions, as SRO or GOV, over 10 rounds. Following well-documented experimental

<sup>8</sup> Option "None" is equal to an investigation probability of zero. The investigation probability is then increased by 16.67% for each of the successive options. Thus, the option "Very Low" is equal to an investigation probability of 16.67%, the option "Low" to one of 33.33%, the option "Medium" to one of 50%, and so on.

<sup>9</sup> See van Koten and Ortmann (2016, p. 92-94) for further details.

<sup>10</sup> See [www.vse-lee.cz](http://www.vse-lee.cz). In addition, I ran 7 sessions in which players made their choices sequentially rather than simultaneously. A detailed account can be found in Van Koten and Ortmann (2016).

practice, participants in each session were divided into 4 groups of 6 to increase the number of independent data points. In each group, 3 participants were randomly assigned the role of GOV and 3 the role of SRO. Roles were fixed throughout the session. In each round, participants were randomly matched with a participant of the other role within their group. Each session thus resulted in 4 (24÷6) independent observations. In total 9 sessions were run, involving 216 participants and generating 36 independent data points.<sup>11</sup> Participants in the role of SRO and participants in the role of GOV made their choices simultaneously.

Neutral language was used in the instructions (reprinted in Appendix A2), and all treatments were implemented using the direct-response method. Participants earned on average CKZ 360 ( $\approx$  €14,  $\approx$  \$19), more than four times the gross hourly average wage in the Czech Republic in 2011) in a session of 50 minutes (including the reading of the instructions).

### 4.3 Results

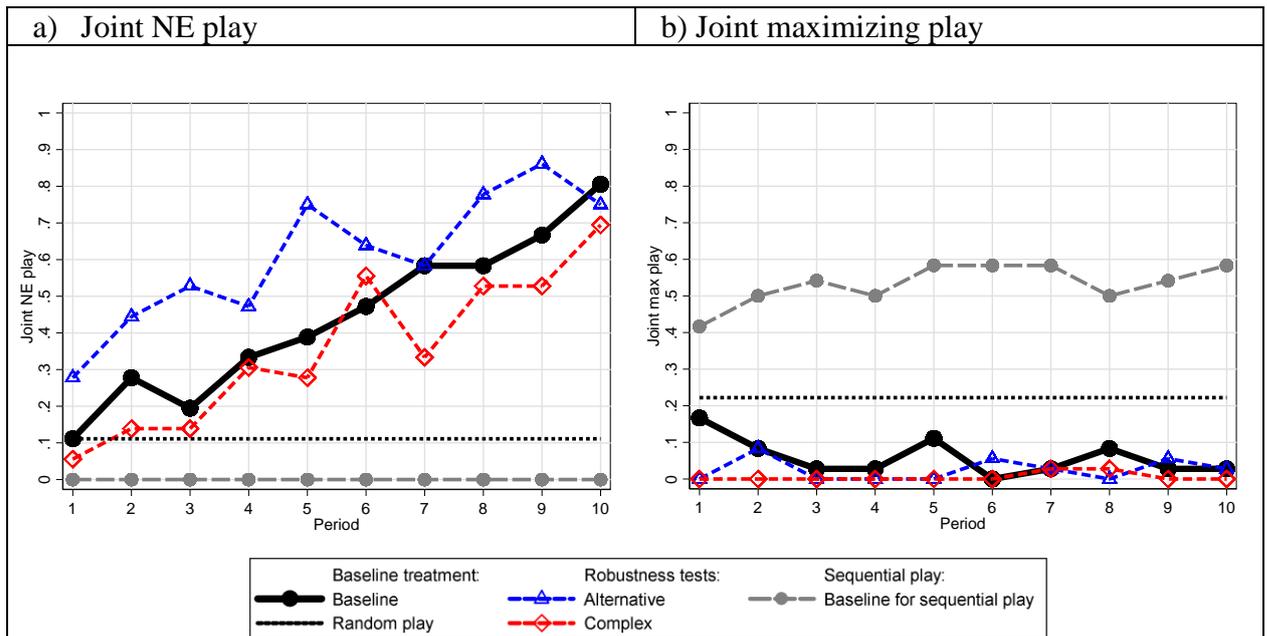


FIGURE 3 Proportion of Nash equilibrium choices

In this section I show the proportion of choices by the participants in the experiments that are part of a Nash equilibrium. I interpret the outcome of a high proportion of choices as experimental corroboration of the theoretical model.

<sup>11</sup> For the statistical test used, at least 7 independent points are required to achieve a power of 0.8 (see footnote 14). All treatments are thus sufficiently powered.

Figure 3a shows the proportion of paired choices that are congruent with a Nash equilibrium. The baseline treatment is indicated by the thick line with the large round markers. Initially, few paired choices are Nash equilibrium choices. Typically, in fewer than half the cases does a pair makes a Nash equilibrium choice in the first three periods. We see, however, a remarkable learning effect. In the last few rounds, paired choices occur at rates of 75%-85%.

While there is some variation in the robustness tests, they follow the same pattern. The proportion of equilibrium choices in the Alternative Parameterization treatments ("Alternative") is initially higher and converges faster to full equilibrium play than the corresponding percentage in the Baseline. This is in line with expectations given the stronger contrast in payoffs in the Alternative parameterization. The choices for the Complex treatment are very much in line with the Baseline treatment. The results thus corroborate the Nash equilibrium predictions: The GOV conducts all of the investigations and the SRO none. The results are robust to a different parameterization and a considerable increase in complexity (from 3 to 6 choices for each participant). To highlight the effect of simultaneous versus sequential decision-making on outcomes and behaviour, I use the results from Van Koten and Ortmann (2016) to also show the responses of subjects making sequential decisions with the GOV moving first in Figure 3 (the gray long-dash line).<sup>12</sup> As Figure 3a shows, none of these paired choices are congruent with the GOV conducting all of the investigations and the SRO none.

