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) have been recognized to usually be cheaper than investigations by the government. However, in practice, oversight by an SRO is mostly still supplied with forms of governmental oversight. The government may exert oversight over the SRO itself, a construction referred to as “meta-regulation" or "co-regulation", or over the members of the SRO. Indeed, the overall performance of SROs has been mixed and theoretical models show that SROs have incentives to set lax standards or cover up detected violations. However, some research indicate that meta-regulation, oversight of the SRO itself, may nonetheless 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 perform additional investigations of the SROs 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 of the (relatively costly) governmental investigations. As a result, no costly governmental investigations of the SRO's members take place, and no meta-regulation of the SRO is necessary.

I extend this model to include plausible settings where the actual rigor of oversight by the SRO can be verified only ex-post. I show that in such settings, the SRO may have incentives to announce stricter regimes than it effectively implements and that, as a result, a "bad", Pareto-inefficient outcome is 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 can be re-established as an equilibrium with sufficient meta-regulation of the SRO. The results thus indicate a continuing need for meta-regulation in these settings. This form of meta-regulation may be of a relatively light-handed nature, limited to verifying and sanctifying 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

1. INTRODUCTION

A self-regulatory organization (SRO) is a non-governmental organization that is owned and operated by their members and has the power to create and enforce industry

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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 Myslivеček, 2010; Ortmann and Svitkova, 2010; Rees, 1997; Sidel, 2005; Studdert et al., 2004; Welch, Mazur and Bretschneider, 2000). Examples of SROs are 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 to be capable of performing regulatory investigations at lower costs than the government as SROs have more information and are better enabled to interpret the information (Braithwaite, 1982; DeMarzo et al., 2005). SROs have, however, a mixed record in their ability to curb market abuse by their members (vanderHeijden, 2015; deLeon and Rivera, 2008; Ronit, 2012). Also, theoretical models indicate SROs to be afflicted with incentive-incompatibility problems: SROs are predicted to set lax oversight standards that benefit their members rather than consumers (DeMarzo et al., 2005) or cover up detected violations (Núñez, 2007).

Indeed, in practice, oversight by an SRO is mostly still supplied with forms of governmental oversight (Carson, 2011; vanderHeijden, 2015). The 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 meta-regulation of the SRO by the government 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 the SRO should be, as there is a trade-off between granting the SRO sufficient freedom and flexibility, to develop its own regulatory priorities, and assuring that the oversight of the SRO be effective (Carson, 2011).

However, some research suggests that meta-regulation of the SRO might not always be necessary. DeMarzo et al. (2005),[1] using the costly-state-verification model of Townsend (1979), Border and Sobel (1987), and Mookherjee and Png (1989), show for financial transactions that, while the SRO has incentives to set lax investigation standards, its incentives change when the government implicitly threatens to perform additional investigations of the SROs members. With the threat of additional governmental investigations, a relatively "good" outcome can be established as an equilibrium. In this "good" outcome, the SRO chooses to follow high investigation standards in order to pre-empt the (relatively costly) governmental investigations. As a result, no costly governmental investigations of the SRO's members take place. Moreover, the "good" outcome requires no meta-regulation of the SRO, thus not risking limiting the flexibility for the SRO. **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 need for meta-regulation of the SRO.

However, it may not always be possible for the government to observe the investigation standard chosen by the SRO reliably. After all, the actually implemented investigation standards are often only observable ex-post. Of course, the SRO may announce its investigation standards, but it is not clear if the announcement is time-consistent without additional oversight over the SRO itself. A central question is therefore whether the SRO has incentives to implement different (less stringent) investigation standards than it announces. If the SRO has such incentives then governmental oversight over the SROs members is not sufficient and, to enforce true revelation, also oversights of the SRO itself is needed.

[1] 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).

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, but the SRO may deviate from its announcement. When the two regulators cannot trust the announcement of one another, the decision-making of the SRO and the government happens simultaneously. This contrasts 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, 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 assumption is that the SRO can announce different investigation standards than it eventually implements. If the SRO was bound to factually implement its announced investigation standards, the "good" outcome from DeMarzo et al. (2005) would be realized. I also show that the reliability of the announcement of the government is basically immaterial to these results. **Economics experiments, using the design in the companion paper Van Koten & Ortmann (2016, p.89-96), have been** performed to test the derived equilibria. The experimental results support the theoretical predictions.

The results indicate a continuing need for meta-regulation of the SRO. The form of meta-regulation is suggested to be of a relatively light-handed nature, restricted to verifying and sanctifying 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 follows DeMarzo et al. (2005) closely. 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 for a customer, such as making an investment. The outcome of the investment is modeled as a random variable W that can have realizations high (w^H) or low (w^L) with probability π^H and π^L , respectively. The realized outcomes are observed by the agent, but not by the customer, giving, for high realizations, the agent an incentive to falsely report a low outcome and to keep the difference $w^H - w^L$. The contracting 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 the customer $z[W]$ and leaves agents 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, have zero initial wealth, face a limited liability constraint and 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 cfd $F[\cdot]$ over $[\underline{\omega}, \overline{\omega}]$. 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.[2] 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 abstain from fraud in equilibrium), it must grant the agent a sufficiently high rent in the form of a success fee. The drawback of granting a rent is that it is costly for customers and also 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

[2] 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.

than 1.[3] As in DeMarzo et al. (2005), I assume that regulators do not duplicate investigations and that the SRO investigates first.[4] Thus, when the GOV decides that an agent needs investigating, it first checks if the agent hasn't already been investigated by the SRO. It can then be easily shown that the total proportion of investigation is cumulative, $p_{TOT} = p_S + p_G$.[5] The higher the proportion p_{TOT}, the lower the incentive for an agent to commit fraud, and thus the lower the rent $W - z[W \mid p_{TOT}]$ 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 regulates, DeMarzo et al. (2005) shows that he relatively high investigation costs work 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).