A statistical test shows that, for all treatments, the proportions are significantly higher than the "random play proportions" (the proportions that would result from random play). For the test, I determine for each independent group of 6 participants the proportion of joint NE play, averaged over the last 5 rounds. I then use a two-sided, single-sample sign-test to test for significance.<sup>13</sup> The baseline and complex treatments are significant at the 1% level.

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<sup>12</sup> The response proportions are averages of 8 independent data points (Van Koten and Ortmann, 2016, p.97).

<sup>13</sup> For an approximate estimate of the required number of independent observations for a sufficiently powerful test, I assume that the real probability of success is 0.5 for an independent group (of 6 participants). For a power of 0.8, the standard deviation of the average proportion should thus be no larger than 0.2. Using the formula  $sd = (p(1-p)/n)^{0.5}$  and solving for  $n$  gives  $n = p(1-p) / sd^2 = 6.25$ . The estimate of the required number of independent observations is thus 7. The estimate is rough, using a normal distribution for such a small sample. On the other hand, the estimate is probably inflated, as no account is made for the fact that the proportion per group likely has a lower standard deviation than 0.25, because it is an average over 3 pairs of participants, averaged over 5 periods.

Figure 3b shows the proportion of paired choices that are congruent with maximizing the joint profits (when the SRO conducts all the investigations and the GOV none). As can be calculated from Table 3 and Figure 2, the maximum joint profit is achieved when the GOV chooses "None" and the SRO "Low" or "High" in the Baseline treatment, the GOV chooses "Low" and the SRO "Low" in the Alternative Parameterization treatment, and the GOV chooses "None" and the SRO "Medium" in the Complex (6x6) treatment. In the first rounds, the proportion is only marginally above the random level for some treatments. In the last 5 rounds, the proportion is mostly close to zero, and in all cases is below the random play level.

Using again the results from Van Koten and Ortmann (2016) to show the responses of subjects making sequential decisions with the GOV moving first (the gray long-dashed line), Figure 3b shows that a large proportion chooses the joint maximizing play.

In line with theoretical predictions, we thus see, under simultaneous decision-making, strong support for the play of the Nash-equilibrium choices and little or no support for profit maximizing choices.

## 5. CONCLUSION

Oversight by an SRO is usually assumed to be cheaper than investigations by a government. However, SROs may not have the incentives to be sufficiently strict and vigilant in their role of regulator. Indeed, oversight by an SRO is mostly still supplemented by forms of governmental oversight, either as a form of "meta-regulation", oversight over the SRO itself, or additional oversight over the SRO members. DeMarzo et al. (2005) indicates that meta-regulation of the SRO may not be necessary. By threatening to conduct additional investigations of SRO members, the government persuades the SRO to set high investigation standards in order to pre-empt any relatively costly governmental investigations.

This study adds an important qualification: When SRO investigation policies can only be verified ex-post, the interaction between an SRO and a government then becomes one of simultaneous moves or one of sequential moves with the SRO moving first. In such cases, oversight by the government completely crowds out oversight by the SRO, and the SRO becomes superfluous. This outcome is Pareto-inefficient as the government has a higher cost of investigation than the SRO. The predictions of the

model with simultaneous moves are borne out in experimental tests using specific parameterizations and implementation details.

One of the ways the "good" equilibrium could be re-established as an equilibrium is by providing sufficient supplemental government meta-regulation: oversight over the SRO itself. The results thus suggest a continuing need for meta-regulation in these settings. This form of meta-regulation may be of a relatively light nature, limited to verifying that the SRO implements its announced policies. When the regulatory policy announcement of the SRO is credible, the interaction between an SRO and government becomes sequential, with the SRO moving first and the government moving second, again enabling the efficient outcome as derived in DeMarzo et al. (2005).

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## Appendix A1: Proofs

### Lemma 1

The optimal solutions to the decision problems of the consumer, the GOV and the SRO can be determined by solving the problems GOVP' and SROP'.

#### GOV Problem (GOVP')

$$a_G[p_S] = \text{Max}_{z^H, p_G} \pi^L w^L + \pi^H z^H - \pi^L (p_S c_S + p_G c_G)$$

$$\text{AIC':} \quad u[w^H - z^H] = (1 - p_G - p_S) \cdot u[w^H - w^L]$$

$$\text{NZG:} \quad p_G \geq 0$$

#### SRO Problem (SROP')

##### Stage 1:

$$V[a | p_G] = \text{Max}_{z^H, p_S} [\pi^H \cdot u[w^H - z^H]], \text{ s.t.}$$

$$\text{CIR':} \quad \pi^L w^L + \pi^H z^H - \pi^L (p_S c_S + p_G c_G) = a$$

$$\text{AIC':} \quad u[w^H - z^H] = (1 - p_G - p_S) \cdot u[w^H - w^L]$$

$$\text{NZS:} \quad p_S \geq 0$$

##### Stage 2:

$$\Pi_S[p_G] = \text{Max}_a F[a]V[a | p_G]$$

#### Proof:

The original problem has the following setup

#### Customer Problem (CP[ $p_S, p_G, x_S, x_G$ ])

$$\text{Max}_z [\pi^L z[w^L] + \pi^H z[w^H]] - \pi^L (p_S c_S + p_G c_G), \text{ s.t:}$$

$$\text{AF:} \quad z[w^L] \leq w^L, \quad z[w^H] \leq w^H$$

$$\text{AIC:} \quad u[w^H - z[w^H]] \geq \left\{ \begin{array}{l} p_S \cdot u[\text{Max}[w^H - z[w^L] - x_S, 0]] \\ + p_G \cdot u[\text{Max}[w^H - z[w^L] - x_G, 0]] \\ + (1 - p_G - p_S) \cdot u[w^H - z[w^L]] \end{array} \right\}$$

#### SRO Problem (SROP)

$$\text{Stage 1: } V[a] = \text{Max}_{z, p_S, x_S} [\pi^L (w^L - z[w^L]) + \pi^H (w^H - z[w^H])], \text{ s.t:}$$

$$\text{CIC:} \quad z \text{ solves CP}[p_S, p_G, x_S, x_G]$$

$$\text{CIR:} \quad \pi^L z[w^L] + \pi^H z[w^H] - (p_S c_S + p_G c_G) \geq a$$

$$\text{Stage 2: } \text{Max}_a F[a] \cdot V[a]$$

#### GOV Problem (GOVP)

$$\text{Max}_{z, p_G, x_G} \pi^L z[w^L] + \pi^H z[w^H] - \pi^L (p_S c_S + p_G c_G), \text{ s.t:}$$

$$\text{CIC:} \quad z \text{ solves CP}[p_S, p_G, x_S, x_G]$$

DeMarzo et al. (2001, 2005, p.706) prove that solving GOVP and SROP are equivalent to solving GOVP' and SROP'. The conditions NZS and NZG have been added to assure that the investigation probabilities stay within the ranges for which the proofs are valid.

**Lemma 2<sup>14</sup>**

For any  $p_s \in [0, p_{G^0}]$ , the solution to the problem GOVP' is characterised by the GOV reaction function  $p_G[p_s] = p_{G^0} - p_s$  with the resulting customer profit given by  $a_G[p_s] = a_{G^0} + \pi^L p_s \Delta c$ .

**Proof:**

In GOVP', substitute  $p_{TOT} = p_s + p_G$ . Then the problem becomes:

$$a_G[p_s] = \text{Max}_{z^H, p_{TOT}} \pi^L w^L + \pi^H z^H - \pi^L (p_{TOT} c_G) + p_s \Delta c$$

$$\text{AIC: } u[w^H - z^H] = (1 - p_{TOT}) \cdot u[w^H - w^L]$$

$$\text{NZG: } p_{TOT} \geq p_s$$

Notice that the problem is the same as when the GOV is the only regulator, except that a constant has been added to the objective function. We can thus see that  $p_{TOT}^* = p_{G^0}$ , and thus  $p_G^* = p_{TOT} - p_s = p_{G^0} - p_s$ . And as  $p_s \leq p_{s^0} < p_{G^0}$  thus  $p_G^* > 0$ , respecting NZG.

Filling out  $p_G^* = p_{G^0} - p_s$  in the objective function gives

$$a_G[p_s] = \pi^L w^L + \pi^H z_G^H - \pi^L (p_{G^0} c_G) + \pi^L p_s \Delta c = a_{G^0} + \pi^L p_s \Delta c$$

**Sublemma 1<sup>15</sup>**

$V[a]$  is strictly decreasing in  $a$ ,  $V'[a] < 0$ .

**Proof.** The SRO maximizes in stage 1 of SROP' its value function by choosing, respecting constraints CIR and AIC, its optimal investigation probability  $p_s[a | p_G]$ .

Thus

$$(A3) \quad V[a | p_G] = \pi^H \cdot u[w^H - z^H]$$

Using CIR to express the contract gives

$$\pi^L w^L + \pi^H z^H - \pi^L (p_s c_s + p_G c_G) = a \Leftrightarrow$$

$$(A4) \quad z^H = \frac{1}{\pi^H} \left( a - \pi^L w^L + \pi^L (p_s c_s + p_G c_G) \right)$$

Using Equation (A4) to substitute for the contract in Equation (A3) gives

$$V[a | p_G] = \pi^H \cdot u \left[ w^H - \frac{1}{\pi^H} \left( a - \pi^L w^L + \pi^L (p_s c_s + p_G c_G) \right) \right]$$

<sup>14</sup> Part of the result has been reported earlier in DeMarzo et al. (2001, 2005).

<sup>15</sup> The proof mostly follows the lines of the proofs in DeMarzo et al. (2005, p.706).

Differentiating with respect to the customer utility level  $a$ , using envelope theorem, gives

$$V'[a] = -u' \left[ w^H - \frac{1}{\pi^H} \left( a - \pi^L w^L + \pi^L (p_s c_s + p_G c_G) \right) \right] < 0$$

**Sublemma 2**<sup>16</sup>

Provided GOVP and SROP have solutions, they are unique and  $\frac{d^2 \Pi_s[a | p_G]}{(da)^2} < 0$ .

*Proof.* We show that GOVP is equivalent to GOVP' and SROP to SROP'. GOVP' is a concave problem and thus the solution, provided it exists, will be a unique maximum. Also, if  $F[a]V[a | p_G]$  is concave in  $a$ ,  $F[a]V[a | p_G]$  has a unique interior solution and thus SROP' has a unique maximum as its solution. It then necessarily follows that  $\frac{d^2 \Pi_s[a | p_G]}{(da)^2} < 0$ . The remainder of the proof establishes the concavity of  $F[a]V[a | p_G]$  in  $a$ .

The concavity of  $F[a]V[a | p_G]$  can be derived by showing that  $V[a]$  can be written as  $V[a | p_G] = k_1 + k_2 \cdot (a + W[V[a | p_G]])$  with  $k_1$  and  $k_2$  constants and  $W$  an increasing, convex function. Then I can show that  $V''[a | p_G] < 0$ , which, together with the fact from Lemma 4a),  $V'[a | p_G] < 0$ , gives that  $V[a | p_G]$  is concave. Together with the assumption that  $F[a]$  is log-concave, it follows that  $F[a]V[a | p_G]$  is concave.