	Prime decision makers	**The present model (Simultaneous moves)**	**The present model (Sequential moves, GOV first)**	**DeMarzo et al. (2005) (Sequential moves, SRO first)**
Stage 1	**SRO** and **GOV** (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	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

[3] As in DeMarzo et al. (2005), the proportion can also be interpreted as the depth or rigor of the investigation.

[4] 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.

[5] 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).

	investigation probability p_S.	investigation probability p_G.

Stage 2	**Customers** (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 $z[W \mid p_{TOT}]$ that results in a rent for the agent in the amount of $w^L - z[w^L \mid p_{TOT}]$ ($w^H - z[w^H \mid p_{TOT}]$) 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	**Nature**: (decide, at random, the investment outcome)	With probability π^L (π^H) the low (high) outcome, w^L (w^H), is realized. The outcome is private knowledge of the agent.
Stage 4	**Nature**: (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.[6]

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')

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

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

NZG: $\quad p_G \geq 0$

[6] Lemma 1 reformulates the problem, applying a number of basic results, such as applying fines only for untruthful revelation, 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.

SRO Problem (SROP')

Stage 1:

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

CIR': $\pi^L w^L + \pi^H z^H - \pi^L \left(p_S c_S + p_G c_G \right) = a$

AIC': $u[w^H - z^H] = \left(1 - p_G - p_S \right) \cdot u[w^H - w^L]$

NZS: $p_S \geq 0$

Stage 2:

$\Pi_S[a \mid p_G] = \text{Max}_a\, F[a] V[a \mid p_G]$ and $a_S[p_G] = ArgMax_a F[a] V[a \mid p_G]$

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 more costly than those by the SRO, participation by the GOV raises costs. Lemma 3 shows that these costs are not completely absorbed by the SRO, but also partly passed on to the 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 does no investigations, $p_S = 0$, and the GOV does investigations given by p_{G^0}.
Proof, see Appendix A1.

Proposition 1 shows that the GOV and the SRO cannot both be performing investigations. Suppose that both were performing investigations. Then, for the GOV, the SRO will always show too little participation, thus the GOV will 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 will 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 performs no investigations, and the GOV performs 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 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 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 does no investigations, $p_S = 0$, and the GOV does 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. **The experimental test 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 where for key variables high and low values are chosen as a way of a very coarse grid search. We showed that the main variable of consequence, affecting the payoff contrast between the preferred outcomes, is the success probability. 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, Table 3 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 (S*P*)	= LOW (25%) or HIGH (50%)
Outside Option (*OO*)	UD over [5,105]
Investigation Cost of SRO (I*Csro*)	= LOW (10)
Investigation Cost of GOV (I*Cg*)	= HIGH (40)

TABLE 2 Parameterizations

Costs			Success Probability: LOW 25% – Baseline Parameterization			Success Probability: HIGH 50% – Alternative Parameterization		
$c_S = 10$			GOV			GOV		
$c_G = 40$			None	Low	High	None	Low	High
	SRO	None	(10, 1)	(14, 4)	**(8, 6)***	(20, 1)	(52, 19)	**(13, 37)***
		Low	(17, 7)	(10, 9)	(0, 7)	(57, 23)	(31, 40)	(0, 40)
		High	(11, 13)	(0, 10)	(0, 9)	(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

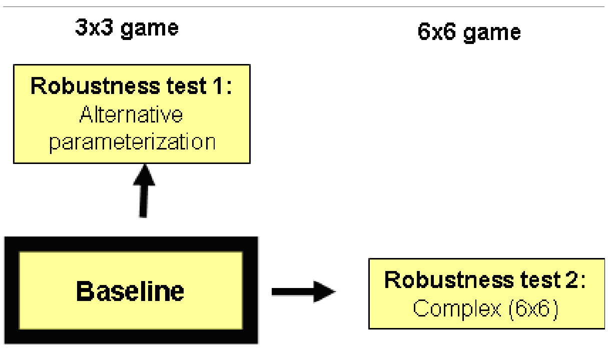


FIGURE 1 Summary of the treatments

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}.[7] 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). I 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 where players options are discrete.[8]

Baseline treatment	3 sessions 72 participants 12 independent observations
Robustness tests	
1. Alternative parameterization (normal form)	1 session 24 participants 4 independent observations
2. Complex (normal form)	2 sessions 48 participants 8 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 in the "LEE" experimental lab of the University of Economics in Prague.[9] In each session 24 participants made decisions, as SRO or GOV, over 10 rounds. Following well-documented experimental 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 6 sessions were run,

[7] 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.

[8] See van Koten and Ortmann (2016, p. 92-94) for further details.