When the SRO chooses the optimal investigation probability, the first stage of SROP', given a parameter  $a$  and the investigation probability of the GOV,  $p_G$ , consists of three equations:

$$(A5) \quad V[a | p_G] = \pi^H \cdot u[w^H - z^H[a | p_G]]$$

$$(A6) \quad a = \pi^L w^L + \pi^H z^H[a | p_G] - \pi^L (p_s [a | p_G] c_s + p_G c_G),$$

$$(A7) \quad u[w^H - z^H[a | p_G]] = (1 - p_s [a | p_G] - p_G) u[w^H - w^L]$$

Using (A7) to substitute for  $u[w^H - z^H[a | p_G]]$  in (A5) gives

$$(A7') \quad V[a | p_G] = \pi^H (1 - p_s [a | p_G] - p_G) \cdot u[w^H - w^L]$$

Rewrite (A5) as

$$(A5') \quad z^H[a | p_G] = w^H - u^{-1} \left[ \frac{V[a | p_G]}{\pi^H} \right]$$

Rewrite (A6) as

$$(A6') \quad p_s [a | p_G] = \frac{1}{c_s \pi^L} (\pi^L w^L + \pi^H z^H[a | p_G] - a) - \frac{p_G c_G}{c_s}$$

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<sup>16</sup> The proof mostly follows the lines of the proofs in DeMarzo et al. (2005, p.706).

Using (A6') to substitute for  $p_s[a | p_G]$  in (A7') gives

$$(A7'') \quad V[a | p_G] = \pi^H \left( 1 - \frac{1}{c_s \pi^L} (\pi^L w^L + \pi^H z^H[a | p_G] - a) + \frac{p_G c_G}{c_s} - p_G \right) \cdot u[w^H - w^L]$$

Using (A5') to substitute for  $z^H[a | p_G]$  in (A7'') gives

$$\begin{aligned} V[a | p_G] &= \pi^H \left( 1 - \frac{1}{c_s \pi^L} (\pi^L w^L + \pi^H \left( w^H - u^{-1} \left[ \frac{V[a | p_G]}{\pi^H} \right] \right) - a) + \frac{p_G c_G}{c_s} - p_G \right) u[w^H - w^L] \\ \Leftrightarrow V[a | p_G] &= u[w^H - w^L] \pi^H \left( 1 + \left( \frac{c_G}{c_s} - 1 \right) p_G + \frac{a - \pi^L w^L - \pi^H \left( w^H - u^{-1} \left[ \frac{V[a | p_G]}{\pi^H} \right] \right)}{c_s \pi^L} \right) \end{aligned}$$

$$(A8) \quad \Leftrightarrow V[a | p_G] = k_1 + k_2 \cdot (a + W[V[a | p_G]])$$

$$\text{Where: } k_1 = u[w^H - w^L] \pi^H \cdot \left( 1 + \left( \frac{c_G}{c_s} - 1 \right) p_G \right), \quad k_2 = u[w^H - w^L] \pi^H \frac{1}{c_s \pi^L},$$

$$\text{and } W[V[a | p_G]] = -\pi^L w^L + \pi^H \left( u^{-1} \left[ \frac{V[a | p_G]}{\pi^H} \right] - w^H \right) \text{ and thus}$$

$$W'[\cdot] = \left( u' \left[ \frac{V[a | p_G]}{\pi^H} \right] \right)^{-1} > 0 \text{ and } W''[\cdot] = -1 \cdot \left( u' \left[ \frac{V[a | p_G]}{\pi^H} \right] \right)^{-2} \frac{1}{\pi^H} u'' \left[ \frac{V[a | p_G]}{\pi^H} \right] > 0$$

as  $u$  is a strictly concave utility function by assumption.  $W[\cdot]$  is thus strictly increasing and convex.

Differentiating (A8) with respect to  $a$ , using envelope theorem, gives:

$$V'[a | p_G] = k_2 (1 + V'[a | p_G] W'[V[a | p_G]])$$

$$(A9) \quad \Leftrightarrow V'[a | p_G] = \frac{k_2}{1 - k_2 W'[V[a | p_G]]}$$

Differentiating (A9) with respect to  $a$ , using envelope theorem, gives:

$$V''[a | p_G] = \frac{k_2^2 V'[a | p_G] W''[V[a | p_G]]}{(1 - k_2 W'[V[a | p_G]])^2} < 0$$

$V''[a | p_G]$  is negative as the denominator is larger than zero,  $W''[\cdot] > 0$ , and, by Sublemma 1,  $V'[a | p_G] < 0$ . Thus, as  $V'[a | p_G] < 0$  and  $V''[a | p_G] < 0$ ,  $V[a | p_G]$  is strictly concave.

**Lemma 3**

For any  $p_G \in [0, p_{G^0}]$ , the optimal level of customer profit in the problem SROP' is given by a SRO reaction function  $a_s[p_G]$  that is decreasing in  $p_G$ .

**Proof:**

**Stage 1.**

First I show that for all the sets  $(a, p_G)$  with  $p_G \in [0, p_{G^0}]$  for which SROP' Stage 1 has a solution,  $V[a | p_G] = V[a + \pi^L p_G \Delta c | 0]$ , with  $\Delta c = c_G - c_S > 0$ .

Let  $p_G \in [0, p_{G^0}]$  and let  $A$  denote all the sets  $(a, p_G)$  for which SROP' has a solution. Then  $A$  is not empty, as for each  $p_G \in [0, p_{G^0}]$ , there is an  $a$  for which SROP' has a solution. It suffices to choose for each  $p_G \in [0, p_{G^0}]$ ,  $p_S = p_{G^0} - p_G$  and then  $a = a_{G^0} + \pi^L p_G \Delta c$ . Then AIC, CIR and NZS hold, and thus at least one case exists that fulfills the restrictions.