[9] See www.vse-lee.cz. In addition, I ran 7 sessions where players made their choices sequentially rather than simultaneously. A detailed account can be found in Van Koten and Ortmann (2016).

involving 144 participants and generating 24 independent data points. 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 (≈ €14, ≈ $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*

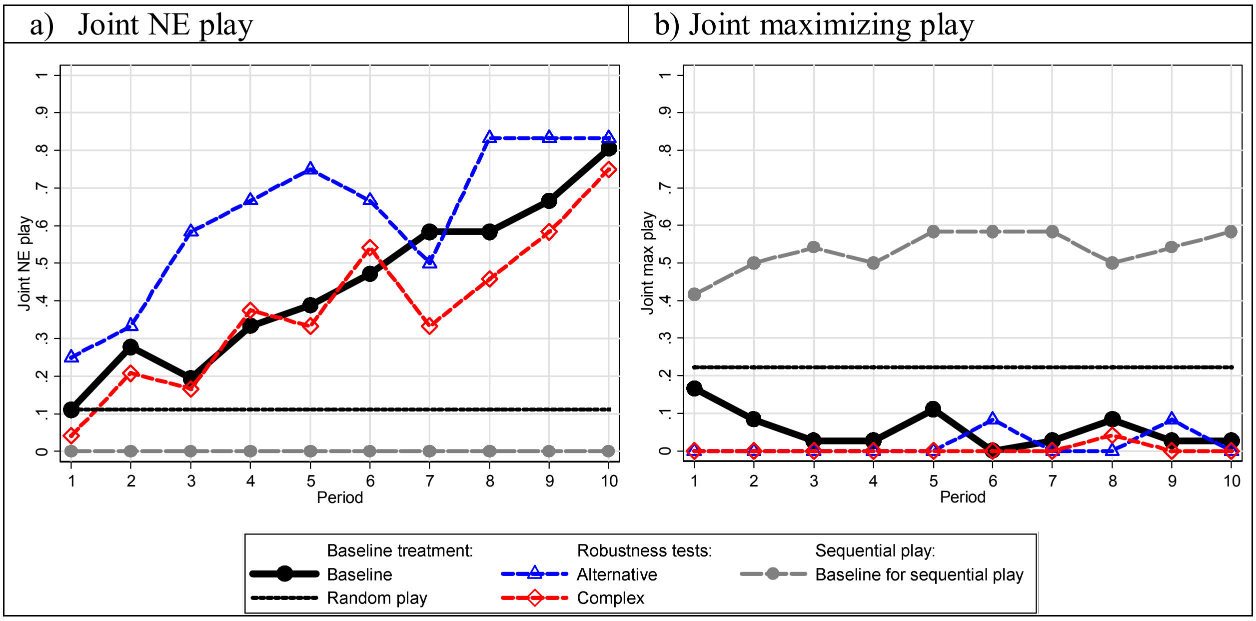


FIGURE 3 Proportion of Nash equilibrium choices

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.

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 less than half the cases 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 are in the range 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 higher initially 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 play of the Nash equilibrium predictions where the GOV does 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 from subjects making sequential decisions with the GOV moving first in Figure 3 (the gray long-dash line).[10] As Figure 3a shows, none of these paired choices are congruent with the GOV doing all of the investigations and the SRO none.**

Figure 3b shows the proportion of paired choices that are congruent with maximizing the joint profits (where the SRO does 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 everywhere below the random play level.

Using again the results from **Van Koten and Ortmann (2016) to show the responses from subjects making sequential decisions with the GOV moving first (the gray long-dash 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.

[10] The response proportions are averages of 8 independent data points (Van Koten and Ortmann, 2016, p.97).

5. CONCLUSION

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

This study adds an important qualification: When investigation policies by the SRO can only be verified ex-post, then 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 are being borne out in experimental tests using specific parameterizations and implementation details.

The "good" equilibrium can be re-established as an equilibrium with sufficient governmental meta-regulation: oversight over the SRO itself. The results thus indicate a continuing need for meta-regulation in these settings. This form of meta-regulation may be of a relatively light-handed nature, limited to verifying and sanctifying that the SRO implements its announced policies. When the regulatory policy announcement of the SRO is credible again, 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).

REFERENCES

Aguilar, L.A. (2013). Public Statement: The Need for Robust SEC Oversight of SROs. At https://www.sec.gov/news/public-statement/2013-spch050813laahtm

Border, K. C. and Sobel, J. (1987), "Samurai Accountant: A Theory of Auditing and Plunder", Review of Economic Studies, 54, 525–540.