Denote  $p_{TOT} = p_S + p_G$  and then rewrite CIR' as

$$\begin{aligned} \pi^L w^L + \pi^H z^H - \pi^L (p_S c_S + p_G c_G) &= a \\ \Leftrightarrow \pi^L w^L + \pi^H z^H - \pi^L ((p_S + p_G) c_S - p_G (c_G - c_S)) &= a \\ \Leftrightarrow \pi^L w^L + \pi^H z^H - \pi^L p_{TOT} c_S &= a + \pi^L p_G \Delta c \end{aligned}$$

And rewrite AIC' as

$$u[w^H - z^H] = (1 - p_{TOT}) \cdot u[w^H - w^L]$$

SROP'-Stage 1 has now become

**SRO Problem (SROP'')****Stage 1:**

$$V[a | p_G] = \text{Max}_{z^H, p_{TOT}} \left[ \pi^H \cdot u[w^H - z_S^H] \right], \text{ s.t.}$$

$$\text{CIR}' : \quad \pi^L w^L + \pi^H z_S^H - \pi^L p_{TOT} c_S = a + \pi^L p_G \Delta c$$

$$\text{AIC}' : \quad u[w^H - z_S^H] = (1 - p_{TOT}) \cdot u[w^H - w^L]$$

$$\text{NZS} : \quad p_{TOT} \geq p_G$$

$$\text{CIR}' : \quad \pi^L w^L + \pi^H z_S^H - \pi^L p_G c_G = a$$

$$\text{AIC}' : \quad u[w^H - z_S^H] = (1 - p_G) \cdot u[w^H - w^L]$$

SROP'' with  $p_G > 0$  is identical to SROP' with  $p_G = 0$ , with  $p_S$  now indicated by  $p_{TOT}$ , but the solution is valid for  $a + \pi^L p_G \Delta c$  instead of for  $a$ . Thus, for all pairs  $(a, p_G) \in A$ ,  $V[a | p_G] = V[a + \pi^L p_G \Delta c | 0]$ .

**Stage 2.**

In Stage 2, the SRO maximizes

$$\Pi_S[a | p_G] = \text{Max}_{a \in A} F[a] \cdot V[a | p_G] = \text{Max}_{a \in A} F[a] \cdot V[a + \pi^L p_G \Delta c | 0]$$

This also results in  $a_S[p_G] = \text{ArgMax}_{a \in A} F[a] \cdot V[a + \pi^L p_G \Delta c | 0]$

Using comparative statics, we can determine the sign of  $a'_S[p_G]$  as:

$$\frac{da_S[p_G]}{dp_G} = - \frac{\frac{d^2 \Pi_S[a | p_G]}{(da)^2}}{\frac{d^2 \Pi_S[a | p_G]}{dadp_G}}$$

By Sublemma 2, we know that  $\frac{d^2 \Pi_S[a | p_G]}{(da)^2} < 0$ .

We now show that  $\frac{d^2 \Pi_S[a | p_G]}{dp_G da} < 0$ .

Differentiating  $\Pi_S[a | p_G]$  with respect to  $p_G$  gives

$$\frac{d\Pi_S[a | p_G]}{dp_G} = \frac{dF[a] \cdot V[a + \pi^L p_G \Delta c | 0]}{dp_G}$$

$$= F[a] \cdot V'[a + \pi^L p_G \Delta c | 0] \cdot k'[p_G] < 0$$

And differentiating this with respect to  $a$  gives

$$\frac{d^2 \Pi_S[a | p_G]}{dp_G da} = \frac{dF[a] \cdot V'[\cdot | 0] \cdot \pi^L \Delta c}{da}$$

$$= (F'[a] \cdot V'[\cdot | 0] + F[a] \cdot V''[\cdot | 0]) \cdot \pi^L \Delta c < 0$$

$$\text{(as } \frac{dk}{dp_G} > 0, V'[\cdot | 0] < 0, \text{ and } V''[\cdot | 0] < 0)$$

Thus, as  $\frac{d^2 \Pi_S[a | p_G]}{dp_G da} < 0$  and  $\frac{d^2 \Pi_S[a | p_G]}{(da)^2} < 0$ , it follows that  $\frac{da}{dp_G} = - \frac{\frac{d^2 \Pi_S[a | p_G]}{(da)^2}}{\frac{d^2 \Pi_S[a | p_G]}{dadp_G}} < 0$ .

And thus  $a$  is decreasing in  $p_G$ .

**Proposition 1:**

Given that  $a_{S^0} < a_{G^0}$  and  $p_{S^0} < p_{G^0}$ , when GOV and SRO simultaneously set their investigation probabilities, then the SRO conducts no investigations,  $p_S = 0$ . The investigation by the GOV is then  $p_{G^0}$ .

**Proof**

Assume that  $p_G > 0$  and  $p_S > 0$  and  $p_G[p_S]$  solves GOVP' and  $p_S[p_G]$  solves SROP'.

Then  $a = a_G[p_S] = a_S[p_G]$  and, from lemma 2,  $p_G = p_{G^0} - p_S$  and  $a = a_{G^0} + \pi^L p_S \Delta c$ .

But, as  $a_S[p_G]$  is decreasing in  $p_G$  (lemma 3),  $a_S[p_G] < a_{S^0}$  and as, by assumption,

$a_{S^0} < a_{G^0}$  and as  $a_{G^0} < a_{G^0} + \pi^L p_S \Delta c = a_G[p_S]$ , we see that  $a_S[p_G] < a_G[p_S]$ . This is a

contradiction. Thus either  $p_G = 0$  or  $p_S = 0$ . Assume that  $p_G = 0$  and  $p_S > 0$ . Then

$p_S = p_{S^0}$ . But then the best reply for GOV is  $p_G = p_{G^0} - p_{S^0} > 0$ , which results in a

contradiction. Assume that  $p_G = 0$  and  $p_S = 0$ . But then the best reply for GOV is  $p_G = p_{G^0} > 0$ , which results in a contradiction. Thus  $p_G > 0$  and  $p_S = 0$ . Then  $p_G = p_{G^0} > 0$ .

**Proposition 2**

When the GOV and the SRO set their investigation probabilities sequentially, with the GOV moving first, then, conditional on the oversight by the GOV being effective in the sense that  $p_{S^0} < p_{G^0}$  and  $a_{S^0} < a_{G^0}$ , the SRO conducts no investigations,  $p_S = 0$ , and the GOV conducts investigations given by  $p_{G^0}$ .

**Proof**

Let be given that  $a_{S^0} < a_{G^0}$ . Assume that  $p_G = p_{G^0}$ . Then SRO will choose  $p_S = 0$  (and NZS is binding) and  $a = a_{G^0}$ . If the GOV chooses  $p_G = 0$ , the SRO chooses  $p_S = p_{S^0}$  with a lower customer profit of  $a = a_{S^0} < a_{G^0}$ , thus this is an inferior action. If the GOV chooses  $0 < p_G < p_{G^0}$ , the SRO chooses an investigation probability that results in a lower customer profit given by  $a_S[p_G] < a_{S^0} < a_{G^0}$ . Thus, the GOV chooses  $p_G = p_{G^0}$  and the SRO  $p_S = 0$ .

## Appendix A2: Consolidated instructions

Codes used to indicate the treatment:

- Base – Baseline parameterization treatment of 3x3
- Alt – Alternative parameterization treatment of 3x3
- 6x6 – a 6x6 payoff matrix

A code indicating the start of a text referring to a specific treatment or a set of treatments always starts with “[“ and follows up with the codes indicating the specific treatment(s). A code indicating the end of a text referring to a specific treatment or a set of treatments always ends with the codes indicating the specific treatment and finishes up with “]“.

### INSTRUCTIONS

Welcome to the experiment!

**General rules**

Please turn off your mobile phones now.

If you have a question, raise your hand and the experimenter will come to your desk to answer it.

You are not allowed to communicate with other participants during the experiment. If you violate this rule, you will be asked to leave the experiment and will not be paid (not even your show-up fee).

### **Introductory remarks**

You are about to participate in an economics experiment. The instructions are simple. If you follow them carefully, you can earn a substantial amount of money. Your earnings will be paid to you in cash at the end of the experiment.

The currency in this experiment is called "Experimental Currency Units", or "ECU"s. At the end of the experiment, we will exchange ECUs for Czech Crowns as indicated below. Your specific earnings will depend on your choices and the choices of the participants you will be paired with.

Your exchange rate will be:

[Base  
2 Czech Crown for an ECU.  
Base]

[Alt, 3x3, SRO  
1.5 Czech Crown for an ECU.  
Alt, 3x3, SRO]

[Alt, 3x3, GOV  
0.5 Czech Crown for an ECU.  
Alt, 3x3, GOV]

This experiment should take at most 60 minutes. There are 10 paid rounds in this experiment.

You are encouraged to write on these instructions and to highlight what you deem particularly relevant information.

**[Please go to the next page now.]**

### **Group assignment**

You will always be a member of a group consisting of you and ONE other person in this room. Group membership is anonymous; you will not know who is in a group with you and the other person in your group will not know that you are in his or her group. **Group membership is assigned anew in each round, in a random way.**

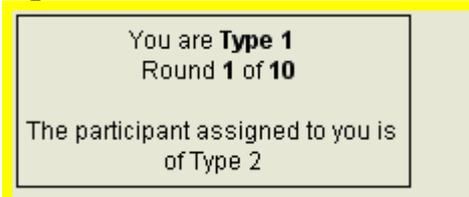
You will be asked to make a series of **interactive** decisions in this experiment, i.e. **your earnings in each round will depend both on your decision and that of the person that you are paired with for that round.**

In each group one participant will be of Type 1 and the other one will be of Type 2.

You will not know beforehand what the other participant chooses and the other participant will not know beforehand what you choose.

The roles of Type 1 and Type 2 are randomly assigned at the beginning of the experiment and remain the same throughout the experiment. Once the experiment starts, you will see whether you are Type 1 or Type 2 on your screen in the upper left corner. Below it you can also see the round. For an example, see Figure 1.

Figure 1



**[Please turn over]**

### **Decision Screen**

In each round you will be presented with a Decision Screen where you will make a choice by clicking on one of the

[3x3  
three buttons labeled NONE, LOW, or HIGH.

3x3]

[6x6

six buttons labeled using NONE, VERY LOW, LOW, MEDIUM, HIGH, VERH HIGH.

6x6]

See the example in Figure 2.

### **Figure 2**

[3x3

**Make your choice**

I choose:

NONE

LOW

HIGH

3x3]

[6x6

**Make your choice**

I choose:

NONE

VERY LOW

LOW

MEDIUM

HIGH

VERY HIGH

6x6]

You can see your possible earnings and the possible earnings of the participant assigned to you for that round in the Earnings Table on the paper with the title “**YOUR EARNINGS TABLE**” which you find on your desk.

Your payoffs are in bolded black numbers on yellow background in the upper left corners of each cell of the Earnings Table. The payoffs of the participant assigned to you for that round are in blue numbers on a white background in the lower right corner of each square of the Earnings Table. To repeat, your earnings in each round will depend both on your choice and that of the person that is assigned to you for that round.

**EXAMPLE BOX**

In this EXAMPLE BOX we will explain how your choices and the choices of the participant that is assigned to you determine your earnings.

**The Example Earnings Table in this EXAMPLE BOX is NOT the earnings table used in the experiment. In the experiment a different Earnings Table will be used: the one on your table with the title “YOUR EARNINGS TABLE”.**

**Example Earnings Table**

*Note: these earnings are not the ones used in the experiment*

		Other's Earnings		
		NONE	LOW	HIGH
My Earnings	NONE	5 4	8 3	4 9
	LOW	3 12	11 5	13 4
	HIGH	6 7	7 5	2 13

If the **Example Earnings Table** would be the relevant Earnings Table, then if the participant assigned to you chose NONE, your earnings will be 5 if you choose NONE, 3 if you choose LOW, and 6 if you choose HIGH. If the participant

assigned to you chose LOW, then your earnings will be 8 if you choose NONE, 11 if you choose LOW, and 7 if you choose HIGH.