Braithwaite, J. (1982). Enforced self-regulation: A new strategy for corporate crime control. Michigan law review, 80(7), 1466-1507.
Carson, J. (2011). Self-regulation in securities markets. The World Bank.
DeMarzo, P. M., Fishman, M. J., and Hagerty, K. M. (2005), "Self-Regulation and Government Oversight", Review of Economic Studies, 72, 687 – 706.
FINRA, 2018, http://www.finra.org/about, retrieved on 2018.07.13.
Gunningham, N., & Rees, J. (1997). Industry self□regulation: an institutional perspective. Law & Policy, 19(4), 363-414.
Gupta, A. K., & Lad, L. J. (1983). Industry self-regulation: An economic, organizational, and political analysis. Academy of Management Review, 8(3), 416-425.
Hilary, G. and Lennox, C. (2005). The Credibility of Self-Regulation: Evidence from the Accounting Profession's Peer Review Program, *Journal of Accounting and Economics*, 40, 211 – 229.
Holt, C. and Laury, S. K. (2002), "Risk Aversion and Incentive Effects", *The American Economic Review*, 92, 1644 – 1655.
Kleiner, M. M. (2006), Licensing Occupations: Ensuring Quality or Restricting Competition? (W. E. Upjohn Institute for Employment Research).
Maute, J. L. (2008), "Bar Associations, Self-Regulation and Consumer Protection: Whither Thou Goest? ", Journal of the Professional Lawyer, 53 – 85.
Mookherjee, D. and Png, I. P. L. (1989), "Optimal Auditing, Insurance, and Redistribution", Quarterly Journal of Economics, 104, 399–415.
Morgenstern, R. D., & Pizer, W. A. (Eds.). (2007). Reality check: The nature and performance of voluntary environmental programs in the United States, Europe, and Japan. Resources for the Future.
NAUFOR, 2018. http://www.naufor.ru, retrieved on 2018.07.13
Nunez, J. (2001), "A Model of Self-Regulation", *Economics Letters*, 74, 91 – 97.
Nunez, J. (2007), "Can Self-Regulation work? A Story of Corruption, Impunity and Cover-up", *Journal of Regulatory Economics*, 31, 209 – 233.
Ortmann, A. and Mysliveček, J. (2010), "Certification and Self-Regulation of Non-Profits, and the Institutional Choice Between Them", in Seaman, B. and Young, D. (eds) *Handbook of Nonprofit Economics and Management* (Cheltanham: Edward Elgar Publishing Company).
Ortmann, A. and Svitkova, K. (2010), "Do Self-Regulation Clubs Work? Some Evidence from Europe and Some Caveats From Economic Theory", in Gugerty, M. K. and Prakash, A. (eds) *Voluntary Regulation of NGOs and Non-Profits: An Accountability Club Framework* (Cambridge: Cambridge University Press).
Rees, J. V. (1997), "The Development of Communitarian Regulation in the Chemical Industry," Law Policy, 17, 477 – 528.
Rivera, J. E., & DeLeon, P. (2008). Voluntary environmental programs: are carrots without sticks enough?. Policy studies journal, 36(1), 61-63.
Rivera, J. E., & DeLeon, P. (2008). Voluntary environmental programs: are carrots without sticks enough?. Policy studies journal, 36(1), 61-63.
Ronit, K. (2012). Business and Climate Policy: The Potentials and Pitfalls of Private Voluntary Programs. UNU Press: Tokyo.
Shaked, A. and Sutton, J. (1981), "The Self-Regulating Profession", *The Review of Economic Studies*, 48, 217 – 234.

Sidel, M. (2005), "The Guardians Guarding Themselves: A Comparative Perspective on Nonprofit Self-Regulation," *Kent Law Review*, 80, 803 – 835.

Studdert, D. M., Mello, M. M., and Brennan, T. A. (2004), "Financial Conflicts of Interest in Physician's Relationship with the Pharmaceutical Industry: Self-Regulation in the Shadow of Federal Prosecution", New England Journal of Medicine, 351, 1891 – 1900.

Sungatullina, L. A., Mikhaylov, A. V., Valeeva, A. V., & Kovshova, A. I. (2018). Self-Regulatory Organizations in Russia and European Countries: Current State and Prospects of Development. HELIX, 8(1), 2214-2217.

Townsend, R. (1979), "Optimal Contracts and Competitive Markets with Costly State Verification", Journal of Economic Theory, 22, 265–293.

Van der Heijden, J. (2015). What roles are there for government in voluntary environmental programmes?. Environmental Policy and Governance, 25(5), 303-315.

Van Koten, S., Ortmann, A. (2014). "Self-Regulatory Organizations Under the Shadow Of Governmental Oversight: An Experimental Investigation," CERGE-EI Working Papers wp519, The Center for Economic Research and Graduate Education - Economics Institute, Prague.

Van Koten, S., Ortmann, A. (2016). "Self-regulating organizations under the shadow of governmental oversight: An experimental investigation", Research in Experimental Eocnomics 19: Experiments in Organizational Economics.

Welch, E. W., Mazur, A., and Bretschneider, S. (2000), "Voluntary Behavior by Electric Utilities: Levels of Adoption and Contribution of the Climate Challenge Program to the Reduction of Carbon Dioxide", *Journal of Policy Analysis and Management*, 3, 407 – 425.

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')

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

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

NZG: $p_G \geq 0$

SRO Problem (SROP')
Stage 1:

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

CIR': $\pi^L w^L + \pi^H z^H - \pi^L\left(p_S c_S + p_G c_G\right) = a$

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

NZS: $p_S \geq 0$

Stage 2:

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

Proof:
The original problem has the following setup

Customer Problem ($\text{CP}[p_S, p_G, x_S, x_G]$ **)**

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

AF: $z[w^L] \leq w^L,\ z[w^H] \leq w^H$

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

SRO Problem (SROP)

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

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

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

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

GOV Problem (GOVP)

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

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

DeMarzo et al. (2001, 2005, p.706) proof 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[11]

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:

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

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

$$\text{NZG:} \quad p_{TOT} \geq p_S$$

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. Fill out $p^*_G = p_{G^0} - p_S$ in the objective function gives.

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

Sublemma 1[12]

$V[a]$ 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 $p_S[a \mid p_G]$. Thus

(A3) $V[a \mid p_G] = \pi^H \cdot u\left[w^H - z^H\right]$

Using CIR to express the contract gives

$$\pi^L w^L + \pi^H z^H - \pi^L \left(p_S c_S + p_G c_G\right) = a \Leftrightarrow$$

(A4) $z^H = \dfrac{1}{\pi^H}\left(a - \pi^L w^L + \pi^L \left(p_S c_S + p_G c_G\right)\right)$

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

[11] Part of the result has been reported earlier in DeMarzo et al. (2001, 2005).

[12] The proof follows mostly the lines of the proofs in DeMarzo et al. (2005, p.706).

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

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

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

Sublemma 2[13]

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

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

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

(A6) $a = \pi^L w^L + \pi^H z^H[a \mid p_G] - \pi^L(p_S[a \mid p_G]c_S + p_G c_G)$,

(A7) $u[w^H - z^H[a \mid p_G]] = (1 - p_S[a \mid p_G] - p_G)u[w^H - w^L]$

Use (A5) to substitute in (A7) gives

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

Rewrite (A5) as

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

[13] The proof follows mostly the lines of the proofs in DeMarzo et al. (2005, p.706).