The earnings of the participant that is assigned to you are determined in a similar manner, with their earnings shown in the lower right corner of each square of the Example Earnings Table.

To make your choice you have one minute; if you have not made a choice during that time, the computer will assign you the choice of NONE. This is the standard procedure for all decisions in this experiment. You can see the time you have left to make a choice in the upper right corner of the screen (“Remaining time”), see Figure 3 for an example.

Figure 3



To repeat, you will not know beforehand what the other participant chooses and the other participant will not know beforehand what you choose.

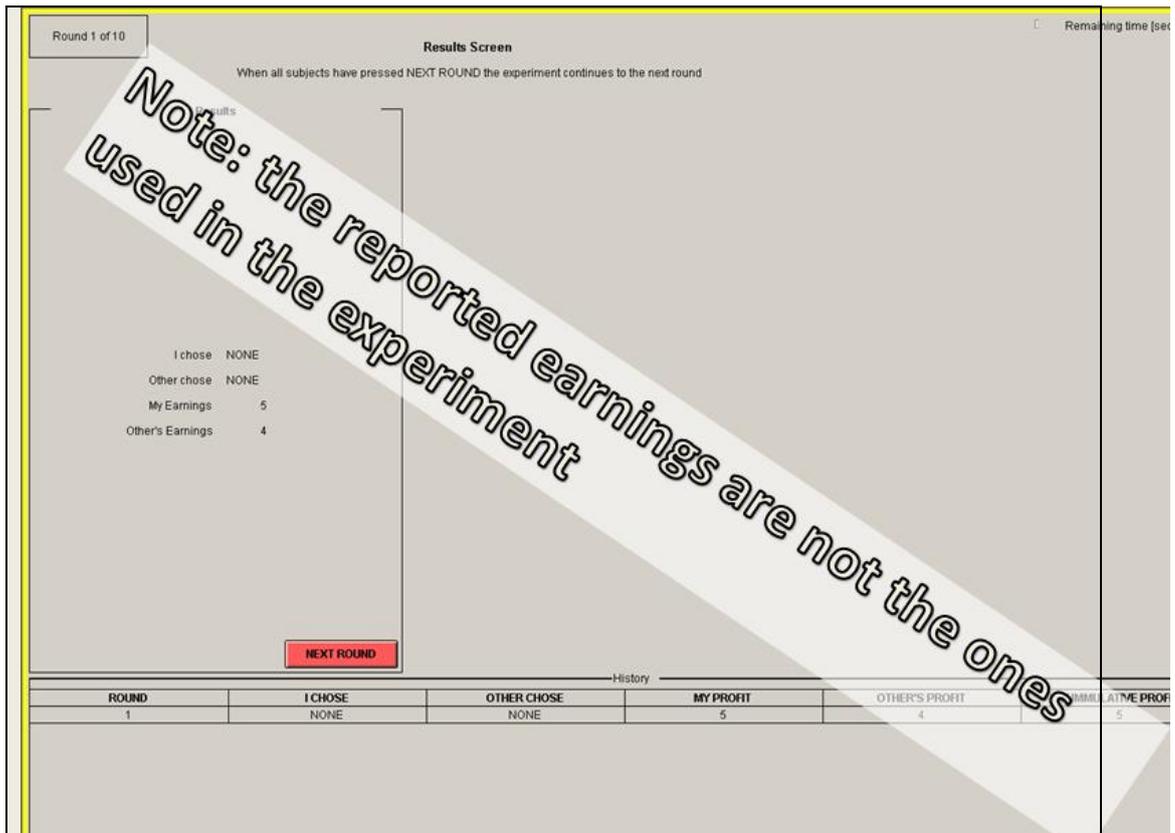
After all participants have made their decisions, or if one minute has expired, the computer will calculate your earnings.

### Results Screen

You will next see a Results Screen. The Results Screen will show your choice and the choice of the participant that is assigned to you for that round. The Results Screen will also show your and the other participants' earnings.

#### EXAMPLE BOX

In the example in Figure 3 you and the other participant chose NONE. In the example in Figure 3 your earnings are thus 5 and that of the other participant are 4 (to repeat: in the experiment a different Earnings Table will be used: the one on your desk with the title “YOUR EARNINGS TABLE”).



You have one minute to inspect the outcomes. (This is the standard time you have for inspecting results). When you need less time to inspect the outcomes, then click the NEXT ROUND button. Once all participants have clicked the NEXT ROUND button, the experiment continues with the next round. Note that the Results Screen will be visible until all participants have clicked on the NEXT ROUND button.

Do you have any questions at this point?

[Base, 3x3, SRO  
**YOUR EARNINGS TABLE**

		Other		
		NONE	LOW	HIGH
Me	NONE	10 1	14 4	8 6
	LOW	17 7	10 9	0 7
	HIGH	11 13	0 10	0 9

Base, 3x3, SRO]

[Base, 3x3, GOV  
**YOUR EARNINGS TABLE**

		Other		
		NONE	LOW	HIGH
Me	NONE	1 10	7 17	13 11
	LOW	4 14	9 10	10 0
	HIGH	6 8	7 0	9 0

Base, 3x3, GOV ]

[Alt, 3x3, SRO]