Rewrite (A6) as

$$\text{(A6')}\quad p_S[a \mid p_G] = \frac{1}{c_S \pi^L}(\pi^L w^L + \pi^H z^H[a \mid p_G] - a) - \frac{p_G c_G}{c_S}$$

Using (A6') to substitute for $p_S[a \mid p_G]$ in (A7') gives

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

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

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

$$\leftrightarrow V[a \mid p_G] = u[w^H - w^L]\pi^H \left(1 + \left(\frac{c_G}{c_S} - 1\right) p_G + \frac{a - \pi^L w^L - \pi^H \left(w^H - u^{-1}\left[\frac{V[a \mid p_G]}{\pi^H}\right]\right)}{c_S \pi^L}\right)$$

$$\text{(A8)}\quad \leftrightarrow V[a \mid p_G] = k_1 + k_2 \cdot \left(a + W\left[V[a \mid p_G]\right]\right)$$

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

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

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

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:

$$V'[a \mid p_G] = k_2 \left(1 + V'[a \mid p_G] W'\left[V[a \mid p_G]\right]\right)$$

$$\text{(A9)}\quad \leftrightarrow V'[a \mid p_G] = \frac{k_2}{1 - k_2 W'\left[V[a \mid p_G]\right]}$$

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

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

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

Lemma 3

For any $p_G \in [0, p_{G^0}]$, the optimal level of customer 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 will 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, $V[a \mid p_G] = V[a + \pi^L p_G \Delta c \mid 0]$, 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 fulfilling the restrictions.

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

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

And rewrite AIC' as

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

SROP'-Stage 1 has now become

SRO Problem (SROP")

Stage 1:

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

CIR':	$\pi^L w^L + \pi^H z_S^H - \pi^L p_{TOT} c_S = a + \pi^L p_G \Delta c$
AIC':	$u[w^H - z_S^H] = \left(1 - p_{TOT}\right) \cdot u[w^H - w^L]$
NZS:	$p_{TOT} \geq p_G$
CIR':	$\pi^L w^L + \pi^H z_S^H - \pi^L p_G c_G = a$
AIC':	$u[w^H - z_S^H] = \left(1 - p_G\right) \cdot u[w^H - w^L]$

We see that 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 $(a, p_G) \in A$, $V[a \mid p_G] = V[a + \pi^L p_G \Delta c \mid 0]$.

Stage 2.
In Stage 2, the SRO maximizes

$$\Pi_S[a \mid p_G] = Max_{a \in A} F[a] \cdot V[a \mid p_G] = Max_{a \in A} F[a] \cdot V[a + \pi^L p_G \Delta c \mid 0]$$

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

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

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

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

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

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

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

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

And differentiating this with respect to a gives

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

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

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

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

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 does 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, 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 does no investigations, $p_S = 0$, and the GOV does 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.

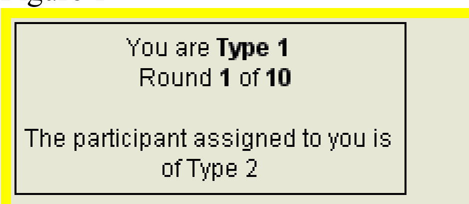
You will be asked to make a series of **interactive** decisions in this experiment, i.e. **your earnings in each round will depend both on your decision and that of the person that you are paired with for that round.**

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]

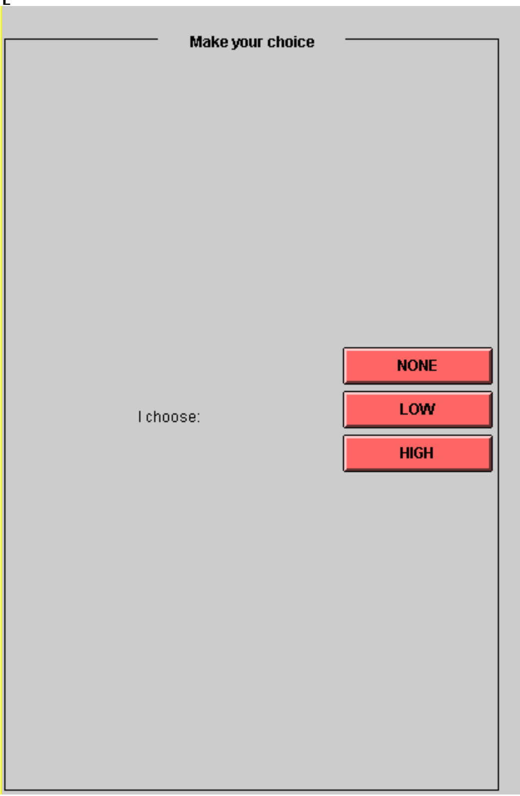
Decision Screen
In each round you will be presented with a Decision Screen where you will make a choice by clicking on one of the

[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.

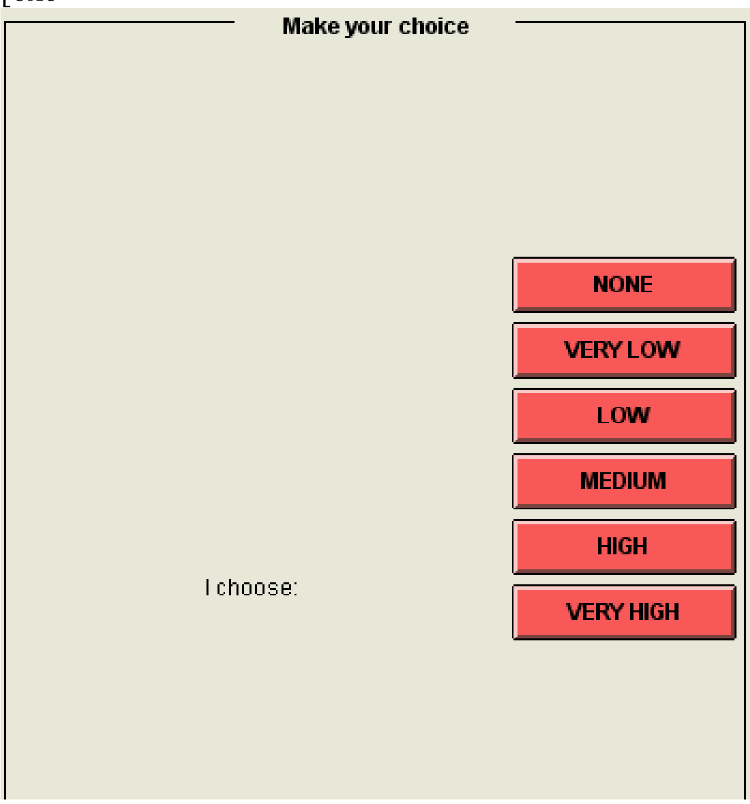
Figure 2

[3x3



3x3]

[6x6



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.

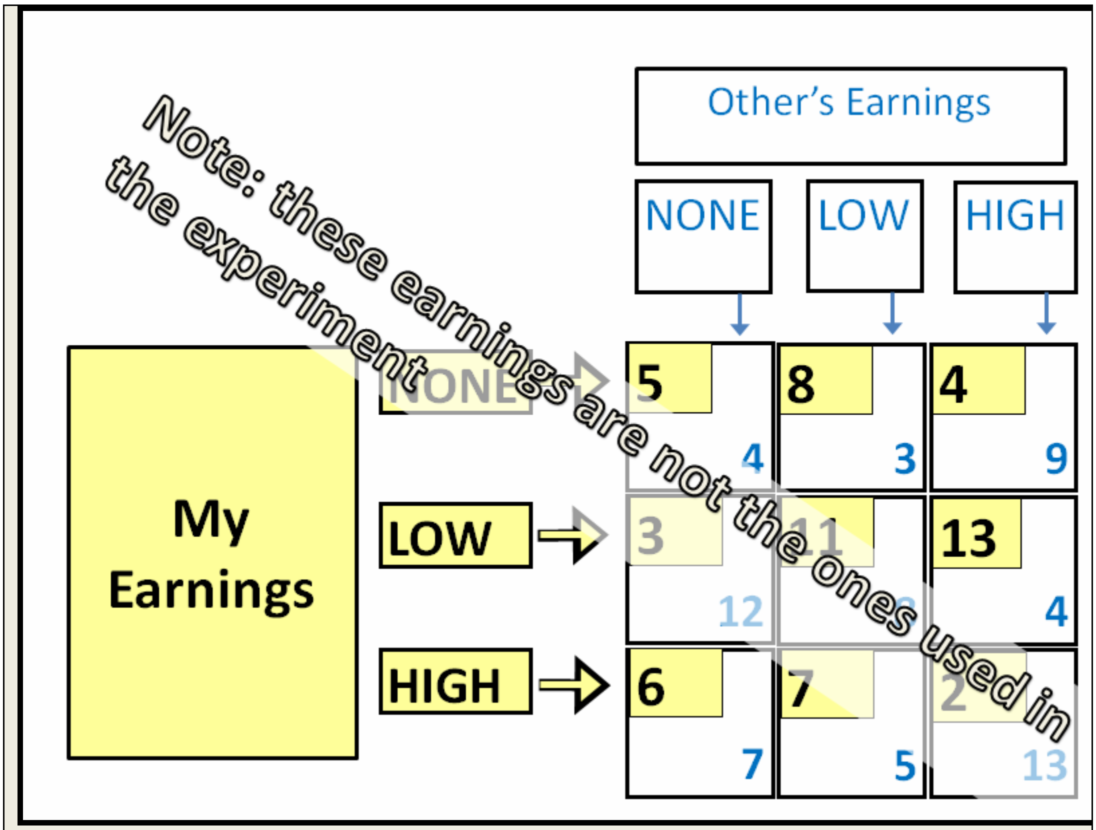
Your payoffs are in bolded black numbers on yellow background in the upper left corners of each cell of the Earnings Table. The payoffs of the participant assigned to you for that round are in blue numbers on a white background in the lower right corner of each square of the Earnings Table. To repeat,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

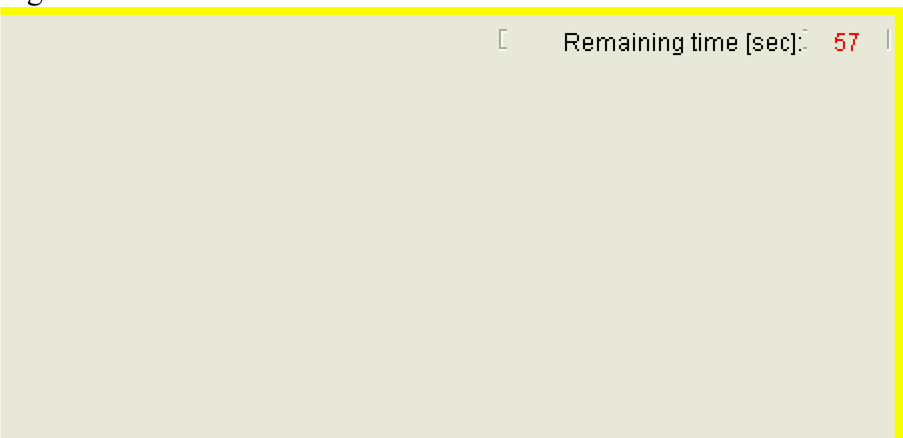


If the **Example Earnings Table** would be the relevant Earnings Table, then if the participant assigned to you chose NONE, your earnings will be 5 if you choose NONE, 3 if you choose LOW, and 6 if you choose HIGH. If the participant assigned to you chose LOW, then your earnings will be 8 if you choose 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.