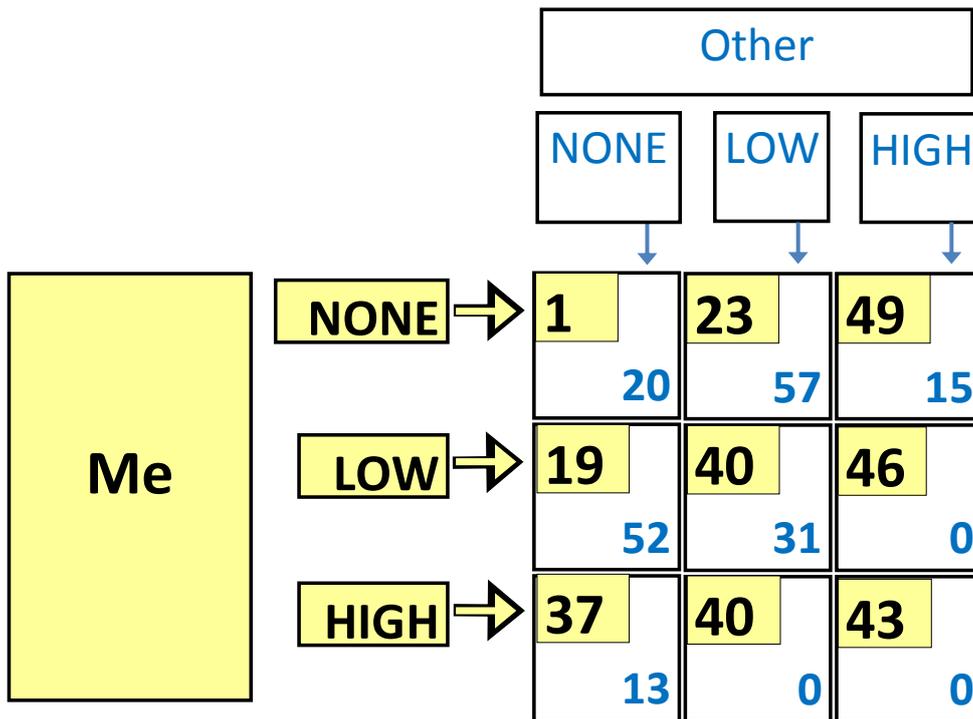
		Other		
		NONE	LOW	HIGH
Me	NONE	20 1	52 19	13 37
	LOW	57 23	31 40	0 40
	HIGH	15 49	0 46	0 43

Alt, 3x3, SRO]

[Alt, 3x3, GOV]

		Other		
		NONE	LOW	HIGH
Me	NONE	1 20	23 57	49 15
	LOW	19 52	40 31	46 0
	HIGH	37 13	40 0	43 0

Alt, 3x3, GOV]



[Base, 6x6, SRO]

		Other					
		NONE	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Me	NONE	10 1	13 3	13 5	11 6	8 6	4 6
	VERY LOW	15 4	15 6	13 7	9 8	4 7	0 6
	LOW	17 7	14 9	10 9	5 9	0 7	0 7
	MEDIUM	15 10	10 11	5 10	0 9	0 8	0 7
	HIGH	11 13	5 12	0 10	0 9	0 9	0 8
	VERY HIGH	6 14	0 12	0 11	0 10	0 9	0 9

Base, 6x6, SRO]

[Base, 6x6, GOV

		Other					
		NONE	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Me	NONE	1 10	4 15	7 17	10 15	13 11	14 6
	VERY LOW	3 13	6 15	9 14	11 10	12 5	12 0
	LOW	5 13	7 13	9 10	10 5	10 0	11 0
	MEDIUM	6 11	8 9	9 5	9 0	9 0	10 0
	HIGH	6 8	7 4	7 0	8 0	9 0	9 0
	VERY HIGH	6 4	6 0	7 0	7 0	8 0	9 0

Base, 6x6, GOV]

## Abstrakt

Regulatoční vyšetřování vedené samoregulujícími se organizacemi (SRO) je obvykle považováno za levnější než vyšetřování vedené vládou. Nicméně, dohled vykonávaný SRO je v praxi obvykle doplněn dohledem vlády. Vláda může vykonávat dohled nad samotnou SRO, jenž je označován jako „metaregulace“ nebo „koregulace“, nebo dohlížet na členy SRO. Celkový výkon SRO je rozporuplný a teoretické modely ukazují, že SRO mají motivaci nastavovat laxní standardy nebo krýt zaznamenané porušení pravidel. Přesto některé výzkumy naznačují, že meta-regulace, tedy dohled nad samotnou SRO, nemusí být v některých situacích nezbytně nutná. S použitím costly-state-verification modelu DeMarze et al. (2001; 2005) ukazují, že pokud při výkonu dohledu implicitně hrozí dodatečné vyšetřování členů SRO ze strany vlády, pak relativně „dobrý“ výsledek může tvořit ekvilibrium. V případě tohoto „dobrého“ výsledku se SRO při výkonu činnosti rozhoduje držet vysokých standardů s cílem předejít jakémukoliv (relativně nákladnému) vyšetřování ze strany vlády. Výsledkem je situace, kdy nejsou prováděna žádná vyšetřování členů SRO a žádná meta-regulace SRO není potřebná.

Rozšiřuji tento model o věrohodné uspořádání, v kterém je možné skutečnou přísnost dohledu SRO ověřit pouze ex-post. Ukazují, že v případě takového uspořádání může SRO mít motivaci k oznámení přísnějších režimů než jaké skutečně implementuje. V konečném důsledku může „špatný“ Pareto neefektivní výsledek tvořit ekvilibrium. V případě „špatného“ výsledku se SRO vzdává veškerého dohledu a přenáší jej na vládu. Předpovědi tohoto modelu jsou podpořeny experimentálními testy. „Dobré“ ekvilibrium může být obnoveno s využitím dostatečné meta-regulace SRO. Výsledky naznačují pokračující potřebu meta-regulace při daném uspořádání. Tato forma meta-regulace může být relativně lehkého charakteru, kdy se omezí pouze na ověřování a případné sankcionování, které zajistí implementaci oznámených politik SRO.

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