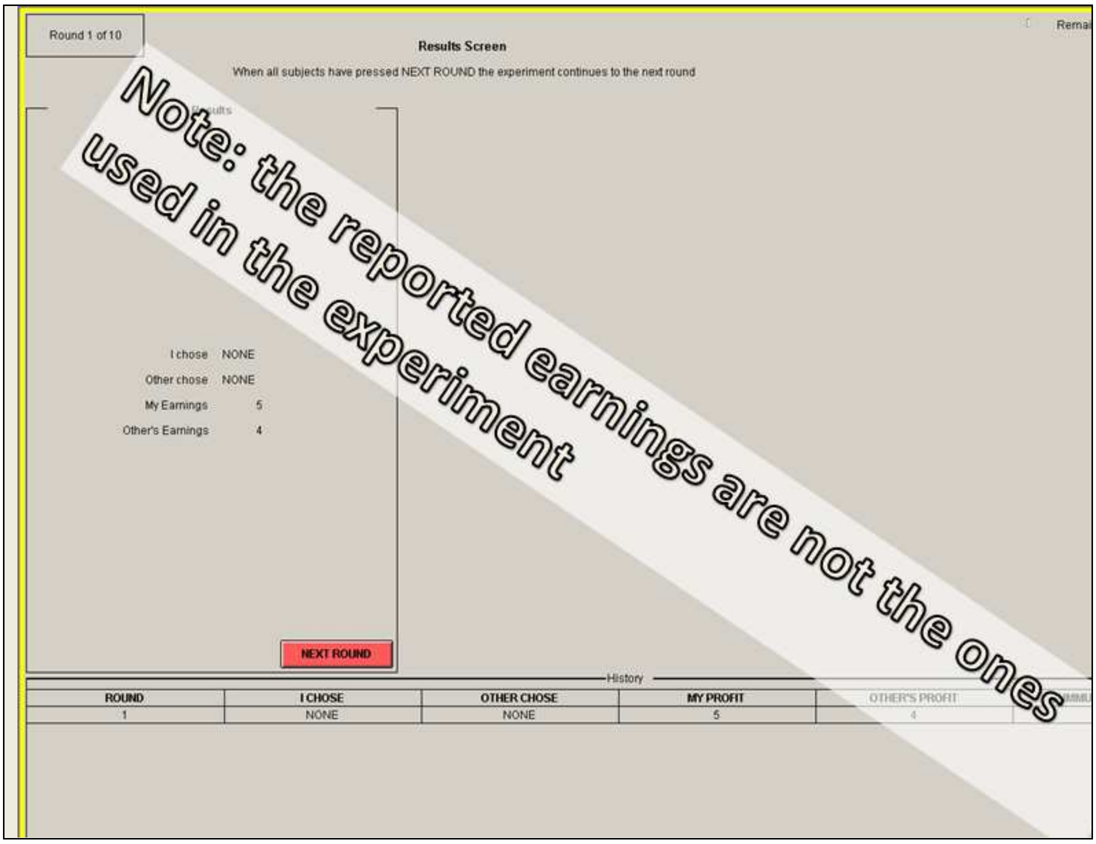
After all participants have made their decisions, or if one minute has expired, the computer will calculate your earnings.

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]

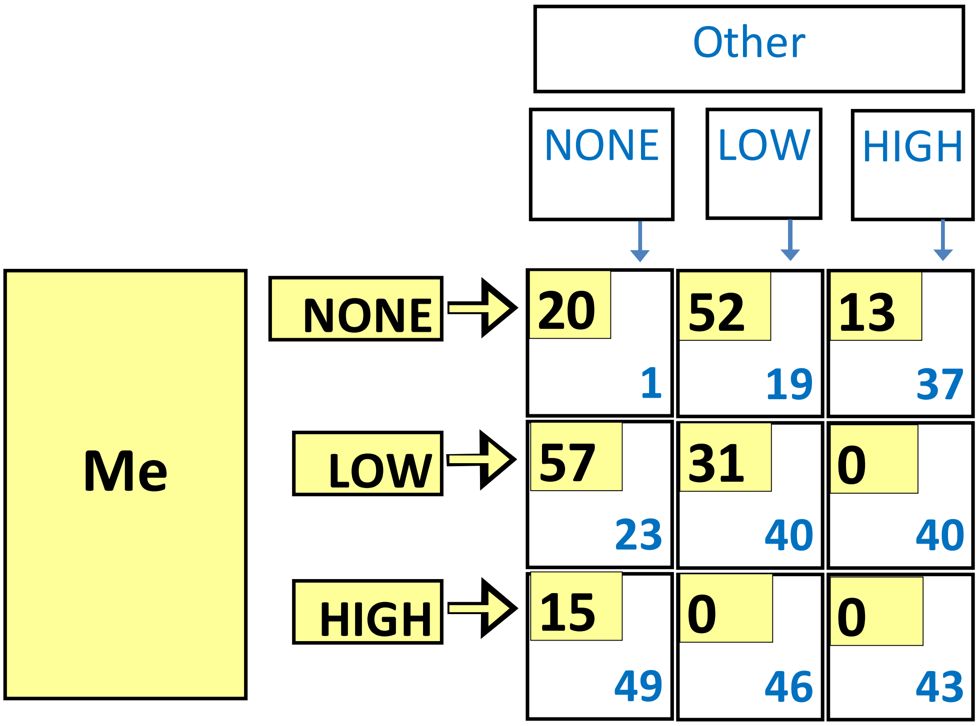
[Base, 3x3, GOV

YOUR EARNINGS TABLE

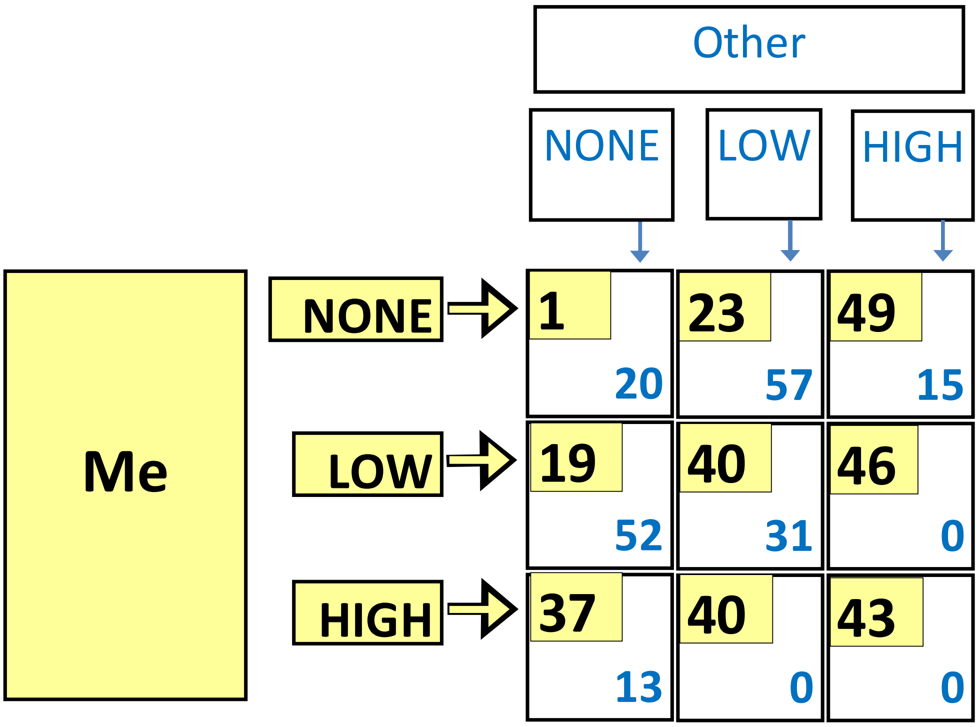
		Other		
		NONE	LOW	HIGH
Me	NONE	1 10	7 17	13 11
	LOW	4 14	9 10	10 0
	HIGH	6 8	7 0	9 0

Base, 3x3, GOV]

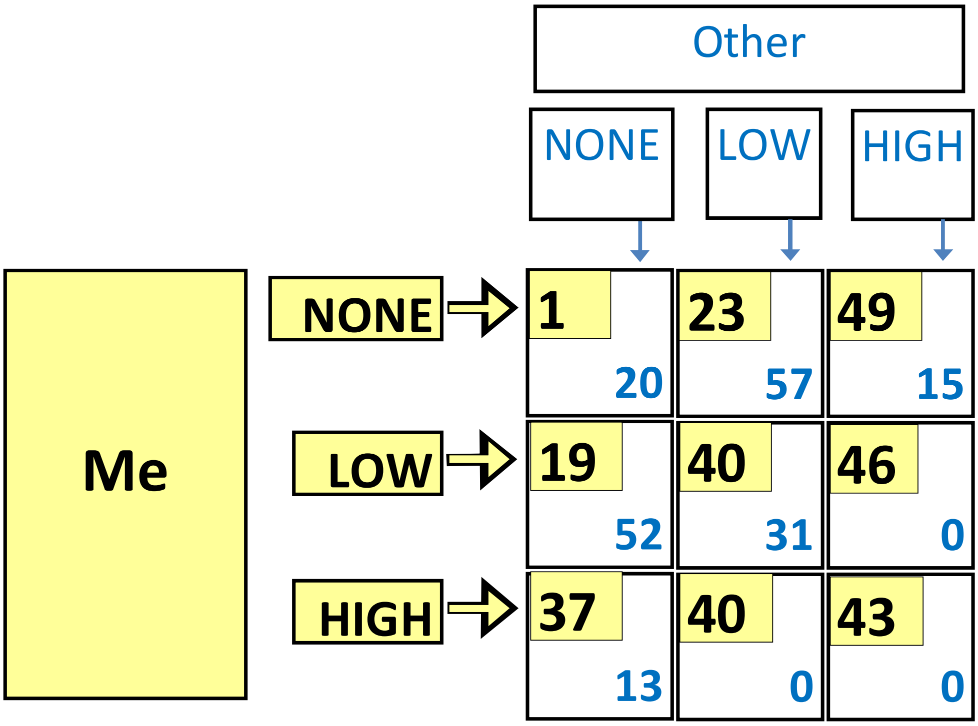
[Alt, 3x3, SRO



Alt, 3x3, SRO]
[Alt, 3x3, GOV



Alt, 3x3, GOV]


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

[Base, 6x6, SRO

Me \ Other	NONE	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
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

Me \ Other	NONE	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
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]